Barriers to the Deployment of Environmental Technologies in the Upstream Oil and Gas Industry

Final Report – January 31, 2005

Prepared by
PTAC Petroleum Technology Alliance Canada and Deep Blue Associates for Technology for Emission Reduction and Eco-Efficiency Project (TEREE)

Recognition

The following organizations contributed funding to this project:

- Alberta Energy Research Institute
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- Alberta Environment
- Western Economic Diversification

The project was overseen by PTAC's Technology for Emission Reduction and Eco-Efficiency (TEREE) Steering Committee:

- Industry Co-Chair: Roxanne Pettipas, ConocoPhillips Canada
- Government Co-Chair: Jerry Keller, Alberta Environment

A list of the TEREE Steering Committee members appears in Appendix A.

We extend gratitude to the following individuals who contributed significant time and effort to seeing this project through to successful completion:

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We dedicate this report to children who will grow up to live in a cleaner environment amid a more vibrant economy through achievement of the long-term view embodied in this report.

Executive Summary

This project set out to identify and assess barriers to environmental technology deployment in the Canadian upstream oil and gas industry, and to propose ways and means of overcoming these barriers.

Data collection took place from July to November 2004, involving a web survey, secondary research, a workshop held in Calgary (Oct. 27) and about two-dozen interviews.

The study found that:

- Deployment of environmental technology in upstream oil and gas is more difficult than in other sectors.
- Deployment of environmental technology is more difficult than for other types of technology.
- Deployment of environmental technology in Canada is more difficult than in other countries.

Barriers to increased deployment of environmental technology in upstream oil and gas include:

- Perception of environmental technology solutions as a “cost” as opposed to cost savings
- Non-competitive returns on investment
- Small scale of many of the environmental technology solutions
- The short-term focus of the industry and financial markets
- Industry’s reluctance to foot the up-front costs of environmental technology.
- Time required to implement the technology
- Regulatory inconsistency and uncertainty
- Measurement challenges
- Insufficient enforcement
- Prevailing attitudes

Despite all this, the upstream oil and gas industry has made progress in recent years. Reductions are occurring in several emissions categories. Flaring is perhaps the industry’s greatest success story. It is clear, nevertheless, that there is room for improvement. In particular, there may be “low-hanging fruit” where environmental benefits are available using existing technology for no or minimal financial detriment to industry.

A “best-practice technology” theme is suggested in order to encourage deployment of environmental technologies without invoking an onerous regulatory or enforcement regime. The recommendations that follow are essentially a series of enablers that will see best-practice environmental technologies not only developed and demonstrated but validated, deployed, shared and monitored, with the resulting “good news” better communicated.

Summary Recommendations

A series of improvements aimed directly at increasing the implementation of “best-practice” environmental technology in upstream oil and gas:

1. Encourage **development** of environmental technologies
    - Income tax credit for investors in environmental technology companies
    - Enrichment of SR&ED tax credit for environmental technology developers
2. Ensure **demonstration** and validation of best-practice environmental technologies
    - Demonstration funding
    - Independent environmental technology validation
    - Innovative Energy Technologies Program “greened” to benefit environmentally responsible recovery of petroleum
3. Take steps that will result in increased **deployment** of the best environmental technologies

- Government-industry group to identify best-practice environmental technologies
- "One window" for best practice technologies and supporting resources

4. Backstop or **defend** best-practice environmental technology deployment through regulation, enforcement and communication
   - Regulatory backstopping and enforcement for best-practice technologies
   - Communication to public

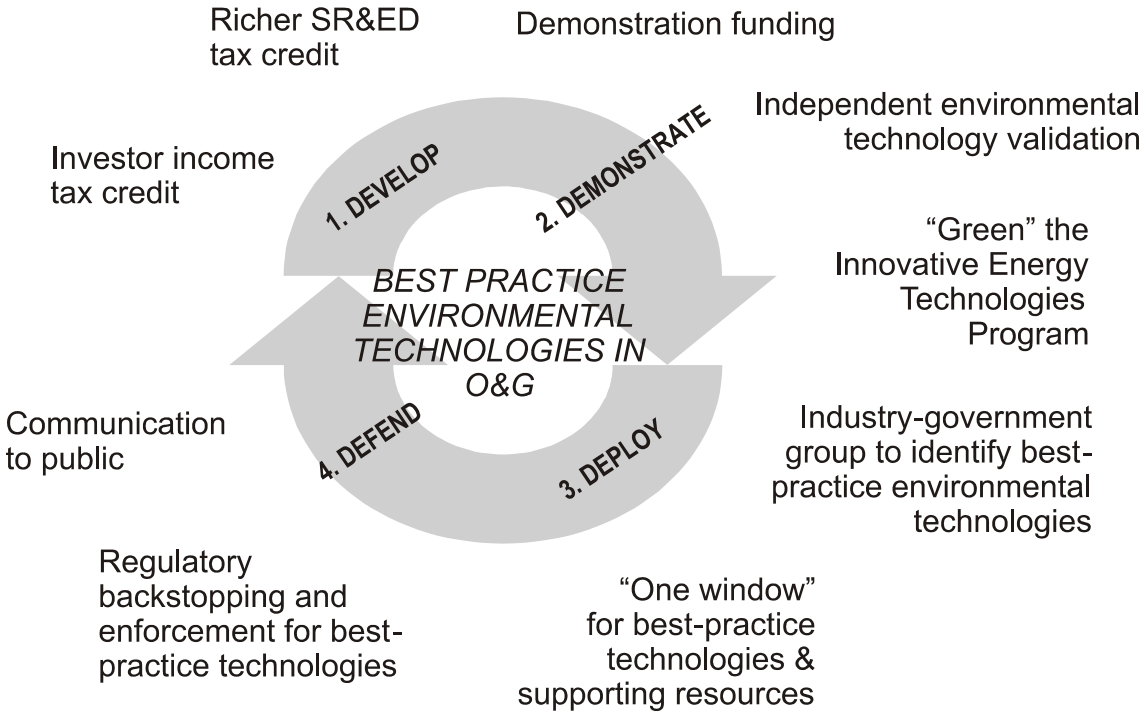

Figure 01: Report Recommendations – This report's recommendations encourage best-practice environmental technologies from development to deployment and beyond.

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1. Background and Methodology

1.1. Background

In 2003, the mandate of PTAC Petroleum Technology Alliance Canada widened to encompass the facilitation of adoption of sustainable, eco-efficient and economical greenhouse gas-reducing technologies. PTAC's first action was to launch the Sustainable Eco-Efficient Technologies (SET) project. This three-year initiative, now renamed the Technology for Emission Reduction and Eco-Efficiency Project (TEREE), is intended to facilitate technologies that will reduce the industry's impact on the environment, while improving profitability and eco-efficiency. It is overseen by an industry-government Steering Committee and PTAC staff have been dedicated to its support.

Since the creation of TEREE, work has progressed on identification and prioritization of environmental technologies. Clearstone Engineering Ltd. of Calgary was contracted to develop a matrix of currently available alternative technologies and their costs.[1] Fugitive equipment leaks, flaring and incineration, heaters and boilers, reciprocating engines, and venting including storage were identified as leading opportunities for emissions reduction.

The TEREE Steering Committee has become increasingly cognizant, however, of economic, regulatory and other impediments to technology adoption; it recognizes the need for these "barriers" to be examined in greater detail.

Deep Blue Associates had been contracted by PTAC in 2003 to examine the challenges and opportunities associated with the deployment of technologies in natural gas and conventional oil. The project included a literature review, straw-case discussion paper, facilitated workshops, one-on-one interviews and a web survey. The subsequent report, *Spudding Innovation*,[2] contributed to the launch of EnergyINet's "Natural Gas and Conventional Oil Recovery Innovation Program" as well as technology-related royalty incentives under Alberta Energy's "Innovative Energy Technologies Program."[3] In 2004 the TEREE Steering Committee foresaw an opportunity to generate a similar report, this time with a focus on barriers to deployment of environmental technologies. Deep Blue was retained in July 2004 to spearhead the "Barriers" project.

1.2. Objectives and Scope

Project objectives were:

- To identify and assess barriers to environmental technology deployment in the upstream oil and gas industry.
- To propose ways and means of overcoming these barriers.

The scope of the project encompassed:

- Emissions
- Land/Water
- Sequestration
- Western Canada Sedimentary Basin

The scope excluded oilsands, refinery/transportation/downstream and the offshore.

For the purposes of this project, "environmental technology" has been defined as all types of technology applicable to oil and gas, incremental or transformative, existing or yet to come, that either reduce negative impact or enhance positive impact upon the environment.

1 Clearstone Engineering presented its findings to TEREE in May 2004. Clearstone's findings may be viewed at http://www.ptac.org/links/dl/TEREEMatrix.xls.

2 PTAC and Deep Blue Associates, *Spudding Innovation – Accelerating Technology Deployment in Natural Gas and Conventional Oil,* Calgary, Oct. 1, 2003.

3 Alberta Energy Research Institute, *Annual Report 2003-04 – A Year in Review,* June 17, 2004.

1.3. Methodology

1.3.1. Secondary research

A literature scan took place between August and October 2004. Internal (PTAC) and external (primarily web-based) avenues were explored. Secondary research work revealed, overall, that barriers to technology deployment are extensively documented (i.e. the problem is widely acknowledged) but that documentation of solutions is scarce (these are not straight-forward issues). Some 137 sources were reviewed during the literature scan.

1.3.2. Web survey

A survey was posted on www.ptac.org in October and November 2004. Its purpose was to facilitate involvement from industry in an inclusive manner. The questionnaire was intended to generate ideas and indications of views; no claim was made to statistical significance of the results. The survey was promoted extensively by PTAC. Respondent categories with sufficient representation were used in resulting segmentation and analysis.

Total response: **100**

PTAC Members: **57%**

Segmentation Categories	Respondent category	Percent of Respondents
Producer	Oil & gas producer/operator	24%
Supplier	Oil & gas service, supplier or manufacturing company	14%
	Company developing and/or supplying environmental technologies	19%
	Company providing services related to environmental technology	20%
	Independent research lab	0%
Government	Government department or agency	16%
	University or college	1%
	Other	6%

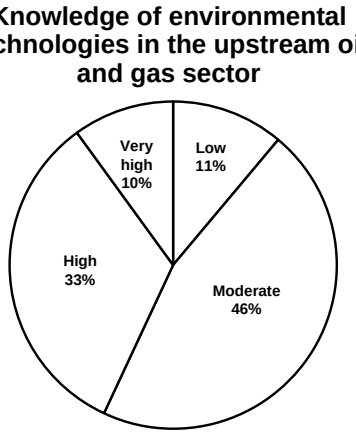


Figure 02: PTAC Web Survey Response Summary – response, segmentation and self-assessed knowledge levels.

1.3.3. Interviews

More than two dozen one-on-one interviews were conducted in order to probe issues and potential responses to those issues. Interviewees included representatives from government, oil and gas producers, NGOs, and technology vendors. A partial list of those interviewed appears in Appendix A.

1.3.4. Workshop

PTAC hosted a free workshop Oct. 27, 2004. Its purpose was to create an interactive forum for the discussion of barriers to the deployment of environmental technologies and ways to overcome them. The workshop was attended by 48 individuals from 35 organizations. Feedback was positive despite the limited time. Participants included 13 environmental technology companies, seven organizations from government / research/academia, six industry associations and five oil and gas producers. A list of attendees appears in Appendix A.

2. Situation Assessment

Data collection and subsequent analysis led to a number of observations. Observations about the progress of the upstream oil and gas industry in regard to technology and, in particular, deployment of environmental technology, appear in the following section.

2.1. A history of innovation

Canada's upstream oil and gas industry has a long history of innovation leading to beneficial deployment of technologies. The following list presents a few of those successful innovations:[4]

- Processing bitumen into synthetic crude oil
- Steam injection (huff-and-puff) for heavy oil production
- Steam-assisted gravity drainage (SAGD)
- Progressive cavity pumps for cold heavy oil production
- Improved capability of refineries to process synthetic crude
- Solvent extraction/upgrading
- Evolution of feedstock sources for petrochemical industry
- Application of 3-D seismic and horizontal drilling
- Real-time drill hole logging
- Rig portability improvements
- Remote data monitoring and intervention
- Tertiary recovery techniques
- Co-generation of electric power and heat at oil & gas facilities

2.2. Environment the "new" challenge

Production of energy from hydrocarbons comes at a significant environmental cost. Impacts are experienced to land, water and air. Petroleum production is one of Canada's largest contributors to greenhouse gas emissions, accounting for about 10% of this country's total.[5] Certainly efforts have been made over the years to minimize the industry's impact on the environment, but recent events have magnified the prominence of the issue. Protecting the environment has become our "new" challenge.

Canada ratified Kyoto in 2002 and the first commitment period for emissions reductions is fast approaching – yet petroleum production in this country is in no way receding. In the next three decades, renewable resources and conservation are expected to make only a dent in world energy demand, which is projected to continue to grow by almost two percent a year.[6]

This much is certain: Canada will remain one of the world's key oil and gas suppliers, and oil and gas will remain one of the largest contributors to our economy (it currently churns more than $15 billion a year in taxes and royalties alone).[7] We will not be reducing our petroleum production, so our choice is to reduce the intensity of its impact. In this regard, the past tells us that technology can play a significant role – *if* we encourage it appropriately.

2.3. Factors critical to innovation not all in place

In their 2003 paper *Shaping an Integrated Energy Future,*[8] Bolger and Isaacs outlined three factors they regard as critical to breakthrough innovation: the presence of strategic research;

4 Most of these are extracted from Len Bolger and Eddy Isaacs, "Shaping an Integrated Energy Future," Sept. 15, 2003. This essay is part of the collection *Fueling the Future: How the Battle Over Energy is Changing Everything,* edited by Andrew Heintzman and Evan Solomon, House of Anansi Press, November 2003.

5 *Stewardship and Benchmarking Report,* Canadian Association of Petroleum Producers and Macleod Institute, 2004.

6 International Energy Agency, *World Energy Outlook 2004*, Paris, Oct. 26, 2004. The outlook projects an increase in energy demand by 2030 of 59%, which equates to a compound annual growth rate of about 1.8%.

7 "industry Facts and Information – Canada," on the CAPP website www.capp.ca

8 Len Bolger and Eddy Isaacs, "Shaping an Integrated Energy Future," Sept. 15, 2003. This essay is part of the collection *Fueling the Future: How the Battle Over Energy is Changing Everything,* edited by Andrew Heintzman and Evan Solomon, House of Anansi Press, November 2003.

availability of patient capital; and know-how to turn research results into commercially viable solutions. They emphasized a fourth requisite, active collaboration, as essential to bringing it all together. The following assesses the upstream oil and gas industry along these four vectors of innovation:

2.3.1. Presence of strategic research

Spudding Innovation (2003) discussed some of the pitfalls of the current research effort, including lack of funding, lack of pooling of research capabilities, and lack of integration with industry needs. Improvements are under way – the University of Calgary's Institute for Sustainable Energy, Environment and Economy (ISEEE) and the National Institute for Sustainable Development Technologies are good examples – although this is a long-term challenge.

2.3.2. Availability of patient capital

This problem is unique to neither this industry nor this geographic region, but the issue is accentuated in Alberta because of a scarcity of venture capital and abundance of alternative capital uses (in the form of risky but shorter term and more familiar opportunities, e.g. drilling for oil and gas). This won't change quickly, but government does have important levers available to increase the availability of capital.

2.3.3. Know-how to turn research results into commercially viable solutions

We have demonstrated our know-how and can-do spirit; we have the "skunk works" in place. The environment industry growing quickly and is now probably a $10-billion industry in western Canada.[9] But we need the oil and gas industry's uptake of the solutions. Suppliers lack bargaining power, and the benefits, although real, aren't compelling to potential customers. There is, consequently, only a limited market for environmental technology in this industry.

2.3.4. Finally, active collaboration

Active collaboration is required among governments, within industry, within the research community, and between industry, government and the research community. It is critical to unleashing our innovation potential. Our technological successes of the past have been characterized by collaboration. Active collaboration exists today, but so do fragmentation, apathy, distrust, divisiveness and misplaced competitive zeal. The solutions will require that we come together much more effectively.

2.4. We're off to a green enough start

In the last five years, the oil and gas industry has been making progress.[10] Examples include:

- Benzene emissions intensity down
- Sulphur recovery rate up
- Flaring and venting dramatically reduced[11]
- Spills and pipeline releases lower
- Carbon sequestration shown to work[12]

9 *An Assessment of Alberta's Environmental Technologies Industry,* Calgary, Nov. 3, 2003. Report estimates Alberta's environmental industry at $3.2 billion in 2002, with growth over the past decade in excess of 15% per annum. Median firm size, however, remains under 20 employees.

10 *Stewardship and Benchmarking Report,* CAPP and Macleod Institute, 2004.

11 The Clean Air Strategic Alliance (CASA) established a flaring project team in 1997 that recommended a management framework for solution gas flaring. EUB followed with Guide 60, which contained a practical decision tree analysis approach for industry. Flaring has been reduced by 70% from 1996 levels. Wayne Hillier, Husky Energy, "Flaring and Venting: Implementation of the New CASA Recommendations," CAPP Environmental Issues Seminar, Calgary, Jan. 20, 2005.

12 Near Weyburn Saskatchewan, where EnCana is using CO_2 to increase oil recovery, results from a $40-million research project indicated in 2004 that CO_2 may be able to be stored safely underground for several thousand years. Near Zama in northwest Alberta, Apache recently reported on a highly successful acid gas flood that could sequester 1 MT of CO_2 in coming years while generating increased oil recovery.

- Measurement has greatly improved
- Dialog with government occurring
- Communication to the public better

Drivers for this progress have included international nudging, pressure from the Canadian public, the resulting regulatory response and, last but not least, industry initiative.

2.5. But we can do much more

A debate exists about whether Canada will be capable of achieving the Kyoto targets it has signed on for. Nevertheless, in the upstream oil and gas industry, real progress is achievable on:

- GHG emissions intensity and volume
- Reduction of other emissions
- Water use
- Reclamation
- Carbon management
- Communication with public
- Constructive industry-government dialog[13]
- Embracing the paradigm of carbon lifecycle management (rather than simply producing hydrocarbons)

From all indications, there is room, before the solutions become onerous or prohibitive (i.e. "before we hit the wall"), to make substantial progress with modest expenditure and even positive business returns, as the following schematic illustrates:

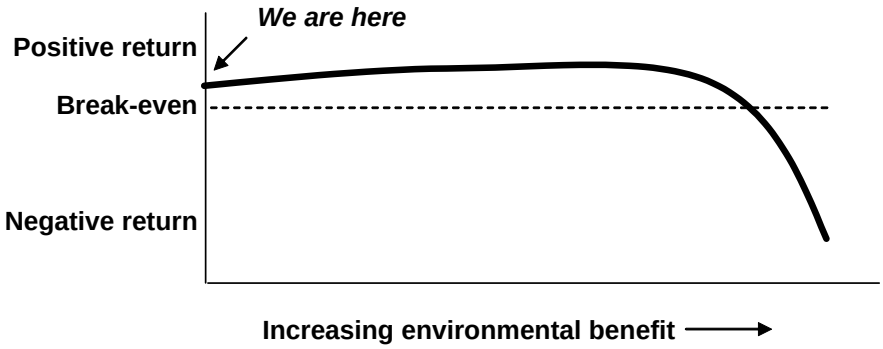


Figure 03: Financial Returns vs. Environmental Benefit – This chart suggests that many technological solutions can be invoked in the near to mid-term that will actually financially benefit producers. Ultimately, the solutions become financially prohibitive – but we are not at this point yet.

2.6. Technology dangles a large carrot

Deployment of environmental technology may not be the fastest way to achieve this industry's Kyoto obligations – trading internationally for emissions credits is probably the more expeditious response – but it is almost certainly the wisest way.

A 2003 PTAC business case suggested that 29 megatonnes (MT) of CO_2 equivalent per year could be shaved from upstream oil and gas industry emissions through the application of existing economical energy and emission reduction technology.[14] By comparison, the current targeted reduction under Kyoto for all Canadian "large final emitters" is 55 MT per

13 Occasional high-profile flare-ups between this industry and government mask the great level of cooperation that already occurs on many levels. More is possible.

14 "A Compelling Business Case for Oil and Gas Facility Energy and Emission Auditing," PTAC, Calgary, Sept. 29, 2003.

year.[15] The PTAC work suggested that about $1 billion per year could be saved by the upstream oil and gas industry through reduction in energy use resulting from application of energy and emission reduction technology.[16] Further benefits surfacing in the research include: saving money on clean-up costs from spills, worker accidents and regulatory fines; saving money on dealings with nearby landowners and communities; and, bottom line, maintaining the social licence to operate.

The inference is that through technology deployment, we can make changes on our own home turf that will go a long way toward achieving Kyoto targets while keeping emission reduction projects in positive NPV territory. Simply put, we can benefit the environment *and make money doing it.* Not everyone believes in this statement, but even if environmental technology deployment here at home costs some money, the ripple effect on our economy (in terms of jobs, export capacity, etc.) cannot be understated.

15 Steven Chase, "As economy revs up, Kyoto obligations mount," *The Globe and Mail,* Toronto, Jan. 17, 2005. Article indicates that a reduction of this target to 37 MT is under consideration by the federal government in order to reduce the "Kyoto burden" on large industrial firms. There are about 700 large final emitters in Canada; together they generate about half of all greenhouse gas emissions in Canada.

16 PTAC, "A Compelling Business Case for Oil and Gas Facility Energy and Emission Auditing," Calgary, Sept. 29, 2003. Improvements would be implemented over a five-year timeframe. The study did not offer a comprehensive breakdown of the cost to deploy energy and emission reduction technology, but payback periods for many of the available solutions are less than one year.

3. Research Findings

Building on the general observations made in Section 2, we present in this section more detail on the findings from our research relating to barriers confronting the deployment of environmental technologies in the upstream oil and gas industry.

3.1. Number one environmental challenge

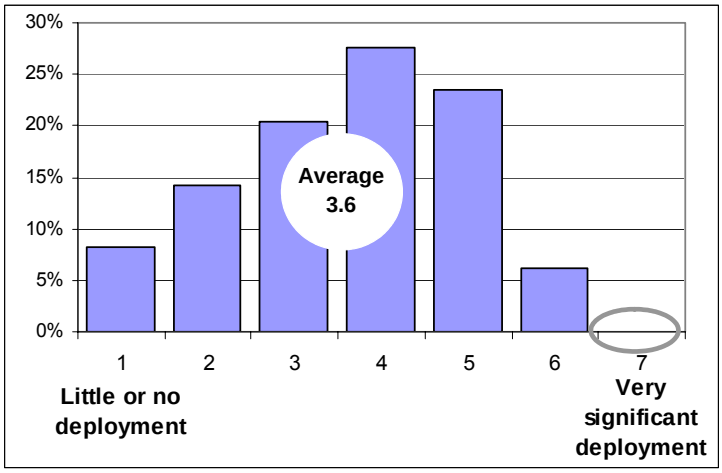
The industry's greatest environmental challenge is seen to be greenhouse gases and related emissions. Use of fresh water also commands a high profile as do land-related issues (habitat destruction, land use). On a less tangible front, uncertainty or insufficiency of regulations is seen as a significant issue. The following chart provides the rank order of challenges volunteered by respondents to the PTAC web survey:

Challenge	# of Responses
GHG; emissions	13
Use of fresh water	9
Habitat destruction, land use	7
Lack of or uncertainty around regulations	6
Degradation of land, soil contamination	6
Waste water treatment/handling produced water	5
Meeting Canada's Kyoto target	5
Sustainable growth/growth with no environmental impact	4
Impacts related to salt	4
Public perception	3
Impact on groundwater	3
Energy consumption	3
Hazardous fumes	2
Flaring	2
Fugitive emissions	2
Abandoned wells	2
Attitude of producers/unwillingness to change unless legislated	2
Dealing with old assets	2

Figure 04: Number One Environmental Challenge – Respondents were asked to rate a number of issues and then queried on what they believed to be the "number one" environmental challenge facing upstream oil and gas today.

3.2. Extent of deployment

Results of the web survey corroborate the hypothesis that that there is room for improvement in the deployment of environmental technologies into upstream oil and gas. Not a single respondent to the questionnaire ranked the extent of deployment as "very significant." Of respondent segments, technology suppliers were more critical of the extent of deployment than oil and gas producers or government.



Type of Organization	Average
Supplier	3.3
Government	3.9
Producer	4.1

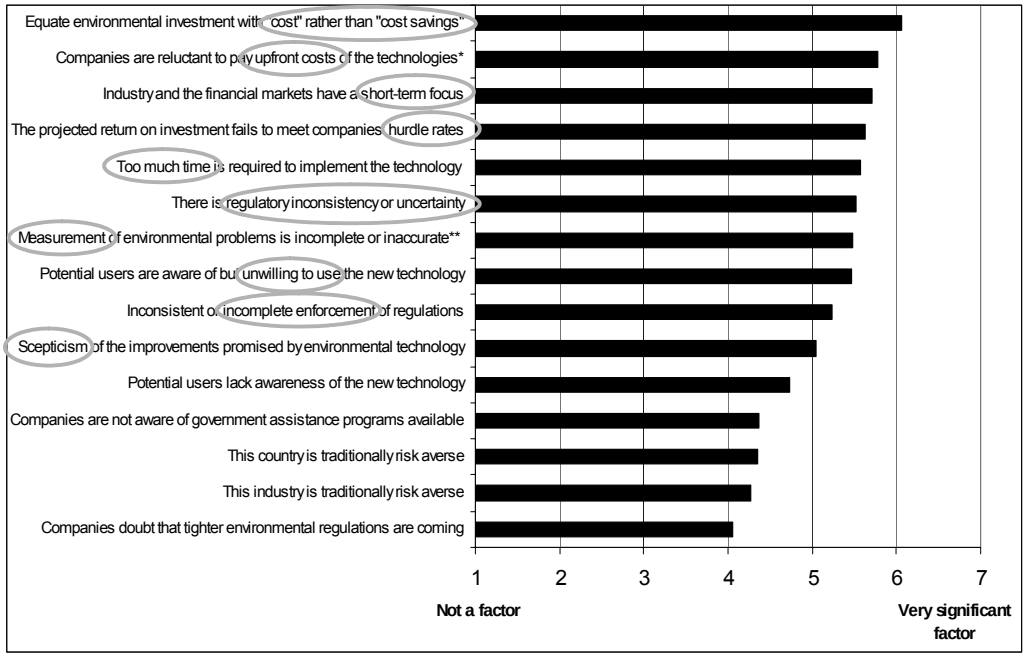
Figure 05: Extent of Technology Deployment – Respondents were asked to rate the extent of deployment of environmental technology on a scale of 1 to 7.

3.3. Why is deployment so limited?

Evidence suggests that the upstream industry is currently not deploying environmental technologies for maximum effect. Themes that turned up repeatedly in our research included:

- Economics are the main driver for business decisions – investment in the environment is a low or no-return investment right now
- There is no regulatory or financial incentive
- The environment is not a priority – the focus is on production and increasing reserves
- Risk of untested technology and adherence to the status quo
- Failure in marketing by suppliers of environmental technology
- Lack of measurement and an inability to demonstrate results (both economic and environmental)
- Lack of financing, both for the developers of new environmental technology and within companies, to get environmental projects deployed
- Industry structure: limited number of multinationals and large number of small caps
- Lack of awareness of funding and available technology
- Lack of internal processes to facilitate the deployment of environmental technology and lack of corporate buy-in from the top
- Lack of internal resources to evaluate and implement new environmental technology

Asked to rate a series of factors that may explain the lack of deployment of environmental technology, web survey respondents awarded top billing to the perception of environmental investment as “cost” rather than cost savings. The following chart illustrates the mean ratings from the 100 respondents to the survey.



*Perception of long payback periods

**Leading to underestimation of scale/cost of environmental problems

Figure 06: Rating of Barriers to Technology Deployment – Web survey respondents rated a series of barriers suggested to them. The four barriers considered most significant were related to financial factors.

3.4. The triple whammy

The series of one-on-one interviewees provided an opportunity to probe some issues in more detail. Overall, interviewees saw:

- Deployment of environmental technologies into the **upstream oil and gas sector** as more difficult than other sectors
- Deployment of **environmental technologies** as more difficult than for other technologies
- Deployment of environmental technologies in **Canada** as more difficult than in other countries

A more detailed description of this observed "triple whammy," including representative quotes from the interviewees, follows.

3.4.1. Upstream oil and gas sector issues

Deployment of environmental technologies in upstream oil and gas is seen as generally worse than in other sectors. Seven in 10 who commented said it was worse and three in 10 said it was no better or worse. Nobody we talked to said it was better. Factors that were cited included:

- Risk
  - "There's more incentive to maintain the status quo then to invest in potentially costly new technology."
- Fuel gas not costed
  - "In oil and gas, fuel gas is free whereas in other industries energy is the biggest cost; therefore they're motivated to reduce their energy usage."
- Industry structure and business drivers
  - "The oil and gas sector is comprised of a few very large companies which are difficult to navigate to find the right person to target, and many small

companies, such as income trusts who generally don't invest in R&D. Their only driver is to reduce costs, run the operation more efficiently."

- "Number and size of the players. Petrochemical industry, which is characterized by a small number of big players, is a better adopter of best practices. There's a greater capability and desire to compare technology."

- Conservatism
  - "Many companies in oil and gas are very conservative – they won't adopt new technology unless they're being forced."
- Regulation
  - "Alberta Environment has environmental protection legislation in place that works in other industries. EUB (Alberta Energy Utilities Board) is largely responsible for carrying out the regulatory duties in the upstream oil and gas industry. The Board has not been a strong enough leader."
- Out of public eye
  - "It's worse in oil and gas because the operations are not in the public eye. Steel, pulp and paper are much more visible. In recent years flaring has been more visible – farmers are being impacted."
- Production focus
  - "A margin business will pay more attention to environmental technology efficiency gains."

3.4.2. Issues related to environmental technologies

Deployment of environmental technologies is seen as generally worse than for other technologies. Of those who commented, six in 10 said it was worse, three in 10 said it was no better or worse, and one in 10 said it was better. Factors that were cited included:

- Benefits are indirect
  - "Companies are not as willing to invest in technology that has indirect benefits or that addresses indirect costs (off balance sheet costs) such as fuel gas. It involves 'doing the right thing' rather than looking at direct costs/benefits."
- Environmental technology not core to business
  - "Engineering technologies have been a matter of course since the beginning. Engineering is core to the industry – there are some environmental benefits but an environmental focus is not pervasive."
  - "Oil and gas companies focus on technology that improves efficiencies (deeper, faster, cheaper)."
  - "Industry treats much environmental stuff with lip service – just look at who sits on the committees – they're not the decision makers."
- Perception as "cost"
  - "Companies look at environmental technology like a muffler – just a way to control emissions rather than as a business saving device or as a means to save money. An example is incinerators instead of flare stacks: incinerators reduce emissions and save money and are only marginally more expensive than small flares (payback in months) yet they're not deployed because they're perceived as a cost, not a cost-saving device."
  - "There is a perception issue with 'environmental' products. Environmental technology is not perceived as being economical when in fact the opposite is true – many 'environmental' technologies optimize production."
  - "Perception that 'if it's environmental it will cost us.'"

- Scale
  - "The business case for environmental projects is usually way too small to take note of."

3.4.3. Issues relating to Canada

Deployment of environmental technologies in Canada is seen as generally worse than in other countries. Of those who commented, six in 10 said it was worse, three in 10 said it was no better or worse, and one in 10 said it was better. Factors that were cited included:

- Lack of financial incentives
  - "There is a lack of financial incentives to try and deploy environmental technology."
- Lack of government regulation
  - "The technology is available everywhere but the drivers for change vary by region. In the European Union there is a stronger push to reduce GHGs because of government regulation. e.g. Norway already has a carbon tax in place."
  - "There are more regulations in Europe and the U.S."
  - "More environmental regulations in other countries."
  - "Loosely regulated jurisdictions (Canada included) can get away with it. Do we have an Environmental Protection Agency (EPA) like the U.S. or anything like it?"
- Waiting game
  - "The U.S. opted out of Kyoto but to their credit, they're under way with the Clean Skies program while the rest of us are waiting for Kyoto."
- Energy abundance
  - "Germany, Japan, Denmark and the U.S. are all better at getting new technology out. They have a need for other energy sources whereas Canada has an abundance of fossil energy and natural resources. Efficiency is not as important."
  - "There are fewer natural resources in other countries therefore more need to be efficient"
- Lack of focus on economy
  - "U.S. has focus on the economy – they always look to develop new technology to position themselves for growth."
- Lack of resources applied to technology
  - "Even other provinces put more resources towards it than Alberta."
- Unsophisticated, lack of decision-making power
  - "It is easier to sell to other parts of the world because operators there are more experienced with more decision-making power."
- Less collaborative (especially from technology supplier perspective)
  - "We have a competitive industry in Canada, protective of intellectual property; there is an unwillingness to proceed in consortia here."
- Absorbed with core business
  - "Canadian companies generally only invest in their core business … they are generally risk averse."

3.5. Summary of barriers

From all our sources we compiled a summarized list of the barriers to deployment of environmental technologies in the upstream oil and gas industry. Some barriers, such as

government, market or even societal issues, were more generic – issues for more than just the upstream oil and gas industry. Some were specific to this industry. The diversity of barriers listed suggests that a suite of interconnected solutions will ultimately be required (rather than the oft-stated but elusive "silver bullet").

3.5.1. Barriers not specific to the upstream industry

- Financial/Markets/Society
  - Limited access to capital
    - Lack of financing available to the developers of new environmental technology
    - Private capital has a number of competing uses and more attractive returns at commensurate levels of risk
    - Investors not necessarily rewarding environmental advances or technology innovation
  - Limited access to larger markets
    - Our environmental technology firms are generally small
  - Failure in marketing by suppliers of environmental technology:
    - Value of products often not effectively communicated (e.g. environmental vs. economic benefits)
    - Wrong approach to solving a problem
  - Consumers not expressing stronger environmental preference
  - Investors and analysts have a quarterly performance emphasis
  - Undeveloped emissions credit/trading rules
    - Emissions trading coming fast but the whole thing is "surreal"
- Government/Regulator/Policy
  - Lack of "innovative" tax policies
  - Government funding for small- and medium-sized enterprises (SMEs) perceived to be fragmented and inadequate
    - Sustainable Development Technology Canada (SDTC) not seen as accessible to SMEs
    - Technology Early Action Measures (TEAM) not highly visible
    - Industrial Research Assistance Program (IRAP) well known but under-funded and seen as somewhat restrictive
    - Scientific Research and Experimental Development (SR&ED) improving, but substantial tax credit value accrues to the consultants retained rather than the companies that qualify
  - Inadequate incentives for technology adoption
    - We are innovating, just not deploying
  - Lack in government leadership to streamline policies and demonstrate a clear commitment to eco-efficiency and sustainability
  - No apparent industry-government partnership emerging
  - Regulatory uncertainty

3.5.2. Barriers specific to the upstream industry

- Energy research & development focus has not been on conventional fossil fuels
  - Research & development not the focus generally: "receptor capacity" low
- The globally most responsive producers have relatively limited positions in our basin
  - Limited number of multinationals vs. large number of small cap companies with short-term mandates

- Lack of financing within companies to get environmental projects deployed
- "Project" focus overshadows "process" focus (environmental technologies apply largely to processes)
- The environment is not a priority; focus is on production and increasing reserves
- Plant and equipment operators "operate" and, once it works, they prefer status quo
  - Production interruptions are not worth risking
- Fuel gas is an assumed and accepted shrinkage, not subject to royalties either
  - There's no value placed on fuel gas, especially when plants are running at capacity
  - No royalties mean no costing, no reporting and little or no management attention[17]
- Lack of environmental and energy efficiency awareness/education/skills
  - Lack of internal resources required to evaluate and implement new environmental technology
- "Equipment working fine" … besides, it's sunk cost
- Reluctance to grant access to field sites for pilots
- Risk of untested technology and adherence to the status quo
- Environmental impacts are an externality
  - View that "environmental costs aren't real costs"
- Measurement/reporting of environmental problems and benefits of new technology is incomplete and inaccurate
- Lack of internal processes to facilitate the deployment of environmental technology and lack of corporate buy-in from the top
- Time (and time perceived for payout)
- Lack of awareness of funding and available technology
- Environmental projects compete for funding with projects with much greater ROI potential
- Gains are many and small, and they don't stack up vs. exploration and production potential (they are not considered "material")
- Multiple points of contact at operator level make sales and decisions hard to achieve
- Economics, legislation, and licence to operate are *the* drivers for business decisions
- Investment in the environment is a low- or no-return investment right now
- Environmental investment is "cost" rather than "cost savings"

3.6. Desired future state

We asked our workshop participants to discuss an ideal future state for environmental technology deployment in upstream oil and gas. While this is not the same as coming up with strategies or solutions, their answers are instructive; they offer focus as we begin to address the barriers confronting us today. It is important, according to Bolger and Isaacs, to identify a "future state in which our problems are solved" so that we can then construct a "portfolio of linked and complementary initiatives that need to all come together to create that future state."[18] Ideally, the hopes expressed in this section will be used to evolve a vision for regulators, NGOs and industry itself to work toward:

17. According to Clearstone, fuel, flared and vented gas currently represents about 2.5 MT of hydrocarbon emissions per year in this industry. Industry does not pay royalties on this gas. In contrast, the Conference Board of Canada reports that the cost of fuel to Canadian industry overall has doubled in less than three years, spurring aggressive approaches to conservation. The recommendation of a royalty on fuel gas was considered, but a recent economic analysis suggests that the impact would not be material.

18 Bolger and Isaacs, "Shaping an Integrated Energy Future," 2003, p 13.

- Industry and all governments on same page using same rulebook
  - Enhanced and strengthened coordination, cooperation and collaboration between government agencies and different governments
- "Certainty"
  - Of policy, of credit pricing, of regulatory consequences, of incentives available, of gains available
- Taxation policy on equal footing
  - Environmentally superior technologies on at least even footing with existing equipment
- Better risk-reward formula for production managers
  - Provide impetus to implement environmental technologies to offset status quo via fear of failure
  - Carrots, sticks and accountability no longer working at cross-purposes
- Triple bottom line focus (increase savings, decrease emissions, societal good)
  - Community and environmental benefit as well as economic benefit
- Industry more plugged into work done by universities
  - ISEEE as one example of environment-economy-energy research initiatives
- Sustainable technologies
- Level regulatory playing field
  - Regulations are enforced fairly
- Clear consumer preference for environmentally friendly products/services
  - In at least some cases, environmentally friendly goods will actually be lower cost
- Risk management results in environmental technology deployment
  - Majority of companies see it as strategically smarter to deploy than to avoid environmental technologies
- Regulators nudge/steer
  - And industry chooses most cost-effective means to reductions
  - Smart, non-prescriptive/flexible regulations
- Credible, efficient measurement/monitoring/tracking
  - Requirement for credible measurement/monitoring and public reporting
  - Single window for reporting
- "PTACs of the world" are lowering collective solution cost
  - Collaborations to channel expertise and solve collective problems for benefit of whole industry
- Carbon credits trading that works for environmental technologies
  - A system that is not only efficient and accessible but that does not discourage companies from deploying new environmental technology (i.e. allow them simply to opt to buy credits instead of use better technology)
- Single window to access information on available funding and technology
  - Reducing confusion and fatigue for would-be participants

For further analysis of the research findings, please see Appendix B. For a breakdown of the issues by technology vendor, oil and gas producer, public, and government, please see Appendix C.

4. Recommendations

This report's recommendations constitute a series of improvements aimed directly at increasing the implementation of "best-practice" environmental technology in upstream oil and gas. This industry has made good use of the "best practices" approach in the past. For example, the Drilling and Completions Committee (DACC) has invested many resources into "industry recommended practices" that have subsequently been adopted by companies and "backstopped" by EUB-issued guides. The Canadian Association of Petroleum Producers (CAPP) has evolved practices that it recommends for streamlined reporting of National Pollutant Release Inventory (NPRI) requirements; these are of significant benefit to all producers.

In this report, we define "best practice environmental technologies" as the best available technologies for addressing specific environmental challenges. They are not a minimum acceptable solution. "Best available" reflects factors including effectiveness, cost, value and support. The focus is on what is most practical and most effective for addressing a given challenge. The upstream oil and gas industry needs successful applied solutions. "Best-practice environmental technologies" are those technology solutions with demonstrated results whose deployment has a high likelihood of being environmentally and operationally sound.

Our recommendations concerning best-practice environmental technologies follow.

4.1. Encourage development of environmental technologies

The environmental technology community needs greater enablement for the development of technologies with potential to become "best-practice." Help is currently available (e.g. companies can obtain commercialization support from CETAC-West) but funding limits the impact of many programs, and small to mid-sized companies with significant technology development commitments are in a position where they cannot afford outside help. The two recommendations described below offer companies the opportunity for enhanced access to capital – and hence support in their commercialization efforts – at the time it is needed.

4.1.1. Income tax credit for investors in environmental technology companies

Mechanism:

- Imitate the Innovation and Productivity Tax Credit (IPTC) pioneered in B.C.; this model was described in some detail in the Globe Foundation report for Western Economic Diversification[19] and became part of its recommendations to the Prime Minister
- Similar credit is being successfully employed to encourage wind power investments in Nova Scotia (Nova Scotia Investment Tax Credit)[20]
- Following the IPTC model, individuals investing in qualifying environmental technology companies would receive a refundable tax credit equal to 30% (15% contributed by the federal government; 15% by provincial government) of the funds they invest in such businesses
- Province would define eligible business criteria and qualify companies as "eligible," allowing the tax credits to flow
- Process would be audited, perhaps through existing infrastructure such as IRAP

Benefits:

- Significantly increase the relative attractiveness of environmental technology investments

19 GLOBE Foundation of Canada, *Report on the Western Canada Environmental Technology Industry Policy Recommendations Survey (2004),* a report to Western Economic Diversification, November 2004. The report requested "serious consideration" for a $100-million tax credit program. "By and large," observed the report, "the impediments to market entry for most environmental technologies are severe, and as a consequence they are not attractive to venture capital investors unless someone else takes the plunge and proves that money can be made."

20 Brian Watling, Scotian WindFields, "Community Economic Development Investment Funds (CEDIFs)," part of a presentation to the fall conference of the New Energy Resource Alliance (NewERA), Calgary, Dec. 3, 2004.

- Put technical and market development money in the hands of technology developers at the time they need it
- Make technology development and commercialization assistance (such as I-CAN, CETAC-West, IRAP) more accessible to companies
- Attract capital from the right sources (local) with the right horizon (patient)
- Direct and accessible benefit for the SME sector (the majority of environmental technology companies in western Canada are in this category)
- Allow government to support innovation without being in a position of having to pick technology winners and losers

4.1.2. Enrichment of SR&ED tax credit for environmental technology developers

Mechanism:

- Scientific Research and Experimental Development (SR&ED) income tax credit is available currently to qualifying companies undertaking R&D
- This is one of the federal government's most important mechanisms for the promotion of innovation – a value of more than $1.5 billion/year
- Improvements have been made to the previously onerous process, increasing accessibility of this credit to companies large and small
- Continued industry reluctance arising from complexity, time and paperwork would be greatly diminished with a 10-percentage-point increase in the value of the investment tax credit (i.e. from 35 to 45% of qualified expenditures for Canadian-controlled private corporations (CCPCs) and from 20 to 30% of qualified expenditures for other companies)
- The extra 10 points would apply only to expenditures related to the development of technologies intended to reduce environmental impact

Benefits:

- Make better use of an existing program (no need to create a whole new infrastructure)
- Allow government to support innovation without being in a position of having to pick technology winners and losers
- Direct and accessible benefit for the SME sector (the majority of environmental technology companies in western Canada are in this category)
- Accessible to all companies, big and small, involved in environmental technology development
- Likely to decrease the proportion of the tax credit value that accrues to the supporting consultant rather than the technology developer

4.2. Ensure demonstration and validation of best-practice environmental technologies

Technology demonstration is expensive and time-consuming yet critical to ultimate wise deployment. Demonstration projects were the 2004 Globe Foundation report's top recommendation to the federal government.[21] Further, oil and gas producers have expressed the need to better discern the "wheat" (best-practice technologies) from the "chaff" (all the rest of the environmental technologies marketed to them). The following three recommendations seek to facilitate demonstration and validation and ultimately improve customer receptivity to best-practice environmental technologies.

21 GLOBE Foundation of Canada, *Report on the Western Canada Environmental Technology Industry Policy Recommendations Survey (2004),* a report to Western Economic Diversification, November 2004. The report recommended a "series of environmental technology demonstration projects across western Canada." "In general," noted the report, "it was suggested that the most effective approach to demonstration projects was to support projects that encouraged the formation of partnerships between governments and industry; that removed impediments to innovation; that encouraged the private sector to provide the technologies and expertise needed to solve real world problems; and that created a climate of innovation and experimentation."

4.2.1. Demonstration funding

Mechanism:

- Public funding to joint ventures involving vendors (contributing equipment, services) and customers (contributing site and people at host facility and corporate oversight)
- Public funding would cover project management and partial funding of vendor and host facility's out-of-pocket expenses
- Ideally the funding from federal (e.g. SDTC, TEAM) and provincial (e.g. AERI) sources would be combined at the project level for maximum effect – evaluation for funding should incorporate knowledge of upstream oil and gas industry needs, e.g. SDTC could partner with and flow funds through a western-based organization
- Additional source for the funding pot could be Alberta's Technology Investment Credits (companies earning bankable emissions credits in return for the funding qualifying technology development, consistent with Alberta's climate change action plan *Taking Action*)
- Energy Innovation Network in collaboration with PTAC (and with support of SDTC) could undertake this work – would become the seventh EnergyINet innovation area and be called the "Petroleum Eco-Efficiency Innovation Program" or be rolled into the existing EnergyINet priority focused on oil and gas recovery
- Process improvements would qualify for consideration along with direct environmental mitigation technologies; program would not impact intellectual property ownership unless otherwise negotiated
- Funding decisions would favour predefined results and multi-party collaboration; success would be tracked through attainment of intended results (not merely by dollars dispersed)
- Critical feature would be customer review panel of some form (perhaps PTAC's TEREE)

Benefits:

- Bring high-potential environmental technologies through the pre-commercialization stage to the point where they have real opportunities to generate top-line growth for vendors and improve the environmental results of large final emitters as well as smaller operators
- Better address the biggest current gap on the technology "S" curve
- Increase access for vendors to field or pilot locations
- Assemble the needed "critical mass" to accomplish goals that one party wouldn't be able to achieve alone

4.2.2. Independent environmental technology validation

Mechanism:

- An objective, expert assessment of the technical and business case for application of a given technology, to be made public once concluded
- This is essentially the determination of a technology's "best practices" standing: identification as a "best available" technology for filling a specific industry need (incorporating criteria including emissions reduction/environmental benefit, anticipated ROI, ease of implementation, etc.)
- Validation would require technically disciplined methodology such as that available from Alberta Research Council (ARC) or ETV Canada Inc.'s Environmental Technology Verification Program
- Validation process must dovetail with the demonstration funding recommendation (4.2.1) and possibly tap same funding sources – with the caveat that the validation must not be a government assessment of technology

- Petroleum Industry Training Service (PITS) training and testing facilities could play a significant role for both demonstration and validation

Benefits:

- Validation is a prerequisite to increased technology penetration
- Investors are looking for validation – should generate additional capital for SMEs because it will moderate the risk perceived by the investor
- Will enhance third-party credibility of the "pitch" from technology vendor to customer
- In customer's eyes, will separate the "wheat from the chaff" thus moderating the risk of any decision to deploy
- As NPRI requirements expand and reviews become more frequent, producers will require credible information on better equipment and processes in order to prudently pursue improvement options
- Will create solid, supported, compelling alternatives to the less-environmentally friendly "operations status quo"
- This activity will unify and put structure to the pockets of best practices identification activity already under way (e.g. CAPP's Stewardship Framework, Clean Air Strategic Alliance, CETAC-West, PTAC TEREE, etc.)

4.2.3. Royalty credit program "greened" to benefit environmental technologies

Mechanism:

- Alberta government announced a $200-million royalty credit program in 2004 called the Innovative Energy Technologies Program
- IETP was designed to advance implementation of innovative technologies to maximize recovery of Alberta's oil, natural gas and in situ oil sands reserves
- Innovative technology implementation is likewise required for the recovery of petroleum in the most responsible manner environmentally
- The proposal is simply to broaden the program's scope to encompass implementation of environmental technology in the recovery of oil and gas

Benefits:

- Without harming the competitiveness of the WCSB, access to these credits would increase corporate receptivity to demonstration and ultimately deployment of best-practice environmental technology
- Would promote earlier adoption of innovative environmental technology (fewer followers and more leaders for the industry)
- Would encourage creation of a market of sufficient volume to generate dependable technology support, incremental technology improvements, critical mass for export possibilities, etc.

4.3. Take steps that will result in increased deployment of the best environmental technologies

It is deployment in volume, not mere development and demonstration, that creates a market and delivers returns commensurate with the vendor's risk. We believe the upstream industry needs a helping hand in this regard. Two recommendations follow that, without affecting the competitiveness of this basin, will remove roadblocks and set the stage for more sustained deployment of best-practice environmental technologies.

4.3.1. Industry-government group to identify best-practice environmental technologies

Mechanism:

- A standing committee or forum or council that focuses exclusively on confirming this sector's needs regarding best-practice environmental technology
- As the ultimate defender of the Canadian public interest (and to lend legitimacy to the process), the federal government would appoint this group, ensuring representation from upstream oil and gas producers that are leaders in environmental performance, as well as relevant provincial government departments, technology experts and the public
- Group would formally identify "best available technology" for environmental benefit in applications in upstream oil and gas, and recommend any policy response or incentive that may be needed to encourage deployment
- This group would have a broader mandate than climate change, but regardless would be advisory to the expected oil and gas "sector table," which will be an integrating mechanism for all aspects of climate change affecting the industry
- The group would also liaise with the Clean Air Strategic Alliance, a multi-stakeholder body that recommends emissions conservation requirements for the upstream industry
- The group would advocate that any environmental regulations under consideration reflect and encourage the benefit available through technology deployment – crafters of the Large Final Emitter regulations, for example, would be encouraged to incorporate mechanisms to specifically motivate technology solutions (as opposed to the international acquisition of emissions permits)

Benefits:

- Good communication between industry and government and between different levels of government
- Oil and gas sector focus
- Opportunity to influence harmonization of approach throughout government
- While regulation is rarely requested by industry, it is clear that regulation is coming – this committee represents an opportunity to raise the profile of best-practice environmental technology and advocate for policy that would focus at least some of the coming emissions trading regime upon technology deployment
- The confirmation of best-practice technologies will take NPRI reporting the next obvious step (which is for companies to search out, confirm and implement improvement options)

4.3.2. "One window" for best-practice technologies and supporting resources

Mechanism:

- One internet "window" of information, supplemented by conferences, libraries, information staff, training, etc.
- Training/orientation in assessment and implementation of best-practice technologies would be marketed to oil and gas producers
- Training/orientation in operating factors critical to producers as well as information on funding assistance would be marketed to technology vendors
- Assistance in identification of consortium or collaboration partners
- Forum for success stories (and lessons learned)
- PTAC well positioned for this as it is already filling elements of this role
- Would link to government databases and effectively interpret (for industry clients) resources available
- Funding to originate from federal and provincial governments as well as industry

Benefits:

- For oil and gas producers, this window would provide current information on technology vendors, the technology's emissions reduction potential, its best-

practice standing, its cost range, its ROI range and references from existing customers

- For technology suppliers, the window would offer current contact points, summaries, focus areas, and advice and guidance regarding assistance programs from industry and government, reducing perceived lack of harmonization and difficulty in obtaining consistent, up-to-date information
- For all of the upstream oil and gas industry, this window would organize and coherently present the currently plentiful but confusing array of relevant federal and provincial government initiatives
- It is likely that uptake in provincial and federal initiatives relating to environmental technology would be improved, thus helping to meet program objectives
- The well-known benefits of innovation clusters would be actualized through this centralized information channelling service[22]
- Will dovetail with Environment Canada initiative to generate "one window to national environmental reporting" (OWNERS)[23]

4.4. Backstop or defend best-practice environmental technology deployment through regulation, enforcement and communication

Creating a sustained cycle of development, demonstration and deployment of best-practice environmental technologies will rely on an appropriate regulatory framework and as well as public understanding and support. Environmental industry respondents to a 2004 Ipsos-Reid survey in western Canada viewed "adopting regulatory regimes that encourage the development of environmental technologies" as the most urgent policy option for the federal government.[24] CETAC-West's 2003 report on Alberta's environmental technology industry concluded that "in terms of its growth potential, the environmental industry relies heavily on the presence of a strong regulatory framework which would influence the operations of the resources sectors in Alberta."[25] In their essence, regulation, enforcement and communication are defensive strategies: they combine to ensure continued focus on pursuing full benefits of the technological solution, while reducing distractions that could include short-term but unsustainable tactics and headline-driven public pressure. Two recommendations follow.

4.4.1. Regulatory backstopping and enforcement for best-practice technologies

Mechanism:

- The industry-government best-practice technology group, recommended earlier, would provide input to regulators on how best to enhance technology deployment
- Regulators would review this input in the process of "drawing a line in the sand" in the form of legislation, policy, regulation or guidelines
- This "line in the sand" would compel best-practice technology deployment by requiring industry to be as eco-efficient as possible – within limits of a moderately negative net present value (NPV) per project
- Once a best-practice technology has proven it can be successfully applied within the range of the NPV guideline, industry would be compelled to deploy it
- Onus would be on each company to show to regulators and the public that they have done the assessment and evaluation work and are as eco-efficient as

22 David Wolfe, "The Role of Industrial Clusters: Lessons from the Innovation Systems Research Network (ISRN) Research Initiative," presentation to InnoWest 2004 Conference, Calgary, Nov. 17-18 2004. A "regional innovation system" is defined as "The set of economic, political and institutional relationships occurring in a given geographic area which generates a collective learning process leading to the rapid diffusion of knowledge and best practice." (Nauwelaers and Reid)

23 Angela Varley, Petro-Canada, "NPRI Reporting Requirements," CAPP Environmental Issues Seminar 2005, Calgary, Jan. 20, 2005. The One Window to National Environmental Reporting System (OWNERS) is expected to go into effect in June 2005.

24 Ipsos-Reid, *Environmental Technology Industry Web Survey Report of Findings (2004),* undertaken for Western Economic Diversification, Nov. 15, 2004. Survey had 68 respondents.

25 CETAC-West, *An Assessment of Alberta's Environmental Technologies Industry,* Calgary, Nov. 3, 2003, p. 26.

possible with documentation that is prepared and signed by qualified professionals

- Emphasis on any regulations arising for environmental protection would be that they are "smart" as per the definition emerging from the External Advisory Committee on Smart Regulation (September 2004): "protecting, enabling, self-renewing, shared responsibility of governments, citizens and industry"
- Ensuing enforcement activities would focus on bringing industry laggards around to employing best-practice technologies

Benefits:

- Permit government – which is ultimately accountable for the health and safety of citizens and protection of the environment – to accomplish its goals while avoiding the prescriptive regulatory approach
- Provide a more level playing field to industry – particularly to operators that have already achieved leading environmental performance
- Emphasis on smart regulation should leave industry with a more practical and applicable and possibly harmonized set of rules to follow
- Technology (given its rapid changes) is better served by a performance-based or backstop regulatory setting than by prescription

4.4.2. Communication to public

Mechanism:

- The Canadian Centre for Energy Information (CCEI) can play the central role in improving communication regarding best-practice environmental technologies in upstream oil and gas
- Government and various industry associations are already represented (i.e. have MOUs) through CCEI
- Associations such as the Environmental Services Association of Alberta (ESAA), whose mandate includes speaking on behalf of the industry,[26] can also play more proactive roles in ensuring that the public perspective is fair and well-informed
- Public sensitivity to environmental issues will only be growing as Kyoto implementation approaches; industry has an opportunity to leverage this interest level
- Climate Change Central and PTAC also have roles to play in communicating appropriate messages to the public

Benefits:

- There will be long-term regulatory benefit from increasing the awareness of the public of the realities in environmental technology and upstream oil and gas
- Public needs to realize that oil and gas will be dominant energy sources for years to come
- Public deserves to know the success stories of the upstream oil and gas industry regarding protection of the environment
- Public will become more aware of the great improvement possible by invoking clever solutions (many of them home-grown) that are either already available or under development
- Public needs to realize the contribution that environmental supply and services is making – and can increasingly make – to our economy and our overall standard of living, particularly in rural areas and smaller centres where much of reduction/abatement activity will occur

26 ESAA, *Three-Year Business Plan 2003/04-2005/06,* July 1, 2004. ESAA representatives are well connected with oil and gas industry committees including CAPP and EUB bodies.

5. Conclusions

We believe that the cause of deployment of environmental technologies in the upstream oil and gas industry will be well served through adoption of a best-practice environmental technology theme and the implementation of complementary or supporting mechanisms including:

- Encouraging **development** of environmental technologies
- Ensuring **demonstration** and validation of best-practice environmental technologies
- Taking steps that will result in increased **deployment** of the best environmental technologies
- Backstopping or **defending** best-practice the oil and gas environmental technology market through regulation, enforcement and communication

With Kyoto coming into force in February 2005, governments' announcements regarding Kyoto plans and industry's reaction to these positions will set the tone of public debate in the months ahead. Important decisions with long-ranging implications, for both the environment and the economy, will be made. Governments provincially and federally are trumpeting the potential of technology to address the challenges of global warming. We have a chance to make the best of this state of affairs through advocacy of solutions via technology that will result in creation of advantages for Canadian industry, as well as sustained improvements for our land, air and water.

The recommendations in this report are not dissimilar to actions advocated in other recent studies addressing the environment and technology. Further, they set out what we believe will be an effective path for Canada's upstream oil and gas industry. It has been said that much of the required change in this industry depends on a cultural shift within the doors of the oil and gas producers. While we observe that our recommendations do not directly address culture, history shows it can be futile to attack culture head-on. We believe that the combined effect of these recommendations has an equal or greater chance of driving the needed paradigm shifts.

PTAC hopes that this report's recommendations will be instructive to the upcoming decisions on environmental policy that will be made at federal, provincial and industry levels. Unlike alternative approaches to Kyoto compliance, a course of action that promotes environmental technologies offers, in the long run, the required potential for emissions reduction while posing very little downside.

Industry and government today have an opportunity to collaborate on solutions that will not only benefit the environment and boost many small to mid-sized companies in the environmental technologies industry, but perpetuate the competitiveness and overall standing of the upstream oil and gas industry in Canada.

Appendix A: Project Information

TEREE Steering Committee

Name	Organization
Roxanne Pettipas (Industry Co-Chair)	ConocoPhillips Canada
Jerry Keller (Government Co-Chair)	Alberta Environment
Les Little	Alberta Energy Research Institute
Al Smandych	Alberta Energy and Utilities Board
Bryan Forsyth	BP Canada Energy Co.
Lynn Sveinson	Climate Change Central
Dave Karg	Devon Canada Corp.
Rudy Sundermann	EnCana Corp.
Shirley-Anne Scharf	Environment Canada
Phil Croteau	Petro-Canada
Roy Kanten	Shell Canada Ltd.
Sean Reilly	Talisman Energy Inc.
John Faber	Western Economic Diversification Canada

The purpose of the Technology for Emission Reduction and Eco-Efficiency Project is to facilitate technologies that will reduce the industry's impact on the environment, while improving profitability and eco-efficiency.

Interviewees

Name	Organization
Allan Amey	Climate Change Central
Rob Beamish	Calgary Technologies Inc.
Roy Kanten	Shell Canada Ltd.
Kathy Cox	Enerplus Resources Fund
John Faber	Western Economic Diversification Canada
Bryan Forsyth	BP Canada Energy Co.
Derek Hibbard	Canadian Association of Oilwell Drilling Contractors
Steve James	Precision Drilling
Norm Jede	Alberta Economic Development
Tony Kosteltz	Environment Canada
Les Little	Alberta Energy Research Institute
Terry Moffatt	Sirius Products Inc.
Joel Nodelman	Nodelcorp Consulting Inc.
Bill Reynen	Environment Canada
Duncan Stanners	Shell Canada Ltd.
John Sutherland	Dominion Exploration
Rudy Sundermann	EnCana Corp.
Amy Taylor	Pembina Institute for Appropriate Development
Gary Webster	Newalta

Interviewees who expressed a wish not to have their names published have not been listed.

Workshop Participants

Organization	Organization
AGAT Laboratories Ltd. – Hydrocarbon Division	International Energy Foundation
Alberta Innovation and Science	Mariah Energy Inc.
Alberta Research Council	MGV Energy Inc.
Bantrel Inc.	Morrow Environmental Consultants Inc.
BP Canada Energy Co.	Mount Royal College
Canadian Natural Resources Ltd.	New Paradigm Engineering Ltd.
Canadian Association of Petroleum Producers	Newalta – Environment and Technology Group
Canada Revenue Agency	OptiMax Energy Solutions Inc.
CDK Services Ltd.	Petro-Canada
CETAC-West	Pildysh Technologies Inc.
Climate Change Central	Pioneer Land and Environmental
ConocoPhillips Canada	Petroleum Technology Alliance Canada
Enviro Line	Sirius Products Inc.
Frac Rite Environmental Ltd.	Tech Com
G Tech Earth Sciences Corp.	University of Calgary
GSCI Geological Storage Consulting Inc.	Western Economic Diversification Canada

	Breakdown of Participants
13	Environmental technology companies
7	Government/research/academia
6	Industry associations
5	Oil and gas producers
2	Other

Appendix B: Further Analysis

PETROLEUM TECHNOLOGY ALLIANCE CANADA

Evidence suggests that ... *

- **The energy sector has *potential* to be a good platform for environmental technologies growth internationally**
- **Vendors sense more urgency to this issue than oil & gas producers or government**
- **Producers don't see themselves as unwilling or risk-averse**
- **Vendors feel they are at a disadvantage in Canada**
- **Government doesn't clearly perceive market deficiencies**
- **Producers don't agree stronger regulation will help**
- **Vendors don't see the energy sector as being overly beneficial thus far**

Level of Agreement with Statements in CETAC-West's 2003 Paper "An Assessment of Alberta's Environmental Technology Industry"
Where 1 = Strongly disagree, 7 = Strongly agree

CETAC-WEST STATEMENTS	AVERAGE LEVEL OF AGREEMENT			
	Total	Supplier	Government	Producer
Success in the energy sector will improve the ability of our environmental technologies industry to expand internationally.	5.51	5.56	5.31	5.38
There is a lack of urgency to dealing with the challenge of commercializing environmental technologies.	5.11	5.34	4.75	4.83
Many energy companies are no longer willing to work with environmental technology providers to trial risky products or services.	4.75	5.00	5.06	4.00
Government programs available to environmental technologies industry are not competitive with government support available in the U.S. and Western Europe.	4.72	5.00	4.19	4.26
The business environment to support the commercialization of environmental technologies is lacking.	4.71	4.94	4.00	4.75
The absence of a strong regulatory framework is a threat to the environmental technologies industry.	4.50	4.74	4.75	3.58
Market access, strong technical skills and a risk-taking culture offered by the energy sector have benefited the environmental technologies industry.	4.19	3.68	5.31	5.38

* These are not conclusions we can report with statistical confidence, but they do point to perception gaps that may exist.

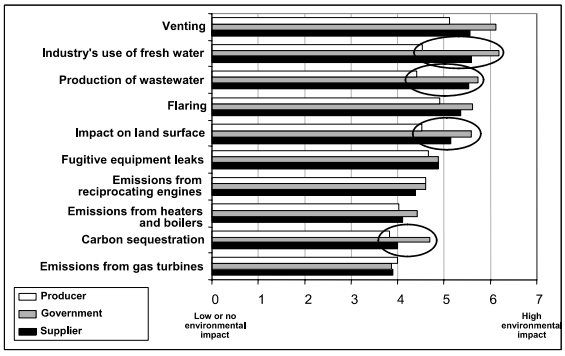
PTAC

Barriers Report 31 Jan 05

PETROLEUM TECHNOLOGY ALLIANCE CANADA

Producers see less environmental impact than government or vendors *

- **Impacts from venting, fresh water use, wastewater production and flaring are seen to be the most significant of environment challenges**
- **Substantial perception differences occur between oil & gas producers and others**
- **Government and technology vendors tend to see greater environmental impact while producers see less**



* These are not conclusions we can report with statistical confidence, but they do point to perception gaps that may exist.

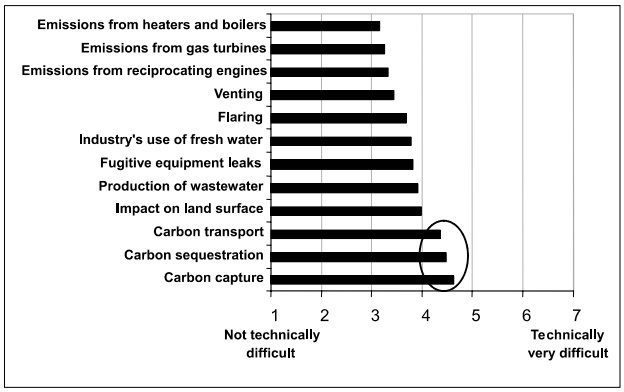
PTAC

Barriers Report 31 Jan 05

PETROLEUM TECHNOLOGY ALLIANCE CANADA

Technical difficulty appears to pose few barriers

- Many of the top environmental issues aren't seen as technically difficult to address, implying that technology exists or can be quickly adapted to meet most of our challenges
- Technical issues related to carbon capture, transport and sequestration are seen to be somewhat greater, but still not overwhelming



PTAC

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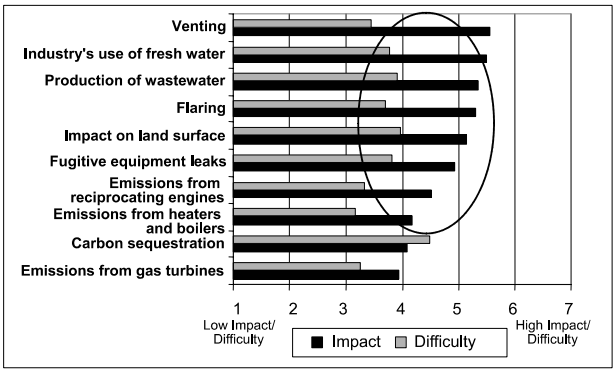
It would seem there is plenty of low-hanging fruit

- The gaps between perceived technical difficulty (generally low) and perceived environmental impact (generally high) suggest we can make considerable "green" mileage simply by better using existing technologies
- However, economic or market difficulty (as opposed to technical difficulty) is another question



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Levers are available to overcome the barriers

- **Most suggestions received relate to ways to create a market where, today, only a limited one exists**
- **Government regulatory actions have a clear role in creating a market**
- **Vendors, oil & gas producers and the public are also "part of the problem" (and can be part of the solution)**

Potential enablers

- Legislation/regulation and enforcement
  - Smart, non-prescriptive, staged, auditable – measurement and reporting requirement
- Joint industry/government-defined best practices and standards
  - e.g. National Framework for Petroleum Refinery Emissions Reductions, benzene dehy
  - e.g. Technology vetted by PTAC, best practices initiative facilitated by CAPP/SEPAC with input from EUB
- Industry/government involvement in technology assessment
  - External verification of costs/benefits of environmental technology
- Incentives for compliance
  - Resources to lower implementation costs and timeline
  - e.g. Flow through costs of environmental technologies to shareholders
- Awareness of environmental technology, benefits and sources of funding
  - Single window for information on technology, funding, success stories, cost/benefits (e.g. PTAC)
- Increase awareness of environmental issues (public and industry)
- Incentives for investment in environmental technology
  - 100% tax credit to investors or flow-through financing programs
  - Wider IRAP coverage (e.g. for equipment, not just labour)
- Requirement for accurate measurement and reporting
- Approach of suppliers of environmental technology more in line with producers
- Energy efficiency fund
  - Fund that industry members pay into for energy efficiency projects
  - Companies contribute to a fund administered by PTAC to disseminate technology
- Improved internal processes

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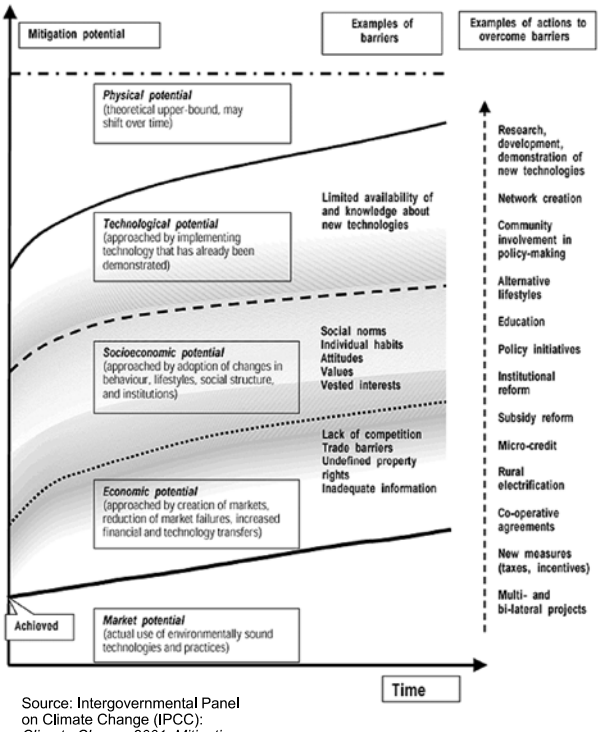
Conceptual framework for the penetration of environmentally sound technologies

- **This is another way of looking at the ground that can be covered through the deployment of environmental technologies**



Source: Intergovernmental Panel on Climate Change (IPCC): *Climate Change 2001: Mitigation*

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Appendix C: Barriers by Segment

Oil and gas producers (the customers)

- Environmental technology neither a core business nor considered central to business success
- Exploration is where this industry spends its risk money; R&D remains a poor cousin
- Spending on R&D is up in Canada but the rise has primarily occurred at the higher education level as opposed to direct government or industry spending; R&D spending as a percentage of GDP remains under 2% nationally[27] and under 1% in upstream oil and gas – with most of that occurring on unconventional energy sources
- At $40+ a barrel, environmental technology is considered a distraction more than an opportunity
- Some customers consider matters of health safety and environment as non-strategic (thus it is outsourced or sidelined)
- Many of the customers who do take a strategic approach to environmental matters are deliberately waiting for regulatory requirements
- Only a few are taking a proactive response by spending money now to prepare themselves for inevitable regulation
- There are "bright lights" including introduction of shadow pricing and emergence of corporate funds devoted to eco-efficiency – but these by no means are the rule
- Requirements including OH&S, Sarbanes-Oxley and emissions reporting are increasing the recognition of the need to better manage factors with potential impact on shareholder value (i.e. environmental risk, perceived or real)
- CAPP's mandatory reporting requirements (part of the Stewardship Framework) are kicking in providing a baseline that will greatly improve tracking and target setting down the road
- There is a critical need to keep the requirements for the customers simple, given time constraints and incredibly streamlined human resource complements

Technology vendors (the suppliers)

- Tends to be a fragmented community consisting of small to mid-sized developers and resellers with limited bargaining power and unsophisticated marketing
- Notwithstanding the issues, this sector has been growing at a rate outpacing the economy
- Indications of positive ROI and early paybacks abound (and are probably largely correct) but the sales process is bogged down by issues including access to decision-makers, credibility of the technology, and questionable need (i.e. existing solution may be dirtier but it is sunk cost and it "works fine")
- Some success getting to the demonstration stage but little carry-over into deployment (customers playing a waiting game)
- Generally a low awareness of how their governments may able to help and low ability to take the steps that would secure this assistance – probably a combination of lack of sophistication and lack of time
- Significant need for capital but a fair amount of difficulty raising capital

The public

- Tend to be reactionary and inconsistent (i.e. isolated incidents have garnered attention leading to pressure on legislators)
- The Clean Air Strategic Alliance (CASA) and the Alberta Water Council would not have happened without the public outcry, but the level of public understanding was sometimes only headline-deep
- Probably a lack of awareness as to the benefits, both public and private, of environmental technology
- Absolutely an absence of pressure originating from the investing public for deployment of eco-efficiency solutions

[27] "Spending on research & development," *The Daily,* Statistics Canada website: http://www.statcan.ca, Dec. 10, 2004.

- Rising energy prices have not triggered an increasing consumer preference for fuel efficiency or greener alternatives
- Support for Kyoto has risen since its introduction, but there is little understanding of the implications
- One-tonne challenge program launched by federal government will begin to heighten awareness
- Polls suggest that attention to oil and gas issues has been increasing and confidence in oil and gas industry's environmental commitment has been declining; in spring 2004, 41% of Canadians agreed that oil and gas is causing "significant damage" to the country's environment[28]

Governments

- From the days of the National Energy Program through ratification of Kyoto Accord, there have been provincial-federal skirmishes over energy and the environment, so while there is a need for enhanced cooperation or integrated programs this is an uphill battle
- Evidence that the federal government has been reaching out to better ascertain the needs of the petroleum industry and the west in regard to environmental policy
- A vacuum of information has been perceived in the past 18 months (once the furor over Kyoto ratification died down)
- Strong likelihood of federal green procurement policies coming down the pipe
- SDTC, innovation programs, sector tables have yet to make any significant imprint on the upstream oil and gas industry – SDTC, despite being established "to support innovative environmental technologies and to further encourage their commercialization,"[29] has a success rate of about 6-7%[30] and is viewed as "nearly impossible to access"
- Little or no input received on TEAM, suggesting awareness issues
- IRAP and SR&ED seen as positive programs with some opportunity for improved delivery but with flawed delivery (IRAP needs more funding, perhaps from the Alberta government, within looser parameters; SR&ED has improved but needs further upgrading and better communication of the process)
- More accessible, visible, trackable claims/applications processing would be a big help to funding/credit applicants for any federal or provincial assistance program
- Simplicity would increase the proportion of the value of these programs that actually accrues to technology development (it was observed that in some cases as much as 40% of SR&ED assistance has gone to the consultant or advisor rather than the applicant)
- Alberta has introduced and has been closely monitoring royalty credit programs designed to spur more investment in and deployment of technologies, particularly CO_2 reduction – seems to consider technology a big part of its plan to respond to Kyoto
- Evidence of an eagerness at many government levels to hear the "industry voice" as Kyoto-related policy gets written up

28
29 Grady Semmens, "Oil industry hurts environment," *Calgary Herald,* Calgary, Nov. 14, 2004.
GLOBE Foundation of Canada, *Report on the Western Canada Environmental Technology Industry Policy Recommendations Survey (2004),* a report to Western Economic Diversification, November 2004.
30 Recipients of funding as a percentage of submitted applications. Based on statistics available through Sustainable Development Technology Canada's website: www.sdtc.ca

Appendix D: Comments of Interest

- "What gets measured gets managed"… the major barrier to the oil and gas industry improving environmental performance is its inability to properly measure emissions. Quantification of baselines and results is necessary to rational management - the possibility of accurate analysis which permits efficient resource allocation. One should not expect the custodians of shareholders' money to incur costs without knowing the benefits.
- Public knowledge and accurate communication of real risks put into context of other common activities - many issues are actually quite easily managed or mitigated, and in my opinion not significant "environmental" issues, but aesthetic issues or conflicts of belief between multiple users.
- Oil and Gas Companies consider this a very low priority. Although you will find Environmental Stewardship in all of their web sites and literature it is either: 1) lip service from Presidential level or 2) not being pushed down to the level of people who can have a strong influence on products being bought buy the companies.
- Environmental projects, even if they offer a positive ROI, must compete for capital against non-environmental projects that offer a substantially higher ROI for the producing oil and gas companies.
- As long as true environmental issues not aesthetic remain unaccounted for in the economy, they will not be accounted for in business planning.
- The environment is not included in share holder value…corporations, boards, and executives are not held accountable for the environmental record of the corporation.
- Environmental stewardship hopes at the corporate level are do not get pushed down to the decision makers at the field level.
- Companies lack the process to get environmental technologies implemented.
- Past experiences have negatively impacted the “trust” needed to move forward new environmental technologies. E.g. Bioremediation.
- Legislation is likely the only driver that will have a significant effect.
- Compulsory education for people in industry and government responsible for environmental matters…ignorance of modern technologies is hurting our environment and our economy.
- Promote environmental technologies as economically beneficial, as well as environmentally and socially beneficial.
- Non partisan explanation of new technology with sufficient detail ... concrete government studies to prove or disprove ... an impartial, publicly available, scientifically defensible database of technologies with success/failure rates.
- Developers and vendors of the new tech need to understand that just because a tech has a short pay-out, that it doesn't mean that it is the best investment that a producer can make with those $$'s- i.e. back to the business case and budget cycle.
- Need to show a business case with less than one year payback, you need to go out to facilities, talk to people, review design and materials, utilization, associate closely with facility managers who sometimes lack the technical competence to follow you or to appreciate situations where excess energy is being used.
- There are hidden costs to the company over and above the cost of technology – training, new hires, stoppages in operations, etc.
- Projects are often too small to be considered. They’re not worth the effort. They’re noise next to the big multi-million dollar projects.
- “It’s a failure in marketing.” Technology companies don’t describe the value or product in terms that potential clients can understand. They need a deep knowledge of their clients to understand their problems, the right approach to solving these problems and to communicate the value of their solutions in the terms/language that their clients understand.
- The main barrier to the deployment of any kind of technology is the risk involved.
- Financial – environmental technology has to show a return significantly better than the average cost of capital to offset the risk.

- How tried/tested is the technology? Companies are hesitant to be the first. Adherence to status quo is less risky.
- Lack of government programming. Fragmented, inadequate government programming for SMEs. There is a lack of an integrated government funding mechanism and strategies. There's a disconnect between the federal and provincial governments over SME support and the development of an innovation system that covers the R&D spectrum.
- Conventional oil and gas is a mature field, a shrinking market. Lots of majors have sold out, consolidated, merged – small caps have taken over the field. They're financial plays. They leverage the balance sheet as far as possible and eventually cash out. The last thing they're interested in is R&D investments. Not interested in efficiency gains, not interested in the environment. They're the death knell for technology and innovation.
- Management is incented to meet but not exceed commitments on environment side.
- In most cases the environmental people in the oil and gas companies have little or no power, no spending authority. There are only a small number of companies where the environmental person has clout – the ear of the VPs.
- Once facilities are established and operating, the budget and logistics process (identifying new technology, vetting it, getting it in front of management and approved) is such a bump that it gets stopped or stalled in the process. It's related to the business design of the oil and gas industry, not a case of people not wanting to spend money or to reduce emissions.
- Challenge has always been not in developing the solution but in getting industry to do something about it.
- Government has to take the lead – that's their job. If they are taking responsibility for Kyoto and our economy they should ensure the processes are in place to facilitate deployment of environmental technology in the industry. They can provide systematic, common sense streamlining of funding programs.
- There needs to be more market push as opposed to business pull. Someone needs to market the good, viable, economic technology that helps address environmental issues because operators don't necessarily know it's out there.
- It's up to the individual technology companies to be more conversant with their customers.
- CAPP should be playing a leadership role. When the NPRI figures are tabulated, oil and gas will stick out. Before the spotlight is on them, CAPP should have a plan in place. They need to work cooperatively with regulators and their members.
- Public – another source of pressure to make change. There's a learning curve there for the public – they need to be informed about the options that are out there. People assume the best technology is being used.
- Given all the cases demonstrating the payback it's amazing that more companies are not deploying this technology. If air quality became a requirement companies would quickly find out what technology was the best.
- This has been sitting with industry for quite some time. It's like allowing the wolf to watch the hen house – it can work but there comes a point when the watchdog has to set the bar.
- Universities provide basic R&D but industry and government need to pickup where they leave off to apply the R&D.
- The EUB is in the best position so they should be in the driver's seat – industry has known better but hasn't done anything about it except minute improvements in air quality around stacks. EU did it with glycol dehydrators – allow industry time to comply, staged compliance.
- The industry is waiting for the EUB to do something – then we'll change.
- Carbon credits are too indirect. It's better to use an industry defined best practices approach. E.g. "Here's a system that's going to promote the engineering change that will reduce emissions." E.g. Glycol dehydrator program.
- Industry defined regulations and determination of best practices – this is an initiative that should be facilitated by CAPP. PTAC would vet the technology/process etc. then CAPP would facilitate the industry best practices initiative. Industry initiatives are better than government regulation – industry needs to strike a deal with government to do this.

- The better suppliers are telling industry “you guys can save money.” This is being done in small pockets, sometimes thru PTAC. Other suppliers are relying on the environmental benefits to try and sell it to industry – they’re stuck in the old paradigm. They must make a business case, not just the environmental case.
- Need increased visibility – a single window to answer producers’ questions about what are the programs, how do you get funding, what environmental technology is available. Everyone should know where the hub is.
- Technology companies need to set up demonstration projects and they need to carefully monitor and record the results to allow them to show the returns to companies. Government can assist with this.
- What is environmental technology? It used to be technology that helps monitor and clean the environment – end of pipe. Now it’s pollution prevention, sustainability. The focus is on clean energy, efficiency, and specific objectives – not environmental technology.
- EUB is one of the best regulatory bodies in the world – other countries come to AB to see how the EUB is modeled then they improve and adapt what they see to fit their situation. As good as the EUB is there’s room for improvement over certain ways of doing things but there’s “we’ve always done it this way” type of thinking.