CARBON CAPTURE AND STORAGE

A Pembina Institute–ISEEE Thought Leader Forum

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Carbon Capture and Storage Forum Proceedings

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About the Pembina Institute

The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org.

About ISEEE

ISEEE, the Institute for Sustainable Energy, Environment and Economy, develops cost-effective solutions to the environmental challenges of energy production and use. Created in 2003 at the University of Calgary, ISEEE provides the institutional leadership and the integrated, multidisciplinary research and education programs required for "Leading Innovation in Energy and the Environment," a top academic priority for the U of C as it drives to become a more prominent world leader in this area. For more information, visit www.iseee.ca or contact info@isee.ca.

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Carbon Capture and Storage Forum Proceedings

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Introduction

On November 10, 2008 the Pembina Institute and the Institute for Sustainable Energy, Environment, and Economy (ISEEE) at the University of Calgary co-presented a one-day *Carbon Capture and Storage Thought Leader Forum.* The forum was sponsored by both federal and provincial governments, a variety of companies and one non-government organization.

This document captures the proceedings from the day. Its goals are to:

a. capture opinions and policy design suggestions related to CCS policy in the areas of evaluation criteria, long-term liability and implementation of CCS, and
b. capture opinions and proposed revisions to the "straw models"[1] presented at the forum.

It does this by providing a synthesis of the break-out session discussions, plenary discussions and summary of plenary group polling on key issues that emerged throughout the day.

The report is organized into five sections. Section 1 provides an overview of the forum and its process. Section 2 provides an overview of the forum, Section 3 presents the results of polling conducted at the start of the day, and Sections 4 to 5 summarize the key issues discussed per issue area and suggested changes to and commentary on the forum's straw models. Finally, Section 6 highlights the key issues discussed and presents some steps forward for the process of developing CCS policy in the areas of evaluation criteria, long-term liability and closing the implementation gap.

It is important to note that the forum discussions were privy to Chatham House Rules; therefore, no attribution is made to any of the conference participants. Further, any inaccuracy in reporting the forum discussions is the responsibility of the Pembina Institute.

[1] It should be noted; policy proposals ("straw models") were developed by the Pembina Institute and ISEEE through their research and discussions preceding the forum. The forum presented an opportunity to test and refine the straw models to provide clear guidance and recommendations to federal and provincial decision-makers dealing with CCS policy.

1. About the Forum

The forum was conceived based on the understanding that:

- Carbon capture and storage has the potential to play an integral role in Alberta and Canada in meeting government commitments to reduce GHG emissions. In the Alberta government's plan, CCS is expected to account for 70% of emission reductions (139MT) by 2050. In the federal government's Turning the Corner Plan, CCS is expected to account for "as high as one-third to one-half " of Canada's projected greenhouse gas emission reductions in 2050.[2]
- Current financial commitments by the Alberta government and the federal government will be sufficient for the development of a few CCS pilot projects; however as those initial investments are phased out, there will exist a future financial gap between the revenue or compliance cost savings associated with CCS and the full price of implementation that will be a barrier to further implementation.
- CCS is a relatively untested technology as an integrated GHG mitigation technology in Canada with the potential to have significant environmental and social impacts. Given the scale and the long-term nature of stored carbon dioxide, these potential impacts must be considered very carefully. There is currently no specific regulatory process to address long-term liability issues. As such, there was a need to discuss the long-term liability for stored carbon dioxide.

It was designed to debate three key questions:

- What policy evaluation criteria are considered most relevant to CCS as a climate mitigation tool in Canada?
- What are the best policy options to cover the financial implementation gap between the revenue or compliance cost savings associated with CCS and the full price of broad-market implementation?
- What are the best options for dealing with post-abandonment liability for the stored carbon dioxide?

1.1 Pre-forum Research

The Pembina Institute and ISEEE provided a series of pre-read papers to provide participants with a basic foundation of working knowledge on the key issues. These included:[3]

[2] Natural Resources Canada, "Canada's Fossil Energy Future: The Way Forward on Carbon Capture and Storage" (January 9, 2008), p. 2. available at www.nrcan-rncan.gc.ca/com/resoress/publications/fosfos/fosfos-eng.php

[3] All the documents are available online at climate.pembina.org/solutions/ccs

- Dave Sawyer, Rochelle Harding, Christine Pozlott, and Peter Dickey, International Institute for Sustainable Development (IISD), *Environmental and Economic Opportunities and Challenges*.
- Nigel Bankes, University of Calgary, *Legal Issues Associated with the Adoption of Commercial Scale CCS Projects*.
- Jacqueline Sharp, M.K. Jaccard and Associates, *Canadian Public Views on CCS*.
- Jacqueline Sharp, M.K. Jaccard and Associates, *CCS Online Survey Results*.
- Marlo Raynolds and David Keith, The Pembina Institute and ISEEE, *Closing the Implementation Gap*.
- Mary Griffiths, The Pembina Institute, *Closing the Liability Gap*.

1.2 Forum Process

The approach of the forum was to bring together a multi-sector spectrum of informed perspectives on CCS as a tool to deal with GHG emissions. The 100 attendees included representatives from academia, environmental NGOs and a variety of private sectors, landowners and First Nations. Facilitators were drawn from both Pembina and ISEEE staff.

Dedicated breakout sessions were set up to address each question. These breakout sessions were composed of facilitated, small groups with representation from all sectors. Further, participants were encouraged to work through a series of steps:

- discuss the proposed "straw-model" options
- react to the options, opinions and ideas on the table
- synthesize areas of convergence, divergence and recommendations for divergences from the discussions

2. Forum Opinion Polling

Pembina and ISEEE commissioned Jacqueline Sharpe from M.K. Jaccard and Associates to conduct original opinion polling and review existing public polling in advance of the forum. The results of this survey were presented as pre-read materials.[4]

At the forum, a second survey was conducted that was meant to capture people's opinions on CCS after reading the forum materials and research papers. This on-site survey was completed by 91 of the 95 forum participants, with 48% from Industry, 20% from NGOs, and the remaining 32% from the Government, Academia, and Other categories combined. This compares to 87 (of 312 invitees polled) respondents to the pre-forum survey, and allows for some comparison between the two polling exercises.

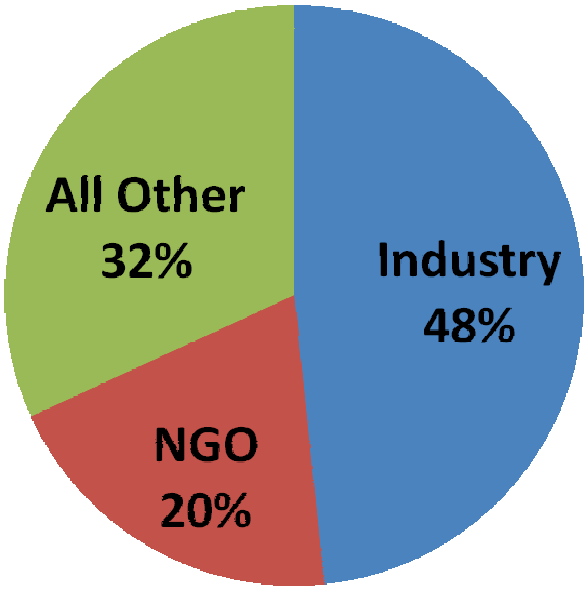

Figure 1. Profile of forum participants who completed the Forum Opinion Polling

2.1 Results of the Forum Poll

Overall, Industry and Other respondents believe that CCS will account for a large share of Canada's GHG emission reductions; more than 80% believe CCS will achieve more than 15% of Canada's GHG reductions, while more than half of NGO respondents believe it will account for 14% or less.

[4] See *Carbon Capture and Storage - Online CCS Survey of Sector Experts*, and *Canadian Public Views on CCS*, both available at climate.pembina.org/solutions/ccs.

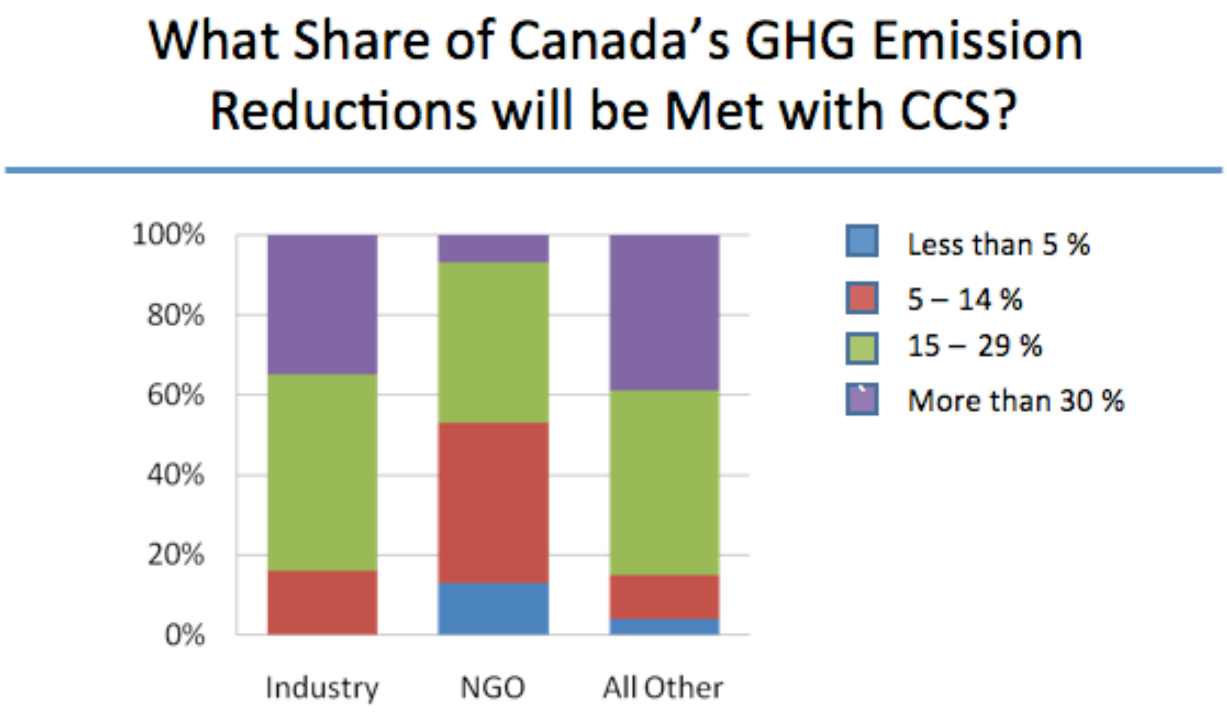

Figure 2. Survey respondents' opinion on what share of Canada's GHG emission reductions will be met by CCS

Source: M.K. Jaccard and Associates, 2008

Sectors represented at the forum were aligned in their level of concern about different CCS issues. Government policy certainty and stability and cost effectiveness were the top two issues for all sectors, while effectiveness of CCS and availability of infrastructure were the issues of least concern.

Relative Concern About CCS Development Issues

	Industry	NGO	All Other
Highest Concern	Government policy certainty Cost Effectiveness	Government policy certainty Cost Effectiveness	Government policy certainty Cost Effectiveness
Lowest Concern	Effectiveness Availability of infrastructure	Effectiveness Availability of infrastructure	Effectiveness Availability of infrastructure

Figure 3. Participants' concerns about CCS development issues

Source: M.K. Jaccard and Associates, 2008

Evaluation Criteria

Regarding policy evaluation criteria, the ability of a policy to result in rapid deployment of CCS is a top criterion for all sectors. Unlike the online survey, the ability of policies to provide investment certainty to industry is no longer one of the lowest ranked criteria for NGO respondents. Industry and Other respondents also put more importance on the ability of policies to protect the environment in the forum survey than they had in the pre-forum survey.

Relative Importance of Policy Evaluation Criteria

	Industry	NGO	All Other
Most Important	Policy predictability Rapid deployment of CCS	Rapid deployment of CCS Protect the environment	Policy predictability Rapid deployment of CCS
Least Important	Stimulate low-carbon tech Stimulate innovation	Stimulate innovation Administrative simplicity	Stimulate low-carbon tech Administrative simplicity

Figure 4. Relative importance of evaluation criteria to forum participants

Source: M.K. Jaccard and Associates, 2008

Closing the Implementation Gap

The forum respondents had different opinions about the share of the cost gap that should be met with a GHG price signal versus public support in the early adoption phase of CCS. Industry and Other respondents thought public support should account for 65% and 51% respectively of the cost gap, while NGO respondents thought public support should cover only 38% of the cost gap. However, by the 'wide penetration' phase, all sectors converged around the opinion that a GHG price signal should cover approximately 90% of the cost gap.

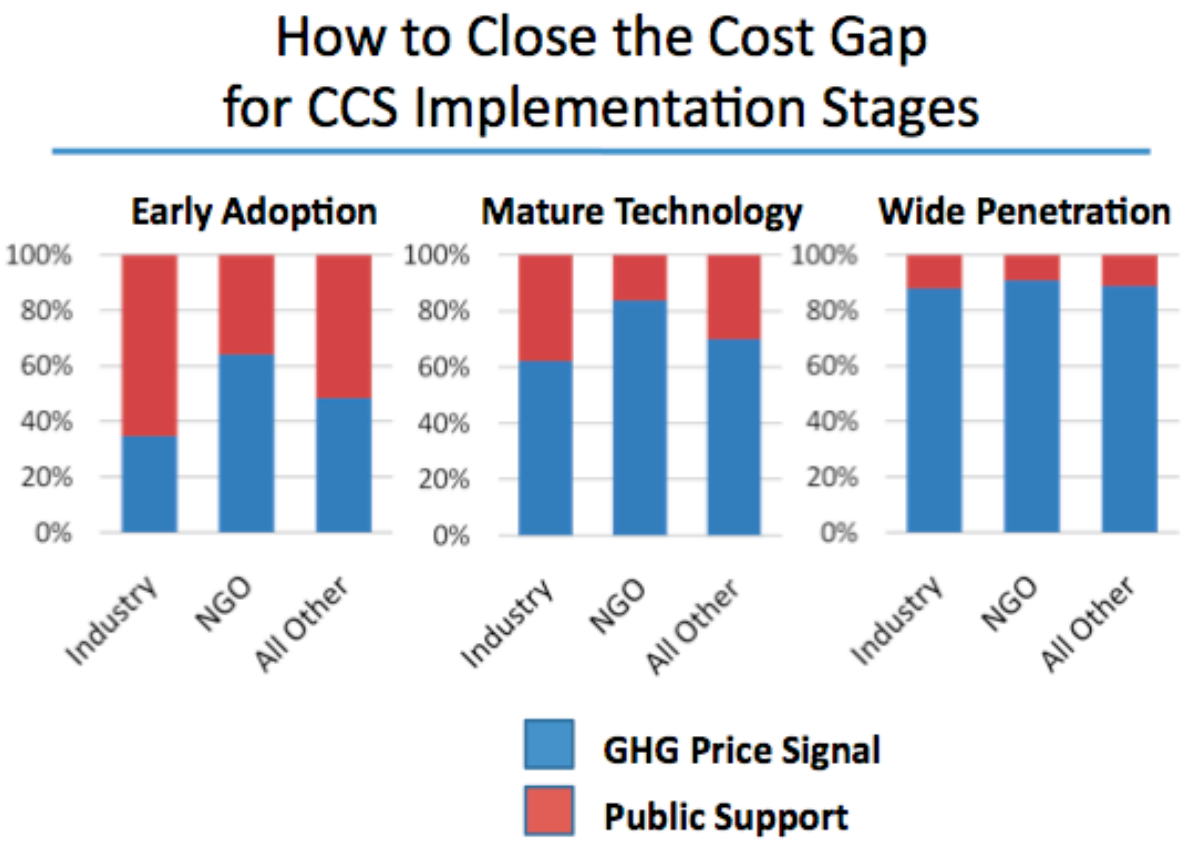

Figure 5. Participants' responses to how to close the cost gap for CCS implementation

Source: M.K. Jaccard and Associates, 2008

Preferences among the policy options for pricing GHG emissions were similar on the forum survey. All sectors agreed that a carbon tax with reinvestment was the best option, while a regulated requirement for CCS is disliked. An absolute cap and trade system with permit auctioning was one of the least preferred options at the forum for industry respondents, while that policy remained one of NGO respondents' most preferred options[5]. For industry respondents, an intensity-based regulation was one of the most preferred options, while it was one of NGO respondents' least preferred options.

[5] One factor to consider when interpreting the results of the surveys is that the pre-forum survey was conducted prior to the 2008 federal election and the on-site forum survey was conducted after the election.

Preferences among Policy Options for Pricing GHG Emissions

	Industry	NGO	All Other
Most Preferred	Carbon tax with reinvestment Intensity-based regulations	Carbon tax with reinvestment Absolute cap and trade	Carbon tax with reinvestment Absolute cap and trade
Least Preferred	Absolute cap and trade Regulated requirement	Intensity-based regulations Regulated requirement	Intensity-based regulations Regulated requirement

Figure 6. Participants' preferences for policy options that price GHG emissions

Source: M.K. Jaccard and Associates, 2008

When looking at the preferences among the different policy options to provide public funding for CCS, direct public subsidies are still one of the Industry and Other respondents' most preferred alternatives, but they rank as NGO respondents' least preferred alternative. Public infrastructure investments are favoured by NGOs and Other respondents, but not by Industry. Putting a guaranteed future value on GHG reduction credits is liked by both Industry and NGOs, but not by Other respondents. 'No Public Funding' (in response to comments received on the pre-forum survey) was an option selected by almost 9% of respondents, primarily from NGOs.

Preferences among Policy Options to Provide Public Funding for CCS

	Industry	NGO	All Other
Most Preferred	Direct public subsidy Guaranteed credit value	Public infrastructure invest. Guaranteed credit value	Direct public subsidy Public infrastructure invest.
Least Preferred	Public infrastructure invest. Royalty reductions	Royalty reductions Direct public subsidy	Government purchase of credits Guaranteed credit value

8 respondents, mostly from the NGO sector, selected "No Public Funding"

Figure 7. Participants' preferences among policy options for funding CCS

Source: M.K. Jaccard and Associates, 2008

Long-term Liability

The last question of the poll was about the relative importance of the various issues related to long-term liability. The top issue that emerged was the need for a clear definition of liability. The way liability costs are covered remained lower in importance to Industry and Other respondents, but was first in importance to NGO respondents.

Relative Importance of Long-term Liability Issues

	Industry	NGO	All Other
Most Important	Clear definition Point of liability transfer	How costs are covered Clear definition	Clear definition Party responsible
Least Important	How costs are covered	Point of liability transfer Party responsible	How costs are covered Point of liability transfer

Figure 8. Participants' responses related to the relative importance of long-term liability issues

Source: M.K. Jaccard and Associates, 2008

Areas of Agreement and Disagreement

Overall, the following are the most significant areas of agreement between the sectors:

- Government policy certainty and stability, as well as cost effectiveness, are among the most important issues to be dealt with around CCS while there is less concern about the effectiveness of CCS and the availability of infrastructure.
- One of the top policy evaluation criteria needs to be the ability of proposed policies to promote the deployment of CCS.
- A carbon tax with reinvestment in emission reduction activities is the best proposed policy for putting a price on GHG emissions, while a regulated requirement for CCS use is among the worst.
- The most important outstanding liability issue is the need for a clear definition of what is included in long-term liability.

Areas of substantial disagreement between the sectors, following review of the discussion papers, include the following:

- When selecting a policy to put a price on GHG emissions, industry favours intensity-based regulations and is opposed to an absolute cap and trade system, which is opposite the views of NGO and Other respondents.
- On the issue of long-term liability regulations, the point at which liability transfers from industry to the government or another body is very important to industry respondents, but of lower importance to respondents from the NGO and Other sectors. Conversely, how liability costs are covered is a top issue for NGO respondents, but remains lower in importance relative to the other issues for Industry and Other respondents.

3. Evaluation Criteria

In this session forum participants were tasked with discussing and prioritizing their most and least important evaluation criteria for effective CCS policies. The facilitators for these sessions were instructed to focus on capturing the areas of convergence, divergence and participant recommendations. This section summarizes these discussions.

A list of possible evaluation criteria, drawn from the forum's two policy option papers (*Closing the Liability Gap* and *Closing the Implementation Gap*), were presented to participants as a conversation starter. Draft evaluation criteria included the following:

- Administrative simplicity
- Ability to result in deployment of CCS
- Ability to provide investment predictability
- Ability to equitability distribute the costs associated with CCS
- Ability to stimulate innovation
- Ability to protect the environment and human health
- Flexibility and adaptability
- Ability to stimulate and expand other low carbon technologies

3.1 Synthesis of Discussions

The areas of convergence on evaluation criteria were by no means uniform across breakout groups. In some groups, individuals questioned whether CCS should be deployed at all while others felt that CCS should be deployed immediately and with details worked out later. (As one participant expressed, "This [long-term liability policy] will be figured out later. We need to get going on this and debates about equity will hold up the process.")

It was clear from many of the breakout groups that the need to protect the environment and human health was a "given."[6] Indeed, many groups expressed explicitly that environment and human health concerns were the main drivers for considering CCS in the first place. Further, a few groups had the view that CCS policy to protect environment and human health is more of an outcome than a specific criterion.

It emerged from the twelve separate breakout discussions that the criteria that were of highest importance to participants were:

- Ability to result in deployment of CCS
- Ability to provide investment predictability
- Flexibility and adaptability

[6] This was not a sentiment shared by consensus but the majority of the discussion tables expressed this sentiment.

Criteria of lower importance were reported as being:

- Administrative simplicity (e.g. "We need simplicity to highest degree possible without over-simplifying.")
- Ability to stimulate and expand other low-carbon technologies
- Ability to stimulate innovation
- Ability to equitably distribute the costs associated with CCS

3.2 Recommendations for Additional Criteria

A number of breakout groups suggested additional criteria for consideration in the design of a CCS policy framework:

- Communicability of the policy (e.g. it will be important that the public, tax payers and rate payers understand what they are paying for)
- Addressing the nature of CCS as a bridging technology (e.g. CCS is a temporary fix to a long-term problem)
- Competitiveness impacts (e.g. how will Alberta's or Canada's CCS policy affect key sectors of the Canadian economy?)
- Political feasibility (e.g. to what degree will governments be willing to mandate high levels of CCS deployment?)
- Timelines (e.g. timelines are critical to CCS, and we need to be clear about how much deployment is needed in what timeframe to gauge investment and policy drivers accordingly)

4. Long-term Liability

A number of liability issues need to be addressed before large-scale CCS can proceed. Mary Griffiths, Senior Policy Analyst with the Pembina Institute, highlighted the regulatory issues governments will face related to the long-term liability associated with CCS in the forum policy option paper *Closing the Liability Gap*.[7]

In the Long-term Liability breakout session, summarized below, participants were tasked with discussing what they liked and did not like about the Straw Model for assigning long-term liability for CCS. This straw model was developed by forum organizers as a result of research conducted prior to the forum.

In addition to capturing the discussions, the forum presented an opportunity to gather some instant opinions on particular issues related to CCS policy. During the lunch period, staff from the Pembina Institute and ISEEE worked with breakout group facilitators to identify key issues and corresponding questions for instant plenary polling. The grey boxes located throughout the next sections present the results of the plenary polling. Appendix A presents the graphical results of the CCS instant polling results.[8]

4.1 Straw Model for Assigning Long-Term Liability for CCS

The following straw model was presented to forum participants as a starting point for discussions.

[7] Mary Griffith. "Policy Option Paper—Closing the Liability Gap." October 2008. See climate.pembina.org/solutions/ccs

[8] We do encourage caution in interpreting the instant polling results, as we were not able to identify which sectors had what concerns.

Table 1. Straw model for assigning long-term liability.

Issue	Straw Model
What is included in long-term liability?	Legal liability for leaks through wells[9] and for leaks through fractures and fissures Liability for remediation Liability for environmental damage (e.g., soils, groundwater, surface ecosystems) due to leaks Liability for damage to wells and mineral resources Liability to compensate individuals for damage to property and/or persons as a result of a leak Monitoring, measurement and verification (MMV) of movement of CO_2 plume and maintenance of records for future generations
Who has responsibility?	The company remains responsible for the decommissioning period after injection well(s) have been abandoned. The length of the decommissioning period will be based both on performance of the CO_2 plume and time. The CO_2 plume should be moving as predicted in models and/or be relatively stable. Under normal circumstances, it is expected that the decommissioning period would last about 30 years. Depending on the CO_2 plume, a longer time-frame may be required for injection into zones for enhanced oil recovery or where there are many injection wells than for injection into a deep saline aquifer.
Which body takes over from company?	A semi-independent government body.
Who pays?	Company pays into a fund to cover MMV and liability and costs of remediation of leakage, etc., after responsibility has transferred to a semi-independent government body.

4.2 Synthesis of Discussions

Summary: What is included in long-term liability?

Some of the notable areas of convergence include:

- long and inclusive with a suite of sources of potential risk (e.g. CO_2 leakage)
- an approach to liability where risk is quantified in financial terms and managed through some form of polluter pays principle (e.g. environmental damage assessment, carbon pricing)

[9] This implies that a company injecting CO_2 should take over the liability for leaks through any abandoned wells within the pathway of the CO_2 plume. At present, the company that operated the abandoned wells has permanent liability.

There appeared to be two major areas where the forum participants diverged from the straw model:

- whether industry liability should/should not run for perpetuity
- whether liability for carbon dioxide emissions should/should not be included in long-term liability assessments and calculations

Some questioned the urgency for developing CCS-specific standards for addressing long-term liability, claiming that liability is adequately addressed by existing resource extraction regulations and common law practices. This led to the following instant polling question and response:

Polling Result: In response to the question *When are the standards for CCS specific long-term liability needed?* 51% of forum participants responded that the standards for CCS long-term liability are not needed now, while 49% responded that standards are needed right now.

The breakout sessions also provided a number of recommendations to consider in re-shaping the current straw model, including:

- assess long-term liability on a project-by-project basis
- include a separate liability for all secondary injections so there can be clear assignment of liability between primary (those that establish the storage field) and secondary injections (those that come after or later than the primary injections, including post-EOR related injections)

Further, there appeared to be a number of areas where forum participants felt that additional discussion and evaluation should take place:

- Who should develop the framework to dictate when liability is transferred?
- How does CCS liability differ from acid gas injection liability?

Summary: Who has responsibility?

The assigning of responsibility for long-term liability generated the greatest amount of debate among forum participants. Some of the clear areas of convergence included:

- There is a need for a formal mechanism to signify liability transfer (although there appeared to be no consensus or clear recommendations for how this mechanism might work).
- Government is ultimately responsible for long-term liability.
- Timing for the shift of responsibility for liability from industry to government would depend on the amount of liability covered by long-term fund payments and the extent that specific projects consistently met established performance standards.

There appeared to be two key areas of divergence related to assigning responsibility for long-term liability. These included:

- whether or not time should be part of a formula to dictate long-term liability handover
- whether or not Government should be forced to assume long-term liability

Individual breakout groups provided a number of recommendations addressing responsibility:

- Further research is needed to determine an appropriate time frame in which to transfer long-term liability.
- Research should be undertaken to determine a minimum time period before liability handover.
- Explore the benefits of strict liability versus standard liability as a policy for long-term liability.
- Consider project-based performance standards (versus a universal time period) for liability hand-off.

A number of critical issues were raised in the discussions related to who has responsibility. A number of groups identified the need to figure out how much risk is involved with CCS as this will ultimately determine who can and will deal with long-term liability.

Summary: Which body takes over from company?

The discussions that focused on which body should take over from companies after the carbon dioxide had been injected, stored and monitored for a minimum period of time was one that generated considerable agreement. A number of clear points of convergence that emerged included:

- Government would likely need to take over long-term liability.
- Government involvement is important.

Polling Results: In response to the question *Should long-term liability be transferable to other companies?,* 47% of forum participants agreed and 26% strongly agreed, while 17% and 10% disagreed and strongly disagreed respectively.

Forum participants provided a number of recommendations for how best to deal with which body takes over from companies. The recommendations included:

- Consider a separate corporation to cover long-term liability.
- Consider an independent body or Crown corporation (provincial or federal) that is science-based, with a board that includes representation from a broad range of stakeholders. The Nuclear Energy Committee, CASA, Alberta Surface Rights Boards, environmental reclamation process were given as examples.
- Consider having a monitoring body that is separate from the liability holder.

Summary: Who pays?

On the issue of who pays (i.e. financial liability) for long-term storage there was a considerable amount of discussion. Three points of convergence on who pays included:

- Risk should be passed to customers and not taxpayers.
- Governments need to gather more information to adequately assess costs and risks.
- Carbon credit ownership will need to be addressed, i.e. which body in the value chain should be able to claim the emission reduction credit?

The issues of who pays also presented areas of considerable divergence:

- payment mechanisms (there were many views on what was most appropriate)
- whether costs should be based on "polluter pays" versus assumed by the public
- whether liability can be shifted over time (i.e. between producers, transporters, injectors and monitoring bodies).

Polling Results: In response to the question *Should liability be heavier on government at the start while CCS matures, and then transfer from government to industry as we move from technology introduction to market maturity?,* 17% of forum participants strongly agreed and 38% agreed, while 28% and 17% disagreed and strongly disagreed respectively.

To adequately address the issue of who pays for long-term liability a number of recommendations were suggested by forum participants. These recommendations deal with how to protect against uncertainty of ownership and who should be responsible for ensuring that financial liabilities are covered.

- Consider multiple shields of liability (insurance, "superfund" and long-term bonds).
- Government should include a reach-back clause to deal with any potential negligence.
- Government has a role to underwrite liability and collect rents on any CO_2 tariff.
- The "Orphaned Well Fund" is a good approach.
- Who pays should relate to who is involved in the implementation stages of CCS.
- Payment mechanisms should include one or a combination of "superfund" payments, post bonds and private insurance.

5. Closing the Implementation Gap

The final breakout session of the day included a discussion of the second major theme of the forum, which focused on closing the implementation gap for broad CCS deployment. To foster discussion on this issue Marlo Raynolds, Executive Director of the Pembina Institute, and David Keith, Director of the ISEEE Energy and Environmental Systems Group, prepared a policy option paper entitled *Closing the Implementation Gap.*[10]

The discussions related to closing the implementation were focused on the straw model described in *Closing the Implementation Gap*. The straw model provided a policy framework and a series of tools for government and industry to consider in order to close the financial gap that currently exists between the price of carbon ($/tonne CO_2e) and the cost of CCS ($/tonne CO_2e).

5.1 Straw Model for Closing the Implementation Gap

The straw model presented in *Closing the Implementation Gap* presented a number of financing policy options for government and industry to close the implementation gap for CCS.[11]

Table 2. Straw model for closing the implementation gap.

Early Adopter Phase 2009 →	*Industry Coin*	Federal and provincial government set a floor on the 2020 price of CO_2 at $75/tonne. Market price signal for CO_2 of at least $30/tonne through provincial / federal regulatory frameworks. Industry at least matches value of all direct subsidies.
	Public Coin	Monitor and evaluate success of Alberta's $2 billion direct subsidy. Based on performance of initial direct subsidy, consider additional resources. Make all components of CCS eligible for accelerated capital cost allowance. Province of Alberta establishes and owns a "CO_2 Storage Utility".
Mature Technology / Rapid Market Transition Phase	*Industry Coin*	Market price signal for CO_2 of at least $50/tonne through provincial / federal regulatory frameworks including cap-and-trade and/or carbon tax. Significant portion of revenue from CO_2 price (e.g. permit auction and/or tax) reinvested in CCS.
	Public Coin	Direct subsidies end.

[10] For a copy of the paper see climate.pembina.org/solutions/ccs

[11] For a copy of the paper see climate.pembina.org/solutions/ccs

		Accelerated Capital Cost Allowance (ACCA) eligibility continues.
Wide Market Penetration Phase 2020 →	*Industry Coin*	Minimum CO_2 price of $75/tonne in place by either cap-and-trade and/or carbon tax. Minimal reinvestment of revenue into CCS. CCS is a requirement for all large point source emissions.
	Public Coin	The province's CO_2 Storage Utility is sold to the private sector with the objective to recover the public's investment. ACCA eligibility ends or is limited.

5.2 Synthesis of Discussions

The breakout discussions related to closing the implementation gap for CCS were undoubtedly the most contentious of all the breakout sessions. There were very clear differences on two critical themes related to CCS implementation:

- What proportion of CCS financing should government (versus industry) provide?
- Where should CCS fit into a general public sector GHG abatement plan?

The discussions were captured by the breakout group facilitators. The participants' comments typically applied across the various phases of CCS deployment presented by the straw model (i.e. Early Adopter Phase, Rapid Transition Phase and Wide Market Penetration Phase). Indeed, much of the focus of the discussion centered not on the specific implementation phases of CCS but rather on the recommended tools in the straw model.

Straw Model Design

Forum participants were able to find convergence on a number of key suggestions in the early adopter phase of the straw model. The convergence included:

- Up-front public investment in CCS is needed but public investment should taper off as CCS markets mature.
- Direct pubic funding for CCS will likely see significant resistance by the general public and a tool like ACCA[12] probably would be most appropriate.
- Governments need to establish suitable price signals to stimulate development; a high carbon price is likely the best tool. A high carbon price would be an effective approach to ensure the deployment and maturation of CCS.
- There is a need for multiple market signals to stimulate CCS project development, not just a floor price on carbon.

[12] Some classes of capital (specifically Class 41a assets) qualify for an accelerated capital cost allowance (ACCA). With accelerated capital cost allowances, the rate at which assets can be written off for tax purposes is more rapid than would be permitted under a neutral tax system. ACCAs result in tax deferrals for companies such that they pay less tax in the present and more tax in the future.

- The price on carbon needs to correspond with international prices to ensure market competitiveness.

The areas of divergence among forum participants related to the straw model but also to the scale of the problem at hand, when talking about the implementation gap:

- The gap in financing was thought by some participants to be understated, while others argued that it is overstated in the current debate.
- CCS may not actually be a cost to industry but an investment.
- An Accelerated Capital Cost Allowance (ACCA) should exist in perpetuity.
- There should be no CCS requirement for all point source emissions, i.e. government should not pick the GHG abatement technology.
- Government should initiate an Alberta CO_2 storage utility but it should not be government owned.
- Government should be involved only in storage, not in transport or capture.
- Storage facilities should be a public-private partnership (P3) rather than a utility model.
- Some participants opposed the price certainty mechanism (i.e. a floor price) and feel that a quantity certainty mechanism should be in place (i.e. government would set a minimum purchase amount).
- Several participants were concerned about the selection of policy mechanisms, and felt that regulation is required rather than a market-based approach.

The breakout groups provided a number of interesting recommendations for governments when dealing with the Early Adopter Phase of CCS implementation. Most notably the recommendations included:

- Governments should better understand how other jurisdictions are approaching carbon pricing.
- Governments should consider a larger GHG credit ratio for CCS (1:4 as in California) to spur deployment, rather than the same ratio as other technologies (1:1).
- Governments should provide additional clarity on what capital costs will be eligible for ACCA as some of the equipment used for CCS is likely to be the same as that of some production processes.
- The sooner we act, the greater the market opportunity is.

Instant Polling Results

Following the implementation gap breakout session, instant polling questions in the plenary indicated what forum participants think about carbon pricing, a major issue related to CCS implementation. The text box below summarizes the instant polling results.

Polling Results: Forum participants were asked three separate questions related to a price on carbon that the economy should be or would be exposed to by 2020. Not surprisingly, the forum participants diverged a great deal:

What price on carbon should the Canadian economy be exposed to by 2020?

A. <$30/tonne 5%
B. $31-$60/tonne 12%
C. $61-$75/tonne 8%
D. $76-$100/tonne 16%
E. >$100/tonne 22%
F. Close to the rest of the world 37%

What price on carbon do you expect the Canadian economy to be exposed to by 2020?

A. <$30/tonne 8%
B. $31-$60/tonne 39%
C. $61-$75/tonne 27%
D. $76-$100/tonne 9%
E. >$100/tonne 16%

What price on carbon should the Canadian economy be exposed to by 2020?

A. <$30/tonne 9%
B. $31-$60/tonne 19%
C. $61-$75/toanne 16%
D. $76-$100/tonne 28%
E. >$100/tonne 29%

6. Summary and Next Steps

6.1 Summary of Evaluation Criteria

The evaluation criteria session reflected degrees of difference between participants on key evaluation criteria, but there were no huge differences of opinion. This does not necessarily suggest wholehearted acceptance of the criteria list, but it does suggest that many components of the list are important to participants.

- The following are **high** priority evaluation criteria for assessing CCS policy:
    - Ability to result in deployment of CCS
    - Ability to provide investment predictability
    - Flexibility and adaptability
- The following are **lower** priority evaluation criteria for assessing CCS policy:
    - Administrative simplicity
    - Stimulation and expansion of other low-carbon technologies
    - Stimulates innovation
    - Equitable cost distribution
- It is clear from comments made by some breakout groups that further clarity will be needed in preparation for more detailed discussions on evaluation criteria. Some groups noted that some of members were at times confused about the precise definitions of each criterion.
- There is a strong need for education, communication and public awareness building in order for CCS to be fully accepted as a viable method for reducing Canada's GHG emissions.

6.2 Summary of Long-term Liability

Discussions during the forum on long-term liability provided a number of important insights for policy makers to consider when drafting policy for CCS long-term liability, and also highlighted the need for more focused and ongoing public dialogue related to the risk, costs, compensation and responsibility of long-term liability associated with CCS.

Some of the main issues related to long-term liability that were highlighted through forum discussions include:

- The role of government in long-term liability is likely to be very important and many participants expect that governments will ultimately be responsible for long-term liability.

- A number of different financing mechanisms should be explored to deal with long-term liability and these mechanisms should be pursued in parallel. The mechanisms identified from the breakout discussions included: a "superfund," long-term bonds, a model similar to the Canadian Deposit Insurance Corporation, and private insurance policies.
- There needs to be a clear framework for determining when and how long-term liability is handed over from companies to government or an independent body.
- A majority of forum participants think that liability should be transferable to other companies.
- Forum participants were evenly split on whether or not standards for CCS-specific liability need to be developed immediately. (The alternative to developing standards in the short-term is having regulators and policy makers draw from existing resource extraction regulations and common law practices.)
- Overall, the long-term liability straw model appears to include many of the critical components needed in a long-term liability policy.

6.3 Summary of Closing the Implementation Gap

The implementation gap straw model instigated an interesting debate about the key themes related to CCS implementation. The majority of the debate related to CCS implementation focused on three key areas:

- A number of possible economic tools can be used to encourage the deployment of CCS. Options that forum participants suggested include:
    - a higher carbon price than currently exists in provincial and federal climate policies
    - a multiple credit scheme for CCS related emission reductions
    - an accelerated capital cost allowance (ACCA) for CCS technology
    - more public subsidies in the early adopter phase and taper subsidies as the CCS market develops
- The roles government should play in CCS implementation, including:
    - whether the government should initiate the creation of a carbon storage utility that could be responsible for all long-term storage of CO_2 (but that government need not necessarily retain ownership of the utility over the long term)
    - whether government should help to initiate a public-private partnership responsible for storage
    - whether government should invest in CCS with an equity stake
- There needs to be further refinement of the "closing the implementation gap" straw model. There are a number of contentious components in the straw model, such as the concept of a government-owned utility, a guaranteed price floor, what assets are eligible for the ACCA and private funding to match public subsidies.

Several forum participants indicated that further research and public discussions are needed to clarify some of the pressing issues related to CCS implementation, for example:

- Clarify the actual costs of CCS implementation for enhanced oil recovery (EOR) and coal-based capture and for applications in the oil sands.
- Explore the potential range of financing options and what their repercussions may be for CCS deployment incentives, government revenue and industry profits.
- Examine a dual pricing scheme that would see a higher carbon price for sectors deploying CCS.

6.4 Next Steps

Discussions at the forum highlighted the fact that CCS policy is complicated and requires additional research, discussions and consultations before an adequate policy framework can be put in place to deal with long-term liability and implementation.

Based on discussion with forum participants, feedback through the forum evaluation forms and the issues highlighted from discussion at the forum, we have identified some possible next steps as important for moving CCS policy forward:

- Present the highlights of the forum to the Alberta and federal governments.
- Invite a smaller group of representatives from each sector to have more detailed discussions about the critical issues identified for CCS policy, namely:
    - Define the role of the government in long-term liability and implementation.
    - Discuss the merits and drawbacks of various financing mechanisms.
    - Develop a strategy to better communicate the key issues associated with CCS to the public.
- Conduct research on several risk scenarios to identify the potential sources of risk associated with the full supply chain of CCS.
- Identify and assess the tools to deal with long-term storage including insurance policies, a "superfund" or something akin to the "Orphan Well Fund," and bonds.
- Further assess the size of the implementation gap under a number of different future scenarios.
- Assess the potential effectiveness of various implementation policy tools, including the ACCA, a carbon price floor, higher carbon prices and a dual carbon pricing scheme.
- Investigate a number of different governance models, including their strengths and weaknesses, for a storage utility body.
- Develop and fund a public awareness and education programs to teach more about the critical issues associated with CCS, with a particular emphasis on landowners[13]. This could be used to build a CCS-appropriate public engagement mechanism to begin addressing the concerns of those within the vicinity of CCS transport and storage.

[13] Landowners as a group were under-represented at the forum, noted the landowners who did attend.

6.5 Further Research

This event has highlighted the importance of CCS as a potential emission reduction option for Canada and reinforced the need for research in a number of critical areas to better understand the risk, potential and opportunities presented by CCS. Possibilities include:

- explore the options and ramifications of various long-term liability financing options for companies, government and other sectors
- evaluate the economic risk presented by various types of CCS projects
- assess the short-term, mid-term and long-term opportunity presented by CCS given the current pace of industrial development, knowledge of the technology, emerging and present market forces and stock of industrial facilities current and scheduled to be in place in coming years
- develop an integrated 'one-stop-shop' resource for the CCS industry that summarizes jurisdictional and national efforts in CCS including research, development and deployment of CCS projects
- gauge and document landowner and Alberta residents' perspective and concerns related to CCS
- identify options and strategies to develop a CCS-appropriate public engagement mechanism to begin addressing local peoples' concerns related to CCS developments
- conduct a survey of industry players to estimate the true costs of CCS for all applications and to identify the business opportunities presented by CCS

Appendix A: Instant Polling Results

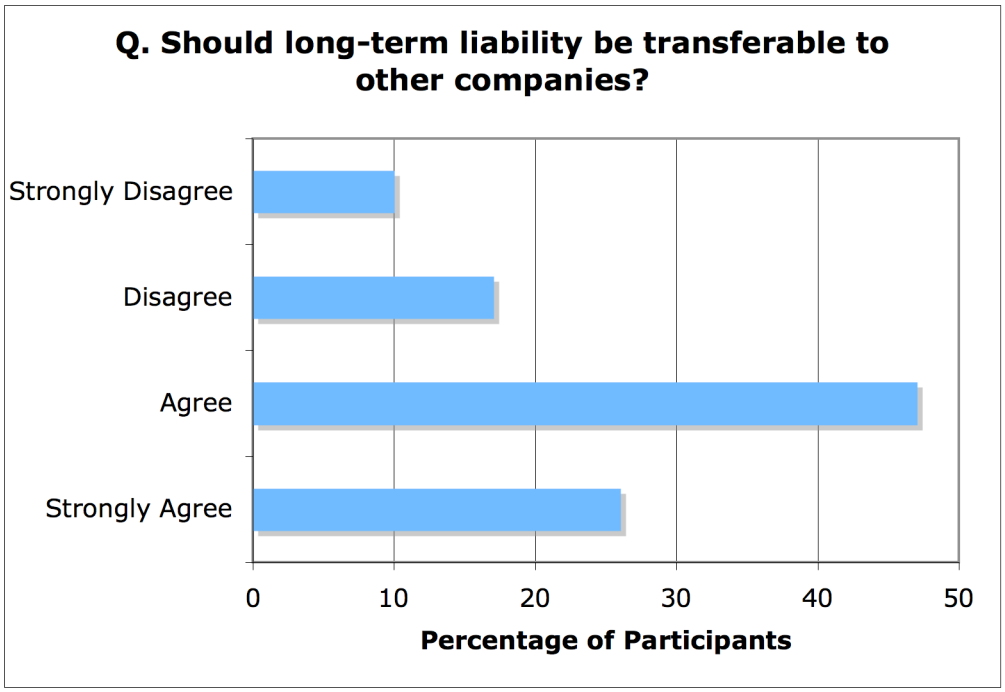

Figure A 1. Should long-term liability be transferable to other companies?

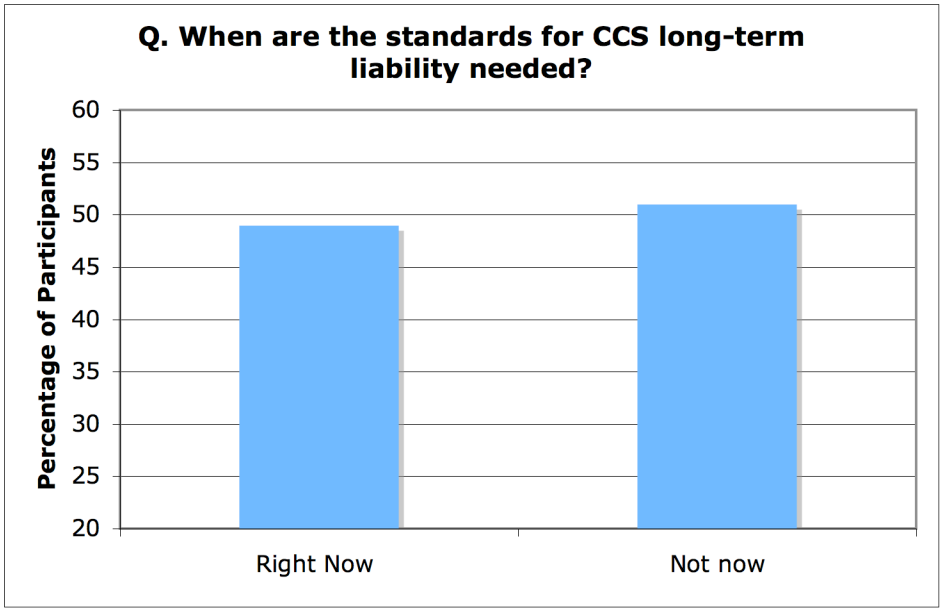

Figure A 2. When are standards for CCS long-term liability needed?

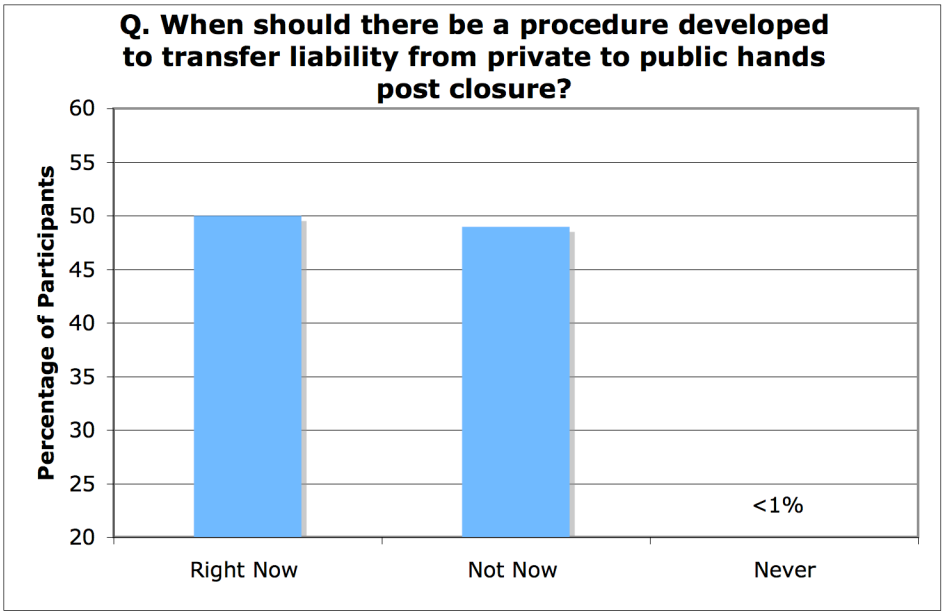

Figure A 3. When should a procedure be developed to transfer liability from private to public hands post-closure?

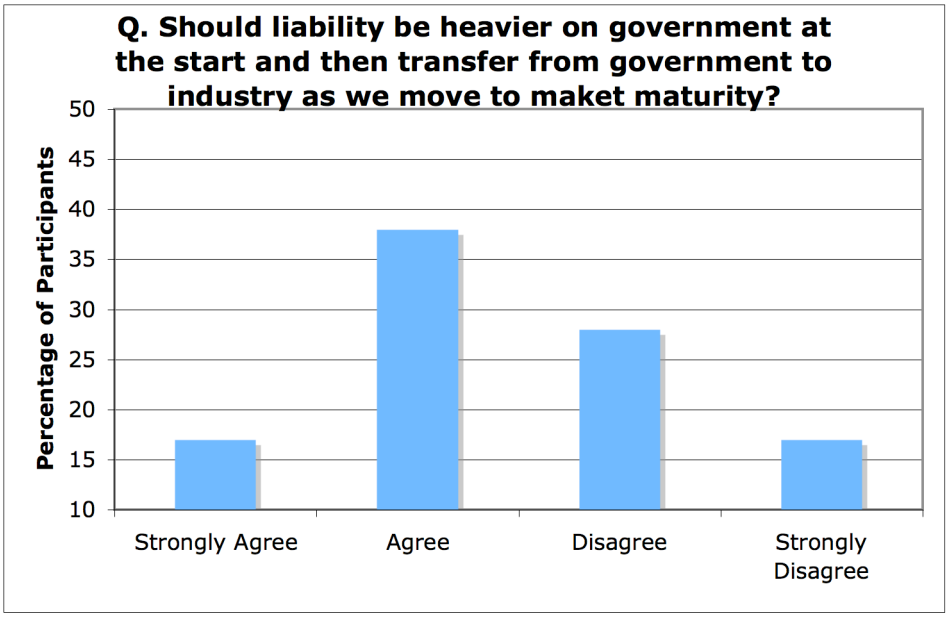

Figure A 4. Should liability be heavier on government at the start and then transfer from government to industry as we move to market maturity?

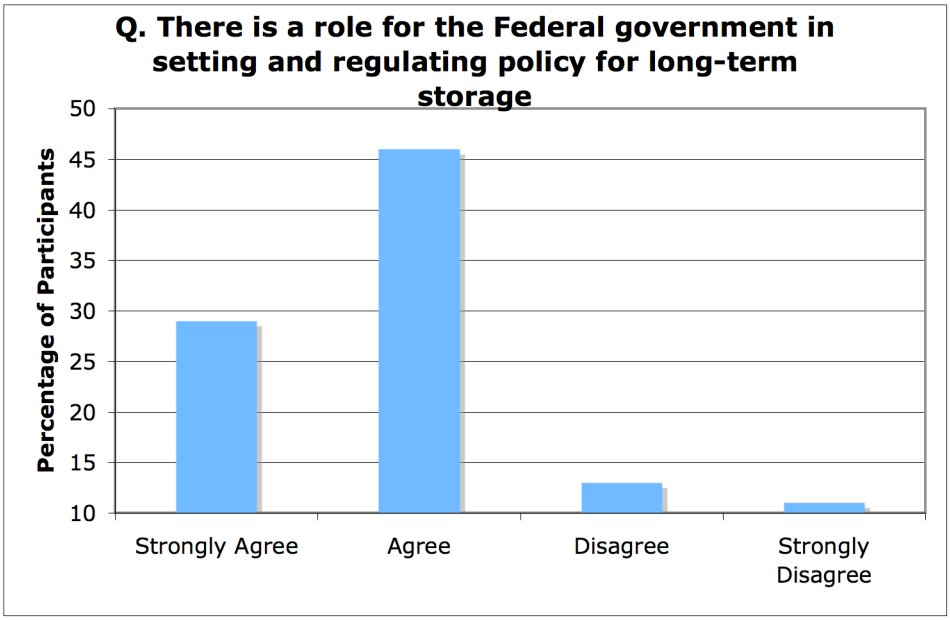

Figure A 5. There is a role for the Federal government in setting and regulating policy for long-term storage.

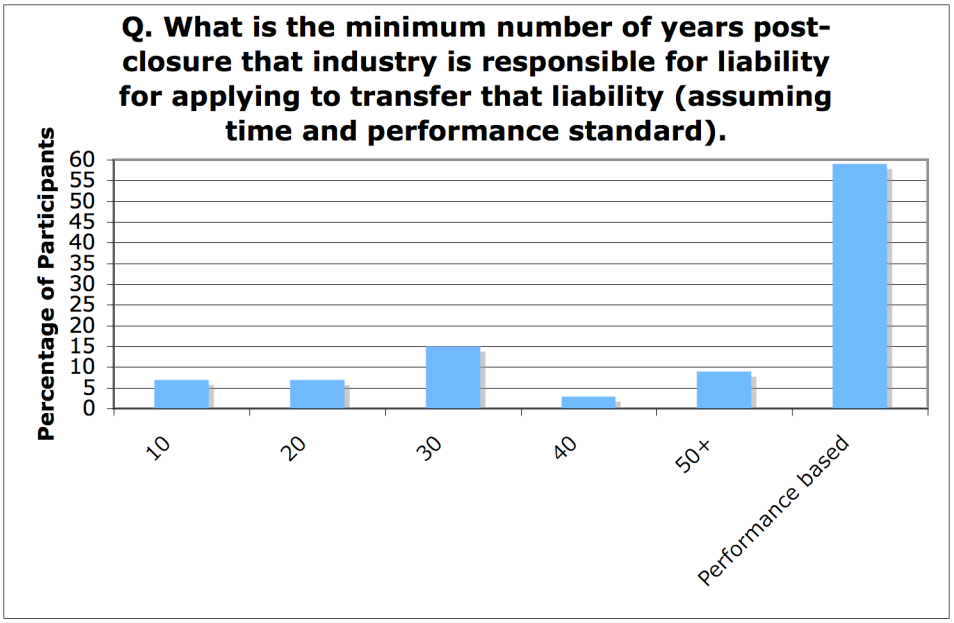

Figure A 6. What is the minimum number of years post-closure that industry is responsible for liability for applying to transfer that liability (assuming time and performance standard).