COUNTDOWN TO KYOTO

Climate change is one of the most important challenges facing the world. Due to the Kyoto Protocol, governments, scientific circles, industry and society at large will be forced to become accountable. To become binding under international law, the protocol now requires only the ratification of the Russian Federation, which could happen in the fourth quarter of this year. A world conference is underway there, at which its president, Vladimir Putin, is expected to make an opening address. What is this complex legal instrument and how might it affect professional engineers?

In 1992, the Rio Earth Summit brought about a major turning point for global policy making. The summit sought to merge two international concerns–environmental protection and economic development. This integrated approach is believed to provide hope for increased international cooperation among nations of the world. Are we all in the same boat? "Yes, and it's getting smaller," says Richard Findlay, P.Eng., a director of the environmental watchdog, Pollution Probe. "The fact is that some of the most intractable challenges the globe faces are life, water and energy, those that can only be wrestled down on a multilateral basis."

The Rio Summit produced an important agreement–The United Nations Framework Convention on Climate Change (UNFCCC). One of the objectives of the convention is to stabilize greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system. Negotiated in December 1997, the Kyoto Protocol to the UNFCCC is another international treaty.

Canada signed the Protocol on April 29, 1998. Signatories must take steps to have the treaty individually ratified by their respective nations. Countries that signed Kyoto will be committed, once it comes into force, to put forth domestic, flexible policies for implementing the reduction of GHGs. If ratified, the agreement will commit the developed and transitional nations listed in its Annex I to national targets. The aim is for an initial 5.2 per cent net global GHG emissions reduction (based on CO_2 equivalents) below the 1990 baseline, to be achieved between 2008 and 2012. The first commitment period consists of an average value of emissions over five years. The agreement sets legally binding limits on the heat-trapping GHGs that are believed to cause global warming.

A UN panel, representing the majority of the world's leading climate experts, reported in 1995 that there was evidence of human-induced alteration in the chemical composition of the Earth's atmosphere, which has influenced the planet's climate. It was predicted that this would, in turn, lead to dramatic and disastrous consequences to the world's food production ability, and economies. Global warming would also lead to extreme and erratic weather patterns, such as floods, hurricanes, and ice storms, with the associated damage to infrastructure and the ecosystem.

It should be emphasized that the cause of climate change is not universally accepted within the global scientific community. It is perhaps because of this that a recent survey taken by the Ontario Society of Professional Engineers found its membership split on ratifying Kyoto—58 per cent favour its implementation.

Both the UN Climate Change Convention and the Kyoto Protocol differentiate between countries that have capacity to reduce emissions and those whose emissions need to grow for economic and social reasons. The protocol's main line of differentiation is the distinction between Annex I (developed and transitional) and non-Annex I (developing) countries.

For Canada, first period implementation commitments under the protocol call for a minimum 6-per-cent reduction of all GHGs below the 1990 baseline

by Dwight Hamilton and Salvatore Guerriero, BCL, LLB, P.Eng.

(Canada's 1990 baseline is set at 611.8 megatonnes).[1] Although the 6-per-cent reduction target appears modest, Canadian emissions since 1990 have risen to the point that the required reduction to meet the Kyoto commitments is estimated at 24-28 per cent of the unabated 2012 level.[2] By that year, it is expected that this commitment may cost the Canadian economy up to 2.3 per cent of its GDP or about $28 billion.[3] The costs must be compared to the devastation that is averted under a business-as-usual scenario, however. The protocol provides market-based solutions and sets up financial funds that aim to minimize the restructuring costs to all nations.

The industrialized countries have agreed to reduce emissions of six greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6)[5] GHG emissions are reported in CO_2 equivalents taking into consideration that different GHGs have stronger effects on climate than CO_2 alone. For instance, methane has an estimated potential on global warming of about 23 times that of CO_2, whereas SF_6 has an estimated 24,000 times greater potential for global warming than CO_2. In order to become legally binding, the protocol requires ratification by 55 countries accounting for at least 55 per cent of global CO_2 emissions under the 1990 baseline. This is known as the "double trigger" mechanism.

Environmental issues are complex with interconnected issues, such as poverty, population growth, trade and economics. Integrated solutions are therefore necessary, because such problems cross jurisdictional boundaries and affect the global commons that is our shared atmosphere. Even if an international agreement cannot be had, social norms against the increased use of fossil fuels might develop domestically to achieve the same result as regulations. Certainly, it is difficult to enact legislation to restrict fossil fuel usage by people who currently enjoy economic prosperity from the use of these fuels.

Not so easy

But nations cannot be forced to meet emissions reduction targets, because such enforcement conflicts with their state sovereignty to develop their own resources within their boundaries as they please. Hence, in the absence of an international agreement, improvement to the shared atmosphere made by one nation might easily be negated by another. An international agreement is also required before "free-rider" nations can be made to contribute their fair share of the costs of improvements that cross jurisdictional boundaries.

Yet even if it never becomes legally binding, the protocol might still be effective by raising awareness and thereby encouraging technological innovation to reinforce voluntary compliance. It also sets up a forum for technological cooperation and continuous exchanges. By integrating the market into flexible and consensual solutions, economic incentives are established to benefit those who choose to implement Kyoto.

When there are benefits in cooperation, enforcement is unnecessary. The protocol brings to the foreground the link between international trade and environmental problems, and recognizes that flexible solutions can generate necessary revenue streams to alleviate poverty in poorer countries, a necessary precondition to their participation in emissions reduction.

Equity and economy

The 1998 data on global CO_2 emissions from combustion reveal that the developed nations (which account for about 20 per cent of the world's population) emitted more CO_2 on a per capita basis than the developing nations.[6] On average, developed nations emitted 11 tonnes of CO_2 per person, while developing nations emitted less than 2 tonnes of CO_2 per person.

The data suggest that developed nations have achieved their economic prosperity by increased GHG emissions. The UNFCCC and the protocol recognize this, and establish differentiated obligations for the developed and developing nations. The proposed market solutions assume that implemented actions have manageable net costs, which are economically justifiable in the long term.

When there are benefits in cooperation, enforcement is unnecessary.

There is a school of thought, however, that believes additional laws and regulations will be necessary to achieve the desired emissions reductions. This legislation would be based on applying the *precautionary principle*, which, unlike most laws, does not require proof of a causal link[7] between an act and its effect, or GHG emissions and global climate change. It introduces an innovative legal principle in international law, in that it recognizes that science has not been fully able to understand the causes of climate change. But faced with the possibly irreversible consequences that might result from business as usual, governments have a duty to err on the safe side by taking concerted and preemptive action. This mitigation approach is analogous to insurance in that an amount is invested now in order to avert a potentially disastrous loss.

Kyoto is a first step to broader and longer-term commitments that aim to stabilize GHG concentration to some safe level for the year 2100 (world levels currently stand at about 365 ppm). For instance, the European Union believes that a target of 550 ppm, or about twice the pre-industrial-era level, may be tolerable. The UNFCCC does not set a maximum ceiling level, but, rather, seeks to stabilize GHG concentrations in the atmosphere at a level that prevents any dangerous anthropogenic impacts on the climate.

Friendly tech

Developing countries will need access to climate-friendly technologies if they are to limit emissions as their economies grow. As a result, they have agreed under the UNFCCC to take all practical steps to promote and finance the transfer to the developing countries of environmentally sound technologies.

Kyoto establishes a joint implementation (JI) mechanism and a clean development mechanism (CDM) to assist in transferring technologies to countries. JI promotes international development of advanced technologies and their transfer between developed countries. Articles 6 and 16 *bis* of the Kyoto Protocol introduce the concept of emissions trading.

The CDM aims to help developing countries achieve sustainable development. Project activities result in certified emission reduction units (CERs) that developed countries can use to meet their own targets. Energy efficiency, renewable energy, and forest sinks projects can qualify, but developed nations are to refrain from any nuclear facilities in the CDM. However, nuclear may still be part of a strategy to meet developed nations' commitments at home. The CDM also recognizes that developed nations should be given credits for improvements made to the Earth's atmosphere, since the benefits of GHG emissions reductions are not dependent on geography.

Technology transfer requires transferring management and technical skills in addition to providing equipment. The goal is to develop sustainable new technologies and know-how. Under Kyoto, CDM projects will be the first to obtain credits that may be used for the first-term reporting requirements. The details have not yet been worked out.

JI allows investment in projects that reduce GHGs among developed countries. Emission reduction units (ERUs) are obtained for the country that provides such projects. JI also enables emissions trading between developed nations.

The goal is to develop sustainable new technologies and know-how.

International emissions trading (ET) is based on creating transferable rights or permits to emit GHGs. The concept is that emitters may choose to invest in ERUs (credits under JI) or CERs (credits under CDM) rather than rely on ET permits alone. Those who employ clean technologies in either their own countries or in developing nations will be able to sell off their excess allowances on the world market. Pricing carbon[8] and controlling GHGs through a cap and trade mechanism pressures the GHG emitters to find more economical solutions.

The concept is being considered by many nations. Several have started their own domestic trading systems to encourage more innovative technologies and in anticipation of the world trading mechanism that will be in place in 2008. Many industries are preparing for the new regulatory framework, even if all the fine print has yet to be written. Other types of trad-

Kyoto in action

With the support of the federal government's Climate Change Action Fund, CCPE held a workshop, "Adapting to Climate Change: The Role of Canada's Engineers," this past February. The Canadian Engineering Qualifications Board (CEQB) subsequently drafted a three-year action plan and has initiated a formal consultation process with CCPE's constituent members. PEO Vice President Bob Dunn, P.Eng., is part of the committee that put the plan together. The objective is to have the plan's final version approved at a CCPE meeting this month. If more time is needed, approval will be delayed until later in the fall.

The workshop's purpose was to give the profession a better understanding of climate change and any potential impacts caused by it, and to examine adaptation strategies relevant to engineers' designs and decisions.

It was concluded that there are two ways to respond to the effects of climate change: mitigation and adaptation. Mitigation is intervening to reduce emission sources or enhancing GHG sinks. Adaptation, which is the focus of the CCPE action plan, is adjusting natural or human systems to actual or expected changes in climate. This moderates harm and exploits opportunities.

The plan recognizes three areas of focus for the engineering profession:

- education (integration of awareness of the need for adaptation to climate change into the Canadian Engineering Accreditation Board's criteria and core sections of undergraduate engineering programs);
- continuing professional development (making professional engineers aware of the need for adaptation to climate change); and
- guidelines, codes and standards (adaptation to climate change will require significant modifications to several existing practice documents).

If the plan is approved, PEO and other CCPE constituent members will begin to develop fact sheets and case studies of climate change impacts and best adaptation engineering practices next year. In addition, it is anticipated that technical workshops would be held by each constituent member.

able units, such as removal units (RMUs), will be created, which will be given for GHG sinks that are said to absorb GHGs from the atmosphere. RMUs are controversial, since carbon sinks such as forests could ultimately re-emit the CO_2 they have captured if their wood is subsequently burned.

Engineering opportunities

Climate change mitigation and adaptation strategies will require investment in such measures as replacement of fossil fuels, and energy-efficient equipment. Climate change will also create a need for changes to design standards and construction codes for infrastructure (buildings, dams, bridges, offshore structures, etc.) that will need to adapt to more frequent–and more intense–climate conditions. In some countries, design of urban stormwater systems will need to account for higher rainfalls. Those that face a rise in sea water levels will need to face more drastic design challenges. Others will need water management and irrigation solutions to adapt to drought conditions.

Practitioners have the opportunity to contribute to reducing GHG emissions, and help to mitigate climate change. P.Engs can develop best practices for energy efficiency, monitoring and energy audits, lifecycle analyses in products, and the reuse of by-products. A good recycling opportunity would be the increased use of fly ash from the burning of coal, to replace a portion of cement used in concrete, thus reducing overall CO_2 emissions.

As the economic engine of Canada, Ontario faces the challenge of switching from coal to other fuels for generating electricity. Interim solutions include high-efficiency combustion technology, switching to other energy sources, increasing end-use energy efficiency, and increased use of nuclear technologies.

A significant capital investment will be required, however. The Conference Board of Canada has estimated a $28-billion cost to the Canadian economy, for the first commitment period alone.

Professional engineers can develop new technologies to reduce GHG emissions in the global commons, and improve the thermal efficiencies of combustion processes. Practitioners will also be called on to

develop monitoring systems to validate proposals under the protocol's flexible market mechanisms. Under the CDM, JI and ET mechanisms, monitoring will be crucial to maintain credibility in the market-based solutions.

Prepare for challenge; not debate

Believing that it is more productive for engineers to focus on what's required to adapt under Kyoto rather than debating the science, the Canadian Council of Professional Engineers (CCPE) held a workshop to do just that (see Kyoto in action, p. 40).[9]

Allan Dakin, P.Eng. (B.C.), chair, CCPE Environment and Sustainability Committee, puts it this way: "As engineers, we look to scientists to say what caused climate change, but we owe it to the public to address the possibility that the climate will change. How do we advise them and our clients on how to address that? We would hate to be in the position where we've got all these floods in certain areas that are caused by an increase in precipitation. The public would say: 'Why didn't you advise us to raise the level of a few buildings or put in some higher dykes at the time? You didn't even raise the issue as the public's standard bearer of the taxpayers' money.'"

The federal government ratified the Kyoto Protocol on December 17, 2002, and recently announced a $1-billion plan to cut Canada's GHG emissions. The protocol will provide many opportunities for engineers to be part of the solutions for sustainable development.

Once the protocol is in force, Canada will be bound under international law to respect its first-period reductions, to 6 per cent below 1990 emissions levels by 2012.

GHG emissions reporting, monitoring, verification and certification will be important activities in a new GHG-restrained environment. The data generated by GHG emitters will result in credits or allowances that will be traded. In the event of non-compliance, fines or other penalties may be imposed. The success of emissions trading will depend on reliable data and trustworthy monitoring systems that can produce reports, and traceable evidence of compliance.

Just the beginning

The ultimate target of the UNFCCC is to stabilize GHGs to a safe level by the year 2100. A maximum GHG ceiling of about 550 ppm (from 365 ppm currently) may be a level under which the world can operate. This maximum GHG level can be maintained only through future commitment periods by all nations of the world, not just the currently listed Annex I countries. The first period commitments are just the beginning, and professional engineers are well trained to meet the challenges of global sustainable development. "We are living off the capital our environment provides and we're not paying back," says Pollution Probe's Findlay. "We must seek out sustainable sources of energy production. Now is the time–it's long overdue."

Sal Guerriero, P.Eng., is a chemical engineer with experience in international technology transfer.

References:

1. UNFCCC, *Climate Change Information Sheet 30*.
2. *Clean Development Mechanism: A Canadian Perspective*, the Centre for Global Studies, University of Victoria.
3. *A Guide to Kyoto: Climate Change and what it means to Canadians*, International Institute for Sustainable Development, 1998.
4. *A Guide to the Climate Change Convention Process*, Climate Change Secretariat, Bonn, 2002.
5. *A Guide to the Climate Change Convention and its Kyoto Protocol*, Climate Change Secretariat, Bonn, 2002.
6. *Climate Change Information Kit*, published by UNEP and UNFCCC.
7. *Understanding Climate Change, A Beginner's Guide to the UN Framework Convention and its Kyoto Protocol*, UNFCCC.
8. *The Kyoto Protocol & Emissions Trading–Operating in a Carbon-constrained World*, M. Eddis & J. Jones, KPMG Sustainability Advisory Services, 2001.
9. *Adapting to Climate Change: The Role of Canada's Engineers*. CCPE Climate Change Impact and Adaptation Action Plan. Canadian Council of Professional Engineers, June 2003.

Things to do

The Kyoto Protocol points to several policies and measures that might help mitigate climate change and promote sustainable development. Here are some examples of what professional engineers could bring to implementation:

- regulatory systems expertise;
- safety systems know-how;
- promotion of research on clean fuels and renewal energy technologies;
- enhancement of energy efficiency;
- protection and enhancement of GHG sinks;
- promotion of sustainable agricultural practices;
- promotion of carbon sequestration and other environmentally friendly technologies;
- removal of subsidies and other market imperfections from non-sustainable industries;
- adoption of transport-sector emission reducing solutions; and
- reduction of methane gas emissions by better waste management processes.