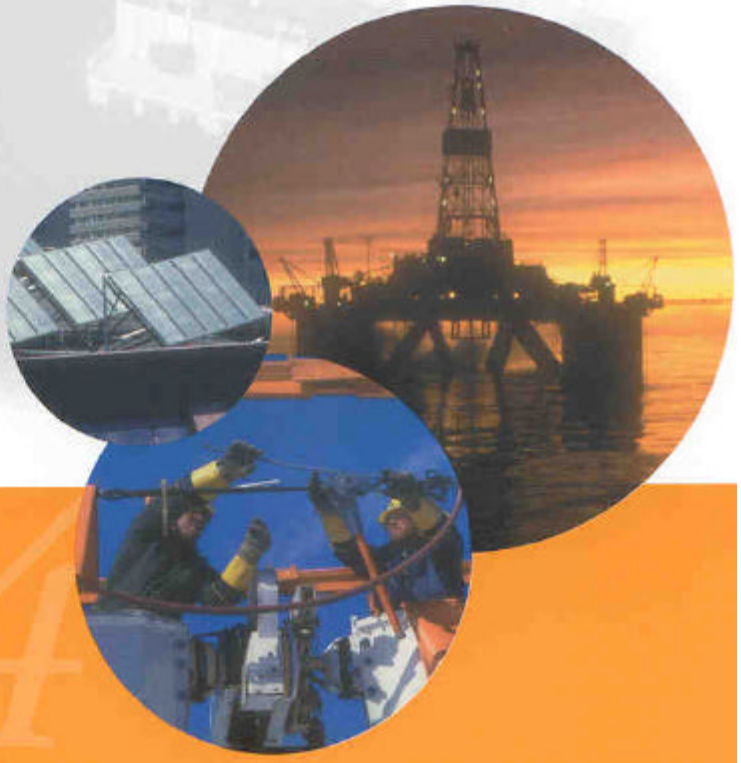
Energy and Sustainable Development: A Canadian Perspective



Monograph No. 14

Canada

ENERGY AND SUSTAINABLE DEVELOPMENT

A Canadian Perspective

A Canadian contribution to the dialogue at the Ninth Session of the United Nations Commission on Sustainable Development, April 16 to 27, 2001

Ottawa, Canada

2001

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Preface

At its ninth session in the spring of 2001, the United Nations Commission on Sustainable Development (CSD) will review progress made by member countries with respect to sustainable energy development and transportation systems as outlined in Chapters 7 and 9 of Agenda 21 and the Energy, Transport, and Atmosphere section of the Programme for Further Implementation of Agenda 21. The Programme of Work for CSD 9 also includes information for decision making and participation, as well as atmosphere and international cooperation for an enabling environment as key cross-sectoral themes for review and action. As a contribution to the CSD 9 dialogue, Canada has prepared a series of three monographs relating its experiences and challenges on energy, transportation, and information for decision making.

Energy is necessary to most forms of economic and social activity. Canada is an energy-rich nation, with substantial resources of oil, natural gas, coal, and uranium, as well as renewable energy sources such as hydro, wind, solar, and tidal power. While energy will continue to fuel economic activity and social development in Canada and other nations, its production and consumption will also present environmental challenges. The first monograph in this CSD 9 series, *Energy and Sustainable Development: A Canadian Perspective*, examines the issue of energy and sustainable development from both domestic and international standpoints. It describes Canada's efforts to improve the efficiency of energy production and use and to develop and promote alternative fuels and processes that minimize environmental impacts. The monograph confirms Canada's commitment to work with other members of the global community to foster energy options for sustainable development worldwide.

As a vast trade-dependent and modern country with a challenging climate and rugged terrain, Canada must be able to rely on a sustainable transportation system—one that is safe, efficient, and environmentally friendly. The second monograph in this CSD 9 series, *Sustainable Transportation: The Canadian Context*, describes the state of transportation in Canada and highlights Canadian activities that are moving us toward a more sustainable transportation system.

Access to pertinent and reliable information—social, economic, and environmental—is critical to good decision making related to sustainable development. *Information for Decision Making in Sustainable Development*, the third in the CSD 9 series, illustrates the work Canada is doing on many fronts to improve the quality of, and access to, the information needed by citizens, businesses, and governments to make better decisions and take action to support sustainable development. From grassroots community awareness to sophisticated analysis for high-level policy development, Canada is meeting the challenge to bridge the data gap and improve the availability of information.

In 2002, the CSD will undertake a ten-year review of the overall progress achieved by member states in their implementation of Agenda 21. Information offered in the Sustainable Development in Canada Monograph Series describes Canada's contribution to global efforts toward sustainable development and provides a baseline against which future conditions and activities can be assessed. For Canada, sustainable development is best represented as a journey, not a destination. The monographs described above, as well as the other monographs in the series, are milestones on this journey.

ENERGY AND SUSTAINABLE DEVELOPMENT

A Canadian Perspective

INTRODUCTION

Throughout history, economic progress has been greatly influenced by the development and use of energy. Energy is the essential common factor in lighting, heating, cooling, food storage and preparation, the transformation of raw materials into finished products, transportation, and communications. Over time, societies have developed by expanding the range of these energy services and by adopting more efficient and less disruptive ways of providing them.

Energy will continue to fuel economic activity and social development in Canada and other nations. At the same time, energy production, transportation, and use have significant environmental implications. Energy must be managed efficiently and responsibly to ensure that increased economic output is accompanied, domestically and globally, by improvements in the overall quality of life, including the quality of the natural environment. In short, energy is an integral element in meeting the objectives of sustainable development.

This monograph provides a Canadian perspective on the issues of energy and sustainable development, from both domestic and international standpoints. As will be illustrated in this document, Canada is a leader in devising and implementing energy options for sustainable development and is committed to working with other members of the global community to pursue this crucial objective worldwide.

ENERGY AND SUSTAINABLE DEVELOPMENT IN THE CANADIAN CONTEXT

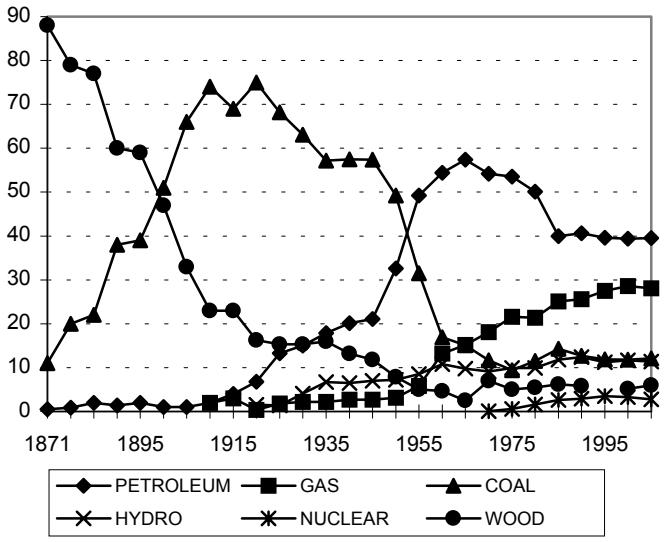
Evolution of the Energy Economy in Canada

Canada is fortunate to have secure, reliable, and diverse sources of energy, which have played an important role in the country's economic growth, helping major industries become established and compete internationally. Over the decades, major investments in Canada's energy infrastructure have supported this economic development and contributed to the quality of life enjoyed by Canadians.

The energy sector in Canada has grown with the economy, and the market share of different sources of energy has evolved significantly over the past 130 years. In the nineteenth century, wood was the primary energy source. At the turn of the twentieth century, coal use was on the rise and replaced wood as the primary source for the next fifty years. The advent of hydroelectricity in the early 1900s spurred enormous improvements in the quality of life in Canada. Canada has also been at the forefront in applying nuclear energy through the development of its CANDU nuclear reactor systems. With the advent of motor vehicles and the growing demand for gasoline and diesel fuel to power them, petroleum and its associated products became the primary source of energy in Canada. Natural gas has also become a major energy source and is used in many parts of Canada to provide heating, generate electricity, and power industrial processes.

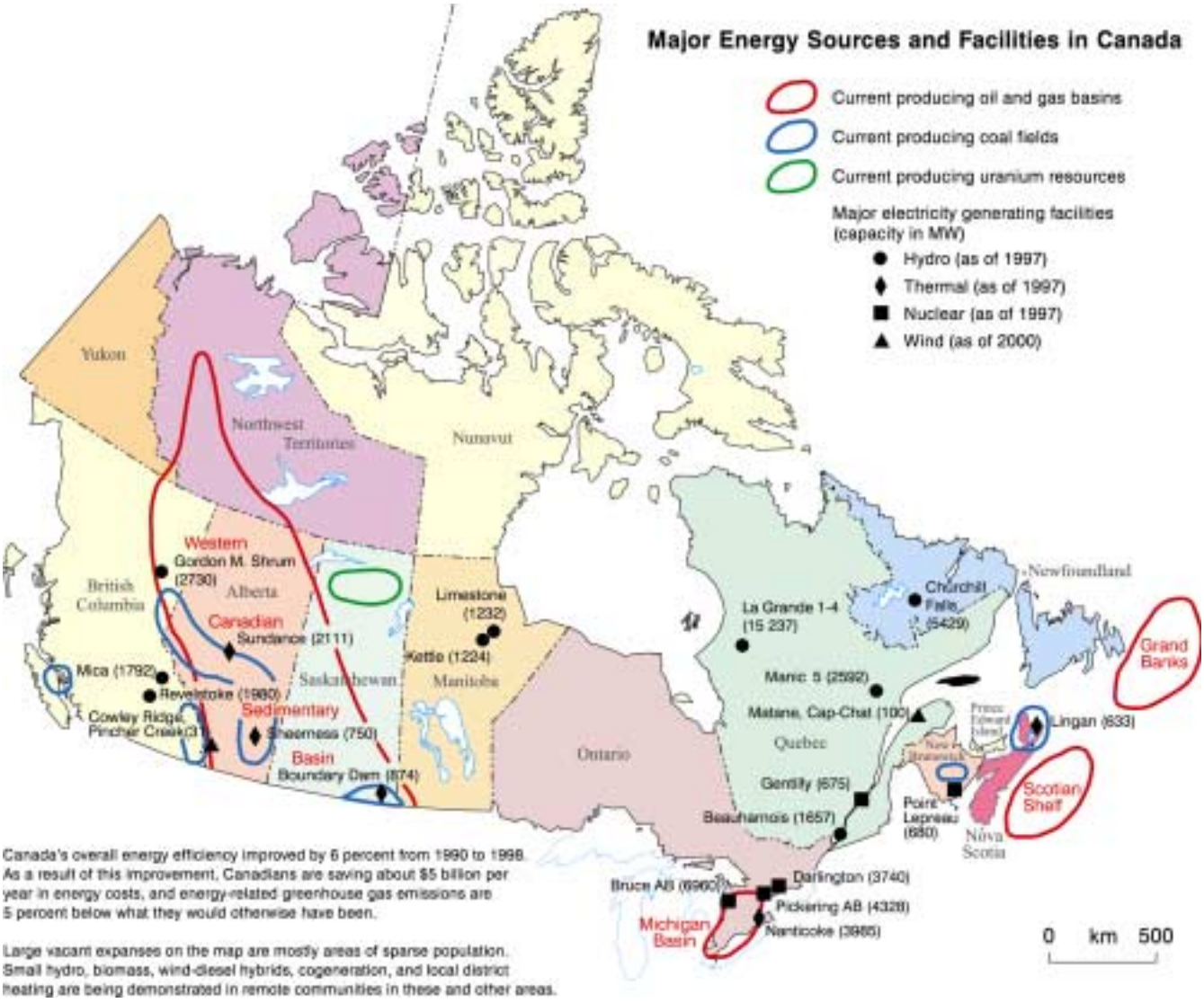
Primary energy by source, Canada, 1871 to 1996.

(Percentage of energy consumption)



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

Today, energy is produced from all of these sources. Fossil fuels are produced primarily from Canada's Western Sedimentary Basin and offshore on its east coast. Canada is the second-largest producer of hydroelectric power in the world. The nuclear power industry, fuelled by domestic uranium, operates twenty-two CANDU reactors in Canada and exports its technology around the world. Coal, mined domestically, is the primary fuel for electricity generation in western Canada. Canada is also at the forefront in research and development (R&D) of renewable and



alternative energy sources, including hydraulic, solar, wind, and biomass, and innovative technologies, such as the fuel cell.

The production of energy from these many diverse sources, its transformation into usable forms, and its delivery to the end-user all directly generate jobs and investment in Canada. For example, the production, distribution, and marketing of conventional energy sources—fossil fuels and electricity generated from oil, natural gas, coal, and nuclear sources—contribute over 7 percent to Canada's gross domestic product, stimulate annual investment of approximately $24 billion, and directly employ nearly 280 000 people. The energy sector also makes a major contribution to Canada's international balance of trade. From 1989 to 1998, Canada's energy trade accounted for some 80 percent, on average, of its trade surplus.

Canada's Energy-Intensive Economy: A Synopsis

Canada accounts for less than 3 percent of world energy use. On a per capita basis, however, Canadians are major energy users. Several factors contribute to this.

- With a land mass that extends roughly 5 300 kilometres from east to west and nearly 4 600 kilometres south to north, Canada faces significant transportation challenges for both people and goods.
- Canada's climate—characterized by long, cold winters and short, hot summers—creates a heavy energy demand for space heating and cooling.
- Canada's resource-intensive and export-oriented industries account for a larger part of the economy than in most other developed countries. These industries generate a large demand for energy to produce and export products.

At the same time, Canada's economy is becoming more energy-efficient due to the use of market-based energy prices, minimum energy-efficiency standards for equipment, information programs for energy consumers, and many other initiatives.

In addition to its proficiency in various forms of energy supply, Canada is at the forefront in developing and applying energy-efficient technologies, practices, and building design and research, which further contribute to job creation and economic growth. For example, the Canadian Industry Program for Energy Conservation has helped improve overall industrial energy intensity by 1.26 percent per year, on average, between 1990 and 1998. Canada's R-2000 housing is widely recognized as being the most energy-efficient housing commercially available anywhere in the world.

The Concept of Sustainable Development Applied to Energy

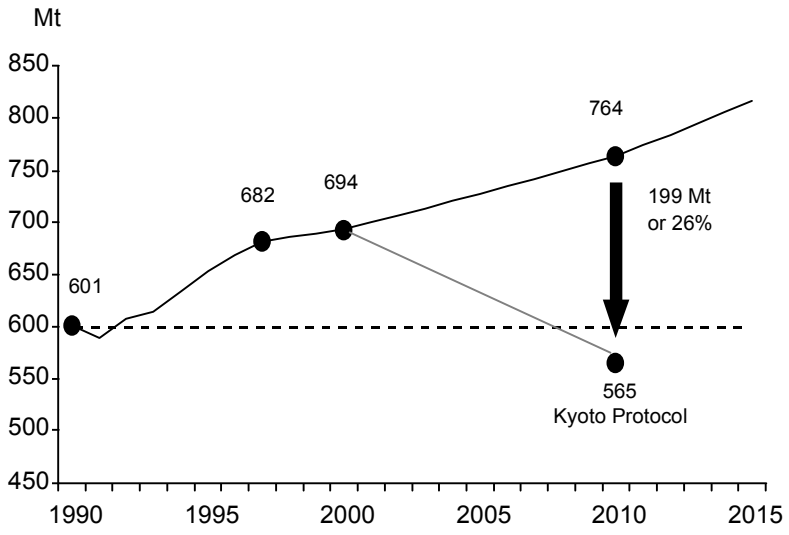
The energy sector makes an important contribution to Canada's economy and to the well-being of individuals, families, and communities. At the same time, the production and consumption of energy affects our environment. The burning of fossil fuels, for example, releases carbon dioxide and air pollutants. Producing energy from nuclear sources gives rise to issues of long-term waste disposal. The damming of large rivers for hydroelectric power results in flooding and other environmental impacts. Other renewable energy technologies (such as wind, biomass, and photovoltaic), while generally more benign, also have environmental impacts.

In 1987, the World Commission on Environment and Development popularized the term "sustainable development", which it defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In Canada's energy context, sustainable development can be interpreted as managing energy's contribution to current well-being and the development of the Canadian economy in a manner that protects environmental quality and ensures resources to meet the needs of present and future generations.

Sustainable development does not imply adopting or abandoning any particular sources of energy. The challenge of sustainable development is not to guarantee that future generations will have specific reserve levels for any particular form of energy. The energy mix in Canada will continue to evolve, as it has in the past, due to the relative prices of various energy sources, advances in science, changes in technology, and demand for new fuels. The key is to ensure that future generations enjoy uncompromised access to the services energy provides—heat, light, motive power, and information and communications. Government's role includes assessing changes in energy needs and demands and looking ahead to identify new, more efficient, effective, and environmentally acceptable approaches to providing energy services.

Sustainable development requires us to examine the present mix of energy production in Canada; to develop new, more environmentally benign energy technologies; to use energy more efficiently; and to ensure that the generations that follow enjoy an equally secure energy future and unimpaired environmental quality.

Canada's "policy as usual" emissions projection and the Kyoto Protocol.



Source: The Path Forward to Sustainable Development Strategy 2000—A Discussion Paper. Natural Resources Canada, July 2000.

One of the most difficult and pressing environmental issues from an energy policy perspective is the growth in emissions of greenhouse gases, notably carbon dioxide from fossil fuel combustion, which are implicated in global climate change. In the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change, Canada set a target of reducing its greenhouse gas emissions by 6 percent from 1990 levels by the period between 2008 and 2012 (compared to an average 5.2 percent reduction for the thirty-eight developed countries that set targets). Canada will need to cut its greenhouse gas emissions by about 26 percent from its projected emissions under a scenario in which no new policy actions are taken ("policy as usual" scenario) in order to meet its Kyoto target. This target is a first step toward further reductions that will likely be needed as part of a global effort to curb increases in atmospheric concentrations of greenhouse gases.

Marshalling Canada's Climate Change Response

Although Canada produces less than 2 percent of the world's greenhouse gas emissions, it needs to take responsible action, along with other countries, to address climate change and find ways to adapt to changes that will likely occur as a result.

Canada has already undertaken significant initiatives to reduce its greenhouse gas emissions by improving energy efficiency and moving toward less carbon-intensive fuels. In 1998, the Government of Canada established the Climate Change Action Fund (CCAF), with funding of $150 million over three years, to help Canada develop its response to the Kyoto Protocol. The CCAF is also leveraging significant funding from the private sector and other governments in Canada, allowing it to make the most of opportunities to reduce Canada's greenhouse gas emissions and to adapt to the impacts of climate change.

In February 2000, the Government of Canada announced that the CCAF would be extended for a further three years as part of a $625-million package of climate change-related measures for the next five years. Other initiatives included the creation of a Sustainable Development Technology Fund, additional funding for energy efficiency and renewable energy programs, and support for climate change actions at the municipal level and for capacity building at the international level.

In October 2000, the Government of Canada announced its Action Plan 2000 on Climate Change as a contribution to the National Implementation Strategy on Climate Change and the National Climate Change Business Plan. These are currently being reviewed with interested parties and will be finalized in the spring of 2001. When fully implemented, this package of practical, cost-effective measures will take Canada an estimated one-third of the way to its Kyoto target by reducing emissions of greenhouse gases by about 65 megatonnes per year. Action Plan 2000 provides for investments of up to $500 million on measures to reduce greenhouse gas emissions. This results in a total commitment of $1.1 billion to reduce these emissions in Canada over the next five years and builds on the $850 million the Government of Canada has spent on climate change since 1995.

Provincial and territorial governments in Canada are important partners in the National Implementation Strategy on Climate Change and have contributed actions that have been integrated into the National Climate Change Business Plan. All jurisdictions have also agreed to share information on greenhouse gas emissions reductions with a view to developing "exemplary practices" for consideration in the context of future business plans.

Canada's Policy Approach to Energy and Sustainable Development

Within Canada, the challenge for governments is to establish an economic framework that allows Canadians to continue to prosper from the country's natural resources, technology, knowledge, labour, and capital while consuming and producing energy in ways that meet the principles of sustainable development.

Canada's approach to sustainable development is to build on the strength of markets while addressing their limitations through carefully targeted initiatives. This approach is based on the premise that sustainable development requires efficient resource allocation, which can often best be achieved by competitive markets.

Governments can foster competitive markets through laws, regulations, and other measures that ensure transparency, predictability, and fairness to all market participants, and provide a stable basis to encourage investment. Energy infrastructure that has the characteristics of a natural monopoly, such as pipelines or electricity transmission and distribution systems, can be provided either by government enterprises or by private companies subject to public regulation.

Photo credit: Paul Gipe.

Shared Jurisdiction for Energy

In Canada's constitution, jurisdiction over energy is shared by the federal and provincial governments.

Provincial governments have jurisdictional responsibility for resource management within their borders, including intraprovincial trade and commerce and environmental impacts.

Federal powers related to energy are primarily associated with the interprovincial and international movements of energy and energy-using equipment and services. The federal government also leads in areas such as energy science and technology and energy-efficiency research. The federal government is responsible for the regulation of nuclear energy, including uranium mining, as well as the development of oil and natural gas in two of Canada's northern territories. (In Yukon, this responsibility has been devolved to the territorial government.)

In the east coast offshore areas of Nova Scotia and Newfoundland, the oil and natural gas industry is jointly managed by the federal and provincial governments.

Canada's federal, provincial, and territorial governments cooperate on energy matters through the Council of Energy Ministers.

Canada recognizes that markets alone do not adequately address social and environmental issues related to energy production and use. Canadian governments take measures to ensure access to energy, notably electricity, especially in rural and remote areas. Canadian governments also use a range of policy instruments to promote energy efficiency and environmental stewardship at all stages of energy production and use. These policy instruments include information provision, voluntary measures (e.g., encouraging organizations to adopt "climate change action plans" and register them with Voluntary Challenge and Registry Inc.), scientific research and technological development, economic instruments, standards, and regulations. Canada's experience affirms that jurisdictions require the flexibility to select policy instruments that best address their own circumstances.

Energy companies and projects are generally capital intensive; they must, therefore, compete for financing with other investments in capital markets and generate adequate returns if they are to be financially viable. Governments in Canada help to provide the conditions for energy sector development by maintaining stable, transparent, and predictable macroeconomic and fiscal policy frameworks that reduce uncertainty and improve the prospects for energy companies and projects to realize adequate returns and to continue to draw on capital markets.

Many other government decisions can have long-term effects on economic development and energy use and, by extension, on the prospects for sustainable development. For example,

- policies on land use and urban development can affect the density and mix of development in an area, which can have important implications for transportation energy use and related environmental impacts

- governments have an interest and role in promoting R&D and technological progress conducive to sustainable development

- governments have an important role in promoting science-based standards for fuels and for energy-using equipment and in supporting the provision of information and analytical capabilities to enable wise choices by energy users.

These and other considerations underline the important role of governments in guiding sustainable development with respect to energy, even within a broadly market-oriented energy policy framework. At the same time, markets should be allowed to function freely within established legal and regulatory frameworks, and market mechanisms should be used wherever possible to implement strategic policies.

Canadian Energy Policy

Canadian energy policy is market-based and oriented toward sustainable development. The main objectives of Canada's energy policy are as follows:

- *implement a framework that promotes a competitive and innovative energy sector and contributes to the economic well-being of Canadians*

- *ensure that the environmental impacts of energy development, transportation, and use are adequately and responsibly addressed and that environmental objectives are integrated into all policies and programs*

- *ensure that current and future generations of Canadians have secure access to adequate supplies of competitively priced energy and that responsible measures are taken to ensure efficient use of existing resources and the provision of reliable energy services to Canadians.*

Prospects for the Future

Canada has developed wide-ranging expertise in the field of energy, including many technologies and practices that can help other nations in their pursuit of sustainable development.

Recognizing that fossil fuels will continue to contribute significantly to the global energy mix for the foreseeable future, Canada has promoted the development and commercialization of advanced oil and natural gas technologies, including a broad range of environmental protection technologies. For example, the Canadian petroleum industry is developing techniques to sequester carbon dioxide by injecting it into reservoirs to enhance oil recovery and to recover coal bed methane. Canadian firms are innovators in directional drilling, natural gas leak detection, geodesic and photogrammetric surveys, mapping, and marine seismic services.

Canada has also made notable progress in developing and deploying cost-effective and environmentally responsible renewable energy technologies, including large and small hydro, active solar, wind energy, and bioenergy systems; Solarwall systems for industrial air preheating; and ground-source heat pumps. As well, Canadian firms are responsible for innovations in clean transportation, including alternative fuels such as natural gas, propane, ethanol, and hydrogen, as well as electric vehicles powered by batteries or fuel cells. New Canadian technologies will also allow the production of ethanol from biomass waste and hydrogen from a variety of sources.

Technological innovations, process changes, and new products continue to be developed to promote energy efficiency and help improve Canada's environmental performance. For residential and commercial buildings, significant progress has been made in integrated mechanical systems, energy-efficient windows and building assemblies, heat-management systems, energy-performance simulation and analysis, advanced building design and construction, and green building components. In the industrial sector, Canadian firms have developed a wide range of innovative technologies, including artificial intelligence systems, advanced clean combustion systems, energy management and process control systems, advanced processes for bitumen extraction from surface-mined oil sands, oil recycling, and advanced industrial drying technologies.

In addition to its hydroelectric expertise, Canada's electric power industry has developed innovative state-of-the-art engineering and technology for generating electricity from coal, natural gas, oil, and uranium. Canada's CANDU nuclear-plant technology ranks among the best in the world.

Oujé-Bougoumou Cree Nation

In 1992, the Oujé-Bougoumou Cree Nation, located some 960 kilometres north of Montreal, Quebec, became the first community in North America to implement a village-wide district heating system based on biomass resources. The project made the remote community energy self-sufficient, strengthened the local economy, and reduced atmospheric emissions from what they would have been with a conventional heating system. As a result, the 650-member Oujé-Bougoumou Cree Nation was recognized by the United Nations with a Global Citizen Award in the category of environment and sustainable development.

The Oujé-Bougoumou project has served as a model for similar remote communities and certain urban areas in Canada. Key to the success of the project was a community-wide commitment to environmental sustainability, local economic development, self-sufficiency, and community participation. There are also community energy systems in the cities of Charlottetown (Prince Edward Island), Cornwall, Windsor, and Sudbury (Ontario), and Fort McPherson (Northwest Territories). As well, the Aboriginal community of Grassy Narrows in northern Ontario now has a biomass-fired district heating system.

In energy policy and planning, Canada is making important contributions to the fields of computer modelling and economic forecasting, as well as innovative policies to encourage energy efficiency and renewable and alternative energy options. Energy policy research and the analysis of broad horizontal issues—environmental, social, and economic—are providing insight into how to achieve the goals of sustainable development in Canada and around the world.

Canada must do more, of course, especially considering its growing population and economy and its participation with other countries in addressing climate change. Nevertheless, Canadians can look forward confidently to a secure energy future and to doing their part to address environmental issues through developing and applying a diversity of skills, practices, and technologies.

Creating a Long-Term Vision of Energy Options for Canada

Natural Resources Canada, a department of the Government of Canada, has conducted a policy research project to help inform Canada's long-term climate change strategy. Called Energy Technology Futures (ETF), the project looked beyond the goals of the Kyoto Protocol to see what new and innovative technologies Canadians might be using thirty to fifty years from now that could alter the relationship between economic growth and greenhouse gas emissions. The ETF team identified the following three factors that will shape Canada's energy future:

- innovation—the pace at which Canada develops new concepts and technologies and brings them to the market
- markets—the ease with which goods, investments, and ideas move across the country and around the world
- environmental awareness—the degree of integration of environmental concepts, attitudes, rules, and activities with economic decision making.

These factors were used to describe several scenarios detailing possible demographic, economic, and technical prospects for Canada in 2050. Scenarios that were lacking in one or more of the factors were all hindered in their performance with respect to sustainable development.

The scenario that incorporates all three factors represents Canada's best option for the future. Inspired by a high level of environmental awareness and driven by the interaction between an increasing pace of innovation and open national and global markets, this view of 2050 is the most conducive to sustainable development.

While many influences could alter the future, the ETF project has underscored the importance of enhanced innovation and greater integration of economic and environmental considerations in achieving sustainable development. More information on ETF can be found at *http://www.nrcan.gc.ca/es/etf.*

Enhancing Canadian Oil Recovery by Sequestering U.S. Carbon Dioxide

In October 2000, injection of significant amounts of carbon dioxide that would otherwise be vented to the atmosphere began at the Weyburn oilfield in southeast Saskatchewan. It is anticipated that, on a net basis, some 14 million tonnes of carbon dioxide will enter into long-term storage, while at the same time at least 130 million barrels of additional oil will be produced. This storage in Canada of carbon dioxide produced in the United States as a byproduct from the gasification of U.S. coal is an example of international cooperation on sustainable development.

The International Energy Agency Greenhouse Gas R&D Programme is coordinating a monitoring project aimed at learning more about the fate of carbon dioxide stored underground. The monitoring project will build on the field experience from the Weyburn Enhanced Oil Recovery Project in Weyburn, Saskatchewan. This research project has attracted international funding and is engaging researchers from Canada, the United States, and Europe. More information on this project is available at http://www.ieagreen.org.uk.

ENERGY AND SUSTAINABLE DEVELOPMENT IN THE INTERNATIONAL CONTEXT

Sustainable Development in Developing Countries and Countries with Economies in Transition

Drawing on its significant expertise in the area of energy and sustainable development, Canada has participated actively in international energy policy discussions and assisted energy sector development in developing countries and countries with economies in transition.

The sustainable development issues being faced by developing countries are difficult and diverse. Sustainable development will require increased access to energy and more efficient energy systems to support both quality of life improvements (such as better health care, education, and water) and economic or production activities (such as small industry, food processing and preservation, and irrigation).

For economies in transition, the main sustainable development issue is typically not one of energy supply, but rather of reducing waste and inefficiencies in energy development and use, along with the resulting environmental impacts. Often, these problems are legacies of inaccurate price signals and ineffective environmental policies under previous administrative systems.

Canada's Participation in International Programs and Initiatives

Canada participates in a wide range of regional and international organizations that are involved in addressing issues of energy and sustainable development.

Canada engages in international development assistance, notably through the Canadian International Development Agency, the World Bank, other multilateral development banks, and the Global Environment Facility.

Multilateral cooperation organizations such as the International Energy Agency (IEA), the Asia–Pacific Economic Cooperation (APEC) Energy Working Group, the Hemispheric Energy Initiative (HEI), the International Atomic Energy Agency, and the Organisation for Economic Co-operation and Development's Nuclear Energy Agency all work to forge a common understanding of energy policy challenges and response options.

Both the HEI and APEC have a diverse membership from the developed and developing world. This allows for cooperation in such priority areas as capacity building, technology transfer, and, particularly, the promotion of energy efficiency and the adoption of cleaner energy processes and sources. These latter objectives are shared by all member countries and will lead to economic, social, and environmental benefits.

Bilateral discussions and cooperative activities are also important vehicles by which Canada works with other governments to address issues of energy and sustainable development.

In both developing countries and countries with economies in transition, energy solutions for sustainable development require fundamentally different approaches than might be taken in industrialized countries. Canada seeks to foster a wide range of energy options, which should be assessed and compared against the criteria of sustainable development with regard to particular circumstances. Access to flexible and diverse energy supplies is key to energy security and reliability, as well as sustainability.

Key Themes and Challenges

Canada believes that several key challenges need to be addressed by both developed and developing countries in pursuing sustainable energy paths. This does not necessarily call for more international fora, but rather for ways in which existing fora can work together more effectively.

Regional and International Cooperation

Regional and international cooperation is critical in establishing the right conditions and processes for effective sustainable development policies and in encouraging nations to work toward common sustainable development goals. Cooperation also facilitates discussions and debates on international issues that can influence domestic policies and measures. Regional and international cooperation can serve as a means of sharing information and assessments of policy and technological options and of undertaking R&D and policy analysis.

A number of important regional and international organizations are already undertaking significant work on issues of energy and sustainable development. Governments and agencies need to consider how to coordinate these various activities most effectively and encourage synergies in the development of global and national policies.

For example, regional economic cooperation organizations (such as the Hemispheric Energy Initiative and the Asia–Pacific Economic Cooperation [APEC]) have an important role to play in facilitating trade and investment liberalization and market reform in energy, energy-related goods, and energy technologies, which in turn will ensure that countries have more secure access to energy, a stronger economy, an improved quality of life, and reduced environmental impacts associated with energy production and use. The APEC Energy Working Group's efforts to harmonize energy-efficiency testing standards for electrical equipment and appliances show how governments, standards organizations, and the private sector can work together to reduce the cost of doing business among participating countries.

IEA Implementing Agreements

The energy technology and R&D collaboration program of the International Energy Agency (IEA) facilitates cooperation among IEA member and nonmember countries to develop new and improved energy technologies and introduce them to the market.

The program brings together experts on specific technologies to work on common problems and share the results of their endeavours. Activities are defined under implementing agreements that set out the commitments of parties (government organizations or private entities) and the management structure that will guide the activity.

Since the program began in 1974, nearly sixty implementing agreements have been established, demonstrating that international cooperation can be effective in accelerating energy technology development by facilitating the sharing of scarce resources and broadening prospects for market deployment.

International collaboration is particularly necessary in the area of energy R&D, since no single country could hope to carry out a comprehensive and meaningful energy R&D program on its own. International R&D cooperation can focus on the longer-term development of new energy technologies or on the more immediate application of technologies. The International Energy Agency, with its implementing agreements to carry out joint energy-related R&D, is an example of how such international cooperation can work.

Capacity Building

Addressing issues associated with energy and sustainable development requires appropriate "capacity" within governments, institutions, private sector organizations, and civil society.

Governments have a vital role to play in establishing and maintaining a sound policy, fiscal, and regulatory environment, which requires capacity building in the key functions of good governance (policy and program development and delivery), institutional development, and science and technology. In their stewardship role, governments require the capacity to

- ensure that enterprises that produce, transform, and distribute energy can remain financially viable and operate in a manner that protects the environment
- regulate the energy industry in a fair and predictable way
- conduct and apply appropriate research in both policy and technological areas
- develop the necessary human resources
- implement programs of information gathering, dissemination, and exchange to support sound decision making and enhance public knowledge and awareness
- engage all stakeholders in project development, including the project proponent, beneficiaries, and affected groups
- operate in a global setting, whether in multilateral fora such as the United Nations or in negotiations with multinational corporations.

There are significant opportunities for international organizations to work together to improve the analytical and policy-making capacity of developing countries. Joint policy discussions and policy research help develop the capacity of governments to undertake their own analyses

Trade Agreements

Canada believes that an open and transparent international trading system is essential to sustainable development. The World Trade Organization (WTO), to which Canada is party, provides its member countries with a common institutional and legal framework for the conduct of their trade relations, including most aspects of energy trade. Canada is also party to the North American Free Trade Agreement (NAFTA) and a number of bilateral trade agreements. In addition, Canada is engaged in negotiations in the context of the Free Trade Areas of the Americas (FTAA) and the WTO General Agreement on Trade in Services. These agreements share two fundamental principles that are key to Canada's international energy objectives:

- *They establish a rules-based system to help trade in goods and services to flow smoothly, ensure predictability, and provide an efficient and fair mechanism for dealing with disputes over trade issues.*
- *They ensure stable, predictable, and transparent legal and policy frameworks within which markets can operate effectively without undue risk for investors and for the common good, and allow governments to supplement the market with strategic initiatives where needed.*

of local energy and transportation issues. The Asia–Pacific Energy Research Center, an arms-length research organization funded by the government of Japan that facilitates the sharing of energy modelling and analysis expertise among APEC members, provides a useful model for such regional cooperation.

SIEMP Takes a Different Approach in Assisting Energy Efficiency

The Southern Africa Development Community (SADC) Industrial Energy Management Project (SIEMP) is sponsored by the Canadian International Development Agency in partnership with the SADC Energy Sector.

Launched in 1994, SIEMP's approach differs from most other donor-assisted energy-efficiency programs, which tend to emphasize technology transfer from industrial countries. By contrast, SIEMP focuses on developing human resources for practical energy management. Rather than introduce training materials from Canada or other industrial countries, both the materials and the overall framework of the SIEMP training program have been developed and tested in the region, based on close consultation with industry and local training providers.

In order to consolidate its work and ensure sustainability, SIEMP has embarked on an initiative to establish an energy management certification program based on a standardized body of knowledge and a network of certifying organizations. More information is available at *http://www.siemp.co.zw*.

Technology Transfer

Pursuing sustainable development as it relates to energy will require significant technological changes in both developed and developing countries. Governments need to foster the early adoption of energy-efficient and clean energy technologies, since energy infrastructure and equipment can affect patterns of energy production and use for many years and even decades. Enhanced R&D and the transfer of energy-related technologies between and among countries are essential and can be implemented through strategic partnerships, joint pilot projects, and training.

Governments can establish an enabling environment for R&D for technology transfer by eliminating economic and institutional barriers in both supplier and recipient countries. A vital starting point for creating a successful R&D/technology transfer strategy is a fundamental assessment of a given country's particular energy and technology needs and circumstances and a willingness to explore new approaches to providing energy and energy services. This fundamental needs assessment is critical to establishing long-term strategies and approaches to sustainable development.

Canada's RETScreen Software

In many countries, the harnessing of renewable energy has been hampered by a lack of knowledge and information about technologies, opportunities, costs, and benefits, compounded by inadequate institutional capacity to assess and plan viable projects.

RETScreen is a standardized software for analyzing renewable energy projects. It can help decision makers identify and evaluate opportunities for cost-effective implementation of renewable energy technologies. Developed by Natural Resources Canada's CANMET Energy Diversification Research Laboratory, (EDRL), with support from the United Nations Environment Programme and others, RETScreen has been used by hundreds of electric utilities, independent power producers, governments, and development agencies to assess renewable-energy technology projects for electricity generation and space heating around the world.

RETScreen can be downloaded free of charge from http://retscreen.gc.ca.

Canada believes that technology transfer is another area in which increased international cooperation is called for, particularly between the private sector (which develops most technologies) and governments (which can help to facilitate the transfer process).

Rehabilitating Small Hydro Sites in China

Bilateral agreements between Canada and China on small hydro development and environmental cooperation are paving the way for the rehabilitation of some fifty-five unused small hydro installations in the Hangzhou region of China. Greenhouse gas reductions from these retrofits, which involve the installation of Canadian-made automated turbine control units, are expected to total 310 000 tonnes of carbon dioxide annually.

Canadian government support for this project will also enable the Canadian manufacturer to market the technology to other Asian countries. Assuming fossil fuels are replaced, this could result in further savings of more than 1.75 million tonnes of carbon dioxide per year.

Small hydro automated control unit in China.
Photo credit: Natural Resources Canada.

Mobilization of Funds

The energy investments needed in developing countries (of the order of several hundred billion dollars per year) could consume more than the sum of all official development assistance (ODA) pledged by developed countries. Because there are other pressing needs for this ODA and for the limited financial resources of governments in developing countries, a substantial proportion of energy investment requirements in these countries will have to be met through private financing, whether from domestic sources or from abroad.

Mobilizing financial capital to meet the world's future energy needs is a key issue being examined by groups such as the Hemispheric Energy Initiative and APEC. While these groups have identified policies that are needed to facilitate the mobilization of capital (e.g., sound legal, economic, and financial frameworks; the availability of technical skills, goods, and services; and a trainable workforce), implementation remains a challenge.

Investment could be facilitated through closer cooperation between regional fora and international financial institutions (e.g., the World Bank and the International Monetary Fund), which have both the financial resources and the policy capacity to help countries establish and maintain the fundamental conditions needed to attract and retain private sector investment.

THE PATH FORWARD

Sustainable development calls for improved energy services to raise the living standards of a growing world population. Nowhere is the need greater than in developing countries, especially for the third of the world's population who currently lack access to affordable and reliable energy sources. At the same time, greater efforts must be made—in both the developed and developing world and at the local, regional, and global levels—to alleviate adverse environmental and health impacts associated with emissions from energy production, transportation, and use.

Over the next few decades, trillions of dollars will be invested in meeting the world's energy needs. Since these investments will determine patterns of energy production and use for decades to come, it is critical that new energy projects incorporate clean and efficient technologies, and make greater use of renewable energy sources wherever practical. This approach must guide energy developments in Canada as much as anywhere else.

Canada believes all countries should be free to develop their energy resources and sectors in accordance with their own national circumstances and should be encouraged to do so in an economically efficient, environmentally sound, and socially responsible manner. To achieve these sustainable development objectives, all nations—developing countries in particular—need to build their capacity to manage their energy sectors, facilitate R&D, apply appropriate policies and technologies, and motivate private sector involvement. As well, international organizations that deal with energy-related issues need to work together more closely and effectively in helping the world to move along the path of sustainable development.

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