Enhancing the Energy Dialogue

WOODROW WILSON CENTER CROSS-BORDER FORUM ON ENERGY ISSUES

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The Canada Institute of the Woodrow Wilson International Center for Scholars and the Canadian Centre for Energy Information continue their series of Cross-Border Forums on Energy Issues. The ninth Energy Forum was held on March 6, 2008 at the Woodrow Wilson Center in Washington, D.C., and explored current initiatives, challenges, and potential bilateral opportunities to further the development and implementation of carbon capture and storage.

The acclaimed Cross-Border Energy Forums have become an important, honest, and open gathering of the energy sectors in both Canada and the United States. What began as a dialogue on a range of business issues between senior industry, academic, and government representatives on both sides of the border has evolved into a regular, structured exchange of views on the challenges confronting the energy sector in North America.

To ensure substantive discussion and interaction, the format for the forums revolves around a closed-door discussion among participants initiated by presentations from guest panelists. Participation is limited to a select group of Canadian and U.S. government and regulatory officials, industry officials, and energy experts whose knowledge of the issues and interest in cross-border energy trade ensure a candid exchange of opinions and thorough discussion of key—and sometimes difficult—questions. As such, the forums are intended to foster and sustain an ongoing dialogue between stakeholders in each country's energy sector.

The Canada Institute has worked with the Canadian Centre for Energy Information, Global Public Affairs in Calgary, the Canadian Consulate General in San Francisco, and the Embassy of Canada to organize these forums.

The seventh forum, "Innovation, Science, and Technology: Pathway to Progress in a North American Market," took place at the Woodrow Wilson Center on March 8, 2007 to discuss ways to balance environmental and economic goals through technological innovation. One of the key themes to emerge from the forum was the critical need to upgrade North America's aging electrical system. Panelists and participants called for increased investment in North America's electrical infrastructure, and noted that this could be done in a fashion that reduces electric sector emissions if emphasis is placed on developing and implementing carbon capture and storage and other non-emitting sources of energy such as nuclear power. The forum also revealed a general consensus over the pressing need to address the skills shortage in the energy sector and the importance of integrating the issue of public education into future discussions of meeting energy challenges.

The eighth forum, "Understanding the Linkages between Energy, the Environment, and the Economy," was held at San Francisco State University on November 9, 2007. The forum explored approaches to create policies that balance economic, environmental, and energy objectives. Panelists stressed that while biofuels and other alternative fuel sources will play an increasingly important role in the global energy market, fossil fuels will continue to dominate the energy market for the foreseeable future. In addition, policymakers must ensure that the public is aware that becoming more energy efficient will involve a degree of economic sacrifice. Governments often perpetuate the myth that environmental challenges can be addressed without compromising economic growth, which may hinder efforts to reduce North American greenhouse gas emissions.

The ninth forum, "Carbon Capture and Storage: Can We? Should We?," took place at the Woodrow Wilson Center on March 6, 2008. The conference assessed whether or not carbon capture and storage (CCS) could allow Canada and the United States to continue to use fossil fuels in a more environmentally sustainable manner, while alternative sources of energy and fuel are developed and implemented. The conference revealed that although CCS has significant potential to reduce greenhouse gas emissions in Canada and the United States, several legal, regulatory, and financial obstacles need to be addressed before the technology can be implemented on a mass scale.

The next energy forum, "Carbon Standards: What Is the Right Choice for the United States and Canada?," will take place in Chicago, Illinois on October 2, 2008. The forum will assess whether implementing carbon fuel standards represents part of the solution toward an economically feasible approach to reduce greenhouse gases in Canada and the United States.

Seventh Woodrow Wilson Center Cross-Border Forum on Energy Issues

Energy Innovation, Science, and Technology: Pathway to Progress in a North American Market

MARCH 8, 2007

FEATURING

Colleen Killingsworth, President, Canadian Centre for Energy Information
Michael Raymont, CEO, EnergyINet
Graham Campbell, Director General, Office of Research and Development, Natural Resources Canada
David Pumphrey, Deputy Assistant Secretary, U.S. Department of Energy
Alison Scott, Deputy Minister, Department of Energy, Government of Nova Scotia
Daniel Desmond, Deputy Secretary, Office of Energy and Technology, Commonwealth of Pennsylvania
Anita Perry, Vice President, Government and Public Affairs, BP Canada
Stan T. Rosinski, Program Manager, Technology Innovation, Electric Power Research Institute
Dennis Ray, Executive Director, Power Systems Engineering Research Center, University of Wisconsin-Madison

As the potential consequences of continued environmental degradation and global warming become more widely acknowledged and accepted in North America, a growing number of Americans and Canadians have called on their governments to support and develop environmentally friendly methods of extracting, refining, and producing energy. However, the transition to an energy-efficient economy is not an easy task. Policymakers are faced with the daunting challenge of how to negotiate a shift toward the adoption and implementation of greener technologies without sacrificing economic growth.

Achieving a balance between environmental and economic goals through technological innovation was the theme of the seventh Cross-Border Forum on Energy Issues. The forum provided an opportunity for 50 Canadian and U.S. government officials, industry representatives, and energy experts to discuss promising new energy technology, the government's role in marketing and distributing innovative energy products, and the challenge of meeting North America's growing demand for energy. The half-day event commenced with panel presentations followed by a closed-door round table discussion. The forum continued with a luncheon program at the Canadian Embassy, where associate deputy minister of Natural Resources Canada **John Knubley** delivered the keynote address.

A Role for Governments in Energy Innovation

The time to adopt and implement cleaner sources of energy is now, argued **Graham Campbell**, director general of Natural Resources Canada's Office of Energy Research and Development. Campbell noted that Canada's current energy mix, which includes the use of biomass, coal, natural gas, hydro power, and other sources of energy, represents the most diverse mixture of energy sources in the country's history. Although energy is a key factor in economic growth and energy security, he said, it is also a contributing factor to some of the most pressing environmental issues of today. Campbell stated that the Canadian gov-

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ernment is working toward creating an "environmental and energy synergy," through investment in cleaner energy technology; encouraging the efficient use and conservation of energy; and investing in emerging technology, such as carbon capture and storage, that mitigate the amount of pollution caused by the use of fossil fuels.

Campbell also argued that governments should be encouraged to collaborate with other countries when addressing energy issues, noting that the Canadian federal government not only works closely with provincial officials, it also works on a trilateral basis with the United States and Mexico to create and foster ongoing technological partnerships in developing cleaner energy technology. Canada's goal, noted Campbell, is to become a "clean energy superpower" that continues to find innovative ways to make conventional energy cleaner and diversify the country's energy mix through the introduction of renewable energy sources: "diversity brings security."

Canada's goal… is to become a "clean energy superpower"

David Pumphrey, deputy assistant secretary at the U.S. Department of Energy (DOE), agreed that a role for government exists in disseminating and developing environmentally sound sources of energy. He noted that investment in innovative energy technologies is at "the core" of the U.S. government's approach to solving the country's energy challenges: "Developing technologies is really the ultimate solution to the critical problems we face in terms of energy security and the challenges of the global environment." FutureGen—a billion dollar DOE project intended to create the world's first zero-emissions fossil fuel plant—is an example of a major U.S. initiative that draws upon the best scientific research to address environmental challenges, he said. Despite continued efforts to develop and commercialize

"Developing technologies is really the ultimate solution to the critical problems we face in terms of energy security and the challenges of the global environment."

groundbreaking energy technology, Pumphrey conceded that the United States should increase cooperation on energy issues not only in North America, but the rest of the world: "This is a global effort."

Aside from initiatives at the federal level, the conference highlighted some of the promising work of provinces and states to promote the use of cleaner energy sources. Deputy Minister of Nova Scotia's Department of Energy **Alison Scott** said her province is working toward developing its resources in a "sustainable and responsible way." She highlighted provincial efforts to develop in-stream tidal energy generating devices that would harness the tidal power of the Bay of Fundy—where a billion tons of water flow through twice a day—as a priority of the government of Nova Scotia and a major reason why the province is considered an "emerging energy market." **Dan Desmond**, deputy secretary of Pennsylvania's Department of Environmental Protection, also stressed the importance of sustainable development. To this end, he said, Pennsylvania's government has prioritized the recruitment of "green-tech" firms, and has successfully attracted several large environmental firms, including the world's second largest wind turbine company. Pennsylvania has demonstrated that governments can "lead the way" in shifting toward a greener economy through investment in innovative technology and progressive regulations that focus on green manufacturing, argued Desmond.

Addressing Energy Challenges through Science and Technology

The extraction of gas resources, as illustrated by Alberta's oil sands project, is becoming increasingly expensive, difficult to develop, and contributes to environmental problems, said **Anita Perry**, vice president of BP Canada's office of Government and Public Affairs. To address this problem, BP is actively developing technology that will allow gas from unconventional sources to be more easily extracted in an environmentally friendly manner. She highlighted the development of decarbonized fossil fuels, advanced solar materials, and advanced biomass conversion as central to BP's efforts to introduce low-carbon technology in the field of oil recovery to help address climate change. While the energy industry "has made strides" in developing low-carbon alternatives to the extraction of oil and gas, Perry stressed that there is still a need for greater collaboration between government and the energy sector that supports the development of innovative technologies: "We all have to do this together."

Despite promising new technology on the horizon, several panelists highlighted the current challenges of developing and implementing innovative energy systems and products. **Dennis Ray**, executive director of the University of Wisconsin-Madison's Power Systems Engineering Research Center, said that there is an urgent need to address the looming shortage of engineers in North America. He noted that approximately 30 percent of engineers in Canada and the United States are scheduled to retire in the next five years, while untenured faculty in the field of power engineering has fallen from 20 percent to 12 percent over the last decade in the United States. To encourage the hiring and training of more engineers, Ray recommended a substantial increase in energy sector research funding from both private and public sources.

Stan Rosinski of the Electric Power Research Institute noted that power outages are on the rise across North America, highlighting the need for accelerated investment in electric technology research and development. Specifically, Rosinski called for increased investment in upgrading the electrical infrastructure in North America that would reduce congestion on transmission lines and manage aging "system assets." Reducing electric sector emissions and improving its productivity, he said, will require the aggressive pursuit of implementing and commercializing carbon capture and storage technologies, as well as other non-emitting sources of energy such as nuclear power. In an effort to meet future energy demands, governments need to send clear signals to the energy industry regarding the direction of CO_2 regulations, said **Steve Fine,** vice president of ICF International's Energy and Resources Practice. Potential regulations have "big implications" into the types of energy plants built and technology developed, he said. To reduce the risk of investing in new energy technology, argued Fine, governments must provide the energy sector with a sense of how future regulations will impact the cost of emitting CO_2: "[There is] a huge amount of uncertainty out there."

Pennsylvania has demonstrated that governments can "lead the way" in shifting toward a greener economy through investment in innovative technology and progressive regulations that focus on green manufacturing.

Moving Forward

Following the presentations, panelists and discussants participated in a closed-door roundtable discussion to discuss major themes highlighted in the presentations. Several discussants reiterated the need for increased collaboration between government and industry on energy issues. Specifically, discussants stressed the need for policymakers to increase consultation with energy

officials when drafting new CO_2 regulations. In addition, participants maintained that policy-makers should provide firms with greater financial incentives to invest in cleaner energy technology. The conversation also revealed a general consensus over the pressing need to address the looming "skills shortage" in the energy sector and the importance of integrating the issue of public education into future discussions addressing energy challenges.

Deputy Minister of Natural Resources Canada John Knubley closed the event with a keynote address that highlighted the value of fostering technology partnerships in the energy sector: "I think there's an agenda here that is pretty clear and I do believe that while the U.S. and Canada are on slightly different paths, we really are aligned to work together in terms of technology partnerships." For the full text of the speech, visit www.wilsoncenter.org/canada.

To reduce the risk of investing in new energy technology governments must provide the energy sector with a sense of how future regulations will impact the cost of emitting CO_2.

Eighth Woodrow Wilson Center Cross-Border Forum on Energy Issues

Understanding the Linkages between Energy, the Environment, and the Economy

NOVEMBER 9, 2007

Institute for Next Generation Internet, San Francisco State University, San Francisco, California

FEATURING

Pierre Alvarez, President, Canadian Association of Petroleum Producers
Joseph Doucet, Enbridge Professor of Energy Policy, Director of the University of Alberta School of Energy and the Environment
Jane C.S. Long, Associate Director at Large, Lawrence Livermore National Laboratory
Dan Skopec, President, Climate and Energy Consulting
Kristi Varangu, Chief, International Energy Relations, Natural Resources Canada
Rhonda Zygocki, Vice President, Policy, Government and Public Affairs, Chevron Corporation

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Regional solutions intended to mitigate the potential impact of global warming continue to be developed and implemented throughout the United States and Canada. California, viewed by many as a leader in addressing carbon emissions, recently passed Assembly Bill 32 (AB 32), which mandates the state to reduce its greenhouse gas emissions to 1990 levels by 2020. California faces the daunting task of implementing an effective regulatory framework to meet this mandated target, and is not alone in facing this challenge. Policymakers across Canada and the United States are faced with the difficult task of balancing economic, energy, and environmental goals when attempting to address global warming. This situation raises the unanswered question of how policymakers should attempt to balance economic, environmental, and energy objectives, while recognizing that trade-offs in each area are likely unavoidable.

The eighth *Cross-Border Forums on Energy Issues*, sponsored by Chevron and held in collaboration with the Wilson Center's Canada Institute, the Canadian Centre for Energy Information, Global Public Affairs, and the Canadian Consulate General in San Francisco, sought to better understand the linkages between energy, the environment, and the economy. The forum provided an opportunity for 40 Canadian and U.S. government officials, industry representatives, and energy and policy experts to discuss a range of questions facing North American policymakers and consumers alike in a carbon constrained future. The half-day event took place at San Francisco State University on November 9, 2007, and was followed by a luncheon program where Pierre Alvarez, president of the Canadian Association of Petroleum Producers, delivered the keynote address.

An Urgent Call to Action on Energy Issues

"The era of easy access to energy is over," noted **Rhonda Zygocki**, Chevron Corporation's vice president of policy, government, and public affairs. Drawing on the conclusions of the National Petroleum Council's 2007 report, *Facing the Hard Truths about Energy*, Zygocki said that an expected increase in resource nationalism, escalating costs of producing oil and gas,

combined with the projected increase in global demand for fossil fuels all highlight the pressing need to find practical solutions to address energy issues. She agreed with the report's findings that promoting energy conservation, finding new supplies of fossil fuels, and developing alternative energy sources will be crucial to meeting future energy demands.

Fossil fuels will continue to dominate the energy market for the foreseeable future.

While biofuels and other alternative sources of fuel will likely play an increasing role in the global energy market, it is important to remember that fossil fuels will continue to dominate the energy market for the foreseeable future, said Zygocki. In fact, oil, coal, and natural gas are projected to provide 85 percent of global energy needs by 2025, a figure that is very close to today's energy mix.This trend is explained in part by the "practical limitations" that continue to plague biofuel production. Zygocki maintained that increased investment is desperately needed to produce alternative fuels at the scale necessary to make a significant impact in the North American energy market. Creating this scale of production will take time, she said, noting that unconventional energy development has historically taken ten or more years to develop. She cautioned, however, that the future use of such fuels will be used in conjunction with traditional sources of energy, and should not be viewed as a replacement for fossil fuels. Zygocki stressed that investment in the production of second generation biofuels, such as cellulosic ethanol, will be critical to avoid the potential political and environmental issues associated with the production of ethanol from food sources.

Zygocki also argued that there is a critical role for government to play in addressing energy issues, particularly in the realm of removing regulatory barriers that impede technological development and implementing policies that mitigate the risk of investing in alternative energy sources. Nevertheless, policymakers are still struggling to agree on the best approach to craft and implement an effective regulatory framework that satisfies economic, environmental, and energy goals. Efficiency by itself, she said, will not meet California's needs. **Dan Skopec**, president of Climate and Energy Consulting, noted that while challenges and questions remain with respect to how to implement AB32, the State of California is currently pursuing an effective and comprehensive approach to implement the legislation that could serve as an example to follow for other states attempting to reduce greenhouse emissions.

Skopec praised California's government for using a variety of approaches to address the state's energy issues. He noted that California's government intends to use a mixture of direct command and control regulations; market-oriented regulations, designed to introduce industry performance standards; various protocols that provide industry with strong incentives to use environmentally sound methods of production; and government incentive programs designed to spur technological innovation—including an initiative devoting $120 million toward the research and development of alternative fuels. However, Skopec pointed out that California still needs to address several issues in order to improve its energy efficiency. He suggested that California should enhance its institutional capacity to distribute money more effectively toward the advancement of technological projects. In addition, California must take measures to encourage efficient energy use in commercial and residential buildings, as well as aggressively pursue "smart growth" policies that would encourage environmentally sound urban planning and reduce traffic congestion.

While acknowledging California as a leader in energy efficiency, Zygocki argued that solving energy issues cannot be solved merely at the state level; it requires "a national framework

with national policies" in order to make significant gains on the energy challenges facing the United States. By acting on their own, states risk creating a regulatory environment that would increase economic and competitive inefficiencies, she said.

Addressing Energy Issues on a National Scale

Kristi Varangu, chief of international energy relations at Natural Resources Canada, outlined Canada's national strategy to address carbon emissions, stating that the strategy was formed within a framework that recognized that energy remains a crucial component of Canada's economy and trade. Though Alberta receives the most attention as an energy exporter, Varangu noted that energy production and development is also of growing economic importance to several Atlantic provinces, as well as to Saskatchewan. She said that the Canadian government is aware of the need to increase its use of renewable energy, but stressed that fossil fuels will remain the country's primary source of energy for decades to come. Consequently, Canada has focused a key part of its efforts to reduce its carbon emissions on research and development projects—such as clean coal and carbon capture and storage—that would make energy production from fossil fuels cleaner and more efficient.

Varangu highlighted Canada's $2 billion investment in EcoENERGY initiatives—intended to promote energy efficiency and provide funding for the research and development of green technology—as a sign of the government's commitment to reducing greenhouse gases and air pollution. These initiatives, combined with Canada's recently announced regulatory framework that sets national emissions limits for large energy industries that produce greenhouse gases, form a central component of the Canadian government's plan to reduce its carbon emissions by 20 percent by 2020, said Varangu.

When developing plans to address energy issues, policymakers must ensure that the public is aware that becoming more energy efficient will involve sacrifices, maintained **Joseph Doucet**, director of the University of Alberta's School of Energy and the Environment. All too often, noted Doucet, governments promise their constituents that it is possible to meet increases in energy demand in an environmentally sustainable manner, without having to sacrifice economic growth. However, this ignores the fact that trade-offs between energy, environmental, and economic ambitions will have to be endured in order to move forward on critical energy issues. The longer governments "perpetuate the myth" that environmental challenges can be addressed without compromising economic growth, explained Doucet, the harder it will be for countries to make serious gains toward energy efficiency and reducing carbon emissions.

> There is a critical role for government to play in addressing energy issues, particularly in the realm of removing regulatory barriers that impede technological development and implementing policies that mitigate the risk of investing in alternative energy sources.

The results of a recent poll commissioned by the Canadian Centre for Energy Information of 1,000 Canadians and 1,000 Americans conducted by SES Research in Ottawa and the University at Buffalo, provided a glimpse into the willingness of Canadians and Americans to sacrifice economic benefits in return for greater energy and environmental security. The poll revealed that a greater percentage of Canadians

Trade-offs between energy, environmental, and economic ambitions will have to be endured in order to move forward on critical energy issues.

than Americans were willing to accept mandatory emissions targets that risked higher energy costs. The results of the poll also indicated that a majority of Canadians and Americans were in favor and recognized the importance of working bilaterally on energy and environmental issues.

Aside from the challenge of convincing Canadians and Americans to accept potential economic trade-offs and the need to make choices, Doucet also highlighted several other factors he believed policymakers must consider when developing a strategy to address carbon emissions. He maintained that markets should not always be viewed as "bad for the environment." In contrast, the flexibility and incentives markets can offer industry to promote energy efficiency and the use of advanced technology can be powerful tools to achieve environmental goals, he said. Nevertheless, Doucet cautioned that market mechanisms should not be perceived as able to solve all environmental problems and should only be viewed as part of the solution to pressing environmental and energy issues.

Striking a Balance between Energy, Environmental, and Economic Goals

There is now consensus among constituents in the environmental, energy, and economic sectors that issues such as global warming and energy security are significant problems that require further discussion and collaboration to solve, said **Jane Long**, associate director at large at the Lawrence Livermore National Laboratory. She suggested that the three sectors must find ways to approach solutions to issues such as global warming in a manner that is beneficial to each. Developing renewable energy can be thought of as one example of an area that each of the three sectors can profit from, said Long, noting that developing renewable energy spurs economic development through the creation of new companies, promotes energy security by reducing the need to import fossil fuels, and satisfies the environmental community by developing sources of energy that do not produce carbon emissions. What remains to be seen, said Long, is the extent to which advanced technology can help solve energy and environmental challenges in a manner that is mutually beneficial to each of the three sectors.

Assessing approaches to better understand the linkages between energy, the environment, and the economy was a theme highlighted among participants throughout an active closed-door discussion period, which followed panel presentations. To this end, participants noted the necessity of facilitating increased collaboration among academics, NGOs, government officials, and industry representatives when addressing energy and environmental issues. Participants also cited the importance of effective leadership on energy issues at the federal, state, and provincial levels of government, and commented on the need

The State of California is currently pursuing an effective and comprehensive approach to implement the legislation that could serve as an example to follow for other states attempting to reduce greenhouse emissions.

to ensure that plans are developed to create the infrastructure that will be needed to transport and produce alternative fuels on a large scale. Several participants noted that there is no "silver bullet" to solve this problem.

The future of Alberta's oil sands was another subject discussed at length. One participant asked whether Canada would be able to meet its climate goals and continue to develop the oil sands. **Pierre Alvarez,** president of the Canadian Association of Petroleum Producers, responded to this question during his keynote address, noting that the oil sands only account for 4 percent of Canada's total greenhouse gas emissions and should not be viewed as the source of the majority of the country's emissions. Throughout his remarks, Alvarez addressed common misperceptions held by the public regarding Alberta's oil sands. For instance, he argued that although the public typically believes that vast amounts of water is used to produce oil from the oil sands, the reality is that the oil sands' total production uses less than 1 percent of Alberta's Athabasca River flow. Given the importance of the oil sands to the economies of both Canada and the United States, Alvarez said it is of critical importance to ensure that Canadians and Americans are better informed of the common myths surrounding their environmental impact.

There is now consensus among constituents in the environmental, energy, and economic sectors that issues such as global warming and energy security are significant problems that require further discussion and collaboration to solve.

Ninth Woodrow Wilson Center Cross-Border Forum on Energy Issues

Carbon Capture and Storage:
Can We? Should We? Can the United States and Canada Move the Marker by Working Together?

MARCH 6, 2008

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Mark Demchuk, Team Lead, Weyburn, EnCana Corporation
Eddy Isaacs, Ph.D., Executive Director, Alberta Energy Research Institute
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David Lewin, Ph.D., Senior Vice President, Integrated Gasification Combined Cycle (IGCC) Development, EPCOR Utilities Inc.
Patrice Merrin Best, Director, Alberta Energy Research Institute
Adam Sieminski, Chief Energy Economist, Deutsche Bank AG
Chuck Szmurlo, Vice President, Energy Technology and Power Generation, Enbridge Inc.

Developing and implementing strategies to reduce greenhouse gases (GHG) and carbon emissions remains a top priority in both Canada and the United States. Although technology and the development of renewable sources represent part of the solution to reducing greenhouse gas emissions, both countries are decades away from abandoning fossil fuels as their primary source of energy. What is needed, therefore, is an interim solution that would allow Canada and the United States to continue to use fossil fuels—both conventional and unconventional—while advancing necessary environmental and energy security goals.

The ninth *Cross-Border Forum on Energy Issues*, organized by the Woodrow Wilson Center's Canada Institute and the Canadian Centre for Energy Information, explored the potential of carbon capture and storage (CCS) to serve as the interim solution to reduce GHG emissions that both countries are currently seeking. More than 65 senior level Canadian and U.S. government officials, industry representatives, and energy policy experts met at the Woodrow Wilson Center on March 6, 2008 to discuss the current initiatives, challenges, and potential bilateral opportunities to further the development and implementation of CCS. The *Forum* began with a keynote breakfast program featuring Saskatchewan Premier **Brad Wall**, followed by panelist presentations and a closed-door dialogue session, and concluded with a keynote luncheon with remarks from the Wyoming Governor **David Freudenthal**. The *Forum* was sponsored by ARC Energy Trust, EnCana, the Canadian Embassy, the Canadian Energy Pipeline Association, and CLEER.

Addressing One of the Greatest Challenges of our Time

Climate change has forced the global community to rethink our entire energy system, noted **Jane Long** of Lawrence Livermore National Laboratory. She described climate change as "one of the largest challenges that mankind has ever faced," and said that the effects of global warming have occurred at a rate faster than originally predicted, in part because of the rapid increase in fossil fuel use in countries such as China and

India. The consequences of inaction against global warming—including increased temperatures, as well as severe droughts and flooding—are becoming more widely known and accepted among policymakers and those in the energy industry, she said.

The challenge for policymakers and industry officials is to develop resources and energy infrastructure in a manner that reflects the urgent need to reduce carbon emissions. In doing so, Long recommended that policymakers and those in the energy sector ask themselves key questions when contemplating how to develop resources in a fashion that balances energy needs and environmental goals. What would it take, for instance, to develop Alberta's oil sands in a way that produces zero emissions? According to Long, answering this question requires a vision and creative thinking. She stressed that while CCS cannot solve the carbon problem on its own, it does represent part of the solution toward the sustainable development of North American resources.

Assessing the Potential of Carbon Capture and Storage

Developing a North American energy strategy will be crucial to meet Canada's and the United States' future energy needs and the shared goal of reducing carbon emissions, said **Eddy Isaacs**, executive director of the Alberta Energy Research Institute. Isaacs noted that there are several options available to reduce CO_2 emissions including CCS, nuclear power, geothermal energy, and the implementation of process development technologies—such as combustion and electrical heating—that would enable fossil fuels to burn more cleanly. While all of these options have potential, Isaacs described CCS as the "ready-to-go option" technologically. This point was reinforced by the promising carbon capture and storage test projects that were subsequently highlighted by several panelists.

EnCana's Weyburn site, located in Weyburn, Saskatchewan, represents a prominent example of carbon sequestration's potential to reduce greenhouse gas emissions. The project, noted **Mark Demchuk**, Encana Corporation's team lead for Weyburn, not only represents the largest enhanced oil recovery (EOR) project in Canada, but is also the largest CCS project in the world. By injecting CO_2 underground as opposed to using conventional waterflood techniques as a means of extracting oil, EnCana has been able to increase its recovery rate from Weyburn's oil fields from 30 to 45 percent. Once injected, the carbon dioxide remains stored underground, a process that has removed nearly 10 million tons of CO_2 from the atmosphere since 2000, which is equivalent to removing roughly two million cars off the road for a year. Demchuk also highlighted EnCana's participation in a world-scale research initiative led by the International Energy Agency. The results of the study determined Weyburn's reservoir to be a safe and suitable location for long-term storage of CO_2.

Panelists also highlighted the potential of deep saline aquifers to store CO_2. According to Chuck Szmurlo, vice president of energy technology and power generation at Enbridge Inc., deep saline aquifers have the potential to sequester all CO_2 emissions worldwide for 800 years.

> Climate change has forced the global community to rethink our entire energy system.

As a first step in realizing this potential, Szmurlo described Enbridge's collaboration with nearly two dozen other members of the energy industry to develop a pilot project in the province of Alberta that would demonstrate the potential and safety of sequestering CO_2 in aquifers throughout the province. If the pilot project proves successful, plans are in place to implement the technology on a commercial scale in Alberta beginning in 2013, which could reduce the province's CO_2 emissions by up to 20,000 tons a day. Doug Bonner, senior vice president of

corporate development for ARC Energy Trust, also acknowledged that deep saline aquifers have enormous potential to reduce carbon emissions. In his presentation, Bonner described ARC's current research project to explore the prospects of Alberta's Redwater Reef as an area that could store vast amounts of carbon dioxide. Initial results from the study indicate that the reef could hold up to one billion tons of CO_2—an amount that could retain existing and projected oil sands emissions for a period of 20 years.

Bringing Carbon Capture and Storage to the Next Level

David Lewin, senior vice president of EPCOR Utilities' Integrated Gasification Combined Cycle Development, highlighted some of the primary barriers to implementing the process of gasification into EPCOR's operations. Lewin explained that while EPCOR has actively sought to reduce carbon emissions through such initiatives as its Genesee 3 power plant (Canada's most advanced clean coal-fired generator located in Leduc County, Alberta), gasification presents the opportunity to reduce emissions further by capturing and sequestering CO_2. Achieving this goal, he stressed, will remain dependent on creating a comprehensive legal and regulatory framework to govern the operation and construction of CCS sites. In addition, those in the industry should remain conscious of the often overlooked challenge of training the necessary workforce to operate and maintain plants with CCS capabilities. Demchuk echoed Lewin's recommendations but added that it is crucial for industry and government to help build public confidence in the realm of the energy industry's ability to operate and maintain CCS technology "safely and effectively."

An additional barrier to implementing CCS on a commercial scale revolves around the uncertainty associated with the costs of investing in the technology, maintained **Adam Sieminski,** chief energy economist for Deutsche Bank. Sieminski noted that cost estimates for the capture, transportation, and storage of CO_2 have varied widely—between $100 to $300 per ton of CO_2—due to

It is crucial for industry and government to help build public confidence in the realm of the energy industry's ability to operate and maintain CCS technology safely and effectively.

continued ambiguity around CCS's precise capital costs, future costs of energy, the possible introduction of carbon taxes in North America, and unresolved liability issues surrounding the technology. The current gap in expected costs must be narrowed to attract the investment needed to implement CCS on the scale necessary to significantly reduce CO_2 emissions. In addition, noted Sieminski, governments can play a significant role in encouraging investors to finance the development and implementation of CCS through research and development subsidies, low cost loans, and buying out those plants that cannot be fitted with the technology.

Progress through Dialogue

Following panelist presentations, participants engaged in a closed-door discussion. A key issue highlighted was the necessity of introducing a carbon price in order for CCS and other renewable energy projects to move forward. An ongoing challenge for policymakers in this area is to determine a price that would not cause the rapid escalation of energy prices, but would be high enough to send a market signal to investors to finance CCS and other renewable energy projects. One participant raised the idea of creating clean coal savings bonds as a means of financing CCS projects.

A third issue that figured prominently in the discussion was how to increase public accep-

tance of CCS. Participants noted that some environmental groups have not endorsed CCS because the technology would not deter future use of fossil fuels and may also pull investment and funding away from developing renewable sources of energy. Participants agreed that improving the public's perception of CCS will require consistent and honest information from both industry and government regarding the safety and reliability of the technology.

Carbon capture and storage's potential was also highlighted during the Forum's two keynote addresses. Saskatchewan Premier Brad Wall noted that enhanced oil recovery and CCS must play an integral role in developing the province's natural resources. He explained that Saskatchewan's oil is extremely difficult to access and noted that a modest 5 percent increase in recovery from its oil fields would effectively double the province's oil production. Wyoming Governor Dave Freudenthal and chair of the Western Governors' Association, stressed that advancing CCS beyond pilot projects will require setting a price for carbon, as well as a strong regulatory and legal framework. Until this is established, he noted, the degree of uncertainty in the energy market will remain significant enough to deter investors from financing CCS and other renewable energy projects.

NOTE: *All affiliations in this report reflect the title and affiliation of the individual at the time of the event.*

The Canada Institute, founded in 2001, seeks to promote policy debate and analysis of key issues of bilateral concern between Canada and the United States; highlight the importance of the U.S.-Canada relationship, both in the United States and in Canada; increase knowledge about Canada among U.S. policymakers; create new channels of communication among scholars, business leaders, public officials, and non-governmental representatives in both countries; generate discussion about future visions for North America; and share relevant programming and publications with the appropriate partners in Canada to encourage dialogue on those issues with Canadian audiences.

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