REVERSING THE WARMING TREND

"Made in Ontario" solutions

by Dwight Hamilton

As you read this, the sixth Conference of the Parties to the United Nations Framework Convention on Climate Change is likely still sitting in The Hague. There, governments have until November 24, 2000, to iron out the details of how to meet the targets for reducing greenhouse gas (GHG) emissions that were set out in the Kyoto Protocol in 1997. To become effective, the Protocol must be ratified by 55 parties to the convention, including industrialized United Nation member countries accounting for 55 per cent of emissions. If this happens, Canada will be committed to reducing its GHG emissions to six per cent below what they were in 1990 by 2012–a goal that government documents describe as "the most profound economic challenge since the Second World War."

Yet swift action appears to be needed to reduce global warming and the environmental damage it's believed to be causing. According to a recent study by the Swiss-based World Wide Fund for Nature, if carbon dioxide emissions continue at their present levels, nearly half the life-sustaining habitats in Canada will be wiped out in this century. What can be done? *Engineering Dimensions* talked with five PEO members working on climate change projects with the promise of making a difference.

DOLLARS FOR EMISSIONS

When making a product, do companies take into account the environmental costs of their choice of materials? According to Steven Young, PhD, P.Eng., a director of Five Winds International, not enough do. So, in collaboration with BASF and SCJohnson, his firm has developed spreadsheet software intended for both buyers and sellers of materials used in industrial processes. It tables the environmental impacts and associated costs a company can anticipate over the course of its use of a particular material.

One of the software's functions is dealing with GHG implications on a purchasing level–a feature designed to help companies achieve emission reductions targets. The Kyoto Protocol includes emissions trading provisions that would allow countries to buy emission reductions from each other, thus adjusting their targets. This means that manufacturers within signatory countries would have to track GHG emissions and meet their own targets. The emissions trading provisions would take effect if and when the Kyoto Protocol becomes binding. If this happens, Young believes it will be commonplace for companies to make business decisions on buying and using chemicals based on how specific chemicals will affect their GHG counts.

Under this scenario, carbon (the major GHG element) would become a new currency, traded in an international market in which there would be a worldwide limit on carbon dioxide emissions. In future, if a company wanted to exceed its assigned limit, it would have to buy the additional amount from another company whose emissions fall short of its allowed limit.

"The numbers are staggering," Young says. "The dollar value of emissions would be in the zillions. In the middle of all this, everyone would have to measure what their GHG emissions are now, what they were in 1990, and what they will be in the future. The cost side is becoming clearer, and that means the opportunities to identify value are becoming clearer too."

NO SHALLOW IDEA

If there's anything that demands a lot of electrical power, it's air conditioning. And in the dense urban area of downtown Toronto, the conventional way to keep a skyscraper habitable in July is via electrical chillers that cool water, which in turn, cools the air, giving the city's coal-fired Lakeview power plant a real work out.

But by the summer of 2003–when the city's deep-lake water cooling system is expected to be up and running–things could change. For nearly the past 20 years, the Toronto District Heating Corp. (recently renamed Enwave District Energy Ltd.) has provided steam heat to about 100 buildings in the city's core. In the future, it will pump ice-cold water through its system as well, water that doesn't need supplemental cooling because it's found 70 metres deep in Lake Ontario at about 4C. The trick to the $120-million plan is to build an intake pipe out to the lake's coldest depth to deliver water to an Enwave facility that acts like a car's radiator. Before the cold water enters the city's distribution system, it will pass adjacent to a closed loop of the firm's heating-pipe system, sending icy water back to the buildings.

Greg Allen, P.Eng., of Allen Kani Associates, has been consulting on the project's environmental and mechanical aspects from the beginning. He says one of the biggest challenges is expansion of Enwave's land-based pipeline network, which may take some city streets out of commission for months at a time. "If you're working downtown, that entails siting issues," he says, noting that Toronto's 2008 Olympics bid and a regeneration report for the city's waterfront presented a lot of red tape. "We've had to go through a lot of entanglement to achieve solutions," Allen says. Enwave expects to cool 1.8 million square metres of office space with the system, equivalent to about five Toronto-Dominion towers.

GREENING OFFICE SPACES

Because plants absorb carbon dioxide–one of the greenhouse gases that traps heat in the atmosphere–vegetation is nature's way of reducing both pollution and global warming. Green Roof Systems Consortium, a public/private sector partnership that includes the Toronto and Region Conservation Authority (TRCA), SDM Inc., York University, Seneca College, CRESTech and Greenland International Consulting Inc., wants to see how far plants can go if commercial buildings use them in an innovative way. During the next four years, the group will set up several pilot sites showcasing rooftop gardens and "breathing walls," which are ecosystems containing supporting wildlife. So far, pilot sites are confirmed at York, Seneca and TRCA, with the hope of adding two more before this summer when construction is set to begin.

The air's better in here: A "breathing wall" built by Greenland International Consulting is put to use.

"We planted a lot of seeds, and the feedback we're getting says that [widespread adoption] needs government support, policies and incentives for inventors and municipalities," says Mark Palmer, P.Eng., of Greenland. Despite these hurdles, the pilot sites will give technology being developed for breathing walls an opportunity to be monitored on a larger scale, says Palmer.

The intent of the project is to demonstrate, evaluate and optimize the combined use of natural systems to improve air quality and water use. For example, rooftops will be equipped to gather and reuse storm water, to reduce demand on local infrastructure. They will also include closed greenhouses for indoor air recycling. The unconventional designs also feature an open garden section to reduce GHGs outdoors. "Hopefully, when my son comes into the company, these technologies will be conventional," says Palmer.

THE FUTURE IS FUEL CELLS

Fossil fuel burning power plants are high on polluting emissions and low on energy efficiency. When a plant burns natural gas to produce the steam needed to run a turbine, only 30 per cent of the fuel's energy converts to electricity.

Kinectrics Inc., a joint venture that includes a former division of Ontario Power Generation, plans to use natural gas to feed the world's largest solid oxide fuel cell electrical generator. Christopher Cheh, P.Eng., project manager, fuel cell technologies for Kinectrics, says the process is expected to deliver at least a 47 per cent conversion rate, and is about 57 per cent cleaner than large, coal-fired plants.

Here's how it works: Natural gas is converted to hydrogen and carbon monoxide by an electrical/chemical process at 1000C, before reacting with oxygen from the air at a temperature low enough so that no nitrous oxide emissions are produced. Only carbon dioxide (CO_2) and water are left as end products.

After being tested for 5000 hours, the fuel cell will be moved to a commercial site, where it will have the capacity to produce 250 kilowatts of electricity. Despite the plant's small output, the company claims that, based on North American market forecasts, systems of this type are expected to cut (CO_2) emissions by more than 430 kilotonnes a year by 2005. "If the cost can be reduced, fuel cells will have a very large market in the future," says Cheh.

AMONG THE PYRAMIDS

To help developing countries catch up in the race to halt global warming, several articles in the Kyoto Protocol require industrialized countries to transfer climate change technologies to them and provide resources for implementation. In a similar initiative, to help make Canadian environmental technology competitive, the federal government's Climate Change Action Fund (CCAF) provides grants for firms who want to develop their expertise internationally.

The expertise to recover landfill gas is crucial to the Middle East, because its arid climate retards the natural decomposition of solid waste. Nowhere is this need more apparent than Egypt's Greater Cairo Area, which produces up to 12,800 tonnes of garbage daily. With funding from the CCAF and Industry Canada, consulting engineering firm R.J.Burnside International Ltd. is there now with what it hopes is a solution.

Following a detailed site assessment, the company will build two bioreactor cells to decompose solid waste. Methane production will be encouraged by water recirculation and leaching, explains Bob Kearse, P.Eng., of R.J.Burnside. "These are very small cells. The objective is to show that the technology is appropriate and can be replicated at larger sites across Egypt," he says. Although the quantity of methane from the project will be too small for commercial use, the long-term goal is to burn the landfill gas to produce electricity. ◆