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POLICY GROUP

Discussion Paper on Public Communication and Outreach

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Note by the Secretariat

Background

At the meeting of the Policy Group in Melbourne, Australia on September 15, 2004, the Secretariat presented a report that recommended that the Policy Group establish a Public Awareness Outreach Task Force whose activities that would support and not supplant CSLF Members' activities in this area. This recommendation was accepted, and the Policy Group created a Public Awareness and Outreach Task Force for this purpose with Canada as lead. Other members of this Task Force were the European Commission, France, and the United States. The Task Force was instructed to produce a discussion paper that would then undergo review and be presented at a full Policy Group meeting. This discussion paper is a result of the Task Force's activities.

Action Requested

The Policy Group is requested to review and consider the Discussion Paper presented by the Public Awareness and Outreach Task Force.

Conclusions

The Policy Group is invited to note in the Minutes of its next meeting that:

> "The Policy Group reviewed and considered the Discussion Paper presented by the Public Awareness and Outreach Task Force."

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PUBLIC COMMUNICATIONS AND OUTREACH

A PAPER FOR CONSIDERATION BY THE CSLF POLICY GROUP

I. INTRODUCTION

The purpose of this paper is to inform the CSLF Policy Group of existing activities, approaches and considerations regarding public communications and outreach around carbon dioxide capture and storage (CCS). Recommendations are provided that outline suggested approaches for the development of public communications and outreach programs for discussion/consideration, along with recommendations for the CSLF Policy Group on how to move forward on this issue.

II. HISTORY

CSLF Policy Group members have noted that public acceptance will be key to the successful deployment of CCS technologies and have expressed that public communications and outreach should be a priority of the group.

At the January 2004 Policy Group meeting, the CSLF Secretariat was tasked with developing a short report on public outreach. As a result, in July 2004, the Secretariat prepared a short paper on public awareness and outreach, which was discussed by the Policy Group in September 2004.

A few notable discussion highlights are:

- There was general agreement that CSLF public outreach activities should support member governments to help them inform their public on issues associated with CCS technologies.

- It was suggested that in order to meet its purpose, CSLF public outreach activities should follow the following principles:
  - Be responsive to the differing needs of Members
  - Ensure the greatest possible objectivity and credibility in all information
  - Support members by providing objectivity and credibility in all information
  - Support members by providing a large and common base of information
  - Reduce the costs of public outreach through costs sharing
  - Provide a forum for information exchange among members on public outreach

- CSLF Members should be encouraged to implement their respective public outreach plans as soon as possible and share them with each other.

In order to further the momentum on this important topic, Canada agreed to coordinate an international effort on public outreach. Working with other members, Canada agreed to prepare a more comprehensive piece for consideration by the Policy Group in September 2005.

In March 2005, the CSLF Secretariat sent a message to Policy Group members outlining Canada's proposed approach and schedule. Input on public communications approaches and materials was solicited from member countries. Canada's input was provided as an example and additional inputs were received from Australia, France and the US. All of the inputs can be found in Annex 1. This report draws upon all of these inputs.

III. CURRENT PRACTICES

The Public Communications and Outreach inputs were reviewed and elements that were most commonly noted have been identified as Current Practices. These Current Practices are listed below, along with the main features and salient points associated with each.

It should be noted that while some of the practices and materials may be targeted specifically at the public, the approach used in most cases is part of a larger effort to engage and inform a wider group of stakeholders.

1. Development of educational materials.

- Fact sheets that address climate change in general, the potential impact of CCS technology as a greenhouse gas mitigation tool, the potential economic benefit associated with enhanced resource recovery due to the use of carbon dioxide, the potential environmental impacts associated with the use of the technology, etc.

- Newsletters on events, research updates, etc.

2. Use of websites to convey information.

- Wide-spread distribution of educational material, such as fact sheets, reports, newsletters, roadmaps and project specific information

- Provide listing of events and associated materials related to carbon dioxide capture and storage

- Establish list of interested stakeholders for mail-outs, electronic invitations

- Used as a tool for opening lines of communication with key stakeholders

3. Use of websites for two-way communication.

- Mechanism for stakeholders to provide feedback and ask questions

- Method to conduct focus group testing

- Facilitate 'Interactive Advisory Panels' and online workshops

4. Field project outreach activities.

- Development of Community Engagement principles
- Important opportunity for targeted outreach activities
- Establishment of a dedicated project team to conduct outreach at the site
- Best for local people to conduct outreach around specific research projects
- Importance of personal contact in securing participation of stakeholders
- Press releases, local media coverage, field trips

5. Public attitudes and concerns surveys/focus group studies.

- Used to gauge current level of understanding of technology, its use and the impact that it can have as a greenhouse gas mitigation tool, etc.
- Used to understand issues and concerns associated with CCS technology
- Used to answer targeted questions and shape broader outreach programs

5. Information sharing meetings/briefings/workshops with stakeholders.

- Stakeholders were most commonly noted as representatives from industry, research organizations, non-government organizations, various levels of government.
- Aimed at increasing awareness of technical, scientific and policy aspects involved in CCS technology.

6. Establishment of Multi-Stakeholder Working Groups.

- Stakeholders were most commonly noted as representatives from industry, research organizations, non-government organizations and various levels of government.
- Ensure common approach towards public communications and outreach
- Opportunity to learn from other initiatives and incorporate ideas

7. Involvement of key government officials.

- Important to build support

- Help move energy policy and technology solutions to be at the forefront of political debate

8. Greenhouse Gas Mitigation Strategy Documents.

- State/provincial/federal level strategy documents on how to address greenhouse gas emissions; places CCS in context with other mitigation/reduction options

IV. CHALLENGES AND LESSONS LEARNED

Important challenges have been identified based on the current practices and experience of countries that are moving ahead on public communications and outreach. The lessons learned to date are outlined below.

- CCS is a multifaceted and crosscutting technology that makes education and outreach a challenge as a variety of issues need to be addressed. The complexity of CCS contributes to perceptions of risks and requires thoughtful approaches to sharing information and eliciting concerns.

- Generally, CCS is not a well-known technology, and, among those who are informed, there are different points of view regarding it.

- Even some who are informed and especially the general public do not know a lot about climate change, let alone CCS. This illustrates the need to provide context around CCS as one tool to address climate change concerns.

- Past experience in terms of studies on natural analogues, EOR projects, acid gas injection and storage in saline aquifers provides a large body of knowledge in addressing the concerns in terms of risk, monitoring, measurement and verification and safety. The challenge lies in effectively communicating these results to the public.

- Within a country, there is a need to identify regional issues surrounding CCS. For instance, there could be greater resistance to the implementation of carbon sequestration in ecologically sensitive areas while other regions may support the technology based on its economic benefit to the region and the low perceived risk associated with the technology. This highlights the fact that outreach strategies and materials are regionally dependent and an outreach program would need to address regional issues, including local regional regulators.

- In addition to identifying regional issues, national issues surrounding carbon sequestration must be addressed. This suggests that at least two 'levels' of information are required in that areas with active CCS projects will likely require more detailed, specific information while on a national level, information that places CCS in the context of the national approach to climate change may be required.

V. CONSIDERATIONS

The following considerations provide overall observations and opportunities for further discussion around public communications and outreach for the implementation of CCS:

- Even though public communications and outreach has been identified as a key issue that needs to be addressed to advance carbon dioxide capture and storage technologies, only a limited number of CSLF members have provided input on their activities. This suggests that this issue needs to be given more emphasis within the Forum to reiterate to all members the importance of developing public outreach practices. As such, public communications and outreach activities should be considered a key area of consideration through the Forum.

- The limited number of submissions by member countries also suggests that this is an area where there is not widespread experience nor expertise among members. The CSLF may be able to assist in developing this capacity in member countries through facilitating information sharing on public outreach approaches and initiatives.

- Generally, the public is not well informed on CCS technologies and the issues surrounding its implementation and potential impact. Therefore, an opportunity exists to provide information in an unbiased, open and transparent manner and engage in constructive dialogue.

- When reviewing the submissions, it became apparent that while there are targeted outreach initiatives underway such as the development of educational materials and outreach associated with specific projects, there are often parallel activities which focus on engaging key government officials with the aim of building support for and advancing the technology from a strategic standpoint.

- In the US, the federal government has developed the Regional Carbon Sequestration Partnerships Program that seeks to identify regional opportunities and address regional concerns surround the implementation of carbon sequestration technologies. The importance of identifying regional issues versus national issues is underlined through this approach. This approach is also of interest in that there is strong support, both financially and politically to explore opportunities and address concerns in those regions with the overall goal of advancing the implementation of the technology for the nation.

- Within a country, there is a need to identify regional issues surrounding CCS. There may be a need for an increased level of outreach in regions where the technology will be applied versus regions where the technology may not have an immediate impact but the implication of the technology still needs to be addressed. Some studies found that stakeholders wanted to know site locations before they would commit significant time to learning about CCS.

- The involvement of stakeholders is an important aspect with respect to public participation/input. Member countries may want to consider the provision of funds to cover costs for those participating in meetings and in the development/review of materials.

- The Canadian study on public attitudes found that respondents who were opposed to the technology were likely to become less opposed if:

    - They received more information
    - There were involvement of independent experts and NGOs
    - There was no reduction in spending on renewables and energy efficiency
    - There were strong regulation and monitoring

    The same study found that respondents were most concerned with the following aspects of carbon sequestration:

    - Unknown future impacts
    - Contamination of groundwater
    - Safety risks of a CO_2 leak
    - Harm to plants and animals near the disposal site and underground
    - The perception that it is the wrong solution to the climate change problem (respondents preferred renewable energy and conservation)

VI. CONCLUSIONS:

RECOMMENDATIONS TO MEMBER COUNTRIES

The following are recommendations to member countries that are in the initial phases of developing public communication and outreach strategies around carbon sequestration:

- Development of educational materials that explain CCS technologies, place CCS in a national context, identify regions that may be most suitable to the application of the technology, address environmental concerns associated with the technology and identify how regulatory and long-term liability issues will be addressed.

- Surveys to obtain baseline information on the current state of knowledge, to identify specific regional/national issues, etc. In cases where the public is unfamiliar with the concept of CCS and/or climate change, providing background materials and soliciting views in a focus group context have proven useful. Focus groups are also a good method of testing educational materials.

- Outreach in the form of briefings/workshops which can be used to provide information as well as solicit feedback.

- Identification of key stakeholders and the formation of a multi-stakeholder group that represents varying interests. This stakeholder group can provide balanced advice on public communications and outreach matters.

RECOMMENDATIONS TO THE POLICY GROUP

In keeping with the ideas presented in this paper and the previously mentioned principles, it is recommended that:

- The CSLF play a role in the development of broader information on the issue of climate change and how CCS serves as a mitigation measure relative to other approaches and the benefits of CCS technology in reducing greenhouse gas (GHG) emissions. This approach ensures that a consistent message about the technology and role of the Forum is being disseminated. These materials would be made available to members by the CSLF Secretariat and would provide member countries with materials to commence outreach activities.

- The issue of public communication and outreach be given higher profile by the Policy Group and the Chairman emphasize the importance of public outreach in Statement(s) by the Chair or press briefings at CSLF meetings.

- The CSLF website be used as a repository of information that members could draw upon to encourage the development of outreach approaches and activities. The CSLF could source and disseminate public outreach information to and from members, such as public outreach approaches, materials and methodologies as submitted by member countries. The Secretariat could also promote the benefits of conducting public outreach activities and offer advice to members on successful approaches. Member country profiles could be updated to include public outreach activities and communication undertaken.

- The CSLF website provide information on the global challenge of climate change and the potential role of CCS as a GHG mitigation option. Some information and perspective on this topic are included in the IEA publication "Prospects for CO_2 Capture and Storage". The Policy Group should consider approaching the IEA on the possibility of quoting certain excerpts of the study and placing them on the web-site for public information and to be available for members to draw upon in preparing public communications material.

- Members start to identify public communication and outreach experts (including research organizations and educational bodies proficient in conducting market research and outreach activities) within their countries who could help with the development of plans and the initiation of activities in those countries and could also dialogue with experts of other member countries.

- The Secretariat compile a listing of public outreach experts from member countries, based on input from members and include them in any stakeholder registry/database that may be developed.

- The Policy Group consider that these experts sit on any future working group related to public communications and outreach and provide recommendations to the Policy Group in this area.

- Members be encouraged to develop public outreach approaches and activities, according to their own circumstances and that they share this information with other members through the Secretariat, as activity is initiated.

- Members provide updates to information provided through the Secretariat, as new activities are developed and/or learnings are gleaned.

- The Secretariat report back to the Policy Group on the status of these and related activities at the next Policy Group meeting. Member countries should also be encouraged to provide updates on public outreach activities at Policy and Technical Group meetings or Joint Group meetings.

Annex 1

Member Country Input

STAKEHOLDER AND COMMUNITY ENGAGEMENT ACTIVITIES FOR CARBON DIOXIDE CAPTURE AND STORAGE IN AUSTRALIA

At the 2nd Carbon Sequestration Leadership Forum (CSLF) Ministerial Meeting in September 2004, public communication and outreach was identified by CSLF members as being critical to the success of deploying carbon capture and storage (CCS) technologies. As a result, Canada was asked to co-ordinate information on CSLF members' public outreach activities associated with CCS.

This paper broadly outlines a range of public outreach activities and stakeholder engagement initiatives either undertaken or underway on CCS issues in Australia.

While Canada's request (as chair of the taskforce) primarily tasks members to report on public outreach activities, this paper also takes into account a variety of stakeholder engagement initiatives. Ongoing work between CCS stakeholders ensures thorough consultation is undertaken to progress the technology and associated management and regulatory frameworks, but also seeks to impart factual information and engages these groups to promote awareness of CCS within a wider public arena.

The paper outlines broad stakeholder engagement and/or public outreach activities conducted by the Australian Government (including State and Territory Governments), Industry and Research Organisations. The paper also notes stakeholder engagement relating to the CSLF and Intergovernmental Panel on Climate Change (IPCC).

GOVERNMENT INITIATIVES

Australian Government

Australian Government (Commonwealth) Interdepartmental Committee

At the Commonwealth Government level, an Interdepartmental Committee (IDC) on CCS was formed in September 2003 to inform other Australian Government Departments of work in this area and to ensure a whole-of-government approach is adopted when dealing with CCS issues.

In late 2003, the CCS IDC drafted a non-government organisation (NGO) consultation strategy. The strategy not only looked at environmental stakeholder groups, but at a range of other indirect stakeholders and looked at ways for the Australian Government to engage with this diverse range of stakeholders across a number of CCS related agendas. The strategy aimed to ensure transparency and openness of dialogue processes and information sharing and provide a mechanism for NGO stakeholders and Government agencies to communicate to each other. Following these recommendations it was agreed a stakeholder group involving industry, research and environment groups should be formed.

Other Australian Government Engagement Processes

The Department of Industry, Tourism and Resources (DITR) and the Department of the Environment and Heritage (DEH) have shared joint Australian Government responsibility for progressing regulatory issues associated with CCS activities since 2003 (during 2003-04 this work was undertaken by the Australian Greenhouse Office which is now a part of DEH). DITR currently chairs and provides Secretariat support to three consultative groups tasked with progressing CCS domestic regulatory issues. DEH also participates in these consultative groups.

Both DITR and DEH hold regular meetings with NGOs, research organisations and potential CCS project proponents outside the consultative forums mentioned above. Officers from both Departments regularly liaise with stakeholders when attending commercial conferences and workshops on climate change issues and CCS related technologies. DITR and DEH officers have also participated in and/or presented at a number of the State Governments' CCS workshops and meetings outlined below.

State Governments

Western Australian State Government

In April 2004, a CCS conference was convened in Perth by the Conservation Council of WA and included over 100 attendees. The conference was a useful forum for raising awareness towards CCS and begin to engage the community and NGOs. In November 2004, an additional CCS workshop was hosted by the WA Department of Industry and Resources and the WA Department of Premier and Cabinet. The one-day workshop aimed to increase public awareness of the technical and scientific aspects involved in CCS technology. The workshop was attended by over 100 individuals representing industry sectors, State and Federal government departments, researchers, NGOs and other interested individuals.

Queensland State Government

In March 2005, the Queensland Department of Natural Resources and Mines facilitated a meeting of high-level government and non-government stakeholders to provide a forum for information sharing on carbon dioxide capture and geological storage. The meeting was well attended and served as a sound basis from which the department intends to support the consultation, policy and legislative development process.

Victorian State Government

In 2004, the Victorian Government held a workshop on CCS with industry and NGOs. The purpose of the workshop was to engage the community on CCS and included participants from environment NGOs, industry, insurance companies and research bodies. Victoria's focus has been on increasing discussion on the technology with all stakeholders. Victoria has also published a booklet on CCS which was revised and re-released at the 2nd CSLF Ministerial Meeting in September 2004. Victoria's *2005 Victorian Greenhouse Strategy Update*, also emphasises that brown coal will continue to play an important role in Victoria's energy mix and new technologies will need to be introduced which deliver greenhouse gas emission intensities significantly lower than current technologies. It further states that "ultimately geosequestration will be required".

New South Wales State Government

In November 2004, the NSW Government held a high level stakeholder meeting (involving peak organisations including NGOs, energy and coal industry) to run through the proposed NSW consultation approach and seek some preliminary feedback. NSW has also developed an inter-agency committee to oversee stakeholder engagement on CCS matters.

South Australian State Government

South Australia's *Petroleum Act 2000* was established as result of a comprehensive public review process. The Act provides for full public consultation on projects such as CCS on a case-by-case basis and also ensures ongoing public reporting of environmental performance against agreed objectives.

Combined Australian/State/Territory Government

Ministerial Council on Minerals and Petroleum Resources

The Ministerial Council on Mineral and Petroleum Resources (MCMPR) consists of the Australian Government Minister for Industry, Tourism and Resources and State and Territory Ministers with responsibility for minerals and petroleum issues.

Development of Guiding Regulatory Principles for CCS

In September 2003, MCMPR established a Regulatory Working Group to develop a framework of nationally agreed standards, regulations and, if appropriate, legislation to guide the development of CCS projects. The Working Group developed a set of draft guiding regulatory principles for CCS which were agreed in-principle by MCMPR Ministers on 29-30 July 2004 on the condition that broader public consultation would take place prior to Council endorsement.

As a result, the regulatory principles and an associated Regulation Impact Statement (RIS) was released for public comment in late 2004. A total of 22 submissions were received from a wide range of stakeholders including State Governments, coal and petroleum industry, potential project proponents, research organisations, NGOs and legal firms.

A key message from the RIS submission comments was that broader consultation was a necessary component in the revision of the guiding regulatory principles, to ensure community understanding and acceptance of CCS as a potentially viable technology for making deep cuts in carbon dioxide emissions to deal with climate change.

Three consultative groups have been involved with the revision of the principles:

- **Australian Government IDC** – Australian Government (Commonwealth) agencies engaged to ensure a whole of government approach is adopted on CCS issues.
- **CCS Stakeholder Group** - engages DITR, DEH, State Governments, research organisations, industry and environment NGOs to facilitate stakeholder engagement for CCS work occurring domestically.
- **MCMPR Contact Officers for CCS Group** - involves DITR and representatives from each State and Territory Government to ensure a nationally consistent approach to CCS issues across jurisdictions.

These consultative groups (and associated revising subgroups) convened approximately 17 meetings during the revision of the regulatory principles and Regulation Impact Statement. The revision process is now is close to completion. It is intended the regulatory principles will be submitted for Ministerial consideration in August 2005.

MCMPR - community engagement principles

In 2004, a Community Engagement Working Group was formed under the MCMPR to progress a community engagement strategy. The objective of the strategy was to identify the key principles for community engagement that are specific to resource industries and that can be applied to most situations. Principles were developed intended to be used as guide the development of engagement practices at a site specific level. In November 2004, MCMPR officials recommended the principles be released for public consultation. Public consultation was completed in March 2005 with 20 submissions received. This Working Group will revise the principles taking into account submission comments and seek MCMPR ministerial agreement in August 2005.

RESEARCH ORGANISATION INITIATIVES

Cooperative Research Centre for Greenhouse Gas Technologies (CO2CRC)

CO2CRC is one of the world's leading collaborative research organisations focused on CCS. Through the CO2CRC, more than 100 researchers in Australia are collaborating to develop safe and economical CCS technologies that will make deep cuts in Australia's greenhouse gas emissions and, therefore, reduce the potential impact of climate change. CO2CRC's cutting-edge research into CCS is conducted with universities and research institutions in Australia, New Zealand, the US, Canada, Europe and Asia. CO2CRC commenced in October 2003, building on an extensive program of geological storage research undertaken by the Australian Petroleum CRC GEODISC Program.

CO2CRC's international collaborative activities are with a range of bodies including the Lawrence Berkley National Laboratories (USA), the University of Regina and the Alberta Research Council (Canada) and Meiji University (Japan). CO2CRC contributes to the work of the Intergovernmental Panel on Climate Change, the Carbon Sequestration Leadership Forum and the International Energy Agency Greenhouse Gas Program.

CO2CRC has developed a range of communication activities that aim to build relationships with stakeholders, such as environmental NGOs; industry; the Australian, State and local governments; and the media to raise awareness about CCS. The following list shows the consultative and communication activities that CO2CRC has undertaken since October 2003.

- Ministerial launch of CO2CRC followed by a public seminar on CCS - October 2003
- Hosted Inter-governmental Panel on Climate Change (IPCC) meeting in Canberra - December 2003
- Organised, in consultation with industry, the International Energy Agency's Zero Emissions Technologies Conference, Brisbane, February, 2004. DVD entitled *Zero Emissions City of the Future* was produced for the event & continues to be widely distributed. It is on permanent public display at CSIRO's Discovery Centre in Canberra.
- Hosted a Climate Action Network Australia conference in Perth - February 2004.
- Hosted briefings by US-based David G. Hawkins, Senior Attorney, Natural Resources Defense Council, for Environmental NGOs in Sydney, Melbourne and Canberra - March, 2004.
- Attended Victorian Government Stakeholders meeting in Melbourne - August, 2004.
- Meetings with Local Government in Victoria – August 2004.
- Attended New South Wales (NSW) Environment Workshop (Mudgee) - September 2004.
- Launch and wide distribution of CO2CRC's Carbon Capture and Storage Technology Roadmap - September 2004.
- Attended Carbon Sequestration Leadership Forum (CSLF) Ministerial Meeting in Melbourne - September 2004
- Provided presentations on CCS at GHGT7 conference, Canada - September 2004
- Participated in Western Australian CCS seminar - November 2004
- Five feature articles, produced in conjunction with the CRC for Coal in Sustainable Development, for publication in *Australia's Mining Monthly* between November 2004 and August 2005.
- CO2CRC Research Symposium, Yarra Valley, Victoria - December 2004.
- Attended the NSW Government CCS Stakeholder Meeting in Sydney - December 2004.
- Attended Central Queensland Field Forum - February 2005.
- Australian Journal of Mining Geosequestration Conference, Melbourne - March, 2005.
- Queensland Government Stakeholder Meeting, Brisbane - March 2005.
- Science Meets Parliament, March 2005. A number of Opposition and Government MPs briefed.
- Advice provided to Australian Government's CCS Stakeholder Group - March-May 2005.
- Participated in IPCC meeting, Ovieda, Spain, April, 2005
- Participated in CSLF meeting, Ovieda, Spain, April, 2005.
- Speak at national industry events such as COAL21 and APPEA conferences - April 2005.

Some upcoming activities for 2005 include:

- The Australian Science Festival - August 2005
- CCS seminars in Victoria, Queensland and NSW - June and October 2005.
- CO2CRC research symposium, November - December, 2005.

Cooperative Research Centre for Coal in Sustainable Development

The Cooperative Research Centre for Coal in Sustainable Development (CCSD) is engaged in exploring public perception on the social aspects of climate change and implementation of Clean Coal Technologies. A range of issues are considered including the need to understand how to target messages for the public relating to energy issues and the importance of understanding community perspectives on energy/climate change. In particular it is intended to review:

- How public handles or deals with risk that may be associated with the implementation of Clean Coal Technologies;
- What do people understand about energy provision and the technologies that produce it and its links with climate change?
- What are their perspectives on different energy technologies and their acceptability of these different technologies?
- How can attitudes and behaviours in relation to energy use be changed?
- What information, policies and processes would make CCS more and less acceptable to the public?

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Centre for Low Emission Technology (cLET)

CSIRO is working to enable the energy debate to be informed by society at large on a number of fronts:

- As part of a National Research Flagship – called 'Energy Transformed'
- In conjunction with the Centre for Low Emission Technology – a joint venture between CSIRO, the Queensland State Government and other coal utilities.

Projects under the National Research Flagship

The CSIRO National Research Flagship (NRF) program is designed to integrate, focus and direct our national scientific resources. There are currently six Flagships within the program, and each is focussed on a challenge of the utmost importance to Australia. The 'Energy Transformed Flagship' goal is to halve greenhouse gas emissions and double the efficiency of the nation's new energy generation, supply and end use, and to position Australia for a future hydrogen economy.
As part of this Flagship CSIRO has completed a study on public attitudes to carbon capture and storage and is undertaking a major initiative to scope different scenarios for Australia's future energy needs.

Public Attitudes to Carbon Capture and Storage

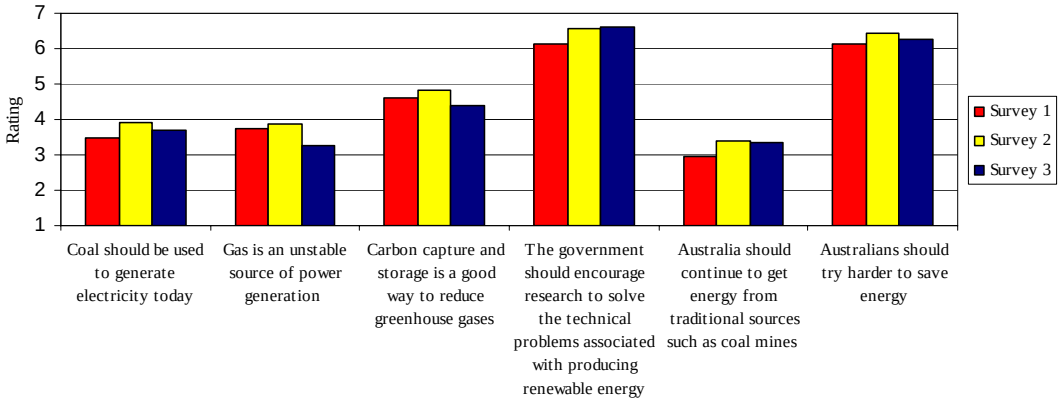
This research looked at public attitudes to carbon capture and storage and has delivered some preliminary information towards addressing these research gaps as well as understanding some of the preferred ways in which CSIRO and its partners can pursue further research.

The workshops for this study involved:

- a facilitated discussion to discover participants current knowledge
- presentation of information through a variety of media channels (TV, radio, a presentation by a CSIRO scientist and written).
- time for participants to interact informally with each other
- an interactive session to gain information on ways participants would like to be engaged and capture changes that occurred.
- three surveys, two used during the workshops and the third 10 to 30 days after the workshop

A number of common themes emerged in relation to carbon capture and storage including:

- a concern that the science is unproven
- that the increase in energy demands will not be adequately met by renewables in the near future
- the need for a portfolio of approaches to find an energy solution
- that if it is used, CO_2 sequestration should only be seen as an interim strategy
- there may be a case for ongoing research into the technology of carbon capture and storage however it should not be at the expense of renewables
- the true costs involved in the process of sequestering CO_2 will need to be considered
- a sense that many in government are supporting the carbon capture and storage technology too early, without giving due process to precautionary principles
- important for the government not to "put all their eggs in one basket"



Note:

Ratings made on a 7-point scale from strongly disagree to strongly agree; higher scores represent more agreement

Quotes from In-depth Interviews

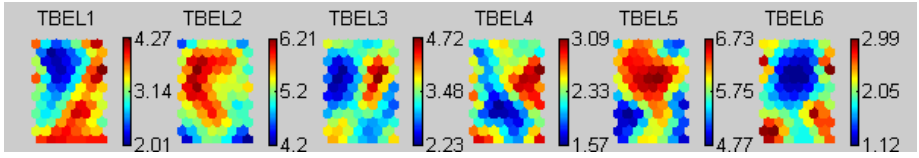
"I think the best analogy I heard is it's like putting a Band-Aid on a severed leg"

"Well I think it's a topic that we need to investigate carefully in this country. There is no doubt that in order to meet the demands for energy as the economy grows, for the next several decades we are going to have to find ways of reducing that energy and not liberating CO2 into the atmosphere doing it. Or certainly emitting less of that and sequestration of CO2 is one way in which we can do that. It is one of a number of ways."

"…the efficiency improvements as I was mentioning in the beginning, a marginal efficiency improvements don't seem to give us the breakthrough we need. Particularly if you look to economies in China and India who aren't part of Kyoto and are not immediately looking for stabilisation of their emissions. They are going to continue to increase their emissions. We need to find an alternative solution to help them so to me at this stage it (CO2 sequestration) provides the most immediate hope that we can manage emissions"

CSIRO has also looked at ways of visualising and analysing the results. The diagrams below are patterns of the full range of attitudes expressed – one diagram for each issue. Matching the patterns before and after the workshop helps us to look at which attitudes are firmly held (essentially value driven), and which change on provision of more information (and so may be more about a belief than a value). Further work on this, particularly when applied to longitudinal data will help us to measure and model societal perspectives on energy initiatives.

Before



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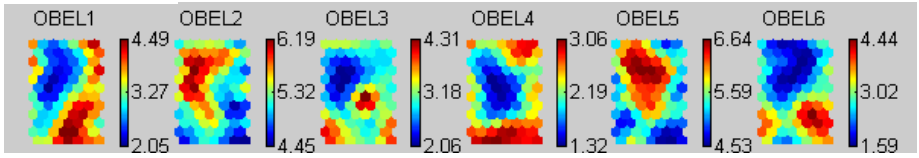
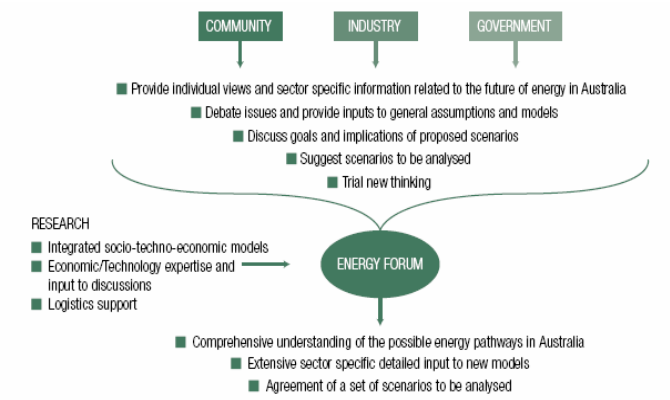


Energy Futures Forum
The Energy Transformed Flagship includes a deliberative process to develop and assess scenarios for meeting Australia's future energy needs, known as the Energy Futures Forum. The Energy Futures Forum brings together a broad spectrum of industry and community groups in a structured scenario planning exercise exploring potential futures of the Australian Stationary Energy and Transport Industries.

The Energy Futures Forum has been established to develop key energy scenarios that will be modelled to determine potential energy industry and technology pathways and highlight potential impacts to society, environment and the economy.



A research project under the title '*Social validation of energy scenarios'* is running in parallel with the Energy Futures Forum and will contribute to the deliberations of Forum members.

The goal of this research is to incorporate lay knowledge into the Energy Futures Forum process by using social research to test the assumptions of the Forum. Deliberative processes will be used to assess whether selected scenarios developed by the Forum represents a plausible future to a lay audience and whether the Forum has been complete in its identification of the range of technologies and events that could happen.

<u>Research for the Centre for Low Emission Technology</u>
The Centre for Low Emission Technology (cLET) is a partnership between world class research and development providers that will make it possible for Australia to continue using its abundant coal resources to provide plentiful, economical energy and power in an environmentally acceptable and sustainable manner, through the production of zero carbon electricity and hydrogen. cLET facilitates the research, development and demonstration of innovative and cost-effective enabling technologies for clean coal use that, when combined with CO2 capture and storage, will dramatically reduce emissions. CSIRO undertakes social research for cLET to look at how to incorporate stakeholder perspectives into low emissions technologies.

Initially cLET commissioned a scoping study from CSIRO working in collaboration with the University of Queensland. The purpose of this Scoping Study was to carry out an initial analysis of national and international trends in participatory research and its application to fossil fuel based power generation to identify whether further work would be valuable, and if so to identify a forward programme.

This scoping study produced reports which included:

- Analysis of trends in social and participatory research
- Review of current activities in the energy domain.

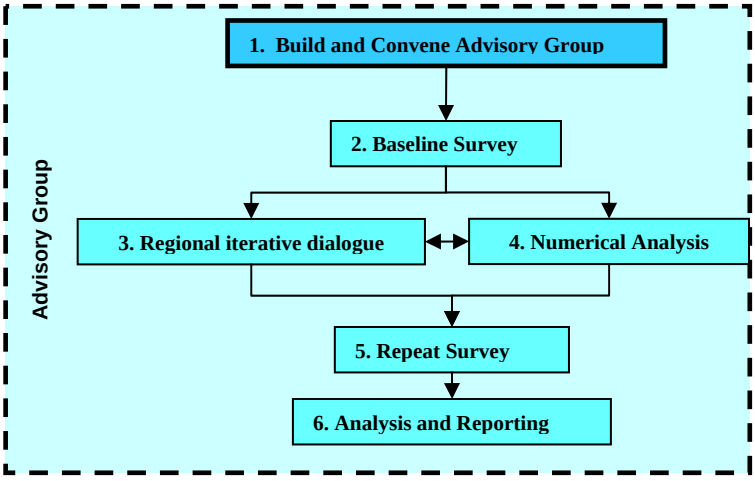
A proposal that cLET undertake a social research programme centred on engagement with selected stakeholders.

Based on this scoping study a forward programme of social research is now underway. The purpose of this project is to inform important stakeholders about research into cleaner generation of power from fossil fuels, and to provide an opportunity for those stakeholders to influence the research agenda.

Specific aims of the project include:

- Establish a baseline of attitudes to low emission technologies in Queensland.
- Understand the issues and concerns associated with clean coal in more depth.
- Inform the decision processes of the cLET partners.
- Provide an opportunity for gauging social influences on low emission technologies.
- Engage within environmental organisations and influential stakeholders.

The project is designed in six major stages.



The project will undertake a stratified State wide quantitative survey of attitudes in Queensland (to establish a baseline) and a more in depth regional dialogue to explore the issues and concerns of a cross section of “issues public”. This participatory programme would be coupled to quantitative predictive modelling, based on the first survey. A second state wide survey would be used to conclude the study, establish the validity of the predictive modelling and examine the impact of the regional dialogue work in changing perspectives. The project is driven by an Advisory group comprising internal partners and others as advised by industry.

<u>Current discussion for further projects</u>

A framework for extending the cLET work to a national approach to measuring and modelling the social landscape surrounding the issue of low emission technology is under discussion. The national approach has been designed to understand the current levels of awareness around low emission technology and examine how this awareness changes in general over the course of a year.

INDUSTRY INITIATIVES

The coal, oil and gas, minerals and energy supply industries have been active members of a number of consultative bodies formed on CCS issues such as the Australian CSLF Regulatory Reference Group and CCS Stakeholder Group through their respective industry associations such as Australian Petroleum Production and Exploration Association (APPEA) and Australian Coal Association (ACA). Examples of other consultative and outreach initiatives explored by APPEA and ACA are outlined below.

Australian Coal Association

COAL21 is a collaborative partnership of industry, unions, governments and the research community. COAL21 commenced in March 2003 when the ACA issued invitations to participate in a process aimed at significantly reducing greenhouse gas emissions from Australia's coal-based electricity generation.

COAL21 activities include a communication and outreach strategy. This attempts to inform the communications activities of individual COAL21 Participant organisations COAL21 also publishes a bi-monthly newsletter with relevant news from Australia and around the world.

In March 2004, the Australian Minister for Industry, Tourism and Resources, the Hon Ian Macfarlane MP, in conjunction with the ACA, launched the COAL21 National Action Plan. The National Action Plan identifies a number of strategic policy and technological options for reducing greenhouse gas emissions from coal-based electricity, particularly the development, demonstration and deployment of breakthrough technologies such as CCS.

The first COAL21 Annual Conference was held in Sydney on 5-6 April 2005. Conference participants included Australian and State Governments, coal industry and unions, electricity industry representatives, research organisations and environmental non-government organisations. The program featured many distinguished Australian and international speakers, including the President of the Pew Centre on Global Climate Change, Hon Eileen Claussen and representatives of the US Department of Energy and Japan's Center for Coal Utilization. The COAL21 Annual Review 2005 was presented to Minister Macfarlane at that conference. The primary purpose of the Review is to assess and report progress made on the COAL21 National Action Plan over the past year.

The Review confirmed a clear escalation of activity towards the goal of near zero emissions technologies for coal-based electricity generation. A key advance listed in the Review is the development of nationally consistent principles and framework for the regulation of CCS. A copy of the COAL21 Annual Review and broader information on CCS issues is publicly available on the COAL21 website – www.coal21.com.au

In addition to the COAL21 process, ACA formed part of the Australian delegation for the CSLF Stakeholder Engagement Workshop, held in June 2004 in London.

Australian Petroleum Production and Exploration Association

In early 2004, Australian Petroleum Production and Exploration Association (APPEA) launched discussion paper *"NatGas - Generating Economic and Social Wealth for the Nation"*. The paper outlines a comprehensive natural gas supply strategy for Australia providing a comprehensive whole of sector picture on the natural gas supply industry and its potential benefits to Australia.

APPEA has also been an active participant in consultative bodies tasked with furthering CCS work domestically including the CSLF Australian Reference Group, Sequestration Regulatory Reference Group and more recently the CCS Stakeholder Group.

AUSTRALIAN STAKEHOLDER ENGAGEMENT PROCESSES FOR INTERNATIONAL FORA

Intergovernmental Panel on Climate Change

The Second Order draft of the Intergovernmental Panel on Climate Change (IPCC) Special Report on CO_2 Capture and Storage was released on 10 January 2005 for government and expert review, with comments due back to the IPCC by 7 March 2005.

DEH co-ordinated the Australian Government's response. DEH's stakeholder consultation process included inviting written comments on the draft Special Report from government and non-government organisations, as well as hosting a public one-day stakeholder workshop in February 2005 in Canberra.

Approximately 50 stakeholders attended the workshop. Three Leading Authors of the Special Report provided presentations and assisted by providing context to the discussion. Industry, research community and several state government representatives attended as well as representatives from Australian Government agencies. Comments on the Special Report made by stakeholders were drawn on in developing the Australian comments on the draft Special Report.

The Australian Government's comments on the report were provided to the IPCC in March 2005. The report is to be finalised in September 2005. One theme of those comments related to the lack of detail on the sections of the report regarding public acceptance of CCS.

Carbon Sequestration Leadership Forum (CSLF)

Australia has been an active inaugural member of the CSLF since 2003. To further CCS stakeholder engagement and feed those views into the CSLF, DITR together with Australian Greenhouse Office (now part of DEH), ACA and APPEA formed the Australian CSLF Stakeholder Reference Group to address these issues. The Group consisted of Australian Government Departments, State Government Departments, energy companies (BHP Billiton, Rio Tinto, Chevron Texaco), researchers (CSIRO, CO2CRC) and industry associations (ACA, APPEA, Energy Users Association of Australia).

The CSLF Reference Group was primarily tasked to provide input into the Policy and Technical Working Groups, specifically in the lead up to the 2nd CSLF Ministerial meeting hosted by Australia in September 2004.

Although the intended work of this group is completed, DITR continues to seek input and feedback from these stakeholders on a number of issues. Stakeholders also continue to form part of Australian delegations to CSLF Policy and Technical Group meetings.

SUMMARY OF CANADIAN ACTIVITIES RELATED TO PUBLIC COMMUNICATIONS AND OUTREACH FOR CARBON DIOXIDE CAPTURE AND STORAGE (CCS)

PREAMBLE

In Canada, jurisdiction over the development of natural resources such as on-shore oil and gas rests with the provincial governments, except in those instances where the resources underlie Crown or aboriginal lands. As such, the ownership of the majority of the storage media for CCS rests with provincial governments. The federal government's related interests are linked to sustainable development and safe and efficient use of Canada's energy resources, the development of greenhouse gas emissions (GHG) inventories and of national strategies to mitigate climate change. Both levels of government are, therefore, actively engaged on CO_2 capture and storage (CCS) and are working collaboratively to advance public communications and outreach on this issue.

In Canada, governments, industry and ENGOs anticipate public interest, involvement and engagement on CCS on at least the following two dimensions:

1. The role of CCS as a GHG mitigation option, the costs, benefits and risks and rewards

2. Health and safety, integrity of storage and other issues related to specific activities or projects

To date, the relative emphasis on each of these dimensions has largely been a function of how CCS activity, particularly storage, has been evolving in Canada.

Canada's major on-shore oil and gas producing region is found in Western Canada, in the provinces of Alberta, British Columbia, Saskatchewan. The Western Canadian Sedimentary Basin (WCSB), from which the oil and gas are produced in this region, has been extensively characterized and an assessment of the storage potential of the basin has found that favourable conditions exist for CO_2 storage in mature or depleted oil and gas reservoirs, deep unmineable coalbeds and saline aquifers. A major advantage for Canada is the proximity of large CO_2 sources to suitable geological sinks in the WCSB.

Since the early 1990s, scientists in Canada have been generating a considerable and growing body of research with respect to the capture and storage of CO_2. In the late 1990s, a growing emphasis on climate change and the development of a large commercial CO_2-based enhanced oil recovery (EOR) project, highlighted to governments and industry the potential of CCS as a GHG mitigation option that could be initiated in the marketplace in the short to medium term.

Since then, additional activities have been undertaken by governments, industry and researchers to learn more about the capture and storage of CO_2, its viability and potential

role as a GHG mitigation option. In addition to applied research on CCS, there are a number of commercial and pilot projects underway in the WCSB. Activities and related learnings are still at a preliminary stage and are just now reaching the point where meaningful public engagement can occur.

To date, project operators have been communicating with local citizens when initiating CCS projects. Participant involvement approaches have been developed in these instances and have been the main vehicle for public communication and outreach. However, the scope of public communications and outreach activity has started to broaden. While most CCS activities are expected to occur in Western Canada, the reach of public communications and outreach activities regarding CCS will be Canada-wide as CCS represents an important option for GHG mitigation in Canada.

This paper serves to outline CCS public outreach activities in Canada and how some of the related thinking has evolved domestically.

Background Studies on Public Outreach in Canada

The activities below reflect initial efforts to address public communications issues related to the concept of CCS and its role in greenhouse gas mitigation.

Recognizing the need for public communications and outreach initiatives, an ad hoc committee was struck in 2003 with membership from the federal and Alberta governments and one NGO group, the Pembina Institute. To date, the committee has:

- supported two scoping studies to develop a path forward on public education and outreach
  - Towards a Strategy for Stakeholder Engagement on Geological Carbon Storage
  - Steps Toward a Strategic Plan for Citizen Involvement for Carbon Capture and Storage Decisions in Canada;

- supported a study entitled 'Public Attitudes Toward Geological Disposal of Carbon Dioxide in Canada' which is currently being finalized; and

- held preliminary discussions on a domestic strategy for public education and outreach on CCS.

Detailed information on these studies is presented below.

Towards a Strategy for Stakeholder Engagement on Geological Carbon Storage (Stratos, 2003)

This study was commissioned to assist in the development of a strategy for stakeholder engagement with respect to issues involved in the geological storage of carbon. While

the focus of the study is more broadly oriented to a range of stakeholders, there are important implications for public communication and outreach.

The report was intended to assist in building a shared understanding of the role for stakeholder engagement and of the variety of issues that would need to be addressed in the development of a successful stakeholder engagement strategy.

The study examined views held on the following issues, through consultation with key players from federal and provincial governments, industry, research institutes, environmental non-governmental organizations (NGOs) and risk management experts involved in the development and oversight of carbon storage initiatives:

- Need for Stakeholder Engagement
- Purpose of Stakeholder Engagement
- Potential Stakeholder Participants
- Activities and Processes
- Delivery Agents
- Measuring Success
- Challenges for Effective Stakeholder Engagement

The report provides a discussion of the implications of the wide range of views on the development of a successful stakeholder engagement strategy, and concludes with an identification of options for consideration in terms of the "next steps" needed to undertake as a strategy for stakeholder engagement on carbon storage is developed.

Steps Toward a Strategic Plan for Citizen Involvement for Carbon Capture and Storage Decisions in Canada (Tim McDaniels Research and University of British Columbia, 2003)

The purpose of this report was to help provide guidance and input toward a strategic plan for structuring and conducting citizen involvement regarding carbon storage policy decisions in Canada. The content of the report is based in part on a one-day workshop where the following questions and issues were addressed:

- What level of activity should be expected regarding carbon storage to 2010?
- What are the objectives of citizen involvement (CI) for carbon storage?
- The future role and responsibilities of a committee on CI
- The multiple levels of decision-making (i.e., local, regional, national and international levels).
- Risk management efforts as a parallel path along with citizen's involvement (CI).
- The kinds of risk communication formats and materials that the committee could design, coordinate and employ
- The messages and sources of information that should be employed.

Public Attitudes Toward Geological Disposal of Carbon Dioxide in Canada (Jacqueline Sharp, M.K. Jaccard and Associates, 2005)

This study is a two-phased approach that examines the acceptability of carbon dioxide capture and storage technology to Canadians. In the first phase, focus group sessions were run in both Toronto and Edmonton, with 20 participants in total, in order to identify attitudinal differences between the two geographic regions (i.e., CO_2 storage would likely take place close to Edmonton but not Toronto). The information gathered from the focus group sessions was then used to design an Internet-based survey for distribution to a much larger sample of Canadians. The survey was administered to 1,967 Canadians, with the Alberta and Saskatchewan sub-sample over-weighted in order to allow for statistically significant analyses of both geographic segments. The key research questions being addressed in this study are:

1. Identify the public's state of knowledge about geological disposal of CO_2 and identify and prioritize any concerns that they have.
2. Identify and prioritize the reasons for public support of geological disposal of CO_2.
3. Separate and identify the opposition stemming from concern about the *risks* of geological disposal of CO_2 from *fundamental* opposition to geological disposal of CO_2 as the wrong solution to the climate change problem
4. Identify and understand some of the features that might determine the degree of public support for geological disposal of CO_2 as a greenhouse gas mitigation measure in Canada.
5. Determine how the presentation of positive (benefit-focused) information versus negative (risk-focused) information about geological disposal of CO_2 impacts support for the technology.
6. Determine how attitudes toward geological disposal of CO_2 differ between residents of Alberta and Saskatchewan, where most of the disposal will take place, and residents living in other areas of Canada.

The results of this work are currently being finalized and will be used to guide future initiatives.

Preliminary Discussions on a Domestic Strategy for CCS Public Education and Outreach

In collaboration, the ad-hoc working group developed a draft strategy for CCS Public Education and Outreach based on the following activities:

- key findings of the Stratos and McDaniels studies
- survey of and participation in other public education and outreach initiatives (conference proceedings, Plains CO_2 Reduction Partnership, etc); and
- examining public education and outreach strategies associated with other domestic issues that are currently more mainstream than the geologic storage of carbon dioxide, such as the development of coalbed methane in Canada.

The following ideas were presented and discussed at a CSLF stakeholder meeting held in January 2005.

- Maintenance of a website that would include:
  - unbiased information to citizens and interested parties
  - research updates to fill in the gaps as more is learned
  - progress reports on monitoring developments
  - credible reading material, website, industry newsletters, etc, news articles and journal information
  - frequently asked questions sheet
  - backgrounders
- Media watch and preparation of responses to articles that may contain misinformation
- NGO workshop to educate on topic and solicit views on effective outreach strategy
- Development of multi-stakeholder advisory group to guide future initiatives

The intent is to further develop these ideas and others through consultation with a wider domestic audience with the aim of agreeing on a domestic CCS Public Communication and Outreach strategy.

Domestic Strategy Activities with a Public Outreach Component

The following activities are directed at the development of Climate Change and CCS Strategies. While the focus is not on public communication, there are implications for public communications and outreach activities.

Towards a Strategy for Implementing CO_2 Capture and Storage in Canada

In 2002, Dr. David Keith from the Department of Engineering and Public Policy at Carnegie Mellon University was commissioned by Environment Canada to examine the opportunity for implementing carbon dioxide capture and storage (CCS) in Canada, focusing on the next 10–15 years. The focus of the report was on the following strategic questions:

- What industrial sectors provide the best opportunities for implementing CCS, and what policy instruments might best promote implementation?
- What are Canada's strategic assets and liabilities in implementing CCS?
- How does CCS couple the control of CO_2 and conventional pollutants?
- What are the risks of CCS, and what options exist to manage and regulate them?
- What are the specific roles for Environment Canada?

This document was made available to the public upon request. To date, libraries, research organizations, small businesses and individuals have asked for copies. A complete version of the report is attached.

Alberta Government

As part of the Government of Alberta's strategy to address climate change and greenhouse gas emissions, ***Albertans & Climate Change: Taking Action*** was released in October 2002. This plan is designed to encourage Albertans to take steps to reduce greenhouse gas emissions intensity and energy consumption, and begin to adapt to potential changes in climate. ***Taking Action*** is an integrated and innovative plan in which the capture and storage of carbon dioxide underground plays a key role. A copy of Alberta's Climate Change Action Plan is attached.

In 2004, the Government of Alberta produced a citizen's guide entitled ***Carbon Capture and Storage of Carbon Dioxide in Western Canada***. The aim of this guide is to inform and educate Albertans about carbon capture and storage projects. A copy of the guide is attached.

In March 2004, the Government of Alberta released ***Key Actions to Date.*** This document summarizes the progress the Government of Alberta has made since the action plan was launched in October 2002. The carbon management component of the plan highlighted the following measures:

- A Royalty Credit Program for projects using CO_2 for enhanced resource recovery;
- Support for research to reduce the costs of CO_2 capture and compression;
- An inventory of Alberta coal seams in targeted areas of the province; and
- The monitoring of CO_2 Enhanced Oil Recovery operations.

A copy of the document is attached.

All the above documents have been posted on Alberta Environment's website http://www3.gov.ab.ca/env/info/infocentre/PubListing.cfm and are available to the public.

Project-specific Public Outreach Activities

Industry-led Projects in Saskatchewan

Oil and gas projects in Saskatchewan require approval from Saskatchewan Industry and Resources and Saskatchewan Environment. Depending on the size and potential environmental impact of a project, project operators may be encouraged by the government to engage in public relations activities such as open houses and the issue of public notices.

To date, CO_2 floods operated by EnCana Ltd. at Weyburn and Apache Canada Ltd. have been brought to the public's attention through open houses and press releases. One such release is attached.

IEA GHG Weyburn CO_2 Monitoring and Storage Project

The IEA GHG Weyburn CO_2 Monitoring and Storage Project (the Project-Phase I) was a significant monitoring project associated with commercial enhanced oil recovery project in Weyburn, Saskatchewan. The Project-Phase I was been designed to address both the economics and long-term fate/security of CO_2 storage in geological formations. The first phase of the project was completed in September 2004 when the final report was issued at GHGT-7 in Vancouver. To date, the results of the Project-Phase I have been disseminated via interviews, media releases and the creation of a video that has been used to provide segments for television programming. It is expected that a website will also be established for the Project-Phase I.

As a result of a recommendation that was made in the Final Report for the IEA GHG Weyburn CO_2 Monitoring and Storage Project, a ***"Final Phase" Strategic Plan*** has been proposed to *'address gaps to enable transfer of technology and knowledge gained in Weyburn to a more widespread industrial implementation of this technology and to build public confidence and acceptability in geological long-term storage of CO_2'*.

A Communications group has been proposed for the Final Phase of the project with an intended goal of developing an effective public outreach and consultation process to ensure public understanding. The proposal has identified several issues that will need to be addressed in the public communications plan. These include but are not limited to:

- long-term legal liability
- emergency planning and protection
- health and safety
- new/amended drilling and well completion standards focused on CO_2 injection and storage.

Industry-led projects in Alberta

As oil and gas projects are developed in Alberta, industry is required by the Alberta Energy and Utilities Board to develop an effective participant involvement program that includes parties whose rights may be directly and adversely affected by the nature and extent of the proposed application (Guide 56 – Energy Development Applications and Schedules). Guide 56 outlines consultation and notification requirements for residents who live within a specified radius of the project. Project-specific information is supplied, such as a description of the project, types of substances that will be processed, transported and drilled for, discussion of the potential sources of emissions, etc. Please refer to http://www.eub.gov.ab.ca/bbs/default.htm for a complete copy of the Guide.

Since 2004, five test projects, which use carbon dioxide to enhance resource recovery, have been announced through the government of Alberta's CO_2 Projects Royalty Credit Program and the Federal government's CO_2 Capture and Storage Incentive Program. These pilot scale trials are all located in Alberta and include four enhanced oil recovery pilot projects and one enhanced coalbed methane pilot project. The companies involved in these initiatives are:

- Anadarko Canada Corporation's Enchant Arcs oil pool project in southern Alberta
- Apache Canada's Zama Keg River oil pool project in northwestern Alberta
- Devon Canada Corporation's Swan Hills oil field project in central Alberta
- Penn West Petroleum Limited's Pembina Cardium oil pool project in central Alberta
- Suncor Energy's CO_2 Sequestration and Enhanced Coalbed Methane Production Pilot

To date, the public has been informed of these pilot projects through the dissemination of materials and direct conversations with surrounding landowners as outlined in Guide 56. An example of information that has been supplied to landowners is attached. Also attached is a press release for one of the projects.

The federal and provincial governments also made public announcements with respect to the initiation of their respective programs and regarding projects chosen to receive funding under those programs.

There are also approximately 40 acid gas injection sites in Alberta (as well as several in British Columbia) where carbon dioxide and hydrogen sulphide streams are geologically stored. Surrounding landowners would also be notified in a similar fashion to that described above.

CCS Activities that have a Public Outreach Component

Natural Resources Canada – Canadian CO_2 Capture & Storage Technology Network

Natural Resources Canada operates the ***Canadian CO_2 Capture & Storage Technology Network (CCCSTN)*** that has been established due to interest and initiatives underway for the implementation of CO_2 capture and storage technologies. The key functions of the CCCSTN include the following:

- facilitate information sharing across all interested parties involved in CCS technology in Canada
- maintain a website which includes all the latest publicly available information on Canadian activities plus links to international activities, along with a brochure
- coordinate outreach and communication activities
- conduct workshops on specific themes

- provide a forum for coordinating the response of governments to requests for support for technology-based projects
- coordinate Canada's interaction with international activities
- identify technology gaps and barriers that prevent CO_2 C&S moving forward

The website for the CCCSTN can be viewed at www.co2network.gc.ca.

EnergyINet – CO_2 Management Innovation Program

The Energy Innovation Network (EnergyINet) is led by champions from both the public and private sectors across Canada. EnergyINet's role is to encourage the development and application of new technologies for responsible energy production and environmental performance. For more information on EnergyINet, please refer to the following website http://www.energyinet.com.

One element of EnergyINet's integrated energy strategy is CO_2 Management. The challenge facing the CO_2 Management Innovation Program is to *'reduce greenhouse gas and other emissions by developing technology to capture, transport and store carbon dioxide and use it to increase oil and gas recovery'*. Program elements include:

- systems for CO_2 capture and storage;
- identification and characterization of sites suitable for underground storage of CO_2;
- development and demonstration of new technologies for effective and safe geological storage;
- development of instrumentation and guidelines to accurately measure, monitor and verify both the short- and long-term efficiency and effectiveness of geological storage of CO_2; and
- risk and performance assessment including identification of safe and acceptable CO_2 leakage rates appropriate to each geological setting.

In accordance with these tasks, the CO_2 Management Innovation Program also plans to engage in public education and dialogue to promote better understanding of human health risks and environmental impacts related to the geological storage of CO_2. The public education component of the program is currently in its initial phases.

Asia-Pacific Economic Cooperation Study on Capacity Building

In 2004, the APEC Energy Working Group commissioned a study on capacity building and awareness to effectively implement strategies and utilize available technologies for carbon dioxide capture and geological storage. The study was carried out by The Delphi Group and the Alberta Research Council which are both based in Canada. As part of this study, a community outreach strategy for carbon capture and storage was developed,

along with information that could be distributed to the public on CCS. For more information on the study, please refer to http://www.delphi.ca/training/home.html.

Next Steps

Domestic Working Group

As Canada has numerous carbon dioxide capture and storage initiatives underway, a formalized domestic working group on public communications and outreach is being established on the matter and is expected to include membership from federal and provincial governments, industry, research organizations and ENGOs. This multi-stakeholder, coordinated approach will ensure that public communications and outreach activities are considered for domestic CCS projects and activities, serve to avoid duplication of efforts and inconsistent information in terms of the development of outreach materials, identify gaps and needs and guide future initiatives in this area.

ATTACHMENTS

a) Towards a Strategy for Implementing CO_2 Capture and Storage in Canada
b) Taking Action: Alberta's Climate Change Action Plan
c) Capture and Storage of Carbon Dioxide in Western Canada
d) Key Actions To Date
e) Background: Apache Midale Unit – Carbon Dioxide Flood Project
f) Coalbed Methane and CO_2 Sequestration: A Primer
g) Penn West Petroleum Ltd. News Release: Announcement of CO_2 Injection

EPS/2/IC/1–Dec. 2002
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Air Pollution Prevention Directorate
Environmental Protection Service

ENVIRONMENTAL
PROTECTION SERIES

Towards a Strategy for Implementing CO_2 Capture and Storage in Canada

December 2002

Environment Canada Environnement Canada

Canada

This report may be cited as follows:

Keith, D. W. (2002) *Towards a Strategy for Implementing CO_2 Capture and Storage in Canada*. Prepared by D. W. Keith, Carnegie Mellon University, Pittsburgh, Pennsylvania, for the Oil, Gas and Energy Branch, Environment Canada, Ottawa, Ontario.

Copies of this report may be obtained from the following:

Oil, Gas and Energy Branch
Environment Canada
351 St. Joseph Boulevard, 10th Floor
Gatineau, Quebec, Canada K1A 0H3
(819) 997-I223

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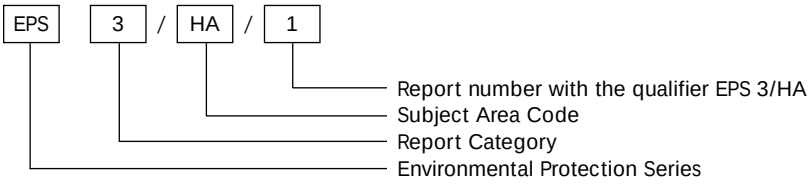

Categories

1 Regulations/Guideline/Codes of Practice
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TOWARDS A STRATEGY FOR IMPLEMENTING CO_2 CAPTURE AND STORAGE IN CANADA

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Executive Summary

The possibility of using CO_2 capture and storage (CCS) technologies to achieve deep reductions in emissions from electric power generation has recently become salient in Canadian climate policy. I argue for a cautious approach. While there are good reasons to expect that CCS will eventually enable deep reductions in CO_2 emissions both in the electric sector and elsewhere in the economy, it is—with one exception—unwise to aim for substantial adoption of CCS in the Kyoto commitment period (2008–2012). Government action to force implementation would be unwise, because rapid implementation of CCS would drive up costs and because important issues surrounding the risks, regulation, and public perception of CCS are unresolved.

The exception is in the oil and gas (O&G) sector, where there is an opportunity to use CCS to achieve significant emissions reductions within the Kyoto time frame. The cost of capturing CO_2 and injecting it into geological reservoirs is strongly dependent on the size and purity of the CO_2 stream. Combustion sources have CO_2 concentrations of 5–15%; for these dilute streams, the cost of capturing CO_2 dominates the cost of storage. The cost of capture is smaller for non-combustion sources and can be zero for high-pressure sources of nearly pure CO_2. In Canada, the most important non-combustion sources of CO_2 are natural gas processing and the production of hydrogen (H_2) used in petroleum refining.

Raw natural gas contains significant CO_2, most of which is removed at gas processing plants prior to delivery to consumers. Some of this natural-gas-associated CO_2 (NG-CO_2) is now injected into geological storage reservoirs as a side effect of sour gas processing. This process provides important practical experience with CO_2 storage and is an area of Canadian expertise. This technology could be extended to capture a significant fraction of the NG-CO_2 stream at low cost. Total NG-CO_2 production is about 9 Mt-CO_2/year. If gas production rises as forecast, it will likely rise to at least 13 Mt-CO_2/year by 2010, equivalent to 2.4% of Canada's CO_2 emissions.

The upgrading of raw bitumen extracted from the oil sands to produce synthetic crude oil requires large amounts of hydrogen. Almost all the required hydrogen is produced from natural gas using a process that can produce a stream of nearly pure CO_2 containing most of the carbon in the initial natural gas stream. Unfortunately, the newest hydrogen plants use a process that does not produce a pure CO_2 stream, so implementing CO_2 capture would require modification of plants now being planned or retrofit of plants that are already built. The construction of hydrogen plants to meet the demands of bitumen upgrading in Alberta may soon produce the world's largest concentration of hydrogen production facilities. The quantity of CO_2 potentially available from hydrogen production may well exceed 10 Mt-CO_2/year by 2010.

Technological capability is a necessary but insufficient condition for CCS to play a major role in mitigating CO_2 emissions. To fulfil its promise, CCS must evolve from a collection of individual technologies into a large-scale technological system for managing fossil fuel carbon. Such a system will require a suite of technologies linked by a network of institutions, financial systems, and regulations that are able to achieve public understanding and acceptance.

Uncertainty in the effectiveness of CO_2 storage, arising from uncertainty in the lifetime of stored CO_2, is not currently addressed by any Canadian government entities. It will need to be. Although management of geological resources is a provincial responsibility, the management of CO_2 stored to avoid atmospheric emissions implies a federal responsibility because it arises from international commitments to control emissions. The international status of CO_2 storage is unclear. While both the Kyoto Protocol and the recent Conferences of the Parties in Bonn and

Marrakech explicitly endorse the use of CO_2 storage, crucial questions regarding the incorporation of CO_2 storage within the accounting rules of the United Nations Framework Convention on Climate Change remain to be decided.

The difficulty in building a system for regulating CO_2 storage is not simply due to technical uncertainty in predicting the lifetime of stored CO_2; it also arises from uncertainty about the goals of storage. Should the median lifetime of CO_2 in storage facilities be 500 years or 10 000? What fraction of early failures are we willing to accept? Uncertainty in predicting the fate of CO_2 in reservoirs cannot be eliminated. The regulatory system cannot therefore demand zero risk. The challenge is to build a regulatory regime that works despite these uncertainties.

Efforts to build a robust regulatory environment for geological storage cannot wait until the technology is ready for large-scale application. Environmental regulators, industry, and environmental groups need to begin to build a common understanding of the current state and future course of regulation, identifying areas of common concern and developing compromises to address areas of disagreement. The federal government must assume a central role in managing this effort.

Wherever it is introduced, CO_2 storage is certain to generate public controversy. This controversy will arise from specific concerns about the safety of storage and more general concerns about sustainability. In contrast to the electric sector, the early introduction of CCS in the O&G sector will likely focus debate on the safety and longevity of CO_2 storage, rather than on the choice between fossil and non-fossil primary energy. While both concerns are legitimate, debate centred on the former will be more likely to resolve key questions about the acceptability of CCS technologies.

Government action to encourage the adoption of CCS technologies in the O&G sector could yield significant, low-cost reductions in CO_2 emissions within the Kyoto commitment period while building the institutional and technological capacity necessary for broader use of CCS in the future. Specifically, I estimate that emissions could be reduced—compared with business as usual—by about 20 Mt-CO_2/year at an average cost[1] of \$15–25/t-CO_2. The rapid growth in the O&G sector would lower the cost of emissions mitigation, because CCS could be built into new facilities where costs are generally lower, rather than added to existing systems where costs would be higher. If action is delayed, much of this opportunity for low-cost mitigation will be lost.

[1] All monetary figures in this report have been expressed in year 2000 Canadian dollars unless otherwise indicated.

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Acronyms, Abbreviations, and Units

AGI	Acid gas injection
AMG	Analysis and Modelling Group
bbl	Barrel
CCS	CO_2 capture and storage
CO	Carbon monoxide
CO_2	Carbon dioxide
ENGO	Environmental non-governmental organization
EOR	Enhanced oil recovery
EUB	Alberta Energy and Utilities Board
FGD&SCR	Flue gas desulphurization and selective catalytic reduction
GDP	Gross domestic product
GHG	Greenhouse gas
Gt	Gigatonne
H_2	Hydrogen
H_2-CO_2	Hydrogen-associated CO_2
H_2S	Hydrogen sulfide
IGCC	Integrated gasification combined cycle
IPCC	Intergovernmental Panel on Climate Change
kg-CO_2	Kilogram of CO_2
km	Kilometre
kPa	Kilopascal
kt-CO_2	Kilotonne of CO_2
kW	Kilowatt
kWh	Kilowatt-hour
Mt	Megatonne
Mt-CO_2	Megatonne of CO_2
MWh	Megawatt-hour
NGCC	Natural gas combined cycle
NG-CCS	Natural-gas-fired CCS
NG-CO_2	Natural-gas-associated CO_2
NO_x	Nitrogen oxides
O&G	Oil and gas
PC	Pulverized coal
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in diameter
ppmv	Part per million by volume
PSA	Pressure swing absorption
R&D	Research and development
scf	Standard cubic feet
SMR	Steam methane reforming
SO_2	Sulphur dioxide

SO_x	Sulphur oxides
t-C	Tonne of carbon
Tcf	Trillion (10^{12}) cubic feet
t-CO_2	Tonne of CO_2
UN-FCCC	United Nations Framework Convention on Climate Change

1. Introduction

Canada stands at the threshold of commitment to costly action aimed at reducing emissions of greenhouse gases (GHGs), principally CO_2. Canada has made international commitments to reduce emissions under the United Nations Framework Convention on Climate Change (UN-FCCC) and the Kyoto Protocol, and the federal government has recently begun to allocate significant resources to mitigating emissions with programs such as Action Plan 2000. Climate policy is nevertheless at a threshold, with crucial questions about the magnitude, timing, and character of the policy measures remaining unresolved. The current commitment of funding is far less than would be required to fulfil the intent of the Kyoto agreement, which was to reduce emissions to an average of 94% of their 1990 levels during the 2008–2012 period. The level of public and governmental support for sustained and costly action is, at best, uncertain. Moreover, there is little agreement about the kinds of measures that should be used to reduce emissions or about the appropriate distribution of economic pain across sectors of the economy. Uncertainty is further compounded by the ambiguity of the international climate policy regime. Put most bluntly, it is still possible—depending on the detailed rules adopted for carbon trading and assuming continued U.S. abstention—that the formal terms of the Kyoto Protocol could be met at very modest cost and with little environmental benefit [1].

It has long been assumed that reductions in CO_2 emissions will be achieved through a combination of increasing the efficiency of energy use and switching to non-fossil sources of primary energy, such as renewables or nuclear. Over the last decade, a new option has emerged: the use of fossil fuels with minimal atmospheric emissions of CO_2, accomplished by capturing the carbon content of fossil fuels while generating carbon-free energy products, such as electricity and hydrogen, and storing the resulting CO_2 away from the atmosphere (Figure 1). Although many of the component technologies necessary for CO_2 capture and storage (CCS) currently exist at large scale, the idea that CCS could play a central role in our energy future is a radical break with recent thinking about energy system responses to the climate problem.

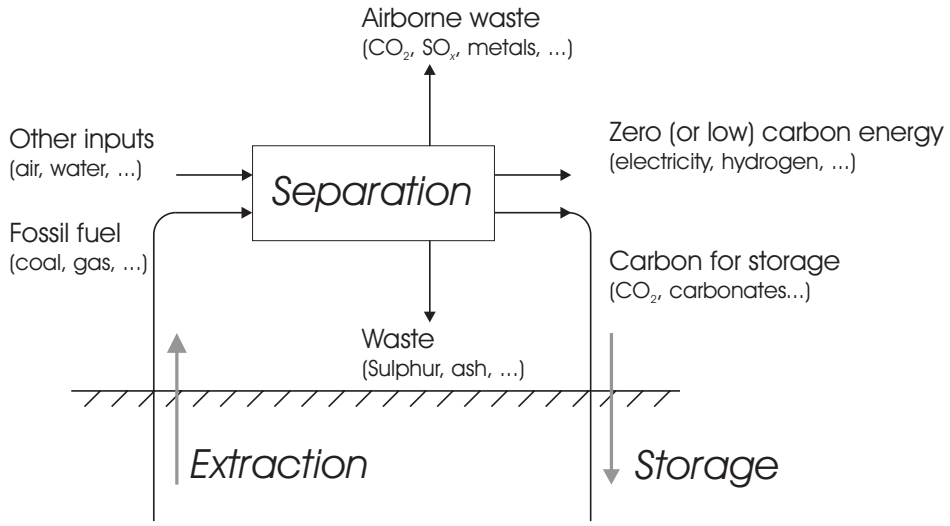

Figure 1. CO_2 capture and storage viewed as a general process for using fossil fuels with minimal atmospheric emissions of CO_2.

While CCS is best viewed as just one element in a broad portfolio of GHG mitigation technologies, it may nevertheless transform the politics of the CO_2–climate problem. By lowering the cost of emissions mitigation, CCS may enable stabilization of atmospheric concentrations at acceptable cost. By weakening the link between fossil energy and atmospheric CO_2 emissions, CCS makes it feasible to consider a fossil-fuelled global economy through the next century. By reducing the severity of the threat that emissions reduction poses to fossil energy industries and fossil-energy-rich nations, CCS may ease current deadlocks in both domestic and international climate policy.

There are, however, no magic bullets with which to slay the CO_2–climate problem. All current energy supply options that might be used to make deep cuts in CO_2 emissions either are impractically expensive (solar) or pose significant environmental challenges (wind, biomass, CCS, and nuclear). Moreover, global energy systems are highly heterogeneous, making it implausible that any single technology will triumph everywhere. Finally, the history of energy policy is replete with technologies that their advocates advanced as being too cheap to meter, yet which are now irrelevant. Thus, while I paint an optimistic picture about the potential role of CCS in mitigating CO_2 emissions, skepticism is in order. The very fact that CCS was not on the energy policy agenda even a decade ago should make one cautious about any predictions for the next century.

1.1 Scope and Purpose of the Report

This report examines the opportunity for implementing CCS in Canada, focusing on the next 10–15 years. I do not aim to provide a comprehensive treatment or precise estimates of the cost of mitigating CO_2 emissions. Instead, I focus on strategic questions:

- What industrial sectors provide the best opportunities for implementing CCS, and what policy instruments might best promote implementation?
- What are Canada's strategic assets and liabilities in implementing CCS?
- How does CCS couple the control of CO_2 and conventional pollutants?
- What are the risks of CCS, and what options exist to manage and regulate them?
- What are the specific roles for Environment Canada?

The possibility of using CCS technologies to enable deep reductions (50%) in CO_2 emissions from Canada's electric sector has recently become salient in Canadian climate policy. I argue for a cautious approach. While there are good reasons to expect that CCS could eventually enable deep reductions in CO_2 emissions both in the electric sector and elsewhere in the economy, it is—with one exception—unwise to aim for substantial adoption of CCS in the Kyoto commitment period (2008–2012). Government action to force substantial implementation by 2008–2012 would be unwise, both because rapid implementation of CCS would drive up costs and so provide economically inefficient mitigation of CO_2 emissions and because important issues surrounding the risks, regulation, and public perception of CCS are unresolved. Overly rapid government action to force adoption of CCS might well produce a public backlash that would frustrate attempts to implement economically efficient measures for mitigating CO_2 emissions.

That exception is the application of CCS to reduce emissions from non-combustion sources of CO_2 in the upstream oil and gas (O&G) sector. A number of technological and institutional factors suggest that significant implementation of CCS could be achieved in this sector at moderate cost within the Kyoto commitment period.

The remainder of the report is organized as follows. Section 2 surveys the opportunities for implementing CCS in Canada, focusing on its application in two sectors, electric power and O&G. It addresses the technology and economics of CO_2 mitigation, while deferring questions of policy and implementation to Section 4. The risks of CCS are surveyed in Section 3, as is the challenge of successfully managing the risks through regulation. Section 4 addresses the strategic challenges of implementation, comparing the opportunities in electric power generation and O&G and analyzing some specific policy instruments that might be used to encourage implementation. Finally, Section 5 reviews the specific roles for Environment Canada in managing CCS.

2. CO_2 Capture and Storage in Canada: Opportunity, Technology, and Economics

Most analysis of CCS has focused on its application to centralized electricity generation, where the technology could enable deep reductions in CO_2 emissions with minimal reorganization of the electricity distribution infrastructure. While the electric sector is an important arena for CCS, the technologies could eventually be applied more broadly to mitigate CO_2 emissions throughout the economy (see Figure 1).

The technology can, for example, be used to produce hydrogen from fossil fuels without CO_2 emissions. The use of hydrogen as an energy carrier could enable deep reductions in CO_2 emissions via the substitution of hydrogen for natural gas or gasoline in buildings and transportation, respectively. Hydrogen can be produced from many primary energy sources; if hydrogen is widely used, however, fossil fuels with CCS will likely be the dominant source, because the intrinsic cost advantage of CCS over other low-CO_2-emission technologies is particularly strong for hydrogen production.[2] In the long run, if CCS makes sense anywhere, it makes sense for hydrogen production. Achieving significant emissions reductions using hydrogen, however, will require the development of a large-scale infrastructure for hydrogen distribution and use [4]—a very difficult and uncertain venture. Because of these structural barriers, hydrogen will not likely play a significant role as an energy carrier for many decades.

Although the great majority of CO_2 emissions arise from combustion, significant non-combustion sources of CO_2 exist for which the cost of capture and storage is comparatively low. These niche applications of CCS provide opportunities for near-term reductions in CO_2 emissions while simultaneously providing invaluable institutional and technological experience with capture and storage. In Canada, the largest concentrated non-combustion sources arise from O&G production and processing.

The various potential applications of CCS may be ordered by their expected mitigation costs[3] or by the difficulty of surmounting the structural barriers that bar their implementation. Either

[2] Like electricity, hydrogen is an energy carrier that must ultimately be generated from some primary energy source. The cost advantage of fossil fuels with CCS over solar, wind, or nuclear power is considerably larger for hydrogen production than it is for electricity because of the relative ease of thermochemical conversion (fuel to hydrogen) compared with electrochemical conversion (electricity to hydrogen) and also because solar and wind power produce electricity, which must then be converted to hydrogen [2,3].

[3] As used here, the "mitigation cost" of a technology is the cost of reducing CO_2 emissions using that technology assuming constant factor prices. This is equivalent to the carbon price at which the technology would provide the same services at the same cost as some baseline technology.

ordering would put non-combustion sources first, electric power generation second, and large-scale use of hydrogen third, as CCS offers the most costly and difficult-to-implement path to emissions mitigation. This report assesses the strategy for implementation of CCS in Canada over the next 10–15 years; it therefore largely ignores opportunities for use of hydrogen as an energy carrier and instead focuses on the electric power sector and on the O&G sector, from resource extraction through refining.

2.1 Electric Power Generation

Electric power generation emits ~100 Mt-CO_2/year, about 19% of Canada's CO_2 emissions. Several recent government studies have suggested that CCS could be implemented to achieve deep reductions (~40%) in emissions from the electric sector, providing an important contribution to meeting Canada's commitments under the Kyoto Protocol [5,6].

Several lines of argument support the idea that CCS might find comparatively early application in electric power generation. First, there are at least four general reasons why electric power generation will likely bear a disproportionate share of the burden of reducing CO_2 emissions over the next few decades:

1. Electric power plants are among the largest point sources of CO_2.

2. Deep reductions in emissions can be achieved without requiring system-wide changes in distribution and end-use equipment, as would be required to achieve similar reductions in other sectors.

3. Most coal is used for electric power generation, and coal has the highest carbon-to-energy ratio of the fossil fuels. Moreover, coal combustion is a significant source of conventional air pollution.

4. The centralization of capital and management in electric power generation makes regulatory implementation simpler than for other end-use sectors.

Second, there are reasons to expect that if deep emissions reductions are demanded in the electric sector, then structural factors may make CCS play a larger role than is suggested by its cost alone. Given open competition between electricity technologies under a carbon tax (or economically equivalent regulatory mechanism), and assuming that carbon storage can meet environmental permitting requirements, CCS may be adopted in preference to non-fossil alternatives, even if their electricity costs are similar. Unlike wind power, for example, CCS plants would match the existing distribution system with respect to sizing and ease of dispatch.[4] Moreover, CCS plants will likely be constructed using existing suppliers, and established upstream fossil energy companies could provide both fuel and CO_2 storage. While nuclear power could, in principle, play a central role in reducing CO_2 emissions, absent sweeping changes in the industry, its regulation, and its public perception, it seems likely that utilities will find CCS less risky and less expensive than nuclear power.

As the capstone of the economic analysis performed by the National Climate Change Process, the Analysis and Modelling Group (AMG) report was perhaps most influential in building

[4] "Dispatch" refers to the adjustment of power plant output to meet varying demand. At good sites, wind can produce electricity at low cost—compared with other low-emission technologies—but this understates the cost of large-scale wind-generated electricity, because additional storage, backup, or transmission would be required in order for wind to supply a substantial fraction of system demand.

expectations that CCS could be widely deployed in the electric sector to meet Canada's Kyoto commitment. Specifically, the baseline assumption of the AMG report[5] is that 42 Mt-CO_2/year could be captured at a price of \$38/t-CO_2. The 42 Mt-CO_2/year was derived by assuming that CCS could be applied to most coal-fired electric capacity located in the Western Canadian Sedimentary Basin. While cost assumptions originated in the Electricity Issues Table, it seems likely that inclusion of CCS in the AMG report played an important role in raising the profile of CO_2 capture technologies in federal and provincial governments.

Notwithstanding the long-term importance of CCS for mitigating emissions from electric power generation in Canada, a policy that forced rapid implementation of CCS—such as the scenarios analyzed in the AMG report—would be both unrealistic and unwise. The wisdom of such a policy is the subject of Section 4.1.2; here, I focus on assessing factors that control the rate at which CCS technologies could be implemented and on the cost of avoiding CO_2 emissions.

2.1.1 Rate of Implementation

In order to capture an average of 42 Mt-CO_2/year over the 2008–2012 period, it is necessary either to have all plants in operation by 2008—six years away—or to increase the amount of CO_2 captured later in the commitment period. An elapsed time of six years from project initiation to first operation is a respectable period for building modern pulverized-coal (PC) plants; in Canada, the time may now be as short as 5 years.[6] It would take significantly longer to built a CO_2 capture plant, particularly one using new technology. Meeting the AMG reduction target would thus require the immediate initiation of planning for all required plants—a highly implausible scenario.

It is marginally more plausible that retrofits could be completed within this time frame; however, since retrofits using current amine technology[7] derate plant output by ~25%, this course would nevertheless require major construction of new capacity to make up for plant derating. Achieving the AMG goal is therefore unrealistic, because the required rate of implementation would be very hard to achieve.

If it were, in fact, necessary to replace all coal-fired electric power generation in Alberta and Saskatchewan with zero-CO_2-emission technology by 2008, it would be easier, and far less risky, to use natural-gas-fired systems. For new plants, natural-gas-fired CCS (NG-CCS) systems are directly competitive with coal-CCS (Figure 2). The overall costs of electricity from the two systems are roughly equal within uncertainties, which are dominated by the uncertainty of future gas prices and by the cost of CO_2 storage[8] [7, 8, 9, p. 256]. While the overall electricity costs are

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[5] The AMG defined various scenarios ("paths"). Paths 1 and 3 assumed that each economic sector contributed equally to emissions reductions; these assumptions produced higher overall costs and resulted in little use of CCS, because electric sector emissions mitigation was modest. Paths 2 and 4 allowed trading between sectors to reduce the overall cost of meeting the Kyoto target, resulting in large reductions in electric sector emissions and an average (between the two paths) of 42 Mt-CO_2/year of emissions reductions achieved through CCS [5, p. 81].

[6] The total time for a generic PC plant would be about 5 years, about 1½ for design planning and permitting and about 3½ for construction (personal communication, Malcolm McDonald, Director Research and Technology, TransAlta, November 2001).

[7] If retrofits had to be operational by 2008, there would likely be insufficient time to develop improved capture technology.

[8] The cost of avoided CO_2 emissions for NG-CCS, as it is conventionally calculated, is roughly twice that for coal-CCS, because the baseline natural gas combined cycle (NGCC) plant has ~50% lower emissions

roughly equal, the capital cost of NG-CCS generation is about two-thirds that of coal-CCS, technical uncertainties are smaller, and permitting and construction would be considerably faster.

2.1.2 Cost of CO_2 Mitigation

Published estimates of the cost of reducing CO_2 emissions from electric generation via CCS vary by almost an order of magnitude; the variance in cost estimates, however, greatly overstates the technical uncertainty. Part of the variance arises from unavoidable uncertainties in assessing the cost and performance of unproven technologies, but additional variance arises from inconsistencies in analytical assumptions that exaggerate the technological uncertainty. Inconsistency arises in three ways:

1. *Choice of reference case*. Analysts often estimate the cost of avoiding CO_2 emissions expressed in $/t-C, but any such estimate necessarily depends not only on the cost and performance of the CCS technology, but also on the specification of a reference case with a specific energy cost and CO_2 emissions per unit electricity. Estimates of the cost of generating electricity with CCS—which depend on factors specific to the plant (such as thermal efficiency)—are therefore more robust than estimates of the cost of avoiding emissions—which depend on the electric power market in which the power plant operates.[9] The multipollutant issues discussed in Section 4.3.1, for example, arise because the performance of the reference plant depends on the assumed controls on conventional air pollutants.

2. *Economic assumptions*. Most obviously, studies may use inconsistent economic assumptions for key parameters such as discount rates, fuel costs, capacity factors, and the costs of CO_2 storage.

3. *Timing*. Engineering studies have used widely differing assumptions about the availability of new technologies, with some estimating the cost of a plant that could be ordered today with performance guarantees and others estimating the cost of novel plant configurations or plants that require components that do not yet exist commercially.

Even when all such inconsistencies are resolved, the variance of results between engineering studies is larger than the uncertainty about the cost and performance of a plant that would actually be built, since the design of such a plant would be chosen to minimize cost (along with other factors such as risk). This is the case because engineering studies generally evaluate the performance of a particular design, and some of their variance reflects emerging knowledge about which plant configurations are best, rather than technical uncertainty about the performance of an optimal plant.

Finally, government action that forces the adoption of environmental controls will likely encourage innovation, which reduces the cost of control. The policy implications of this induced technological change are the subject of Section 4.3.2. The history of sulphur controls on electric power plants provides an important example of induced change. Between the late 1970s and 1995, the capital cost of SO_x controls decreased from US$250 to US$125/kW of capacity while

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than the baseline PC plant. But what matters for electric utility planners (or investors) is the overall cost of generation under a carbon price that is roughly the same for the two systems.

[9] Robust estimates of the cost of mitigation require analysis that captures the trade-offs between various generating technologies and fuels (e.g., gas vs. coal), both on the short timescales on which plants are dispatched to meet demand and on the longer timescale on which installed capacity changes in response to restrictions on emissions.

the average removal efficiency increased from about 75% to 95%, and there is strong evidence to suggest that the primary driver of cost declines was the imposition of government controls on sulphur emissions [10]. While it is not possible to accurately predict how the cost of CCS technologies will respond to controls on CO_2 emissions, there is no doubt that future costs depend not just on R&D, but also—and perhaps more importantly—on experience with the technology in commercial operation.

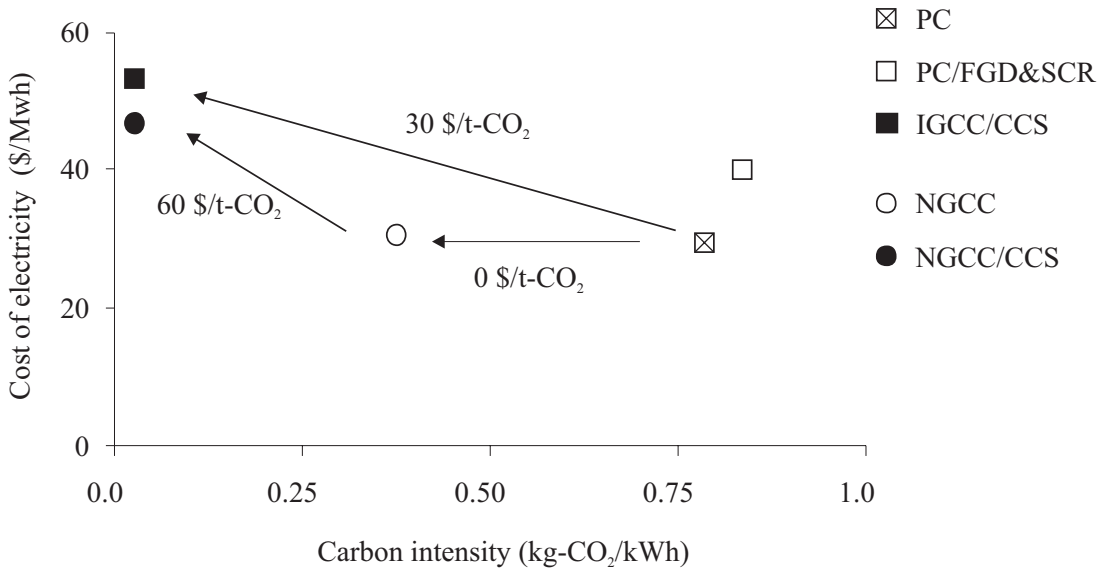

Figure 2. The cost of electricity versus CO_2 emissions per unit of output. Costs (in U.S. funds) are representative of current estimates but are, of course, strongly dependent on assumptions about fuel price and the cost and performance of CCS technologies. With these assumptions, the mitigation cost of coal-to-gas fuel switching is zero for new plants, while the mitigation cost of CCS is ~US$30/t-$CO_2$ and ~US$60/t-$CO_2$ for coal and gas, respectively. Note that this is true despite the fact that NG-CCS provides cheaper electricity than coal-CCS. Note the differing costs and emissions intensities for coal plants with (PC/FGD&SCR) and without (PC) modern emissions controls, demonstrating that the cost of mitigation with CCS depends on the stringency of conventional pollutant control. Note: FGD&SCR is flue gas desulphurization and selective catalytic reduction; and IGCC is integrated gasification combined cycle.

Timing is crucial in assessing the cost of CCS. It is quite plausible that CCS could enable deep reductions in CO_2 emissions from electricity generation at a cost of under $30/t-$CO_2$ if the reductions do not need to be fully implemented until 2015 and if a sustained program to encourage R&D and demonstration projects is begun soon. Conversely, if deep reductions are required by 2008, then it is very unlikely that mitigation costs could be as low as $38/t-$CO_2$ (as assumed in the AMG analysis).

2.2 Oil and Gas

The cost of capturing CO_2 and compressing it to the pressures required for geological storage (typically greater than 10 000 kPa, or 100 atmospheres) is primarily dependent on the size and purity of the CO_2 stream to be captured. Combustion sources have CO_2 concentrations of 5–15%; for these dilute streams, the cost of capturing CO_2 dominates the cost of storage, accounting for perhaps three-quarters of the overall cost of CCS [2, 7]. The cost of capture is smaller for non-

combustion sources and can be zero for high-pressure sources of nearly pure CO_2. In Canada, the two most important non-combustion sources of CO_2 are natural gas processing and hydrogen production; these sources in turn provide the most important opportunities for applying CCS technologies in the O&G sector.

2.2.1 Natural-Gas-Associated CO_2

Raw natural gas may contain significant impurities, with CO_2, H_2S, and nitrogen being the most important. One may consider all of the CO_2 that is produced from wells along with natural gas as a single stream of non-combustion CO_2 to be managed (Figure 3). I call this stream natural-gas-associated CO_2 (NG-CO_2). Much of the CO_2 and virtually all the H_2S are removed at gas processing plants prior to delivery to the final consumer.[10] At present, almost all of the NG-CO_2 is eventually emitted to the atmosphere, either at gas processing facilities or at the point of final combustion. Although emissions of NG-CO_2 amount to only a few percent of the CO_2 emissions that arise from combustion of the natural gas, they nevertheless provide an important opportunity for mitigating Canada's CO_2 emissions and for gaining experience with CCS.

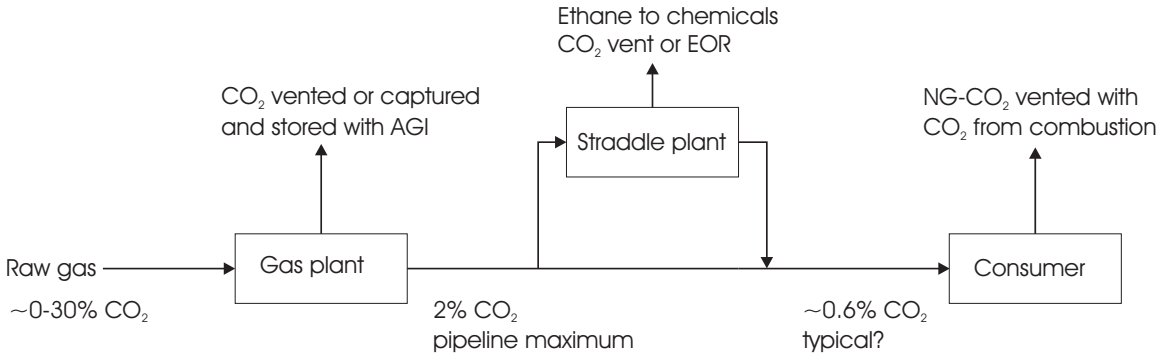

Figure 3. A schematic illustration of the natural gas processing system. Note: AGI is acid gas injection and EOR is enhanced oil recovery.

The mean CO_2 concentration of natural gas produced in Canada is currently about 2.5%, implying that the total production of NG-CO_2 is currently about 9 Mt-CO_2/year, equivalent to 1.5% of Canadian CO_2 emissions.[11] Gas production is forecast to rise by about 50% in the next decade—about half its rate of growth during the 1990s—likely bringing NG-CO_2 production to ~13 Mt-CO_2/year by 2010. At this level, NG-CO_2 would amount to 2.4% of Canada's CO_2 emissions in 2010; if these emissions could be eliminated, they would be about 12% of the CO_2 emissions reductions necessary to meet Canada's Kyoto target.[12] Moreover, the average CO_2 content of produced gas may well rise as gas production moves to deeper reservoirs in the northwest of the Alberta basin and elsewhere in the northern Rockies. Such an increase in CO_2 content might be driven by depletion of the least contaminated (sweet gas) reserves, coupled with declines in the costs of accessing deep gas and processing sour gas. If gas production continues to rise steeply—driven in part by coal-to-gas fuel switching in a CO_2-constrained electric power sector—and if the

[10] Gas sold for distribution to consumers, "sales gas," can contain up to 2% CO_2 and a maximum of 16 ppmv H_2S (4 ppmv in the United States).

[11] I assume that year 2000 natural gas production was 180 billion m^3 (6.4 Tcf) at an average CO_2 concentration of 2.5% (see discussion in the next section).

[12] Using figures from the 1997 emissions inventory and assuming that future emissions and emissions reductions ("the gap") maintain the current relative contributions from the various GHGs.

average CO_2 content rises over 3.5%, then NG-CO_2 production could easily exceed 20 Mt-CO_2/year near the end of the Kyoto commitment period.[13]

The mitigation of NG-CO_2 emissions by capture and geological storage can build directly on industry experience with the disposal of CO_2 plus H_2S (acid gas) mixtures arising from sour gas processing.[14] The least costly method to eliminate H_2S is to flare the acid gas stream, burning the H_2S to SO_2 and releasing the CO_2 to the atmosphere. Over recent decades, concern for the environmental effects of sulphur emissions has eliminated flaring as an option for all but the smallest facilities. In response to restrictions on flaring, gas processors switched to sulphur recovery, which produces sulphur as a saleable by-product but releases the CO_2 as before. In response to falling sulphur prices and increasingly stringent restrictions on residual SO_2 emissions, the industry has recently begun to abandon sulphur recovery in favour of acid gas disposal. For the largest plants, the lowest-cost route may still be sulphur recovery, but for plants with lower H_2S fluxes, the lowest-cost option is to compress the full acid gas stream (CO_2 and H_2S) and dispose of it in a suitable geological formation [11]. This process, called acid gas injection (AGI), is practised in over 31 facilities in Canada and at a rapidly growing number in the United States. For existing AGI facilities, CO_2 mitigation has been achieved at a negative cost, in the sense that AGI is the lowest-cost treatment for acid gas, cheaper than alternatives that would release the CO_2.

Industry experience with AGI provides a technical foundation that could be expanded to achieve the capture and storage of a substantial fraction of the NG-CO_2 stream. In addition, AGI provides important regulatory experience with CO_2 storage, as discussed in Section 3.2. The path from AGI to broader efforts to capture NG-CO_2 will likely involve the following key technological steps:

1. Implementing AGI rather than sulphur recovery for new sour gas facilities. (For small H_2S flows, AGI is already the least costly method, but for the largest facilities, sulphur recovery may still be cheaper.)

2. Converting existing sour gas plants from sulphur recovery to AGI.

3. Implementing CO_2 compression and geological storage from plants that process high-CO_2/low-H_2S gas and currently vent the CO_2.

4. Increasing the CO_2 capture from straddle plants by capturing existing CO_2 streams and modifying processes to increase CO_2 capture.

Finally, there are likely important opportunities to reduce the cost of mitigating NG-CO_2 emissions by optimization across the gas processing system. It might, for example, be efficient to decrease CO_2 capture at some upstream gas plants and increase capture at straddle plants to take full advantage of economies of scale in capture and storage.

Compared with other sectors, the mitigation supply curve for NG-CO_2 is particularly hard to estimate accurately because of the rapid pace of change in the natural gas industry. Principal

[13] A production rate of 285 billion m^3 (10 Tcf) and 3.5% CO_2 implies 20 Mt-CO_2/year. This production rate is ~50% higher than current (2000) production.

[14] A gas stream that contains more than 16 ppmv H_2S must be processed to remove the H_2S. Such processing typically uses amine temperature swing absorption, which captures most of the CO_2 in addition to the H_2S. The resulting CO_2 plus H_2S (acid gas) stream must then be processed to eliminate H_2S.

sources of uncertainty are (i) estimates of future gas composition and production volume, (ii) estimates of the disposition of NG-CO_2 in the absence of incentives to mitigate CO_2 emissions, and (iii) the engineering cost of additional CO_2 capture technologies.

While rapid change in the natural gas industry makes accurate estimates of mitigation cost more difficult, it likely decreases the cost of mitigation, because it allows CO_2 capture to be built into new facilities where costs are generally lower, rather than added to the existing system where costs will be higher and process optimization more difficult to achieve.

It seems plausible that 10 Mt-CO_2/year (two-thirds of the likely total amount of NG-CO_2) could be captured and sequestered at an average cost of about \$20/t-CO_2, assuming (i) continued rapid growth in gas production, (ii) increasingly stringent controls on SO_2 emissions, and (iii) early government action that allows industry to take advantage of the cost reductions that arise from building CO_2 capture into the gas processing infrastructure.

2.2.2 CO_2 from Hydrogen Production

Hydrogen is used in petroleum refining to efficiently produce lighter (lower-molecular-weight) products via hydro-cracking and for desulphurization. The upgrading of raw bitumen extracted from the oil sands to produce synthetic crude oil requires particularly large amounts of hydrogen, about 1000 scf-H_2/bbl of synthetic crude oil. When the hydrogen required for upgrading is combined with the hydrogen required for refining, the total amount of hydrogen required to produce refined petroleum products from the oil sands bitumen is 5–10 times larger than it is from conventional crude oil.[15] Almost all the required hydrogen is produced from natural gas via steam methane reforming (SMR), a process that can produce a stream of nearly pure CO_2 containing most of the carbon in the initial natural gas stream.

As oil sands production expands rapidly, so will production of hydrogen. The construction of hydrogen plants to meet the demands of bitumen upgrading in Alberta may soon produce the world's largest concentration of hydrogen production facilities. Industry estimates suggest that an average of more than one large (100 million scf/day) hydrogen plant will be built each year this decade, raising total capacity to roughly 2 billion scf/day,[16] about four times the current level, a capacity equivalent to about 20% of current world production of hydrogen for refining. This rapid development of hydrogen capacity presents an important opportunity for implementing CCS to mitigate the CO_2 emissions associated with hydrogen production (H_2-CO_2).

z888Conventional hydrogen production using SMR and water-gas shift produces 3.5–4 volumes of hydrogen for each volume of CO_2. A hydrogen production of 2 billion scf/day would therefore result in about 500 million scf-CO_2/day, or 13 Mt-CO_2/year. Because the largest uncertainty in estimating the potential CO_2 production lies in predicting the future rate of synthetic crude production, it is perhaps most useful to estimate the ratio of H_2-CO_2 production to the output of synthetic crude; that ratio is about 5 Mt-CO_2/year for each million bbl/day of synthetic crude.

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15 For comparison, hydrogen consumption in typical refining is 100–200 scf-H_2/bbl crude. Hydrogen consumption in California to produce reformulated gasoline is considered very high at about 600 scf-H_2/bbl crude (all values exclude the by-product hydrogen from naphtha reforming). The 1000 scf-H_2/bbl for upgrading bitumen is to produce synthetic crude; still more hydrogen is needed to produce derived products.

16 Personal communication, Tom McCann, T.J. McCann and Associates Ltd., Calgary, October 2001. This estimate was derived by compiling a list of the hydrogen production facilities under construction or in the planning process and applying a rough discount to account for plants that will not go ahead.

Two obstacles frustrate the immediate application of CCS technologies to H_2-CO_2: first, changes in hydrogen production technology that are eliminating the pure CO_2 streams, and second, the location of most upgrading at Fort McMurray, which is 200–400 km from good geological storage sites near the mountain front.

Older hydrogen plants use SMR to produce syngas (mostly H_2 and CO) followed by water-gas shift reactors to produce a mixed hydrogen and CO_2 stream, which is separated, making high-concentration streams of hydrogen and CO_2. Newer plants use pressure swing absorption (PSA) to remove hydrogen from the syngas stream and reduce the efficiency of the water-gas shift step to exploit the advantages of integration with the refinery's fuel gas system. In these plants, the residual syngas stream (after hydrogen removal) is mixed with other fuel gases and then combusted as fuel. The combustion step in PSA systems eliminates the high-concentration CO_2 stream that was available in the older generation of hydrogen production plants.

Comparatively low-cost opportunities for capturing the non-combustion CO_2 from hydrogen production remain, but it is difficult to accurately assess the cost and quantity of CO_2 available because of (i) the integration of hydrogen production into other refinery processes, (ii) the rapid pace of technological change, and, perhaps most importantly, (iii) the difference in cost of CO_2 capture between retrofits of existing or soon-to-be-constructed plants and the cost from new hydrogen plants optimized to include integrated CO_2 capture.

There are three broad options for capturing CO_2 from hydrogen plants associated with bitumen upgrading:

1. *Retrofit the older non-PSA hydrogen plants*. Costs are dominated by the cost of compression. Depending on the desired CO_2 purity and final pressure, the cost is \$5–15/t-CO_2 [12].

2. *Retrofit the new PSA hydrogen plants*. Costs are likely in the \$15–25/t-CO_2 range if it is possible to capture the CO_2 from the high-pressure syngas stream. If such integration into plant operations is not possible, then the CO_2 must be captured from the combustion gases at significantly higher cost.

3. *Modify the design of new hydrogen plants to incorporate CO_2 capture*. A serious analysis effort is needed to understand the cost of avoiding CO_2 emissions in upgrading and refining operations. Cost will depend on the degree of integration with refinery operations. A significant amount of hydrogen production capacity is now in the planning process. For these plants, the available technical options and therefore the cost of CO_2 capture will be strongly dependent on the timing of a decision to capture CO_2. Previous estimates for the cost of CO_2 capture in PSA systems without fuel-gas integration range from \$13 to \$24/t-CO_2 [13, 14].

The second major barrier to reducing emissions of H_2-CO_2 using CCS technologies is the location of most of the hydrogen production at Fort McMurray, far from good sites for geological storage. Compared with the uncertainties associated with the capture of H_2-CO_2, however, the transport of CO_2 is well understood, and the development of a CO_2 pipeline could proceed rapidly once the source and disposition of the CO_2 were understood. Costs for transporting CO_2 at volumes above 5 Mt/year over the required distance are unlikely to be higher than \$10/t-CO_2. Some bitumen upgrading is now planned for the Edmonton area, with transport of bitumen from Fort McMurray to Edmonton accomplished via slurry pipeline. The presence of an economic incentive to

reducing H_2-CO_2 emissions would add to the economic incentive favouring Edmonton-based upgrading facilities by reducing the cost of CO_2 transport.

3. Risks and Regulation

The technology required to inject large quantities of CO_2 into geological formations is well established. Industrial experience with CO_2 enhanced oil recovery (EOR) and with the disposal of CO_2-rich acid gas streams, together with related experience with natural gas storage and the underground disposal of other wastes,[17] allows confidence in predictions about the cost of CO_2 injection and suggests that the risks will be low. Once CO_2 is injected, evidence from natural CO_2 reservoirs as well as from numerical models suggests that it can—in principle—be confined in geological reservoirs for timescales well in excess of 1000 years, and that the risks of geological storage are small. Not withstanding this reasonable optimism, the risks of geological storage cannot be ignored. Indeed, a robust and inclusive risk assessment process will be needed to ensure the viability of CO_2 storage in Canada.

3.1 Risks

The risks associated with geological storage may be roughly divided into two kinds: first, the local health, safety, and environmental risks, and second, the global risk arising from leaks that return stored CO_2 to the atmosphere. The global risk may alternatively be viewed as uncertainty in the effectiveness of CO_2 storage.

3.1.1 Local Risks

The principal local risks arise from release of CO_2 at the surface, where it can asphyxiate exposed people or animals and can damage local biota. The most obvious local risk is the risk of catastrophic leaks such as well blowouts, pipeline ruptures, or subsurface events that result in sudden releases of CO_2. Catastrophic events can also be caused by slow leaks in deep CO_2 reservoirs if the CO_2 is temporarily confined in the near-surface environment and then suddenly released. In 1986, for example, the water in Lake Nyos (Cameroon) turned over, releasing about 100 kt-CO_2 that had accumulated from volcanic vents that had gradually charged the lake with CO_2. Because CO_2 is denser than air, it can flow downhill, creating asphyxiating conditions near ground level at points distant from the point of initial release. At Lake Nyos, the CO_2-rich cloud travelled over 10 km and killed over 1700 people [15].

While catastrophic releases have attracted the most attention, slow leaks may pose risks that are more difficult to manage. A leak of ~100 t-CO_2/day at Horseshoe Lake in California has killed trees over many hectares. A recent human fatality (July 2000) in a naturally occurring soda springs bath at Clear Lake, California, underlines the constant danger posed by CO_2 emissions from the ground.

The widespread use of natural gas storage facilities provides a useful analogue for assessing CO_2 storage, and the performance of natural gas storage points to the importance of slow leaks. In the summer of 2000, for example, the injection well of a gas storage facility in Hutcheson, Kansas,

[17] There is, for example, extensive experience with underground disposal in the United States. In addition to the ~34 Mt-CO_2 injected each year for EOR, the injection rates for other waste streams are 500 Mt/year for municipal wastewater, 2.7 Gt/year for brines from O&G operations, and 34 Mt/year for hazardous wastes.

leaked, allowing gas to flow into shallow formations, where it travelled approximately 10 km horizontally before erupting at many spots in the town site.

An entirely distinct class of local risks arises from the displacement of fluids during underground disposal. The injection of large volumes of fluids—equivalent to the volumes of CO_2 that would be stored over the lifetime of a coal-fired power plant—(i) may have induced seismicity, (ii) has produced ground movements that can cause structural damage to buildings and has obstructed the flow of irrigation water, and (iii) has caused the contamination of potable aquifers stemming from underground movement of displaced fluids.

Experts in the upstream O&G industry are generally confident that the risks from underground injection are small, and this confidence is strongly supported by the long history of underground disposal and specifically by the experience with CO_2 injection for EOR and AGI. While proper facility operation, site characterization, and monitoring can very likely reduce risks to low levels, they cannot be ignored.

3.1.2 The Uncertain Effectiveness of CO_2 Storage

We lack validated modelling tools that could enable confident predictions about the lifetime of CO_2 in underground storage. While there is ample reason to expect that sufficiently low leak rates can be achieved, it is not yet possible to specify with confidence the site characteristics and injection technology that are required to ensure (within some level of uncertainty) that a given confinement lifetime or leak rate will be attained. Such knowledge will be needed to build a robust technical and institutional system for storing CO_2.

In the worst case, the risk of CO_2 leakage is not simply that CCS will be ineffective, but that it will be detrimental. All CO_2 capture technologies extract an energy penalty, typically 10–20%. Thus, more fuel must be consumed, and more CO_2 produced, per unit of delivered energy than would be the case if the CO_2 were not captured. If CO_2 leaks to the atmosphere within centuries, CCS could therefore *increase* future concentrations of CO_2.

3.2 Regulation

Technological capability is a necessary but insufficient condition for CCS to play a major role in mitigating CO_2 emissions. To fulfil its promise, CCS must evolve from a collection of individual technologies into a large-scale technological system for managing fossil fuel carbon. In order to be successful, such a technological system must comprise a suite of technologies linked by a network of institutions, financial systems, and regulations that are accepted by industry and are able to achieve broad public understanding and acceptance.

What form those regulations assume, what entities are involved in project approval and ongoing oversight, how cooperative or adversarial the regulatory process is, and how many opportunities are presented for litigation and other third-party interventions will together be critically important in determining the economic attractiveness and social acceptance of CCS.

The regulation of a new activity does not usually arise in a vacuum, but is strongly shaped by the existing regulatory and institutional context. Regulation commonly builds by the accretion of new authority onto existing entities (such as government departments) as they battle with rival entities over resources.

Efforts to build a robust regulatory environment for geological storage cannot wait until the technology is ready for large-scale application. Action is needed now to build understanding of

the regulatory environment for geological storage in Canada. Such action might include the commissioning of studies aimed at (i) clarifying current roles and responsibilities with respect to underground storage, (ii) synthesizing scientific knowledge and risk assessment methodology, and (iii) setting reasonable goals for the management of CO_2 storage.

Local and global risks are currently regulated by different entities, within different regulatory frameworks, at different levels of government. In Canada, the regulation of local risks is a provincial responsibility performed by entities such as Alberta's Energy and Utilities Board (EUB).

The EUB already regulates the disposal of CO_2 and H_2S mixtures (Section 2.2.1). AGI is the best regulatory analogue for CO_2 storage, because the toxicity of H_2S means that the regulatory goal is to keep the gas from leaking to the surface. Like the injection of CO_2 for the purpose of avoiding atmospheric emissions—and unlike CO_2 injection for EOR—the regulation of AGI is aimed at ensuring safe, long-term disposal. Moreover, like CCS at coal-fired power plants, AGI links SO_2 and CO_2 emissions and thus provides a test bed for multipollutant regulation (Section 4.3.1).

Uncertainty in the effectiveness of CO_2 storage, arising from uncertainty in the lifetime of stored CO_2, is not currently addressed by any Canadian government entities. It will need to be. If Canada uses CO_2 storage to meet international commitments under the UN-FCCC, the federal government will need to account for it in the national emissions inventory. The responsibility for managing this process will presumably be divided among the departments of Foreign Affairs and International Trade, Environment, and Natural Resources.

The status of CO_2 storage under the UN-FCCC is unclear. While both the Kyoto Protocol and the recent Conferences of the Parties in Bonn and Marrakech explicitly endorse the use of CO_2 storage,[18] crucial questions regarding the incorporation of CO_2 storage within the framework convention's emissions accounting rules remain to be decided. The crux of the problem is deciding the extent to which CO_2 storage counts as non-emission.

The difficulty in building a system for regulating CO_2 storage is not simply due to the technical uncertainty in predicting the lifetime of CO_2 in reservoirs; it also arises from uncertainty about the goals of storage. Should the median lifetime of CO_2 in storage facilities, for example, be 500 years or 10 000? What fraction of early failures are we willing to accept? Uncertainty in predicting the fate of CO_2 in reservoirs cannot be eliminated. The regulatory system cannot therefore demand zero risk or perpetual storage. It must incorporate some "permission to fail." The challenge is to build a regulatory regime that works despite these uncertainties. Efforts to design technology for injection and monitoring of CO_2 and to craft a system to regulate these activities cannot succeed until there is some common understanding about these programmatic goals (Figure 4).

[18] In Article 2, Section 1, the Kyoto Protocol includes "Research on, and promotion, development and increased use of, new and renewable forms of energy, of carbon dioxide sequestration technologies," as a method for Parties to achieve their "quantified emission limitation." The agreement at the seventh Conference of the Parties in Marrakech requests that the Intergovernmental Panel on Climate Change (IPCC) study "geological carbon storage technologies" (Paragraph 7) and endorses CO_2 capture in Paragraphs 8.d, 13.d, and 29.

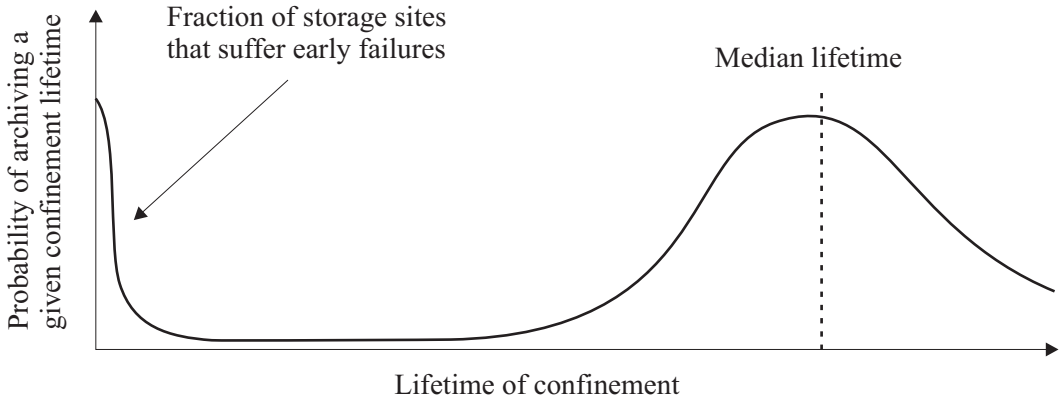

Figure 4. A schematic illustration of the probability distribution of confinement lifetime in a hypothetical set of storage reservoirs. The shape of the probability distribution will be determined by the technical standards for site selection, injection, and monitoring. These standards should themselves be chosen so that the resulting performance—expressed here as the probability distribution of confinement lifetimes—meets the overall programmatic goals. Two crucial programmatic goals are illustrated: the expected lifetime of CO_2 in storage reservoirs, and the fraction of storage sites that suffer early failure.

4. Implementing CO_2 Capture and Storage in Canada

4.1 A Strategy for the Oil and Gas Sector

Government action to encourage the adoption of CCS technologies in the O&G sector could yield significant, low-cost reductions in CO_2 emissions within the Kyoto commitment period while building the institutional and technological capacity necessary for broader use of CCS in the future. Specifically, I estimate that emissions could be reduced—compared with business as usual—by about 20 Mt-CO_2/year at an average cost of \$15–25/t-CO_2. As a sector in which to focus government action on CCS technologies, O&G offers several distinct advantages over electric power generation:

1. *Technical opportunity*. Because of the presence of large high-CO_2-concentration gas streams, the cost of CO_2 capture is less than half that in the electric sector. In addition, rapid growth in the O&G sector adds to its attractiveness, because CO_2 capture would be built into new facilities where costs are generally lower, rather than added to existing systems where costs will be higher and process optimization more difficult to achieve. If action is delayed, much of this opportunity for low-cost mitigation will be lost.

2. *Institutional ability*. Many of the large multinational firms in the O&G sector are uniquely able to manage the rapid implementation of CCS technologies. Specifically, these firms have in-house technical expertise covering all facets of CCS from CO_2 capture to long-distance transport and geological storage and an institutional culture that emphasizes long-range planning under uncertainty. In sharp contrast, many firms in the electric power generation sector are focused on near-term issues arising from market restructuring and lack the technical depth to effectively manage uncertain new technologies.

3. *Opportunity for constructive public engagement*. Wherever it is introduced, CO_2 storage is certain to generate public controversy. This controversy arises from specific concerns

about the safety of storage and more general concerns about sustainability. The introduction of CCS in the O&G sector will likely tend to focus debate on the safety and longevity of CO_2 storage rather than on the choice between fossil and non-fossil primary energy, as would the use of CCS in electric power generation. While both concerns are legitimate, debate centred on the former will be more likely to resolve key questions about the acceptability of CCS technologies. Moreover, both environmental non-governmental organizations (ENGOs) and the public are concerned about the environmental impacts of O&G production—both because of its rapid growth and because much of the production is exported—and use of CCS will directly reduce these impacts.

4. *Commercial benefits for Canadians.* Development of novel technologies for integrating CO_2 capture with natural gas processing and petroleum refining operations could produce an export-driven market for Canadian firms. Related claims can, of course, be made for almost any investment in CO_2 mitigation, but the claim is particularly plausible here because of the comparatively large size and technical sophistication of the Canadian O&G sector. While investment in wind or coal-CCS electricity generation could also generate commercially valuable Canadian expertise, the case is less plausible because of the weak Canadian position in the design and construction of wind turbines or coal-fired power plants.

4.1.1 Policy Options and Economic Instruments

A wide variety of policy instruments might be employed to drive adoption of CCS technologies in the O&G sector. Policy design will be unavoidably complicated by the divergence of federal and provincial interests, the limited suite of available policy instruments, and limited analytical capabilities of governments in a technically complex arena. Industry accepts that some GHG restrictions are inevitable, but argues that a cap-and-trade system would favour weak companies with slower growth rates; instead, industry is arguing for individually negotiated (company-by-company) caps on emissions intensity (e.g., kg-CO_2/bbl).[19] Individual caps are a blunt instrument, however, because they encourage companies to transfer emissions outside their operations without changing actual emission rates, thereby complicating emissions accounting and obscuring the real costs of emissions control. Plausible policy instruments include:

1. *A sector-wide price on CO_2 emissions*. A tax or cap-and-trade system could be applied to set an even price for GHG emissions throughout the upstream O&G sector. A tax naturally puts a constant price on emissions as production expands, but a cap-and-trade system could do the same if the total number of permits was increased in proportion to production. If needed, the ratio of permits to production could be made to decline according to an agreed schedule. This latter option allows transparent, economically efficient, sector-wide regulation of emissions intensity.

2. *Specific credits for CO_2 storage*. Specific monetary credit could be given for CO_2 stored in geological reservoirs, with a compensating increase in royalties or taxes to maintain overall sector-wide revenue neutrality.

3. *A sector-wide price on fugitive/non-combustion CO_2 emissions*. A tax or tradeable permit system could be imposed on non-combustion CO_2 streams.

[19] Personal communication, Rick Hyndman, Senior Policy Advisor on Climate Change, Canadian Association of Petroleum Producers, October 2001.

4. *Encouraging the adoption of enabling technology*. Rapid growth in long-lived capital stock in the O&G sector, in combination with the cost advantage of implementing CO_2 controls for new facilities rather than retrofits, means that there may be public value in driving the adoption of technology that would allow future implementation of CO_2 capture at low cost prior to imposing systematic CO_2 controls. For example, capital depreciation rates could be adjusted for specific hydrogen production technologies.

4.1.2 The Need for Improved Cost Analyses

New analysis is urgently needed to quantify near-term potential for implementing CCS in the O&G sector. Previous analyses have examined the overall costs of CCS across economic sectors, looking at both combustion and non-combustion sources of CO_2. Such analyses tend to focus on the largest CO_2 sources—electric power plants—where the costs of mitigation are high and the likelihood of early action is low. Further, because of their breadth, such analysis cannot include sufficient analytical detail to make a robust estimate of the costs of control for non-combustion sources.

What is required is an analytical effort focused on estimating the lowest-cost end of the supply curve for CO_2 mitigation using CCS. The rapid pace of change in O&G production strongly suggests that such an effort should not focus exclusively on estimating the costs under current market conditions, but must instead strive to incorporate forecasts of market growth. This is particularly true in assessing the cost of capturing NG-CO_2 and H_2-CO_2 (Section 2.2). The analysis should aim to quantify the uncertainty in cost estimates, explicitly documenting the dependence of cost estimates on assumptions about government and industry behaviour.

4.2 A Strategy for the Electric Sector

The use of fossil-fuel-based electric power generation with CCS could enable deep reductions in the CO_2 emissions from Canada's electric sector while maintaining growth in electricity supply. It is reasonable to aim at reductions of 50% by 2020 and to expect that the marginal increase in generation costs will be between $15/MWh and $25/MWh. In addition to the evident dependence on the performance of the CCS technologies themselves, the marginal mitigation cost is strongly dependent on three other factors—the price of natural gas, the stringency of control on conventional pollutants, and the cost of CO_2 storage (or value, if CO_2 is used to enhance upstream O&G production using EOR or enhanced coal bed methane).

It is technically possible to implement CCS electric power generation technologies quickly enough to achieve deep emissions reductions in the 2008–2012 Kyoto commitment period—as suggested in the AMG report—but a strategy aimed at this end would have two serious disadvantages:

1. The necessary rapidity of action would increase the cost of CO_2 mitigation by limiting opportunities for learning-by-doing and for leveraging global R&D efforts aimed at reducing CCS costs (Section 2.1.2). The costs would likely be higher and more uncertain than they would be under a strategy based on coal-to-gas fuel switching. Strong technology-specific incentives might then be required to force the implementation of CCS.

2. Rapid implementation of CO_2 storage would force rapid resolution of the regulatory questions described in Section 3.2, thus increasing the risk of setting bad regulatory precedents. The rapidity would likely limit the opportunity to craft a broadly based risk

assessment process and might limit public involvement in such a process. Such a process could easily result in strong public opposition. The use of CCS-specific incentives to encourage implementation, as described above, would increase the likely opposition by ENGOs, because it would directly pit CCS against coal-to-gas fuel switching, an alternative that would in this case be lower in cost and is already preferred by several ENGOs.

Near-term government action to encourage the development of CCS technologies in Canada could secure the option of using CCS to achieve deep reductions in CO_2 emissions from electric power generation. Any technology development program aimed at reducing future costs faces difficult choices in allocating resources between R&D and demonstration projects. In developing CCS in Canada, several strategic factors suggest a particular focus on demonstration projects. First, Canadian firms have comparatively little expertise in manufacturing the core component technologies, such as gas turbines or coal gasifiers, whereas Canadian firms have comparatively strong positions in the engineering and integration of large energy projects. Thus, the benefits of a demonstration project are more likely to be retained by Canadian firms than are benefits accruing from R&D on the component technologies. Second, early CCS demonstration projects will likely attract significant international R&D funding, and some of the expertise and intellectual property will be retained by the host country. An early Canadian demonstration of electric power generation with CCS would likely attract international collaboration, as has been demonstrated by the CO_2 storage monitoring program at PanCanadian's Weyburn EOR project.

4.3 Crosscutting Issues

4.3.1 Multipollutant Control

There are strong technological links between the control of CO_2 and the control of conventional air pollutants. These links are particularly important for coal-fired electricity generation but are also important in the O&G sector. Government policy must account for these links if it is to achieve cost-effective regulation of CO_2 and conventional air pollutants.

The marginal cost of capturing CO_2 from coal-fired power plants is strongly dependent on the stringency of controls on conventional pollutants (SO_x, NO_x, particulate matter, toxic metals). The reasons are simple: most proposed CO_2 capture plants have very low emissions of conventional pollutants, so their cost of electricity is roughly independent of the stringency of pollution control; for plants without CO_2 controls, however, the cost of electricity rises significantly with the stringency of control. Moreover, controls on conventional pollutants generally decrease plant efficiencies—increasing CO_2 emissions per unit of electricity and so further increasing the cost of CO_2 control with increasing stringency of control on conventional pollutants (see Figure 2). CO_2 capture plants will differ in their control of air pollutant emissions, and some designs may increase emissions; post-combustion capture with amines, for example, can increase NO_x emissions per unit of electricity because amine capture decreases plant efficiency without removing NO_x [16].

If the regulation of conventional air pollutants were static, then it might be reasonable to ignore the coupling between CO_2 and air pollution. The regulatory environment, however, is changing rapidly, driven by new scientific understanding of the health and environmental impacts of pollutants and by continued improvement in the technical and economic performance of emission control technologies. Important areas in which new scientific understanding may influence the regulatory environment include (i) the health effects of fine particulate matter; (ii) the formation of secondary particulates from gaseous emissions of SO_x and NO_x; (iii) the effect of industrial

NO_x emissions in generating ozone far from the sources of emission; (iv) the environmental and health impacts of low levels of ozone; and, finally, (v) the hazards posed by emissions of metals such as mercury. The proposed Canada-wide Standards for ozone and $PM_{2.5}$ reflect this emerging knowledge of the risks of air contaminants, but it is highly unlikely that the standards represent the final word on this issue. More plausibly, change in the regulatory environment for air contaminants will continue and will be at least as rapid as changes in the regulation of CO_2 emissions.

The technological link between control of CO_2 and control of air contaminants demands a corresponding link between government policy in the two domains. Without such linkage, the environmental regulation of power plant emissions is unlikely to be cost effective. Consider the management of emissions at coal-fired power plants. Without linkage, air pollution regulations might force operators to install expensive control technology in the next decade, only to have the plants retired a few years later because of restrictions on CO_2 emissions. In contrast, a coordinated policy might achieve the same environmental benefit at lower cost by accelerating the implementation of near-zero emission technologies, while allowing some existing facilities to run without new control technology until their retirement.

The multipollutant control problem is particularly difficult in Canada because of the absence of effective programs for emissions trading. If control of CO_2 and control of SO_2, for example, were both achieved through measures that set a price on emissions, then efficient multipollutant control might emerge without explicit government action. In the existing policy environment, however, where governmental measures are predominately sector specific and standards based, it is likely that opportunities to efficiently mitigate both pollutants will be missed.

Near-term options for building multipollutant considerations into CO_2 control policy include the following:

1. Focus CO_2 control efforts on technologies or sectors where multipollutant benefits are largest—coal rather than gas, for example, or heavy freight transport rather than personal automobiles.

2. Explicitly mandate the consideration of air pollutants in allocating resources for CCS R&D and demonstration projects. For example, if all other factors are equal, then gasification or oxygen-fired retrofits should be given precedence over amine capture.

3. Build multipollutant control into targeted programs for CO_2 control that will result in new long-lived capital stock by setting program-specific emissions prices for key pollutants. A reverse auction for emissions reductions similar to that of Pilot Emissions Reductions, Removals and Learnings, a pilot initiative of Environment Canada, might build in explicit prices for SO_2 and NO_x that would be used solely to compare bids in the auction program without committing the government to broad-based emissions prices.

4.3.2 Induced Technological Change

Distributing the burden of emissions mitigation across economic sectors, across geographic regions, and between present and future is one of the thorniest problems in climate policy. Two distribution problems are particularly relevant to the implementation of CCS. The first is the distribution of burdens between economic sectors; however, because this topic was carefully addressed in the AMG report, little additional discussion is needed here. The second is the distribution of effort between the Kyoto and post-Kyoto periods: current resources may be

directed either to reducing emissions in the 2008–2012 Kyoto commitment period or towards achieving efficient mitigation over a longer period.

The Kyoto versus post-Kyoto distribution is often framed as a choice between spending aimed at achieving immediate mitigation of emissions and spending on R&D that can drive down the cost of mitigation in the future. This framing is too restrictive, however, because spending aimed at achieving immediate emissions mitigation can also reduce the cost of future mitigation without government-sponsored R&D. Government action that sets a price on CO_2 emissions in a given sector induces private innovation that can bring down the cost of mitigation. Such induced (or endogenous) technological change can occur in many ways, ranging from the acceleration of learning-by-doing in the application of existing technologies to the creation of new technologies by induced R&D in the private sector. Because of the long time horizon of the climate problem, induced technological change plays a crucial role in determining the cost of emissions control [17–19].

The presence of induced technological change has important implications for climate policy. Most generally, there is an unavoidable coupling between the allocation of burdens in the Kyoto and post-Kyoto periods. More specifically, while an economy-wide tradeable permit system that equalizes the marginal price of emissions mitigation across the economy may produce the most economically efficient mitigation in the short run, it may be inefficient in the long run. This would, for example, be true if the resulting carbon price were too low to induce innovation in a sector where early innovation was important for bringing down the long-run cost of mitigation. The upshot is that the problems of sectoral and temporal allocation described in the first paragraph of this section are tightly entangled.

Considering the implementation of CCS, the distribution of financial burdens between the O&G sector as described in Section 4.1 and the electric sector as described in Section 4.1.2 is also a choice between the mitigation of emissions in the Kyoto and post-Kyoto periods. It will be difficult for government decision-makers to craft a robust consensus about the allocation of funding for CCS absent some programmatic guidance about the appropriate distribution of current federal resources for CO_2 mitigation between the disparate Kyoto and post-Kyoto goals. These issues cannot be resolved by departmental program managers; clear guidance from higher levels of government will be required to resolve this allocation problem.

4.3.3 The Federal Role in Regulating and Managing CO_2 Storage

It seems plausible that existing systems for regulating the underground disposal of wastes from the O&G sector—an area of provincial jurisdiction—could be extended to successfully manage the *local* risks arising from large-scale geological storage of CO_2. While Environment Canada may have little to no direct responsibility for managing the local risks, there is reason to contemplate a federal role in facilitating risk assessment and risk communication and in documenting CO_2 storage activities.[20] This role might reasonably be split between Natural Resources Canada and Environment Canada.

If CCS plays a significant role in managing Canada's CO_2 emissions, then there may be a gigatonne of CO_2 stored in underground reservoirs in Canada within several decades. It seems very likely that a new federal regulatory system will be needed to successfully manage the global risks of large-scale CO_2 storage—the possibility of leakage that could compromise the

[20] Such documentation might include the quantity injected, the methods used for injection and monitoring, and a summary analysis of significant problems or failures.

effectiveness of CO_2 storage in mitigating atmospheric emissions. Although management of geological resources, and of the local effects of CO_2 storage, is a provincial responsibility, the management of CO_2 stored to avoid atmospheric emissions implies a federal responsibility, because it arises from national and international commitments to control CO_2 emissions. The discharge of this federal responsibility would fall, at least partially, under the jurisdiction of Environment Canada.

Considering the more immediate future, one might argue that Environment Canada could avoid involvement in the regulation of CO_2 storage until a problem arises. The storage of CO_2, after all, will start small. Moreover, provincial regulators already manage the storage of CO_2 when it occurs as a side effect of AGI (Sections 2.2.1 and 3.2), and there seems little immediate likelihood of any serious challenge to the idea that CO_2 stored in geological formations should be excluded from national emissions inventories.

While delay is possible, there are strong arguments for early federal involvement in the regulation of CO_2 storage. Within this decade, Canadian firms will likely seek permits to inject significant quantities of CO_2 underground for the explicit purpose of avoiding CO_2 emissions to the atmosphere. Without adequate assessment of the risks of CCS and of the existing regulatory environment for CO_2 storage, there is a risk that environmental regulators will respond ad hoc, crafting regulations to fit the demands of the moment without adequately understanding their long-term implications. Such early regulatory action is often difficult to amend and could affect the development of the technology for decades. Efforts to build a robust regulatory environment for geological storage cannot wait until the technology is ready for large-scale application. Environmental regulators, industry, and ENGOs need to begin to build a common understanding of the current state and future course of regulation, identifying areas of common concern and developing compromises to address areas of disagreement. Environment Canada should lead this effort.

Specific areas in which early action by Environment Canada appears most likely to be useful include the following:

1. *Risk assessment*. Environment Canada should facilitate an assessment of the risks of CO_2 storage. The effort should be coordinated with efforts under way in the United States and elsewhere. While the explicit purpose of the assessment will obviously be to improve technical understanding of the risks, a well-run assessment process that involves diverse stakeholders can serve a vital role in building public trust, even if little new knowledge is generated.

2. *Setting goals for CO_2 management*. Research aimed at improving the tools for monitoring storage is already under way in Canada. Improved technical understanding is, however, a necessary but insufficient requirement for the successful management of CO_2 storage. The risks of CO_2 storage cannot be eliminated, and a management regime that aims at zero risk will be certain to fail. Stakeholders need to clarify the strategic goals at which a management regime should aim. Environment Canada should facilitate an inclusive process aimed at defining such goals (Section 3.2, Figure 4).

3. *Clarifying international commitments*. As discussed in Section 3.2, the status of CO_2 storage in the international climate policy regime has not been completely resolved. In concert with the Department of Foreign Affairs and International Trade, Environment Canada should seek resolution.

5. Summary: Specific Roles for Environment Canada

If CCS is widely implemented, Environment Canada will play multiple, partially independent roles in managing the technology. Many roles for Environment Canada are implicit in the foregoing discussion of strategies for implementation. In some areas, such as the near-term use of CCS in the O&G sector (Section 4.1), managerial responsibility is spread between multiple federal and provincial departments in a complex and already somewhat contentious mixture. Sorting out the precise roles for Environment Canada is beyond the scope of this report. In other areas, such as multipollutant regulation (Section 4.3.1), the role for Environment Canada emerges more clearly due to the overlap between the department's responsibilities for conventional air pollution and its responsibilities for GHGs. Finally, in Section 4.3.3, I argue that there is a specific role for Environment Canada in managing long-term CO_2 storage.

Environment Canada has a broader role in promoting the success of a national regime for managing CO_2 emissions, a role that is distinct from the details of building an effective and efficient system for managing CO_2 capture and storage. Over the next half century, the cost of managing CO_2 emissions will likely rise steadily to a total of over 1% of Canada's GDP. The urgency of disputes over the management of CO_2 emissions will likely continue to grow with the size of the economic stakes. With respect to CCS, there will likely be two crucial areas in which it will be vital to build public trust. The first is in ensuring the safety and stability of CO_2 storage. The second, and perhaps most important, is in the distribution of resources between CCS and other means of managing CO_2 emissions. In both areas, Environment Canada has a responsibility to ensure that environmental concerns are given—and are publicly seen to be given—serious consideration.

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October 2002

Albertans & Climate Change

Taking Action

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In May 2002, the Government of Alberta released a draft *Plan for Action* proposing an Alberta approach to address the issue of climate change and reduce greenhouse gas emissions.

Following extensive consultations, the finalized Alberta plan - *Albertans & Climate Change: Taking Action* - establishes a framework to reduce greenhouse gas emissions.

The plan focuses on improving energy efficiency, enhancing technology to control industrial emissions, seeking out renewable energy sources and better emissions management. Alberta's action plan is another step towards an achievable national climate change strategy.

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Alberta's Climate Change Action Plan

Executive Summary

The Alberta government is committed to taking effective action on climate change. *Albertans & Climate Change: Taking Action* provides a comprehensive framework for an aggressive set of actions that will reduce greenhouse gas emissions and train Alberta's economy to operate in a way that contributes to our environment and our future.

By 2020, Alberta will cut emissions in the province relative to GDP by 50 per cent below 1990 levels. This will be about a 60 million tonne reduction in greenhouse gas emissions below "business as usual" levels. To measure our progress towards this target, Alberta's greenhouse gas emissions will be expected to be 20 million tonnes lower than "business as usual" by 2010.

The following actions will be taken to achieve this target.

Negotiate agreements with key sectors

The Alberta government will:

- Work with stakeholders through the Clean Air Strategic Alliance on managing air emissions from Alberta's electricity sector.
- Begin negotiations on emissions reductions with the oil and gas sector in November 2002.
- Begin negotiations with nine other sectors by Spring 2003.
- Include regulatory backstops such as standards, inclusion in approvals, and financial consequences for non-participation, in emission reduction targets.
- Define expectations for mandatory industry greenhouse gas reporting.

Emissions trading

The Alberta government will:

- Develop a definition for eligible greenhouse gas offsets.
- Establish a registry for greenhouse gas offsets.
- Take part in initiatives to buy real emission reductions.

Put the Alberta government "house" in order

The Alberta government has now cut greenhouse gas emissions from its own operations by more than 20 per cent (compared with 1990 levels). We have won three national awards for these efforts and are committed to reducing our emissions by 26

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percent below 1990 levels by 2005. We will:

- Fund deployment of innovative technologies in government operations.
- Continue to acquire alternative and hybrid vehicles for government use.
- Support energy retrofits for Alberta's schools.
- Roll out a government driver education program that encourages more fuel-efficient driving.
- Insist on "best in class" when leasing vehicles.
- Establish, as part of the Alberta government's own sectoral agreement, a longer-term (post 2005) emission reduction target.

Help Albertans conserve energy

- Climate Change Central's new *Energy Solutions Alberta* office will provide a one-stop shop for information about energy efficiency and conservation opportunities for homes and small businesses.
- The Alberta government will support Climate Change Central led initiatives including: municipal building and street lighting retrofits, consumer education, energy labeling, vehicle anti-idling, energy-efficient "teletrips", pilot programs for accelerated replacement of household appliances, adoption of new technologies and reducing barriers to low-impact power generation.

Support technology

- Enhance government support for the Alberta Energy Research Institute and make climate change a key part of its focus.
- Support centres of excellence for clean energy technologies and climate change analysis.

Carbon management

- Start pilot projects/monitoring programs for using carbon dioxide for enhanced oil recovery. The Alberta government will set a royalty credit for demonstration projects using CO_2 for enhanced oil recovery.
- Start a pilot project for CO_2 Enhanced Coal Bed Methane recovery.
- Work with other governments to develop protocols for the monitoring of CO_2 in stored geologic formations.

Renewable/alternative energy sources

- The Alberta government will expect average emissions intensity from electricity generation to decrease and will look to Alberta's Clean Air Strategic Alliance for an overall framework under which this will happen. As part of this, the government will expect the renewable and alternative energy portion of the province's total electricity capacity to grow by 3.5 per cent by 2008.
- The Alberta government will expect electricity retailers to disclose the emissions intensity of the electricity they market.

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Biological sinks

- Confirm ownership of the carbon sequestration potential of soil and forests.
- Develop a land use registry to track greenhouse gas emission reductions/removals.
- Participate in and support a Canada-wide university-based research effort to confirm the reliability and estimate the potential for biologic storage of carbon.
- Support Climate Change Central initiatives to develop ways of measuring, monitoring, verifying and trading sink-related greenhouse gas offsets.

Adapting to climate change

- Work with stakeholders to understand climate change impacts.
- Take part in national and regional research initiatives (Prairie Adaptation Research Collaborative; Water Institute for Semi-Arid Eco-Systems, University of Lethbridge).
- Enhance the Alberta government's adaptation research.

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Introduction

Alberta is committed to reducing greenhouse gas (GHG) emissions and contributing to an effective approach for responding to the risks of climate change. The Alberta government and many of our partners in industry, academic institutions, municipalities and environmental organizations have been actively involved in the search for an effective climate change response since the issue emerged in the late 1980s and early 1990s. The Alberta government recognizes that global climate change is real and that the current level of scientific agreement on this issue warrants further action. Alberta is prepared to contribute to the global objective of reducing the concentrations of greenhouse gases in the atmosphere through a set of challenging and promising actions.

Over the past decade, Alberta organizations have been recognized as national leaders in taking action to reduce greenhouse gas emissions. Our industries have successfully begun the long-term task of reducing the environmental footprint of the commodities and services they provide to consumers. These organizations have set an example for others to follow on the long road towards a less emissions-intensive economy. Alberta citizens and industries have told us that they are ready for the challenge ahead. They realize the benefits of continuing to search for more efficient ways of producing goods and services and using new technologies that increase competitiveness while reducing waste. The public is increasingly expecting "best in class" environmental performance as well as competitively priced products and services. Alberta organizations are rising to meet this challenge.

Alberta's commitment to sustainable resources and environmental management runs deep and has been well established. Albertans enjoy a high quality of life based on economic, social and environmental factors. Employment opportunities and access to educational, health and social programs flow directly from the strength of our resource-based economy. Alberta's high quality of air and water help ensure the health, well-being and enjoyment of Albertans as they live, work and play in the province. Alberta's dynamic economy and the ability to maintain it in the long term are the direct result of the sustainable management of our natural resources.

In February 2002, the Alberta government released *Albertans & Climate Change: A Strategy For Managing Environmental and Economic Risks*. This strategy outlined the government's climate change approach of influencing the development of an effective national climate change response, while at the same time, taking action within the province to reduce greenhouse gas emissions.

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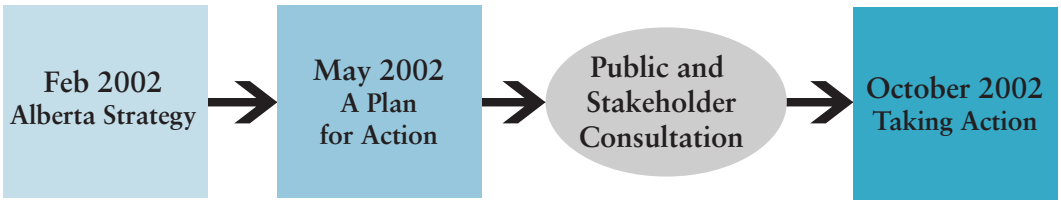
To provide further detail, in May 2002 the province released *Albertans & Climate Change: A Plan for Action*. This draft for discussion outlined how the Alberta government proposed to make an effective contribution to global greenhouse gas emissions reductions.



The draft *Plan for Action* detailed a number of actions for pursuing sustainable greenhouse gas emission reductions within the province. The draft was tested through an extensive set of stakeholder consultations with a range of sectors. Albertans also provided their input. Elements of Alberta's draft plan received strong support. In some areas, stakeholders and the public asked for further detail.

After integrating input from stakeholders and the public, *Albertans & Climate Change: Taking Action* provides the guideposts and signals that define how Alberta will tackle the climate change challenge. This finalized plan establishes the framework and the specific actions the province will take on its long-term journey towards reduced greenhouse gas emissions.

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Background

In May 2002, the Government of Alberta released *Albertans & Climate Change: A Plan for Action*. This draft plan outlined Alberta's position on taking action on climate change and proposed goals, timelines and actions that Albertans could take to address the possible effects of climate change. The *Plan for Action* also represented an approach to reducing greenhouse gas emissions that could be considered by other governments in Canada.

Alberta's *Plan for Action* heavily emphasized the following features:

- Outlining a technologically driven approach, rather than a politically driven one.
- Allowing for immediate action on climate change.
- Setting a realistic timeframe to reflect technology lead times and expected time to replace capital stock.
- Allowing the province to keep capital in Alberta and Canada, facilitating further investment in technology, research and development, rather than spending it primarily on international emission permits.
- Allowing Alberta to exercise its responsibility to address climate change as an environmental and natural resource related issue.
- Working collaboratively - in strategic partnerships with other governments and stakeholders.

Over the summer and fall of 2002, the Alberta government sought the input of Albertans and a wide range of stakeholder groups on the *Plan for Action*. A number of common themes emerged from these consultations, including:

- Albertans recognize the need to take action on climate change. The risks are real and action needs to begin now.
- Environmental progress cannot be achieved in isolation of other policy objectives, including the need to maintain economic prosperity.
- All sectors of the economy must play a role in reducing greenhouse gas emissions.
- Primary emphasis should be placed on achieving emission reductions within the province, positioning Albertans to contribute to lasting emission reductions.
- Our progress in reducing greenhouse gas emissions must be measured and managed in a timely and effective manner. A variety of tools should be used in measuring our progress.

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- There is a need for a cooperative national approach. Stakeholders, particularly industry, require certainty. Duplicate and inconsistent provincial and national approaches are not desired.

Albertans & Climate Change: Taking Action is a plan that builds on our dialogue with Albertans and reflects key public and stakeholder priorities, emphasizing climate change actions that have received widespread support. Reflecting the desire of the public and stakeholders for an effective national approach to climate change, this plan is presented as a workable approach that fits Alberta's circumstances and allows Alberta to do its fair share in dealing with an international problem. This plan reflects:

- **A collaborative approach,** through which the Alberta government will work with stakeholders and other governments in a collaborative manner.
- **Our fair share** - which is based on the pursuit of environmentally effective innovative actions that allow for truly "win-win" results.
- **Immediate action** - building on the leadership the province has already shown in reducing greenhouse gas emissions within the province.
- **An appropriate timeframe** - that is consistent with the lead-time necessary for technological innovation and behavioral change.
- **An emphasis on consumers** - as real, long-term greenhouse gas reductions require action and behavioral change by all consumers.
- **A workable and positive national approach** that allows all governments and sectors to contribute to sustainable development.

This plan was built on the following Core Principles:

- Informed consultation with key stakeholders and the public in developing and implementing a climate change action plan is vital if we are going to make a meaningful and real difference.
- Any actions we develop must be compatible with our largest trading partner - the United States - to ensure we maintain a competitive economic advantage.
- Immediate investment in emissions control technology is the key to environmental improvements that will also reap economic benefits.
- Ongoing investment in technology and energy research is the key to breaking the link between increasing emissions and economic development.
- As energy consumption drives emissions, energy conservation and efficiency must be a core part of our climate change response.
- Alberta will continue to work with other provinces and territories to develop a national plan that is in Canada's best environmental and economic interests.
- All Albertans must be part of the provincial climate change solution.

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Alberta's Climate Change Strategy, released in February 2002, emphasized the importance of taking action to reduce greenhouse gas emissions. *Albertans & Climate Change: Taking Action* provides the framework - targets, goals and milestones - that will ensure challenging and effective actions are taken to reduce greenhouse gas emissions. This plan will position the province's citizens and businesses to compete and prosper in a carbon emissions-constrained future and will help the world meet its energy requirements with sharply reduced emissions over the longer term.

Albertans & Climate Change: Taking Action sets a province-wide emission reduction target. Alberta's target balances emission reductions and economic performance. It also signals that absolute net reductions in greenhouse gas emissions will be expected. While our target is long-term, actions to reduce greenhouse gas emission reductions will begin immediately. Alberta is prepared to do its part to reduce global greenhouse gas emissions. This plan includes actions in the following areas:

- Government Leadership
- Energy Conservation
- Carbon Management
- Technology and Innovation
- Renewable and Alternative Energy
- Enhancing Carbon Sinks
- Adaptation

The goals, targets and milestones contained in this plan will lead to emissions reductions and the long-term objective of reduced concentrations of greenhouse gas emissions in the atmosphere. Focusing on arbitrary, internationally imposed, short-term targets that are unrealistic and costly for Canada risks a large diversion of investment capital out of Canada. That investment capital is required for developing and implementing technologies and practices within Canada to cost-effectively address our own climate change contributions (i.e., supporting new energy production technologies, developing methods of capturing and storing carbon dioxide, and reducing costs associated with renewable energy).

Albertans & Climate Change: Taking Action addresses Alberta's long-term technological opportunities and the role of all energy consumers in reducing greenhouse gas emissions.

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Alberta will contribute to reducing emissions through our expertise in developing and demonstrating leading-edge technologies and innovative practices for producing and delivering low-emissions energy. Our approach will be based on partnering with industry, other organizations and the federal government to pursue shared objectives. This plan will provide a basis from which these organizations can work collaboratively to address climate change.

What We Heard:

Alberta's plan provides a balanced approach to responding to the climate change issue. The province has provided an effective framework under which action can be taken but renewable energy should have a higher profile.

Our Response:

***Albertans & Climate Change: Taking Action* continues to frame action under the same broad focus areas while adding a seventh focus area - Renewable and Alternative Energy.**

Emissions Reductions

Overall Objective

By the year 2020, the province will reduce greenhouse gas relative to Gross Domestic Product (GDP) by 50 per cent below 1990 levels. This is a reduction of about 60 million tonnes of carbon dioxide equivalent gases below expected levels. By 2010, Alberta expects to have achieved an emissions intensity improvement of more than 20 per cent and will have reduced emissions by the carbon dioxide equivalent of about 20 million tonnes below expected levels.

Alberta's Emissions Reduction Target

Albertans recognize that our climate change response must include both environmental and economic objectives. A provincial greenhouse gas reduction target based on emissions intensity allows us to measure both environmental and economic progress. This approach recognizes the reality of multiple policy objectives and sets a course for a win-win solution. The Alberta government will reduce the greenhouse gas emissions intensity of its economy (emissions relative to GDP) by 50 per cent below 1990 levels by the year 2020. "60 million tonnes by 2020" is a translation of what that level of intensity improvement would mean in tonnes of carbon dioxide equivalent. "20 million tonnes by 2010" is a milestone on the path to 2020.

An emissions intensity objective represents a new way of thinking about our overall objectives. Such targets challenge us to think about what progress will look like at the end of the day. Some stakeholders have equated a 50 per cent reduction in carbon intensity to a doubling of our existing energy efficiency. Other stakeholders still want to see how this target translates into an absolute emission reduction in order to compare Alberta's plan to alternative approaches.

The following table outlines Alberta's emission intensity target and how it translates into projected emission reductions below forecasted levels. While this table also

identifies an interim milestone that may be helpful in measuring our progress towards the 2020 target, other interim milestones will be developed in conjunction with agreements developed between the Alberta government and key sectors (see Government Leadership: Sectoral Agreements).

Alberta's Target: Key Milestones

Year	1990	2000	2010	2020
Actual/ "Business as Usual" Emissions Intensity Improvement (below 1990 level) without this plan		13%	16%	28%
Alberta Action Plan Emissions Intensity Target			22%	50%
Actual/ "Business as Usual" Greenhouse Gas Emissions (Million tonnes of $C0_2$ equivalent) without this plan	171	223	258	278
Milestone Emission Reductions (Million tonnes of $C0_2$ equivalent) Expected from Action Plan			20	60

This framework for pursuing our target provides a meaningful approach for managing our progress in reducing greenhouse gas emissions. It avoids "solutions" that simply transfer revenue to other parts of the world through permit purchases, leaving less investment capital here to further improve our reduction efforts.

What We Heard

Provincial stakeholders expressed support for an emission intensity targets as a useful way of pursuing greenhouse gas emission reductions without jeopardizing economic growth. Some stakeholders suggested that to make these targets more relevant to Albertans and to key sectors, shorter-term milestones are also required. Others suggested more strongly linking progress towards our carbon intensity targets with reductions in absolute greenhouse gas emissions. They saw merit in having performance measures that relate to intensity improvements as well as absolute reductions in greenhouse gases.

Our Response

Albertans & Climate Change: Taking Action **further elaborates on our 2020 emissions intensity target by outlining mid-term (e.g. 2010) milestones. This plan also translates our emissions intensity improvements to actual greenhouse gas emission reductions below forecast levels.**

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Relationship to our long-term goal

The Alberta government is committed to a long-term goal of preventing atmospheric concentrations of greenhouse gases from reaching levels that have negative impacts on people and ecosystems. In pursuit of that goal, Alberta recognizes that more significant emissions reductions will be required over the longer term (2050). This action plan is therefore only the beginning of a 50-year initiative to dramatically reduce the carbon intensity of the province's economy. The approach outlined in this plan will ensure Alberta organizations are prepared for this long-term challenge. The plan allows the province to focus its efforts on changes and investments that lead to lasting reductions in greenhouse gas emissions.

Why an intensity target makes sense

Responding to climate change requires substantive long-term improvements in efficiency and reductions in emissions. Absolute emission reduction targets simply force a jurisdiction to bear the costs of emission reductions while displacing investment, jobs and emissions to nations without greenhouse gas emission reduction targets. Alberta cannot control the global demand for goods and services (especially fossil fuel) but through emissions intensity improvements, we can ensure that our commodities and services reflect best-in-class performance and result in fewer emissions than similar commodities and services produced elsewhere.

Intensity based targets allow organizations, firms, industries and nations to improve their efficiency, reduce waste and ultimately increase their competitiveness. The end result is an effective integration of social, economic and environmental priorities - i.e., People, Prosperity and Preservation.

For Alberta, an emission intensity target makes sense because Canada's major trading partner, the United States, has not adopted an absolute emission reduction target but is instead focusing on improvements in emissions intensity. Canada's approach must reflect the trading relationship we have with the United States. With our economies so closely interrelated, substantive increases in production costs in Canada will simply erode our ability to compete in the international marketplace and attract investment. Alberta needs an approach that will allow our economy to continue to flourish within the North American context while at the same time positioning the province for long-term contributions towards effective emission reductions.

Some stakeholders have questioned what a 50 per cent reduction in carbon intensity means. A wide range of perspectives has been put forward. Some feel it reflects little more than "business as usual" improvements, while others equate this target with a "wartime" effort. The Alberta government believes that a 50 per cent reduction in emissions intensity is a realistic yet challenging target. Based on emissions data from Environment Canada and economic data from Alberta Finance, Alberta has already reduced its intensity by about 13 per cent between 1990 and 2000 (a period of significant economic growth within the province). Current national economic projections suggest that without additional action, emissions intensity would be about 28 per cent below 1990 levels by 2020. The 50 per cent target is almost a doubling of

our efforts to improve efficiency and reduce emissions. This level of reduction will be challenging. Some stakeholders have equated this effort to the level of efficiency gains the economy experienced in the late 1970s and early 1980s - a period of rapidly rising energy costs.

A 50 per cent reduction in greenhouse gas emissions intensity is a goal that will require investment to develop new technologies and innovations, and put new technologies and practices into operation. It is a tough but realistic level of emission reductions. Achieving these reductions will require action across the Alberta economy - in all areas that consume energy - and in areas that can potentially sequester or capture and store carbon dioxide emissions.

Achieving our Target

Albertans & Climate Change: Taking Action outlines the approach Alberta will use to get to our target. The plan outlines a framework for the Alberta government to work with our partners to set greenhouse gas reduction expectations. This framework provides organizations (including energy producers and energy consumers) with certainty as to what government expects of them - while at the same time providing them with flexibility and innovation in pursuing these reductions.

This plan also outlines how the government will facilitate investment in technologies related to conserving energy, lowering the emissions intensity of fossil fuel production and consumption, and non-fossil fuel based technologies. The Alberta government expects that all sectors, energy consumers and other governments will play a meaningful role. Responding to climate change requires a fundamental shift in our energy consumption patterns. The Alberta government, through our partnerships in groups like Climate Change Central, will provide consumers with the information and tools they need to contribute to climate change efforts.

The Alberta government will ensure that actions to achieve the emissions intensity objective contained in this plan - as well as other key elements of the plan - are given a high level of priority and importance.

- Alberta will back up its targets with the necessary legislative, regulatory and financial provisions to provide all organizations with certainty about the province's expectations for carbon intensity improvements and the steps being planned to achieve this target.

Best-in-Class Performance

Many Alberta organizations have told us that they strive to use best practices in their production of goods and services. They realize that increasing their energy efficiency and reducing their waste are practical actions that enhance competitiveness. *Albertans & Climate Change: Taking Action* is based on the principle that all Alberta organizations should demonstrate best-in-class performance - using the best technologies and practices that are commercially feasible. Alberta will ensure that its energy services are as clean or cleaner than their international competition.

Global competitors of Alberta organizations will continue to increase their energy efficiency and improve their emissions intensity performance, so it is vital to the

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ongoing competitiveness of Alberta organizations that they innovate and pursue leading-edge, best-in-class production practices. The Alberta government will work with industry and business to accelerate their adoption of best practices and deployment of best-in-class technologies. Through negotiated agreements with key sectors, the Alberta government will establish a framework under which best-in-class performance can be achieved. Many Alberta organizations have told us they are ready and willing to take up this challenge.

What We Heard:

Some stakeholders found it confusing to differentiate between Alberta's emissions related to domestic consumption and emissions related to the goods we produce for export out of the province.

Our Response:

***Albertans & Climate Change: Taking Action* is based on the principle that our target relates to all provincial greenhouse gas emissions regardless of the destination of Alberta's commodities. This plan does not differentiate between emissions produced by goods produced for consumption within or outside Alberta.**

Government Leadership

Vision

Alberta organizations and the public will have a clear understanding of the role they can play and the tools they can use to reduce the carbon intensity of their activities. In leading the way, the Alberta government will adopt leading-edge energy efficient practices and technologies that significantly reduce the environmental footprint of government operations.

The government's overall role in addressing climate change is to be a leader, a partner, a facilitator and an innovator. It is government's role to educate, motivate, inspire, celebrate and ensure action is being taken.

The Government of Alberta has been addressing climate change since 1990 by seeking to influence national policy and by taking action to encourage the reduction of greenhouse gas emissions in Alberta. We are acknowledged as a national leader in this area both through our early actions to date, and by the fact that the Alberta government is the only government in Canada to win a national leadership award — three times to date — for voluntarily reducing greenhouse gas emissions.

In 1995, the government made a written public commitment to reduce overall greenhouse gas emissions from its operations by 14.1 per cent below 1990 emission levels by 2000. By the end of 2000, the government had exceeded this target, reducing emissions by 22 per cent below 1990 levels.

As well, in 1999 the Government of Alberta formally established Climate Change Central, a unique private-public partnership non-profit organization, to follow up and implement key directions and recommendations for addressing climate change.

The Government of Alberta is committed to leading action on climate change on key province-wide actions and initiatives, and to taking action immediately and, where possible, within government itself.

Climate change is not just a government issue. It is not just an industry issue. Consumption is the key driver behind emissions - so it is an issue for everyone. As a result, all Albertans must work together to make a difference. The government will work directly, as well as through Climate Change Central and other established, complementary organizations, to engage all Albertans in reducing emissions.

Sectoral Agreements

Alberta organizations - industry, municipalities, consumer organizations - are looking for an overall framework under which they can take best-in-class actions to reduce greenhouse gas emissions and reduce economic and environmental risks. The Alberta government is committed to providing leadership and increased certainty to these organizations and clearly outlining how it will work in partnership to achieve these reductions.

In May 2002, the Alberta government proposed to negotiate agreements with specific economic sectors, including electricity, petroleum, transportation, forestry, municipalities and other industries to gain commitment for action to reduce greenhouse gas emissions. The province will also commit to reducing emissions from its own operations — in effect a sectoral agreement with Albertans – setting an example for others by demonstrating a range of cost-effective actions.

These agreements will be based on realistic emission reductions expectations. Industry will be asked to reduce emissions to levels that are consistent with the adoption of best practices. The opportunity for further reductions will be provided through emissions trading mechanisms, allowing for least-cost emission reductions.

What We Heard

During our consultations, Alberta stakeholders expressed strong support for using sectoral agreements as the key policy mechanism for pursuing emission reductions. Stakeholders believed that this mechanism could ensure emission reductions targets were firm and well understood while providing key sectors with flexibility in how they achieved the reductions. Some stakeholders identified the importance of having a strong framework that ensures a "level playing field" among different organizations within a sector. They supported the idea of a regulatory "backstop" to ensure fairness and that the desired results are achieved.

Our Response

Sectoral agreements are a key element of *Albertans & Climate Change: Taking Action*. To ensure fairness, equity and certainty, the province will establish regulatory "backstops." Alberta will ensure that the necessary legislative, regulatory and financial provisions are developed to provide these "backstops."

Taking Action

Albertans & Climate Change

ACTION:

Over the next two years, the Alberta government will negotiate binding agreements with specific sectors, including electricity, petroleum, transportation, forestry, municipalities, mining, manufacturing, commercial and agriculture to set measurable goals for reducing greenhouse gas emissions.

These agreements will be negotiated between the Alberta government and various sectors of the economy using sector associations to bring companies to the table. Government will define the sectors and the agreements will focus on covering all the firms and emissions in a sector. The specific approach to negotiating agreements will be tailored to the circumstances of each sector.

The Alberta government will seek to work with other provincial and territorial governments and the federal government to ensure the consistency, compatibility and harmonization of these agreements across the country. Where appropriate, other provinces or territories may spearhead specific sectoral negotiations with the expectation that agreements consistent with Alberta's plan would be applied and accepted in Alberta.

Each agreement will establish a measurable goal based on emissions per unit of production. The objective of each agreement is to establish a reduction target that reflects reasonable costs, takes into account expected technological or other opportunities, and encourages investments that enhance competitiveness. The negotiated agreements will establish greenhouse gas emission reduction targets that are linked to the overall Alberta target. Specific objectives related to the sector as a whole, such as support for research and technology development or infrastructure improvements, could form part of the agreements.

Regulations will ensure that organizations who choose not to sign on to a sector agreement will be required to meet at least the same reduction requirements.

The agreements will:

- Be developed in an open and transparent manner.
- Cover most of the greenhouse gas emissions and all but the smallest companies within each sector.
- Allow for sector-wide initiatives to be pursued.
- Allow flexibility in how the target is achieved (not prescriptive).
- Establish a baseline from which performance is compared.
- Cover the period to 2020 with periodic reviews to assess performance and relevance.
- Include specific goals and interim benchmark/targets to encourage continuous improvement.

- Include ongoing monitoring, verification and reporting.
- Include commitments by both government and the sector.
- Include a regulatory backstop to ensure a level playing field within each sector.
- Allow for innovative mechanisms (e.g. the option for participants to contribute to an Alberta Climate Change and Emissions Management Fund that would be used to support further technology deployment and development and energy efficiency and conservation initiatives) if sectoral greenhouse gas objectives are not met.
- Strive for consistency and fairness across sectors.
- Be signed at an executive level.

The Alberta government is already pursuing this approach for Alberta's electricity sector through a collaborative process run by Alberta's Clean Air Strategic Alliance (CASA). In June 2003, the Alberta government will receive CASA's recommendations for a new air emissions management framework for Alberta's electricity sector. The government expects that those recommendations will provide the basis for an agreement for the electricity sector.

Sectoral agreements will build on existing initiatives - the work of CASA in developing a framework for reducing flaring within the petroleum sector provides an excellent example. Under this approach, the government made a clear policy statement that flaring had to be reduced. A workable framework for reducing and managing flaring was developed, including performance standards that could be met through voluntary actions but were "backstopped" by clear government statements regarding the regulatory consequences of not achieving the sector-wide objectives. Through this broad sectoral approach, this sector has been able to reduce flaring of oilfield gases by 50 per cent in the past year - well ahead of projected targets.

- In November 2002, the Alberta government will begin discussions with the petroleum sector to develop a sectoral agreement for reductions in emissions intensity. It is expected these negotiations will be completed within one year.

In addition to the Alberta electricity and petroleum sectors, partnership agreements will be sought with a broader range of sectors that will include: agriculture, transportation, mining, manufacturing (chemical, pulp and paper, etc.), commercial, municipalities, and forestry.

- In Spring 2003, negotiations will commence with these other key sectors.

ACTION:

Implement mandatory greenhouse gas emissions reporting for large emission sources.

Taking Action

Albertans & Climate Change

The Alberta government will require large emitting sources (facilities with annual carbon dioxide equivalent emissions higher than 100-150 kilotonnes) to report their greenhouse gas emissions, allowing the province to develop a better understanding of the nature of its greenhouse gas emissions sources. Greenhouse gas reporting will also help industry better manage its own emissions - allowing them to track progress and understand opportunities for emission reductions.

- Alberta Environment, working with industry, has begun to develop a system through which large greenhouse gas emitting facilities will report on their annual greenhouse gas emissions - with the first annual reports filed in the beginning of 2004 for emissions in 2003.

Efforts will be made to avoid duplication (e.g. provincial and federal reporting requirements). Alberta's approach will allow for the development of an effective national system of greenhouse gas reporting that can be adopted by other governments.

ACTION:

Lead the development of an emission offset trading system. This system will reflect Alberta's unique needs and circumstances, complement the negotiated sectoral agreements, and work with national, continental and international systems.

In addressing climate change, an emission reduction in southern Alberta has the same environmental benefit as an emission reduction in northern Alberta. Emission offset trading is a mechanism by which an organization could purchase emission reductions from another organization that had exceeded its emission targets. The purchasing organization would then apply this offset to its own emission reduction objectives. Rules would ensure that such emission reductions were real and verifiable, and properly tracked to ensure that a particular offset is used by a single organization.

Emission offset trading systems, if properly designed, can provide an effective tool through which organizations can understand emission reduction costs and opportunities and ensure least-cost emission reductions are being achieved. They also allow organizations to pursue emission reduction opportunities that are outside of their operations. The Alberta government recognizes the merits of emission trading systems.

In *Albertans & Climate Change: A Strategy for Managing Environmental and Economic Risks*, the Government of Alberta outlined its commitment to a domestic emissions trading system that allows the province to retain the ability to set overall greenhouse gas emission reduction objectives and participate in national, continental and international trading systems that may allow for larger emission reduction opportunities to be pursued.

The Alberta government has already begun to establish a foundation for an emission offset trading system. Alberta has provided the stimulus for emissions offset trading by requiring that all new approved thermal (coal-fired) generation facilities offset their greenhouse gas emissions down to the level of a combined cycle natural gas turbine. This represents a 53 to 63 per cent reduction in net greenhouse gas emissions from these facilities. In developing rules around the creation and use of offsets, the Alberta government will build on experience gained through provincial, regional and national emission offset trading initiatives (e.g. Greenhouse Gas Emission Reduction Trading (GERT) Pilot).

Building on this initial direction, Alberta is well positioned to move forward as a leader in establishing the mechanisms for emission offset trading. Alberta can build on its experience in developing energy markets and defining commodities that can be traded on the open market.

Alberta will determine the reduction commitments of Alberta sectors through negotiated sectoral agreements. These negotiations will determine the scope through which sectors will be able to pursue emission reductions through emissions trading systems. In advance of sectoral consultations, the Alberta government is taking action to facilitate participation in emissions trading systems. For example:

- Alberta will work with Climate Change Central and the Voluntary Challenge and Registry (VCR Inc.) to develop an effective Emission Reduction Registry. Existing registries (such as VCR Inc.) will be considered for this role, with the goal of ensuring registered emission reductions have clear and unique title and can form the basis for transparent verification protocols.
- Alberta will build on its current work within the electricity sector to further expand on rules for creating and using emission offsets. As part of this work, the Alberta government is consulting with stakeholders on:
  - The range of activities and initiatives within the province that would be eligible for credit creation (e.g. role of telecommuting initiatives).
  - Linking our approach to emerging continental trading systems (possibly linked to NAFTA) that allows for U.S.-based credits.
  - The viability of developing a joint industry/government Climate Change and Emissions Management Fund to support provincial investments in real emission reductions that also advance Alberta economic and technology transfer opportunities.
- The Alberta government is supporting efforts by Climate Change Central to develop standard mechanisms for trading the emission reductions associated with agriculture and forestry sinks.
- Alberta has launched a major feasibility study on the potential design of an emission trading system. This study will examine the potential for emission trading for greenhouse gases as well as for air contaminants, such as sulphur dioxide and nitrogen oxides. The results of this major study will inform our negotiations on sectoral agreements.
- The Alberta government will participate in a national program involving the review, selection and purchase of emission reductions by governments across Canada. Participation in this initiative, called the Pilot Emission Removals, Reductions and Learnings (PERRL) program, will provide valuable information for the Alberta government around emission reduction opportunities in Alberta and the process and procedures for determining real and verifiable emission reductions. The Alberta government will work on this initiative with Climate Change Central, who will serve as Alberta's PERRL Program Authority.

What We Heard

Stakeholders generally supported the Alberta government's emphasis on sectoral agreements. They concurred that such agreements could challenge sectors to achieve meaningful yet realistic emission reductions. These agreements could help ensure that financial resources are focused on greenhouse gas activities within the province rather than on the purchase of international emission permits. While emission offset trading could play an important role, care needs to be taken to ensure that provincial offset trading systems are consistent with emerging continental and international approaches.

Our Response

The Alberta government will use sectoral agreements as the primary approach to establishing meaningful emission intensity targets. By using the "bottom up" approach - focusing on realistic targets that can be achieved by actions in Alberta - this plan limits the need for purchasing international emission permits and trading. However, emission offset trading which is compatible with continental and international systems will be established to provide sectors with flexibility.

The Alberta government seeks to ensure the broadest possible framework for emissions trading, thereby ensuring a robust and effective market that lowers the cost of achieving any specific reduction. Through mechanisms such as an Alberta Climate Change and Emissions Management Fund, the province will effectively limit the costs to industry of having to purchase greenhouse gas emission reductions and, instead, allow for the private sector to invest in provincial research and development and energy efficiency and conservation initiatives, keeping investment and capital in Alberta.

The Alberta government will continue to work with other governments in Canada to ensure there is a consistent commodity that can be traded across Canada, and possibly within North America and internationally.

ACTION:

Lead by example through action within the Government of Alberta.

The Alberta government has led by example and reduced emissions from its own operations. Cost effective actions taken in government buildings and fleets since 1995 have resulted in a 22 per cent reduction in greenhouse gases below 1990 levels. This achievement exceeded the government's target (established in 1995) of a 14.1 per cent reduction in greenhouse gas emissions below 1990 levels by the year 2000.

A new target of a 26 per cent reduction below 1990 levels by 2005 has been established. Longer-term targets will also be established as part of the Alberta government's own sectoral agreement with Albertans.

Taking Action

ALBERTANS & CLIMATE CHANGE

In its efforts to continue to highlight the range of opportunities available to others, the Alberta government will take actions that include the following:

- Reduce emissions related to government activities and facilities by 26 per cent below 1990 levels by 2005 as set out in the Alberta government's Voluntary Challenge and Registry (VCR) Action Plan and take action to encourage boards and authorities to reduce emissions in government funded facilities (i.e. schools and hospitals).
- Complete energy retrofit programs in 190 government facilities, comprising 60 per cent of the area managed by government.
- Install cogeneration (combined power and heating from natural gas) units at government-funded research facilities.
- Consider recommendations of the Minister's Symposium on Schools to support the development of durable, multi-functional, flexible "Green" schools. This will include implementing a sustainable building rating system.
- Ensure new government buildings and government-funded buildings are built to energy efficiency standards that exceed those of the Model National Energy Code for Buildings.
- Register the Alberta Government VCR Action Plan under the VCR Inc. Champions in Action initiative - ensuring the province's plan receives a rigorous peer review and receives the highest level of national recognition.
- Establish, as part of the Alberta government's own sectoral agreement, a long-term (post 2005) emission reduction target.
- Establish a Sustainable Infrastructure Fund for reducing emissions within government through the deployment of innovative low-emission technologies.
- Install solar panels to generate electricity for the Alberta Legislature.
- Purchase or lease 100 new alternative fuel or hybrid vehicles for the government fleet over the next three years, building on Alberta Environment's purchase of hybrid vehicles.
- Commit to purchasing green power (beginning in 2004) for at least 10 per cent of electricity consumed at government facilities and immediately begin securing a diverse portfolio of green power providers.
- Roll out a Driver Education Program to government fleet drivers.
- Implement a government vehicle leasing process that accounts for "best in class" fuel efficiency ratings.

What We Heard:

Some stakeholders thought that Alberta government success stories needed to be more broadly communicated to encourage action in institutional and commercial sectors.

Taking Action

Albertans & Climate Change

Our Response:

The Alberta government will remain committed to the national Voluntary Challenge and Registry (VCR Inc.) as a means of taking action within its own operations. Over the coming year, the Alberta government will register its Action Plan with the VCR Inc. Champions in Action initiative. The Alberta government will also apply its knowledge to key institutional sectors such as schools and hospitals.

Technology and Innovation

Vision

Alberta is recognized around the globe for leading-edge innovation in environmentally sustainable technologies that maximize the value of Alberta's energy and other resources and the prosperity of its citizens.

The Government of Alberta is supporting strategic research into reducing the costs and environmental footprint associated with energy production, distribution and use in Alberta. The intent is to break the link between hydrocarbon energy development and greenhouse gas emissions, thereby sustaining Alberta's ability to develop its resources in a carbon-constrained world.

To address the global challenges of energy for the future, the Alberta government, working with the energy industry and research providers, must embrace new and innovative approaches that result in positive incremental changes in environmental practices. Through strategic investments, our aim is to make the province a world-class energy research centre that can develop, adopt and adapt transformational technologies that minimize the impact on our environment.

Alberta's investment in sustainable energy technologies will be coordinated through the Alberta Energy Research Institute (AERI). AERI provides funding, coordination and harmonizing of energy research and technology development. AERI's mandate is to promote energy research, technology evaluation and technology transfer in areas that include oil and gas, heavy oil and oil sands, coal, electricity, and renewable and alternative energy. The AERI research strategy is intended to lead and support the transformation of separate sectors of the economy into an integrated energy industry focused on using Alberta's resources to their fullest potential while ensuring clean air, water and land.

AERI advises the Minister of Innovation and Science and the government regarding energy research and the development of resources in the interest of Albertans.

AERI will maintain a portfolio of research and technology programs that is directed towards maintaining current levels of oil and gas revenue; developing innovative technologies to address the challenges of climate change; extending the life of conventional resources; and exploiting additional unconventional resources.

AERI's strategic intent is to stimulate the research and development of new technology and assist the energy sector to play a dominant role in the new economy by:

- Developing value-added products and processes including alternate and renewable energy sources.
- Using best-in-class knowledge.
- Advancing technologies and environmental standards.

The intent will also be to adapt, demonstrate and use the best available technologies available elsewhere. Specifically in the area of renewable energy, the Government of Alberta will supplement its research, development and demonstration efforts with efforts taking place elsewhere in the country. Some government leadership will take place through the demonstration or purchase of these technologies, such as in retrofits to government buildings (solar energy) or in the purchase of green power for government use.

The three initial primary strategic drivers for research and technology will be:

- Development of cleaner coal technologies for electricity generation. In addition, the use of coal and other feedstocks for production of steam, hydrogen (for oil sands upgrading and fuel cells) and the capture of concentrated CO_2 streams for enhanced oil and gas recovery.
- Oil sands upgrading technology to produce new products customized for North American refineries. This will allow Alberta to reduce environmental impacts, and maintain/enhance the value obtained from bitumen and synthetic production, which is expected to double in the next five years.
- Management of CO_2 and other emissions by developing technology that will capture, transport and use CO_2 for increasing the recovery of conventional crude oil and injection into coal beds to release natural gas (see Carbon Management).

In addition to these major thrusts, the strategy includes research issues related to:

- Unlocking the potential of coal bed methane.
- Developing renewable and alternative energy sources associated primarily with fuel cell development and hydrogen technology.
- Lowering the emissions intensity of oil sands production and upgrading.
- Enhancing the recovery of conventional oil and gas.
- Reducing greenhouse gas emissions associated with oil, gas and coal production and use.

Our investments will lead to field plant demonstrations of value-added upgrading of Alberta resources into energy services and feedstocks (e.g. electricity, hydrogen, biofuels) with a significant reduction in greenhouse gas emissions intensity.

The Alberta government is committing to a partnership that is based on leveraged funding from the federal government, other governments and industry. In 2003/04 the Alberta government will invest in the Alberta Energy Research Institute.

Taking Action

Albertans & Climate Change

In addition, the Alberta government will work with industry, universities and other research providers to develop world-class, cross-disciplinary centers of excellence in energy and environmental research and technology development.

Specific areas of focus related to the Alberta Energy Research Strategy include:

Managing CO_2 and other emissions

See the Carbon Management section of this plan for the province's strategy for carbon capture and storage in geological formations.

Burning coal cleanly with significantly reduced environmental emissions to generate electricity; using coal and other feedstocks to produce steam, hydrogen, synthetic natural gas, chemicals; adapting clean coal technologies to Alberta resources and integrating them with oil sands, petrochemicals, biomass and fuel cells; and capturing concentrated $C0_2$ streams to reduce environmental impacts and using this by-product as a vehicle for enhanced oil and gas recovery.

- Develop a network linking provincial, national and global research activities in cleaner energy.
- Leverage funds from the federal government, industry and research funding sources into a cleaner energy research program.
- Promote bench scale and pilot projects in clean coal technologies, integration with other feedstocks and low intensity heavy oil upgrading, and in emissions sensing and mitigation.

Increasing the marketability and value of bitumen

- Conduct a technical audit of research programs to understand the benefits and help reposition upgrading research areas that involve less energy intensity and customized synthetic products.

Increasing recovery from conventional oil and gas and accessing additional non-conventional reserves; natural gas from coal beds, bitumen and heavy oil; lowering intensity of extraction and recovery processes; management of oil field water and tailings.

- Work with other research agencies on less energy intensive in-situ and extraction processes, water use and tailings management issues.
- Work with research organizations and industry associations to promote industry working groups with a focus on oil and gas enhanced technology and optimizing economics.
- Work with Climate Change Central, the Petroleum Technology Alliance of Canada (PTAC) and the Canadian Environmental Technology Advancement Corporation (CETAC-West) to support emerging greenhouse gas reduction technologies in energy and other sectors.
- In October 2002, the Alberta government, in partnership with industry, invested $7 million in a $30 million heavy oil research partnership project to test the economic, environmental and technical viability of a process that involves injecting vaporized solvents into heavy oil. Known as the VAPEX Process, this promises to virtually eliminate greenhouse gas emissions and significantly reduce water consumption, as compared to other extraction technologies currently being used.

Moving from hydrocarbons to a hydrogen economy with a focus on infrastructure and fuel cell development that use Alberta resources; developing alternate sources of clean energy, including bioenergy.

- Develop and implement an Integrated Energy Research Strategy for Alberta.
- Increase the focus on alternative and renewable energy projects, in areas such as fuel cells and hydrogen technology.
- Interact with renewable and alternative energy industries and associations to establish their research priorities and assist research providers to address these priorities. The renewable and alternative energy sectors will be allocated between 13 to 23 per cent of the total new funding proposed by AERI.
- Focus on demonstration projects with private sector partners to promote knowledge of the new technologies and promote adoption of these technologies.

What We Heard:

Albertans liked the strong emphasis the province is placing on technology. A long-term issue such as climate change requires significant investments in new technology. Some stakeholders felt that while technological innovation related to fossil-fuel energy sources required further investment, non-fossil fuel based energy sources also required provincial support.

Our Response:

Technological innovation will remain a key part of Alberta's Action Plan. In addition to supporting the fossil fuel-related research through AERI, the alternative energy and renewable energy sectors will be allocated between 13 to 23 per cent of the total proposed new funding for the Alberta Energy Research Strategy.

Carbon Management

Vision

Alberta develops the capacity for cost-effective and safe capture, use and storage of carbon dioxide (CO_2) for enhanced resource recovery.

Carbon management is the capture and storage of CO_2 in geological formations.

Alberta CO_2 (e.g. from oil sands upgrading, oil refining, power generation, gas processing and petrochemical production) could potentially be captured and used to increase production from oil reservoirs and coal bed methane, or be stored in geological formations.

Currently, market conditions do not encourage widespread commercial use of CO_2 in Enhanced Oil Recovery (EOR), or Enhanced Coal Bed Methane (ECBM) recovery or other applications. The economics of capturing a pure stream of CO_2 are, at present, marginal. However, with oil and natural gas prices at high levels, there is industry interest in exploring the options for enhanced oil and gas recovery using captured CO_2.

The proposed carbon management strategy consists of eight broad goals. Each goal will be addressed over a planning cycle of eight years, which has been divided in three phases:

Phase 1: Current - 2003 - Enhanced recovery of Alberta fossil fuel resources.

Phase 2: 2004 - 2007 - Building the CO_2 market in Alberta.

Phase 3: Post 2007 - Commercially testing zero-emission coal plants.

The eight goals are:

1) Developing the CO_2 EOR Market

- By 2003, the Alberta government will partner with industry on three demonstration projects to use CO_2 to enhance oil production or maintain reservoir pressure.

2) Developing Alberta's Geo-science Base for CO_2 Storage in Geological Media

- The Alberta Geological Survey, in partnership with the Geological Survey of Canada will expand and support activities in the analysis of Alberta's subsurface suitability and capacity for CO_2 sequestration in hydrocarbon reservoirs, coal beds, and deep saline formations.
- The Alberta Geological Survey, Environment Canada, Alberta Research Council, Natural Resources Canada, Alberta universities, and industry will work together to assess the integrity and safety of such locations, both in the short and long term.

Taking Action

Albertans & Climate Change

3) Cutting the Costs of Capture

- Considerable global research is underway to reduce the costs of purifying and capturing CO_2 from plant stacks. Drawing upon these efforts, research, adaptation and demonstration of new capture technologies will be a primary part of the proposed new focus on energy research.
- As part of the Alberta Energy Research Institute's Energy Strategy, initiatives will be pursued with a goal of reducing the cost of capture and compression of CO_2 by 50 per cent for retrofit operations and 75 per cent reduction in costs associated for new facilities.

4) Finding New Resources - Coal Bed Methane

- The Alberta Geological Survey and the Alberta Research Council will expand efforts to map and characterize coal beds and develop a better understanding of Alberta's coal bed methane potential. They will identify which coal beds are appropriate for enhanced methane production by CO_2 injection and storage, and address issues related to the disposal of produced water.
- Partnerships will be pursued with industry players that are already engaged in research efforts, and also to bring in new players. A key component will be to proceed with technical demonstration projects for Enhanced Coal Bed Methane recovery.

5) Infrastructure Development

- Identify infrastructure needs (e.g. pipelines or other facilities required for CO_2 transmission to selected sites) and pursue projects to build the infrastructure through incremental efforts under an industry/government partnership.

6) Develop Economic, Fiscal and Regulatory Requirements

- Work in collaboration with government agencies (including the federal government) and industry, to identify the types of economic, fiscal and regulatory frameworks that are conducive to a Carbon Management Strategy. For example:
  - The Alberta government will work with the federal government and other western provinces to develop protocols for measuring actual CO_2 stored, and to form the basis for environmental and safety regulations.
  - Alberta Energy will establish a royalty credit program to encourage early action for the use of CO_2 in Enhanced Oil Recovery operations. Companies who are interested in participating in demonstration projects will be eligible for this royalty.
  - The Alberta government will define the ownership, rights and policy regime for geologic pore spaces for long-term CO_2 storage.

7) Clarify Environmental/Health and Monitoring Requirements

- Focus research on the short and long-term fate and safety of geologically stored CO_2 to increase confidence and reduce risk. Build on the lessons learned from acid gas injection projects.
- Through demonstration projects with industry in Alberta (anticipated to begin in 2003) and elsewhere (e.g. Weyburn, Sask.), resolve any outstanding and new health, environmental and safety issues dealing with capture, transportation and storage of CO_2.
- Establish a CO_2 monitoring component on storage and leakage associated with three commercial demonstration projects.

8) Consult with the Public to Increase Awareness, Understanding and Acceptance

- Help achieve greater public awareness and understanding by addressing public concerns on possible safety and environmental issues associated with CO_2 storage. A strategy to engage key stakeholders and the public is currently being developed.

Taking Action

Albertans & Climate Change

Energy Conservation

Vision

Albertans are North American leaders in the efficient use of energy.

This strategy takes a very broad definition of energy conservation. It includes energy conservation, energy efficiency, and using alternative energy sources (the next section provides a specific focus on renewable and alternative energy). Energy conservation and improved energy efficiency are key ways Albertans can begin breaking the link between economic prosperity and emissions growth.

Over the past several years, Alberta organizations (industry, small businesses, municipalities) and people have increased their energy efficiency through a range of cost-effective actions. Equipment, materials, and technologies are continuing to evolve and increased efficiencies are possible.

Achieving further efficiencies will require a renewed commitment from all Albertans. The Alberta government will partner with other Alberta organizations and stakeholders to facilitate further action on energy efficiency and conservation.

The Alberta government's approach to energy conservation will focus on the following four elements:

- Facilitating access to electricity generated from a diversity of energy sources - including renewable power — and other energy conservation alternatives (for a further discussion of renewable energy, see the next section of this plan).
- Demonstrating leadership and reducing operating costs by promoting and implementing energy efficient options for government operations (see previous section on Government Leadership).
- Increasing the awareness of, and choices for, Albertans to adopt energy conservation opportunities.
- Encouraging innovation through energy efficiency demonstration projects or by facilitating action by energy consumers.

Achieving further efficiencies will also require a broad mix of initiatives, including incentives for energy efficient investments and minimum energy efficiency expectations.

The key mechanism for pursuing action on energy efficiency and conservation will be Alberta's new energy efficiency and conservation office - Energy Solutions Alberta. Established by Climate Change Central in partnership with the Alberta government in June 2002, Energy Solutions Alberta will focus on increasing access to new low emissions technologies, creating awareness and choices for Albertans, and encouraging innovation through demonstration or by encouraging action.

A website containing energy efficiency information for individuals and businesses www.altaenergysolutions.com has been established.

The office will have four core components:

- Public Awareness and Program Marketing.
- Program Advice and Support.
- Policy Advice and Recommendations.
- Program Development and Delivery.

Taking Action

Albertans Climate Change

Energy Solutions Alberta will concentrate on the residential and commercial sectors. Many of the building technologies and materials that make significant efficiency gains in this area already exist and their use depends on incentives, consumer education and removing policy barriers. Action on energy efficiency and conservation in other sectors will be addressed through the development of sectoral agreements.

Energy Solutions Alberta will take the following actions to support its core objectives:

1) **Expand public communication and education programs on energy efficiency and develop publicly accessible information tools to engage Albertans in taking action to reduce their GHG emissions.**

- Implement a strategy to ensure provincial activities related to climate change education and information programs are coordinated with the activities of Energy Solutions Alberta.
- Engage the efforts of Alberta's Public Education and Outreach Hub, established under Climate Change Central in 2000 to coordinate climate change education and awareness activities, to help Albertans demonstrate environmental stewardship (including energy efficiency) through school-based programs and public awareness.
- Launch public education and awareness campaigns on energy efficiency and conservation opportunities.

2) **Augment existing national energy conservation initiatives by increasing accessibility to these programs and by expanding them to the entire Alberta market.**

- Energy Solutions Alberta will work with the national Office of Energy Efficiency and establish a partnership agreement where it can jointly deliver national programs in Alberta, and act as an information clearinghouse and one-window contact for information.

3) **Compare the effectiveness of other programs/services delivery models and recommend effective implementation methods for Alberta.**

- Energy Solutions Alberta will commission an expert study to review energy efficiency programs in North America and recommend programs that could be implemented in Alberta.

4) **Design and help implement innovative programs that address GHG emissions through energy efficiency and conservation actions and result in real, quantifiable and verifiable GHG reductions.**

- Partner in the development and launch of a municipal building retrofit program.
- Explore options for launching a municipal street light pilot project targeted at testing new technologies in smaller communities and removing barriers to implementation. Based on results of this pilot initiative, expand program through innovative financing mechanisms.
- Expand the vehicle scrappage program based on the results of the Calgary pilot.

- Launch "teletrips" initiative in targeted Alberta municipalities.
- Partner on delivery of the EnerGuide Audit and Rebate program for homes.
- Determine a course of action for an enhanced provincial labeling program that makes it easy for the public and key energy consuming sectors to understand the environmental and economic consequences of their purchase decisions.
- Partner on delivering an anti-idling awareness program.
- Undertake a pilot initiative to reduce the up-front capital costs of retrofits, new appliances or distributed energy sources (e.g. micro-turbines or small fuel cells used to generate electricity at or near the point of energy consumption).
- Explore developing a pilot green mortgage or green loan program that would allow for energy efficiency considerations to be included in mortgage financing.
- Support the demonstration of energy efficiency buildings and practices across a variety of sectors.

5) **Increase local investments in energy efficiency and conservation.**

- Consider options for establishing a revolving fund for auditing and upgrading buildings not amenable to energy performance contracting.

6) **Leverage the effectiveness of the energy efficiency/conservation office by pursuing partners from all stakeholder groups and levels of government.**

- Partner with other governments and stakeholders on energy efficiency and conservation programs being undertaken in Alberta municipalities.

7) **Identify, review and recommend options to government for removing barriers that prevent the adoption of more energy efficient alternatives.**

- Develop interconnection guidelines for distributed electricity generation.
- Partner with Alberta Chapter of Canadian Electricity Code to recommend further changes to facilitate interconnection for small distributed generation.
- Review potential for net metering in Alberta (net metering would make it easier for homeowners or small businesses who generate their own electricity to sell surplus electricity back to the power grid).
- Partner on the removal of administration and procedural barriers to distributed generation.

8) **Collect the information required to properly analyze the success of Energy Solutions Alberta's activities.**

- Document and analyze energy efficiency trends, and develop performance measures for new programs.

What We Heard:

Albertans liked the fact that Alberta's plan included an emphasis on energy efficiency and conservation. They support an increased focus on specific initiatives that target energy consumers.

Our Response:

The Alberta government will ask Climate Change Central to be the lead provincial organization for developing and implementing energy conservation and efficiency initiatives. The Alberta government expects that the focus of these initiatives will be on the public and key energy end-use sectors (e.g. municipalities, small business, commercial sector) that require additional support for energy conservation.

Encouraging innovation through demonstration or by encouraging action.

The Alberta government will also support additional actions aimed at encouraging innovation and action to improve energy efficiency across the provincial economy. For example:

- The Alberta Energy Research Institute (AERI) will support research aimed at energy efficiency and alternative energy technologies.
- The Alberta government will partner with the building construction sector to increase the efficiency of new and existing buildings by incorporating an energy efficiency requirement into the provincial Building Code, establishing new Energy Codes or through other mechanisms.
- Alberta Environment and Alberta Revenue will establish a task force to consult with stakeholders and consumer groups to explore how market signals can encourage increased energy efficiency and conservation and identify potential revenue sources.
- The Alberta government will partner with municipalities to facilitate more environmentally sustainable forms of municipal infrastructure and planning (e.g. support for the City of Edmonton's Light Rail Transit expansion, or the City of Calgary's Ride the Wind transit power project).

Renewable and Alternative Energy

Vision

Alberta's renewable and alternative energy sector will make a growing and significant contribution to the province's energy mix. Through an effective policy framework, the renewable and alternative energy sector will be competitive with other energy sources. Alberta will be recognized as a renewable energy center within North America.

What We Heard:

Albertans indicated they would like to see the government place a stronger emphasis on the role that renewable energy can play as part of the province's climate change response.

Our Response:

The Alberta government will make renewable energy a key component of the Alberta government's climate change response. In the May 2002 *Plan for Action*, action on renewable and alternative energy was included under the broad category of Energy Conservation. To reflect what we heard, Renewable and Alternative Energy is now a separate component of *Albertans & Climate Change: Taking Action*. In addition to supporting the work of groups like Climate Change Central in demonstrating new technologies and removing barriers to renewable and alternative energy technologies, the Alberta government will outline its expectations for the contribution that renewable and alternative energy will make to the provincial energy mix.

Alberta's renewable and alternative energy sectors have experienced tremendous growth over the past five years. The province's electricity deregulation has been a key factor in facilitating new renewable and alternative energy development and private sector investment in these sectors. For example, Alberta's wind capacity has increased from 21 megawatts in 1996 to approximately 100 megawatts as of 2002. As well, the private sector has proposed a wide range of new wind, hydro and biomass projects that will allow Alberta's renewable energy capacity to increase over the coming years. Despite this tremendous growth, renewable energy remains a relatively small proportion (less than nine per cent) of the province's overall electricity portfolio and an even smaller proportion of the electricity actually consumed in the province.

Alberta's climate change response calls for a larger role for renewable energy. *Albertans & Climate Change: Taking Action* signals the province's interest in increasing the capacity of the renewable energy sector and an increase in electricity generated from these sources.

Taking Action

Albertans & Climate Change

Policy Framework for Renewable and Alternative Energy

The Alberta government is committed to the principles of electricity deregulation and the need for a level playing field among all electricity generation sources. The Alberta government is also committed to increasing the proportion of renewable and alternate energy supplied to consumers. It does not, however, believe that it is prudent

to directly subsidize the renewable or alternative energy sectors. The government's efforts to support these sectors will instead be focused on removing policy, regulatory or technical barriers, facilitating customer choice and consumer understanding of the emissions intensity of their electricity purchases and working with stakeholders to identify realistic yet challenging expectations on the appropriate minimum capacity of renewable and alternative electricity the province should be moving towards.

Specific initiatives include:

- The Alberta government will set a goal for increasing the renewable and alternative energy portion of total provincial energy capacity by 3.5 per cent by 2008. This equals about 560 Megawatts of new capacity. The specific framework for reaching this target will be established by the Clean Air Strategic Alliance Electricity Project Team.
- Requiring electricity retailers to disclose the emissions intensity of the electricity they market to consumers.
- In 2004, the Alberta government will require at least 10 per cent of the electricity consumed at government facilities to be generated from green power sources. The Alberta government will immediately begin securing a diverse portfolio of green power providers.
- The Alberta government will continue to work with our partners in industry and other governments to develop "green corridors" that support increased use of alternative fuel vehicles. We will build on initial efforts to establish a green corridor between Calgary and Banff.

Storing Carbon in Agricultural and Forestry Sinks

Vision

To develop, enhance and promote environmentally sustainable agriculture and forestry practices across Alberta that make meaningful, long-term contributions to reducing atmospheric greenhouse gas concentrations and maintain or enhance ecosystem health and integrity.

Alberta has significant potential for capturing and storing carbon in our agricultural lands and forests. Alberta stakeholders understand the opportunity in taking action to enhance carbon storage in soils and forests. For example, early indications are that by adopting environmentally sustainable management practices, agriculture can contribute significantly to offsetting greenhouse gas emissions.

Alberta organizations are moving to realize this potential. For example, no-till and low-till farming practices are now commonly accepted as effective farming practices. Some forest producers are exploring ways of enhancing the carbon uptake from managed forests. The Alberta government's Forest Management Agreements outline clear expectations for reforestation. The benefits of environmentally sustainable management practices to both the environment and agriculture/forestry sectors justify

programs and policies directed towards promoting the use of these practices.

Current approaches under consideration include: using currently available best management practices such as reduced or zero till farming, comprehensive nutrient management practices, reduced summer fallow and using bioenergy sources.

Enhanced forest management can result in a timely benefit to global well-being by increasing the carbon stored in both forest soils and trees.

The overall strategy for forest management in Alberta is to ensure that the values and benefits Albertans receive from environmental resources and economic, recreational, cultural and social activities conducted on Alberta's public lands are sustainable for future generations.

Alberta continues to explore sustainable forest management options that will maintain or increase carbon storage, reduce emissions, or reduce the risk of emissions.

Most stakeholders agree that agriculture and forestry sinks can provide an interim, cost-effective solution for major greenhouse gas emitters to meet targets for greenhouse gas emission reductions. However, clear rules around the ownership of emission reductions, as well as an emission trading framework, are required.

Many organizations, including industry, are increasingly looking at emission reductions from carbon capture and storage as an element of their overall greenhouse gas plans. Carbon capture and storage is an important activity to help ease the transition until low-emitting technologies enter the market. In conjunction with the development of an emissions offset trading system, the Alberta government will ensure that emission reductions achieved through verifiable carbon sequestration initiatives can be used against corporate or sectoral objectives.

Agriculture and forestry stakeholders have asked for clear policy direction on the ownership of carbon in the soil and vegetation (applying primarily to emission removals). They also are seeking confirmation of the government's expectations of how their sector will be expected to contribute to future emission reductions. A clear government statement on the ownership of emission reductions from agriculture and forest sinks will be the initial step for facilitating private sector activities to enhance these carbon sinks.

Carbon capture and storage in agriculture and forest sinks is a reversible process, and this reversal can happen within a very short period of time. The core concern associated with the impermanent nature of carbon sinks is determining who bears the ultimate liability for released carbon - if credit is given when carbon is captured and stored, who is responsible for the debit when carbon is released? This liability issue needs to be resolved.

To realize Alberta's biological sink opportunities, the following focus areas are being pursued:

ACTION:

Explore the use of biological sinks (agriculture soils and forests) to store carbon.

- Work with Climate Change Central and other stakeholders to finalize and implement a biosinks framework aimed at enhancing carbon capture and storage activities in the agriculture and forest sectors.
- Conduct and compile cost/benefit analyses of best management practices in agriculture and forestry to demonstrate their efficiency and conservation benefits.
- Identify the gaps and uncertainties in our current estimates of greenhouse gas removal/reduction by biological sinks, and carry out research designed to address these gaps.
- Explore the feasibility of establishing a provincial multi-sector fund that offers conservation incentives for environmentally sustainable agriculture/forestry practices and adoption of new technologies.
- Examine potential market-based instruments for adopting these practices, such as tradable permits (land use, GHG emissions), tax credits, financial incentives, etc.
- Assess the use of the environmental farm plan as a delivery mechanism for best management practices.
- Assess incentives for adopting conservation practices.

ACTION:

Address stakeholder uncertainty.

- The Alberta government position on the ownership of the carbon in biological sinks is that:
  - the title to sinks on Alberta Crown land is a property right vested in the Alberta government.
  - the title to sinks on all other land in Alberta is a property right vested in the owner of the land. The ownership of any incremental carbon offsets created through forest or soil capture or storage activities is a private matter.
  - sinks will be considered personal property for the purpose of emission reduction trading.

ACTION:

Establish a provincial GHG emissions trading framework that links carbon enhancements to soil and forest sinks to the trading of emission reduction offsets (see Government Leadership-Action: Emission offset trading system).

- Develop specific criteria for applying sink credits to current offset obligations for new thermal power plants or other projects.
- Work with Climate Change Central to establish the framework for a measuring, monitoring and verification system.
- Through pilot programs and research in partnership with other stakeholders, advance understanding of the role that emission offset trading can play within the agriculture and forestry sectors.
- Undertake a full cost analysis of greenhouse gas reduction practices, including monitoring and verification.
- Establish a 1990 soil carbon/forestry level baseline to recognize and not penalize early adopters.
- Work with Climate Change Central to develop a land use registry for documenting greenhouse gas emissions reductions and removals.
- Develop long-range forecasts on the value of carbon credits.

ACTION:

Overcome permanence and liability issues.

- Examine an appropriate mechanism for dealing with liability in emissions removal.
- Couple this mechanism with standard contracts for facilitating trades and minimizing risks between buyer and seller.
- Assess the risk/cost of emissions from previously sequestered soil carbon.
- Develop criteria for applying sinks credits to current offset obligations related to new facilities (e.g. new thermal power plants).

What We Heard:

Some provincial stakeholders believe that biological sinks will create new opportunities but would like more information on the role, management and regulatory regime for biological sinks.

Our Response:

The Alberta government will pursue a coordinated approach to removing barriers associated with using biological sinks.

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Adapting to climate change

Vision

Albertans, their communities and industries take steps to prepare for possible future climates and develop the ability to adapt successfully to changes in climate.

While it is important to reduce greenhouse gas emissions in an effort to mitigate the effect of climate change, we must also be prepared to adapt, regardless of the ultimate causes of these changes.

Adaptation seeks to ensure that our natural and socio-economic systems are able to cope with the potential impacts of climate change and can take advantage of potential opportunities.

Adaptation must take place where climate effects are felt, addressing the particular changes being experienced. Alberta requires its own adaptation strategy geared towards our specific needs, building on what is transferable from elsewhere.

Adaptation is risk management based on sound science. Risk management for climate change will be based on anticipating, understanding and addressing the effects of climate change. Scenarios of emissions, climate and socioeconomic conditions are used to provide estimates of potential impacts. Scenarios are not forecasts or predictions - they describe plausible futures and a range of scenarios is needed to assess the risk. They rely on sound science and objectivity to ensure Albertans are well informed about the options available and are able to make good decisions.

Research and development, monitoring and communications are important to ensure good information is available to everyone affected by climate change.

Climate change affects our whole society, environment and economy. However, different systems have different natural and socio-economic characteristics, so adaptation to climate change will differ among systems. An Alberta climate change adaptation strategy will involve cooperative efforts among the sectors affected by climate change. This cooperation will improve overall priority setting and help ensure the objectives of different government departments complement each other and are responsive to changing needs. Cooperation is necessary to assess and monitor progress when dealing with the long-term adaptation process.

ACTION:

Establish an adaptation research program including collaboration with other governments in Canada.

- Establish partnerships with federal-provincial research agencies, such as the Prairie Adaptation Research Collaborative (PARC), for collaboration in research on prairie adaptation.
- Support the University of Lethbridge Water Institute for Semi-arid Ecosystems (WISE) program, which includes a significant climate change adaptation component.
- Identify information gaps and coordinate research in the science, impacts and adaptation of climate change, focusing on Alberta.

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Albertans & Climate Change

- Develop synergy and partnerships with other climate change research and development efforts such as BIOCAP Canada Foundation, a national university research organization for biology-based research in climate change.
- Provide a basic set of climate scenarios for use by government departments and all Albertans.
- Develop suitable indicators and information systems so that significant changes can be detected.

ACTION:

Help Albertans explicitly address the risks of short-term climate variability and extremes - notably in the management and planning for agriculture, forestry, health, municipalities, infrastructure and water.

- Assess the impacts associated with current and future climate extremes.
- Assess current responses to climate extremes.
- Incorporate improved responses to climate extremes into management and planning at provincial and regional levels.

ACTION:

By 2010, prepare Albertans to deal with longer-term climate changes as a result of developing scenarios.

- Assess the ability of our major systems (natural, economic and institutional) to adapt to the range of possible future climates.
- Develop options to increase adaptability of those systems that are not sufficiently robust.
- Implement changes to management systems to ensure that they have the ability to address possible future climates.

ACTION:

Keep Albertans informed of the risks and opportunities of climate change and engage them in efforts to adapt.

- Inform Albertans of what the government is doing on adapting to climate change.
- Involve Albertans in adapting through their daily activities.
- Facilitate access to current knowledge of climate change and adaptation.

Conclusion and Next Steps

Albertans & Climate Change: Taking Action reflects the interests of Albertans by responding to the climate change issue in a manner that is environmentally effective and economically responsible. This plan will result in real greenhouse gas emission reductions in Alberta. It focuses on actions that increase the productivity and efficiency of all sectors of the economy, and prepares Albertans and Alberta organizations for the long-term challenge of achieving deeper reductions in greenhouse gas emissions over the coming century.

Alberta's approach is based on partnering with all stakeholders to identify challenging goals for reducing the emission intensity of their operations. Alberta will work with industry and other governments to support innovative technologies, and best practices will play a key role in facilitating reduced emission intensities. Through our strong partnerships in organizations such as Climate Change Central, our approach will also provide Alberta energy consumers with the tools and resources they need to improve their efficiency.

Effectively contributing to climate change solutions requires a workable plan for stakeholders to adopt. Alberta's plan reflects the interest of Alberta organizations and the public in developing an environmentally effective response. Our plan also clearly identifies the expectations that the province will have of all sectors in contributing to the challenge ahead.

Most of all, *Albertans & Climate Change: Taking Action* reflects a commitment:

- To take immediate action on climate change.
- To work collaboratively - building genuine partnerships with trust and confidence.
- To make strategic investments that position us to make ever increasing contributions to actions on climate change, and to continue to develop our economy to be more competitive under any world policy and in any environmental or economic climate.

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Albertans & Climate Change

A Glossary of Terms

Carbon Sinks

Any naturally occurring thing, like forests or specific kinds of agricultural activity, that can be grown or created specifically to help absorb more carbon dioxide.

Cleaner Energy Exports

Natural gas or hydropower from Canada provides an environmental benefit to the United States when they buy and use these "cleaner" fuels in place of their coal-fired electric power. However, producing this cleaner energy generates greenhouse gas emissions in Canada, for which we would be liable under any international emissions reduction agreement like Kyoto. The federal government is now arguing that Canada's cleaner energy exports should be recognized internationally.

Climate Change

The Earth's climate system adjusts to any rise in greenhouse gas levels to keep its global "energy budget" in balance. A thicker blanket of greenhouse gases - from increased human burning of fossil fuels for example - will result in warming of the Earth's surface and its lower atmosphere, or in changed climate patterns.

Climate Change Central

A unique public-private partnership that promotes the development of innovative responses to global climate change and its impacts. The Alberta government is a partner in Climate Change Central's efforts to build links and relationships between businesses, governments and other stakeholders in Alberta interested in pursuing greenhouse gas reduction initiatives.

Domestic Emissions Trading

Emissions trading within Canada, as distinct from international emissions trading.

Emissions Intensity

Greenhouse gas emissions released as measured against some other factor like the Gross Domestic Product (GDP) of a nation, province or state. Other standards by which emissions intensity can be measured include: per barrel of oil; per million cubic feet of natural gas; per tonne of coal, cement, etc. produced; or per megawatt hour of electricity.

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Albertans Climate Change

Emissions Trading

A market-based system that allows companies flexibility to choose the most cost-effective solutions to achieve established environmental goals. Companies that produce fewer emissions than they are allowed could sell their "excess capacity" to others who do not.

Greenhouse Gases (GHGs)

The main greenhouse gases are CO_2, methane, nitrous oxide and the chlorofluorocarbons (CFCs). All but CFCs occur naturally. Collectively, these gases make up less than one per cent of our atmosphere, sustaining what is called the Earth's "natural greenhouse effect." Without this, Earth would be 30 degrees cooler - essentially, a frozen planet.

International Credits/Permits

The Kyoto Protocol allows for creation and transfer of emissions credits or permits between countries. These are designed to minimize the cost of reducing global greenhouse emissions and include: Joint Implementation (emission-reducing projects between two countries with a Kyoto target); Clean Development Mechanisms (project-based reductions between developed and developing countries), and International Emissions Trading (international trading of international greenhouse gas permits).

Intergovernmental Panel on Climate Change (IPCC)

A panel set up by the World Meteorological Organization and the United Nations Environment Programme in 1988, in recognition of potential global climate change. The panel's role is to assess the scientific, technical and socio-economic information needed to understand the risk of human-induced climate change. IPCC does not carry out research or monitor climate related data, but bases its assessments mainly on peer reviewed and published scientific/technical literature.

Kyoto Protocol

Adopted in 1997, Kyoto's key concepts state that: developed countries should commit to reducing collective emissions of six key greenhouse gases by an average of at least five per cent; national emissions targets must be achieved by 2008-2012; and, countries have some flexibility in how to make and measure their emissions reductions.

Non-Renewable Energy

Non-renewable energy comes from a resource that is not replaced, or replaced only very slowly, by natural processes. Primary examples of fossil fuels are: oil, natural gas and coal. These fossil fuels are produced by decay of plant and animal matter, at much slower rates than our present fossil fuel consumption.

Renewable Energy

An energy resource that is replaced rapidly by natural processes. Examples include: sunlight, hydropower (water a through a dam) and wood.

Tradeable Emissions Permits

Part of a domestic emissions trading system *(see above)* that allows an emitter a specified number of tonnes of emissions. Once this limit has been reached, the permit expires. Total number of permits in any tradable market equals the level of emissions sought by the regulating authorities.

U.N. Framework Convention on Climate Change

This is the governing body for international climate change negotiations that was established in 1992 at the Rio Earth Summit. The convention's primary objective is: "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system." This level is to be achieved "within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner." The Kyoto Protocol document came out of this U.N. convention.

Notes

Taking Action

Albertans & Climate Change

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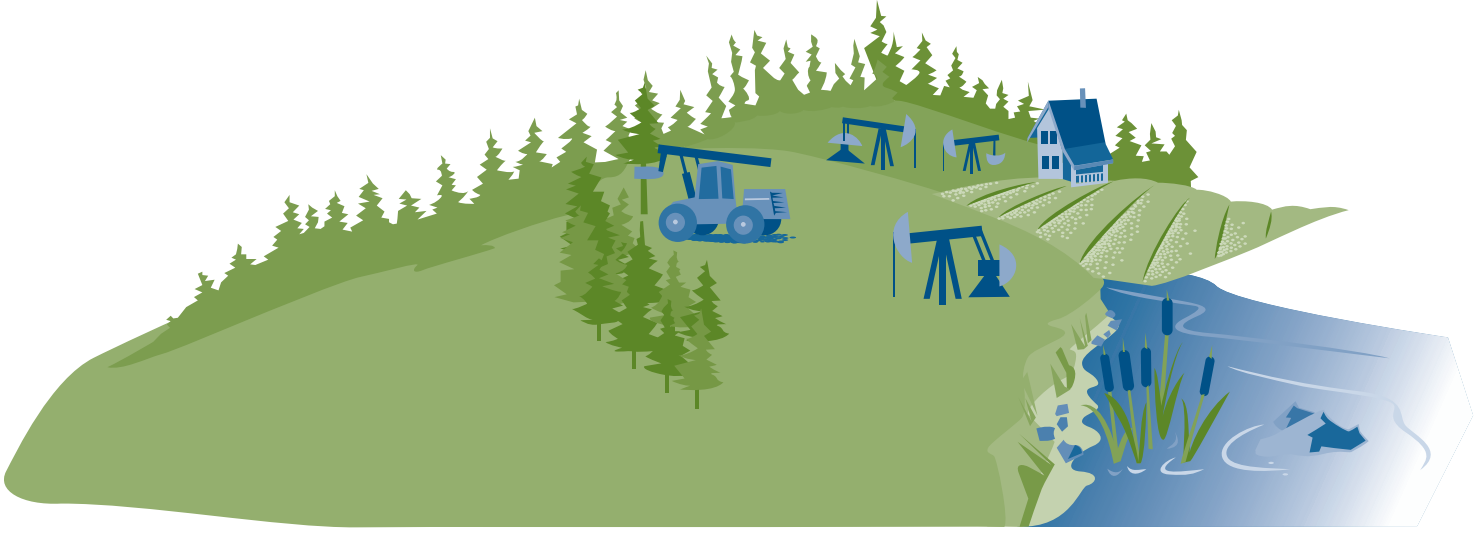
Albertans Climate Change TakingACTION

Carbon Management

Capture and Storage

of Carbon Dioxide in Western Canada



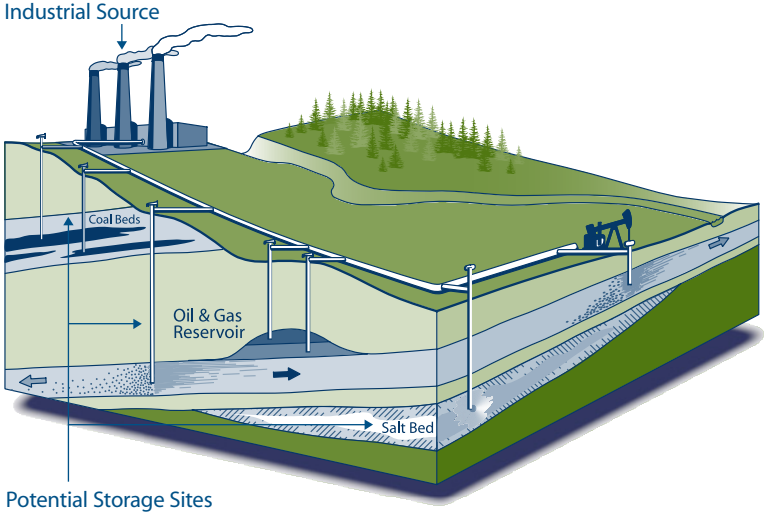
Introduction

CARBON DIOXIDE CAPTURE AND STORAGE: THE BIG PICTURE

Alberta's response to climate change – *Albertans & Climate Change: Taking Action* – is designed to encourage Albertans to take steps to reduce greenhouse gas emissions intensity and energy consumption, and begin to adapt to potential changes in climate.

Taking Action is an integrated and innovative plan in which the capture and storage of carbon dioxide underground plays a key role. In relation to this, the Alberta government and stakeholders are working together on a Canadian carbon storage **network of excellence**; Alberta Energy has a $15 million **royalty credit program** for carbon dioxide injection projects and Alberta Environment and the Alberta Energy Research Institute are involved in a $25 million **monitoring and evaluation project** on the long-term reliability of storing carbon dioxide in geological formations.

How is Carbon Dioxide Captured?



Emissions are captured from an industrial source, transported to a storage site and injected deep below ground into coal and salt beds and oil and gas reservoirs, as shown here.

Source: Alberta Energy Utilities Board, Alberta Geological Survey

Carbon dioxide is captured from an industrial source such as a fertilizer plant, oil refinery, oil sands upgrader, petrochemical or power plant and then dehydrated and compressed. Next, it is transported by pipeline to the storage site. And finally the carbon dioxide is injected (in a dense, liquid-like form) into the geological formation.

Cost has always been an important factor with this type of capture. The Alberta Energy Research Institute's energy strategy aims to reduce the cost of capture and compression of carbon dioxide by 75 per cent for new facilities and 50 per cent for retrofit operations. For more details on this strategy, please visit www.aeri.ab.ca.

Depleted oil and gas reservoirs, coal seams and salt beds – rocks saturated with brine – far beneath the Earth's surface are suitable for carbon dioxide storage. The injection technique has been used for decades, to enhance oil and gas recovery.

One risk involved in carbon storage is leakage from the geological formation. Early detection of potential leakage paths is key to preventing such leaks.

Where Could Carbon Dioxide Be Stored?

The Alberta and Williston basins that underlie much of Alberta and Saskatchewan could provide vast geological storage areas for carbon dioxide.

Source: Alberta Energy Utilities Board, Alberta Geological Survey

Because of its significant industrial sources of carbon dioxide and its geology, the Western Canadian Sedimentary Basin that stretches from the Rocky Mountains to the Canadian Shield is a prime storage area for carbon dioxide. Geologists believe the most suitable formations for storage are in the southwestern regions of the Prairie provinces, lying in a broad region that runs north to south through Alberta.

Preliminary findings suggest low impact on the environment from this type of storage. The Government of Alberta will continue to work with a wide range of Albertans as this process is explored.

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Alberta

Albertans Climate Change Taking Action

Key Actions to Date

March 2004

Introduction

In October 2002, the Government of Alberta released *Albertans & Climate Change: Taking Action*, Canada's first government action plan to address climate change and reduce greenhouse gas emissions.

The Government of Alberta is taking a lead on climate change and greenhouse gas reductions with initiatives such as:

- Canada's first legislation to address greenhouse gas emissions
- North America's largest green power contract
- $100 million in interest-free loans for municipal energy efficiencies
- $30 million towards technology/innovation and energy efficiency, and
- mandatory greenhouse gas emissions reporting by large emitters, coming in the near future

This booklet summarizes some of the highlights of the progress that Alberta has made since the action plan was launched.

Government Leadership

CLIMATE CHANGE LEGISLATION Alberta is the first jurisdiction in Canada with climate change-specific legislation. The *Climate Change Management and Emissions Act* provides the legal backing for implementing the province's climate change action plan.

www.gov.ab.ca/env

GOVERNMENT GREEN POWER PURCHASE The Government of Alberta signed North America's largest green power contract in 2003. As a result of the $200 million agreement, 90 per cent of the electricity used in provincial government operations will come from green power sources by 2005. New wind turbines in southern Alberta and a new biomass plant in northern Alberta will generate the power.

Alberta leads country in purchase of green power: Government of Alberta news release March 12, 2003, www.gov.ab.ca/acn

MANAGING ALBERTA'S ELECTRICITY SECTOR EMISSIONS The Government of Alberta has accepted recommendations from the Clean Air Strategic Alliance (CASA), providing a framework to reduce significantly emissions of mercury, sulphur dioxide, nitrogen oxides and primary particulate matter from the province's thermal electricity generation. CASA is still developing greenhouse gas recommendations. Coupled with an earlier "clean as gas" rule for all greenhouse gases from new electric generation facilities, these recommendations will likely become the foundation of an electricity sector agreement under the province's climate change action plan.

Full framework and summary recommendations at: www.casa-electricity.org

MANDATORY GREENHOUSE GAS REPORTING A mandatory greenhouse gas reporting framework is in the final planning stages. Alberta Environment has conducted stakeholder workshops to gain agreement on how reporting will be carried out. The Government of Alberta is working with other governments to ensure that this framework complements a national greenhouse gas reporting program.

www.gov.ab.ca/env/climate/actionplan/

SECTOR AGREEMENTS The Government of Alberta is continuing discussions with a number of sectors to develop sectoral agreements. The government has signalled the need for coordination among federal and provincial discussions with industry.

EMISSIONS OFFSET TRADING SYSTEM The Government of Alberta is leading development of an emissions offset trading system to fit Alberta's specific needs and circumstances. The system would be part of negotiated sectoral agreements, complementing any national, continental or international system. Investments in technology (through the Alberta Energy Research Institute) are recognized as part of an emissions reduction strategy.

HYBRID VEHICLES An Alberta Environment pilot program is using three hybrid compact passenger cars for its regional operations. The province is looking at hybrid alternatives to conventional courier vans for the government's internal fleet.

Technology and Innovation

INVESTMENTS IN RESEARCH The Government of Alberta is providing $27 million in funding for Alberta's investment in sustainable energy technologies over a three-year period. The Alberta Energy Research Institute will coordinate this energy research and technology development, in addition to providing $2.7 million a year to 50 Alberta university research training projects in natural gas in coal, fuel cell development, hydrogen technology, enhanced oil and gas recovery and emissions reductions related to oil sands production and upgrading, conventional oil, gas and coal.

For more on this research, visit www.aeri.ab.ca

CLEAN COAL TECHNOLOGY Through the Alberta Energy Research Institute, the Government of Alberta is a partner in the Canadian Clean Coal Power Coalition's research and development of cleaner coal technologies for electricity generation. The institute is also funding an industrial research chair at the University of Alberta for advanced coal cleaning and combustion, aimed at reducing mercury emissions.

www.canadiancleanpowercoalition.com

FUEL CELL TECHNOLOGY Excess heat from a state-of-the-art high voltage fuel cell now heats the swimming pool at the Northern Alberta Institute of Technology. The (200–kilowatt) fuel cell installation is funded through a $3.25 million applied research project that involves the Alberta Energy Research Institute, ATCO Gas and Western Economic Diversification Canada. The project will provide both energy savings and learning opportunities for those studying electrical generating technologies.

$3.25 million applied research project: NAIT news release, June 24, 2003, www.nait.ab.ca/news

COMBINED GREENHOUSE HEAT AND POWER In partnership with Climate Change Central, the Government of Alberta provided funding for a pilot installation of a combined heat and power system designed by Mariah Energy Corporation in Suntec Greenhouses, Medicine Hat. The project is expected to halve the greenhouse's carbon dioxide emissions, reduce nitrous oxide emissions by 97 per cent, cut fuel/power costs and create surplus energy for sale to the provincial grid. Results of this pilot will be useful to light industrial users interested in increasing their energy efficiency and reducing greenhouse gas emissions.

Mariah Energy-Climate Change Central sponsored project wins APEGGA Award: Climate Change Central news release, May 9, 2003 www.climatechangecentral.com

OPTIONS FOR BITUMEN RECOVERY The Dover Vapex Field Pilot is a $30 million project – funded 25 per cent by the Alberta Energy Research Institute, 25 per cent by the federal government and the rest by industry partners – situated just north of Fort McMurray at Devon's Dover lease. The pilot project injects vaporized solvents into heavy oil. The promise is for significantly reduced greenhouse gas emissions and water consumption, compared to steam-assisted gravity drainage technology.

Energy research helping reduce CO_2 emissions: Government of Alberta news release, September 4, 2003, www.gov.ab.ca/acn

MORE OLEFINS, LESS ENERGY A consortium of Nova Chemicals, the Alberta Research Council Inc., and the University of Waterloo received funding (July 2003) to develop an improved separation process for production of olefins at petrochemical plants. (Olefins are the synthetic polymers of ethylene or propylene used in textile fibers and "nylon" rope.) The consortium's process, based on a new membrane technology, offers a viable alternative to the high-cost, energy consuming operation currently performed by large distillation columns.

Carbon Management

ROYALTY CREDITS The Government of Alberta's 2003 royalty credit program offsets up to 30 per cent of costs for projects that capture/inject carbon dioxide into oil or gas pools to improve resource recovery and store the carbon dioxide. In addition to this $15 million program, the province has revised royalty deductions under its *Enhanced Oil Recovery Program* for carbon dioxide enhanced projects. Additional royalty reductions will be available to cover the higher costs involved in this type of enhanced oil recovery. www.energy.gov.ab.ca/ind/publications

CAPTURE AND STORAGE Part of the Alberta Energy Research Institute's energy strategy aims to significantly reduce the cost of carbon dioxide capture and compression. The goal is a 75 per cent reduction for new facilities and 50 per cent for retrofit operations. www.aeri.ab.ca

COAL SEAM INVENTORY To help assess the potential of carbon dioxide to enhance the recovery of natural gas in coal, the Alberta Geological Survey has completed a report on coal seams in targeted areas of Alberta. This is part of a three-year data collection/analysis project. www.ags.gov.ab.ca

ENHANCED OIL RECOVERY MONITORING Alberta Environment and the Alberta Energy Research Institute are involved in a monitoring project for carbon dioxide enhanced oil recovery in Weyburn, Saskatchewan. This $25 million, four-year research initiative is examining technologies that monitor and evaluate the long-term reliability of storing carbon dioxide in geological formations. www.aeri.ab.ca

Energy Conservation

ENERGY SOLUTIONS ALBERTA Opened in 2003, Energy Solutions Alberta is a provincial office of energy efficiency aimed at helping Albertans reduce emissions through energy conservation, improved efficiency and increased access to new low-emissions technologies. Established by Climate Change Central, Energy Solutions Alberta aims to be the main source in Alberta for consumer education and energy conservation programs.

For more on this office, visit www.energysolutionsalberta.com

MUNICIPAL ENERGY EFFICIENCY The Government of Alberta's four-year, $100 million interest-free *ME First!* loan program helps municipalities carry out energy efficiency projects in their buildings. Administered by Energy Solutions Alberta, the program's first approved projects are expected to be announced in spring 2004.

www.energysolutionsalberta.com

GREENER BUILDINGS The *Alberta Plus Initiative* provides building design dollars to encourage Alberta developers to increase their energy efficiency and cut greenhouse gas emissions. Energy Solutions Alberta provides up to $40,000 of extra funding, towards funds available from the Natural Resources Canada commercial building incentive program. A Vegreville 55-suite senior citizens complex received the maximum $100,000 in federal and provincial rebates through this program in 2003. Energy savings at the complex will be passed on to residents in the form of reduced rents.

www.energysolutionsalberta.com

FURNACE REBATES Energy Solutions Alberta is running a pilot *Alberta Furnace Rebate Program* from January, 2004 until March 31, 2004, with rebates up to $400 for consumers who replace their older furnaces with an Energy Star™ high efficiency model.

Furnace rebates heating up energy efficiency in Alberta: Energy Solutions Alberta news release, January 21, 2004
www.energysolutionsalberta.com

SCRAPPING OLDER CARS *Car Heaven Alberta* aims to get up to 1,500 vehicles 13 years and older off the streets of Edmonton and Calgary as one means of tackling greenhouse gas reductions. The Government of Alberta provided support for this Climate Change Central-sponsored program that offers as incentives bus passes and discounts towards buying a bike. Partners include the Clean Air Foundation, Pick-Your-Part, the Kidney Foundation, the City of Calgary and the City of Edmonton.

For more information, visit www.energysolutionsalberta.com

LESS IDLING PROMOTED Climate Change Central received Government of Alberta support for a *Reduce Idling Program* to encourage Edmonton and Calgary drivers stopping near schools or municipal buildings to turn off their vehicles while they wait. Testing showed that the number of idling vehicles was reduced by 10 per cent in the study areas. Partners include Natural Resources Canada and the Sierra Club of Canada.

www.climatechangecentral.com

Renewable and

Alternative Energy

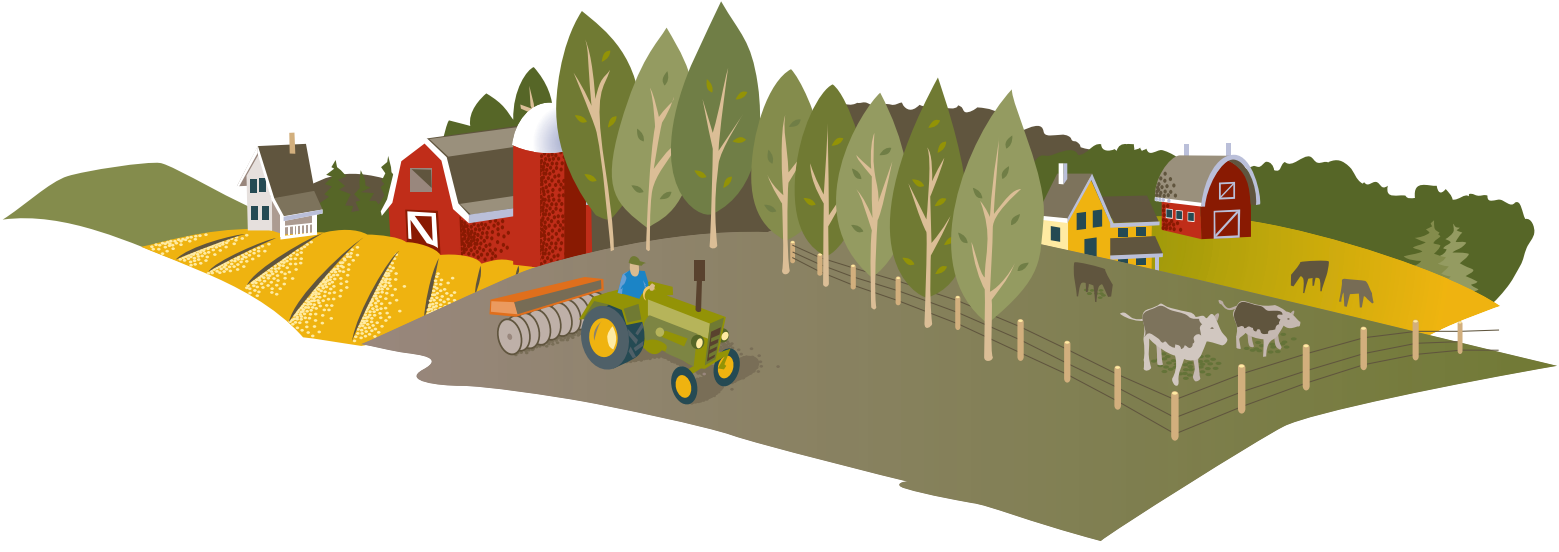
GREEN POWER PURCHASE The Government of Alberta's commitment to buy 90 per cent of its power needs from green sources (see Government Leadership), means that new wind power and biomass facilities are being expanded/built in Alberta. This will make green power more accessible and affordable to commercial and household consumers. Alberta's wind capacity has increased to approximately 100 megawatts in 2002, up from 21 megawatts in 1996.
www.gov.ab.ca/acn

SOLAR PANELS AT ALBERTA LEGISLATURE A small (three-kilowatt) solar array is now a part of the power behind the Alberta Legislature. Installation of this solar array has helped determine the regulatory/financial barriers that renewable and alternative energy generation projects face in relation to the provincial power grid.
www.gov.ab.ca/acn

ENERGY SAVING IN PARKS A solar energy project at Lesser Slave Lake Provincial Park completed in March 2004 has upgraded an existing solar array on one of the park's buildings. It is one of 21 energy efficiency projects funded by Alberta Environment at parks throughout the province. Most of these involve replacement of older, inefficient furnaces or upgrading of insulation.

Storing Carbon in

Agricultural and Forestry Sinks



BIOCAP CANADA The BIOCAP Canada Foundation targets university research support in Canada, especially in priority areas of biosphere greenhouse gas research. The Government of Alberta supports BIOCAP research specifically into the economics of various Alberta farm management practices and the policy tools to encourage them.

For more information, visit: www.biocap.ca

AGRICULTURAL SINKS The Government of Alberta, in partnership with BIOCAP Canada, is funding a project to examine legal mechanisms for use with agricultural sinks. The project, led by the University of Calgary, will look at the contractual arrangements and market mechanisms that are needed for trading emissions offsets, as well as defining how buyers and sellers share the risks.

Adapting to Climate Change

CLIMATE CHANGE ADAPTATION PLANNING Twelve Alberta government departments and Climate Change Central have developed a provincial climate change adaptation strategy. Research and analysis is being carried out in key areas like glacier response and southern Alberta's water supply and the response of Alberta's ecosystems to climate change.

DESIGNS FOR A CHANGING FUTURE Alberta is one of the first North American jurisdictions to require that any proposed facility's design or layout can accommodate future changes to emissions standards, limits and guidelines. This unique requirement is built into Alberta Environment's environmental impact assessments for projects whose nature or scale requires them (pulp mills, mines, oil refineries, etc.).

PRAIRIE ADAPTATION RESEARCH The Government of Alberta is a partner in the Prairie Adaptation Research Collaborative, an organization whose projects involve research into climate change impacts on the Canadian prairies. The Government of Alberta is also providing $7.5 million (over three years) to the Alberta Ingenuity Fund to help fund projects, through its new water research institute.

www.parc.ca

WATER FOR LIFE In November 2003, the Government of Alberta released *Water for Life*: *Alberta's Strategy for Sustainability*, the most comprehensive strategy of its kind in Canada. Based on more than 18 months of consultations and discussions with Albertans and water experts, it outlines a series of short-, medium- and long-term actions aimed at ensuring Albertans have safe, secure drinking water, healthy aquatic ecosystems and a reliable water supply to support provincial economic development.

More on the plan at www.waterforlife.gov.ab.ca

Next Steps

The Government of Alberta's action plan on climate change aims by the year 2020 to reduce the province's emissions intensity by 50 per cent below 1990 levels. The plan's timeframe recognizes the importance of such things as capital stock turnover, technological innovation and changes in consumer behaviour.

The Government of Alberta will continue to advance an integrated, innovative approach that can serve as a model for a national climate change plan. And that plan, in the words of the 2004 federal Speech from the Throne, will be developed "in partnership with provincial and territorial governments and other stakeholders."

To find out more about what Albertans are doing to reduce emissions, go to www.gov.ab.ca/env or call (780) 427-6267 for an information package on *Albertans & Climate Change: Taking Action*.

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Alberta

Background
Apache Midale Unit – Carbon Dioxide (CO2) Flood Project

The Midale Unit CO_2 enhanced oil recovery (EOR) project operated by Apache Canada Ltd. will be Saskatchewan's second commercial scale CO_2 flood project. The project will develop in phases with the first injection of CO_2 scheduled to begin in the summer of 2005. The CO_2 flood project is expected to extend the life of the Midale Unit by about 25 years and permanently sequester a significant amount of greenhouse gas.

The Midale oil pool was discovered in 1953. The main Midale Unit was formed in 1962 and a waterflood project commenced at that time to maintain the pressure in the reservoir and improve oil recovery rates.

The original oil-in-place for the Midale Unit is estimated to be 515 million barrels. The recoverable reserves for the Unit under water flooding are estimated to be 165 million barrels or 32 per cent of the original oil-in-place. To the end of 2004, 131 million barrels of oil have been produced from the Unit. The Midale Unit CO_2 flood project is expected to add up to 45-46 million barrels of recoverable oil.

The first field-testing of CO_2 injection began in the Midale Unit in 1985. A second phase was carried out from 1992 to 1999 with CO_2 injection commencing in late 2000. A 325-kilometre pipeline currently delivers CO_2 from the Dakota Gasification project in Beulah, North Dakota to Weyburn. A short pipeline will be built to access CO_2 from this existing pipeline. About 1,350 tonnes per day of purchased CO_2 are expected to be injected in the Midale Unit over the next 20 years with up to 8.75 million tonnes being permanently sequestered in the deep underground oil reservoir.

Studies conducted by the Petroelum Technology Research Centre have shown that the geological setting of the nearby Weyburn oilfield is highly suitable for long-term subsurface storage of CO2. These studies have highlighted the significant capacity of the geosphere region surrounding the reservoir to effectively store CO2 and prevent its migration to the biosphere.

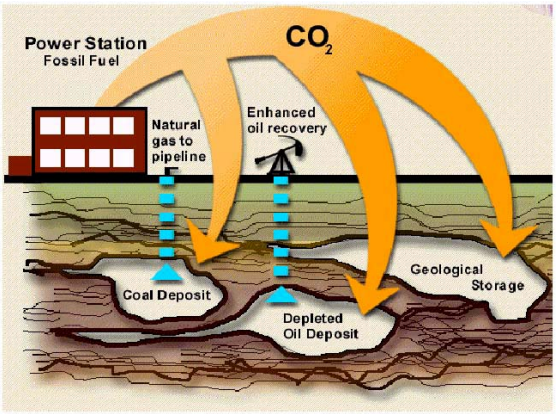
"For the case study…results indicated that over 5,000 years, the average release of CO2 to the biosphere was 0.2% of initial CO2-in-place" (IEA GHG Weybrun CO2 Monitoring and Storage Project: Summary Report 2000-2004).

There are about 250 producing oil wells and 65 water injection wells in the Midale Unit. Oil production from the Midale Unit in 2004 was slightly more than 2.5 million barrels.

Over the life of the project, the following incremental benefits are anticipated

- Capital Investment - $95 million
- CO_2 purchases and operating expenditures - $670 million
- Employment (direct and indirect) - 5,400 person years.
- Provincial royalties/taxes - $106 million
- Permanent sequestration of 8.75 million tonnes of CO_2

If test projects in $C0_2$ sequestration prove economical on a large scale, a coalbed methane operation could have a double benefit, providing clean fuel for power generation and reducing greenhouse gas emissions.



Coalbed Methane and $C0_2$ Sequestration

As a company that relies on access to the land and community support to grow our business, Enerplus Resources Fund places a high priority on being a good neighbour. We are committed to sharing information with landowners and community members where we operate, involving our stakeholders in decisions that affect them.

One of today's primary environmental issues is climate change. Increasing levels of atmospheric carbon dioxide ($C0_2$) potentially induces it. There are natural sources of $C0_2$ as well as industrial, commercial, residential and agricultural emissions. The emissions are created from the burning of fossil fuels like gas, oil and coal for production, vehicles and home

furnaces and by industrial plants and are considered to contribute to the risk of global climate change.

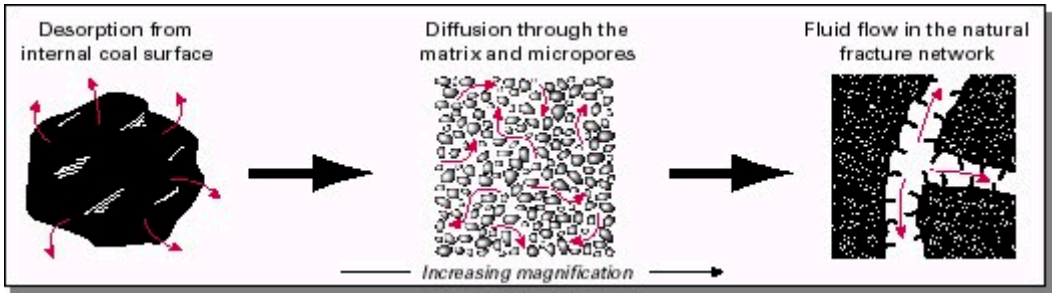
Fossil fuels are predicted to be the mainstay of energy production well into the future. Their availability to provide clean, affordable energy is considered essential for the prosperity and security of North America. However, increased concentrations of CO_2 are expected unless energy systems reduce the carbon emissions to the atmosphere.

$C0_2$ sequestration is considered by some to be a way of managing greenhouse gas (GHG) emissions while business, government, environmental organizations and other interested stakeholders work on ways to decrease GHG emissions.

$C0_2$ sequestration involves the injection and storage of $C0_2$ where it is prevented from escaping into the atmosphere. Typically this would be into mineral, petroleum or coal bearing seams deep in the earth's subsurface. Recent research in Canada and the United States suggests that CO_2 can be injected into coal seams and locked up, or sequestered, indefinitely.

Coalbed methane (CBM) is a clean-burning fuel made up of pure or nearly pure methane – the main component of natural gas with no H_2S (hydrogen sulfide). It is a byproduct of the process by which plant material is converted into coals or petroleum. Like conventional natural gas, coalbed methane is trapped under pressure in subsurface geological formations.

Methane is released by the coal and it travels through pores and is drawn to the surface.



Although production methods are altered by minor differences in geologic conditions, CBM is produced, transported and used in the same way as natural gas produced from conventional petroleum fields.

CBM development is not new. Exploration and production is occurring in the United States and energy companies already have fields in production for over 20 years. Coalbed methane currently meets about seven per cent of America's natural gas needs. In Canada, CBM is at an earlier stage, with exploratory work and several small-scale production tests underway.

A producing CBM well.

Enerplus' development proposal near Alder Flats, Alberta

Enerplus has received encouraging results from preliminary tests done with industry partners. The step Enerplus is currently focusing on is the development of a pilot-scale project in a location where data can be collected and the technical and commercial feasibility of constructing a commercial project in another location can be determined.

Several federal and provincial government agencies are helping to fund this pilot with a focus on climate change mitigation.

Development in stages

Before the CO_2 sequestration well site can be established, the project must go through a number of stages. These include:

- stakeholder consultation,
- water monitoring system,
- review of coal permeability,
- seismic survey,
- production well development and
- impact assessment.

If results are positive and a project can be developed in an environmentally responsible manner, Enerplus may proceed with the test project upon receiving regulatory approval.

Seismic Monitoring

Seismic surveys will be completed during various stages of the development. These surveys will help determine if a project is worth continuing.

Well development

To establish a CO_2 sequestration project, a test well will be initiated to confirm the depth and thickness of the coal seams, the potential to produce methane and the progress of removing water from the coalbed. Coal samples would also be obtained that indicate how much CBM gas is available. This program may include the production of water and/or coalbed methane on a limited basis. Information collected from this stage of the program will be critical in assessing whether the next phase proceeds from a regulatory, environmental and reservoir viewpoint.

If the project results are considered positive, the well would be transformed into a CO_2 injection

well, and an additional production well will be drilled to produce the water and CBM from the coal seam.

Facilities at the injection well could include a wellhead, underground pipelines, metering facilities, well monitoring equipment, CO_2 pumps, water monitoring wells, separators and a CO_2 storage tank. The production wells will only contain a wellhead, underground pipelines, metering facilities, well monitoring equipment, pumpjack and an onsite water storage tank.

If a test well does not prove to be viable or have any alternate use, it is plugged with cement and the well site area and access road are restored. Similarly, when a producing well is no longer needed, surface equipment is removed, the wellbore is plugged with cement and the well site is restored.

$C0_2$ source

The CO2 for this project will be industrial grade (>99% pure) that will be trucked in from Air Liquide then pumped into the well. CO_2 is a non-toxic, naturally occurring gas that disperses widely in the event of a failure. A 325-kilometre pipeline is currently delivering 5,000 tonnes per day of CO_2 from a coal gasification plant in North Dakota to Encana's CO_2-based enhanced oil recovery project in Weyburn, Saskatchewan.

Wells are drilled with a rig similar to the kind used to drill shallow gas wells.

Environmental Issues

Coalbed methane is clean burning with relatively low GHG and particulate emissions. On the ground, coalbed methane operations impact the environment in a number of ways, similar to conventional oil and gas development.

There is surface disturbance during drilling and development of the access road and well site. Pipelines must be installed to connect a well to its $C0_2$ source and transport the methane to market. The area of land required to drill a well is about 400 x 400 feet to ensure operations occur in a safe and environmentally sensitive manner. Once drilling is complete, the land required to produce the well can be reduced. Once CBM production is shown to be feasible, the development will proceed and include CO_2 gas injection facilities and a series of wells similar to a conventional gas development.

Production of water along with coalbed methane is common. Coalbed methane wells are regulated under the same legislation as conventional oil and gas wells. As such, well operators are required to safely handle and dispose of produced water, ensuring groundwater and soils are not contaminated. Subsurface coalbed methane activity is designed to protect existing ground water supplies. The target coal zone is about 1,400 feet in depth, considerably deeper than most local aquifers currently being used. As they are drilled, wells are sealed with steel pipe casing and cemented to prevent the mixing of groundwater at shallower depths.

Similarly, the injection of CO_2 into the coal seam is not expected to result in any effect on the groundwater, primarily as numerous layers of rock and shale separate these subsurface aquifers. The CO_2 is expected to be stored indefinitely within the coal matrix, the same way the methane was trapped.

For more information regarding Enerplus' CBM activities, contact:

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For more information on Enerplus, visit our website at www.enerplus.com

Sources:

U.S. Geological Survey – www.usgs.gov

Natural Resources Canada – "The Capture and Storage of Carbon Dioxide Emissions"

Created in 1986, Enerplus Resources Fund is North America's largest conventional oil and natural gas income fund. As an experienced acquirer, operator and exploiter, Enerplus invests in properties located primarily in western Canada. Enerplus' operations include conventional oil and natural gas production and coalbed methane.

August 2004

PENN WEST
PETROLEUM LTD.

NEWS RELEASE

Penn West Petroleum Ltd. Announces the Commencement of Carbon Dioxide Injection into the Pembina Oil Field

FOR IMMEDIATE RELEASE, Thursday, March 31, 2005

PENN WEST PETROLEUM LTD. (TSX – PWT) commences carbon dioxide injection at the Pembina Cardium enhanced oil recovery pilot project

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Penn West Petroleum Ltd. ("Penn West") is pleased to announce the commencement of carbon dioxide ("CO2") injection at the Pembina Cardium enhanced oil recovery pilot project. This is the first phase of field work that will test the use of CO2 capture and injection to improve recovery from the multibillion barrel Pembina Cardium oil pool. If successful, the pilot project could lead to a large scale project that will provide the ability to capture CO2 from heavy industry in Alberta, and significantly reduce associated greenhouse gas emissions through CO2 sequestration. As an added benefit, a successful large scale project will provide additional recovery of oil and the continued revitalization of Canada's largest conventional oil pool.

The initial phase of the Pembina Cardium enhanced oil recovery pilot project has a cost of $15 million that is being shared through a cooperative effort of the Government of Canada, the Government of Alberta and Penn West under incentive programs to explore the potential and benefits of CO2 capture and storage.

Penn West Petroleum Ltd. is a senior independent Canadian oil and natural gas company based in Calgary, Alberta. Penn West focuses on exploration and development activity in the Western Canadian Sedimentary Basin. Penn West trades on the Toronto Stock Exchange under the symbol PWT.

For further information, please contact:

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SHORT SUMMARY OF FRENCH ACTIVITIES RELATED TO PUBLIC COMMUNICATION AND OUTREACH FOR CARBON DIOXIDE CAPTURE AND STORAGE (CCS)

In France, CCS is an important R&D priority and French researchers have been involved in projects abroad during the last 15 years. One of our targets today is to launch a CO2 injection project in France. Preliminary investigation is going on and accelerating.

Important steps concerning public communication and outreach have already been taken:

1 – Since 2003, there has been an intense public debate in France about energy issues before the adoption of a new French law on Energy (law voted in June 2005). Reducing greenhouse gas emissions is one of the top priorities of French energy policy. Various mitigation options have been discussed and R&D priorities have been defined; CCS is one of them. Specific communication campaigns have been organized to make people aware of the effect of their behavior on greenhouse gas emissions and on the environment.

2 – France has a long and strong experience concerning underground storage of natural gas, including communication with local citizens. A public outreach and communication process has been developed concerning this kind of storage.

3 - The "CO2 Club", where most French researchers from public research centers and private companies discuss and coordinate their works on CCS, has initiated contacts with the French climate change network.

4 - The National Research Agency has recently (June 2005) launched a new call for projects focusing at CCS. The call asks for studies on public outreach.

5 - France is organizing an international symposium in Paris on September, the 15th and the 16th. The purpose of this symposium is to examine the role of technical innovation as well as the capture and geological storage of CO2 in reducing greenhouse gas emissions. This symposium will also give opportunities to discuss the role of CCS at a national level.

6 – Many French companies and research centers develop their own communication programs concerning climate change and more specifically CCS.

7 - France is involved in major European and international programs, which include specific communication tasks. Communication is part of FP6 projects,

such as CO_2Geonet, CASTOR and InCA CO2. This last project is aimed at promoting links between EU and other international programs. France participates actively in various programs and initiatives, such the IEA GHG program and CSLF, which contribute to communication at the international level.

More initiatives will be announced in a near future taking into account the progress made by R&D programs.

SUMMARY OF U.S. ACTIVITIES RELATED TO PUBLIC COMMUNICATIONS AND OUTREACH FOR CARBON DIOXIDE CAPTURE AND STORAGE (CCS)

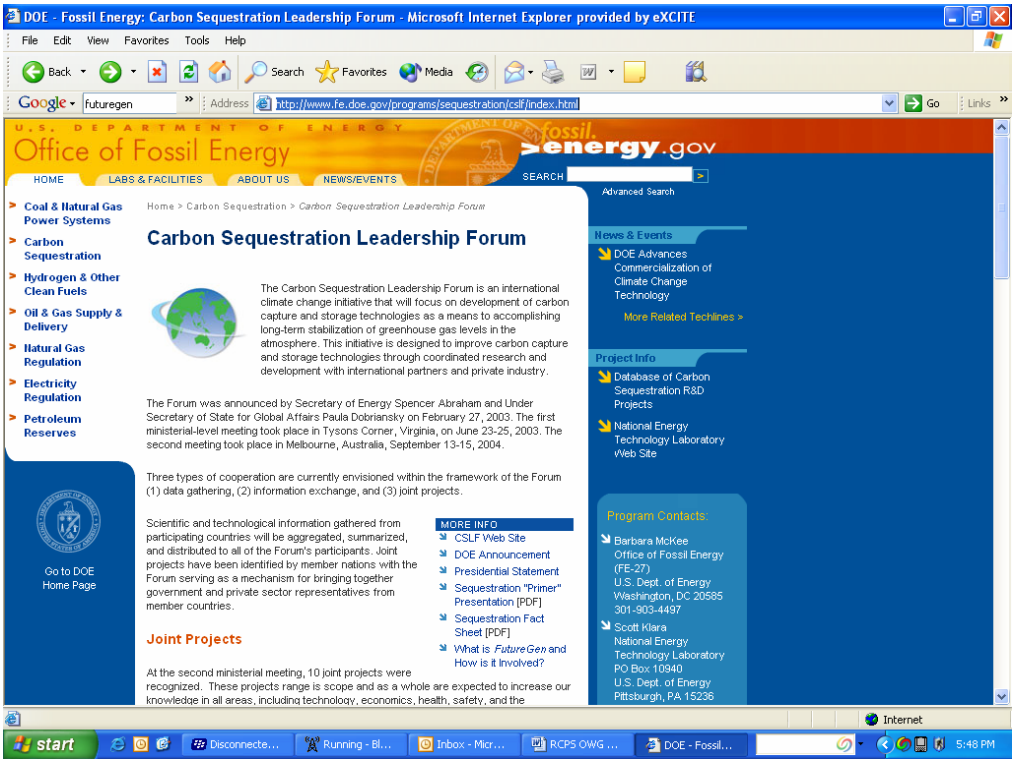
Background: Public communication and outreach has been identified by CSLF members as being critical to the success of deploying CCS technologies. At the CSLF Policy Group meeting in September, Canada agreed to co-ordinate public communication and outreach activities through the CSLF.

The United States agrees that outreach and education efforts will be a critical component to the vitality and acceptance of a carbon sequestration as a means to carbon mitigation. The U.S. has taken many steps at home to broaden the acceptance and understanding of this technology. These include (1) CSLF Domestic Activities (2) Regional Partnerships (3) Activities related to Futuregen and (4) Carbon Sequestration Core Program & Public Information

1. CSLF DOMESTIC ACTIVITIES

The United States is committed to increasing public awareness of the CSLF and its related activities. We have found that there are many ways at home to communicate the efforts and goals of the Forum by reaching out to the public and educating them on the Forum's progress. Specific examples of our domestic activity with respect to the CSLF include:

- CSLF Fossil Energy Website
  The Office of Fossil Energy of the USDOE has also committed space on its website to the CSLF. On this page, viewers can get a general overview of the Forum, find relevant DOE contact information, read related news releases, read about projects nominated by the United States to the CSLF, view factsheets, as well as link directly to the CSLF Offical website. This site can be found at http://www.fe.doe.gov/programs/sequestration/cslf/index.html



- CSLF Stakeholder Briefings
  So far, the United States Government has hosted three (3) Stakeholder Briefings in the Washington D.C. area in conjunction with the United States Energy Association. The first meeting to place just prior to the meetings in Melbourne in 2004. We called this a 'pre-brief' and shared our expectations for the upcoming meeting with interested members of the public. In addition, we had a similar event shortly after the Melbourne Ministerial to debrief the public on the success of the meeting. We held a 3rd briefing in May of 2005 to update the public on the status of the CSLF projects and prepare for the policy & technical group meetings in Berlin. We have found these briefings to be very valuable as a means of maintaining communication with interested parties outside of the USG.

- CSLF Promotion on the Road
  Attending national and international conferences to promote the CSLF is an ongoing aggressive activity. By utilizing the Office of Public Affairs in the Office of Fossil Energy at the USDOE, we have been able to take the CSLF message and US support of the program on the road to trade shows and international conferences. At these meetings informational packets are disseminated and media representatives educated on the aim and role of the Forum. Using US DOE dollars, we have sent USG representation to –the United Nations Conference of the Parties meetings on climate change in_Milan, Italy, and Buenos Aires, Argentina. As part of this ongoing effort to raise the public visibility of the Forum, the CSLF was prominently featured at these meetings at the United States' exhibit on international partnerships. Here visitors were free to take educational literature and ask questions. Additionally, one conference session open to all delegates and media featured a review of CSLF activities.

2. THE REGIONAL SEQUESTRATION PARTNERSHIPS

In August 2003 the U.S. Department of Energy and the National Energy Technology Laboratory (DOE/NETL) named seven regional carbon sequestration partnerships (RCSPs) to develop the core of a nationwide network to help determine the best approaches for capturing and permanently storing greenhouse gases. Today these partnerships include 216 universities, state agencies, private companies and NGOs located in 40 states, three Indian Nations and four Canadian provinces.

During Phase I, the RCSPs are tasked with a number of technical characterization assessments of the potential sources and sinks for CO2, potential environmental impacts, and the potential for existing regulatory infrastructure to support deployment and/or the need for new regulatory infrastructure in the region. In addition, the partnerships are tasked with assessing public acceptance, identifying potential issues of concern and developing programs for public education and outreach in order to build public awareness and acceptance.

The seven RCSPs have used a variety of approaches and techniques for informing the public and assessing public acceptance levels and issues. This paper presents a brief description of each partnership region, emphasizing regional characteristics that may have an impact on public acceptance; as well as an outline of the methods, approaches, techniques and tools used by each.

1. Introduction: The U.S. Department of Energy and the National Energy Technology Laboratory (DOE/NETL) envisioned the regional carbon sequestration partnerships as playing a key role in establishing the infrastructure for carbon sequestration across the country. A Phase I planning program was initiated with the announcement of seven regional partnerships in August 2003 and it will be continued with a Phase II proof-of-concepts program to be announced in 2005[i]. Infrastructure is a broad term that suggests the physical and regulatory policy components of a system to safely capture, transport, and sequester CO_2. In planning to establish that infrastructure, the regional partnerships are assessing and characterizing potential geologic and terrestrial sequestration options; CO_2 sources; and, existing and needed regulatory policies for permitting, operation, long term monitoring (MMV), and, if needed, mitigation. This information can be used to determine the potential regional benefits from carbon sequestration and can inform the identification of the best approaches for each region.

The solicitations for Phase I and II both emphasize the need to engage regional, state and local governments as well as to lay the groundwork for helping the public toward a basic understanding of the role of sequestration in carbon management, methods to accomplish sequestration and the implications for the particular region. DOE/NETL believes that it is important to build public support as part of the general carbon sequestration infrastructure, and each of the partnerships has made public outreach an important function within their projects by designating an outreach coordinator.

2. The Challenges in Building Public Acceptance: The outreach coordinators formed the outreach working group during the kick-off meeting for the partnership program in order to provide a vehicle for "shamelessly stealing" good ideas and materials from each other and to create an opportunity for sharing lessons and information related to outreach and carbon sequestration. Information shared during outreach working group meetings describes the broad challenges facing the outreach coordinators and is briefly outlined here.

a. Carbon sequestration is multifaceted - The outreach working group brought in experts to help discuss a variety of the technical aspects of and related to carbon sequestration including the mechanics of terrestrial and geologic sequestration; CO_2 handling issues; measurement, monitoring & verification (MMV); and mitigation strategies. These discussions provided an opportunity to identify questions and issues that might arise during discussions with the public.

b. Among those who are informed, there are different points of view regarding carbon sequestration. The outreach working group talked about attitudes toward carbon sequestration among various segments of the environmental community and industry. These discussions provided a chance to explore effective ways of communicating with different groups of stakeholders.

c. Even some who are "informed" and especially the general public do no know a lot about climate change, let alone carbon sequestration. One researcher shared their public survey results with the outreach working group, confirming this observation. Representatives of national, regional and local environmental groups made the point that the partnerships would perform a useful service by raising awareness about carbon sequestration; although they also pointed out that many environmental groups face numerous issues and have limited resources – two factors increasing the challenge of public education. One public relations expert described the use of surveys and focus groups to help in developing an understanding of public attitudes and views. This presentation showed that statistics are only as good as the underlying quality of the measurement tools and emphasized the notion that you cannot weigh real attitudes before people are informed. Given that few people are well-informed about climate change and carbon sequestration, it may be difficult to identify real attitudes.

d. The outreach working group participated in a multi-session risk communication workshop which provided a framework to better understand how people perceive risk on both technical and emotional levels. The complexity of carbon sequestration alone contributes to this perception of risk and requires thoughtful approaches to sharing information and eliciting concerns.

e. Past experience provides helpful but imperfect insights. The outreach working group learned about a few actual field tests, two that are successful and one that failed. The failure involved the proposal to conduct a field test of ocean sequestration off the coast of Hawaii; the group read a paper prepared by MIT that documented the problems associated with a lack of public acceptance – in fact outright opposition. The two successes included the Mountaineer and the Frio Brine projects. Representatives from each project described for the outreach working group the nature of the field test and the specific steps taken to build public acceptance. In both cases, the projects were discrete and the outreach activities were intensive and were focused on very specific sites. In contrast, the partnerships cover large regions, do not focus on any specific sites during Phase I and each have limited resources for outreach activities.

3. The Regional Carbon Sequestration Partnerships: Some of the challenges described above were understood in August 2003 when the partnerships were launched, others were revealed as Phase I progressed. What follows is a description of each regional partnership, the outreach activities undertaken in Phase I and the proposed activities for Phase II. It should be noted that at the time this paper is being written, Phase II proposals have been submitted to DOE/NETL, but it is not known if all the partnerships in Phase I will be awarded a Phase II grant and/or if additional partnerships will be added to the program during Phase II. For purposes of this paper, we describe the activities that will be planned for Phase II provided the partnership moves forward into Phase II.

There are seven regional partnerships. Each is unique in terms of its geology, land use, population base, socio-economic condition and cultural backgrounds. These factors influenced the design of outreach activities during Phase I. As will be described, all of the partnerships engaged in two general sets of activities during phase I: data gathering and awareness building. In addition, there are some additional activities worth noting individually. The seven partnerships are indicated geographically in Figure 1 and enumerated in Table 1.

Figure 1: Geographic Distribution of Regional Partnerships

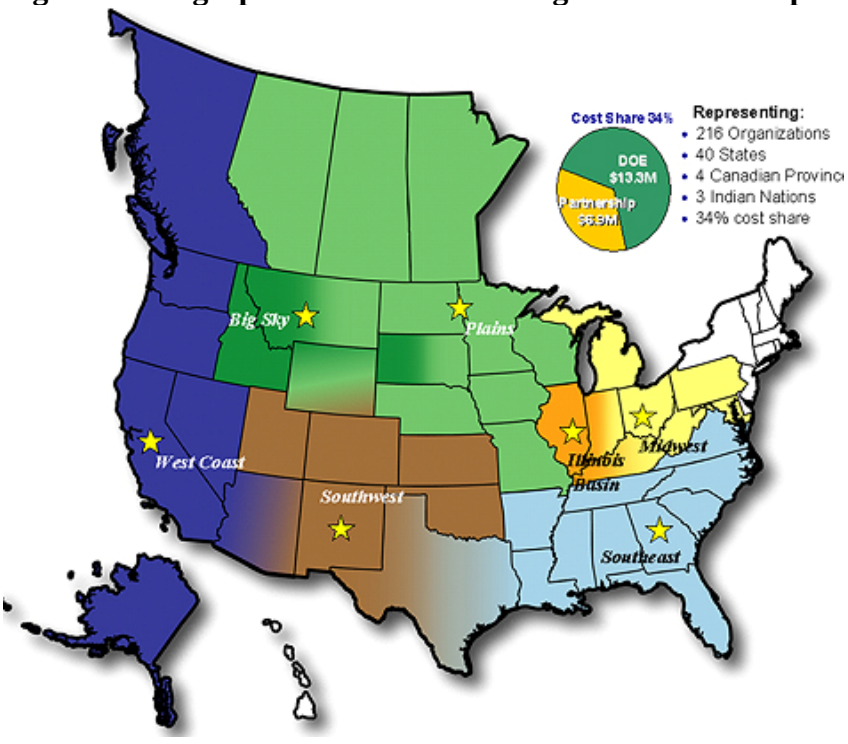


Table 1: Regional Partnerships

Partnership	*Lead Investigator*	*States Represented*
Midwest Regional Carbon Sequestration Partnership	Battelle Memorial Institute	IN, KY, MI, MD, OH, PA, WV
An Assessment of Geological Carbon Sequestration Options in the **Illinois Basin**	The Board of Trustees of the University of Illinois, Illinois State Geological Survey	IL, IN, KY
Southeast Regional Carbon Sequestration Partnership	Southern States Energy Board	AL, AR, FL, GA, LA, MS, NC, SC, TN, TX, VA
Southwest Regional Partnership for Carbon Sequestration	New Mexico Institute of Mining and Technology	AZ, CO, KS, NM, OK, TX, UT, WY
West Coast Regional Carbon Sequestration Partnership	State of California, California Energy Commission	AK, AZ, CA, NV, OR, WA, and Canadian Province of British Columbia
Big Sky Regional Carbon Sequestration Partnership	Montana State University	ID, MT, SD, WY
Plains CO2 Reduction Partnership	Energy & Environmental Research Center, University North Dakota	IA, MO, MN, ND, NE, MT, SD, WI, WY and Canadian Provinces of Manitoba, Saskatchewan and Alberta

a. Midwest Regional Carbon Sequestration Partnership (MRCSP)

With seven states in what is often referred to as the nation's engine room (Indiana, Kentucky, Michigan, Maryland, Ohio, Pennsylvania, and West Virginia), the MRCSP is the fourth largest partnership in terms of states included in the region and is one of the largest in terms of population and emissions. The region is home to more than 50 million people (about 16% of the US population in 2003) and contains many large point sources of anthropogenic carbon dioxide, such as power plants, refineries, cement plants and iron and steel plants. Power plants located in the region generate roughly 21% of all power generated in the US. In 2003 the region produced $1,534 billion in Gross Regional Product, accounting for more than 15% of the US economy. At the same time, more than 75% of electricity generated in the region is generated using coal and the region accounts for about 26% of CO_2 from all power plants. The region is heavily dependent on coal, much of it coming from indigenous sources. If shown to be feasible, carbon capture and storage technologies would likely be used intensively in this region.

The region is also home to an existing field-test of geologic sequestration technology. The Mountaineer Power Plant, located along the Ohio River Valley in New Haven, West Virginia and owned by American Electric Power, is host to the Ohio River Valley CO_2 Storage Project. For the initial phase of this project, researchers conducted seismic surveys; drilled an approximately 9,200-feet deep test well; and conducted reservoir modeling to characterize the

candidate storage reservoirs in the Appalachian Basin. Several members of the MRCSP team worked on the project and their experience helped to inform the outreach activity in Phase I.

The region has numerous options for both terrestrial and geologic sequestration. Early on, the MRCSP realized that one challenge would be to narrow the potential options for any Phase II activity. There is a long history of coal mining as well as past and present oil and gas production, leading to storage potential in coal seams and depleted oil and gas reservoirs. In addition, the region sits atop three sedimentary basins which provide many potential deep saline reservoirs. There is also a large amount of land that may be well-suited to terrestrial sequestration in minelands, croplands, forests, and marginal lands. When these factors are combined, there are numerous possibilities for geologic sequestration in saline reservoirs, oil and gas fields, and deep coal seams and plentiful options for terrestrial sequestration as well.

The region's strong reliance on coal and energy production may contribute to public support for activities such as carbon sequestration that help enable continued use of coal by making it cleaner or by mitigating the effects of coal combustion. However, this potential for support should be balanced by concern expressed by some groups in the region about the environmental impacts of many existing coal mining practices. Research to date, (including media analysis that had been conducted as part of the Mountaineer project) indicates that most people in the region would not be familiar with carbon sequestration. This unfamliarity provides an opportunity for introducing and presenting the issues in a constructive, problem-solving mode.

The primary emphasis of the outreach work, therefore, has been on communication and awareness building. The outreach team planned their work in three primary phases that were generally linked to the overall project activities:

- An initial, foundation-building step of developing information and contacts, corresponding with the technical activities of data collection and need to coordinate with PEIS activities.
- A second, follow-up phase of consolidating and expanding information and contacts via an interactive web site, corresponding with the technical team's activities of data analysis and integration.
- A final phase of initiating more direct interaction and communication with key state officials, corresponding with development of the Phase II proposal and selection of candidate sites and projects.

During the initial phase, the outreach focus was on developing information materials, creating an initial web site to post fact sheets and reports, and opening lines of communication with key stakeholders across the region. Information materials included a series of fact sheets on climate change, terrestrial and geologic sequestration, the MRCSP and other related topics, as well as a briefing package for use by partners. The outreach team worked with communication contacts from each of the partner organizations to develop a database of nearly 150 stakeholders in the region from government, industry, environmental group and other civic organizations. They sent a mass mailing that included an introductory letter and a subset of fact sheets, along with a link to the website, to all the people in the data base.

Toward the end of the initial phase in the summer of 2004, the outreach team conducted a series of informal discussions with key stakeholders to obtain feedback and to develop ideas for effective outreach. It was agreed that, at this stage of the project, a web site that allowed for

feedback would be more cost-efficient and effective in reaching a large number of stakeholders than conducting town meetings.

The enhanced, interactive website, which was introduced during the second outreach phase and launched in January 2005, is modeled after a few interactive sites found on the internet that cover scientific and technical issues. In its first revision, it is designed to introduce carbon sequestration and solicit feedback on a broad set of issues. Visitors move through a series of screens that are primarily based on the fact sheets, although a navigation bar allows the user to jump around at will. They are invited to offer responses to questions on seven topics that seek to identify the level of desired information, attitudes about carbon sequestration in general and both terrestrial and geologic sequestration in particular. In addition, visitors are encouraged to offer any other feedback they wish or ask additional questions. To date, feedback received from the site has primarily concerned additional questions rather than reactions to the questions posed by the team. This is one aspect of the website that the MRCSP intends to develop further as they move forward.

The response to the enhanced website has been positive and instructive. During the period mid-January through March 2005, the database of stakeholders has increased by about 150 (from an initial 430 to almost 590); web traffic more than doubled; and more than 2,660 came to the site and downloaded almost 300 copies of the fact sheets. The MRCSP followed the email announcement with reminder calls to roughly 100 stakeholders. These calls revealed that many stakeholders had overlooked or deleted the email thinking it was "spam," a useful lesson in thinking about how to structure future notices about the site. Also, the calls provided a low key and relatively low-cost opportunity for "doing outreach." The web visitation tracking showed an increase in traffic surrounding these calls. The MRCSP has also conducted a few briefings for state officials and other stakeholders. Again, visitation to the website increased after each of these briefings.

MRCSP outreach is now entering the third phase of initiating more direct interaction with state officials and industry partners across the region. While continuing the web site, outreach staff has been accompanying technical team members on briefings to Pennsylvania, Ohio and Maryland officials and accompanying regulatory team members on briefings and discussions with regulatory officials in all seven states.

Plans for outreach in Phase II incorporate the lessons from Phase I and the Mountaineer project. A major theme will be shifting from a relatively "top down" approach to a more "bottom up" approach that involves a greater focus on interacting with the broader public at specific sites. This will include obtaining feedback to be used in narrowing the scope of potential research from small focus group interviews and testing ideas through the website. Further, as specific field tests are selected, the MRCSP will endeavor to replicate the approach to building public trust and acceptance used in the Mountaineer project. Hallmarks of this approach include building an integrated team of researchers and key staff from the industry partner that owns the site where field testing will occur; working closely with that industry partner to conduct intensive outreach to employees, local citizens and government; and being proactive in addressing potential concerns and questions.

b. An Assessment of Geological Carbon Sequestration Options in the Illinois Basin (Midwest Geological Sequestration Consortium)

The Midwest Geological Sequestration Consortium (MGSC) is unique among the partnerships in several ways. Geographically, it is the smallest of the partnerships; it consists of parts of three states: Illinois, Indiana, and Kentucky. Geologically, it is the least complex of the partnerships; it has "one set of rocks," meaning that it contains a single geologic basin and a single stratigraphic column. And finally, because of these characteristics, the partnership is primarily focused on geologic sequestration and does not anticipate conducting research into terrestrial sequestration.

There are several regional characteristics which led the MGSC team to believe that the public would tend to be receptive to geologic sequestration. These characteristics derive from the region's history as a coal and oil producer and the subsequent experience that has been gained over time with activities that are fundamentally analogous to carbon sequestration.

The region was a prime area for oil and gas production in the US from the early to mid 1900's. In the 1940's the region produced more than 150 million barrels of oil per year, the equivalent of about 11% of total US oil production. Today there are significant, marginally productive and depleted oil and gas fields and a strong economic interest in deploying enhanced recovery techniques. At the same time, the region's stationary sources emit more than 250 million metric tons of CO_2 per year, so there is interest in exploring options for mitigating the impacts of these emissions.

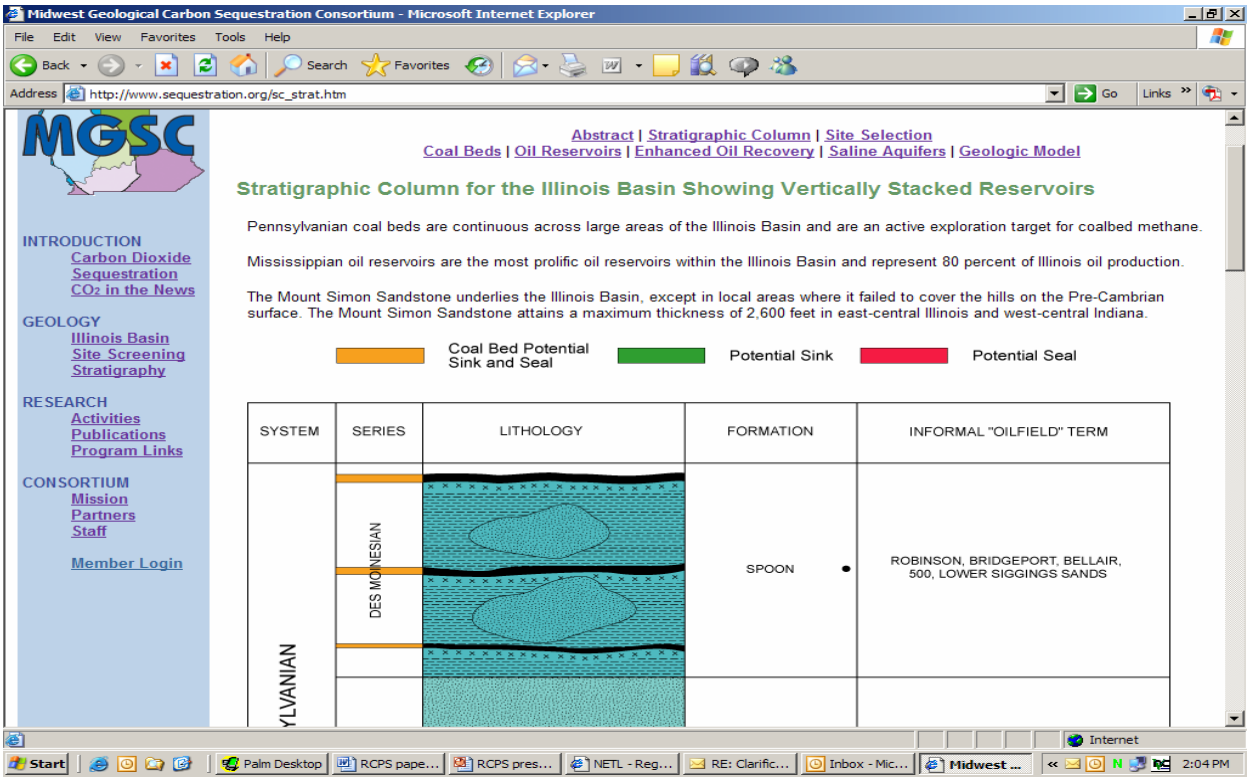
In addition to oil and gas, the region also produces significant amount of coal and there are a large number of coal mines and unmineable coal seams that may provide options for geologic sequestration. Because the economy is strongly tied to these mining activities, it is believed the public will be receptive towards technologies that enable these mines to continue to operate.

Finally, the MGSC region has the largest concentration of gas storage projects using saline reservoirs in the country. There are professionals in the area who are expert in injecting gas into

the subsurface; and the general public is more likely to understand and accept the risks associated with injection than they may be in other regions.

During Phase I a major outreach objective was to develop the information necessary to anticipate and respond to the key questions that would be raised by policy makers, industry and the general public. These questions were likely to include issues such as the level of economic benefit of moving forward with EOR, some assessment of the amount of oil and/or water would be displaced and what would happen to it; and the likely costs.

The partnership developed facts sheets and a website (See below) as a central source of information. It also conducted more than a dozen briefings for different trade, industry, profession and government groups. Additional work focused on completing the technical assessments and using them to build the understanding of stakeholders in the region. Like many of the other partnerships, MGSC found that stakeholders wanted to know specifically where field tests would be located before they committed significant time to learning about carbon sequestration.



Another potential concern is addressing the potential for leaks. There is some experience with gas leaks in the region. As a result, the project is building safeguards into the research plan and is also developing a set of materials to address the concerns and explain how they will be avoided with the carbon sequestration efforts. This includes determining the best way to convey information about the integrity of geologic seals and the formations the MGSC would plan to use for sequestration. In Phase II the partnership will place emphasis on selecting sequestration sites that have both good reservoirs and good seals or cap rocks.

In addition to these small briefings, the MGSC will sponsor two major information briefings. One session will be held in Springfield, Illinois; the other will be in the heart of oil producing

territory in Indiana. These sessions included policy and decision-makers including state legislators, state EPAs, oil industry groups, the corn growers association, oil and gas regulators and others. Some of these members are on the partnership's advisory groups.

In Phase II the MGSC will engage in significant "retail outreach" focused on the specific sites selected as research locations. Much of this outreach will target technical experts, trade and professional associations and others who are likely to be participants in the research of Phase II and beyond.

c. Southeast Regional Carbon Sequestration Partnership (SECARB)

The Southeast region includes the largest number of states: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. There is a strong reliance on coal for the production of energy in the region. There are 628 power plants in the region with annual CO_2 emissions of 743MT per year. Of this amount, 72%, or 538MT/yr is from coal-fired power plants.[ii]

During Phase I, SECARB's outreach focus has been on raising awareness and developing a better understanding of the attitudes of stakeholders. The main activities consisted of developing a website and fact sheets, participating in the Outreach Working Group's Risk Communication Workshop and hosting small briefings. These activities were coordinated for SECARB by the Southern States Energy Board (SSEB).

In addition, SECARB presented the partnership's activities to regional decision makers such as regulators and policy makers as well as industry representatives and affiliates at the 2004 SSEB Annual Chairman's Forum. SECARB has worked with SSEB, as a regional compact among southern states, with a membership that includes state governors, legislators and industry affiliates, to piggyback on routine SEEB communications and meetings to share information about carbon sequestration. SECARB used these meetings both to raise awareness on the part of participants and to solicit feedback on the direction of the project. These discussions helped to develop a baseline understanding of the opinions and concerns of various stakeholder groups.

SECARB also employed a series of focus group and in-depth interviews to further develop its understanding of public attitudes to help shape public education and outreach efforts. The first of these involved a focus group with industry representatives and interviews with policy makers. In general these discussions showed that industry stakeholders seemed open minded but expressed some concern about the potential costs of CCS. The discussions also showed that another segment of the "influential public" does not know much about carbon sequestration. The perception among the policy makers and industry affiliates was that the ENGO community might be open minded about sequestration but would have underlying concerns about the long term environmental impact and continued concern about the impact of mining activities. These factors are being considered in conducting interviews with representatives from environmental groups. SECARB utilized its team members, which include opinion research and communications firms, to conduct these sessions.

In general, SECARB is finding that the general public and certain specific segments such as the environmental community are not particularly focused on carbon sequestration or on climate change in the Southeast region. This suggests that if there will be concern over carbon

sequestration it may not surface until the list of candidate sites has been narrowed to just a few or even until a final set of research projects has been identified.

In addition to the data collection activities SECARB partnered with Augusta Systems and others to launch an online information exchange about carbon offsets called the Carbon Offset Opportunity Program or CO-OP. This tool "facilitates collaboration in the development of projects that offset or reduce greenhouse gas emissions, including those in the emerging area of carbon sequestration. A searchable database, CO-OP brings together project developers and project investors, allowing them to post their needs online."[iii] A copy of the CO-OP webpage is included below.

In Phase II, SECARB expects to narrow its focus to a few specific field test sites as it continues to refine its regional mapping activities. SECARB will consider a number of factors in selecting the final research projects and sites. A primary factor continues to be the technical quality of the research project and the site. In addition, it intends to use its ongoing public attitudes information gathering to develop addition considerations for screening candidate sites. SECARB intends to run each research project with a distinct project team that will be responsible for a host of specific activities including major public outreach at the site. The local project team will do the extensive "retail" outreach related to the project. SSEB will provide a coordinating role among these projects but the feeling is that local people are best suited to conducting outreach around specific research projects.

d. Southwest Regional Carbon Sequestration Partnership (Southwest)

Encompassing all or parts of eight states (Arizona, Colorado, Oklahoma, New Mexico, Utah, and portions of Kansas, Texas, and Wyoming), the Southwest Partnership (Southwest) is the third largest partnership. Yet, the Southwest is also probably one of, if not the, least densely populated partnership. Vast open spaces contribute to a different sense of scale in the Southwest – what might seem large in the East would not seem so in the Southwest region. In addition, the amount of open space provides a lot more opportunity for locating field tests in remote areas than is found in many of the other regions.

Historically, oil and gas have been very important to the region. As the industry matured, oil and gas fields became depleted, and enhanced oil recovery (EOR) was pioneered in the region to help extend the life of those resources. As a result, the region has the largest CO_2 transportation infrastructure in the country and it also has in place the basic regulatory infrastructure to cover drilling as well as CO_2 transport and injection. The industry base in the region is interested in carbon sequestration in part because they recognize its potential to provide economic benefits to the region through EOR.

When asked if the outreach team anticipated that public acceptance would be high, they indicated that they thought it might be "bimodal" in that most stakeholders would have strong opinions in favor of or opposed to carbon sequestration. As a result, the outreach activities in Phase I were geared towards gathering information about public attitudes and concerns about carbon sequestration while also enabling the public to evaluate the costs and benefits of carbon sequestration for themselves. The outreach team listed four main objectives:

- Identify and respond to needs, fears and desires related to carbon sequestration
- Inform the public about the mechanics of carbon sequestration
- Involve the public in the "discovery of opportunities"
- Enable negotiation of mutual benefits

Like many of the other partnerships, the Southwest region employed some conventional tools for raising public awareness. These included formal stakeholder briefings and town hall meetings, development of an information packet, and use of the web to disseminate fact sheets. The Southwest region has also employed some innovative tools. The first of these is a "mediated modeling" activity and the second is a set of live webcast briefings and town hall meetings.

Mediated Modeling Workshops: The Southwest region created an "Interactive Advisory Panel" to participate in a series of in-person and online workshops to develop a model of carbon sequestration options for the region. When completed, the model will help both researchers and the public to better understand the potential options for sequestration in the region. It could also be used to evaluate the tradeoffs related to carbon sequestration and provide a quantitative framework for comparing sequestration options. The model will be further developed in Phase II and also used as a communications tool. A diagram describing the mediated modeling effort from the Southwest's website is below.

The model will answer a variety of questions including[iv]:

- How do CO_2 emissions change as the region grows?
- What happens if CO_2 is not sequestered?
- What role will different sequestration methods play?
- What are the tradeoffs among different types of sequestration methods?

The Southwest partnership modified an existing Sandia US greenhouse gas model to reflect the region. It used the mediated modeling workshops to develop recommendations to include in the revised model to better reflect the conditions, opportunities and challenges of the region. Additional technical research conducted during Phase I regarding sources, sinks, technologies, costs and other data are being added to the model during Phase I.

The Interactive Advisory Panel was a self-selected team – in other words a diverse group of stakeholders were invited to participate on a voluntary basis. Once formed, the group "met" through a series of face-to-face workshops, smaller subgroup meetings, interactions with the modeling team, web-based sessions, and conference calls. In addition, members were encouraged to work with the model on their own.

The mediated modeling activity provided the Southwest partnership with a model to aid in prioritizing potential sites for field tests in Phase II, developing criteria for selecting sites, and in developing an approach to sequestration in the region. The modeling exercise also provided useful insights. One of the challenges lay in attracting stakeholders with diverse backgrounds to the Interactive Advisory Panel. The region was disappointed that it was unable to obtain the participation of stakeholders from the environmental community. The partnership believes that members of the environmental community feared that participation on the Interactive Advisory Panel would be perceived as endorsement of the plans of the Partnership or that it might force groups to take a position on sequestration before they were ready to do so.

Another important benefit of the modeling activity is that the interaction between the research team and the Interactive Advisory Panel was a true "two-way" communication. The panel

learned from the researchers and the researchers learned a great deal from the panel. The outreach team informed its messages and materials based on these exchanges.

The second notable activity was the use of the internet to conduct live online town hall meetings. The partnership conducted two of these meetings. For each meeting, a group of stakeholders from across the entire region was invited to participate. The meetings consisted of a series of presentations by members of the research team followed by question and answer sessions. The purpose of these meetings was to transmit information and obtain feedback. Given the geographic range of the region, webcasting provided several benefits including facilitating discussion among participants based in multiple states who might not otherwise get to interact with each other, consistency of message, and minimizing travel costs and time.

Originally the partnerships planned three town hall meetings – one for industry, a second for environmental groups and a third for policy makers. The first meeting was well attended but the sign-up for the remaining two was low enough that the second two meetings were combined. The region found that personal contact was a key factor in securing the participation of stakeholders. Further, the format for the first meeting was less conducive to discussion so the agenda for the second meeting was modified.

In Phase II the region plans to create local teams of experts for each field test location. The outreach team will help to coordinate the activities of these teams, who will make key decisions about local media coverage, stakeholder meetings and other activities suitable for their areas. In addition, the outreach team is developing methods to better monitor the effects of these outreach activities.

In Phase II the Southwest region will also expand its use of the website as a method of communication. One planned activity would include best practices videos about sequestration to help stakeholders develop a keener understanding of the mechanics of sequestration and the safeguards put in place to protect public health and the environment. A second activity will be coordinated with schools in the region and will include virtual field trips to various carbon sequestration sites. Finally, they hope to make the model available online for interested persons to explore themselves.

e. West Coast Regional Carbon Sequestration Partnership (WestCarb)

The West Coast Regional Carbon Sequestration Partnership (WESTCARB) includes six states: Alaska, Arizona, California, Oregon, Nevada and Washington, as well as the Canadian Province British Columbia. California's economy alone is the 6th largest economy in the world. When adding the rest of the areas to the mix, WESTCARB emerges as both a geographically and economically large region. There is a strong environmental ethic in the region and at the same time, there is recognition in the region of the need for expanded energy supplies as well as a heavy reliance on highway transportation infrastructure. This tension lays at the root of some ambivalence about carbon sequestration and its future role in the region.

The region, starting with Arizona and moving up the coast to Alaska, hosts some of the most spectacular parks and wilderness areas in the country. Citizens within the region and the country are concerned about preserving and protecting these areas. In addition, parts of the region are often considered to be the epicenter of a focus on sustainability, low-impact development,

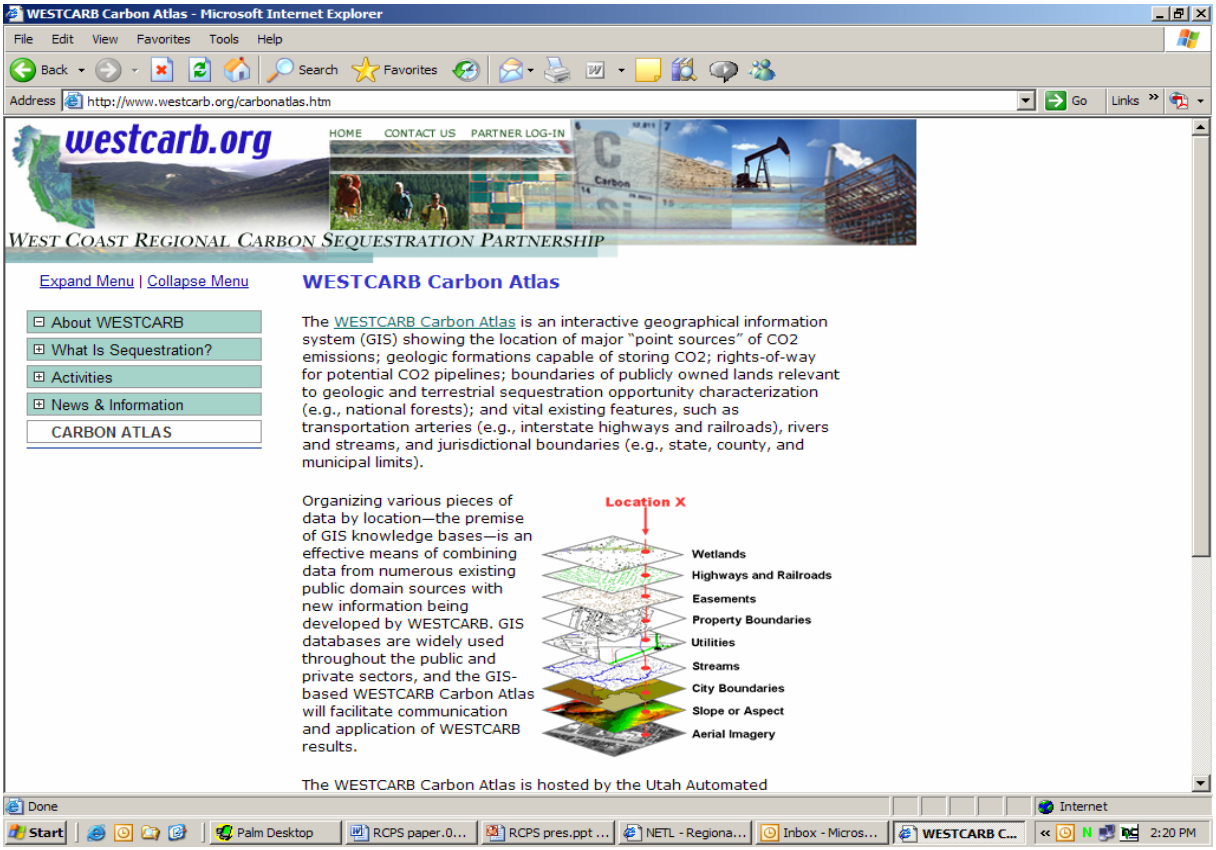
environmental stewardship and outdoor recreation. Regionally popular environmental groups have concern about technologies that promote or enable the continued use of fossil fuels.

Parts of the WESTCARB region, in contrast, rely on energy production and transportation infrastructure for their livelihood. California and Alaska both have a long history of oil and gas production. Alaska's North Slope, for example, remains one of the major oil producing areas of the country. Although CO_2-injection enhanced oil recovery may not work well in some fields that produce heavy oil, it may help to extend the economic life of others. In addition, land development, particularly in southern and central California, Phoenix, and Las Vegas (but also elsewhere in the region), has resulted in urban sprawl. This, in turn, has led to increased fuel use and demands on the highway transportation infrastructure. Today the majority of CO_2 emissions in California are from the transportation sector. Carbon capture and sequestration (which can produce hydrogen during the CO_2 separation process) holds some promise as part of a system to use fuel cells in transportation, but this may not be mature for some time. Further, given stringent air emission restrictions, energy production continues to be pushed out of California and into the surrounding states. The Western Governors' Association started a "Clean and Diversified Energy Initiative" in June 2004 that aims to expand energy supplies in the region.[v]

On top of these efforts to expand energy supplies, in 2004 the three Pacific coast states (California, Oregon and Washington) signed an agreement called the "West Coast Governors' Global Warming Initiative" calling for the implementation of a set of recommendations designed to combat global warming.[vi]

There are significant opportunities for both geologic and terrestrial sequestration within the region. The main focus with respect to terrestrial sequestration is on proving the feasibility and economics to professional managers of public and private lands as well as forestry and fire protection officials. In Phase II, WESTCARB envisions a series of terrestrial sequestration projects that involve all classes of land owners. One major emphasis will be demonstrating forest treatments to simultaneously curb the potential for catastrophic wildfires and sequester carbon. In addition, WESTCARB intends to leverage interest in these projects by getting them validated by the California Climate Action Registry or Oregon's Climate Trust for transaction in carbon credits markets. The WESTCARB region also has a large variety of geologic sequestration options, including oil and gas producing fields in Alaska and California, the massive sedimentary basin underlying California's Central Valley, deep coal beds in Washington, and deep saline reservoirs in northern Arizona and eastern Oregon. In addition, there are large CO_2 sources (i.e., major coal-fired power plants) in northern Arizona directly above target formations.

During Phase I WESTCARB focused on "two-way communication on sequestration technology with the research community, policymakers, non-governmental groups, industry, and the public."[vii] As with most of the other partnerships, WESTCARB established a website, created fact sheets and other briefing materials and conducted a series of smaller briefings, information sessions and interviews. In one instance, their Technical Director was interviewed by the cable television station TechTV. WESTCARB also developed a strategy for additional activities (not yet conducted), including discussions with editorial boards of local newspapers to get op-eds and stories about the partnership. A sample of the WESTCARB carbon atalas is below.



The partnership sponsored two public meetings. The first was in Sacramento, CA in October 2003 and served as the Phase I kick-off meeting. Although this meeting was open to the public, it was oriented towards the partners. The second was more of a town-hall style meeting that took place in Portland, OR in October 2004. WESTCARB used electronic invitations, direct mail, news releases, and partner communication networks to encourage participation. This meeting attracted a good number of participants that might be labeled as the interested public, decision makers and related industry professionals. Both meetings provided a forum for information sharing and discussion. Interestingly, WESTCARB found that many industrial stakeholders did not fully understand how sequestration works or its current stage of development. The forum meetings were useful in helping to inform these industry/agency affiliates. The environmental community was present at the meetings but has not weighed in with positions on carbon sequestration. One environmental group at the California meeting raised the concern that policy focus and support on carbon sequestration might come at the cost of similar focus on renewable energy and energy efficiency in California.

WESTCARB plans to continue holding this type of town-hall style forum at least once a year during Phase II. The session in Oregon included two panels of experts; one panel focused on climate science and technical and policy responses and the second focused on terrestrial and geologic sequestration and the DOE regional carbon sequestration partnerships. WESTCARB continues to work with the Western Governors' Association on initiatives to address climate change

Throughout the Phase I activities, the partnership's outreach team monitored the response of stakeholders and collected information about concerns and questions. So far, WESTCARB has learned that public awareness of carbon sequestration is very low and the potential for skepticism towards industry-backed solutions, like sequestration, is high. The partnership used a computer

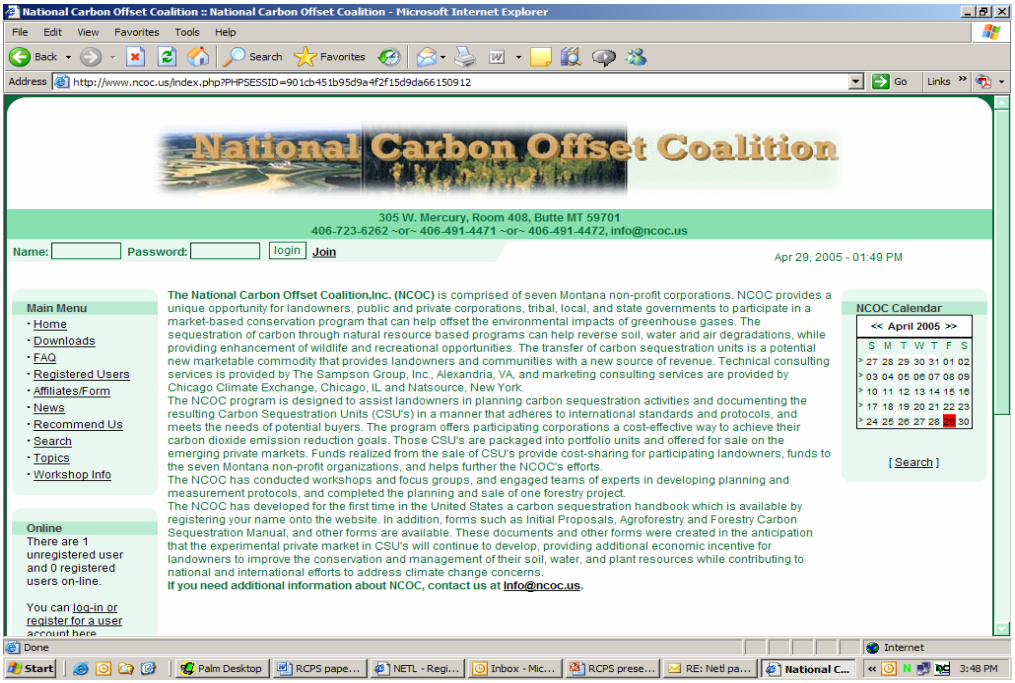
program to help organize the data collected during Phase I into weighting criteria for selecting pilot field studies for Phase II. If fully funded, WESTCARB expects to conduct 5-7 Phase II pilot projects.

Moving forward in Phase II, the partnership is putting high emphasis on the ability of locally established teams to plan public outreach tailored to the community and specific pilot project. The partnership is looking for local hosts that have the sensitivity and capacity to interact on more than just a technical level. Finally, WESTCARB will continue to host an annual public forum and they will develop intensive outreach activities around each pilot.

f. Big Sky Regional Carbon Sequestration Partnership (Big Sky)

The Big Sky partnership encompasses a large geographic area in four states, Idaho, Montana, South Dakota, and Wyoming. The region is characterized by vast tracks of private, public and tribal lands and its culture, history and economy are closely linked to agriculture and mining. Given its vast sources of coal and natural resources, the region currently produces some of the lowest-cost electricity in the country and is poised to meet growing western electric power demand.

Many in the region view growing western power demand as one of the region's key economic development opportunities. Recent developments include advances in renewable energy, proposed new coal-fired power generation including IGCC, and passage of $6.6 million by the WY Legislature and Governor to work toward the goal of opening new transmissions corridors. Growth in regional electricity supply from coal is also viewed as a way to help maintain low cost electricity that can attract other industries and preserve an economic base into the future. Furthermore, because of the region possesses large tracks of land and forests, terrestrial sequestration is viewed as an economic development opportunity. In fact, the partnership is home to one of the nation's leading carbon trading pilot programs created by the National Carbon Offset Coalition (NCOC), a partnership member. Over the past five years and throughout Phase I, NCOC has conducted extensive regional and national outreach and has created a handbook for foresters and land managers to effectively design their lands to enroll in carbon offset projects. A sample of the NCOC website is seen below.



While energy development and natural resource extraction are broadly recognized as key contributors to the region's economy, culture and history, stewardship of the land is viewed as critically important. Therefore, any discussion of farming, ranching, mining or electric power generation inevitably includes public discussion of their environmental impacts. Recent environmental impacts associated with coalbed methane extraction have required the region to pursue a new, innovative public outreach approach to enhance public involvement and trust designed by the Ruckelshaus Institute of Environment and Natural Resources. The partnership is leveraging this outreach effort to raise the profile and level of the discussion on the region's energy future and the role carbon sequestration and advanced technologies such as IGCC and FutureGen.

It is important to note that the region maintains the lowest population density in the nation which the partnership considers an advantage. Low population density enhances the partnership's ability to conduct strategic outreach and access and network key decision makers that would be involved in any carbon sequestration project. Therefore, the partnership's approach has been to conduct a series of individual meetings with key representatives from industry, government, the agricultural and environmental communities, tribal nations and the public sector (including regulatory and economic development agencies) and hold small community roundtables for various constituencies. Similar to the other partnerships, the Big Sky partnership created a web site, fact sheets, poster and program briefing materials. During Phase I, the partnership conducted over 40 joint briefings, three roundtables and five workshops; developed a database of media outlets and reached beyond the region to collaborate with professionals in China, Norway, and Canada.
(More detail on these activities and approach may be found in the partnership's Public Outreach Plan.)

During its outreach discussions, the partnership introduced the opportunities and issues associated with advanced fossil fuel power generation and carbon sequestration and engaged participants in a dialogue on their views of the region's energy future and the role of coal and issues associated with CO2 emissions. In general, the partnership found many constituencies in

support of electricity contributing to regional economic growth (from both coal and renewables) yet there is concern that such development be done in an environmentally sustainable manner. Therefore, there is considerable interest in terrestrial sequestration in terms of its environmental and economic development benefits along with cautious interest in geologic sequestration. These public outreach sessions will be the foundation of a stakeholder network during Phase II and provided useful feedback regarding public attitudes towards carbon sequestration. Some of the partnership's observations of the region's public perception of carbon sequestration include:

- Climate change is the "800 lb gorilla" – meaning that CO2 and climate change is an issue that is critically important yet more immediate regional environmental issues such as endangered species tend to take prescience;
- Carbon sequestration is generally associated with terrestrial sequestration which could provide an important regional economic development opportunity;
- Most constituencies are not familiar with the geologic CO2 storage option; yet are cautiously interested and curious about its potential role in the region's energy future;
- Public concerns relating to geologic storage do arise around environmental impacts and issues of permanence and safety; and,
- Economic development in the region is very important and energy and natural resource extraction is considered key.

In Phase II, the partnership will enhance its outreach network and establish a more formal outreach infrastructure. A number of activities will provide the foundation for that infrastructure including:

- Establish an outreach network comprised of individuals from partnership public relations departments;
- Utilize its outreach network and newspaper/media database to distribute partnership news and articles on carbon sequestration;
- Form the Big Sky Energy Future Coalition, a high-level group to help move energy policy and technology solutions into the forefront of the state, regional and national political debate;
- Establish the Annual Big Sky Energy Forum, with broad participation from groups with a stake in regional, national and global energy policy;
- Produce the *Big Sky Annual Energy Report* with regional inputs that will serve as a critical resource for regional and national policy discussions and planning;
- Conduct state legislative symposia and other targeted outreach to various constituencies.

The partnership will also work with its industry partners who are developing coal-fired power generation projects in the region to leverage their carbon mitigation plans and outreach efforts. Furthermore, the partnership will implement an innovative, well-tested process to regulatory and public outreach that will help ensure that all regulatory permitting requirements (including NEPA) are met for validation tests and full scale implementation projects, enhance public involvement and trust and raise the profile and level of discussion on the region's energy future and role of advanced technologies such as FutureGen, IGCC and carbon sequestration.

g. Plains CO2 Reduction Partnership (PCORP)

The Plains CO_2 Reduction Partnership (PCORP) is an international partnership, including more than 40 private and public sector members, which covers nine states (Iowa, Missouri, Minnesota, North Dakota, Nebraska, South Dakota, Wisconsin, and parts of Montana and Wyoming) and three Canadian Provinces (Manitoba, Saskatchewan, and Alberta) in the heartland of North America. The

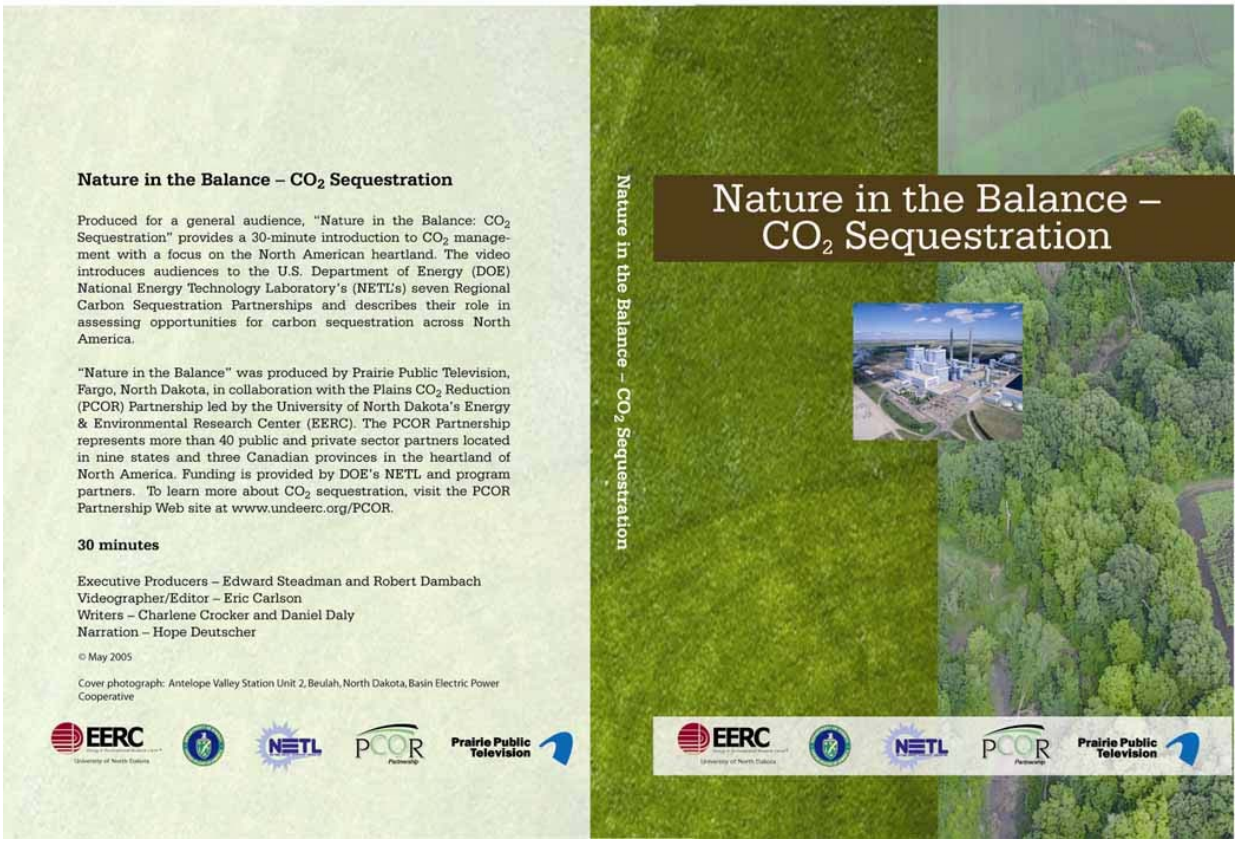
region accounts for about 11% of U.S. CO_2 output, 16% U.S. land area, and 8% of U.S. population.

The area encompassed by the PCOR Partnership corresponds in large part to the grasslands of the central and northern Great Plains where there is a strong tradition of agriculture. There is a transition from the prairie to the Canadian Shield, Interior Lowlands, and the Ozark Plateau in the Provinces and states along the eastern edge of the region.

From an energy standpoint, the PCORP region has significant fossil fuel resources (coal, oil, and natural gas) and production in the Williston Basin (North Dakota, Montana, and Saskatchewan), Powder River Basin (Wyoming and Montana) and in the Western Interior Basin (Alberta). The region is a significant source of both coal-fired and hydro electrical generation, biomass energy activities (e.g., ethanol and biodiesel), and wind energy development. The region is also home to the Dakota Gasification's Great Plains Synfuels Plant, a commercial facility that produces syngas from lignite coal.

Finally, the PCOR Partnership region is home to one of the world's major value added use of anthropogniic carbon dioxide in the EnCana/Dakota Gasification oilfield flooding operation in the Weyburn Field in the Saskatchewan portion of the Williston Basin. In turn, the International Energy Agency (IEA) Greenhouse Gas R&D Program Weyburn CO_2 Monitoring and Storage Project (coordinated by the Petroleum Research Technology Center at Regina Saskatchewan), that is piggy-backed on this successful commercial CO_2 flood operation.

At the outset of Phase I PCORP sought to raise awareness of carbon sequestration and gauge public understanding of the various aspects of carbon sequestration including the mechanics, the regulatory and permitting framework and its potential role in the larger economy. During Phase I PCORP started with a series of conventional outreach activities including a website, fact sheets and local media coverage. In addition they are in the process of completing approximately 20 technical reports on various aspects of sequestration pertinent to the region. As they are completed, these papers will be available through the website. The partnership also developed and produced in collaboration with Prairie Public Television a 30 minute video on carbon sequestration, the cover of which is pictured below. The video is scheduled for broadcast on PPTV on May 12 2005 (the station reaches 520,000 households in the PCORP region) and DVDs will be produced for use in classrooms and by other groups. The video is a general introduction to sequestration with a focus on the PCORP region and information on DOE's overall Regional Sequestration Partnership effort. The video and other select outreach products were tested through Focus Groups conducted in the energy producing area of the north-central Williston Basin (northwestern North Dakota) in April of 2005. These focus group interviews are being used to assess the response to the outreach materials and to sharpen the approach being developed for the outreach action plans that are intended to facilitate future sequestration outreach activities in the region.



[i] Note that DOE/NETL recently announced a solicitation for Phase II but will not name Phase II partnerships until a later date. See DOE/NETL press release dated December 14, 2004: "DOE Asks Regional Partners to Validate Carbon Sequestration Technologies" - http://www.netl.doe.gov/coal/Carbon%20Sequestration/partnerships/index.html

[ii] From SeCarb presentation at annual NETL progress meeting and available at: http://www.netl.doe.gov/publications/proceedings/04/RCSP/hill.pdf

[iii] http://www.offsetopportunity.com/Common/GeneralInfo.aspx

[iv] From presentation on Website: insert correct citation

[v] See Western Governors' Association webpage: http://www.westgov.org/wga/initiatives/cdeac/index.htm

[vi] See West Coast Governors' Initiative at: http://www.climatechange.ca.gov/westcoast/index.html

[vii] From WESTCARB presentation at annual NETL progress meeting and available at: http://www.netl.doe.gov/publications/proceedings/04/RCSP/NETL%20WESTCARB%20review.pdf

3. INTEGRATION OF TECHNOLOGIES: FUTUREGEN

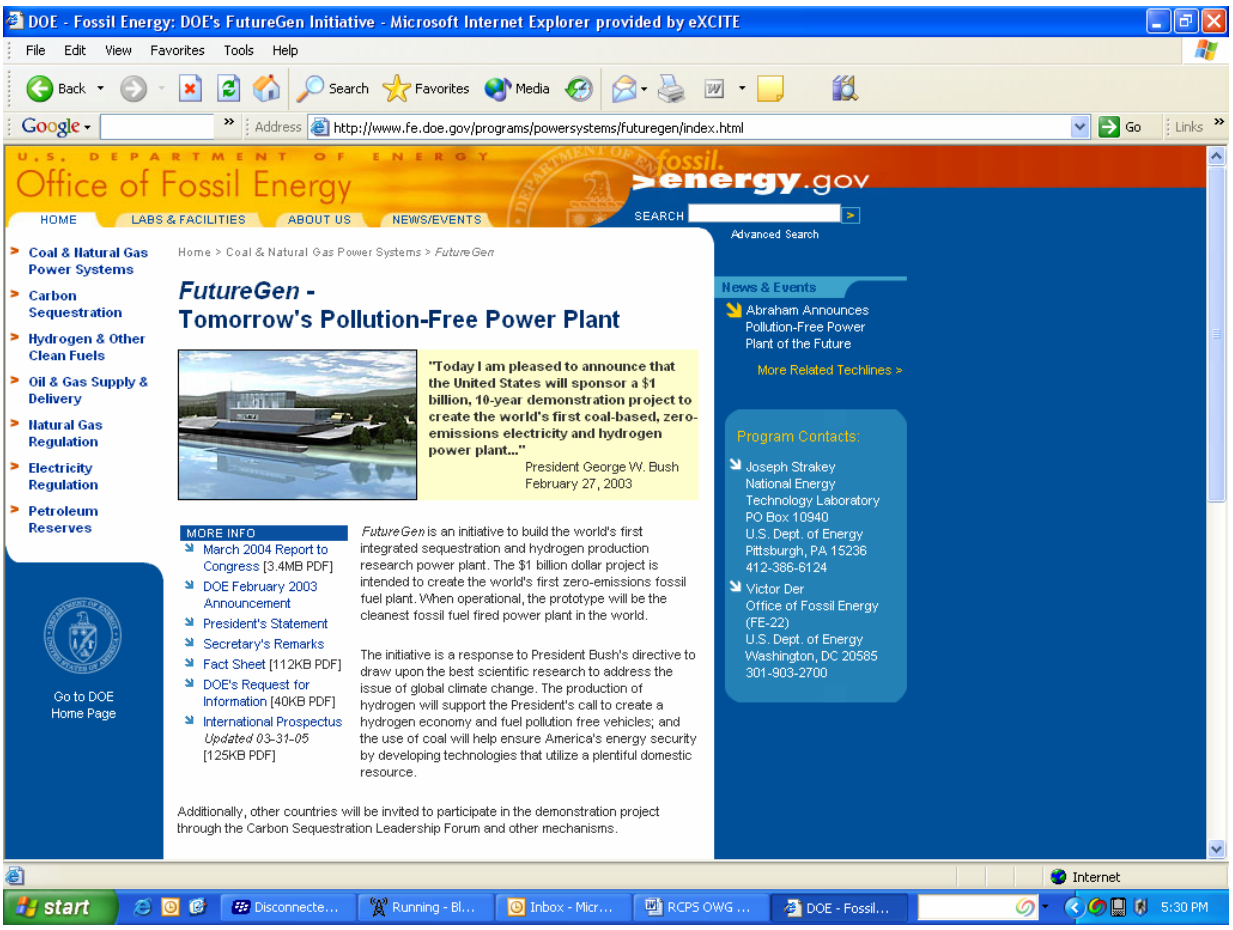
Futuregen, the Bush Administration's $1 Billion USD initiative to build the world's first integrated sequestration and hydrogen production research power plant, has also created a unique opportunity for outreach and communication in the area of CCS technologies. The initiative will be a government/industry partnership to pursue an innovative 'showcase' project focused on the design, construction and operation of a technically cutting-edge power plant that is intended to eliminate environmental concerns associated with coal utilization.

The nature of this initiative has resulted in an increased awareness among industry into not only the technologies involved in such a project (i.e.; CCS) but also the United States Government's support of and commitment to this technology as a long term solution to carbon emissions.

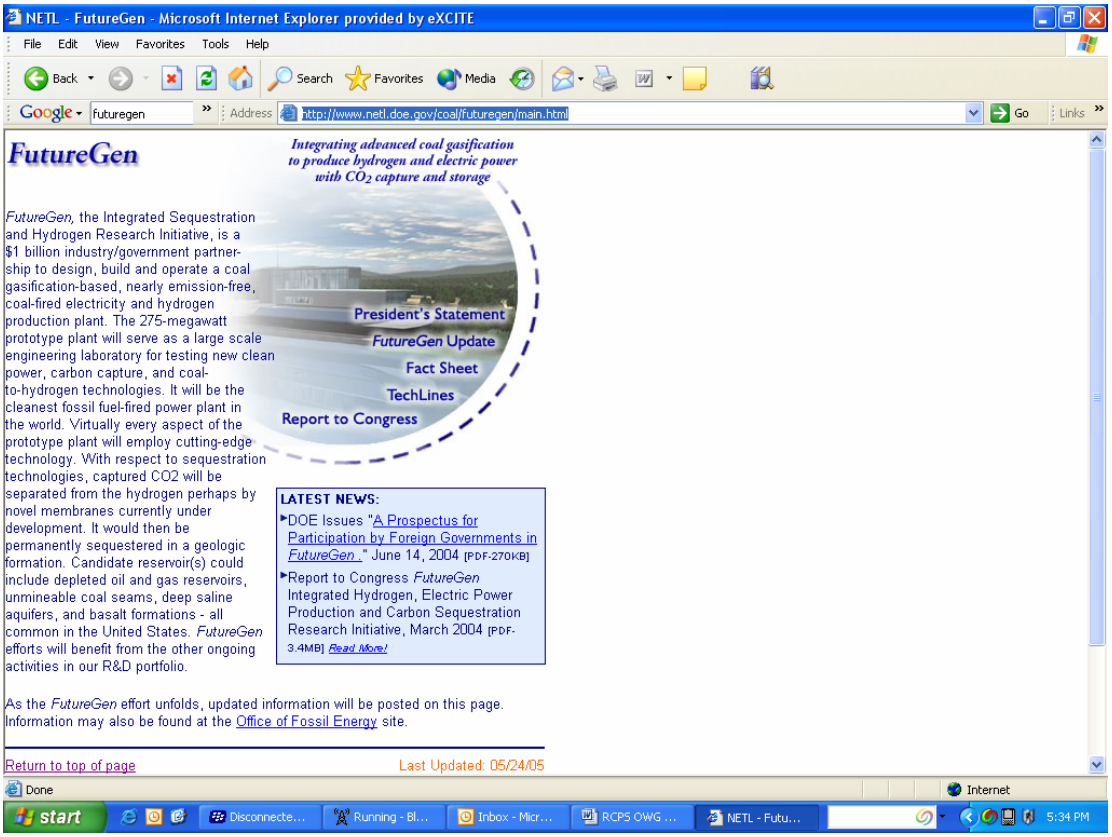
By year-end 2005, our FutureGen exhibit, touting the technology of the future and the importance of carbon sequestration, will have been on the road at 14 different meetings and conferences across the United States since the initial joint announcement of the CSLF and FutureGen in February 2003.

Additionally, numerous descriptive brochures, white papers, submitted articles and news releases have been prepared and released extensively discussing FutureGen and the science of carbon capture and sequestration.

The FutureGen effort has its own website within the Office of Fossil Energy which details the process and is used as an educational tool for those interested in carbon capture and sequestration and can be found at http://www.fe.doe.gov/programs/powersystems/futuregen/index.html.



There is also a Futuregen website hosted by the National Energy Technology Laboratory at http://www.netl.doe.gov/coal/futuregen/main.html



In addition, the Office of Public Affairs has been working to utilize media sources as a means to further educate the public on the promise of carbon capture and sequestration and the Futuren proposal. Some of the recent articles include:

- NY Times (details?)
- Scientific American
- Various DOE press releases

A key component to the Futuregen proposal is the Futuregen Alliance, a consortium of industry representatives committed to the project. The creation of this consortium has given the USDOE another outlet for education and communication. As attention surrounding the Futuregen project increases and it receives more media attention, so does public curiosity. We are hoping that major initiatives such as Futuregen can help the USDOE to reach out to the public and educate them on these promising technologies.

4. CARBON SEQUESTRATION CORE PROGRAM & PUBLIC INFORMATION

In addition to the United States Department of Energy's involvement in specific activities like the CSLF, Futuregen, and the Regional Partnerships, we also have additional activities that create outlets for public outreach and communication both in our Office of Fossil Energy and our technology laboratory, the National Energy Technology Laboratory (NETL.)

- USDOE Core R&D Program in CCS
  The core R&D program within the Office of Fossil Energy and its related websites are home to easily accessible information and background. The sites provide a wealth of educational information, contact information and additional relevant publications. The areas covered on the website include an educational overview of different types of sequestration, a database of carbon sequestration R&D projects, and a copy of the USDOE/NETL recently released "Carbon Sequestration Techology Roadmap and Program Plan.

- USDOE National Energy Technology Laboratory
  NETL has compiled a comprehensive Outreach Plan that includes various activities:

  - *Website:* FE/NETL operates an official website on which it posts news, reports, white papers, announcements and other information (http://www.netl.doe.gov/coalpower/sequestration). This site also enables interested individuals to sign up to receive FE/NETL's Carbon Sequestration Newsletter and to offer comments to FE/NETL.

  - *Carbon Sequestration Newsletter*: The monthly newsletter provides an excellent summary of important notices, reports, events and other information about carbon sequestration. Efforts are being made to get it more widely distributed and to seek feedback from readers on possible enhancements.

  - *The Carbon Sequestration Technology Roadmap and Program Plan*: This document is available on the website[10] and provides detailed information about the overall program. It is currently written in accessible text but is a long document. The May 2005 updated version was just recently released.

  - *Annual Carbon Sequestration Technical Conference:* FE/NETL currently sponsors an annual technical conference that covers a variety of research and policy topics. The primary audience is the research and technical community; however, an increasing number of NGO's are attending. In 2004, FE/NETL will actively seek the participation of additional NGO representatives, teachers and local regulators.
  - *Speaking Engagements:* Staff from FE/NETL are invited to speak at a number of different conferences, meeting and events. In 2004, a set of talking points will be developed and options for webcasting will be explored to further take advantage of these opportunities.

  - *Curriculum:* The Keystone Center is working with FE/NETL to develop a middle school curriculum on climate change that also adheres to National Science Education Standards. By meeting existing teaching requirements, teachers' concerns about adding additional work to tight schedules is allayed, and the curriculum can be

seamlessly integrated into existing teaching materials. In 2004, 30 teachers were trained in the curriculum and used it in their classrooms. Based on their feedback, the curriculum will be finalized and certified and then made available for widespread use in classrooms.
Available at http://fossil.energy.gov/programs/sequestration/publications/program_plans/03/.

- *Risk Communication Workshop* – FE/NETL conducted a risk communication and messaging workshop with FE/NETL staff and participants from the Regional Carbon Sequestration Partnerships (RCSPs) in Spring 2004. The objective was to draw on the academic field of risk communication to develop new ways of looking at carbon sequestration and ways of communicating about it to the public. In addition, FE/NETL developed a paper on risk communication and stakeholding as it relates to the issue of carbon sequestration. This paper will be suitable for sharing with others involved in carbon sequestration projects and with the general public, and will be posted on the FE/NETL website.

- *Regional Partnership Outreach Coordination and Assistance* – As described above, FE/NETL has convened a working group of outreach coordinators. FE/NETL will work with this group to assist in coordinating among the regions and to help in developing outreach materials, sharing lessons learned and best practices. This activity will be designed to fit the needs expressed by the partnerships.

- *Development of an EIS for FE/NETL's overall carbon sequestration program* – FE/NETL has initiated an environmental impact statement (EIS) for the carbon sequestration program including research activities and the regional partnerships. FE/NETL has launched a dedicated webpage to the EIS and updates will be posted there routinely (http://www.netl.doe.gov/coalpower/sequestration/eis). During 2004 it public meetings took place around the country to provide the public with an opportunity to learn more about FE/NETL's program and to voice their comments and concerns.

- United States Energy Association
  The United States Energy Association has also played a major role in outreach and education when it comes to CCS technologies. Membership in USEA is open to any organization engaged in any manner in the energy sector of the United States, and they currently have over 150 members. In January of 2005, they hosted a 'Membership Technology Briefing on Carbon Sequestration' in Washington, DC open to all members of their organization. This was a general briefing aimed at educating key energy industry participants to the developments and advancements in carbon sequestration.