Creating a More Resilient Yellowknife

Climate Change Impacts & Municipal Decision Making

Final Project Report

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Sustainable Energy Solutions

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About the Pembina Institute

The Pembina Institute creates 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. More information about the Pembina Institute is available at http://www.pembina.org or by contacting info@pembina.org.

About the Pembina Sustainable Communities Group

Since 1992, the Pembina Institute has worked with First Nations communities throughout Alberta, British Columbia, Manitoba, Saskatchewan, Ontario, Quebec, the Northwest Territories and the Yukon. The Sustainable Communities program is an integrated team of professionals with the qualifications, experience and enthusiasm to provide quality education, capacity building, planning and engineering, technical assessment and business development components for sustainable energy projects.

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1. Executive Summary

Canada's municipalities are increasingly facing the realities of climate change impacts, none more so than northern communities. Early understanding of local climate change impacts and a pro-active approach to reducing the community's vulnerabilities to them is essential to build a more resilient community.

The municipal decision making process has many components: staff reports; the work of standing committees and ad-hoc task forces; recommendations from external agencies; issues brought directly to the municipalities attention by committee members, community or Councilors; and ultimately Council decisions that set the course for the future of the community and its residents.

Many of these decisions have a durable impact many years into the future. This future has significant uncertainties with regard to climate change impacts and how they might affect the longer-term outcome of those council decisions. Understanding these climate change scenarios, their degree of uncertainty and how they might affect major capital investment decisions is essential to ensuring efficient use of tax dollars.

The intent of this project is to set Yellowknife on a path to prudent risk management of climate change vulnerabilities. It will result in improvements to decision-making that gives appropriate significance to climate change impacts, and enables the municipality to adequately consider community safety, security and livability in every decision.

The overall objective is to develop the tools, capacity, and decision-making processes necessary for the City of Yellowknife to systematically address any community climate change impact as it emerges.

The project was targeted at elected officials and administration at the City of Yellowknife. Three half-day workshops were hosted for these decision makers. The workshop objectives were to:

- create a common understanding of climate change adaptation and what it means for Yellowknife;
- engage participants in identifying climate change impacts and how to improve the City's response to impacts;
- develop risk assessment and decision-making criteria, structure and model for Yellowknife;
- identify how to add value to other planning processes;
- identify decision-making triggers and explore opportunities for implementation.

Much information was gathered in advance of participant workshops to allow elected officials and staff to collectively work through the adaptation issues at hand. Real world examples of local impacts and responses were used wherever possible.

In the space of 3 half-day workshops, participants were lead through a process that:

- reviewed past historical and future climate scenarios for Yellowknife;
- undertook a high level scoping of anticipated future impacts;
- reviewed responses to climate change impacts to date and identified opportunities for improvement;
- reviewed case studies from other jurisdictions;
- introduced risk management and evaluation tools, applied the tool to anticipated future impacts, and revised them for Yellowknife's needs;
- identified when climate change impacts should be considered in municipal decision making;
- identified where policy and practices need to be revised to include climate change impacts in these decisions;
- generated common understanding among decision makers to enable a shift in how decisions are made with respect to climate change adaptation without resorting to paralyzing analysis.

The results of the workshops informed the development of risk management and evaluation tools and the development of a series of recommendations to put Yellowknife on the road to the systematic consideration of climate change impacts in decision-making. These recommendations were developed by the Pembina Institute after completion of the workshops and are presented for the City's consideration in developing an implementation plan. The recommendations are:

1. Adopt a comprehensive climate change adaptation policy.
2. Assign a Climate Change Adaptation Co-coordinator
3. Establish a multi-stakeholder 'Climate Change Adaptation Review Committee'.
4. Employ the decision support tools developed through this project to create a climate change risk and adaptation library.
5. Host a public open house to share these tools and findings with the public.
6. All 'requests for decision' reports for Council should include a section on 'Implications for Climate Change Adaptation'.
7. Have all suppliers of goods and services over a predetermined value provide evidence of how they have considered climate change impacts in providing goods and services.
8. In advance of (7), educate the City's suppliers and service providers on the climate change adaptation policy.
9. Address any critical climate change impact risks as a matter of urgency.
10. Review public infrastructure investment plans through the climate change adaptation 'lens' for prioritization.

11. Establish a schedule for the review of Yellowknife's bylaws, policies and plans
12. Give climate change adaptation its own line item in the Operating Budget.
13. Four times a year, the Adaptation Coordinator should host a meeting of the Climate Chang Adaptation Review Committee to consider key adaptation decisions made.
14. Consider commissioning a climate futures study for the area that has greater resolution than the data provided for this project.
15. Pursue intergovernmental policy review to maximize opportunities for adaptation where there is shared responsibility for services and infrastructure.
16. Press for the development of institutional support for ongoing adaptation work

This project has enabled the City of Yellowknife to make progressive steps towards becoming a model of climate change adaptation decision making for other communities. Implementation of the recommendations will ensure informed, accountable decision making that evolves and becomes refined with time.

Creating a More Resilient Yellowknife

Climate Change Adaptation & Municipal Decision Making

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2. Introduction

"Adaptation to climate change is now inevitable. The only question is whether it will be by plan or by chaos"

Roger Jones, Co-Author of the IPCC Report *Climate Change 2007: Impacts, Adaptation & Vulnerability* in an interview with Time magazine, April 2007.

Canada's municipalities are increasingly facing the realities of climate change impacts, none more so than northern communities. Early understanding of local climate change impacts and a pro-active approach to reducing the community's vulnerabilities to them is essential to build a more resilient community. This sentiment was echoed in two key reports in the fall of 2006.

Firstly, Johanne Gelinas, the Commissioner of Environment and Sustainable Development noted in her report of September 2006 that 'The government has not yet put in place key measures to support Canadians in adapting to a changing climate. . .. . . Federal progress in working with provinces and territories has been limited". '"'Climate change is upon us and no matter how you look at it, the stakes for Canada are high" she said in the accompanying press release.

Secondly, Sir Nicholas Stern, former Chief Economist and Senior Vice President for the World Bank, and the current Head of Government Economics Service for the British Government released his report on *The Economics of Climate Change* in October 2006. The report stated that, if not addressed immediately, the impacts of climate change could cost the world economy between 5% and 20% of GDP, whereas immediate action could limit that cost to around 1% of GDP. Stern stated in his report, "Our actions now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes". While efforts to reduce greenhouse gas emissions can limit the degree and duration of future impacts, only adaptation strategies can begin to insulate our communities from those effects already occurring or confidently anticipated given the current concentration of greenhouse gases in the atmosphere.

At the community level, the City of Yellowknife has undertaken some preliminary work to raise awareness of the possible impacts of climate change on municipal infrastructure. In March 2006 Ecology North facilitated a workshop to introduce some of the basic concepts behind municipal adaptation and explore some of these issues. The workshop was based on 'Adapting to Climate Change – An Introduction for Canadian Municipalities', a publication by the Canadian Climate Impacts and Adaptation Research Network (C-CIARN) in February 2006.

This early work engaged municipal staff in beginning to think about how their community services may be impacted. Some existing, observed impacts included:

- Impacts of freeze/thaw 'heaving' on infrastructure;

- Thaw slumping into surface waters that are the source for potable water (resulting in high turbidity issues); and
- More intense and frequent snowstorms impacting the transportation of goods and services in the region.

This project aims to build on that brief introduction with a systematic and comprehensive review of how prepared the municipality is to make decisions on climate change adaptation. The review will inform the development of more robust systems to ensure that climate change impacts are addressed effectively and efficiently.

The municipal decision making process has many components: staff reports; the work of standing committees and ad-hoc task forces; recommendations from external agencies; issues brought directly to the municipalities attention by committee members, community or Councilors; and ultimately Council decisions that set the course for the future of the community and its residents.

Many of these decisions have a durable impact many years into the future. This future has significant uncertainties with regard to climate change impacts and how they might affect the longer-term outcome of those council decisions. Understanding these climate change scenarios, their degree of uncertainty and how they might affect major capital investment decisions is essential to ensuring efficient use of tax dollars.

Pro-active consideration of climate change impacts on infrastructure investment decisions is crucial to the development of a resilient community – one that protects the social fabric, economic heart, and environmental assets of the community.

The intent of this project is to set Yellowknife on a path to prudent risk management of climate change vulnerabilities. It will result in improvements to decision-making that gives appropriate significance to climate change impacts, and enables the municipality to adequately consider community safety, security and livability in every decision.

The overall objective is to develop the tools, capacity and decision-making processes necessary for the City of Yellowknife to systematically address any community climate change impact as it emerges.

Little work has been done to date to examine how climate change impacts should be addressed within municipalities in Canada. Questions that have not been fully explored yet include: What impacts have been observed to date? How well did the municipality respond to it? Can we rely on these traditional types of responses in the future? How do we inform ourselves of future risks and develop better ways to address them?

By using past examples to analyze municipal responses, improvements can be made to ensure that the community is as robust as possible to the threats of climate change impacts.

There are two key parts to the project.

First, how do we ensure we have decision making systems in place that give appropriate significance to climate change impacts in the decisions Council and administration makes every day, week and month?

Secondly, how do we ensure that climate change vulnerabilities are adequately considered in strategic community plans?

The City of Yellowknife is an ideal candidate for this project based on the following recent experiences:

- The introductory climate change adaptation workshop that was facilitated by Ecology North in March 2006 has established a solid foundation from which to build on;
- Impacts on the community from climate change are already being felt and is creating a sense of urgency to pro-actively address them; and
- The strategic planning that is currently underway at the City provides opportunity to demonstrate integrated thinking and progressive action on the protection of community assets for future generations.

This project will create a City of Yellowknife that is inherently and pro-actively 'climate impact conscious'.

Community resiliency to the impacts of climate change requires the development of adaptation strategies that reduce the risks to community resources and infrastructure. By pro-actively increasing the coping capacity of community systems, the risk of these impacts on the community can be reduced to an acceptable level.

Building adaptive capacity involves the identification of future climate change impacts, assessing the vulnerability of community resources and infrastructure, and putting in place the decision making process to address them proactively. Funded by Indian and Northern Affairs Canada, this project aims to build adaptive capacity within the governance and administration of this northern community.

It should be noted that the City of Yellowknife is already actively engaged in climate change *mitigation* measures with the implementation phase of its Community Energy Plan. These climate change *mitigations* and *adaptations* compliment each other by creating a holistic approach to protecting community assets by reducing the risk of significant impacts. *Mitigations* (reducing greenhouse gas emissions) essentially aim to reduce the degree and duration of climate change impacts by reducing our contributions of atmospheric greenhouse gases, and hence the resultant changes in climate. *Adaptation* aims to insulate our community systems from the climate change impacts that are now likely to occur despite our efforts to mitigate them.

3. Methodology

3.1 Local Context

The City of Yellowknife undertakes numerous activities with respect to community planning, and many are directly related to climate change. This section summarizes several of these initiatives and their link to climate change.

The City of Yellowknife had already invested significant time and resources into climate change mitigation in terms of the development of the Community Energy Plan and its consequent and ongoing implementation. However, proactive attention to climate change adaptation was largely absent. This is not surprising given the emerging nature of the discipline. The City's enthusiasm for this project was clearly an indication of their desire to lead their community and others in this regard.

The 2004 Yellowknife General Plan is the official community plan that details the history of development in the area and sets out the preferred future of the community. This plan takes the traditional approach of employing the last 30-year average weather pattern as a template for what should be expected of the local climate in the future. Weather records from Yellowknife airport suggest that this assumption is ill founded. The significance of this becomes apparent when considering the long-term land use and development patterns that are found in official community plans.

In 2006, the City commissioned a Capital Infrastructure Deficit Plan. This plan aims to provide the City with a calculated assessment of the value of public infrastructure in the community, its lifespan, remaining expected life, cost of replacement, and cost of maintenance for municipal budgeting and capital project prioritization purposes. This Plan did not consider anticipated climate change impacts in its assessment, thus limiting its resiliency to expected changes.

In the fall of 2006 as this project got underway, the Government of the Northwest Territory launched a series of workshops aimed at engaging communities in the design of a template for developing their Integrated Community Sustainability Plans (ICSPs). The development of these plans would be a prerequisite for the communities to access gas tax revenues for infrastructure spending. Integrating climate change adaptation into community planning processes like the ICSPs is a crucial step towards ensuring the long-term resiliency of the community.

3.2 Project Rationale

The methodology followed a logical progression from examining past climate change threats and responses, to a review of the desired future for the community, the potential future climate change risks and how to improve municipal decision making to address them. The project involved:

- A review of existing community planning documents and infrastructure plans, the community vision and the desired future for the community;
- A review of the outcomes of the March 8th Climate Change Adaptation workshop facilitated by Ecology North with City of Yellowknife staff. This included an examination of historical threats to the community from climate change;

- An examination of how any existing climate change impacts have been addressed. (What brought the issue to the attention of the municipality? Was it addressed pre-emptively, or did it become a crisis management situation? How was the decision made to take action? What were the difficulties in making an informed decision?);
- A review of the potential risks to the preferred 'community future' described in existing community plans from climate change scenarios and their impacts;
- Presentations of the most up-to-date climate change scenarios available from technical partners (e.g., Environment Canada, the Climate Change Impacts & Adaptation Research Network C-CIARN);
- An examination of the scope of possible climate change impacts from these scenarios. (How significant would they be to the community? How pro-active does the municipality need to be in addressing these issues?);
- An exploration into how best to improve those decision making processes to ensure they are made more effectively, efficiently and remain consistent with the long term vision of the community;
- Engaging the municipality's elected officials and key administrative staff in the process to ensure organizational buy-in to ensure climate change adaptation is a priority consideration in the City's planning & operations;
- Engaging the relevant territorial government departments that maintain key relationships with the City on climate change impacts (e.g., the Department of Municipal and Community Affairs, and the Department of Public Works and Services);
- A review of the existing committee structures, policy standards, risk management tools, project prioritization tools, and decision making processes as they relate to climate change impacts.

The project was targeted at elected officials and administration at the City of Yellowknife. However, it is recognized that there are other key decision makers in the community who support different aspects of community life who need to be engaged also. Chapter 7, 'Recommendations', addresses this.

Much information was gathered in advance of participant workshops to allow elected officials and staff to collectively work through the issues at hand. These workshops were held in Yellowknife City Hall. Real world examples of local impacts and responses were used wherever possible. Integration of this work into the development of the ICSP and capital infrastructure plan was not possible due to timing limitations, although the many lessons learned will influence their future review and revision.

The workshop design initially called for 3 full-day workshops with Council and key staff at the City. Unfortunately, this proved too demanding a time commitment for the municipality and the design was adjusted to deliver 3 half-day workshops. The reduced contact time made the project schedule very challenging and required the redesign of workshops to ensure the agendas accommodated the key capacity building themes.

These workshops involved working groups where participants were presented with key material for about hour, with the remaining 3 hours of the afternoon dedicated to participants working through issues and developing solutions themselves. The intent was to provide an engaging

process that would build understanding, commitment and desire for action within the working group to continue with the work in the future. This project did not intend to produce a climate change adaptation plan for the City of Yellowknife, or solve particular project or impact issues.

By creating the conditions for the integration of decision support tools, and the internal infrastructure to support it at the City, the ongoing attention to adaptation would be secured and left sustainable in the hands of project participants.

3.3 Workshop Objectives

Workshop #1: Climate Change Impacts & Current Response Capacity

18 January 2007, Yellowknife City Hall

Objectives: To create a common understanding of climate change adaptation and what it means for Yellowknife.

To engage participants in identifying climate change impacts and how to improve the City's response to impacts.

Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application

22 March 2007, Yellowknife City Hall

Objectives: To develop risk assessment and decision making criteria, structure and model for Yellowknife.

To identify how to add value to other planning processes.

Workshop #3: Decision Making Triggers & Implementation (revised)

10 April 2007, Yellowknife City Hall

Objectives: Initially, this workshop was reserved for the development of activities that would foster continued implementation amongst stakeholders. However, due to the limited amount of total workshop time, some activities from workshop #2 were not completed on that day and were deferred until workshop #3. As a result, workshop #3 focused on decision-making triggers and opportunities for implementation. The initial objective of workshop #3 was still achieved as this process demonstrated the degree of unity amongst stakeholders for further progress on the issues.

4. Yellowknife's Changing Climate

4.1 Historical Climate Data

Concurrent with this project, Jim Sparling, Manager of Climate Change Projects at the Government of the Northwest Territories (GNWT) was managing a project researching weather data from Yellowknife airport for a report titled 'Climate Observations in the Northwest Territories". This data dated from the 1940's to 2005. The report focuses on seasonal temperature means and precipitation patterns. It does not address the frequency or severity of extreme weather events, or the degree of predictability of short-term weather forecasts – a key variable in climate change impacts.

For temperature, the data showed:

- Mean annual temperature rise of 2°C (1943-2005). See Figure 1.
- Mean winter temperatures rise of 3.5°C (1943-2005). See Figure 2.
- Mean spring temperatures rise of 2°C (1943-2005). See Figure 3.
- Mean summer temperature rise of approximately 1°C (1943-2005). See Figure 4.
- Mean fall temperatures showed no significant change. See Figure 5.

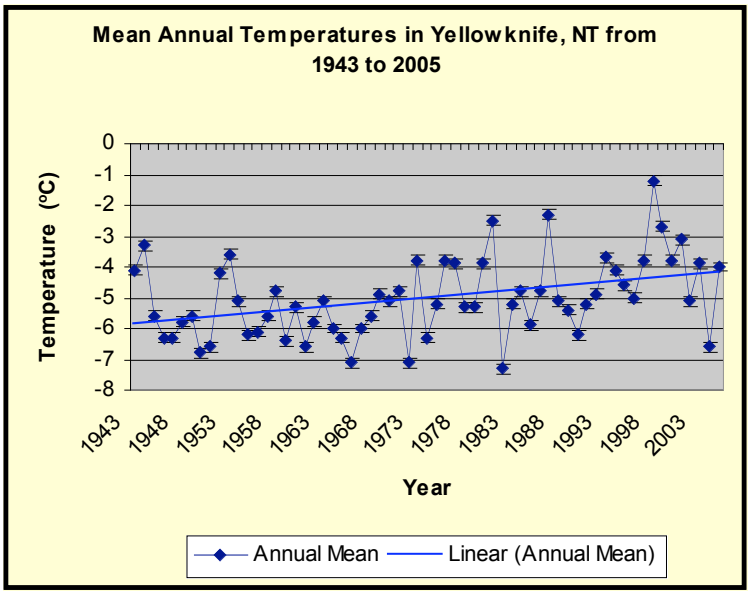

Figure 1: Mean Annual Temperatures - Trends

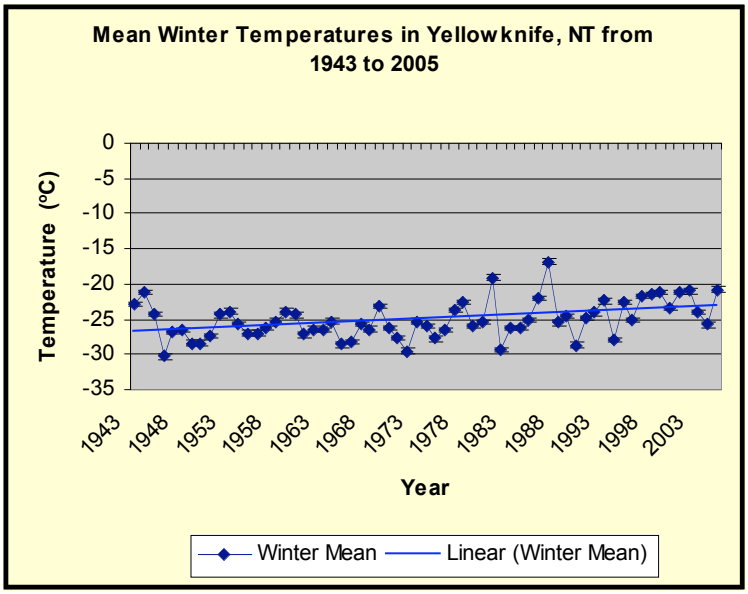

Figure 2: Mean Winter Temperatures - Trends

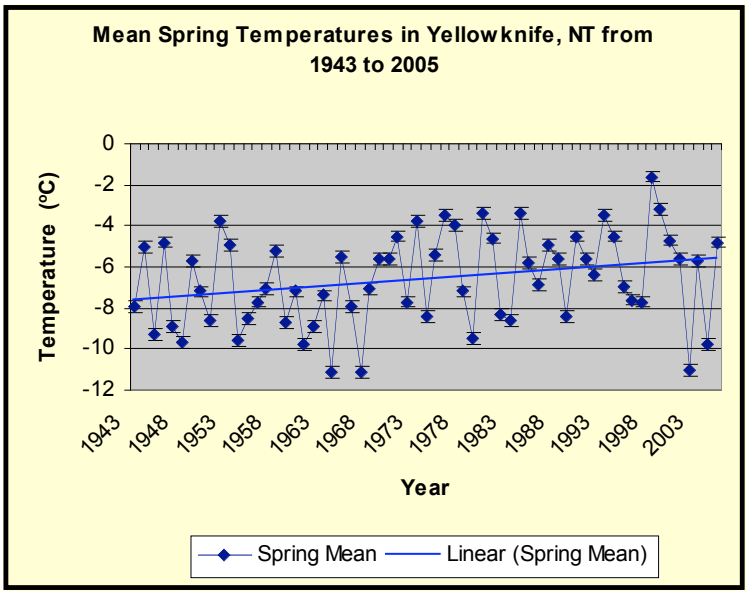

Figure 3: Mean Spring Temperature - Trends

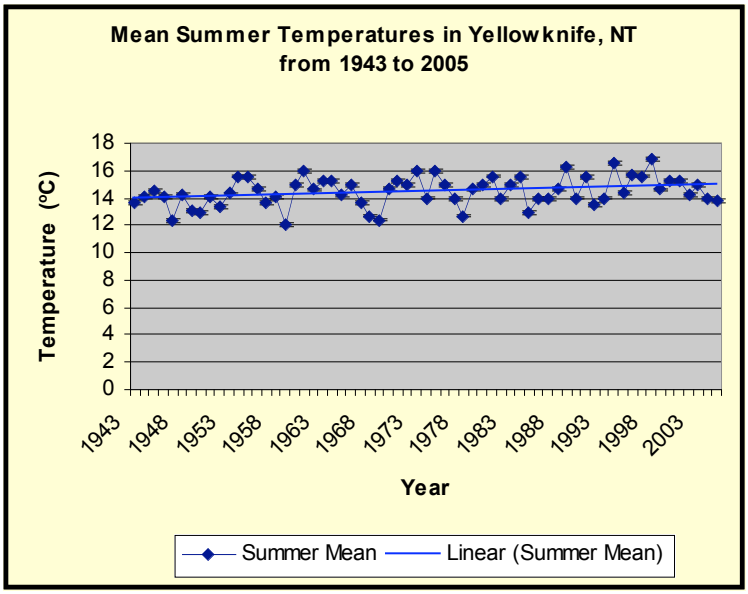

Figure 4: Mean Summer Temperature – Trends

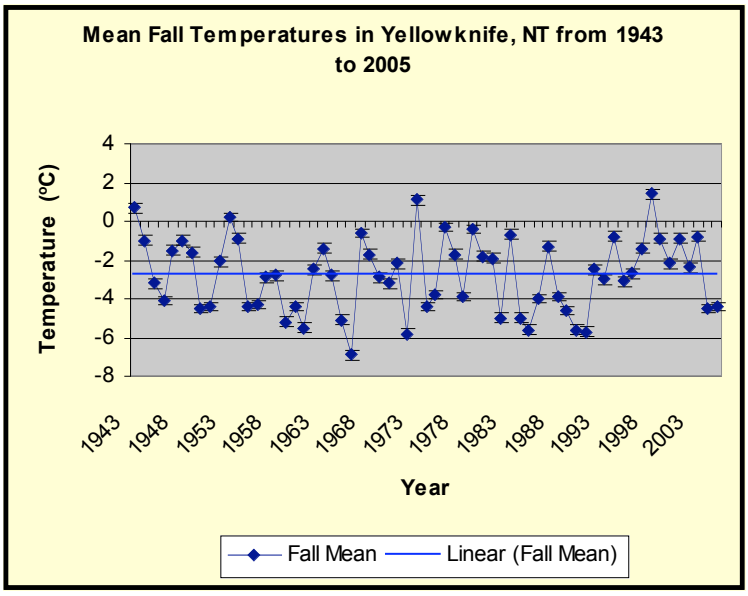

Figure 5: Mean Fall Temperatures - Trends

For precipitation, that data showed:

- Average annual precipitation in the range of 20% (1945-2005). See Figure 6.
- Average winter precipitation showed no significant change (1945-2005). See Figure 7.
- Average spring precipitation increase of around 25% (1945-2005). See Figure 8.
- Average summer precipitation increase of around 38% (1945-2005). See Figure 9.
- Average fall precipitation showing a minimal increase. See Figure 10.

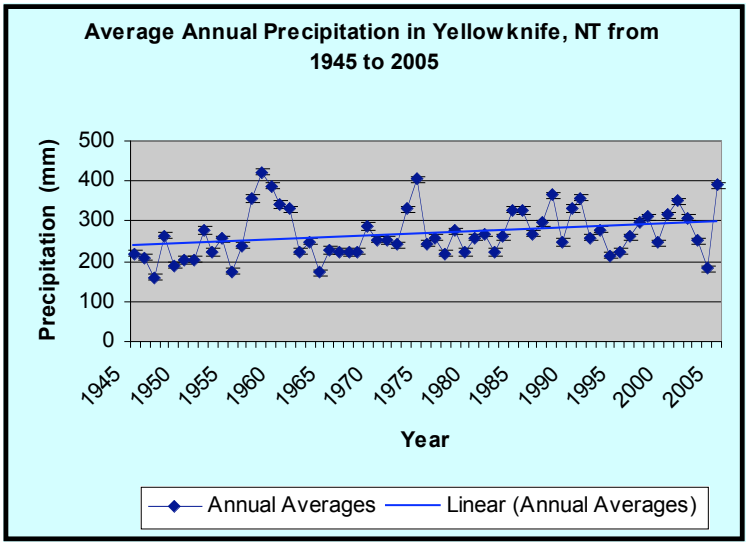

Figure 6: Average Annual Precipitation - Trends

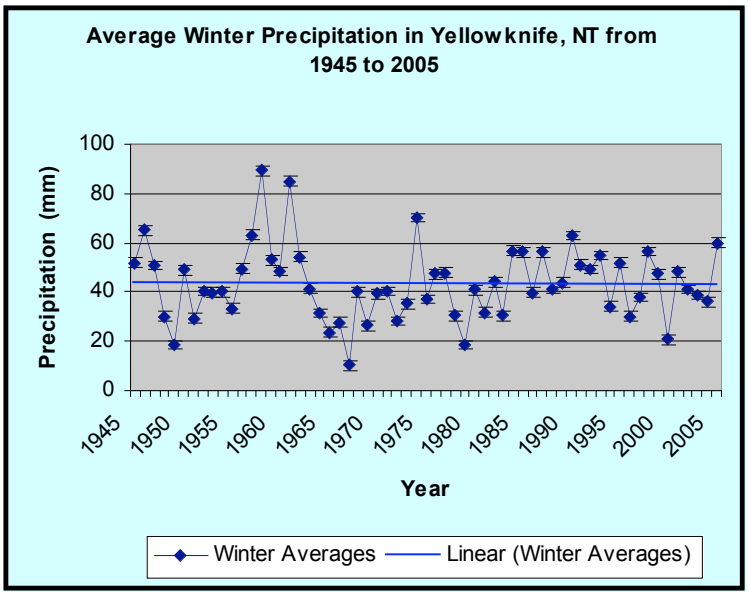

Figure 7: Average Winter Precipitation - Trends

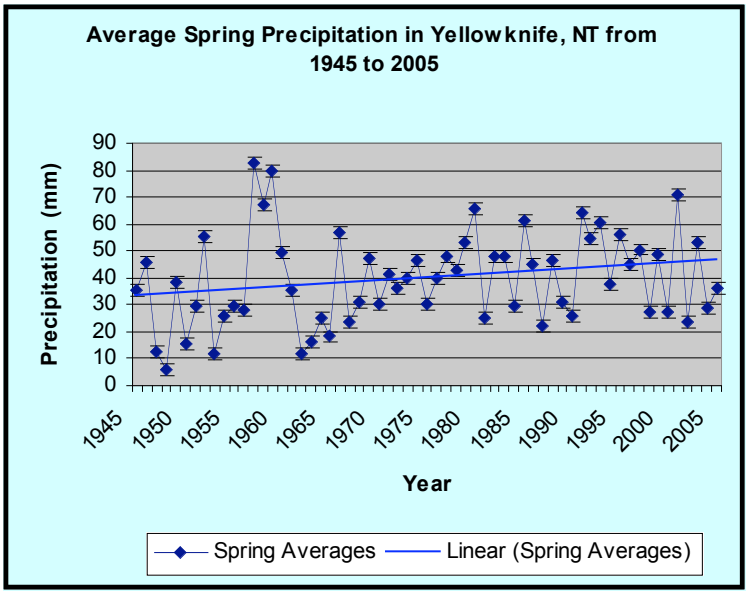

Figure 8: Average Spring Precipitation - Trends

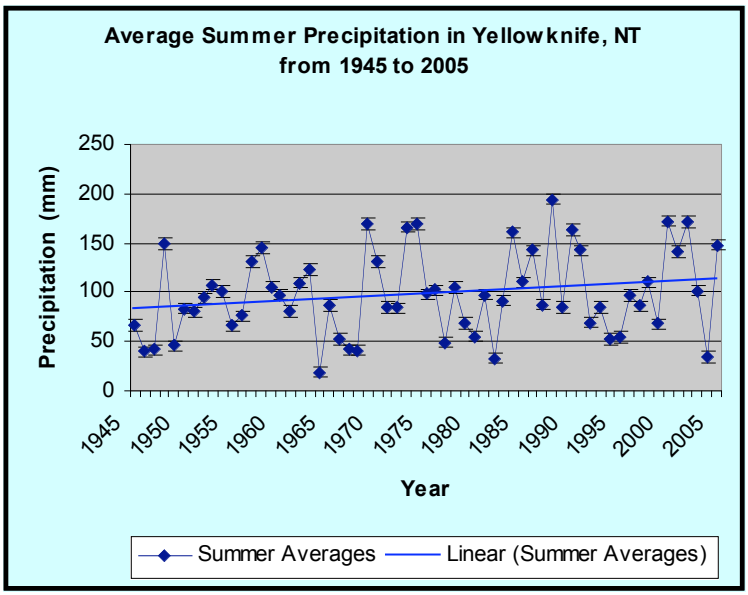

Figure 9: Average Summer Precipitation - Trends

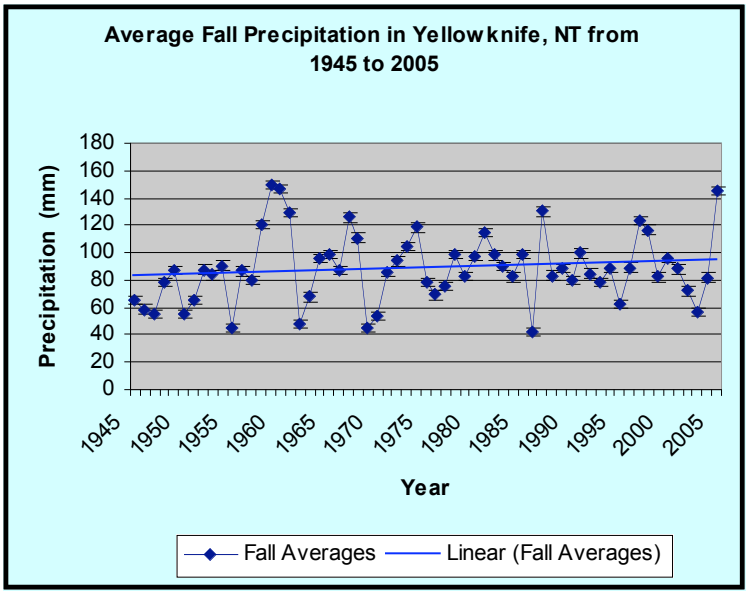

Figure 10: Average Fall Precipitation - Trends

Average annual precipitation had increased 20%, mostly in the form of summer rain, but with likely a change in the rain/snow mix in spring due to the temperature shifts.

4.2 Anticipated Future Climate of Yellowknife

4.2.1 Scenarios & Time Horizons

The degree of uncertainty of climate change scenarios increases with projection time, making 100-year scenarios much less certain than 20 year scenarios. However, using a 50-year horizon has a number of advantages. First, there tend to be easily accessible scenarios that use 2050 as a projection date. Secondly, the time horizon is similar to that of the useful lifespan of much public infrastructure. Thirdly, it places this current project in the middle of a 100-year period of climate change, having real climate data from the local airport for approximately the last 50 years, as well as scenarios that stretch into the future 50 years. This is a very useful visualization for workshop participants to grasp, however, it would be a mistake to think that the scenarios provide the same degree of certainty as the observed data. Workshop participants were cautioned on this.

4.2.2 Limitations of Models

The climate models used in these processes have inherent limitations. The geographic data points in the atmosphere are very far apart leading to some significant resolution issues and a poor interpretation of local micro-climates that are influenced for example by local topography or large water bodies. Canadian Global Climate Circulation Models for example have a grid size of 3.75^{o} latitude by 3.75^{o} longitude – making the grid square around 74,000 km^2 (see Figure 11). Models developed by the Meteological Office's Hadley Centre for Climate Change (UK) use a grid size of 2.5^{o} latitude by 3.75^{o} longitude, making for a grid size of around 50,000 km^2 (see Figure 12).

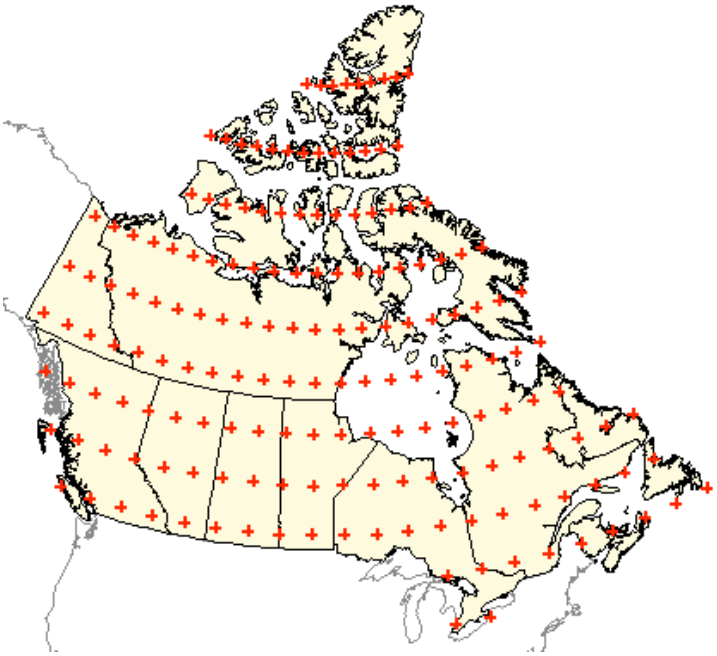

Figure 11: CGCM1 Resolution: 3.75° (lat) x 3.75° (long). Area = 74,000 km^2

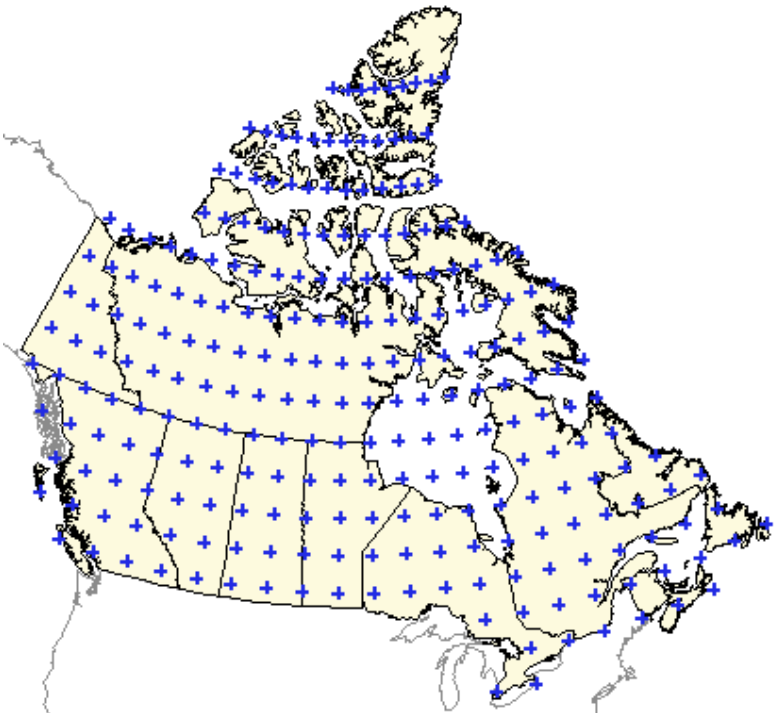

Figure 12: HadCM3 resolution: 2.5° (lat) x 3.75° (long). Area = 50,000 km^2

One technique being employed to overcome this is called statistical down-scaling models (SDSM). This process effectively shrinks the data from global circulation models to provide site-specific information. This is a specialized field that would require the City to commission its

own study should it decide that greater resolution of climate futures is needed for decision-making,

The alternative to pursuing greater resolution and certainty from the models (which may prove expensive and would not fully remove uncertainty), is to develop ways to deal with the uncertainty that is inherent in the data by changing the way decisions are made. This is where decision support tools and risk management techniques prove useful.

It should also be noted that the models do not speak to the frequency and severity of extreme weather events, or the unpredictability of weather – all of which can have significant implications for climate change adaptation strategies.

4.2.3 Range of Climate Futures

Climate change scenarios for Yellowknife were obtained from the Canadian Climate Impacts Scenarios (www.cics.uvic.ca/scenarios/) developed by the University of Victoria. Although a little dated (2004), the projections are still based on the current socio-economic scenarios prepared by the Intergovernmental Panel on Climate Change (Special Report on Emissions Scenarios 2001, due to be updated in 2007/8). This webtool allows for projected changes in temperature and precipitation to be plotted over time for a range of socio-economic futures. This range of possible futures in global economic activity and social change creates a range of possible temperature and precipitation projections for a given future year. Degrees of uncertainty in the future climate become apparent from the time series plots.

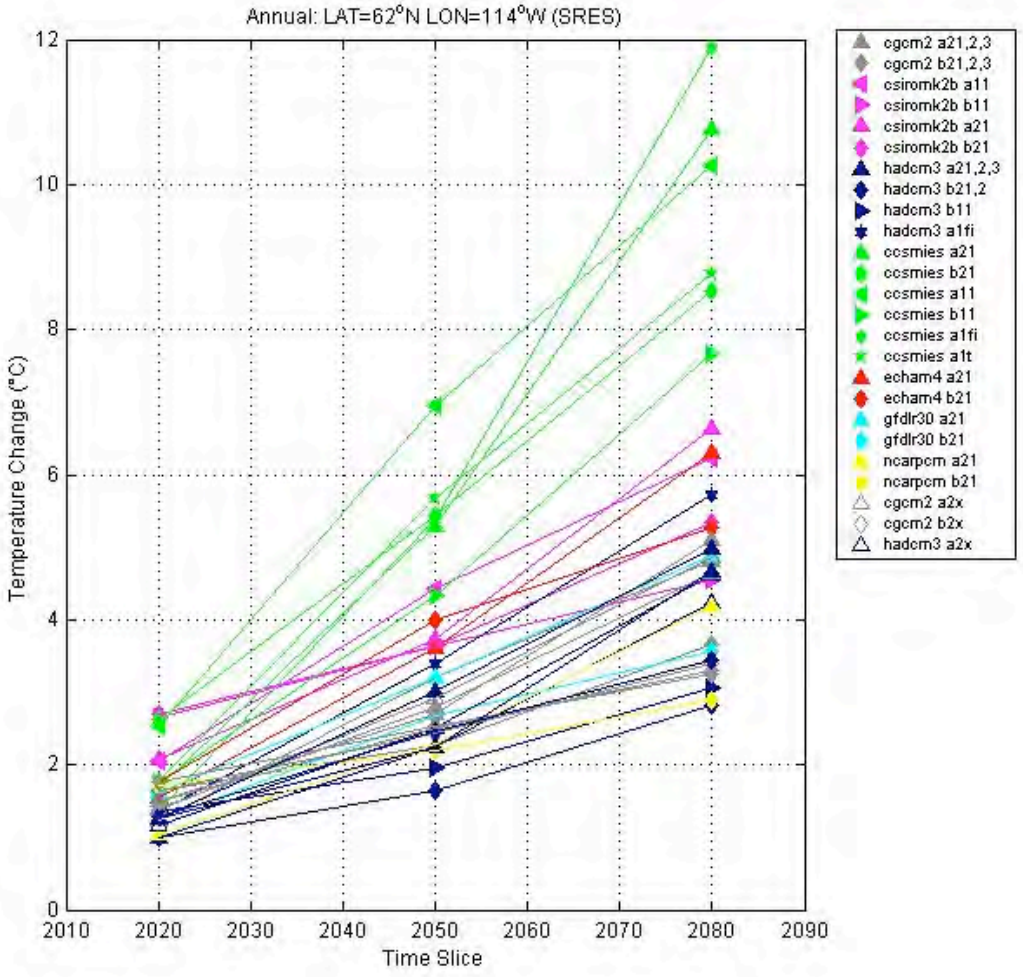

Figure 13: Climate Change Scenarios - Temperature Change

The climate change futures presented here (Figure 13) indicate a shift of +2°C to +4°C from 1990 temperatures by 2050 with strong correlation in the trend indicated amongst the different scenarios.

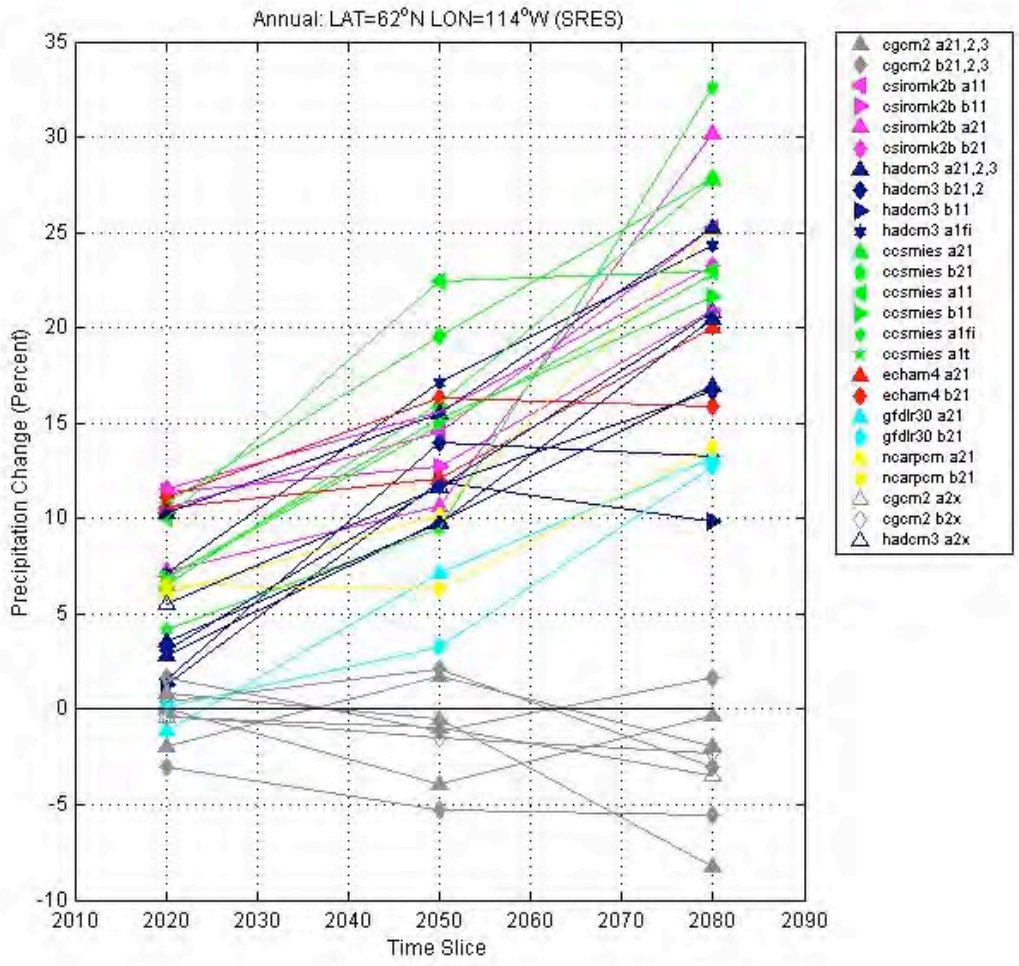

Figure 14: Climate Change Scenarios - Precipitation Change

The precipitation chart (Figure 14) displays much greater variability in the results which is common amongst different scenarios and locations. The range shown is from –5% to +23% with a much less defined trend between the scenarios.

It should be noted that the models shown in these charts use slightly different grid squares for their calculations. For the purpose of this chart, the grid square with its center closest to the coordinates of Yellowknife is the one whose results are shown. While it is important to recognize this, the impact of the size of the grid squares on accuracy and reliability, along with the lack of consideration of topography and large water bodies (like Great Slave lake) on local climate greatly reduces the relevance of this inconsistency.

5. Climate Change Impacts & Responses in Yellowknife

5.1 Observed Climate Change Impacts

The project workshops were an invaluable forum through which participants could tell stories of climate change impacts – or observations for which climate change was at least partly to blame. It was noted that it was impossible to credit climate change as the sole cause of many issues, but in these cases, it was possibly a contributing factor. It was also identified that it is important not to assume climate change is the sole cause of community issues. It can be both incorrect, and alienate those who are already skeptical about climate change, thus limiting public buy-in and compromising the success of the wider program. This anecdotal evidence of how climate change is affecting the community and its infrastructure demonstrated a number of things:

- It is crucially important to have front line staff at the city, as well as the community at large aware of climate change adaptation so they can communicate their observed impacts to the project coordinator. Since many future impacts cannot be foreseen from a desk-top study, leveraging the eyes and ears of the community in this way is a key tool for informing adaptation action.
- Assuming, or describing climate change as the sole cause of community issues can alienate stakeholders, and create polemic argument among decision makers.
- When building scenarios of future climate change impacts, assuming a greater frequency and severity of observed impacts is a good start from which to do some visioning for other impacts that may threaten the preferred future of the community.

Stories of observed impacts were diverse, very significant, and had potentially huge social, environmental and economic cost associated with a reactive response. These examples demonstrated the need for pro-active consideration of the impacts and a course of action that respected the magnitude of the risk and potential consequence.

> Example 1: the roadway buckling on Franklin Avenue hill. This road was rebuilt after only 3 years in service due to excessive buckling. The cause was a subsurface with variable degrees of support along the length and width of the road. Climate change is impacting the depth of the active permafrost layer contributing to the lack of uniform support. The City rebuilt the road using a concrete product that created a 'floating' roadbed to overcome the uneven support. The additional cost over and above the regular construction standard was in the order of $400,000.
>
> Example 2: The City of Yellowknife takes its potable water from the Yellowknife River. This surface water source has experienced very high and unpredictable turbidity levels in recent years that has compromised the effectiveness of the water treatment plant to provide potable water. The cause was identified as increased sloughing of the river banks depositing high volumes of sediment into the river as a result of changes in the freeze-thaw process. Administrators have identified climate change as a key contributor to this.

> Example 3: Changes in temperature and humidity have seen a new problem with above-ground power lines. The development of thick and heavy hoar frost on the lines has required the commissioning of the local helicopter service to fly along the lines with a special tool for scraping the ice from the lines to prevent the weight from bringing them down. The cost of this maintenance and the potential for major power distribution failure in the winter illustrate the magnitude of the problems being experienced already.

Many other examples were raised throughout the workshops. The raw data from the workshops can be found in Sections 7.1.4, 7.2.4, and 7.3.4 of this report. They were relevant to both the capital cost of infrastructure replacement as well as increased operating costs for such things as road clearing of larger winter snowfalls, and the management of recreation on frozen lakes as they freeze later and thaw earlier than in previous years.

The exploration of these issues in a group forum was a huge education for stakeholders. It paved the way for the identification of anticipated future impacts and illustrated the range of issues that can challenge the coping capacity of existing municipal infrastructure.

5.2 Anticipated Future Climate Change Impacts

Many anticipated future impacts of climate change were identified through workshop exercises and a literature review of a number of technical papers. The workshops tended to focus on hard infrastructure issues, economic development constraints and opportunities, and human migration patterns.

Hard infrastructure concerns included issue such as:

- winter road maintenance (increased snow removal),
- vulnerable electricity supply from hydro sources as water levels change,
- land use and development concerns where changes will occur in the active permafrost levels (including building standards and shore line setbacks on waterfront development)

Economic impacts included issues such as:

- the economic challenges and opportunities of requiring design standards that take into account the uncertainty of the future climate
- Longer summers providing opportunity for expanding summer tourism, but winter conditions not necessarily more favorable for aurora watching
- Changes in insect populations (number, type and seasonal peaks) affecting health (vector borne diseases), recreation (visitor tolerance for bugs) and the food chain

5.3 Summary of Climate Change Impacts

The diversity of impacts and their potentially large systemic impact on the quality of life of residents requires that the coping capacity of the community systems be considered in proactive decision making to reduce the risk to an acceptable level. The Yellowknife General Plan does not speak to the need for resilient community systems or the integration of climate change considerations in municipal decision-making. This lays open the possibility of a vulnerable budgeting process that may require significant changes throughout the year to provide recurring band-aid solutions to systemic issues.

5.4 Climate Change Decision Making & Responses in Yellowknife

Workshop discussions showed that the responsiveness of the City to deal with observed climate change impacts were very effective given that they were reactive. The ability of the administration to respond quickly and decisively has kept the community from suffering any catastrophic loss. However, as described previously, the costs of that reactive response have been at times significant. The response model to date has been one of purely reactive response to impacts as they occur. It is this type of response model that has led other municipalities to use a scenario approach, or an emergency response planning model to plan for a particular type of extreme weather event that the region is already prone to. While an emergency response plan can work well to respond to a sudden crisis situation it is limited in its ability to be pro-active in mitigating risks before they reach crisis.

During the project, several decision-making processes were reviewed to determine the extent that climate change considerations were used. It was concluded that neither Council nor the Administration have an explicit mandate to include climate change considerations within their work. Some senior staff are trained in the use of risk management tools, however, no system is in place to ensure consistent application of tools across departments, and therefore no assurance that climate change considerations would be included in such analyses. It was also observed that both Council and Administration made it clear that they valued the opportunity to sit in the same room for a few hours and work through some significant issues as this was not a common meeting format for them.

The primary direction given by the City of Yellowknife with regards to the potential development of decision-making tools was that the tools should:

- ensure integration with existing decision making structures and processes, and
- leverage the opportunity to design risk management tools that could be applied consistently across the organization, not just with respect to climate change risks, but others as well.

6. Best Practices & Case Studies

6.1 The Decision Making Process

6.1.1 Identifying types of decisions

Decision-makers must first recognize there are various levels of adaptation decisions that will need to be made in the municipal context. In some case, a concern or opportunity related to anticipated climate change may be the sole driver for the decision to be made; these decisions can be referred to as *climate adaptation decisions*.

In other cases, anticipated climate change will be only one of many factors influencing the decision, and may not even be the primary reason for taking a decision. The types of decisions can be referred to as *climate influenced decisions*.

In all cases however, municipal decision makers will want to identify how climate change could affect the decision being made. In this way, decisions that constrain the ability of the municipality (or of individuals, communities or ecosystems within or influenced by the municipality) to respond to changes in climate can be avoided. Decisions that negatively impact the ability of the municipality to adapt to climate changes in the future are labeled *climate constraining decisions*.

Implementing a climate constraining decision is a form of maladaptation. The UK Climate Impact Programme (UKCIP) has developed a table, reproduced here, that identifies a variety of maladaptive and climate change decision errors.

Table 1: Maladaptation and other climate decision errors

Consequence of poor decision	Description of cause of poor decision
Under-adaptation 1	Where adaptation to climate change is or should be an essential component of the decision, but it is either ignored, or insufficient actions are taken to adapt
Under-adaptation 2	Where non-climate factors are perceived as having greater importance to the decision than climate change factors, the result may be that insufficient weight is attached to the need for adaptation.
Over-adaptation 1	Actions are taken where climate change is considered to be a significant factor in the decision to be made, but it will have or should have little or no influence on the decision.
Over-adaptation 2	Actions taken where non-climate factors that should have a significant influence on the decision are ignored or given insufficient weight compared to climate change factors.
Maladaptation	Actions taken that reduce the options or ability of decision-makers now or in the future to manage the impacts of climate change. Such actions are sometimes described as reducing climate headroom.

Source: UKCIP (finish source).

Regardless of the decision to be made, identifying *no-regret climate adaptation decisions* is desired, as recognizing and implementing a no-regret options will provide benefits to the decision-maker and the municipality regardless of the climate scenario that unfolds.

6.1.2 Identifying an approach

Several methods have been used to approach the decision-making process. Each has its virtues and disadvantages. In many instances, a combination of each approach will best serve the municipality since it can capitalize on the strengths of the approach without succumbing to its limitations. Each approach is outlined in the following sections.

In any decision making scenario, the approach must be adaptable and useful to the decision makers, and must be appropriate and suitable for the decision to be made. Engaging in a resource intensive decision making process when a decision must absolutely be made within a week clearly is not strategic. The municipality and decision-makers must determine the appropriate amount of time and resources to dedicate to each decision. As stakeholders and decision-makers become more familiar with the process, the process may become more time and resource efficient.

6.1.2.1 Scenario approach

In this approach, a climate scenario is developed for the municipality or region based on the best available data and research. The municipality or decision-maker, in this case, would then take decisions designed to adapt to this anticipated climate.

The primary disadvantage of this approach is that it is dependant on the development of accurate and long-range climate forecasts. Development of such climate scenarios is difficult at best, and may change depending on any number of factors. Recognizing this difficulty, it may be difficult to achieve consensus in any decision taken to adapt to this new climate.

6.1.2.2 Vulnerability approach

The vulnerability approach differs from the scenario approach in that decision-makers identify where or how their community may be vulnerable to climate change in a variety of possible climate scenarios. This approach is therefore not dependant on the development of a single climate change scenario, and can result in adaptation decisions that respond appropriately to anticipated climate changes.

The primary steps in the vulnerability approach, as identified by Natural Resources Canada (NRCan), are

1. Engage stakeholders
2. Assess current vulnerability
3. Estimate future conditions
4. Estimate future vulnerability
5. Decision and Implementation

It is important to recall that these steps do not necessarily represent a linear decision-making process. Iteration during the decision-making process, and evaluation of the process and results following the implementation of a decision, are encouraged.

6.1.2.3 Risk Assessment approach

The risk assessment approach consists of essential elements that help to identify and prioritize competing decisions, as well as the factors that impact those decisions. In a report for NRCan, Global Change Strategies International (GCSI) outlined several risk assessment approaches, including the Canadian Standards Association guideline, first developed in 1997 (see Figure 15 below).[1] This approach, according to GCSI, outlines a common language and process for the identification, analysis, evaluation and control of risks. As with the vulnerability approach, this approach is iterative.

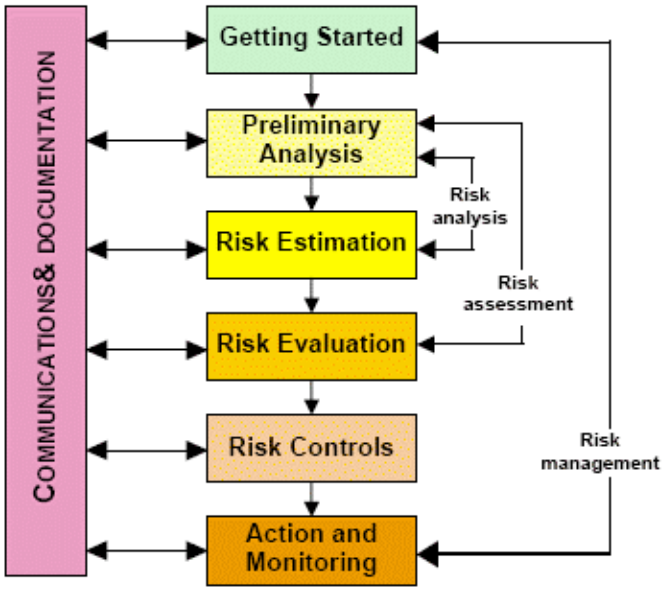

Figure 15: The Risk Assessment Approach

GCSI later adapted this framework for use in climate change adaptation work with Caribbean island countries. An advantage of using this approach is that it provides a framework and language for climate change adaptation decision making that is consistent with risk management in other sectors.

The UK Climate Impact Programme (UKCIP) has also developed and recommends a risk management approach to climate change adaptation. Their approach is explicitly iterative, in order to emphasize the need to revisit decisions in light of new information on climate change impacts, or as new options are identified (see Figure 16 below). This approach also outlines a process that has a tiered decision-making structure. In other words, a process that allows the decision maker to identify, screen, prioritize and evaluate both climate and non-climate risks and options before deciding whether more information is required, or if action can be taken.[2] This framework does not explicitly reinforce stakeholder engagement and thorough documentation and communication, as does the GCSI model. An awareness of the preceding and following stages in the framework is identified as critical in ensuring the robustness of the decision-making process.

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[1] Noble, D., Bruce, J., and Egener, M. (2005). *An Overview of the Risk Management Approach to Adaptation to Climate Change in Canada*. Prepared for Natural Resources Canada, Climate Change Impacts and Adaptation Directorate, by Global Change Strategies International.

[2] Willows, R.I. and Connell, R.K. (Eds.). (2003). *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report. UKCIP, Oxford.

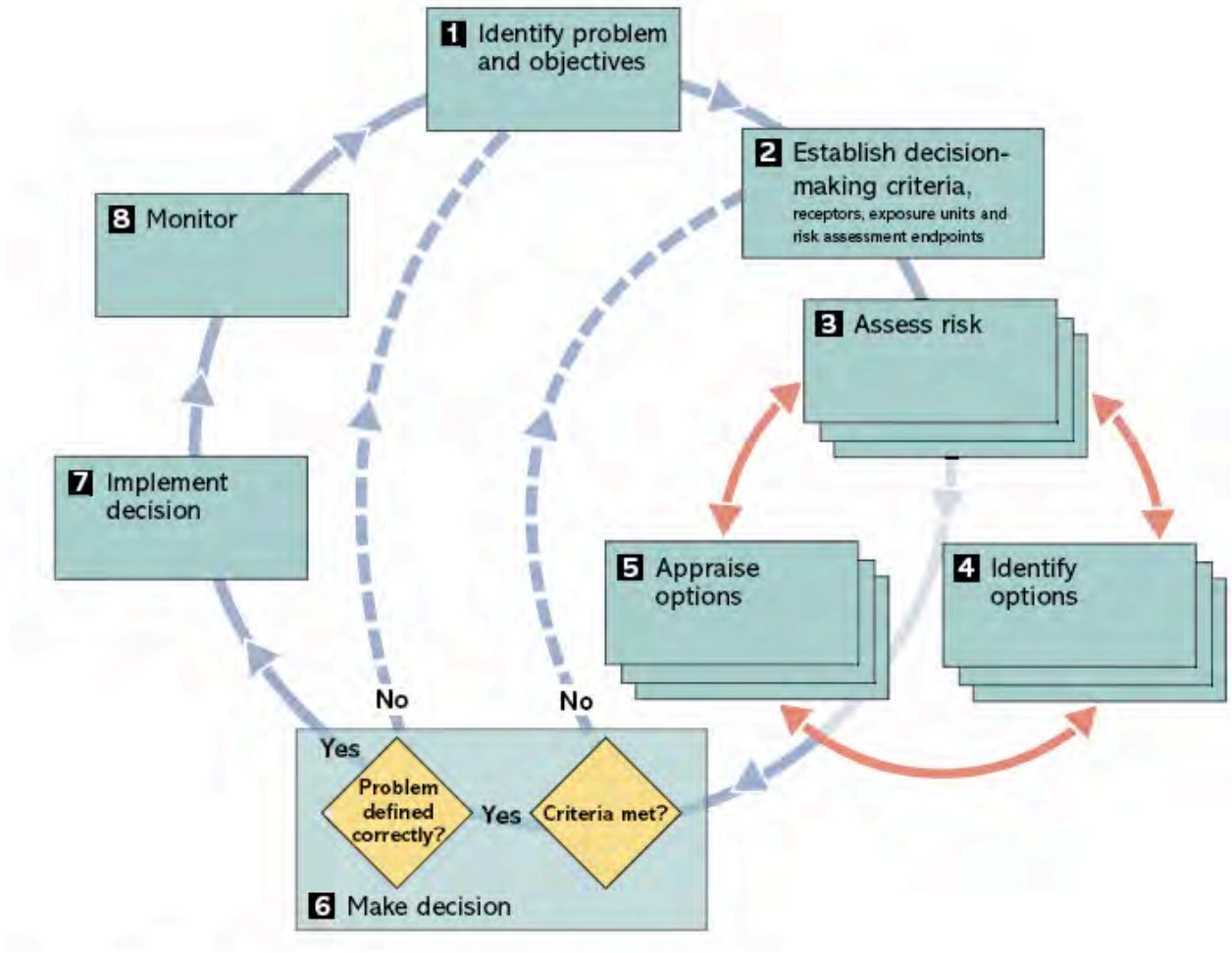

Figure 16: UKCIP Framework to Support Climate Change Decision Making

Several common themes emerge from the various approaches, including:

- **Iteration.** Each process emphasizes the need to revisit the decision when new information or new options are available.
- **Research.** Thorough research and assemblage of appropriate information will assist in making well-informed decision making. Involving stakeholders and experts in the process can ensure that up-to-date information and sufficient perspectives are heeded.
- **Stakeholder Engagement.** Each approach emphasizes the need for stakeholder engagement. Engaging stakeholder not only provides a variety of valuable perspectives, but can ensure buy-in from the community.
- **Prioritization.** Each step in the process facilitates the prioritization of decision making.

6.2 Case Studies

Participants in workshop #1 identifed several questions and research priorities for workshop #2. These included:

1. Researching adaptation tools being used in other jurisdictions, with particular attention to northern communities (in Canada and abroad).
2. Research how other municipalities have tied climate change adaptation into programs and projects. Subjects of particular interest included: smart growth, water and waste water infrastructure, managing changes in permafrost, and sharing best practices.

Early on in the research phase of the project, it became apparent that although there are several cities, communities and municipalities who are engaged in climate change adaptation planning in Canada, and internationally, overall there is very little in the way of experiences or resources to draw from. With respect to 'tools' and linking climate change adaptation into most (if not all) programs and projects, little has been completed to date.

In particular, many of the communities contacted or researched through this project have either:

- Developed adaptation plans that respond to one (or a limited number) of high-risk climate change impacts. Examples in this category include the City of Toronto (who have developed a heat-alert system to respond to increase severity and length of heat waves) and the City of Halifax (who have developed an emergency response system in anticipation of increased severity and likelihood of storm events),
- Only recently started developing the capacity and skills to integrate climate change adaptation into decision making. Examples in this category include King County (Washington, USA), London (UK), and, closer to home, Iqaluit and Nunavut. The latter has only just embarked on a territorial adaptation plan.

In many respects, the path that the City of Yellowknife has chosen with respect to climate change adaptation – systematically assessing climate change risk in municipal decision making – positions it among a very few communities who are developing the skills and capacity to address climate change impacts as they are identified, and conversely, to identify potential climate change risks in the day-to-day decision making processes at the City.

Irrespective of these limitations, there is a significant amount of experience that has been accumulated by a variety of jurisdictions, both within and outside of Canada, that the City of Yellowknife can benefit from examining. These cases studies are discussed in the following sections.

6.2.1 Toronto

6.2.1.1 Project History

As early as the mid 1990s, the City of Toronto Health Department recognized the danger that heat waves posed to the health and wellbeing of locals. The Department of Health began developing plans to cope with these heat waves, and also coordinated with the City to promote clean air and climate change mitigation.

The City of Toronto has now identified vulnerability to increasing frequency and severity of heat-waves associated. The City, very early on, developed partnerships with universities and local/regional NGOs, and a variety of other stakeholders to advance adaptation and heat-response planning work. The City also initiated a strategic, long-term partnership with the Clean Air Partnership (CAP), a local NGO.

Early in the process, CAP and City officials established the following goals:

1. To work with City staff and other stakeholders on incorporating climate change issues into work programs and planning
2. To decrease the vulnerability of Torontonians to climate change impacts
3. To increase Toronto's capacity to respond to extreme events

6.2.1.2 Actions

CAP is working with the City of Toronto to incorporate climate change into program planning and implementation. The project will involve the following tasks (some are underway or have been completed):

1. **Impacts Scan.** With input from stakeholders, experts, and City Officials, CAP has identified a number of potential impacts and vulnerabilities for the City of Toronto. From this, City Officials identified two potentially high risk impacts for which it will develop adaptation plans.
2. **Learning from other Cities.** CAP hosted a workshop for City Officials and stakeholders that brought together experts and representatives from leading municipalities and jurisdictions across Canada and the United States. The workshop facilitated networking among city officials who are facing climate change impacts in their jurisdictions, those with experience developing adaptation plans, as well as experts in the field of climate change adaptation planning. CAP researchers also traveled to cities comparable to Toronto (including London UK, Boston, New York, Halifax, Vancouver and Seattle) to compile a report on the lessons Toronto could learn from their experience and knowledge.
3. **Decision-Makers Workshop.** This workshop was be held in June 2006 with Toronto decision-makers to identify key areas where the City needs to be developing and implementing adaptation strategies. Officials identified heat waves and urban forestry and two areas where adaptation plans should initially be developed.
4. **Adaptation Strategies**. CAP is now working with a variety of stakeholders (including industry, business and labour groups, as well as NGOs) to identify potential adaptation responses.
5. **Next Steps**. Securing funding for long-term adaptation strategy development.

The CAP/City of Toronto approach generally follows the vulnerability approach outlined earlier in this chapter. CAP has developed, following their research and consultations with stakeholders, an adaptation process based on a model developed by the Organization for Economic Cooperation and Development (OECD).

Through their research, CAP believed that the OECD model[3] best described the work the reviewed in other urban areas. However, the OECD model did not include an 'Awareness and Engagement' element, something they noted was critical in the success to the adaptation projects they reviewed. CAP's modified process is shown in Figure 17, below.

[3] Gangon-Lebrun, and Agrawala. (2006). *Progress on Adaptation to Climate Change in Developed Countries*. OECD.

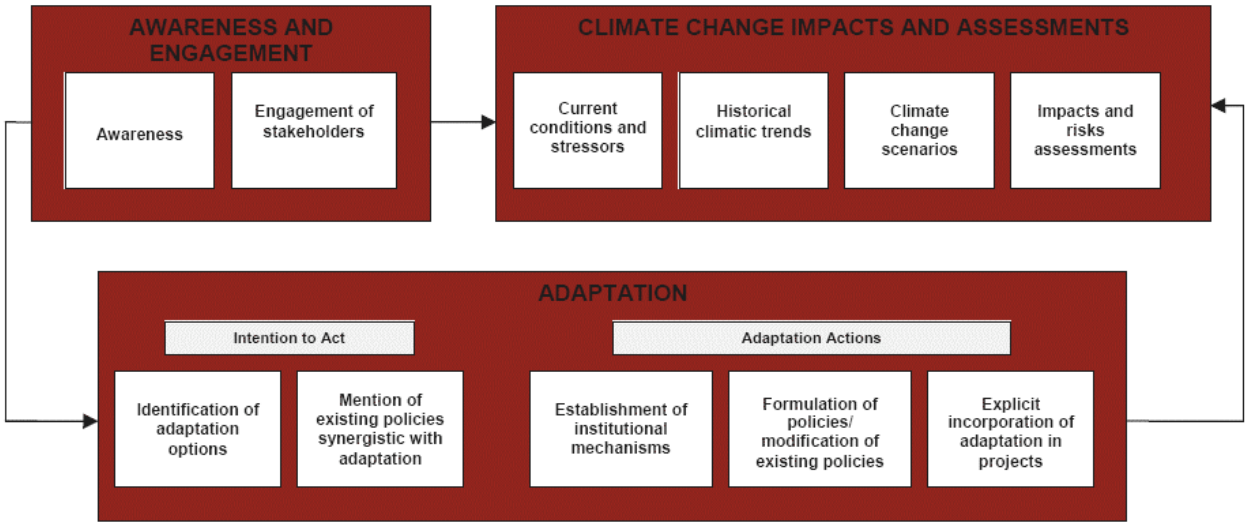

Figure 17: Clean Air Partnership (Toronto) Adaptation Process[4]

As with other models, CAP stresses that the process need not be linear. They also noted that the process should include ongoing monitoring of climate change, and an evaluation of any adaptation actions taken.

CAP has diligently published all materials, including workshop outcomes, on their website. CAP is encouraging public and stakeholder involvement, through its website and through media.

6.2.1.3 Current Gaps

CAP has identified that increasing the capacity and knowledge of planners is needed incorporate adaptation planning into City planning and programs. The following gaps in skills and knowledge were identified as barriers to further action on adaptation at the City level:

- City staff and politicians need more locally specific information (with a higher degree of certainty) about the impacts of climate change
- City staff need to develop skills on how to incorporate climate risk assessments into their programs and planning

6.2.2 Halifax

6.2.2.1 Project History

In Canada, Halifax is regarded as a leader in climate change adaptation. In some respects, this may be a consequence of geography and circumstance. Prior to 2004 a consultant group (ClimAdapt) had been working on climate change adaptation in the Caribbean, and agreed that Halifax would be an ideal 'early adapter' in Canada. The consultant group approached the City with a concept. In 2003 and 2004, Halifax and Nova Scotia were faced several extreme weather events, including ice storms, torrential rain and flooding, and two natural disasters – Hurricane Juan and 'White' Juan, a massive snow storm. The convergence of the natural events and approach suggested by the consultants drove

[4] Penney, J. and Wieditz, I. (2007). *Cities Preparing for Climate Change. A Study of Six Urban Regions*. Clean Air Partnership. Toronto.

the City's adaptation in high-gear, as many residents, city officials and politicians recognized the economic and cultural vulnerability of their city to climate change.[5] The City initiated the ClimateSMART program (Climate **S**ustainable **M**itigation and **A**daptation **R**isk **T**oolkit).

6.2.2.2 Actions

The Halifax Regional Municipality (HRM) encompasses urban, suburban, rural and agricultural populations, in addition to two First Nations communities. The HRM, as part of the Partners for Climate Protection program, had significant experience with climate change mitigation actions; this background and experience was important in ensuring support and understanding for adaptation work.[6]

The HRM created an internal working group (part of ClimateSMART) on adaptation early in the process. This group developed 'issues' documents, and drafted an adaptation risk guide. The key item for the working group was prioritization.

The HRM issues papers adopted a risk assessment approach to evaluating climate change impacts. The issues papers drew on existing studies to identify potential impacts on a variety of sectors and to estimate probability and severity of each impact on both socio-economic and environmental factors. Researchers then applied this to a risk management matrix (see Figure 18, below). Priority impacts were then subjected to a more detailed risk evaluation. At this point, the HRM moved to develop options for adaptation.

	PROBABILITY			
IMPACT SEVERITY		LOW	MEDIUM	HIGH
	HIGH	M	H	H
	MEDIUM	L	M	H
	LOW	L	L	M

Figure 18: Halifax Regional Municipality Risk Matrix

One of the primary actions taken by ClimateSMART was to develop a Community Action Guide to Climate Change and Emergency Preparedness. Their five-step response plan is explained in the community action guide, and outlined here:

Question 1. Be aware of how our community may be at risk from climate change.

- Learn from past experiences (extreme events).
- Be familiar with CC projections

[5] Both "Juan's" caused massive economic and cultural disruption in the form of downed power lines, damaged infrastructure, costly snow removal, expensive repairs, and the devastation of significant cultural and tourist attractions including Point Pleasant Park.

[6] King, S. (2007). Personal Communication. City of Halifax.

- Identify what might be at risk.

Question 2. Know our vulnerabilities and resources.
- Identify groups/persons/infrastructure/environments at risk
- Identify resources: e.g. volunteers, websites, equipment, expertise

Question 3. Minimize our risks through adaptation actions.
- Minimize risk (e.g. don't build in flood-prone areas)
- Prevent stress to sensitive systems (e.g. maintain sensitive coastal ecosystems)
- Adapt to increased risks (e.g. to reduce risk west nile virus, avoid standing water that can be used as breeding ground for mosquitoes).

Question 4. Prepare a Climate SMART Action Plan to address climate related emergencies:
- What to Do Before
- What to Do During
- What to Do After

Question 5. Publicize, test & evaluate the Climate SMART Community Action Plan.
- Inform community about the plan.
- Conduct simulations

Note that this response plan generally follows the vulnerability approach as well (engage stakeholders → assess current vulnerability → estimate future conditions → estimate future vulnerability → take adaptive action) as well, but is modified to include an emergency response plan and thorough engagement with stakeholders in the planning and post-emergency evaluation.

In addition to emergency preparedness, the HRM continues to develop capacity and knowledge to implement adaptation plans in several sectors. A list of ongoing actions is outlined here:

- Undergrounding. The City is working with stakeholders, including the Canadian Standards Association and the Canadian Council of Professional Engineers to develop a cost/benefits analysis for undergrounding infrastructure, including power lines. Protecting infrastructure was identified as a high priority through the risk management approach. The City identified the need for accurate infrastructure data in this endeavor (made particularly difficult in this case because of the age of the city's infrastructure in historic areas).
- Mapping: The HRM recognizes that sea-level rise and storm surges have the potential to significantly impact the region. The HRM has invested in the acquisition of very detailed Light Detection and Ranging (LIDAR) mapping. LIDAR mapping will provide the city with accurate data on which land is within (x) meters of sea level; with this information they can develop appropriate development boundaries than maximize development value but provide an appropriate set-back from sea-level in response to climate change.
- HRM has incorporated climate change impacts in Environmental Impact Assessments.
- The HRM and ClimateSMART have developed guide books for homeowners, as well as developers (The Risk Management Guide for Developers).

- The City is working with the Director of Legal Services to evaluate the impact of climate change and adaptation measures. In particular, they have engaged in 'back-casting' exercises, i.e revisiting previous decisions in light of new information on climate change impacts, to determine if the decisions taken would have been different, and what the consequences of those decisions might have been.

6.2.2.3 Lessons

The HRM experience is valuable in that it illustrates many of the steps and processes beyond the initial planning and impacts scan. In particular, lessons that Yellowknife can take from the HRM experience include:

- Building on experience and momentum in climate change mitigation can accelerate and/or promote buy-in on adaptation planning.
- The risk management approach, with elements of the vulnerability approach, can provide a method to identify climate change impacts, and subsequently, to identify the priority impacts that require adaptive action to reduce vulnerability. This approach also identified opportunities for early action, and no-regrets options.
- Accurate data is essential in the decision making process. The HRM has invested in obtaining accurate data with respect to infrastructure and elevation. In particular, the accuracy of the LIDAR mapping has the potential to significantly impact property values.
- Maintaining stakeholder involvement is essential, but requires and investment of time and resources ('policing the process'[7]). One risk of involvement of multiple stakeholders is coordination and consensus on priorities and timelines.

6.2.3 Iqaluit and Nunavut

6.2.3.1 Developing an Adaptation Plan

Iqaluit and Nunavut had developed parallel processes for adaptation, but these are now being coordinated. The City of Iqaluit, having already developed knowledge of climate change through mitigation and sustainability work (including sustainable buildings initiatives) has established a plan, modest in it's scope, to begin investigating the impacts of climate change on infrastructure. Nunavut, by comparison and with secured funding for the period 2007 through 2009, has launched a more ambitious program for the territory.

Iqaluit

Staff at the City of Iqaluit have begun research and consulatation on impacts of infrastructure from a variety of climate change impacts, including melting permafrost, erosion, extreme weather events, and increased temperature/precipitation. At present, they have engaged stakeholders in one-to-one interviews, and completed research on work to date in other jurisdictions.

Generally, they have identified a lack of consistency among engineers and city planners. In some cases, engineers were considering climate change impacts, but city staff were not incorporating climate change into their decisions (despite having a mitigation plan in place).

[7] King, S. (2007). Personal Communication. City of Halifax.

Consulting with stakeholders, including local business and industry (developers, builders, etc) yielded little in terms of constructive input, perhaps in part because of a lack of awareness of potential climate change impacts. When asked what adaptive actions builders had considered, a common response was that they were continuing on with 'business as usual' since buildings in North already needed to be strong because of the harsh climate. Some builders did remark on perceived changes to permafrost, and the impact that was having on building foundations.

Nunavut

Iqaluit has outlined a three year process for developing knowledge and capacity to implement adaptation plans. This plan will incorporate both scientific and traditional knowledge, and will involve working with a community to pilot adaptive actions.

The outline of their process, based on the vulnerability approach, includes:

- Traditional Knowledge
- Baseline Studies
- Monitoring Programs
- Vulnerability Assessment
- Forecasting Impacts
- Adaptation Planning
- Pilot Projects

Iqaluit has completed an initial workshop, in which stakeholders and experts were brought together to discuss topics including integrating climate change adaptation in community planning, incorporating traditional knowledge and scientific research in adaptation planning, and raising awareness of the need for adaptation.

6.2.3.2 Lessons

Iqaluit and Nunavut, despite both being very early in the adaptation learning and planning process, offer unique insights.

- Coordination between territorial and local governments can improve knowledge-sharing and capacity to adapt.
- The adaptation planning process can be tailored to meet local and regional demands. The vulnerability approach is a good foundation for local/regional adaptation planning.

6.2.4 Other Case Studies

6.2.4.1 London (UK)

Among major urban centres, London has taken a lead in developing and implementing progressive climate change mitigation measures. The City of London has now translated this initiative into pro-active adaptation planning.

In 2002, the London Climate Change Partnership (LCCP) was formed in order to "ensure that London is prepared for its changing climate". The LCCP quickly established clear, guiding goals:

- Provide high quality information on impacts and adaptation options
- Help integrate climate change into decision making
- Engage the media
- Monitor preparedness

The LCCP is a dedicated partnership with 20 full-time staff. The partnership steering committee convenes every 2 months to discuss program direction, and to establish sub-groups (including transport, buildings, finance, etc). The LCCP is authorized to participate and actively intervene in on-going policy and decision making processes, in this way they have the capacity to insert climate change adaptation and impacts in city planning.

To date, the LCCP has produced several publications on climate change impacts in London, and has integrated climate change into the comprehensive "London Plan" (the primary City planning document).

6.2.4.2 Northern Initiatives

Forest Management in Southwest Yukon

While this is not a municipal project, The Northern Climate Exchange is working with forest managers and practitioners in the Southwest Yukon to develop a forest management plan that considers climate change impacts, and develops options for adaptation.

A comprehensive overview report for the project (Forest Management in a Changing Climate: Building the Environmental Information Base for Southwest Yukon) is available through the Northern Climate Exchange website[8], or through the project website.[9]

This project is developing indicators for forest management that include climate change. This project is not exclusively driven by climate change issues, economic, food security and forest fires are also among the important factors incorporated in this comprehensive plan. The goal of the project is to develop over a period of 3 years, a set of tools for forest managers and practitioners to use.

Various Communities

The community of **Old Crow (Yukon)** began in the past year to develop a climate change plan based on the Risk Management framework. Results from this work are not yet available.

The community of **Atlin (Northern BC)** is working with Micheal Westlake and the Northern Climate Exchange on a sectoral approach to climate change adaptation. Sectors include land-based economy (forestry, trapping, etc), as well as infrastructure and energy. This work, in its initial phases, will expose the community to a risk management concepts and aims to develop a risk management plan for each sector. This project is unique in that it will combine the risk management approach with the scenario approach.

The community of **Mayo (Yukon)** undertook a process to examine the effects that climate change could have on the community and residents. The council stated that "climate change could adversely affect our community in the future, and therefore, we would be interest in having climate change

[8] Northern Climate Exchange. http://www.taiga.net/nce/.

[9] Forest Management in a Changing Climate. http://www.yukon.taiga.net/swyukon/.

studies take place in Mayo area to find out what impacts climate change may have on future (generations)". The community secured funding to complete a report on climate change impacts in central Yukon, and have initiated a community-based monitoring program. They are incorporating climate change considerations in community decisions.

6.2.5 General Lessons from Case Studies

Overall, there are several general lessons that can be drawn from the case studies outlined here:

- Clearly defining goals helps direct the adaptation process
- 'Personalizing' the process promotes stakeholder engagement and ensures buy-in.
- Establish and manage a stakeholder process. This could include options such as working groups, steering committees, etc. Including public stakeholders and media in the engagement and awareness building process.
- Leveraging commitment to climate change mitigation action and/or sustainability initiatives can increase support for adaptation.
- Collaboration and networking with other 'early adapters' as well as experts from NGOs, governments and academia is critical.
- Establish priorities (acquisition of data or information, development of options, implementation of adaptation measures to reduce vulnerability to high-risk impacts).
- Get started on action! Look for opportunities to integrate climate change in on-going decision-making processes.

7. Results of the Workshops

7.1 Workshop #1: Climate Change Impacts & Current Response Capacity

7.1.1 Workshop Objectives

Create a common understanding of climate change adaptation and what it means for Yellowknife. Engage participants in identifying climate change impacts and how to improve the City's response to impacts.

7.1.2 Desired Workshop Outputs

1. A list of potential climate change impacts identified by participants.

2. A select number of impacts for use as examples in developing adaptation tools.

3. A list of opportunities for improvement that can be applied to general adaptation risk-management models to tailor them to Yellowknife's specific needs.

7.1.3 Workshop Process

Jake Pryor presented a series of slides (found in Appendix B) covering the following topics:

- Climate Change Adaptation: What is it? Why are we doing this?
- Links to the General Plan, ICSP, Infrastructure Plan
- Climate change scenarios and historical data for Yellowknife
- Examples of risk management approaches to adaptation used elsewhere

Climate Summary: Historical data from Yellowknife airport showed a 2^{o}C rise in annual temperature from 1943 to 2006 which was more pronounced in the winter, and a 20% increase in annual precipitation which was more pronounced in the summer. Climate change scenarios for the region indicate a minimum additional 2^{o}C by 2050 with precipitation changing between -5% and +20%.

Participants self-organized into groups of 4-5 to answer each of the following four questions. Participants largely remained in the same groups throughout the afternoon with some participants having to leave and later return after attending to other meetings. In each case the groups discussed the question and wrote short answers on large post-it notes. After 15 minutes discussion on a question, the facilitator collected up the responses, and a 10 minute plenary followed were they were discussed. This plenary session gave everyone opportunity to learn from the suggestions of others and add any remaining thoughts. The responses are recorded below. Numbers in parenthesis indicate participant responses to prioritization task of issues to further consider (see below).

Question 1. <u>What have been the observed impacts from climate change in YK?</u>

- Longer construction season
- Longer growing season

- Warmer summer temperatures bringing longer summer tourist season
- Higher costs for roads – permafrost
- Shorter ice road season resulting in increased air transport – social and economic impacts (on local carriers, and aircraft noise)
- Shorter ice road season resulting in higher costs of flying goods in rather than trucking
- More snow melt and litter creating flooding
- Increased stress on emergency response with respect to floods and unstable ice
- More cloud cover reducing (winter aurora viewing) tourism
- Big snow dumps (especially in November) creating greater need for snow clearing services (increased costs, labor, equipment)
- Icy roads requiring more maintenance
- Increasing population of southern wildlife and grizzly bears
- Animal migrations result in less food available from the land therefore more store-bought food
- Insect infestations
- Changing Animal Ranges
- Longer fire season and more lightening = increase in fires and impacts on emergency services
- Overflow on lakes – impacts recreational use and emergency response
- Unpredictable weather – freeze/thaw. (Once cold would stay, now temperature fluctuates).
- More frost on power lines resulting in maintenance issues and power outage (2006) – rotating power availability
- More freeze-thaw cycles
- Higher water & sewer costs (?)
- Warmer winters
- Unpredictable weather

Question 2. <u>What climate change impacts do you foresee for the future?</u>

- Water/sewer infrastructure – less heating needed for flow, greater siltation/ lower quality water (6)
- Increased road O&M costs – sanding, pot holes, shortening of lifetime for surface (4)
- Increased infrastructure costs due to climate change (capital and O&M) (4)
- Review ground carefully where the city is expanding (incidence of ice in permafrost soils indicates level of expected destabilization) (3)
- Longer summers, increased food production and recreation (eg soccer pitches)
- Water table impacts of frozen arsenic encapsulation at decommissioned gold mine (1)

- Landscaping impacts, water availability, length of growing season, ditch maintenance
- Challenge for budgeting on snow removal
- Changed insect populations (mosquitoes, black flies) – impacts on health & recreation – swarms of flies not good for playing golf in. Food chain impacts. (1)
- Southern invasive species, social, health impacts (vector borne disease)
- Warmer weather bringing more permanent residents – impacts on growth and tourism
- Longer summer so more tourism
- Tourism – winter shorter so less Japanese (1)
- Water quality and quantity (2)
- Impacts of permafrost on sewage lagoons (increase in active layer resulting in leaching/ draining)
- Precipitation effect on landfill – leaching
- Changing storm water impacts – flood impacts
- More permafrost degradation
- Electricity supply is from hydro, tied to water levels so vulnerable
- More fires and lightening requiring more fire break planning
- Challenges of climate change design – minimize risk but also increases $
- More effort and costs for building foundations
- Increasing costs for roads will make infill development more economical
- Shoreline effects – need to change development set-backs from water line, consider wave action (changing wind regimes)

Question 3. <u>What have been the strengths of the City's response to observed climate change impacts?</u>

- More flexibility in approach to snow removal (snow removal started 3 weeks early this winter)
- City already engaged in national climate change issues (FCM application) – see Greg
- Community energy plan reducing costs – resulting in more cost effective infrastructure planning
- Community involvement- using community resources like Ecology North
- Water tempering in pipes reducing water breaks
- Engineering efforts – insulation pipes (less impact of heat escaping into surrounding ground)
- More detailed designs – storm water
- Preparing for population increases (engaging in smart growth project)
- Considering LUB changes

- Engaging in studies (like this project) on adaptive capacity
- Innovation in construction to adapt to ground conditions – permafrost (end bearing pillars)
- Design change of Franklin Hill with concrete slab to minimize settlement
- Economic diversification – promoting tourism to put less eggs in one basket
- Public communication through newsletter
- As a growing community, economies of scale provide more fiscal capacity to address issues.
- Have set up CEP, smart growth plan, adaptation , ICSP

Question 4. How can the City's existing response capacity be improved?

- Smart growth – infill, density, zoning (6)
- Have guaranteed long term funding for adaptation (3)
- Sharing best practices (Iqaluit model, Whitehorse ICSP) (1)
- Incorporate new data (temperature) for best practices
- More resources – higher standards for buildings, roads, water treatment (1)
- Staff training (best practices) in smart growth, energy, building standards, infrastructure standards (1)
- Empower staff, identify savings, energy, efficiency
- Energy optimization
- Implementation of plans – CEP, smart growth, ICSPs (1)
- Measurable indicators & targets (EGH80 standard for residential units), sustainability indicators, energy use vs temperature for example.
- Facility planning – energy efficiency
- Citywide storm water management plan (underway)
- Promote best practices of mitigation & adaptation (tie public/community adaptation with that of other agencies and individuals) (2)
- Partnerships with Arctic Energy Alliance, Ecology North and private industry to improve facilities
- Community Capacity building (info and experience)
- Greater dialogue with Dene – different approaches (1)
- Education & public awareness (1)
- Water treatment plant & sewage treatment plant (1)
- Well-being – social stresses need addressing (general) (1)
- Ensure climate change impacts are placed into annual budgeting cycle (1)
- Increased funding and services

Participants were invited to use sticky dots to pick out two key priorities. The questions and their responses follow. In each case the number of participant votes is shown in brackets.

Prioritization Task 1. Which of the 'future impacts' (responses to Q2) should we use to test adaptation models for Yellowknife?

- Increased infrastructure costs due to climate change (capital and O&M) (8)
- Impacts on water and sewer infrastructure – less heating needed for flow (+ve), greater siltation/ lower quality water (6)
- Assessing the ground carefully where the city is expanding (incidence of ice in permafrost soils indicates level of expected destabilization) (3)

Prioritization task 2. What are the biggest challenges for the City of Yellowknife in improving its response to climate change (responses to Q4)?

- Developing smart growth – infill, density, zoning (6)
- Have guaranteed long term funding for adaptation (3)
- Sharing best practices (Iqaluit model, Whitehorse ICSP) (1)

The facilitator indicated that these priorities would inform the research tasks between now and the next workshop. He thanked participants for their time and energy and proposed suggested dates for future workshops.

7.1.4 Workshop Results

1. Historic climate data indicates Yellowknife has observed an increase in average annual temperature of 2^{o}C from 1943 to 2006. This warming has been most pronounced in the winter. Climate change scenarios indicate a further warming of at least 2^{o}C by 2050.
2. During the same 1943-2006 period, Yellowknife has seen an increase in annual precipitation of 20%, mainly as summer rain. Scenarios of future precipitation indicate a broad range of projections from -5% to +20%.
3. Participants identified 23 observed impacts and 24 potential future climate change impacts, although participants noted that it was difficult to attribute observed impacts solely to climate change.
4. The prioritized issues for further research were:
    a. Researching decision-making support tools in use in other jurisdictions.
    b. Smart growth
    c. Planning for increases in capital and operating costs to address impacts/ securing predictable funding.
    d. Water and waste water infrastructure adaptations
    e. Managing changes in active permafrost
    f. Sharing best practices.

5. The City's historical response to climate change impacts has successfully demonstrated flexibility, resourcefulness, and innovation - although it remains fragmented in the absence of a systematic adaptation process.

7.1.5 Facilitators Observations

Participants had some difficulty attributing observed impacts solely to climate change. This was an important admission of the limitations of our understanding of the many variables that affect community systems. However, since most climate change adaptations are not implemented solely to address climate change impacts, but also for their additional benefits, this limitation does not devalue decisions on future adaptations.

The break-out groups occasionally mixed mitigation measures with adaptation. It is not clear whether this was a result of a holistic approach that encompassed both strategies was being expressed, or whether it was a lack of understanding of some terminology. Greater emphasis will be placed on defining adaptation terminology in future workshops to prevent any confusion of terms and maximize the value of participants' insights.

7.1.6 Workshop Evaluation

At the end of a workshop, participants were invited to complete a workshop evaluation form. Nine forms were returned completed. Participants were asked to rate the following aspects of the workshop from 1 to 5, with 1 being 'very unsatisfied' and 5 being 'very satisfied'. The average scores for each aspect of the workshop is shown below.

Degree of organization	4.22
Workshop materials	3.67
Clarity of presentation	3.89
Workshop pace	4.33
Breakout groups	4.22
Plenary discussions	3.88
Quality of facilitation	4.25
Confidence in the outcomes/ progress	3.67

Written responses to the remaining questions are summarized below.

Question 1. Did the workshop meet its objective?

All responses to this question indicated a confidence that the workshop had met its objective.

Question 2. What was the most valuable part of this workshop for you?

All responses to this question focused on the value of sharing ideas in the small groups. One response added the value in recognizing the work the City has already undertaken to address climate change impacts.

Question 3. What aspects of the workshop would you have changed?

The 3 responses to this question mentioned: scheduling workshops for the morning to improve energy levels in the room; more discussion on linkage between measure sand impacts; and clearer direction going into groups.

Question 4. Any additional comments?

The sentiments of all responses to this question were satisfaction with the workshop and facilitator, and looking forward to the next workshop.

7.2 Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application

7.2.1 Workshop Objectives

Develop risk assessment and decision making criteria, structure, and model for Yellowknife.

7.2.2 Desired Workshop Outputs

1. A risk management tool that can be used consistently across the municipality to prioritize the needs for climate change adaptation.

2. An accountability framework that will ensure that responsibility is assigned, and appropriate action is taken to address climate change impacts and adaptation as they are identified.

7.2.3 Workshop Process

The facilitator presented a series of slides (at Appendix C in this document) covering the following topics:

- Concepts and definitions
- Adaptation Planning, Frameworks and Decision Making
- Case studies

The facilitator explained that some of the research questions identified during Workshop 1 could not be addressed. This was due to the limited number of case studies available, and the fact that they had not addressed the issues themselves. There were however, some important observations and lessons from the case studies that would help inform the Yellowknife process:

- Mitigation action is more common than adaptation
- Adaptation action mostly linked to issue-specific responses to date (disaster management)
- There is limited (if any) integration of climate change into on-going decision making processes
- Adaptation processes are tailored to each community
- They leverage commitment to sustainable development
- They establish stakeholder processes
- There is generally a weak understanding of potential impacts and their link to climate change
- Decision makers risk focusing on short term costs of adaptation instead of the long term cost of not adapting

- Challenges of short political cycles and secure ongoing funding

The facilitator introduced a risk management tool to the group that they would be working with for the afternoon. It was a slightly adapted version of the tool developed by Bruce Egener & Noble (2006) in their Guide for Ontario Municipalities. The tool consisted of two parts – an Impact Rating Matrix, and a Risk Evaluation Matrix (shown on the next two pages). This choice of tool as a starting point for tailoring a Yellowknife-specific tool was based on its balance of meaningful utility and simple manageability.

Climate Change Adaptation - Impact Rating Matrix[10]

1. Choose the climate change impact to review
2. Determine the severity of different aspects of the impact.
3. Record your determination in the matrix.

Consider:

1. What made you decide the impact fell into one category (eg Moderate) and not a neighboring category (eg Low or Major).
2. Do the suggested factors work for your example? Are there others you would like to include? Some you would like to delete? Which ones are most informative about the issue?

Table 2: Impact Rating Matrix

Climate Change Issue: _____												
Impacts	**Social Factors**				**Financial Factors**				**Environmental Factors**			
Severity	Displacement	Health & safety	Los of livelihood	Cultural aspects	Property/ asset damage	Financial impact	Impact on municipal finances		Air	Water	Land	Ecosystems
Very Low												
Low												
Moderate												
Major												
Extreme												

[10] Adapted from Bruce, Egener, Noble, 2006.

Risk Evaluation Matrix[11]

Table 3: Risk Evaluation Matrix

Impact Severity						
	Extreme					
	Major					
	Moderate					
	Low					
	Very Low					
		Very unlikely to happen	Occassional occurance	Moderately frequent	Occurs often	Virtually certain to occur
	Frequency/ Probability					

Extreme risk: Immediate controls required.

High risk: High priority control measures required.

Moderate risk: Some controls may be required to reduce risk to acceptable level.

Low risk: Controls not likely required.

Negligible risk: No further consideration required.

[11] Adapted from Bruce, Engener, Noble. 2006.

Participants self-organized into groups of 4-5 to:

- Apply the tool to issues identified in Workshop #1
- Identify where the tools were deficient, difficult to use or understand
- Suggest revisions to the matrices that would lead to a bespoke risk management tool for Yellowknife

After 30 minutes the facilitator asked the groups to share their experiences of first trying to apply the tool. Lengthy and engaging discussion followed that identified some key changes would be required.

Dave Devana indicated that he considered this exercise one through which a general risk management tool would be developed for the City that was not climate change specific, but which would be applicable in other scenarios as well. This demonstrated a great opportunity for leveraging the results of the workshop into something of further value for the city. Dave also introduced some risk management training materials he had received from a course that assisted him in providing some informed feedback on where the tools could be improved.

Changes suggested by the participants:

1. **Reduce the number of categories of severity from 5 to 3 (low, medium, high)**

   The suggested 5x5 matrix was considered unnecessarily complex by the group. Since the tool is a decision support tool, each location in the matrix should relate to a different type of response action. Twenty five different types of response action seemed excessive. A 3x3 matrix was suggested that would provide sufficient differentiation in evaluated risks to allow appropriate response actions to be tailored without becoming onerous.

2. **Do not be prescriptive about impact categories and allow the user of the tool the autonomy to determine some of the variables.**

   The Impact Rating Matrix presented to the participants already had some generic categories listed under the headings of ‘social’, ‘financial’, and ‘environmental’ impacts. The participants were invited to change these as they felt necessary. After much valuable discussion, the response was to recommend that these sub-categories not be prescriptively provided, but that the user of the tools should be free to identify the relevant subcategories for the impact being rated. In addition, the user should be left to determine what thresholds will determine whether the risk is low, medium or high for each of the subcategories they have created. This recommendation creates opportunity for autonomy of the user, as well as subcategories that are much more relevant to the issue.

   Participants recognized the risk of introducing inconsistent subjectivity into the tool by allowing the user the autonomy to define some of the elements of the tool up front, but felt this was mitigated by the fact it should be used not by an individual, but by a multidisciplinary group that should be able to moderate any isolated and unusual evaluations.

3. **When using the Impact Rating Matrix, do not start with too broad an issue, but be quite specific.**

   The range and number of issues raised in Workshop #1 meant that attempting to assess risks in a ‘summary’ fashion did not yield sufficient information to support the decisions

that would need to be made to address them. The groups determined that it was better to complete an Impact Rating Matrix for each issue rather than, for example starting with the broad statement of "The impact on permafrost of a 2^{o}C increase in temperature over the next 50 years".

4. **When making the transition from the Impact Rating Matrix to the Risk Evaluation Matrix, use only the highest impact rating found in each of the three categories.**

   The idea of averaging the impact ratings was eliminated as it risked 'losing' an issue that scored higher than the average and required more urgent action. The concept of taking the highest score found in each of the three categories – social, environmental, economic – means that the tool is capturing the most significant issues.

   Cumulative effects on the community and its infrastructure are not evaluated by this tool. Once the tool has been applied to the climate change risks, the library of information that is generated will need to be crosschecked for cumulative impacts, otherwise many impacts on the same infrastructure in the low-moderate range may go unnoticed.

7.2.4 Workshop Results

Case studies from other jurisdictions indicate:

1. Climate change adaptation in other jurisdictions is largely as a result of a response to specific issues and linked to disaster response planning.
2. Very little, if any, work has been done to integrate climate change risks and adaptations into ongoing decision making at the municipal level in other jurisdictions.
3. There is generally a weak understanding of potential impacts and their link to climate change.
4. Decision makers risk focusing on short term costs of adaptation instead of the long term cost of not adapting.
5. Adaptation processes should be tailored for each community and include stakeholder engagement.

Review of the risk management tool presented by the facilitator resulted in substantial recommendations for improvement by workshop participants, including:

1. Reduce the number of categories of severity from 5 to 3 (low, medium, high) to simplify the tool and range of responses required
2. Do not be prescriptive about impact categories and allow the user of the tool the autonomy to determine some of the variables to better capture the nature of the risk.
3. When using the Impact Rating Matrix, do not start with too broad an issue, but be quite specific to ensure adequate resolution of the issue at hand.
4. When making the transition from the Impact Rating Matrix to the Risk Evaluation Matrix, use only the highest impact rating found in each of the three categories. Avoiding averaging ensures no issue is 'lost' in the process.

Data from the revised risk management tool has two potential routes depending o the urgency assigned to the risk/ impact. The process is outlined in a slide from the workshop presentation (below).

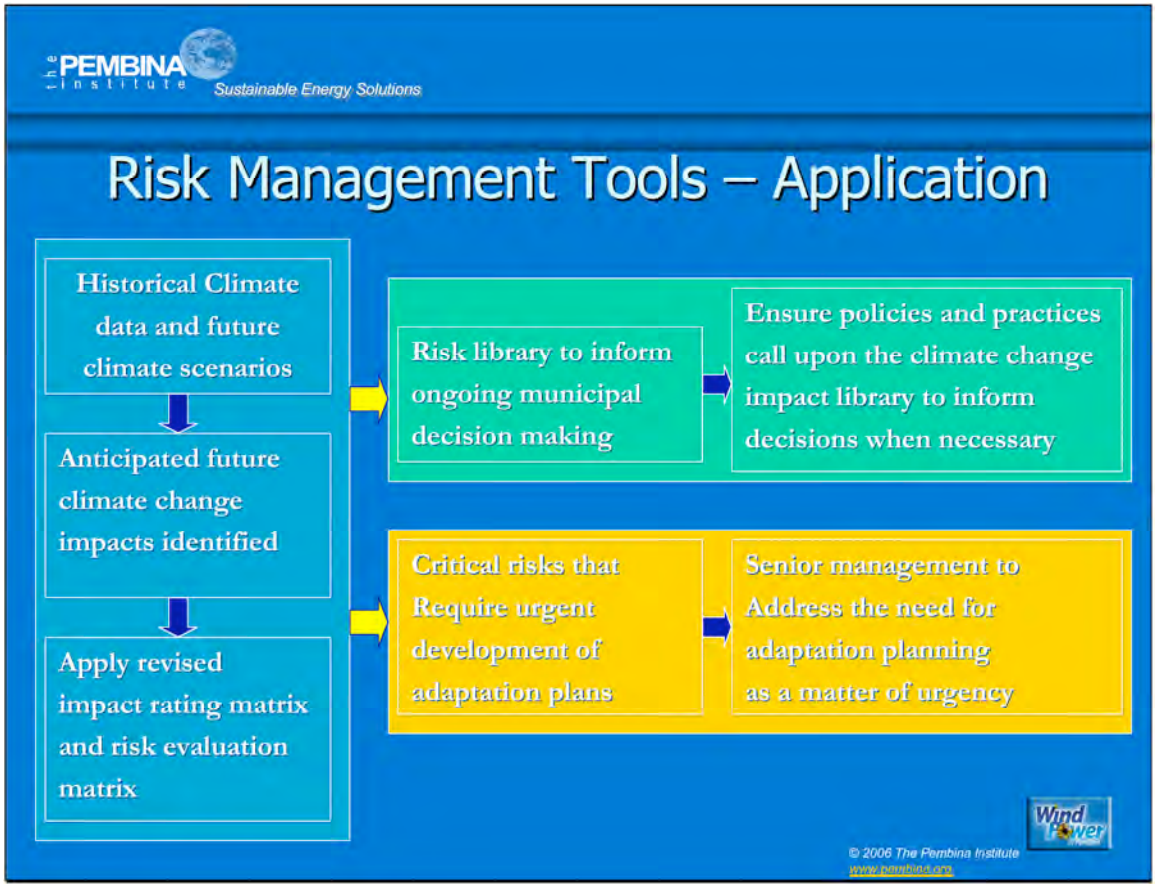

Figure 19: Risk Management Tools

Participant's engagement in the process resulted in invaluable learning and capacity building, however lack of time resulted in some agenda items being deferred until Workshop #3.

7.2.5 Facilitators Observations

This was destined to be a challenging workshop. Risk management tools present an inherent subjectivity which is normally only accepted by users as they become more familiar with it. Not only was this the first time some of the participants had seen a risk management tool, but they were being asked to apply it to real life issues, as well as identify how best to adapt it for Yellowknife's future use. This resulted in considerable learning and capacity building among the participants, however a few participants expressed some frustration at the lack of a final solution. This was possibly the result of a focus on the need for an end product rather than the value of going through the process itself – an experience that will be invaluable in future use of the tools. The facilitator recognized the key challenges the tool presented. The suggested changes will inform the development of a revised tool to be presented back to the group during workshop #3.

A larger than anticipated amount of workshop time was dedicated to the revision to the risk management tool, to the extent that the accountability framework exercises were not completed. In view of the limited face-to-face time, the facilitator decided that it was more important to continue with the engaging discussion on this issue than risk losing valuable input. The exercise on accountability was deferred to the third workshop

7.2.6 Workshop Evaluation

There was no time left at the end of the afternoon to distribute and complete workshop evaluations and a number of participants had departed early to accommodate other commitments. The facilitator chose to dedicate this time to needed discussions on the risk management tool, and ensured that sufficient time was made available at the end of the third workshop for an evaluation on the process as a whole.

7.3 Workshop #3: Decision Making Triggers & Implementation (revised)

7.3.1 Workshop Objectives

1. Identify the core elements of an accountability framework to ensure climate change risks and adaptation are considered in all relevant municipal decision-making.
2. Foster momentum and conditions for continued commitment to stakeholder collaboration on adaptation.

7.3.2 Desired Workshop Outputs

1. A list of types of municipal decisions that should require consideration of climate change risks.
2. A list of opportunities for incorporating new policies and practices that will ensure the risk management tool is used.
3. Identify the need for ongoing support for implementing the tools.

7.3.3 Workshop Process

The facilitator presented a review of Workshop #2 and the revised risk management tool to ensure the suggested improvements were accurately recorded and provide clarity on the direction the process would take from this point forward.

Participants self-organized into groups of 4-5 to answer each of the following questions. Participants largely remained in the same groups throughout the afternoon with some participants having to leave and later return after attending to other meetings. In each case the groups discussed the question and wrote short answers on flip charts. After 20-30 minutes discussion on a question, the facilitator collected up the responses, and a 10 minute plenary followed where they were further discussed. This plenary session gave everyone opportunity to learn from the suggestions of others and add any remaining thoughts. A synthesized summary of participants' sentiments follows, along with the raw responses.

Question 1. <u>When should climate change impacts and adaptation be considered in municipal decision making?</u>

Participants developed recognition of the far-reaching implications of climate change impacts and adaptation on a wide range of decisions. The nature of these decisions ranged from the approval and funding of major capital projects, to the review and revision of key planning documents and policy tools for more systemic implementation. The budgetary implications of many of these decisions is huge, especially where durable infrastructure is at issue. The Yellowknife General Plan (2004) was identified as being a key document that relies on climate projections based on a 30-year historical average. The recently completed Infrastructure Deficit Plan, upon which the city bases its infrastructure maintenance and replacement budget, did not consider the impacts of climate change on that infrastructure either. This is not a criticism of the way the City of Yellowknife has developed these plans, but rather an indication of how the new and evolving discipline of climate change adaptation may impact future planning processes.

Raw responses:

- Review of the General Plan
- Land acquisition and development schemes
- Land use zoning
- Building by-laws
- Long term capital plan
- Water and sewer infrastructure projects
- Roads maintenance planning and network design
- Drainage lift stations
- Landfill and sewage lagoon
- Engineering standards for all of the above.
- Water treatment and sewer provision
- Technology availability, labor and training issues
- Land development decisions
- Transportation planning
- Emergency planning
- Capital budget project prioritization
- Budget criteria & tender process
- Insurance & risk management decisions
- Financial eligibility for projects
- Review of codes and standards
- Anything affected by climate
- Buildings – bylaws
- Capital decisions – infrastructure and buildings (city)
- Infrastructure and facility maintenance planning

- Lands planning – subdivisions, roads, machinery, utilities
- Recreation & tourism
- Winter power failure
- Forest fire risk – summer
- Regulation reviews/ updates (building bylaws, land use zoning, emergency response plans)

Question 2. What constitutes 'appropriate significance'?

The facilitator gave a short presentation providing suggested guidelines for determining whether appropriate significance had been given to climate change adaptation in decision making. These included consideration of the following questions. Does the decision:

1. Limit present day or future climate change adaptation options? (Limit climate change 'headroom'?)
2. Affect the ability of other decision makers to manage the consequences of climate change?
3. Address the climate change risks identified by positively increasing coping capacity?

A discussion followed that highlighted the need for this significance to be weighed against other factors affecting a decision. These three questions aim to ensure the decision makers are aware of the consequences of a course of action with respect to climate change. If the decision is not made in favor of the climate change adaptation, there is at least an open and accountable recognition of the consequences.

Question 3. What policies and practices are necessary to ensure appropriate significance?

The review of by-laws, design standards and building codes gives some formal teeth to any revisions made to planning tools. It was recognized that the General Plan is not due for review until at least 2009, delaying an incorporation of climate change considerations into this key guiding document. It is therefore important to prioritize the review of policy tools to maximize the opportunities for *ad hoc* integration of climate change adaptation until such time that high level planning documents are revised. Once this is achieved, the door will open to more aggressive and timely integration in all implementation tools that are in place to support the General Plan.

Some progressive ideas were shared including the consideration of natural capital in decision making, building relationships with insurers to provide incentives for pro-active adaptation design (for both public facilities and private buildings) and providing a climate forecast (scenario) universally acceptable by key stakeholders upon which to base coordinated responses.

Raw responses:

- Strong planning tools: 5 year review of the General Plan
- Ongoing reviews of land use zoning, Building By-law, SMART Growth Redevelopment Plan

- Develop standards based on risk – current standards are in place but do not consider climate risks, e.g. water treatment, sewage treatment, engineering standards for roadways, water/sewer and facilities.
- Develop procurement & budget policies – could be ad-hoc by memo to council
- Overarching policy on climate change
- Communication tools for Council and all staff to become aware of the issues
- Documentation of decision making (for accountability and future learning)
- Progressive leadership engaging other agencies
- Periodic evaluation of overall policy and individual projects
- Long-term planning criteria
- Maintenance of risk management library
- Updating the climate forecast
- Natural capital decision-making
- Consideration of climate change in all city decisions
- Access to best practices
- Memos to council with risk management library attached
- Climate change procedures manual
- Interdepartmental review of reports and projects
- Public marketing (use of risk management library)
- More prescriptive local standards (higher standard than national)
- Develop relationship with insurers to get breaks for better designed buildings (public and private)

Question 4. <u>What ongoing support is needed for implementing the tools?</u>

This question was addressed in a plenary format to encourage broad brainstorming. A number of key issues arose that were common concerns. The agreement between stakeholders on these issues demonstrated the value of the workshop process in that a common understanding and basis for progress had been established.

- There are resource constraints that will challenge the financial sustainability of this adaptation process
- This is an ongoing process and should have its own budget line in the municipal operating budget
- Public buy-in is essential. The City of Yellowknife may need external support for this
- We must be able to streamline this process into existing tools to be 'good enough' [for administration to want to use it].
- An intuitively prioritized schedule for reviewing design standards etc needs to be established.

The facilitator discussed the scope of this project and the support available from the Pembina Institute to assist in the implementation of recommendations resulting from this project.

The facilitator gave a short presentation showing just how much had been achieved during the short 3 afternoons of meetings with participants. During that time, participants had:

- Reviewed past historical and future climate scenarios for Yellowknife
- Undertaken a high level scoping of anticipated future impacts
- Reviewed responses to climate change impacts to date and identified opportunities for improvement
- Reviewed case studies from other jurisdictions
- Introduced risk management and evaluation tools, applied the tool to anticipated future impacts, and revised them for Yellowknife's needs
- Identified when climate change impacts should be considered in municipal decision making
- Identified where policy and practices need to be revised to include climate change impacts in these decisions
- Reviewed the workshop process and what to expect from the project report

The energy and motivation brought by participants to the workshops facilitated a great deal of learning and capacity building within a short space of time. This was evident from the scores logged by participants on the project feedback forms.

7.3.4 Workshop Results

The following section summarizes the main outputs from the workshop.

Decision-making processes that require consideration of the impacts of climate change fall into two categories:

1. The revision of plans and policy tools that provide the formalization of climate change adaptation in decision-making. This would include high level planning documents like the General Plan, by-laws, design standards, tenders and building codes.
2. Project specific approvals for a wide range of planning and engineering projects where the future climate will affect the lifecycle, maintenance or safety of infrastructure or facilities.

Participants recognized the limitations of revising key planning documents with already established review periods (e.g. the general Plan), but pressed for *ad hoc* revision of existing implementation tools to integrate adaptation into current practices in a more timely fashion (e.g. tender process, building by-laws).

Participants also recognized the need for more prescriptive local standards and codes (over and above established national standards) to achieve an acceptable level of risk.

Key areas where ongoing support is needed for implementation were identified:

- Municipal budget constraints that may challenge financial sustainability

- As an ongoing process, adaptation should have its own budget line in the municipal operating budget
- Public buy-in will be key to implementation (political support)
- Process needs to be streamlined into existing tools to be 'good enough'.
- An intuitively prioritized schedule for reviewing design standards etc needs to be established.

The degree of agreement amongst the participants was the defining success of this workshop. The common understanding and capacity developed amongst the stakeholders during the entire workshop process was evident in the unity of support for issues identified.

7.3.5 Facilitators Observations

Time spent up-front reviewing workshop #2 and clarifying the direction of the process restored focus to the workshops. However, the agenda for Workshop #3 had to be changed to accommodate some tasks not completed in Workshop #2. This was a function of the limited contact time available with participants and the complex nature of the issues at hand. The result was that the initial objectives of this last workshop were met as collective spirit developed in the room. Comments from participants included; "Very useful to have Council and Administration in the same room", and "Admin were a bit of a mystery to me until now."

The workshop experience and time dedicated to these tasks have furnished participants with a consistent and rational approach to addressing climate change risks. As ambassadors for adaptation, Yellowknife has a strong team of elected officials and professionals whose shared experience of the workshops will strengthen their responses immeasurably. While not all participants will approach this issue in the same way in the future (this was never the intent of the project), they now share some common understanding of the significance of the issues and how best to consider their potential solutions.

7.3.6 Workshop Evaluation

At the end of a workshop, participants were invited to complete a workshop evaluation form. Ten forms were returned completed. Participants were asked to rate the following aspects of Workshop #3 from 1 to 5, with 1 being 'very unsatisfied' and 5 being 'very satisfied'. The average scores for each aspect of the workshop is shown below.

Degree of organization	4.3
Workshop materials	3.9
Clarity of presentation	3.9
Workshop pace	3.4
Breakout groups	3.9
Plenary discussions	3.8
Quality of facilitation	4.2
Confidence in the outcomes/ progress	4.0

Written responses to the remaining questions are summarized below.

Question 1. Did the workshop meet its objective?

"Yes"

"?"

"So far, so good"

"I believe so"

"Generally the objectives appear to have been achieved, although it is not exactly clear what the next steps of Admin/ Council will be"

"OK"

"Yes, well organized"

'I think so"

"Too soon to tell"

"Yes"

Question 2. What was the most valuable part of this workshop for you?

"Candid discussion on climate change and getting administrations views on how some of these ideas are implemented"

"Valuable to have council and administration and other government folks in the same room devoted to this topic"

"Interaction of Council, admin & 'outside'"

"Sharing of info between differing backgrounds"

"Confirmation of climate change issues & discussions"

"Learning about risk assessment"

"The distinction between climate adaptation and prevention/ mitigation requires a shift in mindset and the exercises demonstrated the need for planning, strategy and implementing a climate adaptation approach"

"Mix of participants good"

"Learning about potential climate change impacts. Working through the risk model. Talking about implementation ideas"

Question 3. What aspects of the workshop would you have changed?

"More time to participate –my schedule not a working (?) schedule"

"Very process heavy – especially workshop #2. Could have benefited by first discussing concepts further with admin so more finely homed when brought to group"

"More written materials? More advance notice of meeting times"

"Needed more guidance for breakout groups"

"Can't think of anything"

"More background material/ case studies"

"More pre-workshop material may help"

Question 4. Any additional comments?

"Good facilitation for a vague and evolving issue. Hope to bring a lot of lessons from this to GNWT. Looking forward to the report"

"Perhaps inclusion of further invited participants. Group is biased towards bureaucrats – some 'on the ground' people might be good?"

"Well done – thanks!"

"Thank you"

"Need to quantify most probable future based on climate change threats and impacts to get buy-in from Council, staff and public. Key component to success"

"Great facilitator"

7.4 Summary of Workshop Tasks

In the space of 3 half day workshops, participants were lead through a process that:

- Reviewed past historical and future climate scenarios for Yellowknife;
- High level scoping of anticipated future impacts;
- Reviewed responses to climate change impacts to date and identified opportunities for improvement;
- Reviewed case studies from other jurisdictions;
- Introduced risk management and evaluation tools, applied the tool to anticipated future impacts, and revised them for Yellowknife's needs;
- Identified when climate change impacts should be considered in municipal decision making;
- Identified where policy and practices need to be revised to include climate change impacts in these decisions;
- Reviewed the workshop process and what to expect from the project report.

Workshop participants brought a terrific amount of energy, enthusiasm and diverse material content to each workshop which fuelled the pace and maximized the available workshop time.

8. Recommendations for the City of Yellowknife

The results of the workshops informed the development of risk management and evaluation tools and the development of a series of recommendations to put Yellowknife on the road to the systematic consideration of climate change impacts in decision-making. These recommendations were developed by the Pembina Institute after completion of the workshops and are presented for the City's consideration in developing an implementation plan.

8.1 Year 1

1. Council should **adopt a comprehensive climate change adaptation policy**. A template version is attached at Appendix E.
2. **Assign a Climate Change Adaptation Co-coordinator**

   Formal recognition of this role in a job position reinforces the ongoing commitment to the project and provides the foundation of accountability for the maintenance and application of the decision support tools. It is suggested that this role could be accommodated within a 0.2 FTE and so may be considered as part of an existing job description, or alternatively, contracted out to one of the very capable local not-for-profit groups. This latter alternative brings the added value of building relationships with stakeholders in the community to promote unity of purpose in the project.

   The key roles of this position would be to:

   - Provide coordination to all departments in their use of climate change risk management tools and the adaptation library of data
   - Maintenance of a library of data regarding climate change adaptation
   - Chair and provide administrative support to the Climate Change Review Committee (see below)
   - Provide ongoing proactive communication with staff and public on the adaptation program
   - Promote the profile of adaptation issues within the decision making structure at the City of Yellowknife
   - Document the use of the adaptation library, decisions influenced by its use, and evaluation of administration and Council's application of the tools
3. **Establish a multi-stakeholder 'Climate Change Adaptation Review Committee'**. It should be chaired by the Adaptation Coordinator and comprise largely the members of the workshops of this project. Its role will be to:

- As a committee, apply the decision support tools to climate change risks, to create the information library, and identify any critical issues that require immediate attention. Employing the decision support tools this way eliminates any potential bias that could be introduced by one individual.
- Review decisions made by Council where significant adaptation issues were reported in the 'request for decision'. This will be an invaluable feedback route through which to adapt the information library to best meet the needs of council to make informed decisions.

4. The Climate Change Adaptation Review Committee, under guidance from the Adaptation Coordinator, should **employ the decision support tools** developed through this project to create a climate change risk and adaptation library of information. This library of information will be called upon by the Adaptation Coordinator and other staff to complete the mandatory sections of Council reports and provide some consistency in how the data is presented, and how significant it is.
5. The **Climate Change Adaptation Review Committee should host a public open house** to share these tools and findings with the public. The purpose is to get buy-in from the community so they understand why future decisions may not be made the same way as past decisions have and that there are very significant reasons for that.
6. Council should require that **all 'requests for decision'** reports written by administration for Council **include a section on 'Implications for Climate Change Adaptation'**. Current practice sees 'environmental implications' already included in such reports, however, given the significance of climate change adaptations, an entirely separate section is recommended. This will keep adaptation at the forefront of the decision maker's minds, as well as ensure that the comments are material. The section should respond openly to the following questions:
    a) Does the decision limit present day or future climate change adaptation options? (Limit climate change 'headroom'?)
    b) Affect the ability of other decision makers to manage the consequences of climate change?
    c) Address the climate change risks identified by positively increasing coping capacity?

    The responses to these questions can then be considered by decision makers to help make an informed decision. The relevant data from the climate change risks library should be appended to the Council reports.
7. Require that all contractors and suppliers of durable goods and services over a predetermined value must provide evidence of how they have incorporated Yellowknife's anticipated climate future and impacts into their designs, products and services to be considered in any tendering process.
8. In advance of (7), **educate the City's suppliers and service providers on the climate change adaptation policy** to raise awareness that the standards to which the City will hold potential suppliers with respect to adaptation.

9. **Address any critical climate change impact risks as a matter of urgency**. While the focus of this project was to incorporate climate change adaptation into municipal decision-making, some issues will emerge as critical for immediate action through the decision support tools. Where this occurs, the adaptation coordinator should inform the senior management team for urgent interdepartmental review and action.
10. **Review public infrastructure investment plans through the climate change adaptation 'lens' for prioritization**. The recently completed Infrastructure Deficit Plan was commissioned by the City of Yellowknife as a tool for assessing the financial resources required to maintain, repair and replace public infrastructure. This plan did not consider the impacts of climate change in its assessment. Administration should undertake a coordinated review of the plan alongside the adaptation information library created by the decision support tools to come to a more informed assessment of resources required for these tasks. This could have a significant impact on the city's capital program budget.
11. **Establish a schedule for the review of Yellowknife's bylaws, policies and plans** so that prescribed review periods for strategic planning documents are not overlooked when opportunity arises to incorporate adaptation thinking into them.

8.2 Year 2

12. **Give climate change adaptation its own line item in the Operating Budget**. This budget will pay for:
    - the annual costs of the Adaptation Coordinator role (0.2 FTE),
    - education and professional development opportunities in adaptation for Council, the Adaptation Review Committee members, and the Adaptation Coordinator
    - meeting costs for the Adaptation Review Committee,
    - sufficient funds for ongoing education and communication, both internally and externally, and
    - miscellaneous office costs.

    It is suggested that a budget in the order of $25,000 be established in the first year, to be reviewed depending on progress and actual needs as the program develops. Funds required for taking adaptive action, increase coping capacity, or implementing adaptation plans for particular projects, should not be included in this line item, but evidenced in the budget for that particular project.
13. **Four times a year, the Adaptation Coordinator should host a meeting of the Adaptation Review Committee** to:
    a) Review any new data that may influence the climate change risk information library
    b) Determine whether further information or studies should be pursued to strengthen the library
    c) Review any Council decisions made during the last quarter that included significant adaptation issues

d) Adapt the decision support tools, data library, or methods of data delivery to ensure adaptation issues are being adequately considered

14. The City of Yellowknife should **consider commissioning a climate futures study for the area that has greater resolution than the data provided for this project.** Reducing further the uncertainty over what the future climate looks like and what impacts should be anticipated will make for more confident decision making.

15. **Pursue intergovernmental policy review to maximize opportunities for adaptation where there is shared responsibility for services and infrastructure**.

16. **Press for the development of institutional support for ongoing adaptation work** through organizations such as the Federation of Canadian Municipalities and the International Council for Local Environmental Initiatives. These are key institutions with the capacity to leverage resources and share best practices from other jurisdictions on an ongoing basis. The emergence of institutional support on a broad scale will be invaluable in keeping the long-term costs of adaptation down for communities like Yellowknife.

9. Project Evaluation

9.1 Workshop Evaluation Surveys

The overall objective of the project was to develop the tools, capacity and decision-making processes necessary for the City of Yellowknife to systematically address any community climate change impact as it emerges.

A project evaluation questionnaire was developed to determine whether this objective had been met. Participants were asked to rate their response to nine statements from 'strongly agree' (5) to 'strongly disagree' (1). Ten evaluation sheets were returned with the following results.

"Compared to before the project started. . . . . ."

Statement	Average score (1 to 5)
You have a better understanding of Yellowknife's climate and climate change impacts	4.0
Your knowledge of climate change adaptation approaches, their value and limitations has increased	4.0
You know when to include adaptation issues in decision-making	3.9
You have a better understanding of what questions to ask when faced with such a decisions	3.8
Your understanding of risk management tools has increased	3.9
You feel the tools the project will provide will be effective in incorporating climate change adaptation into municipal decision-making	4.1
Your overall ability to address adaptation has improved	3.9
You feel the group workshops have provided some valuable common ground for participants	4.5
You are confident of keeping adaptation on the 'agenda'	4.1

It is clear from the participant evaluations that value was created by the project for the participating councilors and staff. The degree of engagement in the workshop tasks, which were at times quite challenging for the group, was reflected in the level of sophistication that discussions and questions were ultimately elevated to. This is a particularly satisfying result given that face-to-face time for workshops was half of that initially proposed for the project.

However, some of the project objectives were not met. The desire to integrate the adaptation decision-making support tools into the Integrated Community Sustainability Plans was

dependent on the time-line of the territorial government as they developed a template for the plans. These templates would determine the mandatory and elective elements of a plan that would qualify the community for gas tax revenues to spend on public infrastructure. As it happened, the template design and consultation process was not open to the project team, nor was it early enough to be incorporated into this process.

One of the unexpected but crucial results was the value placed on having councilors and senior administrators in the same room to work through some very important but often complex issues. This form of meeting was not common at the City of Yellowknife and resulted in significant unity of understanding of the issues and the establishment of a common foundation from which a shift in decision-making would result more readily.

9.2 Lessons Learned

1. **Making Decisions Possible**. Often in municipal decision making the lack of opportunity to work through complex issues in such a forum compromises the tremendous progress some initiatives promise. The critical eye so often focused on local politicians can drive them to request almost omniscient levels of data and certainty before a decision is made. In such an uncertain field as climate change, great efforts need to be made to create a common understanding of both the value and limitations of the data so that important decisions are not deferred for the sake of further analysis that generates no more added value.
2. **Time Allocation**. Condensing the volume of material for this project into 3 half-day workshops was very challenging. Realistically, the time investment required to replicate this process is 3 full days of workshops with key decision makers and support staff.
3. **Institutional Support**. The long term, widespread application of processes like this one into other communities is dependent on the development of readily available institutional support. This support is required to keep costs down, provide a forum for the sharing of best practices and processes, and to keep climate change adaptation on the pro-active radar of community leaders.
4. **Integration with Other Processes**. Opportunities for integration of climate change adaptation into the highest policy and planning levels may be temporally constrained by the already established review periods for documents like the official community plan (typically every 5 years), land use bylaw (typically after each community plan review), and others. Municipalities should be encouraged to identify key opportunities for engaging climate change adaptation professionals before they arise and plan for their contributions accordingly.

Appendix A: Glossary[12]

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic *stimuli* or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation:

- ***Anticipatory Adaptation***. Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive adaptation.
- ***Autonomous Adaptation***. Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
- ***Planned Adaptation***. Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.
- ***Private Adaptation***. Adaptation that is initiated and implemented by individuals, households or private companies. Private adaptation is usually in the actor's rational self-interest.
- ***Public Adaptation***. Adaptation that is initiated and implemented by governments at all levels. Public adaptation is usually directed at collective needs.
- ***Reactive Adaptation***. Adaptation that takes place after impacts of climate change have been observed.

Adaptive Capacity

The ability of a system to adjust to *climate change* (including *climate variability* and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Adaptation Benefits

The avoided damage costs or the accrued benefits following the adoption and implementation of *adaptation* measures.

Adaptation Costs

Costs of planning, preparing for, facilitating, and implementing *adaptation* measures, including transition costs.

Climate

Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

[12] Terms and definitions are referenced from the Intergovernmental Panel on Climate Change Third Assessment Report, Working Group II. 2001.

Climate Change

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the *United Nations Framework Convention on Climate Change (UNFCCC)*, which defines "climate change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." See also *climate variability*.

Climate Impacts

Consequences of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts.

- ***Potential Impacts*** — All impacts that may occur given a projected change in climate, without considering adaptation.
- ***Residual Impacts*** — The impacts of climate change that would occur after adaptation.

Climate Scenario

A plausible and often simplified representation of the future *c l i m a t e*, based on an internally consistent set of climatological relationships, that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as about the observed current climate. A "climate change scenario" is the difference between a climate scenario and the current climate.

Climate Variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability*)*, or to variations in natural or anthropogenic external forcing (external variability). See also *climate change*.

Coping Capacity

Coping capacity or adaptive capacity is the ability of an affected (human or natural) system, region, or community to cope with or adapt to the impacts and risks of climate change

Exposure

The nature and degree to which a system is exposed to significant climatic variations.

Greenhouse Effect

Greenhouse gases effectively absorb infrared radiation emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus greenhouse gases trap heat within the surface troposphere system. This is called the "natural greenhouse

effect." Atmospheric radiation is strongly coupled to the temperature of the level at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of on average -19°C, in

balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of on average 14°C. An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radiative forcing, an imbalance that can only be compensated for by an increase of the temperature of the surface-troposphere system. This is called the "enhanced greenhouse effect."

Greenhouse Gas

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum

of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. This property causes the *greenhouse effect*. Water vapor (H2O), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), and ozone (O3) are the primary greenhouse gases in the Earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine-containing substances which are dealt with under the Montreal Protocol. Beside CO2, N2O, and CH4, the *Kyoto Protocol* deals with the greenhouse gases sulfur hexaflouride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Hazard

A field of certain threats or impacts, which exist regardless of the availability of object or element (i.e., recipient) exposed to the impact (compare with gravitational, electromagnetic or radiation fields).

Maladaptation

Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead.

Mitigation

A human intervention to reduce the sources or enhance the sinks of GHGs

No Regrets Policy

One that would generate net social benefits whether or not there is *anthropogenic* climate change.

Resilience

Amount of change a system can undergo without changing state.

Residual risk

The risk that remains after all management options have been exhausted.

Risk

A function of the probability and consequences (i.e., magnitude and severity) of an adverse event or hazard.

Risk communication

Any two-way communication between stakeholders about the existence, nature, form, severity, or acceptability of risks.

Risk management

Decisions to accept exposure or to reduce vulnerabilities by either mitigating the risks or applying cost-effective controls.

Risk perception

The significance assigned to risks by stakeholders. An individual's or group's perception, or belief, that a particular event or hazard is a threat (usually to human health or property). Perceptions of risk are generally determined by one's values, attitudes, socioeconomic class, gender, and other factors. In this sense, risk is often said to be "socially constructed".

Sensitivity

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

Sustainable Development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Vulnerability

The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity

Appendix B: Model Climate Change Adaptation Policy

City of Yellowknife
[Model] Climate Change Adaptation Policy

<u>Purpose</u>: To ensure the risks of climate change impacts and necessary adaptation measures are considered in all aspects and levels of municipal decision-making.

WHEREAS the Intergovernmental Panel on Climate Change (IPCC) has shown, beyond reasonable doubt, that the global climate is changing as a result of man-made contributions to greenhouse gases in the atmosphere; and

WHEREAS climate change impacts are currently being felt in communities, and will be increasingly so, despite efforts to mitigate them; and

WHEREAS these impacts are, and will continue to be, more pronounced in communities at northern latitudes; and

WHEREAS these impacts negatively impact the safety, livability, and effective functioning of our community; and

WHEREAS a community's ability to cope with these impacts is improved with pro-active consideration of the impacts in advance of its consequences; and

WHEREAS Section 3 of the Northwest Territories *Cities, Towns and Villages Act* states that:

Municipal corporations are established for the following purposes:

(a) to provide good government to the residents of the municipality;

(b) to develop and maintain a safe municipality;

(c) to provide the services, products and facilities required or allowed by this or any other enactment or considered by council to be necessary or desirable for all or part of the municipality.

Therefore be it resolved that:

1. The City of Yellowknife recognize the challenges that climate change impacts and adaptation present to the provision of good governance and decision-making, and to the provision of a safe community; and
2. The City of Yellowknife take pro-active and timely measures to ensure that climate change adaptation is explicitly considered in all aspects and levels of municipal decision making;

_____ _____

Mayor & Council **Date**

Appendix C: References & Resources

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Municipalities are bearing the costs, Chris Rickett, Erin Shapero, Elio Di lorio, Municipal World Magazine, November 2006

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Adaptive Decision and Planning Tools (ADAPT) in Canadian Artic Communities, Hadi Dowlatabadi

Government Roles in Climate Change Adaptations for Urban Infrastructure, Nick Pryce

Climate-SMART (Climate-Change Sustainable Mitigation & Adaptation Risk Toolkits), Rob Young

Climate Change in Northern Quebec and Nunavik: Access to Territory and Resources, Dr. Martin Tremblay

Adapting to Climate Change in Toronto, Eva Ligeti

Appendix D: Report of Workshops #1, #2, #3

A full report of Workshop #1, #2 and #3 is included here.

the PEMBINA institute

Sustainable Energy Solutions

Creating a More Resilient Yellowknife: Climate Change Impacts & Municipal Decision Making

Report of Workshop #1: Climate Change Impacts & Current Response Capacity

Thursday January 18th, 1pm-5pm,
Downstairs Boardroom, Yellowknife City Hall

Submitted by Jake Pryor, Director Sustainable Municipalities
Submitted to Mark Henry, Energy Co-ordinator, City of Yellowknife

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Appendix A

Presentation slides.

1. Backgrounder & Summary

Community resiliency to the impacts of climate change requires the development of adaptation strategies that reduce the risks to community resources and infrastructure. By pro-actively increasing the coping capacity of community systems, the risk of these impacts on the community can be reduced to an acceptable level.

Building adaptive capacity involves the identification of future climate change impacts, assessing the vulnerability of community resources and infrastructure, and putting in place the decision making process to address them proactively. Funded by Indian and Northern Affairs Canada, this project aims to build adaptive capacity within the governance and administration of this northern community.

This report summarizes the results of the first of 3 workshops with City of Yellowknife elected officials, administration and stakeholder representatives to develop the tools to address emerging climate change impacts. The process of the workshops is as follows:

Workshop #1: Climate Change Impacts & Current Response Capacity
Objective: Create a common understanding of climate change adaptation and what it means for Yellowknife. Engage participants in identifying climate change impacts and how to improve the City's response to impacts.

Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application
Objective: Develop risk assessment and decision making criteria, structure, and model for Yellowknife. Identify how to strategically leverage its application to add value to other planning processes.

Workshop #3: Interagency Implementation
Objective: Foster momentum and the necessary conditions for continued commitment to stakeholder collaboration on adaptation.

It should be noted that the City of Yellowknife is already actively engaged in climate change *mitigation* measures with the implementation phase of its Community Energy Plan. These climate change *mitigations* and *adaptations* compliment each other by creating a holistic approach to protecting community assets by reducing the risk of significant impacts. *Mitigations* (reducing greenhouse gas emissions) essentially aim to reduce the degree and duration of climate change impacts by reducing our contributions of atmospheric greenhouse gases, and hence the resultant changes in climate. *Adaptation* aims to insulate our community systems from the climate change impacts we now know are now likely to occur despite our efforts to mitigate further.

Summary of Findings

1. Historic climate data indicates Yellowknife has observed an increase in average annual temperature of 2°C from 1943 to 2006. This warming has been most pronounced in the winter. Climate change scenarios indicate a further warming of at least 2°C by 2050.
2. During the same 1943-2006 period, Yellowknife has seen an increase in annual precipitation of 20%, mainly as summer rain. Scenarios of future precipitation indicate a broad range of projections from -5% to +20%.
3. Participants identified 23 observed impacts and 24 potential future climate change impacts, although participants noted that it was difficult to attribute observed impacts solely to climate change.
4. The prioritized issues for further research were:
    a. Researching decision making support tools in use in other jurisdictions.
    b. Smart growth
    c. Planning for increases in capital and operating costs to address impacts/ securing predictable funding.
    d. Water and waste water infrastructure adaptations
    e. Managing changes in active permafrost
    f. Sharing best practices.
5. The City's historical response to climate change impacts has successfully demonstrated flexibility, resourcefulness, and innovation - although it remains fragmented in the absence of a systematic adaptation process.

2. Workshop #1 Objective:

Create a common understanding of climate change adaptation and what it means for Yellowknife. Engage participants in identifying climate change impacts and how to improve the City's response to impacts.

3. Desired Outputs:

1. A list of potential climate change impacts identified by participants.
2. A select number of impacts for use as examples in developing adaptation tools.
3. A list of opportunities for improvement that can be applied to general adaptation risk management models to tailor them to Yellowknife's specific needs.

4. Workshop #1 Agenda

Creating a More Resilient Yellowknife:
Climate Change Adaptation & Municipal Decision Making

Workshop #1: Climate Change Impacts & Current Response Capacity
Thursday January 18th, 1pm-5pm, Upstairs Boardroom, Yellowknife City Hall

Agenda

1pm Welcome & Introductions

1.15pm Presentations

Climate Change Adaptation: What is it? Why are we doing this?
Links to the General Plan, ICSP, Infrastructure Plan
Climate change scenarios and historical data for Yellowknife
Examples of risk management approaches to adaptation used elsewhere

2pm Workshop Activities to Address Key Questions

- What have been the observed impacts from climate change in YK?
- What climate change impacts do you foresee for the future?
- What have been the strengths of the City's response to observed climate change impacts?
- How can the City's existing response capacity be improved?

4pm Prioritizing future impacts. Which should we use to test adaptation models for Yellowknife?

Identifying the biggest challenges for the organization in improving its response to climate change

4.30pm Next Steps

5pm Wrap-up.

5. Workshop Attendees

The following individuals were present for all or part of the workshop session:

- Gordon Van Tighem, Mayor
- Paul Falvo, Councillor
- Mark Heyck, Councillor
- Kevin Kennedy, Councillor
- Shelagh Montgomery, Councillor
- Dave Devana, Director, Corporate Services
- Jeffrey Humble, Director, Planning & Lands
- Greg Kehoe, Director, Public Works
- Grant White, Director, Community Services
- Peter N., Director, Economic Development
- Dennis Kefalas – Manager, Public Works
- Mark Henry, Energy Coordinator
- Craig Scott, Climate Change Programs, GNWT
- Doug Ritchie, Executive Director, Ecology North
- Eleanor Young, Ministry of Municipal and Community Affairs, GNWT
- Shirley Cook, Dene First Nation
- Greg Cousineau, Transportation, GNWT
- Jake Pryor, Facilitator, Pembina Institute

Regrets:

- Dennis Marchiori
- Dennis Althouse, Superintendent, Operations & Maintenance, Public Works

6. Record of Proceedings

1pm Welcome & Introductions

Participants introduced themselves by name, role within the municipality, or other agency.

1.15 Presentations

Jake Pryor presented a series of slides (at Appendix A in this document) covering the following topics:

- Climate Change Adaptation: What is it? Why are we doing this?
- Links to the General Plan, ICSP, Infrastructure Plan
- Climate change scenarios and historical data for Yellowknife
- Examples of risk management approaches to adaptation used elsewhere

Climate Summary: Historical data from Yellowknife airport showed a 2^{o}C rise in annual temperature from 1943 to 2006 which was more pronounced in the winter, and a 20% increase in annual precipitation which was more pronounced in the summer. Climate change scenarios for the region indicate a minimum additional 2^{o}C by 2050 with precipitation changing between -5% and +20%.

2pm Workshop Activities to Address Key Questions

Participants self-organized into groups of 4-5 to answer each of the following four questions. Participants largely remained in the same groups throughout the afternoon with some participants having to leave and later return after attending to other meetings. In each case the groups discussed the question and wrote short answers on large post-it notes. After 15 minutes discussion on a question, the facilitator collected up the responses, and a 10 minute plenary followed were they were discussed. This plenary session gave everyone opportunity to learn from the suggestions of others and add any remaining thoughts. The responses are recorded below.

Q1. What have been the observed impacts from climate change in YK?

- Longer construction season
- Longer growing season
- Warmer summer temperatures bringing longer summer tourist season

- Higher costs for roads – permafrost
- Shorter ice road season resulting in increased air transport – social and economic impacts (on local carriers, and aircraft noise)
- Shorter ice road season resulting in higher costs of flying goods in rather than trucking
- More snow melt and litter creating flooding
- Increased stress on emergency response with respect to floods and unstable ice
- More cloud cover reducing (winter aurora viewing) tourism
- Big snow dumps (especially in November) creating greater need for snow clearing services (increased costs, labor, equipment)
- Icy roads requiring more maintenance
- Increasing population of southern wildlife and grizzly bears
- Animal migrations result in less food available from the land therefore more store-bought food
- Insect infestations
- Changing Animal Ranges
- Longer fire season and more lightening = increase in fires and impacts on emergency services
- Overflow on lakes – impacts recreational use and emergency response
- Unpredictable weather – freeze/thaw. (Once cold would stay, now temperature fluctuates).
- More frost on power lines resulting in maintenance issues and power outage (2006) – rotating power availability
- More freeze-thaw cycles
- Higher water & sewer costs (?)
- Warmer winters
- Unpredictable weather

Q2. What climate change impacts do you foresee for the future?

- Water/sewer infrastructure – less heating needed for flow, greater siltation/ lower quality water (6)
- Increased road O&M costs – sanding, pot holes, shortening of lifetime for surface (4)
- Increased infrastructure costs due to climate change (capital and O&M) (4)
- Review ground carefully where the city is expanding (incidence of ice in permafrost soils indicates level of expected destabilization) (3)
- Longer summers, increased food production and recreation (eg soccer pitches)
- Water table impacts of frozen arsenic encapsulation at decommissioned gold mine (1)
- Landscaping impacts, water availability, length of growing season, ditch maintenance
- Challenge for budgeting on snow removal

- Changed insect populations (mosquitoes, black flies) – impacts on health & recreation – swarms of flies not good for playing golf in. Food chain impacts. (1)
- Southern invasive species, social, health impacts (vector borne disease)
- Warmer weather bringing more permanent residents – impacts on growth and tourism
- Longer summer so more tourism
- Tourism – winter shorter so less Japanese (1)
- Water quality and quantity (2)
- Impacts of permafrost on sewage lagoons (increase in active layer resulting in leaching/ draining)
- Precipitation effect on landfill – leaching
- Changing storm water impacts – flood impacts
- More permafrost degradation
- Electricity supply is from hydro, tied to water levels so vulnerable
- More fires and lightening requiring more fire break planning
- Challenges of climate change design – minimize risk but also increases $
- More effort and costs for building foundations
- Increasing costs for roads will make infill development more economical
- Shoreline effects – need to change development set-backs from water line, consider wave action (changing wind regimes)

Q3. What have been the strengths of the City's response to observed climate change impacts?

- More flexibility in approach to snow removal (snow removal started 3 weeks early this winter)
- City already engaged in national climate change issues (FCM application) – see Greg
- Community energy plan reducing costs – resulting in more cost effective infrastructure planning
- Community involvement- using community resources like Ecology North
- Water tempering in pipes reducing water breaks
- Engineering efforts – insulation pipes (less impact of heat escaping into surrounding ground)
- More detailed designs – storm water
- Preparing for population increases (engaging in smart growth project)
- Considering LUB changes
- Engaging in studies (like this project) on adaptive capacity
- Innovation in construction to adapt to ground conditions – permafrost (end bearing pillars)
- Design change of Franklin Hill with concrete slab to minimize settlement
- Economic diversification – promoting tourism to put less eggs in one basket
- Public communication through newsletter

- As a growing community, economies of scale provide more fiscal capacity to address issues.
- Have set up CEP, smart growth plan, adaptation , ICSP

Q4. How can the City's existing response capacity be improved?

- Smart growth – infill, density, zoning (6)
- Have guaranteed long term funding for adaptation (3)
- Sharing best practices (Iqaluit model, Whitehorse ICSP) (1)
- Incorporate new data (temperature) for best practices
- More resources – higher standards for buildings, roads, water treatment (1)
- Staff training (best practices) in smart growth, energy, building standards, infrastructure standards (1)
- Empower staff, identify savings, energy, efficiency
- Energy optimization
- Implementation of plans – CEP, smart growth, ICSPs (1)
- Measurable indicators & targets (EGH80 standard for residential units), sustainability indicators, energy use vs temperature for example.
- Facility planning – energy efficiency
- Citywide storm water management plan (underway)
- Promote best practices of mitigation & adaptation (tie public/community adaptation with that of other agencies and individuals) (2)
- Partnerships with Arctic Energy Alliance, Ecology North and private industry to improve facilities
- Community Capacity building (info and experience)
- Greater dialogue with Dene – different approaches (1)
- Education & public awareness (1)
- Water treatment plant & sewage treatment plant (1)
- Well-being – social stresses need addressing (general) (1)
- Ensure climate change impacts are placed into annual budgeting cycle (1)
- Increased funding and services

4pm Workshop Activities to Prioritize Issues

Participants were invited to use sticky dots to pick out two key priorities. The questions and their responses follow. In each case the number of participant votes is shown in brackets.

Prioritization task 1). Which of the 'future impacts' (responses to Q2) should we use to test adaptation models for Yellowknife?

- Increased infrastructure costs due to climate change (capital and O&M) (8)
- Impacts on water and sewer infrastructure – less heating needed for flow (+ve), greater siltation/ lower quality water (6)
- Assessing the ground carefully where the city is expanding (incidence of ice in permafrost soils indicates level of expected destabilization) (3)

Prioritization task 2). What are the biggest challenges for the City of Yellowknife in improving its response to climate change (responses to Q4)?

- Developing smart growth – infill, density, zoning (6)
- Have guaranteed long term funding for adaptation (3)
- Sharing best practices (Iqaluit model, Whitehorse ICSP) (1)

4.30 Next Steps

The facilitator indicated that these priorities would inform the research tasks between now and the next workshop. He thanked participants for their time and energy and proposed suggested dates for future workshops. Workshop #2, March 22,23. Workshop #3, April 10,11.

5pm Wrap-up.

7. Facilitators Observations

Participants had some difficulty attributing observed impacts solely to climate change. This was an important admission of the limitations of our understanding of the many variables that affect community systems. However, since most climate change adaptations are not implemented solely to address climate change impacts, but also for their additional benefits, this limitation does not devalue decisions on future adaptations.

The break-outs groups occasionally mixed mitigation measures with adaptation. It is not clear whether this was a result of a holistic approach that encompassed both strategies was being expressed, or whether it was a lack of understanding of some terminology. Greater emphasis will be placed on defining adaptation terminology in future workshops to prevent any confusion of terms and maximize the value of participants' insights.

8. Research Priorities for Workshop #2:

The following research priorities have been synthesized from the participants' responses during the workshop.

1. Research adaptation decision making support tools in use in other jurisdictions, with particular attention to northern communities (in Canada and abroad).

2. Research how other municipalities have tied climate change adaptation into programs and projects. (Paying particular attention to those with high participant scores).

    a. Smart growth plans that specifically refer to climate change impacts in establishing design and rationale.
    b. Planning for higher capital and operating costs with predictable long term funding. How are municipalities funding their adaptation planning & implementation? (Are municipalities relying on usual sources of funding? Are they securing predictable multi-year funds?). This research question applies to both increases in capital investment required of climate change design, and increases in operating and maintenance costs associated with day-to day weather impacts.
    c. Water and waste water infrastructure adaptations. What impacts are other communities facing? How are municipalities changing their design criteria?
    d. Managing changes in permafrost with new development/ construction.
    e. Sharing best practices – what are the preferred clearing houses for sharing best practices? How can the City of Yellowknife be empowered to capitalize on these resources?

In addition, the facilitator has identified the following City of Yellowknife information required to supplement this research from other communities:

1. Research existing risk management tools used by administration
2. Research existing budgeting tools that prioritize projects/ spending
3. Research council committee structure and the committee's Terms of Reference.

9. Workshop Evaluations

At the end of a workshop, participants were invited to complete a workshop evaluation form. Nine forms were returned completed.

Participants were asked to rate the following aspects of the workshop from 1 to 5, with 1 being 'very unsatisfied' and 5 being 'very satisfied'. The average scores for each aspect of the workshop is shown below.

Degree of organization	4.22
Workshop materials	3.67
Clarity of presentation	3.89
Workshop pace	4.33
Breakout groups	4.22
Plenary discussions	3.88
Quality of facilitation	4.25
Confidence in the outcomes/ progress	3.67

Written responses to the remaining questions are summarized below.

Q. Did the workshop meet its objective?

All responses to this question indicated a confidence that the workshop had met its objective.

Q. What was the most valuable part of this workshop for you?

All responses to this question focused on the value of sharing ideas in the small groups. One response added the value in recognizing the work the City has already undertaken to address climat change impacts.

Q. What aspects of the workshop would you have changed?

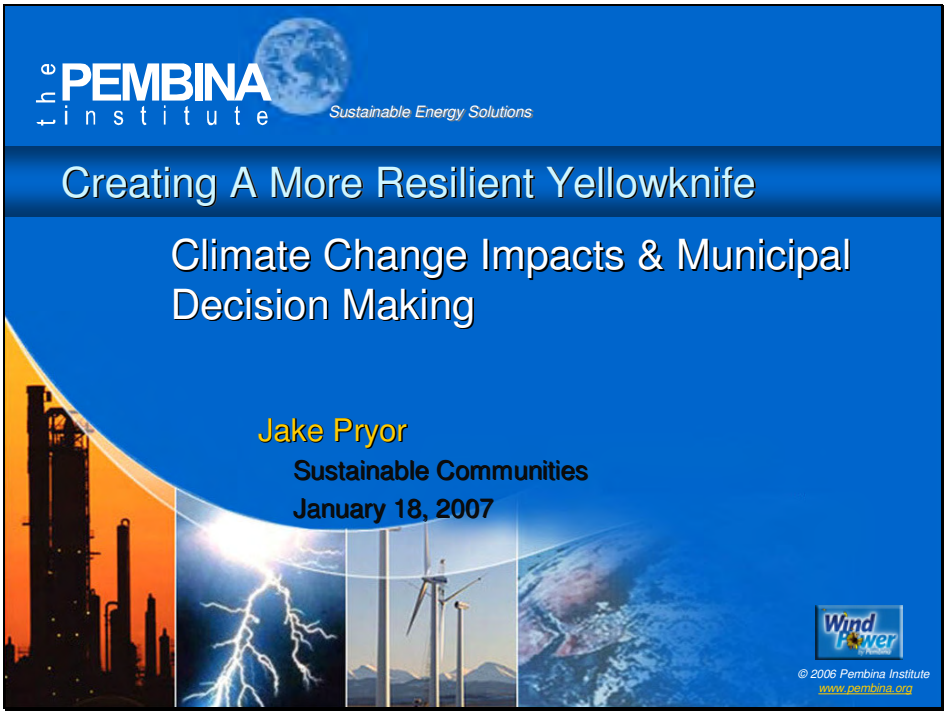
The 3 responses to this question mentioned: scheduling workshops for the morning to improve energy levels in the room; more discussion on linkage between measure sand impacts; and clearer direction going into groups.

Q. Any additional comments?

The sentiments of all responses to this question were satisfaction with the workshop and facilitator, and looking forward to the next workshop.

Appendix A: Presentation Slides

Slide 1



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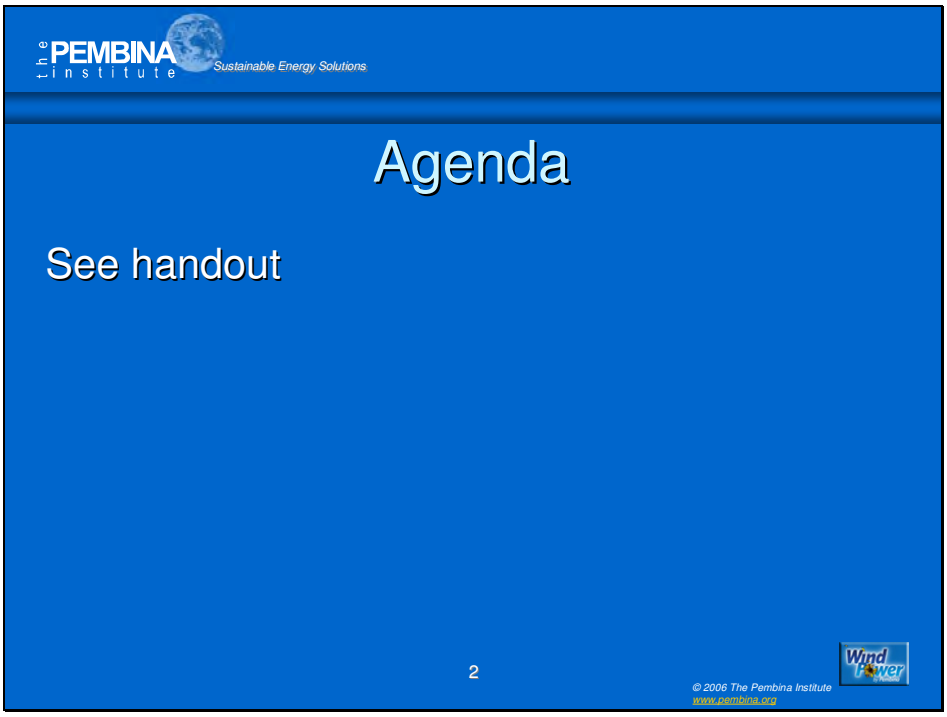

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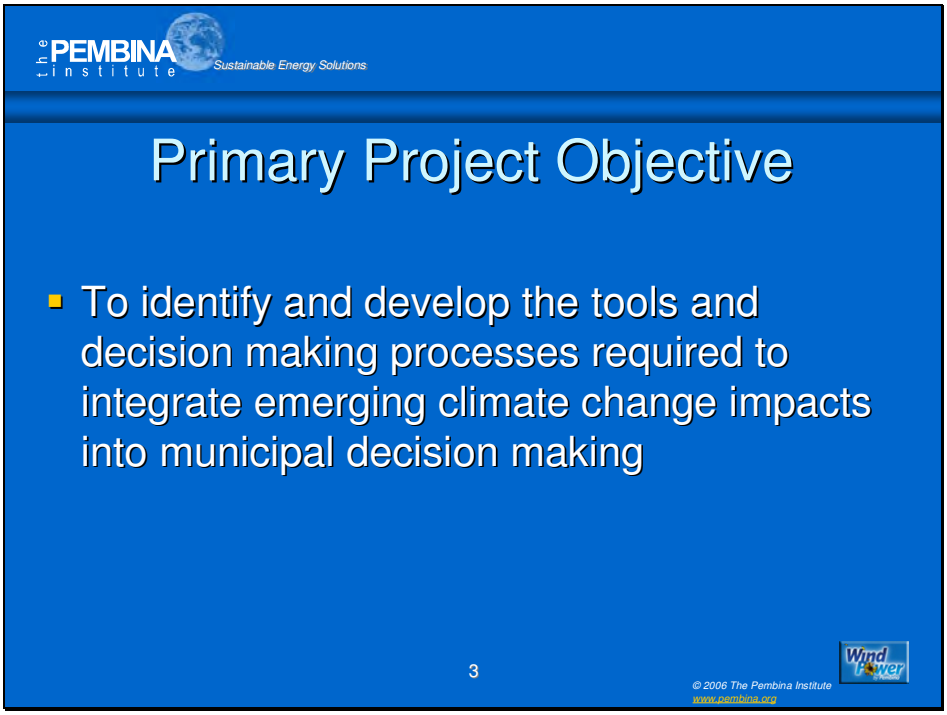

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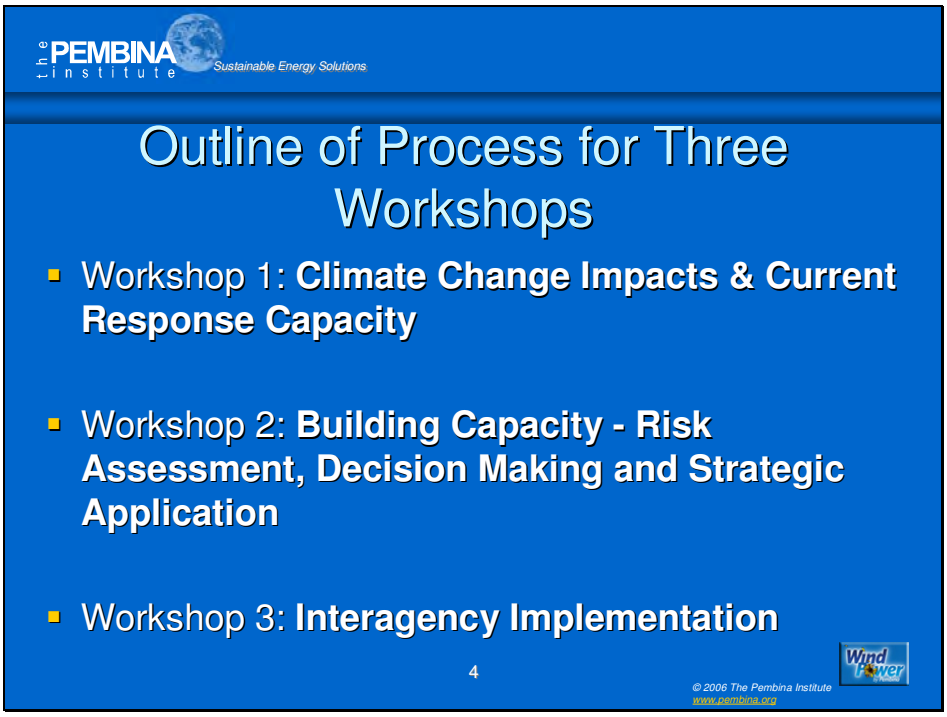

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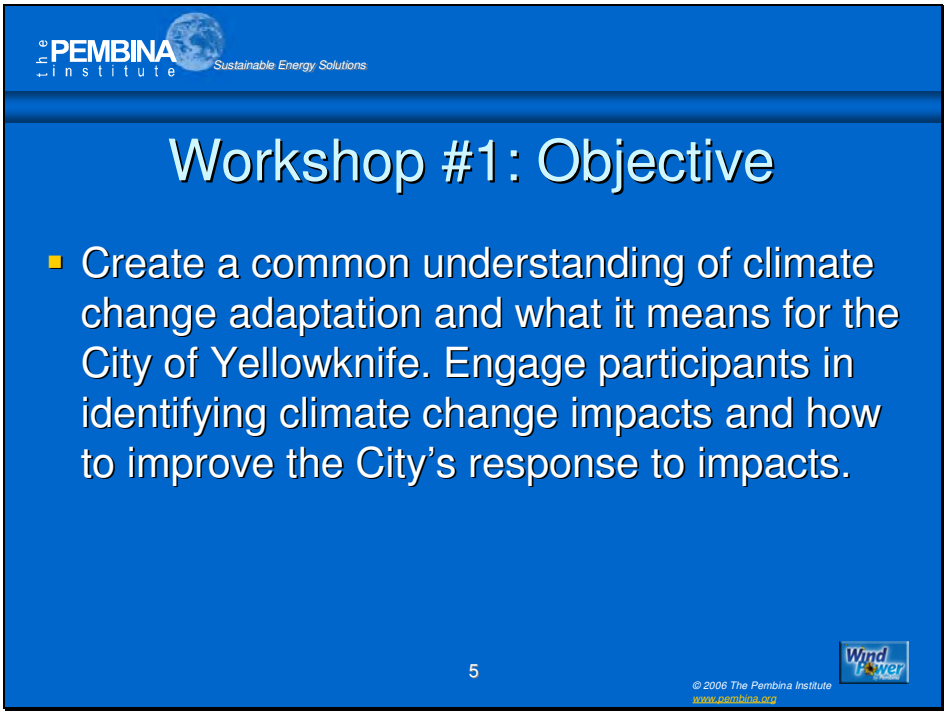

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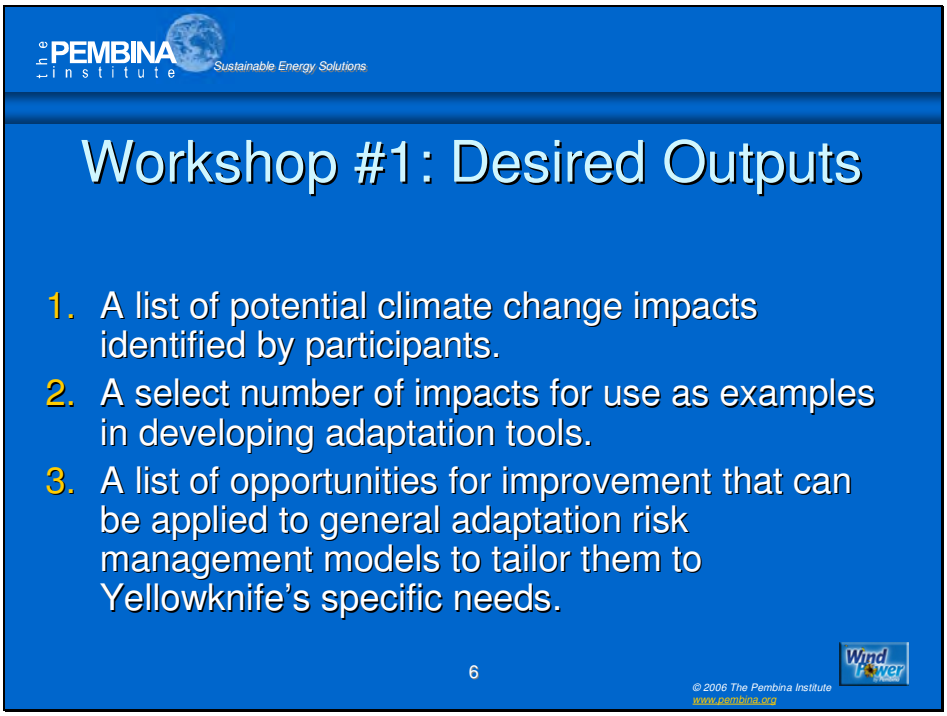

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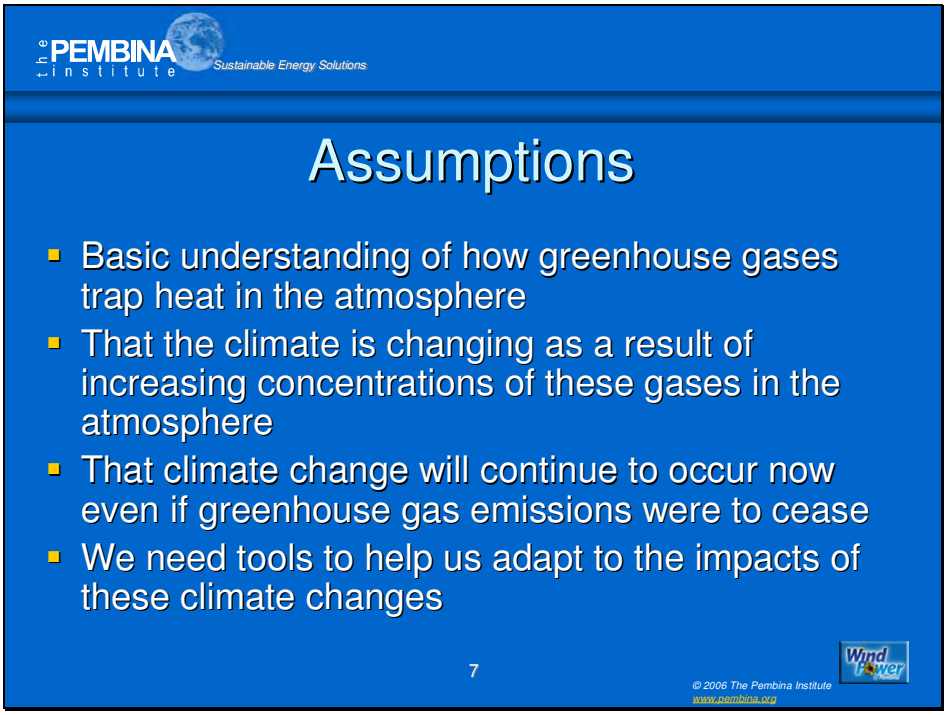

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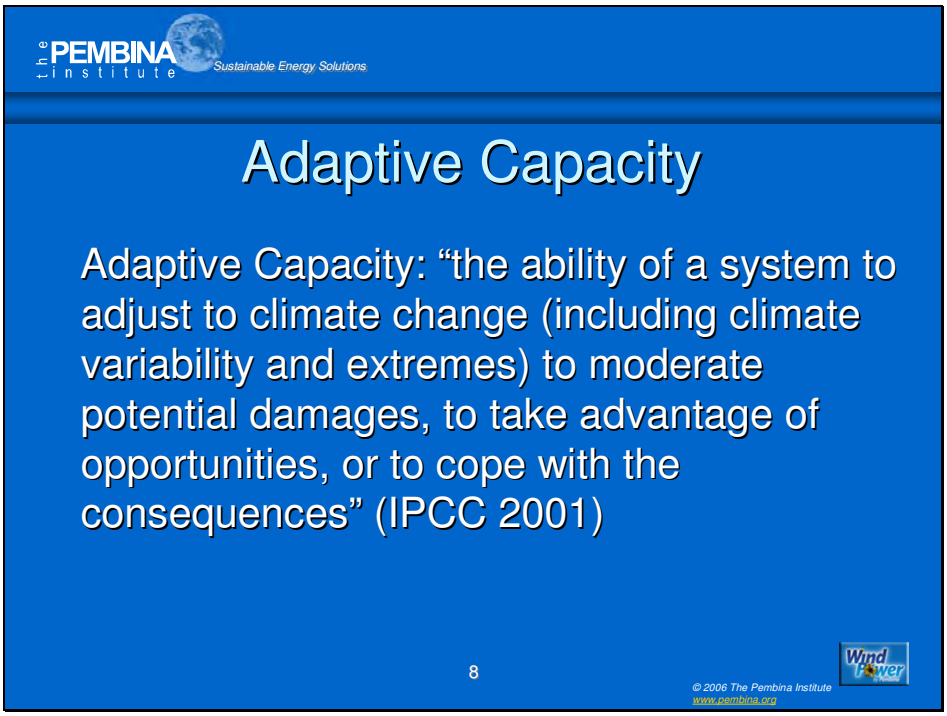

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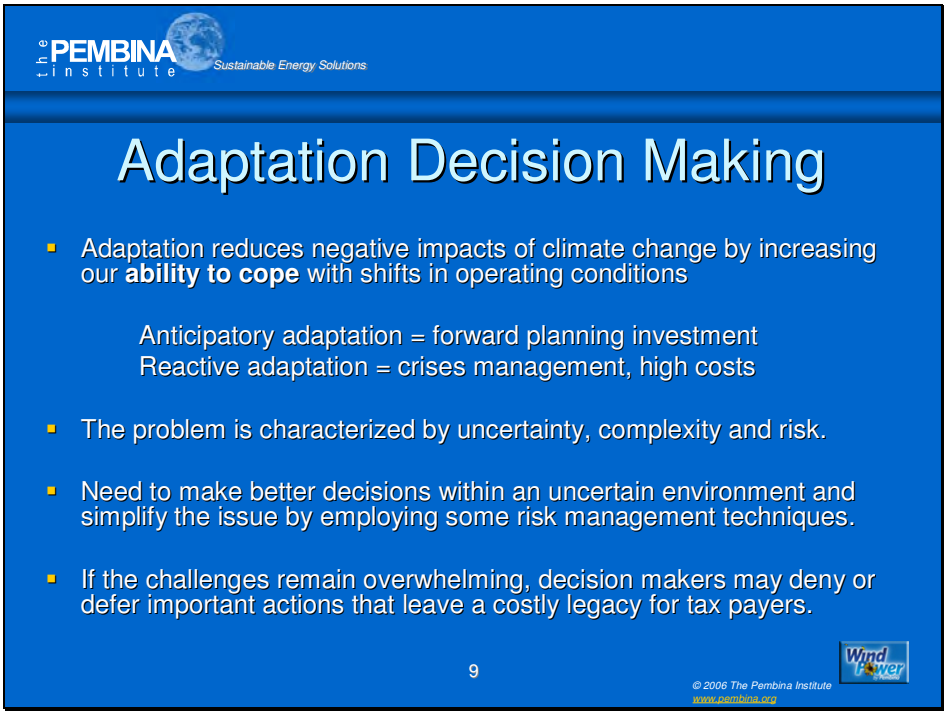

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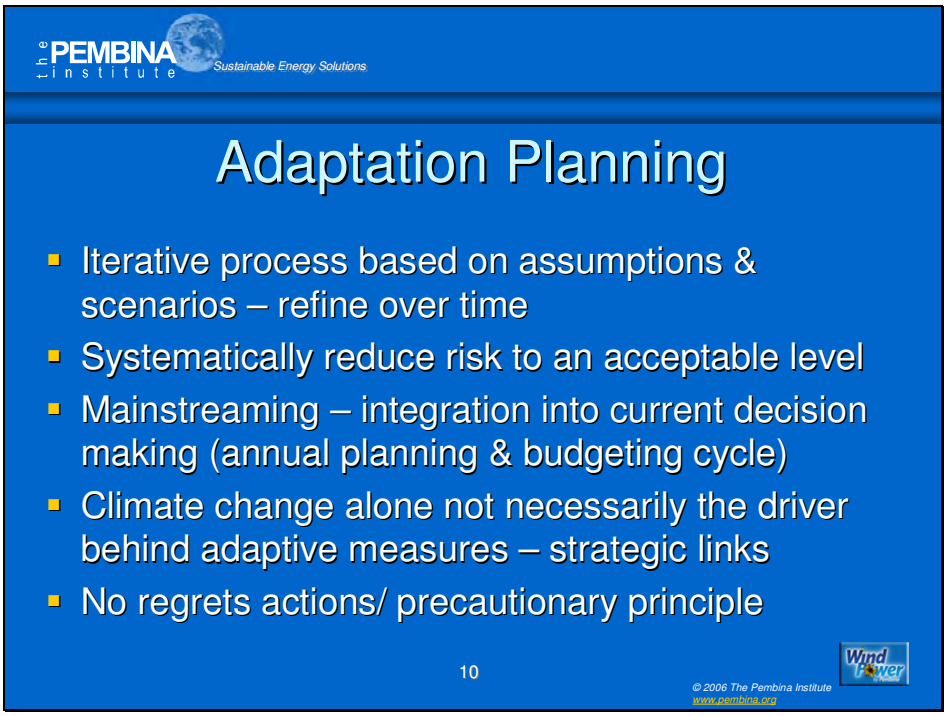

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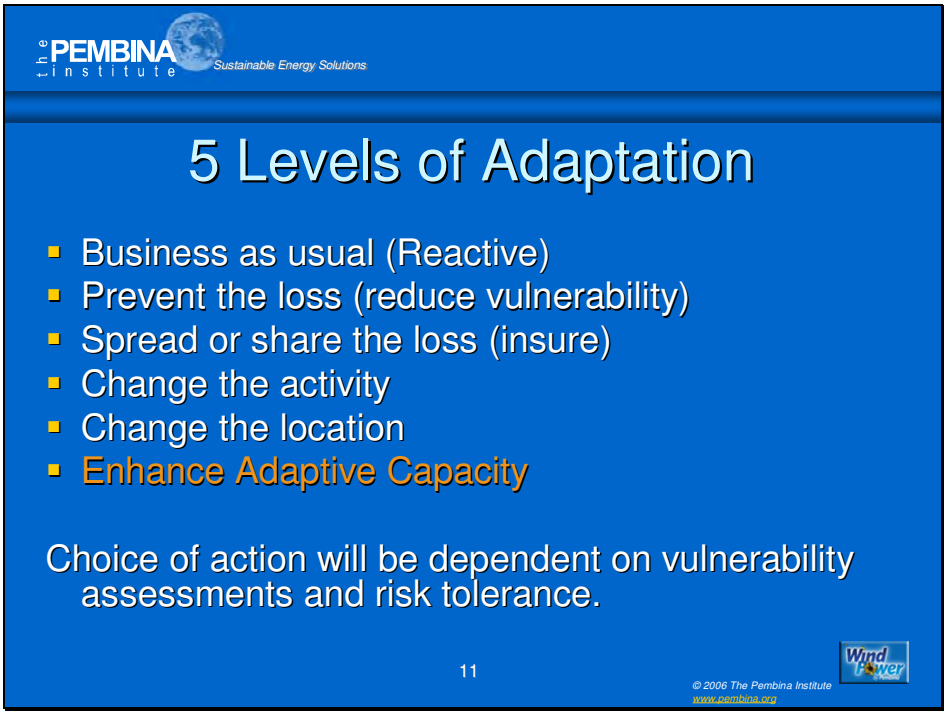

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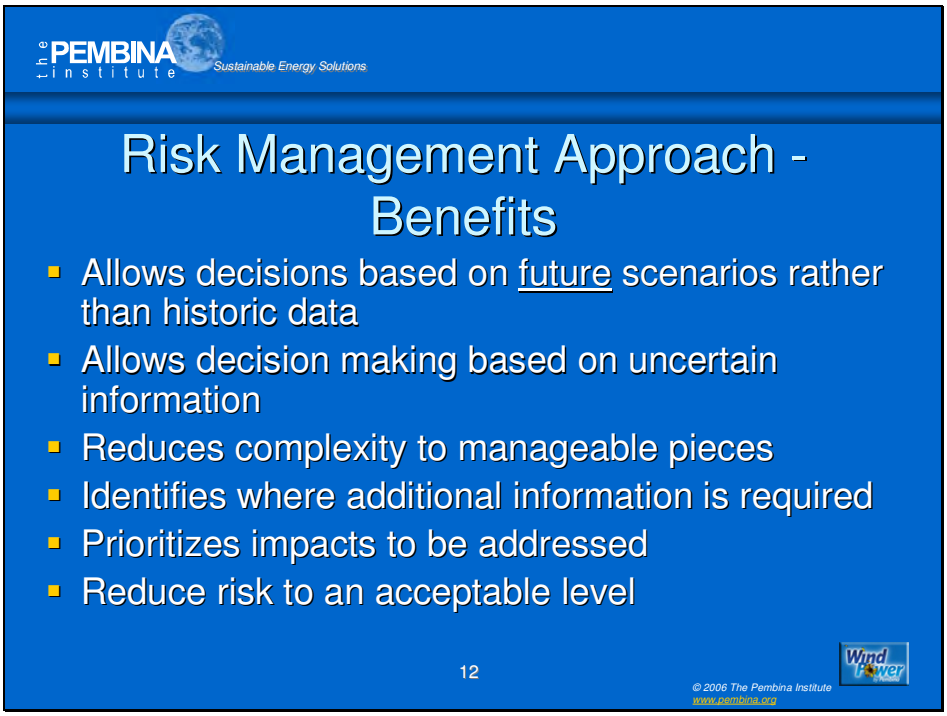

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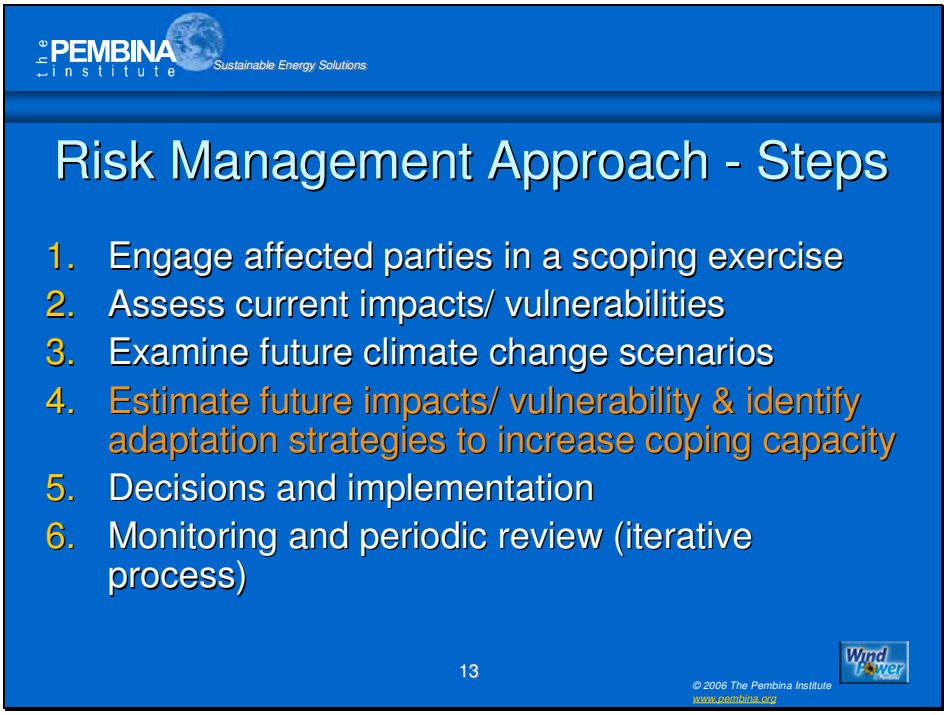

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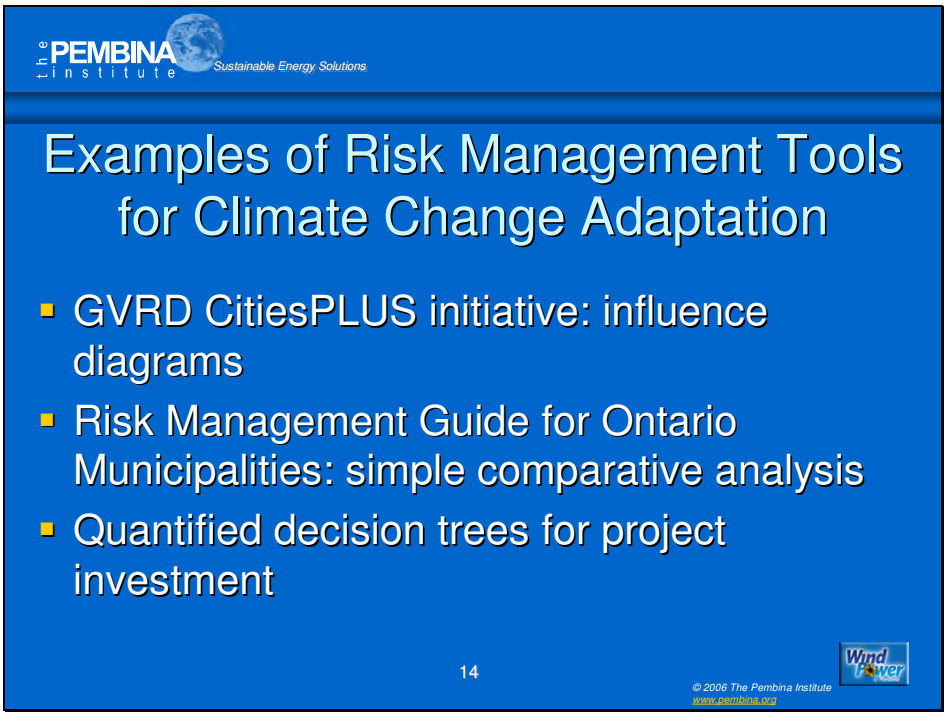

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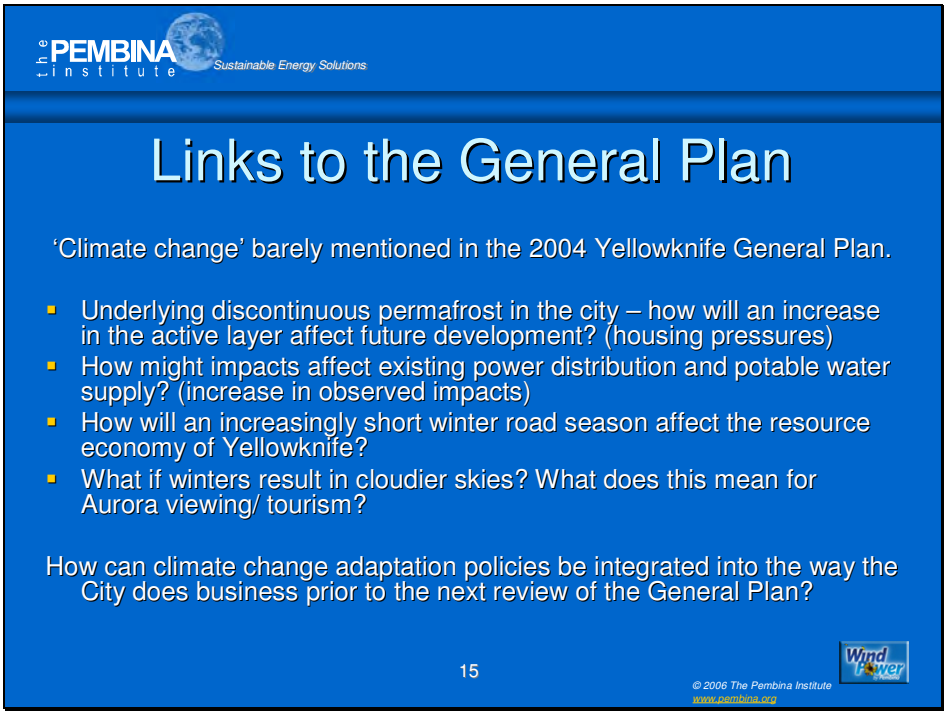

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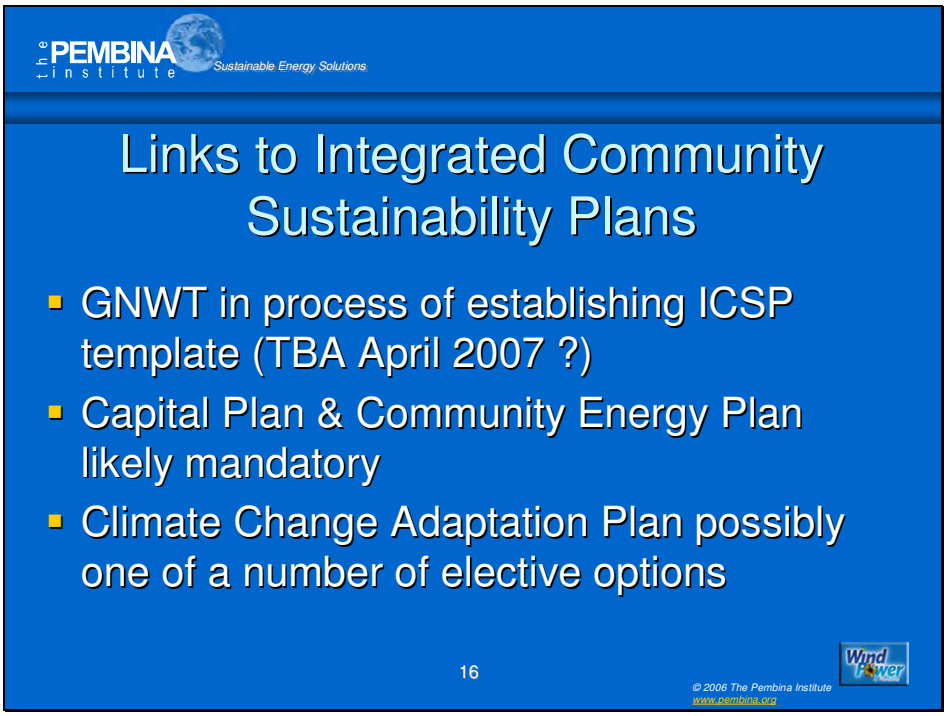

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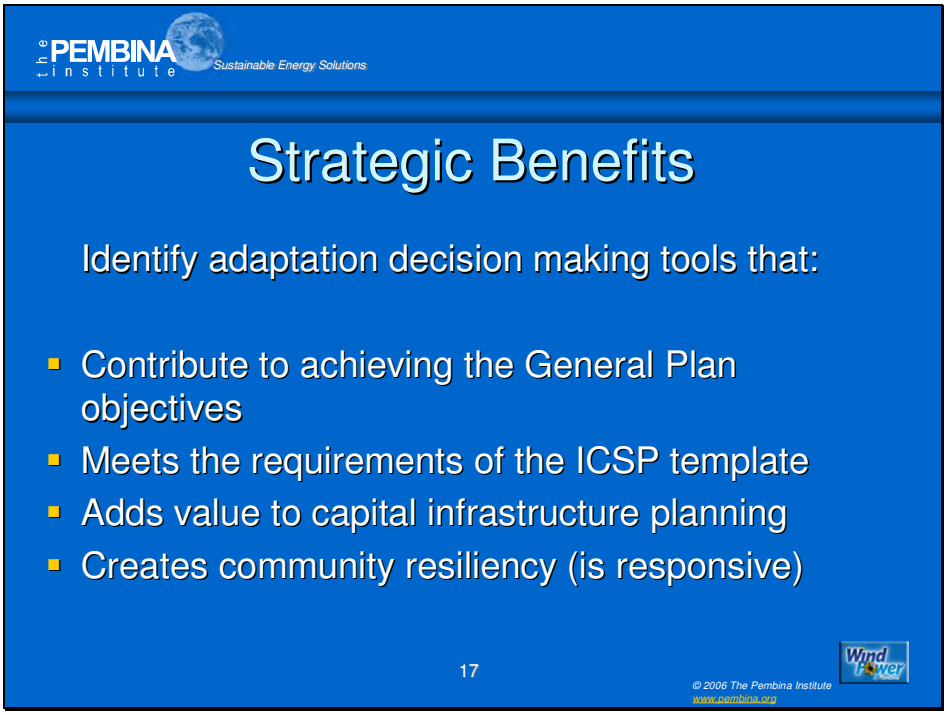

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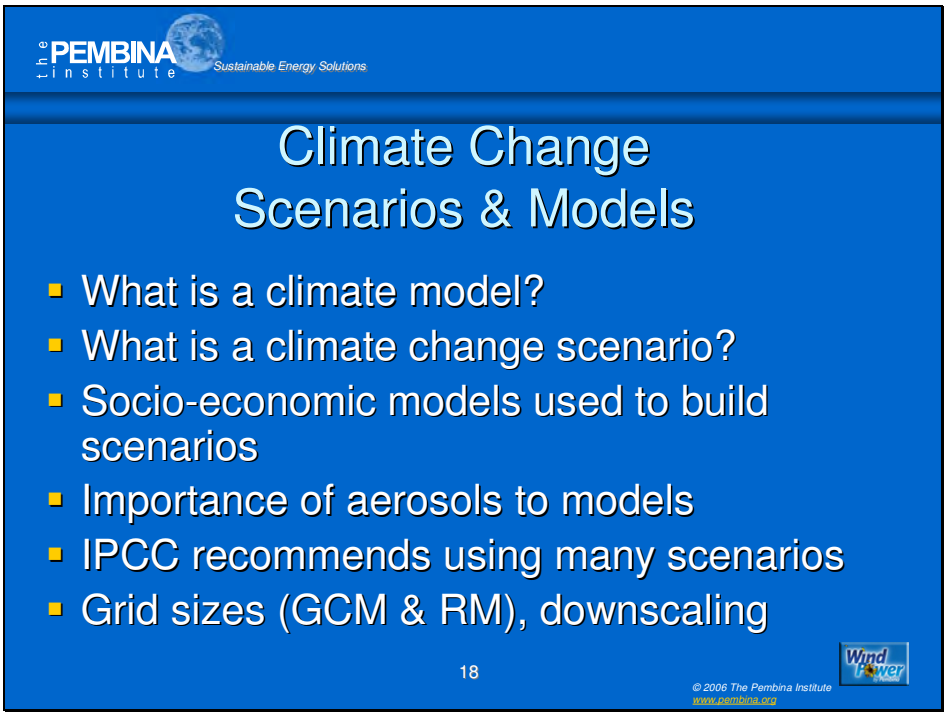

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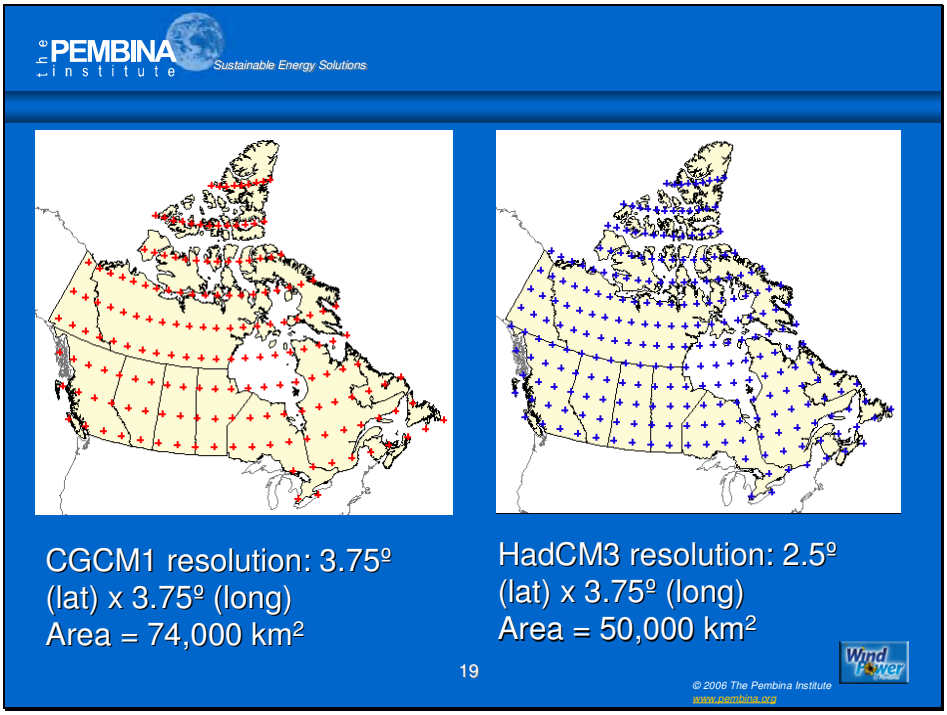

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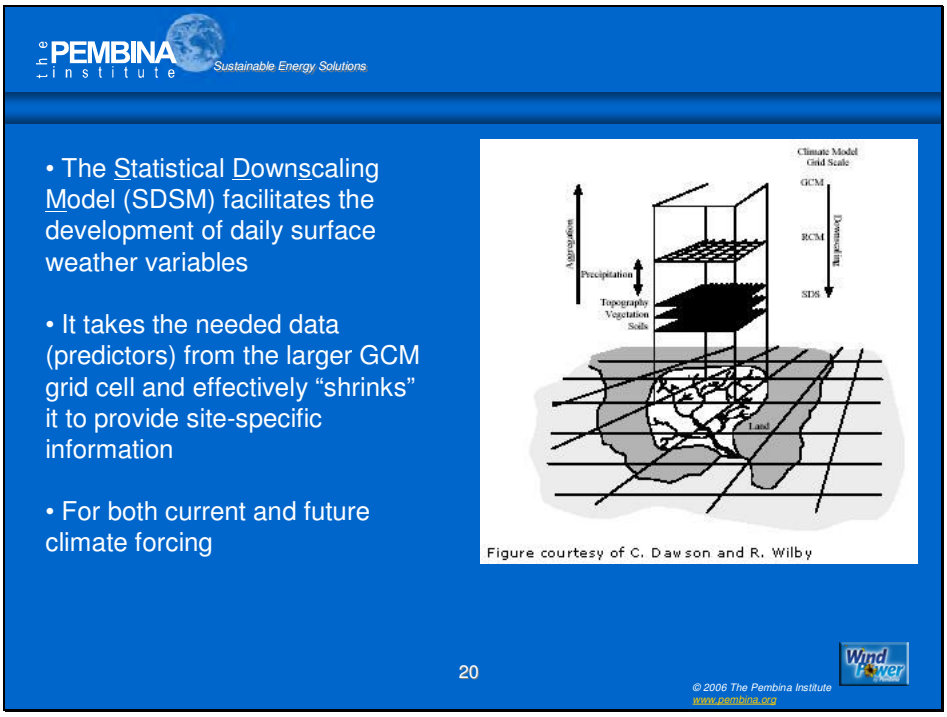

Slide 21

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Climate Change Data & Models

Climate Change Data and Models for Yellowknife

- 3 sources
  - Observed airport weather station data
  - Canadian Climate Impacts Scenarios (University of Victoria)
  - Canadian Centre for Climate Modeling & Analysis (Environment Canada)
- 6 SRES 'marker' scenarios (IPCC Special Report on Emissions Scenrios, 2001)
- Changes compared to historical period (1961-1990)

21

Wind Power

Slide 22

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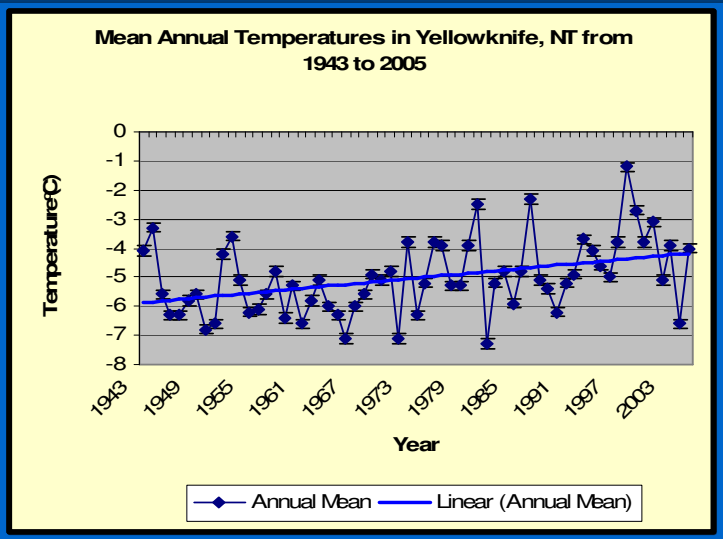

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Wind Power

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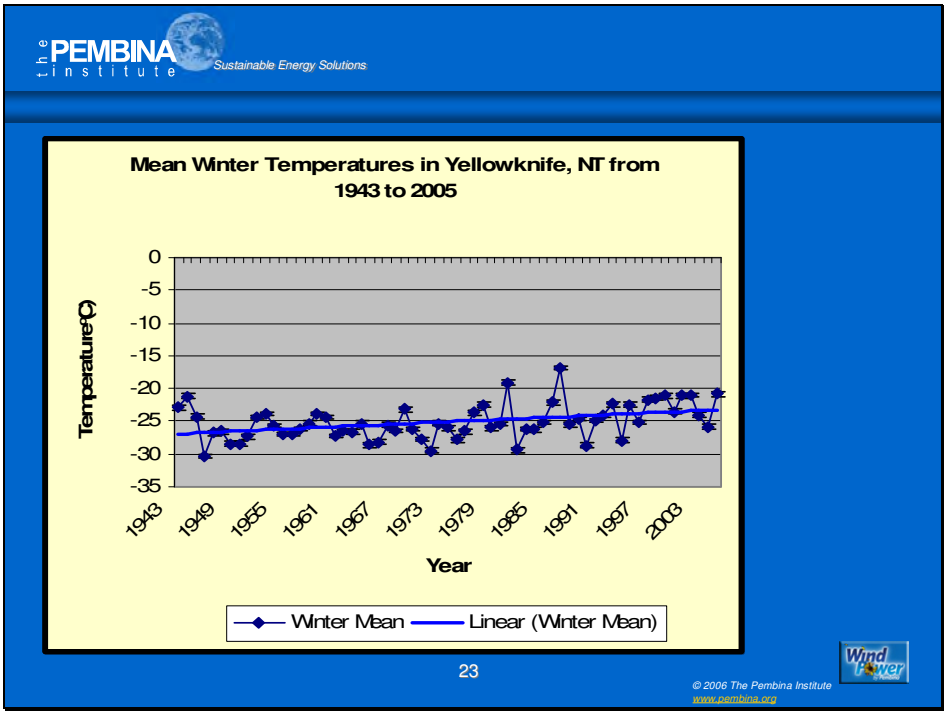

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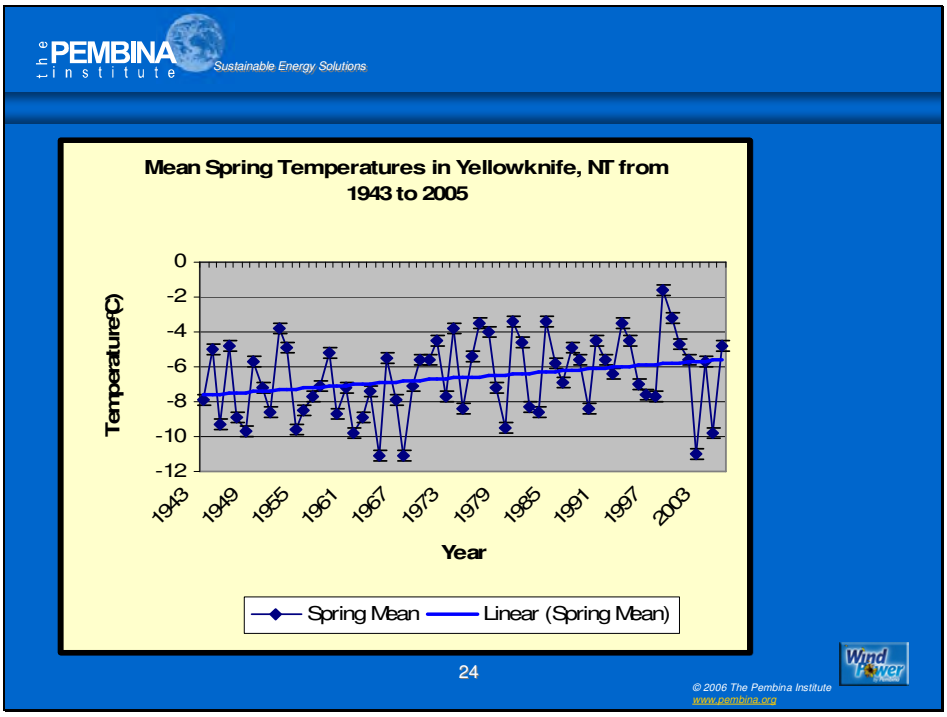

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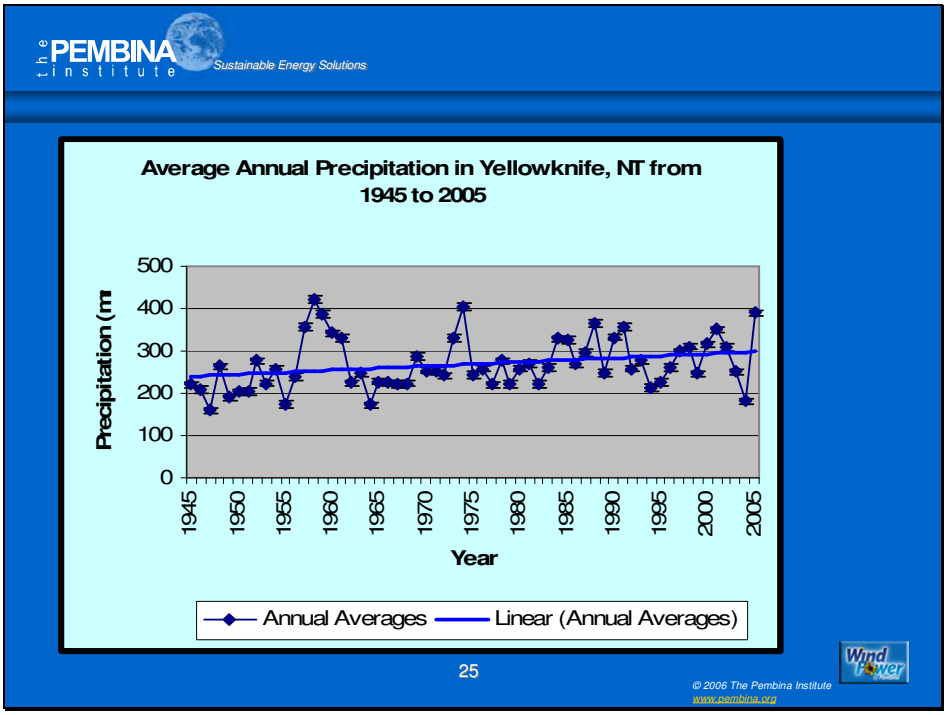

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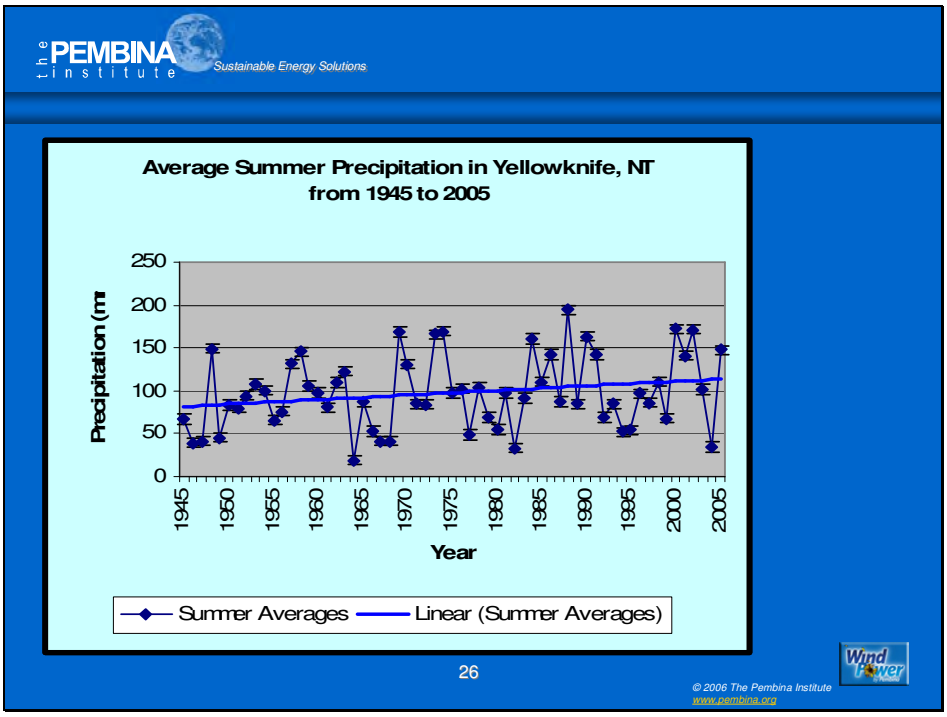

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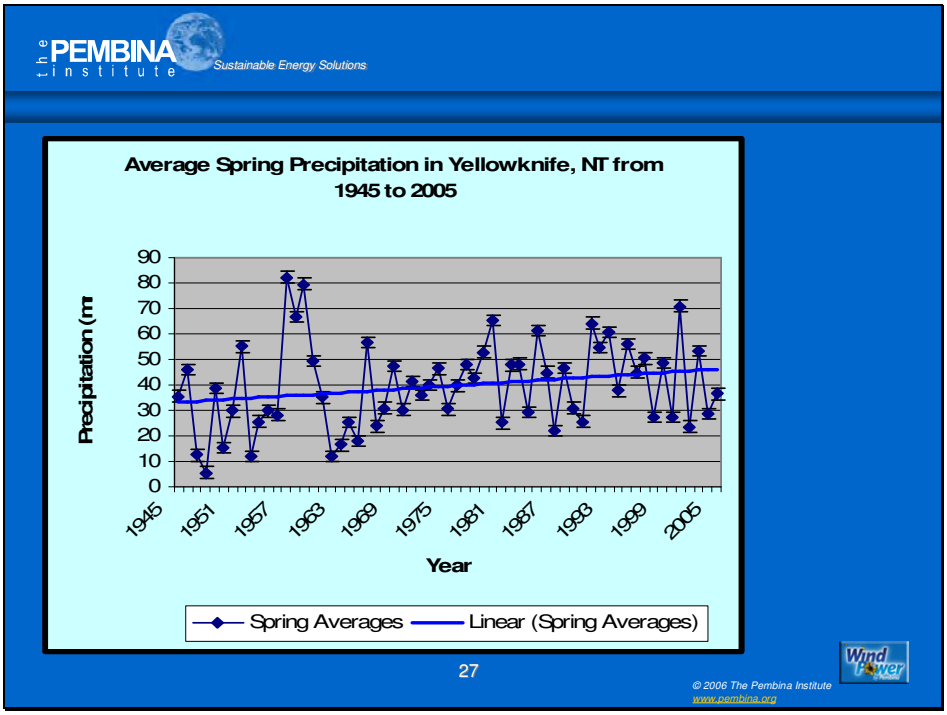

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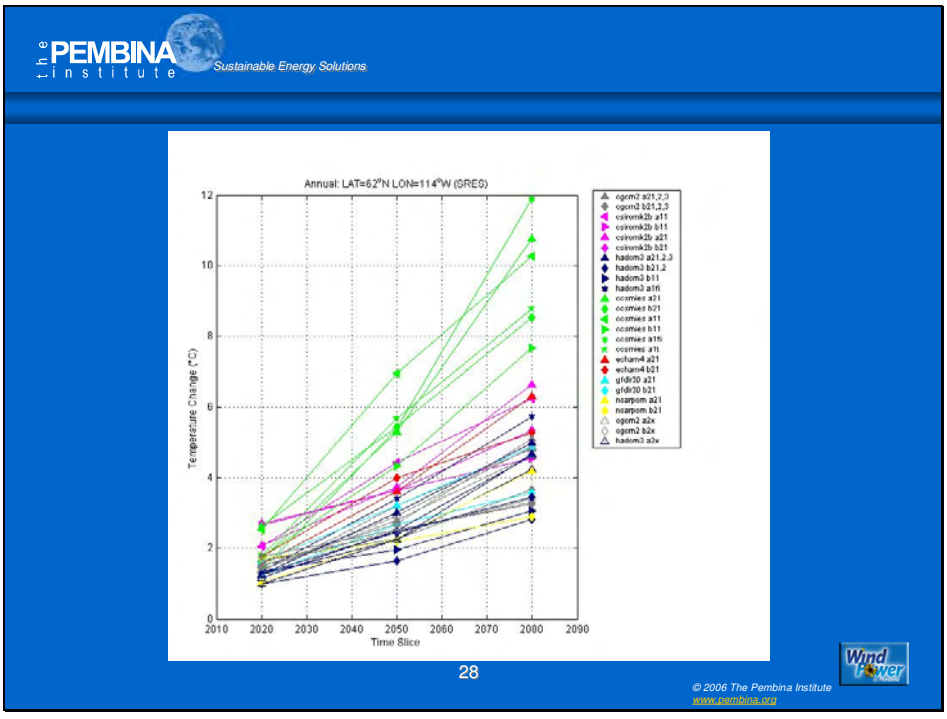

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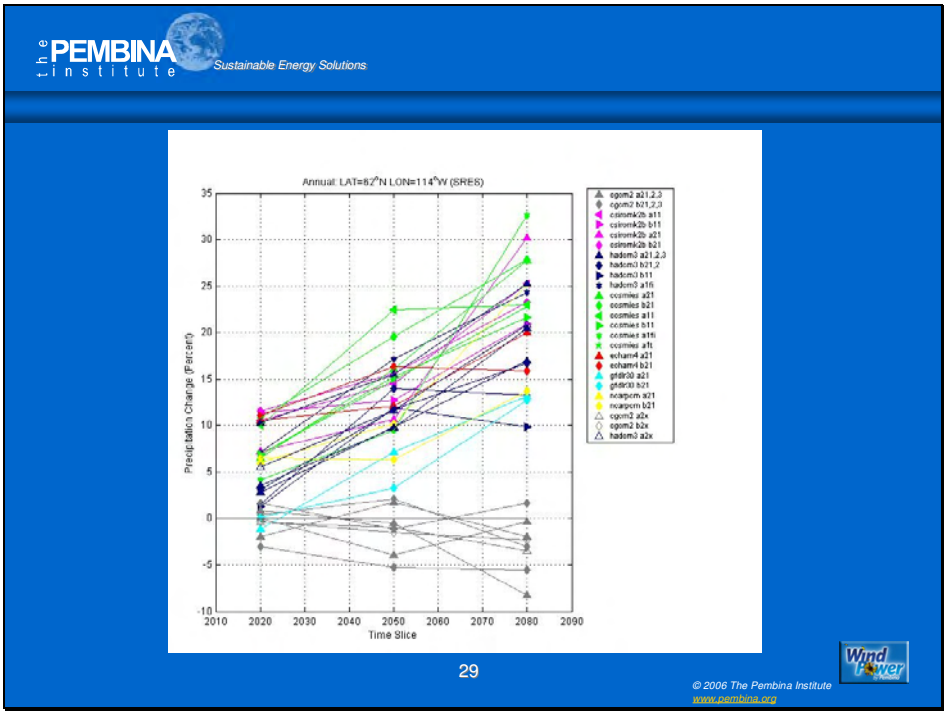

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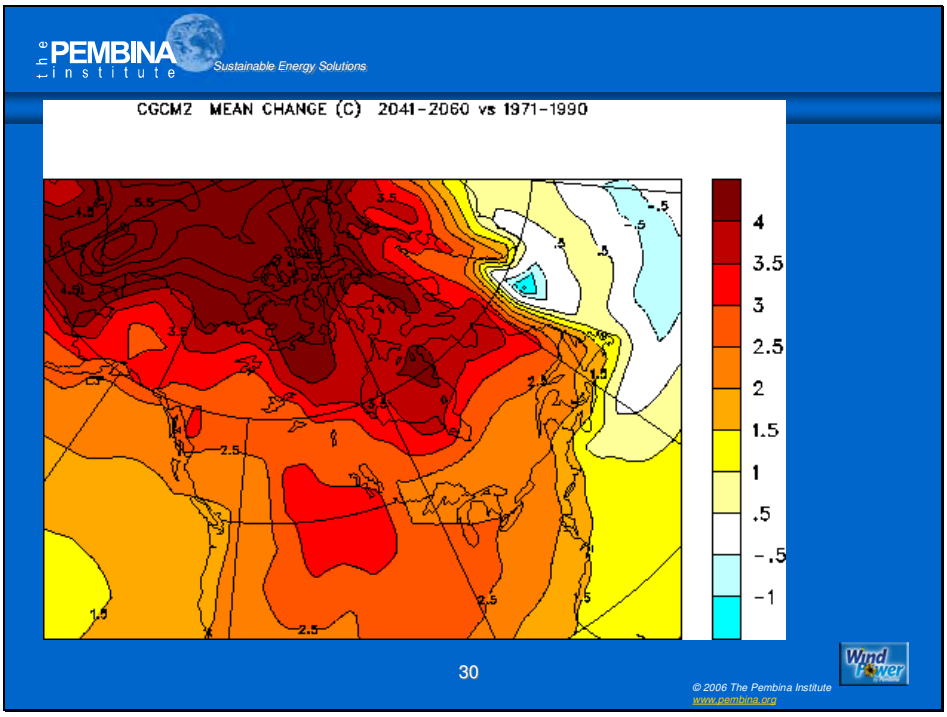

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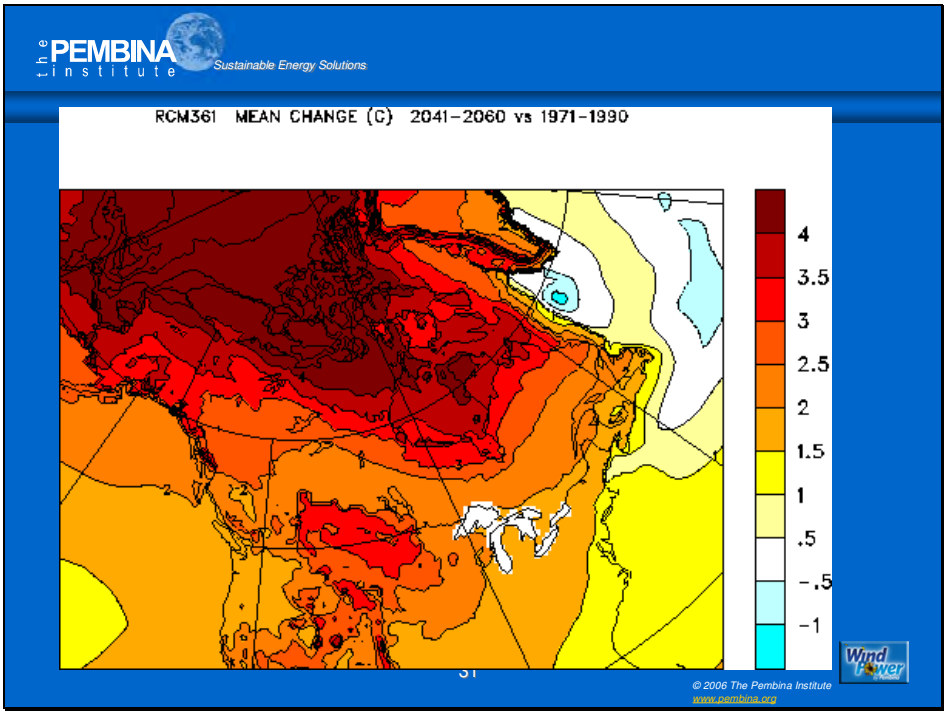

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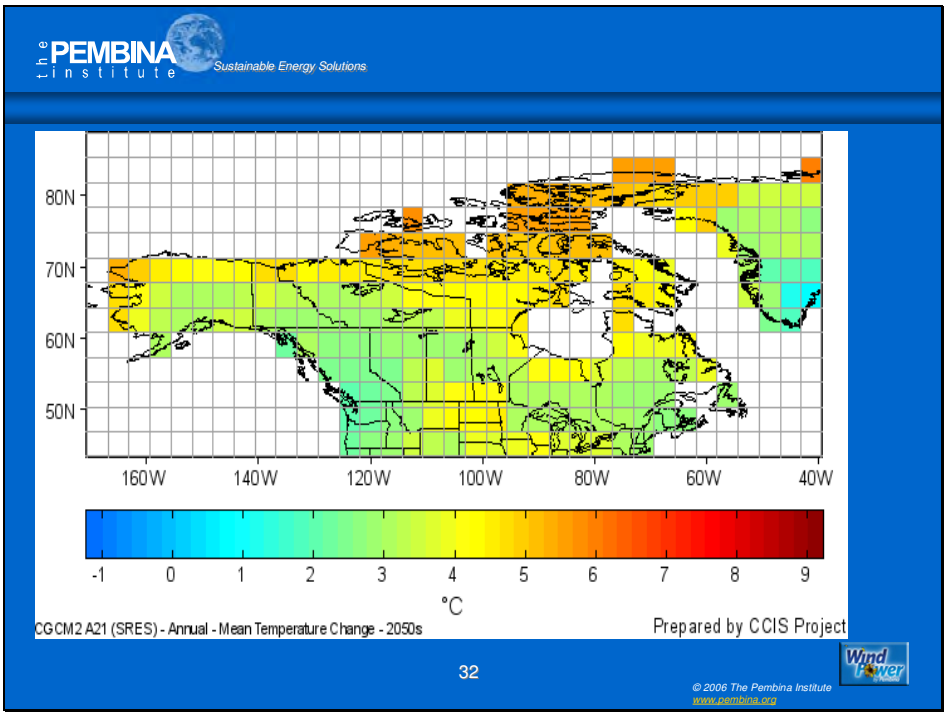

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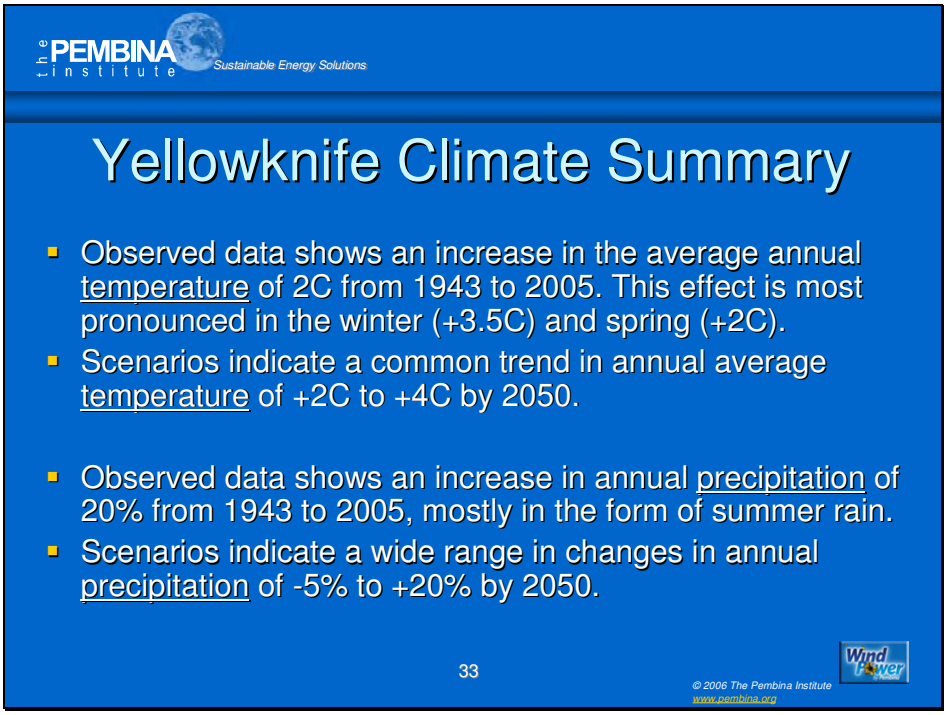

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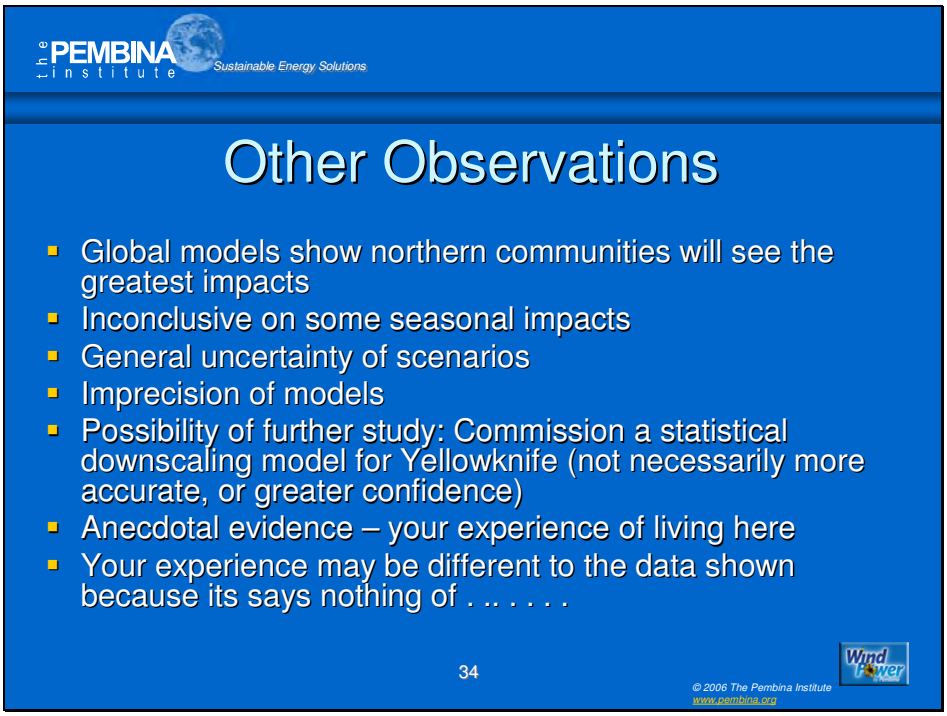

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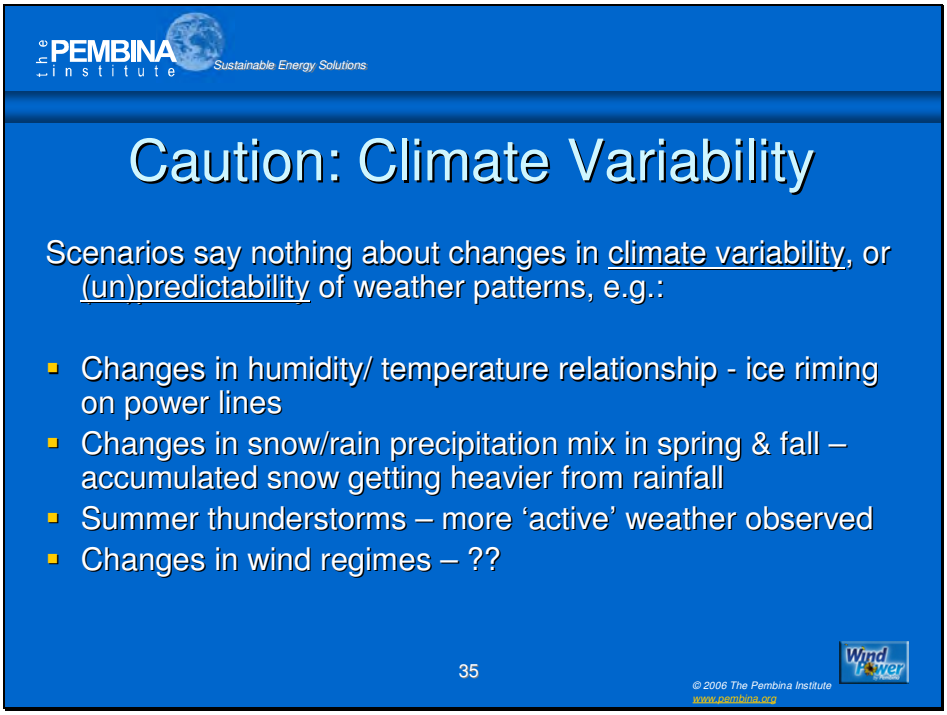

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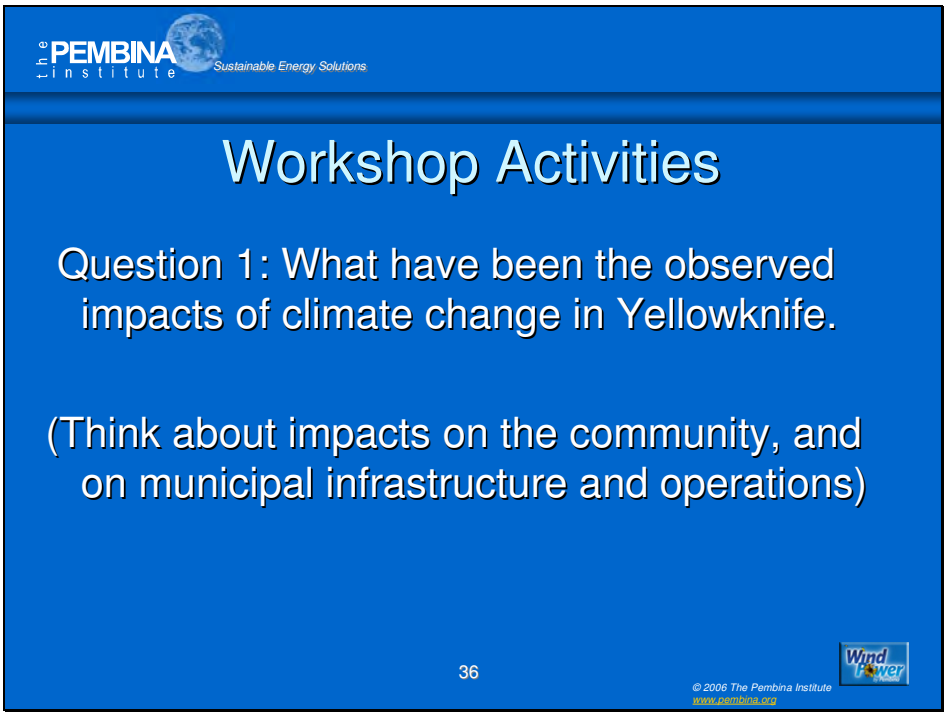

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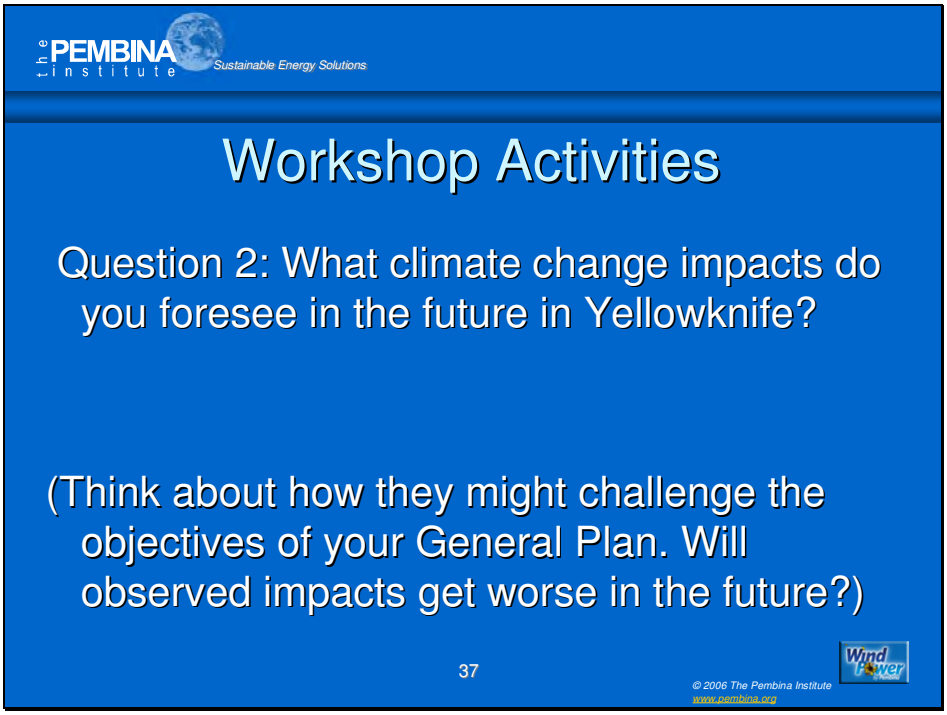

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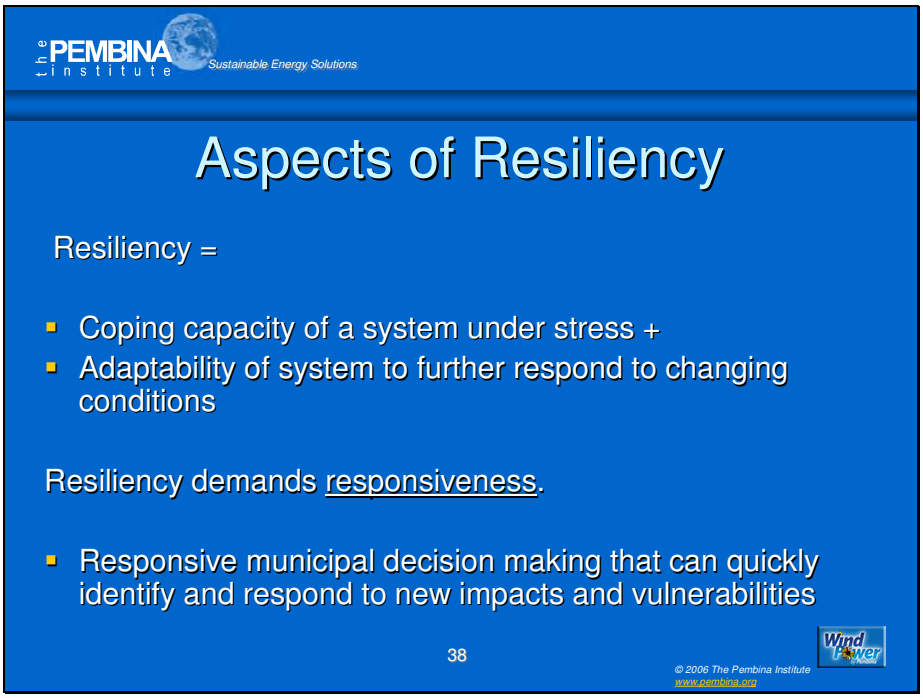

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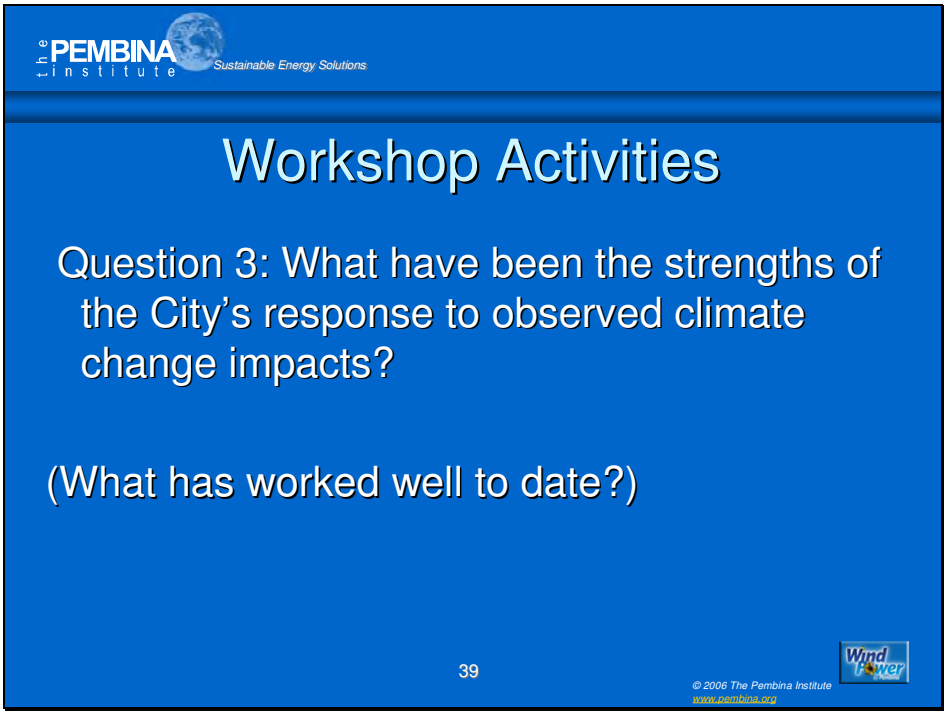

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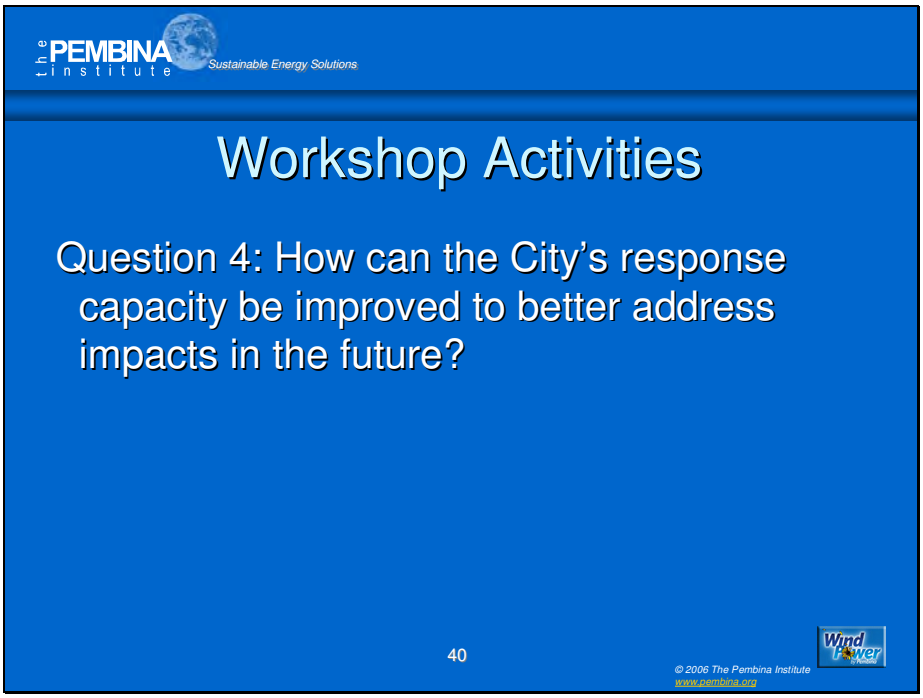

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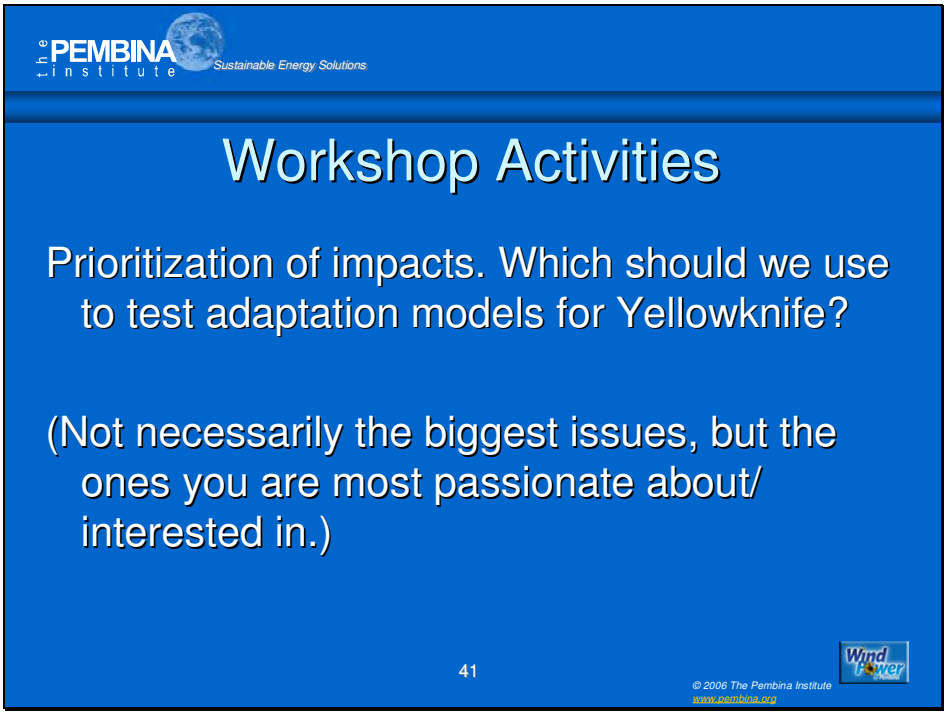

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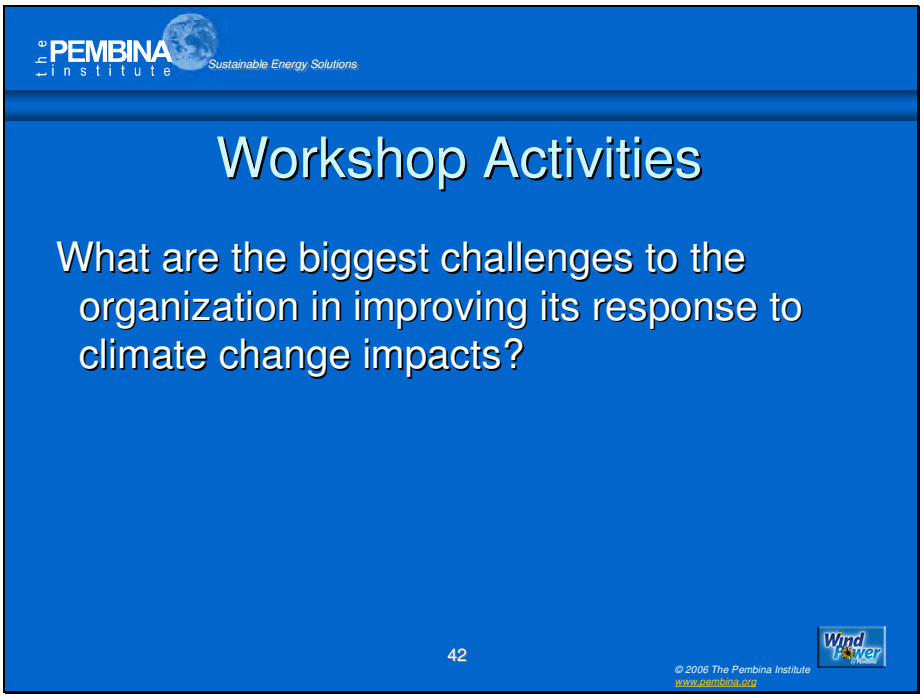

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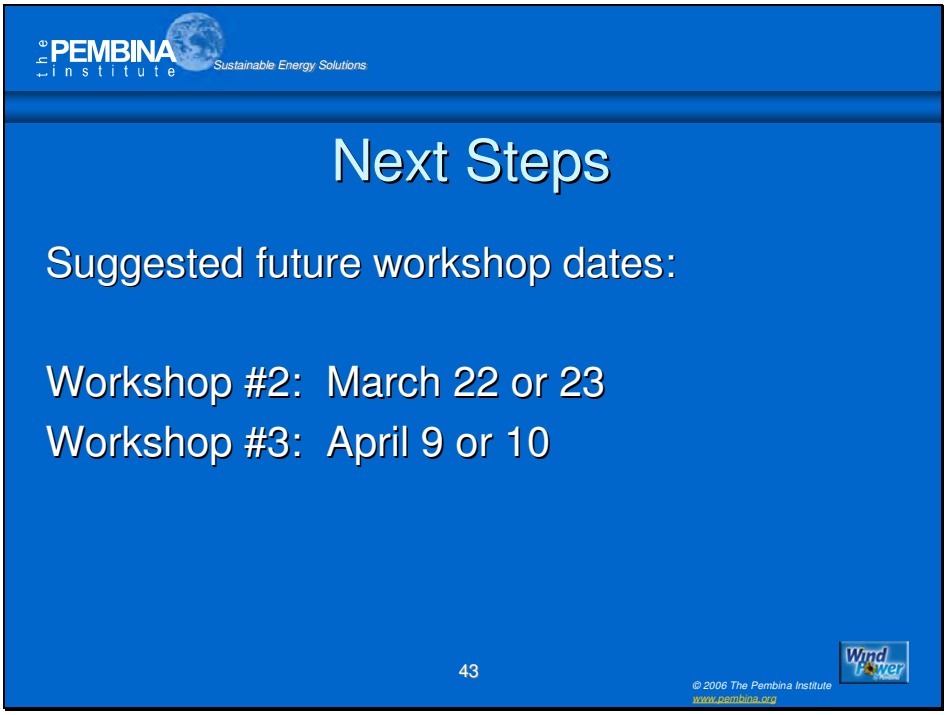

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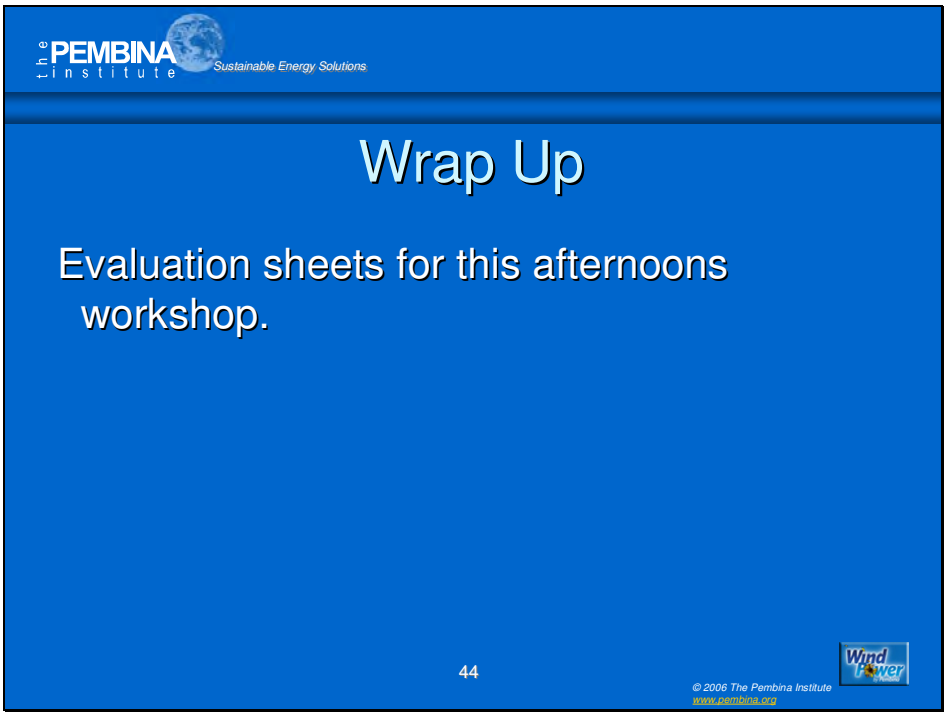

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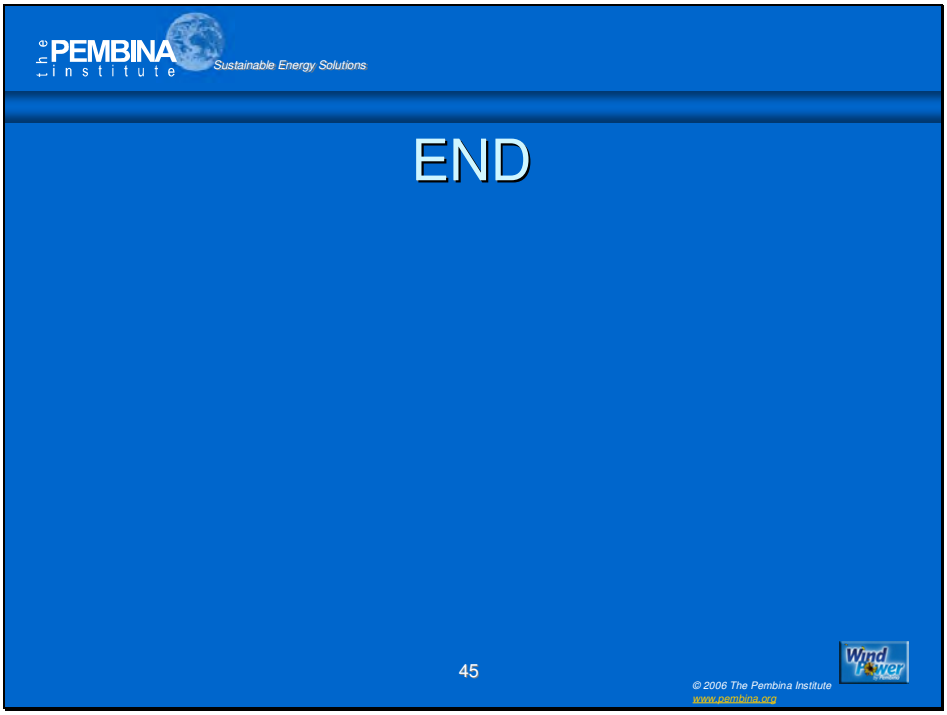
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Creating a More Resilient Yellowknife: Climate Change Impacts & Municipal Decision Making

Report of Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application

Thursday March 22nd, 1pm-5pm,
Downstairs Boardroom, Yellowknife City Hall

Submitted by Jake Pryor, Director Sustainable Municipalities
Submitted to Mark Henry, Energy Co-ordinator, City of Yellowknife

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Appendix A

Presentation slides.

1. Backgrounder & Summary

Community resiliency to the impacts of climate change requires the development of adaptation strategies that reduce the risks to community resources and infrastructure. By pro-actively increasing the coping capacity of community systems, the risk of these impacts on the community can be reduced to an acceptable level.

Building adaptive capacity involves the identification of future climate change impacts, assessing the vulnerability of community resources and infrastructure, and putting in place the decision making process to address them proactively. Funded by Indian and Northern Affairs Canada, this project aims to build adaptive capacity within the governance and administration of this northern community.

This report summarizes the results of the second of 3 workshops with City of Yellowknife elected officials, administration and stakeholder representatives to develop the tools to address emerging climate change impacts. The process of the workshops is as follows:

Workshop #1: Climate Change Impacts & Current Response Capacity
Objective: Create a common understanding of climate change adaptation and what it means for Yellowknife. Engage participants in identifying climate change impacts and how to improve the City's response to impacts.

Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application
Objective: Develop risk assessment and decision making criteria, structure, and model for Yellowknife. Identify how to strategically leverage its application to add value to other planning processes.

Workshop #3: Interagency Implementation
Objective: Foster momentum and the necessary conditions for continued commitment to stakeholder collaboration on adaptation.

It should be noted that the City of Yellowknife is already actively engaged in climate change *mitigation* measures with the implementation phase of its Community Energy Plan. These climate change *mitigations* and *adaptations* compliment each other by creating a holistic approach to protecting community assets by reducing the risk of significant impacts. *Mitigations* (reducing greenhouse gas emissions) essentially aim to reduce the degree and duration of climate change impacts by reducing our contributions of atmospheric greenhouse gases, and hence the resultant changes in climate. *Adaptation* aims to insulate our community systems from the climate change impacts we now know are now likely to occur despite our efforts to mitigate further.

Summary of Findings for Workshop #2

Case studies from other jurisdictions indicate:

1. Climate change adaptation in other jurisdictions is largely as a result of a response to specific issues and linked to disaster response planning.
2. Very little, if any, work has been done to integrate climate change risks and adaptations into ongoing decision making at the municipal level in other jurisdictions.
3. There is generally a weak understanding of potential impacts and their link to climate change.
4. Decision makers risk focusing on short term costs of adaptation instead of the long term cost of not adapting.
5. Adaptation processes should be tailored for each community and include stakeholder engagement.

Review of the risk management tool presented by the facilitator resulted in substantial recommendations for improvement by workshop participants, including:

1. Reduce the number of categories of severity from 5 to 3 (low, medium, high) to simplify the tool and range of responses required
2. Do not be prescriptive about impact categories and allow the user of the tool the autonomy to determine some of the variables to better capture the nature of the risk.
3. When using the Impact Rating Matrix, do not start with too broad an issue, but be quite specific to ensure adequate resolution of the issue at hand.
4. When making the transition from the Impact Rating Matrix to the Risk Evaluation Matrix, use only the highest impact rating found in each of the three categories. Avoiding averaging ensures no issue is 'lost' in the process.

Participant's engagement in the process resulted in invaluable learning and capacity building, however lack of time resulted in some agenda items being deferred until Workshop #3.

2. Workshop #2 Objective:

Develop risk assessment and decision making criteria, structure, and model for Yellowknife.

3. Desired Outputs:

1. A risk management tool that can be used consistently across the municipality to prioritize the needs for climate change adaptation.
2. An accountability framework that will ensure that responsibility is assigned, and appropriate action is taken to address climate change impacts and adaptation as they are identified.

4. Workshop #2 Agenda

Creating a More Resilient Yellowknife:
Climate Change Adaptation & Municipal Decision Making

Workshop #2: Building Capacity - Risk Assessment, Decision Making & Strategic Application
Thursday March 22th, 1pm-5pm, Downstairs Boardroom, Yellowknife City Hall

Objective:
Develop risk assessment and decision making criteria, structure, and model for Yellowknife.

Desired Outputs:
1. A risk management tool that can be used consistently across the municipality to prioritize the needs for climate change adaptation.
2. An accountability framework that will ensure that responsibility is assigned, and appropriate action is taken to address climate change impacts and adaptation as they are identified.

Agenda

1pm Welcome & Introductions

1.15pm Presentations

Results of research priorities from Workshop #1
Case studies from other jurisdictions
Risk management practices at the City of Yellowknife
Council committees and their potential 'adaptation' roles

2pm Workshop Activities to Address Key Questions
- What makes a good risk management tool?
- Applying proposed risk management tool to issues from Workshop #1

3pm BREAK

4pm
- Accountability, responsiveness and 'keeping it on the radar'
- Proposed accountability framework

5pm Next steps and wrap-up.

5. Workshop Attendees

The following individuals were present for all or part of the workshop session:

- Gordon Van Tighem, Mayor
- Shelagh Montgomery, Councillor
- Dave Devana, Director, Corporate Services
- Greg Kehoe, Director, Public Works
- Mark Henry, Energy Coordinator
- Craig Scott, Climate Change Programs, GNWT
- Eleanor Young, Ministry of Municipal and Community Affairs, GNWT
- Shirley Cook, Dene First Nation
- Aleta Fowler, Indian & Northern Affairs Canada
- Jake Pryor, Facilitator, Pembina Institute

Regrets:

- Dennis Marchiori
- Dennis Althouse, Superintendent, Operations & Maintenance, Public Works
- Paul Falvo, Councillor
- Mark Heyck, Councillor
- Kevin Kennedy, Councillor
- Jeffrey Humble, Director, Planning & Lands
- Grant White, Director, Community Services
- Peter N., Director, Economic Development
- Dennis Kefalas – Manager, Public Works
- Doug Ritchie, Executive Director, Ecology North
- Greg Cousineau, Transportation, GNWT

6. Record of Proceedings

1pm Welcome & Introductions

Participants re-introduced themselves to one another and were welcomed by the facilitator.

1.15 Presentations

The facilitator presented a series of slides (at Appendix A in this document) covering the following topics:

- Concepts and definitions
- Adaptation Planning, Frameworks and Decision Making
- Case studies

The facilitator explained that some of the research questions identified during Workshop 1 could not be addressed. This was due to the limited number of case studies available, and the fact that they had not addressed the issues themselves. There were however, some important observations and lessons from the case studies that would help inform the Yellowknife process:

- Mitigation action is more common than adaptation
- Adaptation action mostly linked to issue-specific responses to date (disaster management)
- There is limited (if any) integration of climate change into on-going decision making processes
- Adaptation processes are tailored to each community
- They leverage commitment to sustainable development
- They establish stakeholder processes
- There is generally a weak understanding of potential impacts and their link to climate change
- Decision makers risk focusing on short term costs of adaptation instead of the long term cost of not adapting
- Challenges of short political cycles and secure ongoing funding

2.15pm Coffee

2.30pm Workshop (small group exercises)

The facilitator introduced a risk management tool to the group that they would be working with for the afternoon. It was a slightly adapted version of the tool developed by Bruce Egener & Noble (2006) in their Guide for Ontario Municipalities. The tool consisted of two parts – an Impact Rating Matrix, and a Risk Evaluation Matrix (shown on pages 8 & 9).

Climate Change Adaptation - Impact Rating Matrix

(Adapted from Bruce, Egener, Noble, 2006)

1. Choose the climate change impact to review
2. Determine the severity of different aspects of the impact.
3. Record your determination in the matrix.

Consider:

1. What made you decide the impact fell into one category (eg Moderate) and not a neighboring category (eg Low or Major).
2. Do the suggested factors work for your example? Are there others you would like to include? Some you would like to delete? Which ones are most informative about the issue?

Climate Change Issue: _____

Impacts	**Social Factors**				**Financial Factors**				**Environmental Factors**			
Severity	Displacment	Health & safety	Los of livlihood	Cultural aspects	Property/ asset damage	Financial impact	Impact on municipal finances		Air	Water	Land	Ecosystems
Very Low												
Low												
Moderate												
Major												
Extreme												

Risk Evaluation Matrix

(Adapted from Bruce, Egener, Noble, 2006.)

Impact Severity						
	Extreme					
	Major					
	Moderate					
	Low					
	Very Low					
		Very unlikely to happen	Occassional occurance	Moderately frequent	Occurs often	Virtually certain to occur
	Frequency/ Probability					

Extreme risk: Immediate controls required.

High risk: High priority control measures required.

Moderate risk: Some controls may be required to reduce risk to acceptable level.

Low risk: Controls not likely required.

Negligible risk: No further consideration required.

Participants self-organized into groups of 4-5 to:

- Apply the tool to issues identified in Workshop #1
- Identify where the tools were deficient, difficult to use or understand
- Suggest revisions to the matrices that would lead to a bespoke risk management tool for Yellowknife

After 30 minutes the facilitator asked the groups to share their experiences of first trying to apply the tool. Lengthy and engaging discussion followed that identified some key changes would be required.

Dave Devana indicated that he considered this exercise one through which a general risk management tool would be developed for the City that was not climate change specific, but which would be applicable in other scenarios as well. This demonstrated a great opportunity for leveraging the results of the workshop into something of further value for the city. Dave also introduced some risk management training materials he had received from a course that assisted him in providing some informed feedback on where the tools could be improved.

Changes suggested by the participants:

1. **Reduce the number of categories of severity from 5 to 3 (low, medium, high)**

   The suggested 5x5 matrix was considered unnecessarily complex by the group. Since the tool is a decision support tool, each location in the matrix should relate to a different type of response action. Twenty five different types of response action seemed excessive. A 3x3 matrix was suggested that would provide sufficient differentiation in evaluated risks to allow appropriate response actions to be tailored without becoming onerous.

2. **Do not be prescriptive about impact categories and allow the user of the tool the autonomy to determine some of the variables.**

   The Impact Rating Matrix presented to the participants already had some generic categories listed under the headings of ‘social’, ‘financial’, and ‘environmental’ impacts. The participants were invited to change these as they felt necessary. After much valuable discussion, the response was to recommend that these sub-categories not be prescriptively provided, but that the user of the tools should be free to identify the relevant subcategories for the impact being rated. In addition, the user should be left to determine what thresholds will determine whether the risk is low, medium or high for each of the subcategories they have created. This recommendation creates opportunity for autonomy of the user, as well as subcategories that are much more relevant to the issue.

Participants recognized the risk of introducing inconsistent subjectivity into the tool by allowing the user the autonomy to define some of the elements of the tool up front, but felt this was mitigated by the fact it should be used not by an individual, but by a multidisciplinary group that should be able to moderate any isolated and unusual evaluations.

3. **When using the Impact Rating Matrix, do not start with too broad an issue, but be quite specific.**

   The range and number of issues raised in Workshop #1 meant that attempting to assess risks in a 'summary' fashion did not yield sufficient information to support the decisions that would need to be made to address them. The groups determined that it was better to complete an Impact Rating Matrix for each issue rather than, for example starting with the broad statement of "The impact on permafrost of a 2^{o}C increase in temperature over the next 50 years".

4. **When making the transition from the Impact Rating Matrix to the Risk Evaluation Matrix, use only the highest impact rating found in each of the three categories.**

   The idea of averaging the impact ratings was eliminated as it risked 'losing' an issue that scored higher than the average and required more urgent action. The concept of taking the highest score found in each of the three categories – social, environmental, economic – means that the tool is capturing the most significant issues.

   Cumulative effects on the community and its infrastructure are not evaluated by this tool. Once the tool has been applied to the climate change risks, the library of information that is generated will need to be cross-checked for cumulative impacts, otherwise many impacts on the same infrastructure in the low-moderate range may go unnoticed.

4.50 Next Steps

The facilitator thanked participants for their perseverance with what was a challenging task, and reminded them of the date of Workshop #3, April 10 2007, 1pm-5pm. The tasks not completed from the day's agenda will be addressed in Workshop #3.

5pm Wrap-up.

7. Facilitators Observations

This was destined to be a challenging workshop. Risk management tools present an inherent subjectivity which is normally only accepted by users as they become more familiar with it. Not only was this the first time some of the participants had seen a risk management tool, but they were being asked to apply it to real life issues, as well as identify how best to adapt it for Yellowknife's future use. This resulted in considerable learning and capacity building among the participants, however a few participants expressed some frustration at the lack of a final solution. This was possibly the result of a focus on the need for an end product rather than the value of going through the process itself – an experience that will be invaluable in future use of the tools. The facilitator recognized the key challenges the tool presented. The suggested changes will inform the development of a revised tool to be presented back to the group during workshop #3.

A larger than anticipated amount of workshop time was dedicated to the revision to the risk management tool, to the extent that the accountability framework exercises were not completed. In view of the limited face-to-face time, the facilitator decided that it was more important to continue with the engaging discussion on this issue than risk losing valuable input. The exercise on accountability will be addressed in the third workshop.

8. Priorities for Workshop #3:

The agenda items for workshop #2 were not all completed as the discussion on the risk management tools overran. It was clear at the end of the session that participants required some additional closure on the recommendations for changes to the risk management tool. The facilitator will synthesize the comments and suggested changes and revise the tools accordingly for presentation at Workshop #3.

The participant exercise on accountability was the exercise that did not completed due to lack of time. Had their been time to compete this, it would have satisfied participants need for clarity over when and how the tool would be used and how it will 'fit' within the existing decision making processes at the City of Yellowknife. Workshop #3 will include group exercises on identifying decisions where consideration of climate change impacts is required, as well as what policies and practices are necessary to ensure climate change is given appropriate significance in these circumstances.

To provide some clarity, a review of progress and direction will be provided with the agenda for Workshop #3 in advance of the event.

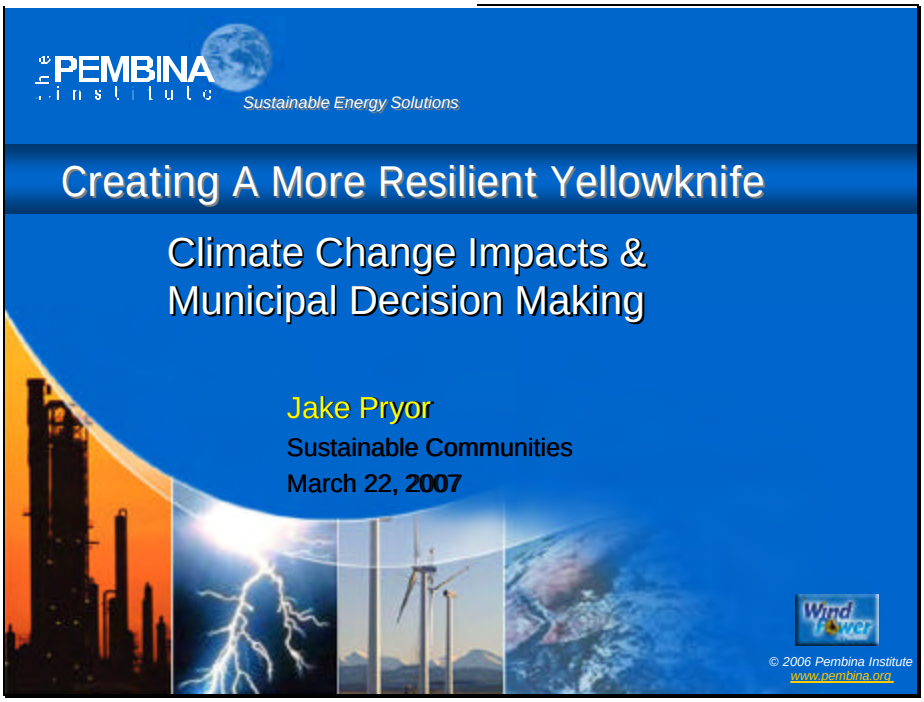
9. Workshop Evaluations

There was no time left at the end of the afternoon to distribute and complete workshop evaluations and a number of participants had departed early to accommodate other commitments. Feedback on the quality of workshops is important to Pembina, but not at the expense of quality workshop time with clients. The facilitator did not wish to truncate the groups' discussion on the revisions to the risk management tool as the face-to-face time is limited.

The facilitator will ensure sufficient time at the end of the third workshop to provide participants the opportunity to comment on the process as a whole for the purpose of project evaluation rather than workshop evaluation.

Appendix A: Presentation Slides

Slide 1



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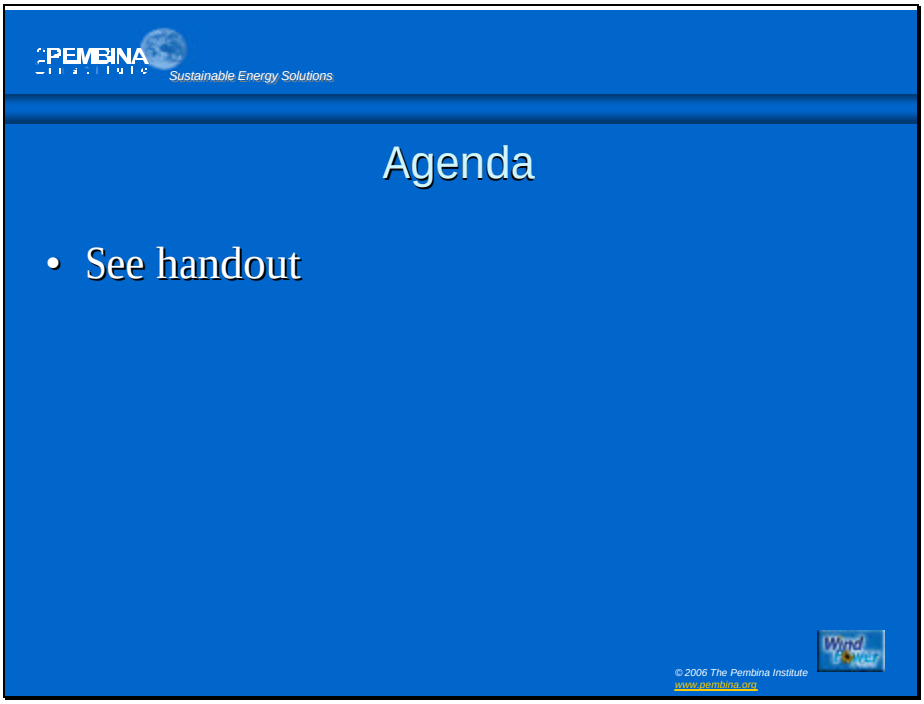

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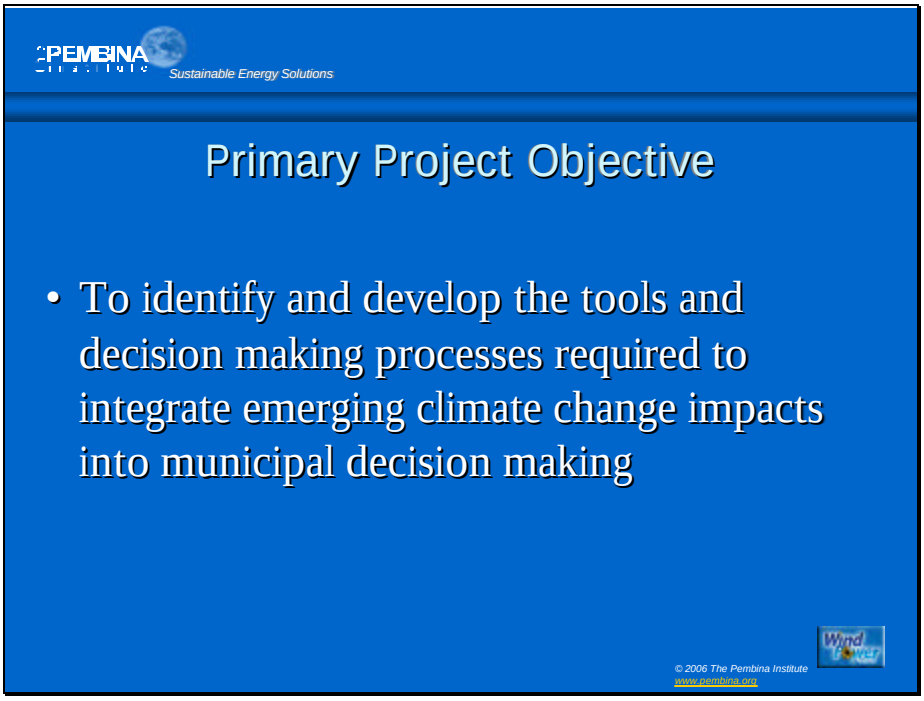

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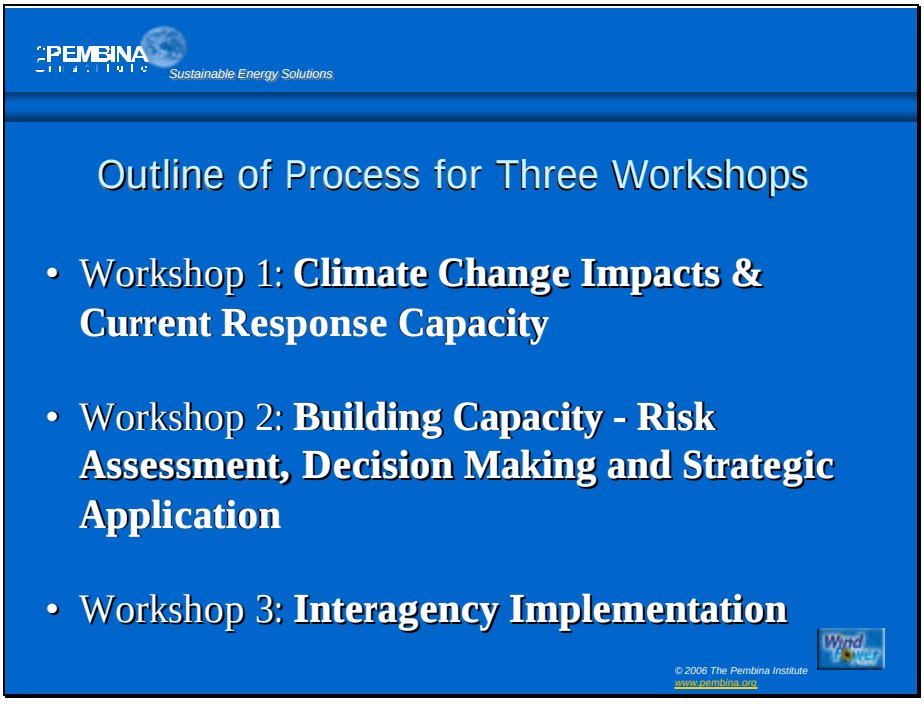

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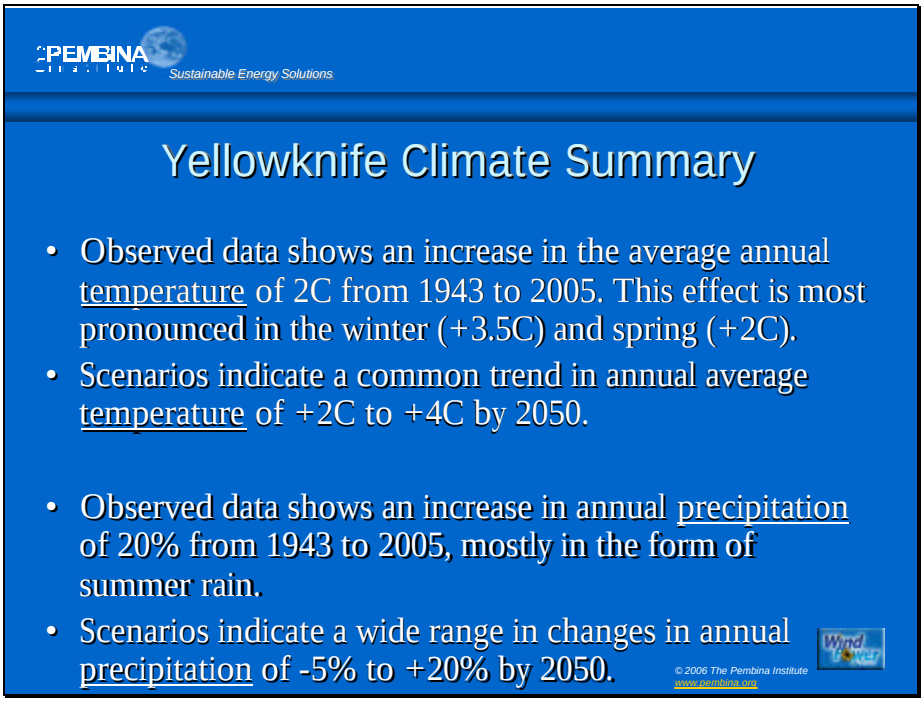

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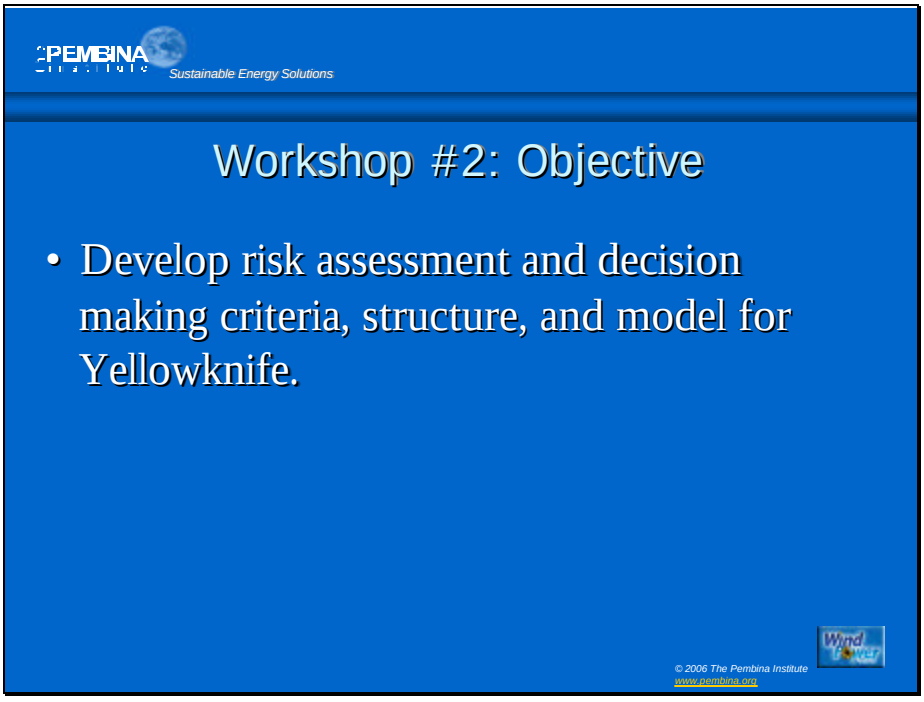

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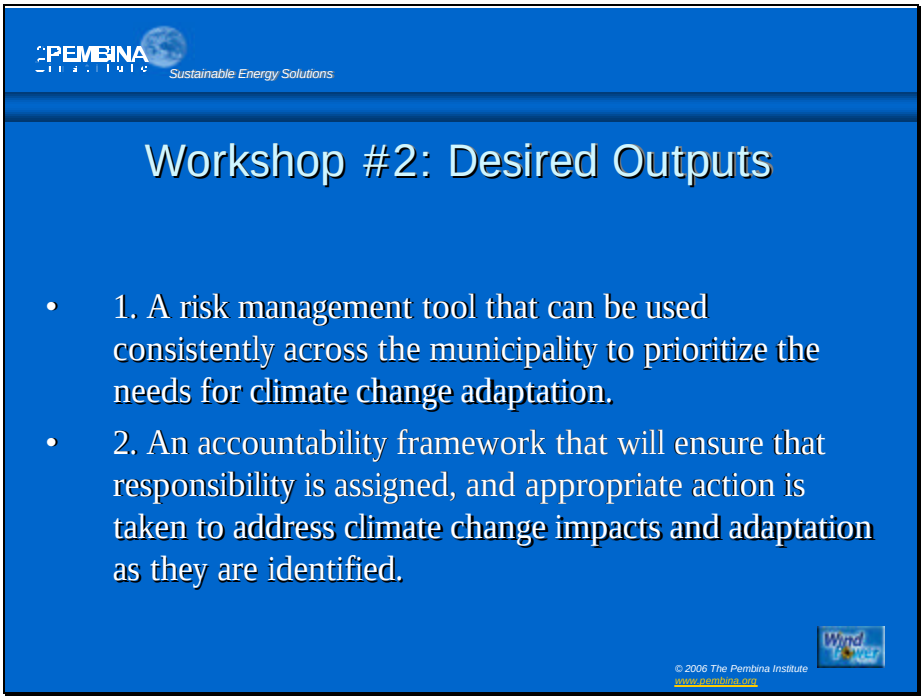

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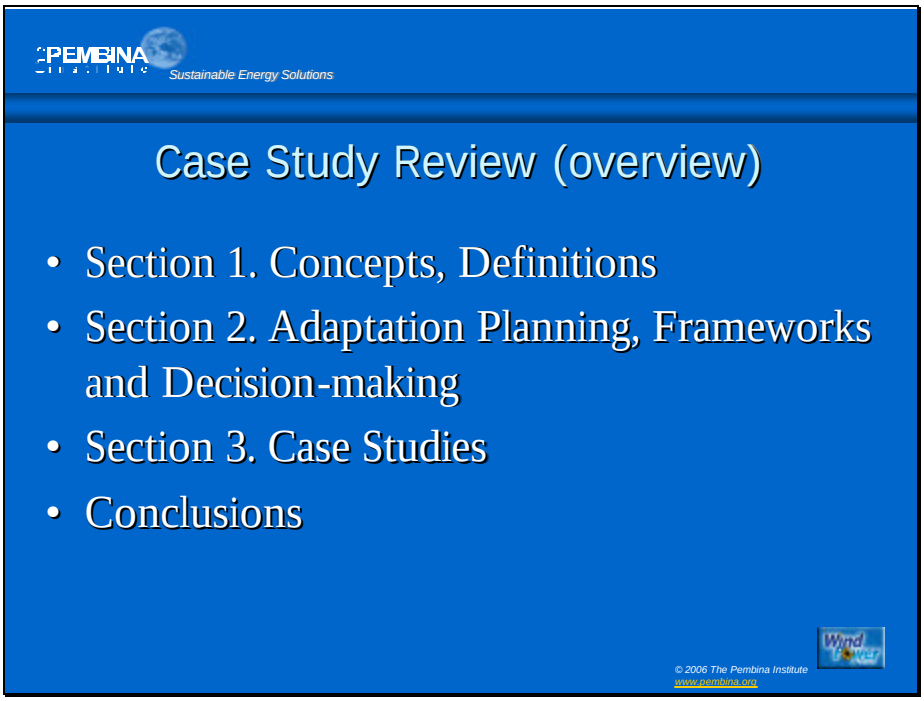

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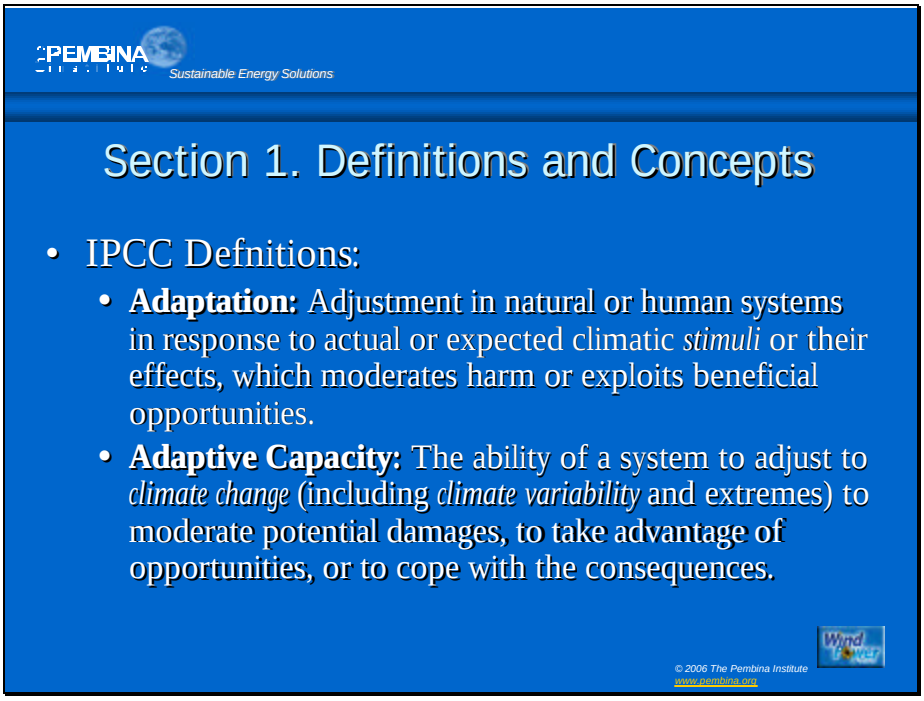

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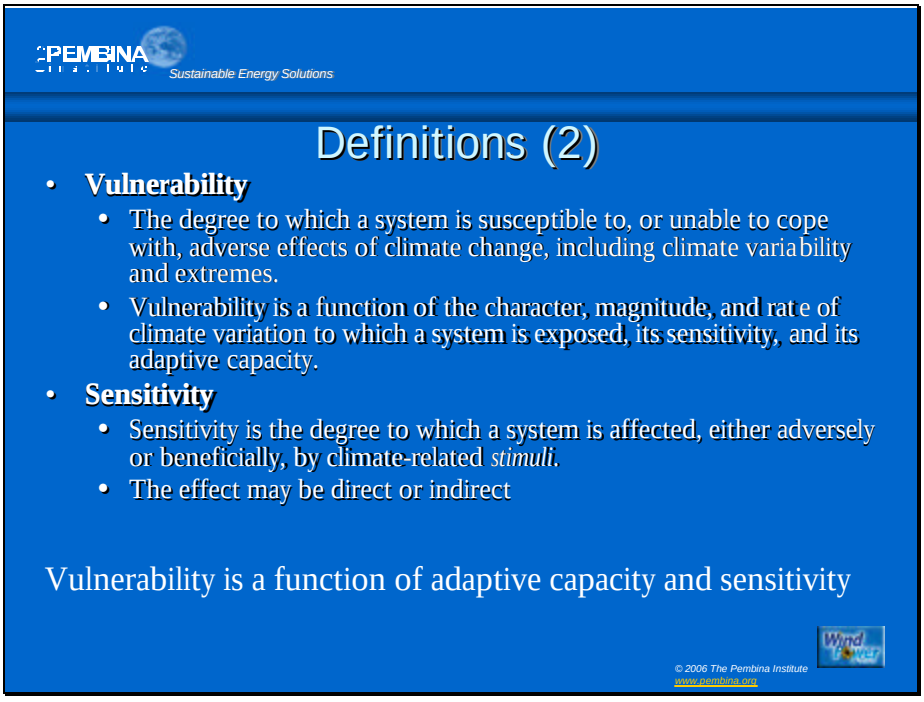

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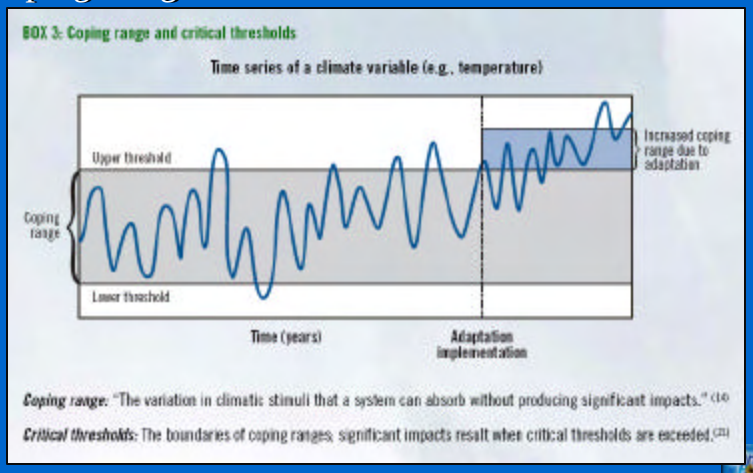
Concepts

- Coping Range



Source: NRCan

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Types of Adaptation Decisions

- Climate Adaptation Decisions
  - Decisions where the prospect of climate change provides the sole reason for considering a decision
- Climate Influenced Decisions
  - Decisions where the outcomes could be affected by climate change, but where climate change is only one of a number of factors of differing importance.

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Types of Decisions (2)

- No-regrets
  - Climate-sensitive decision areas where no apparent uncertainty exists as to the best adaptation option to implement. This option is anticipated to deliver benefits under any foreseeable climate scenario, including present day climate.
- Climate constraining decisions (avoid!)
  - Decisions that reduce either present day and/or future climate adaptation options;
  - Decisions that affect the ability of other decision-makers to manage the consequences of climate change.

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Types of Decisions (3)

- More on Climate-Constraining Decisions
  - It is important to keep open or increase the options that will allow climate adaptation measures to be implemented in the future

Table 1: Maladaptation and other climate change decision errors

Consequence of poor decision	Description of cause of poor decision
Under-adaptation – 1	Where adaptation to climate change is or should be an essential component of the decision, but it is either ignored, or insufficient actions are taken to adapt.
Under-adaptation – 2	Where non-climate factors are perceived as having greater importance to the decision than climate change factors, the result may be that insufficient weight is attached to the need for adaptation. This may tend to lead to under-adaptation.
Over-adaptation – 1	Actions taken where climate change is considered to be a significant factor on the decision to be taken, but where it will have or should have little or no influence on that decision.
Over-adaptation – 2	Actions taken where non-climate factors that should have a significant influence on the decision are ignored or given insufficient weight compared to climate change factors. This may tend to lead to over-adaptation.
Maladaptation	Actions taken that reduce the options or ability of decision-makers now or in the future to manage the impacts of climate change. Such actions are sometimes described as reducing climate headroom.

Source: UKCIP

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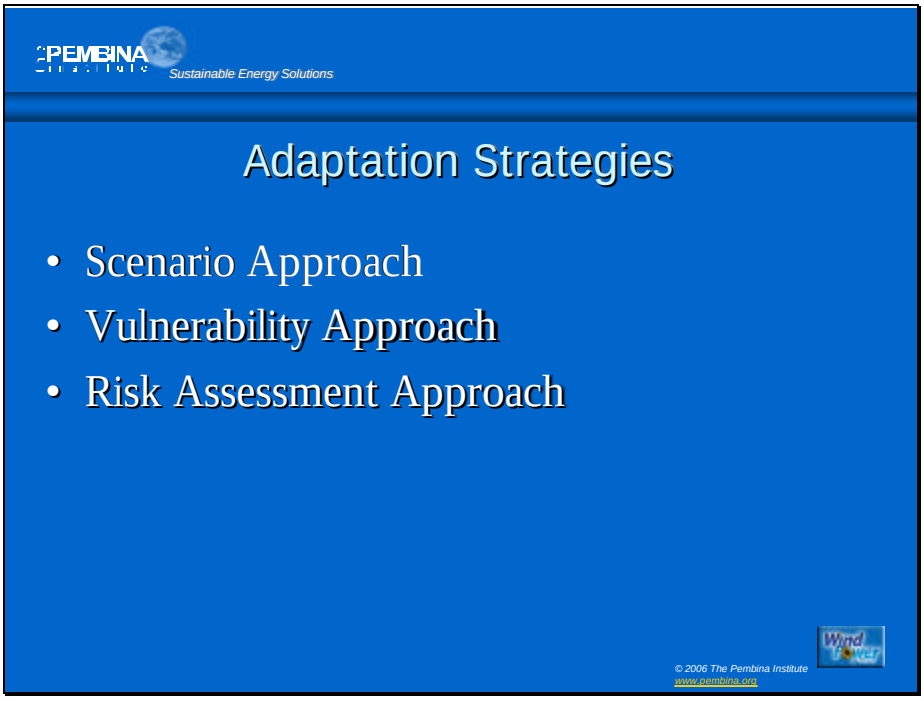

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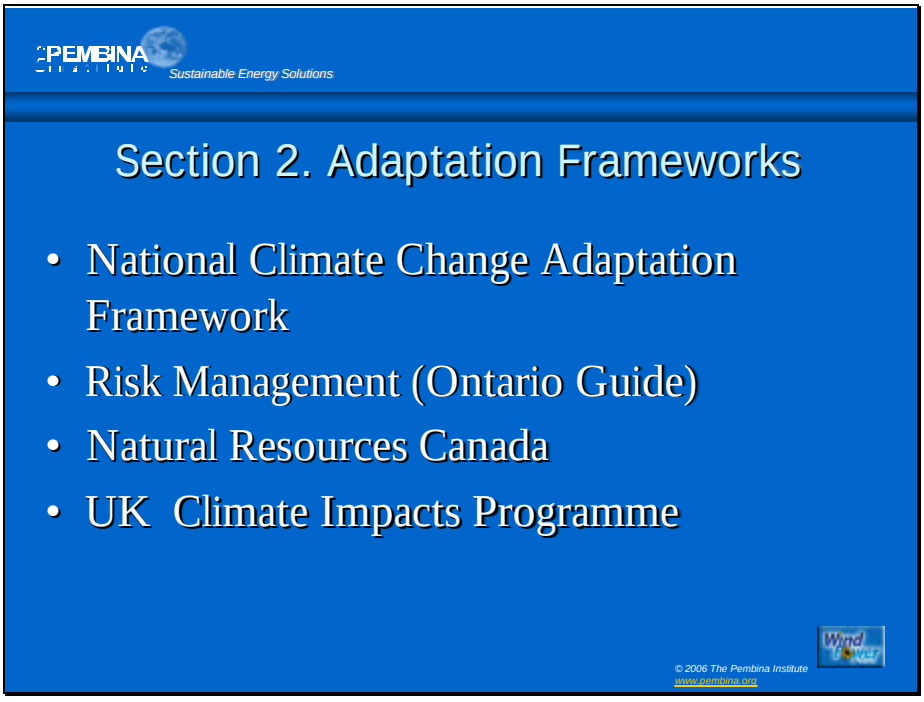

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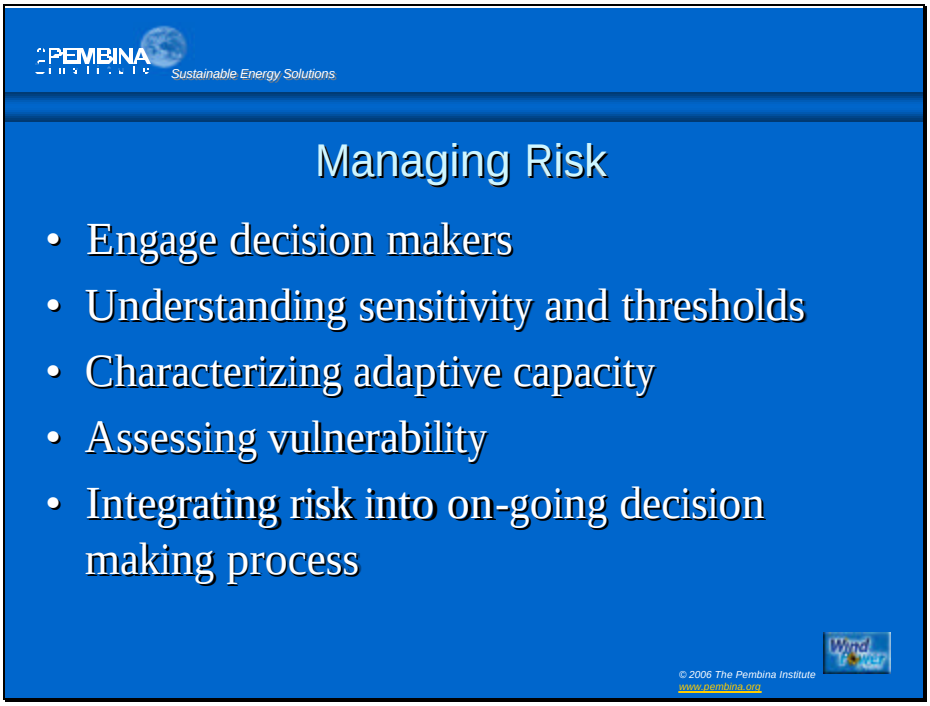

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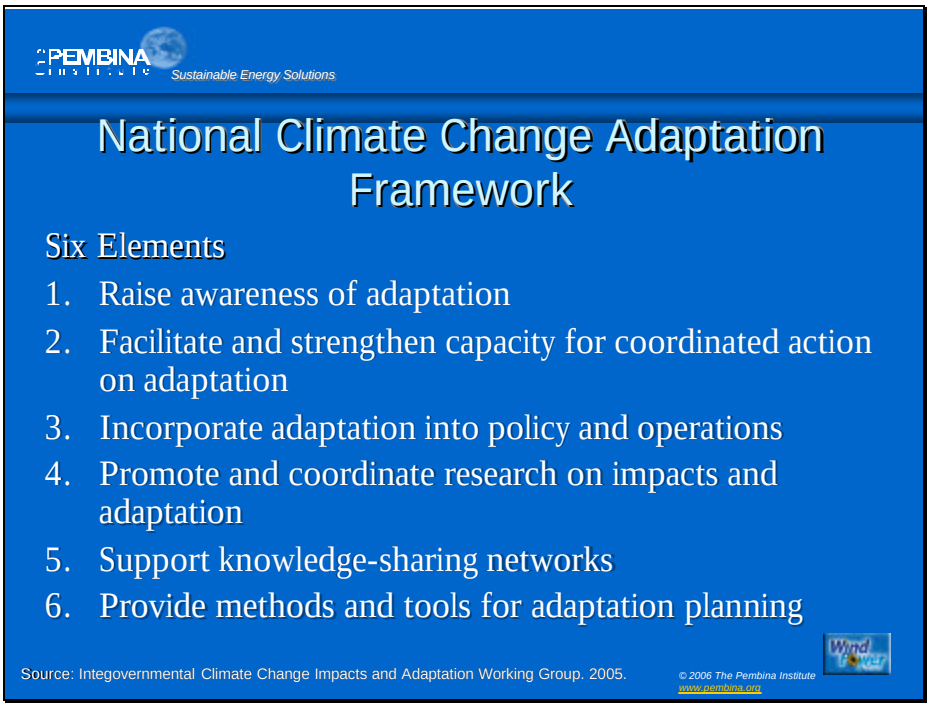

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Risk Management

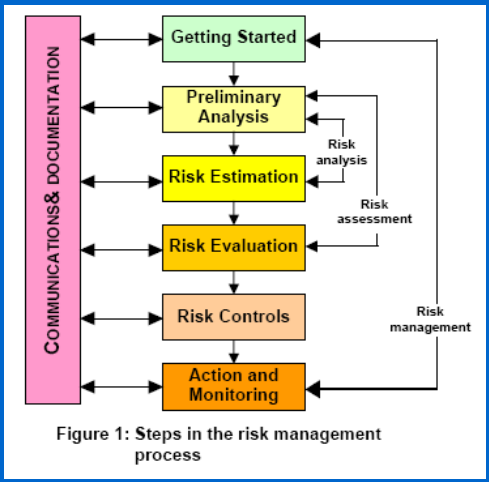

Figure 1: Steps in the risk management process

Guiding Principles

- Stakeholder Engagement
- Communication
- Promotion of Sustainable Development
- Documentation
- Use of Existing Tools, Human and Technical Resources
- Public Education and Awareness

Source: Adapting to Climate Change: A Risk Management guide for Ontario Municipalities. Bruce, Egener and Noble. 2006.

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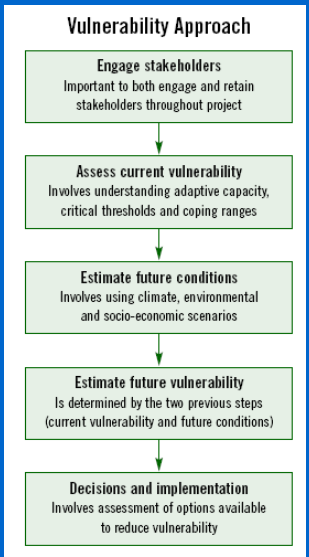
Natural Resources Canada



- Improve understanding of the current state of the system
- Develop more realistic estimates of feasibility of adaptive action
- Facilitates implementation of no-regrets actions

Source: NRCan

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UK Climate Impacts Programme

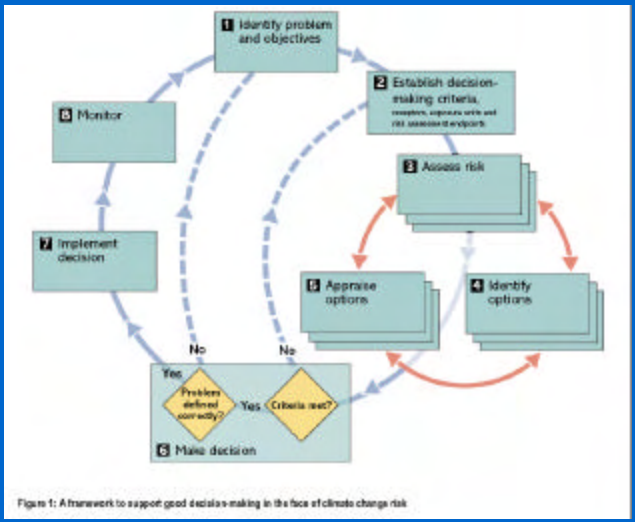

Figure 1: A framework to support good decision-making in the face of climate change risk

Source: UKCIP

- Flexible approach
- Feedback & Iteration built-in.
- Tiered decision making

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Common Themes of Processes

- Processes are iterative – can be revisited based on new information, new criteria, etc.
- Information and research essential
- Stakeholder engagement
- Each step facilitates prioritization of actions

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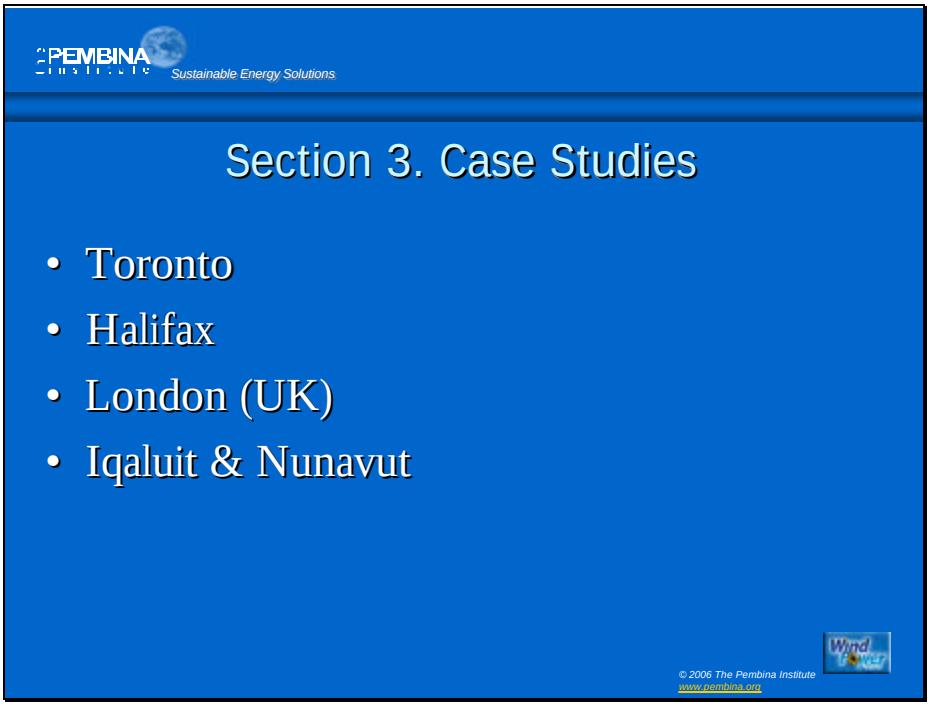

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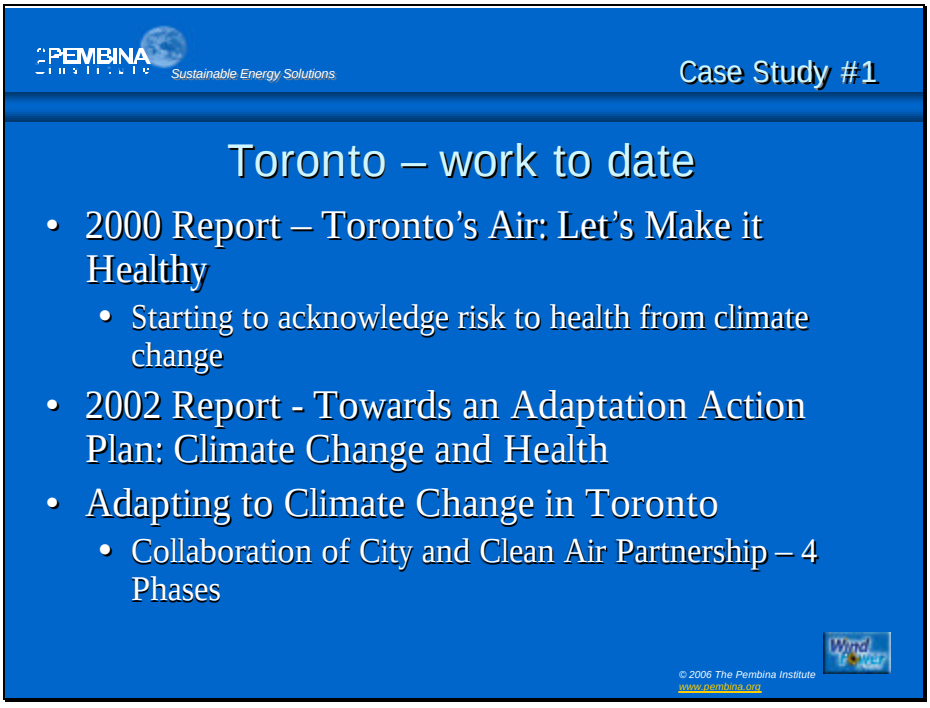

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Case Study #1

Toronto's Process

- Impacts scan
  - (report completed)
- Learning from Other Cities
  - (workshops/reports underway)
- Decision makers workshop
  - (completed)
- Adaptation Strategies for two strategic areas developed in collaboration with City
  - (reports/workshops underway).
- Next Steps

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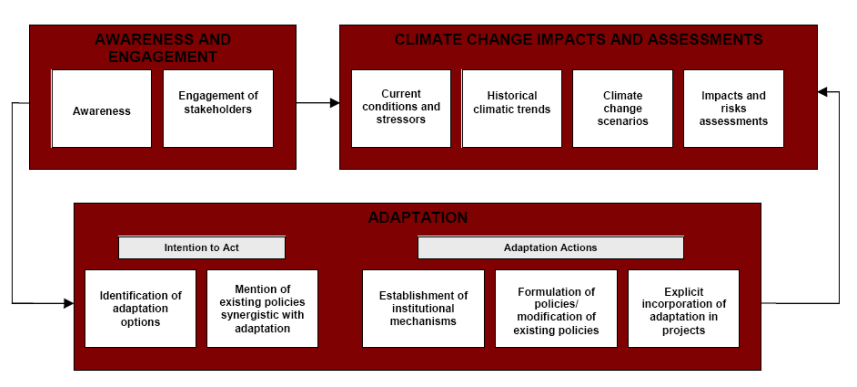

- Clean Air Partnership suggests this modified process based on common themes it has found in successful initiatives in other urban centers they studied.

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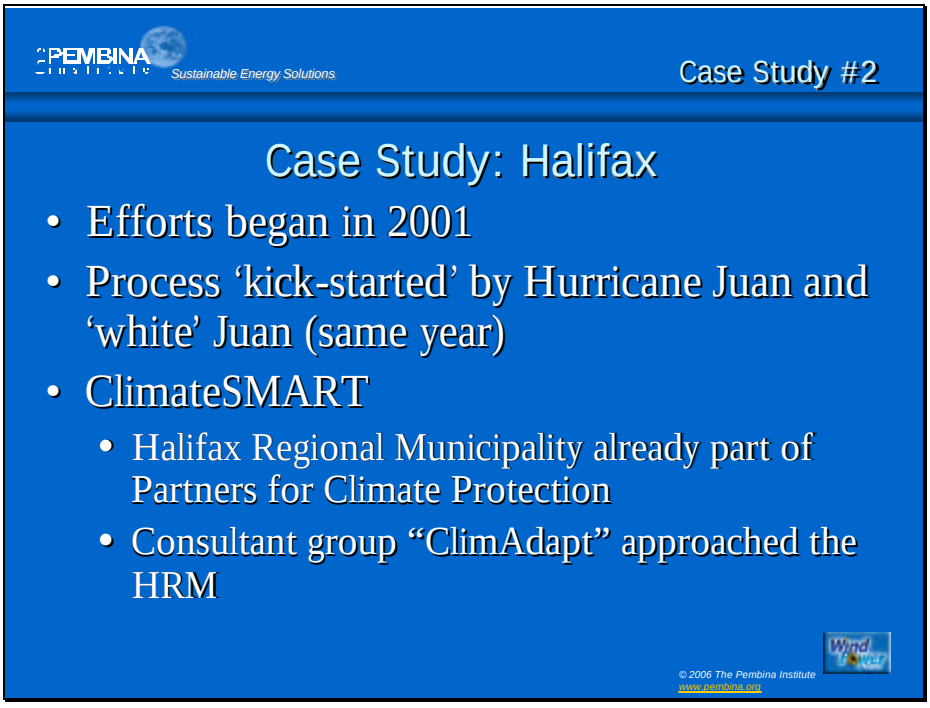

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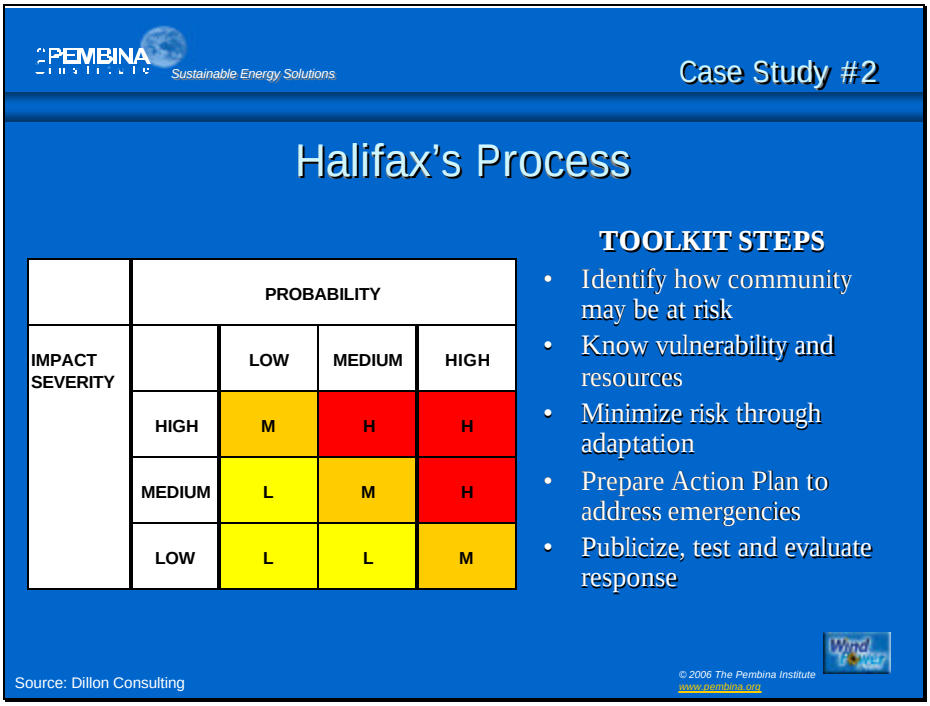

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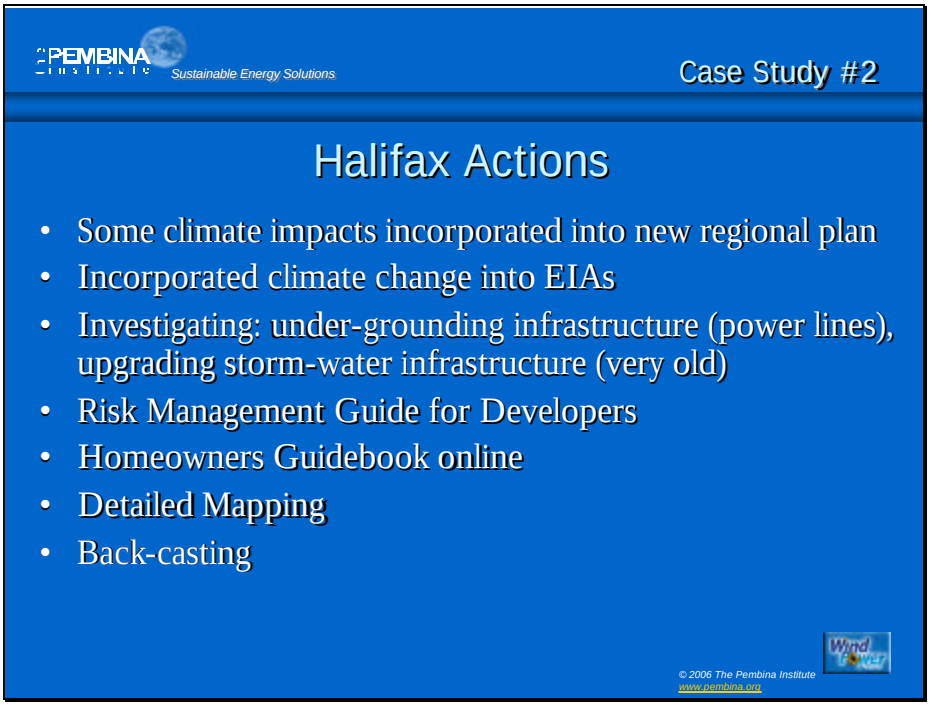

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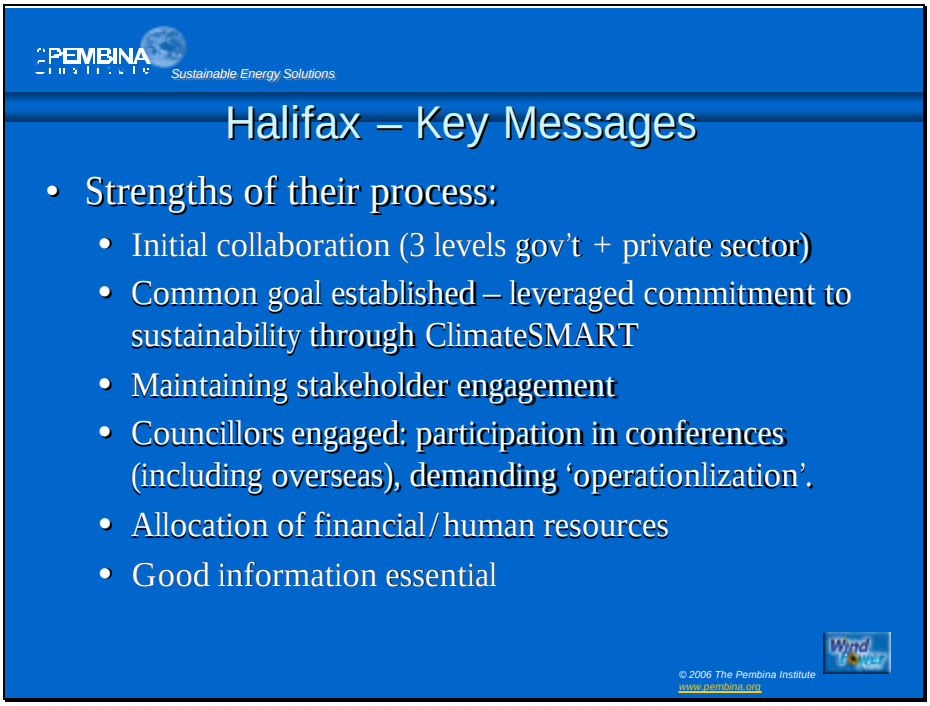

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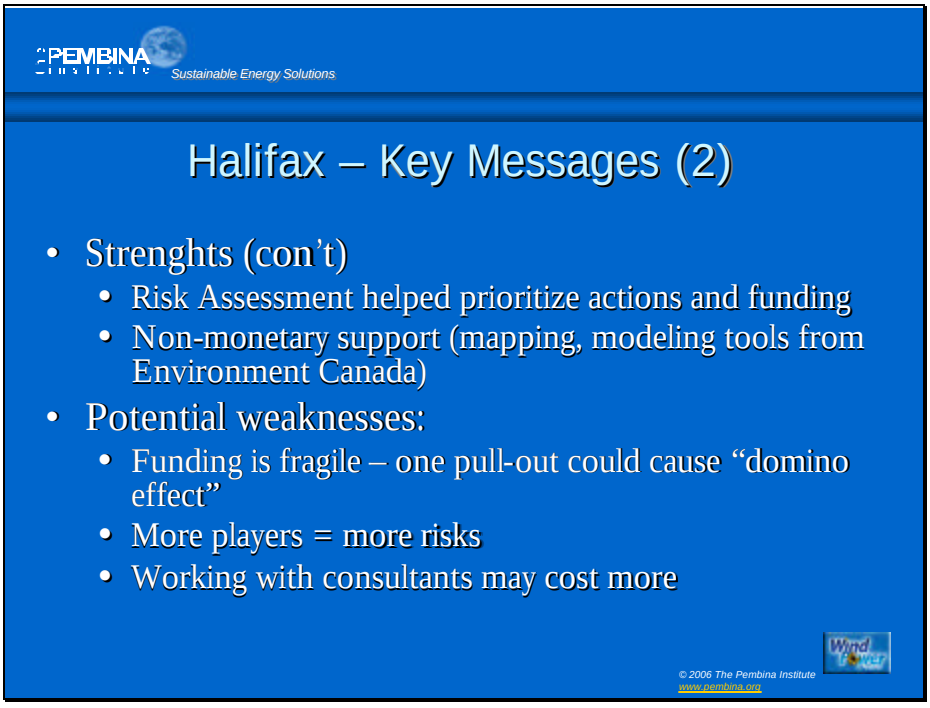

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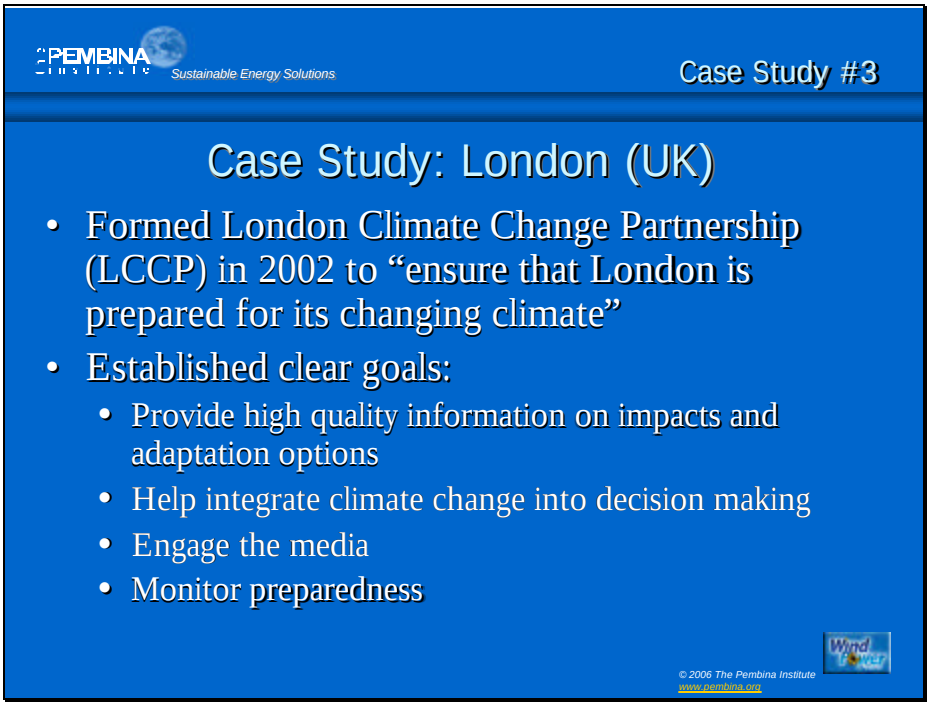

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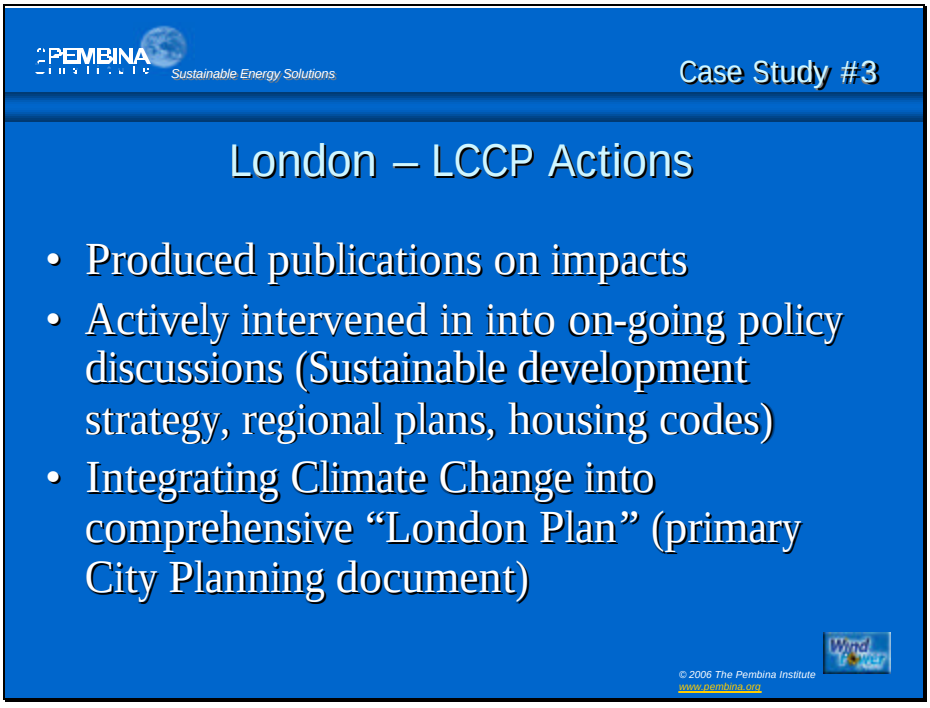

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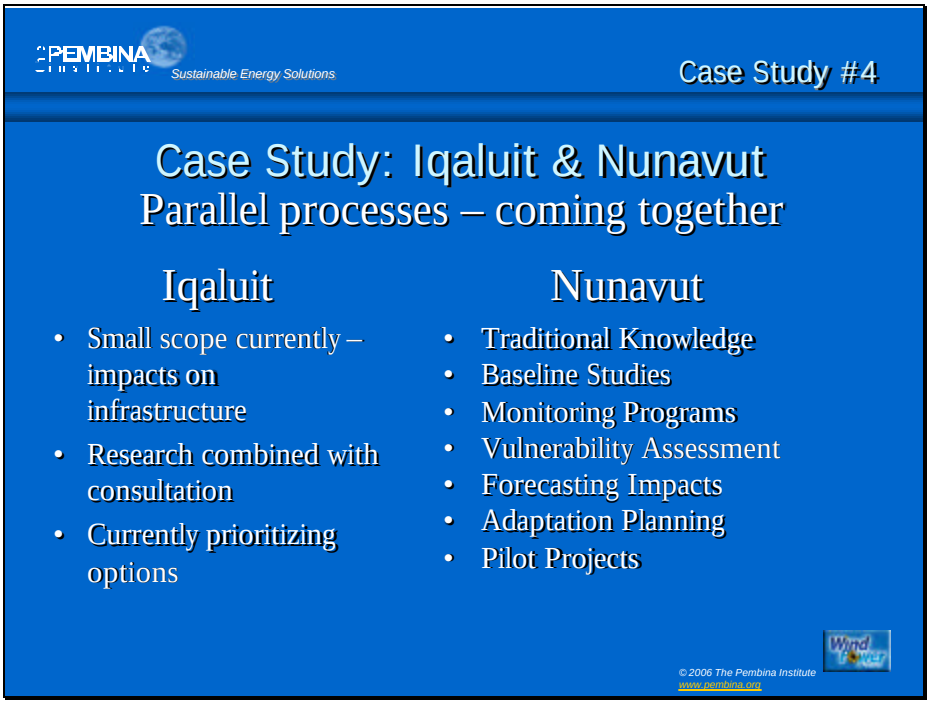

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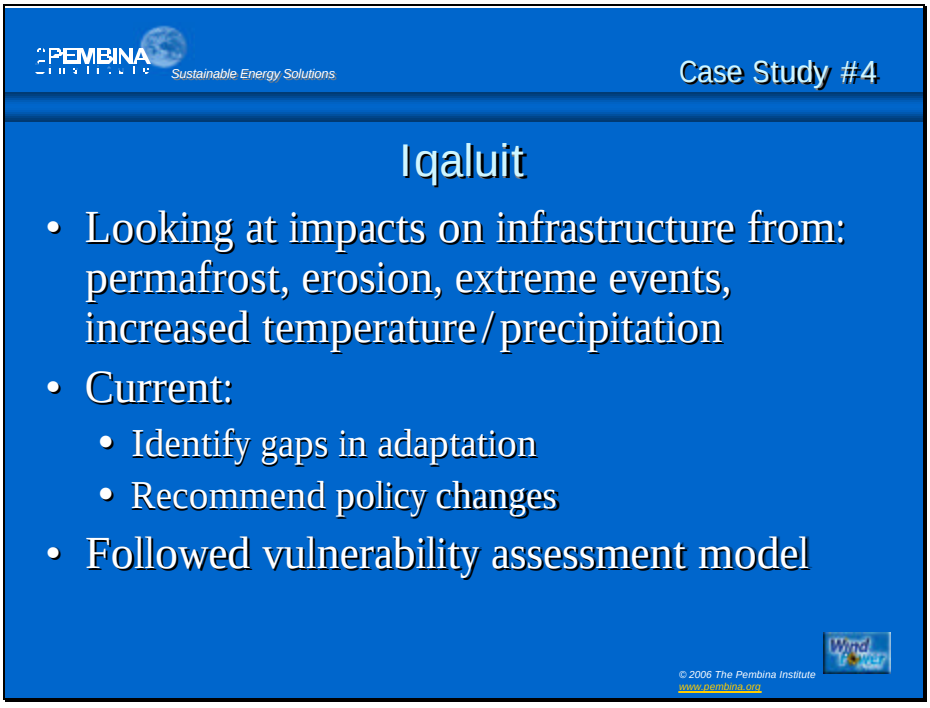

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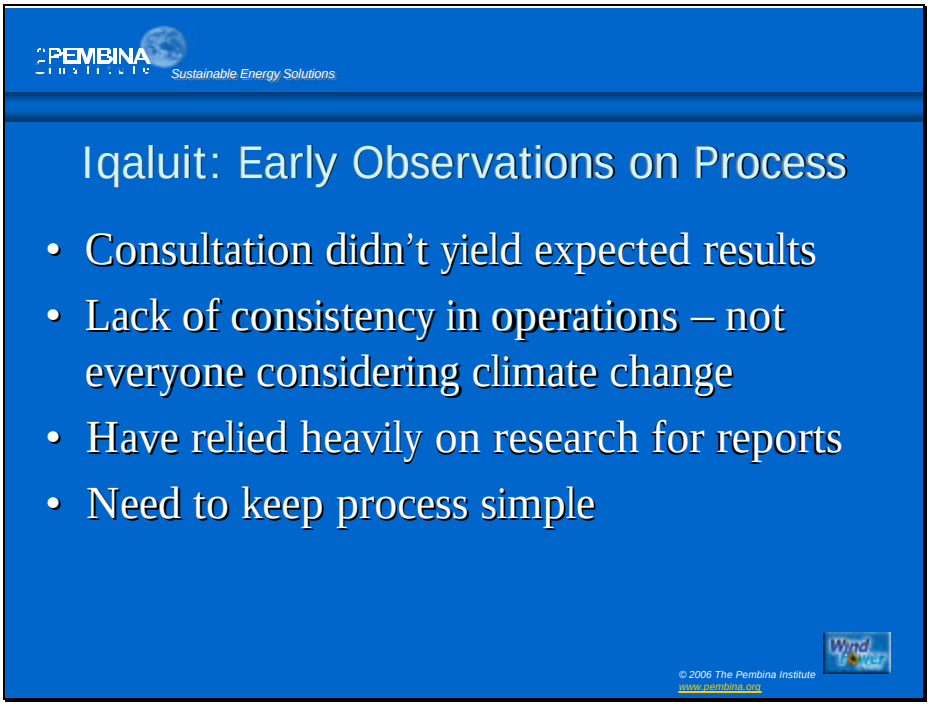

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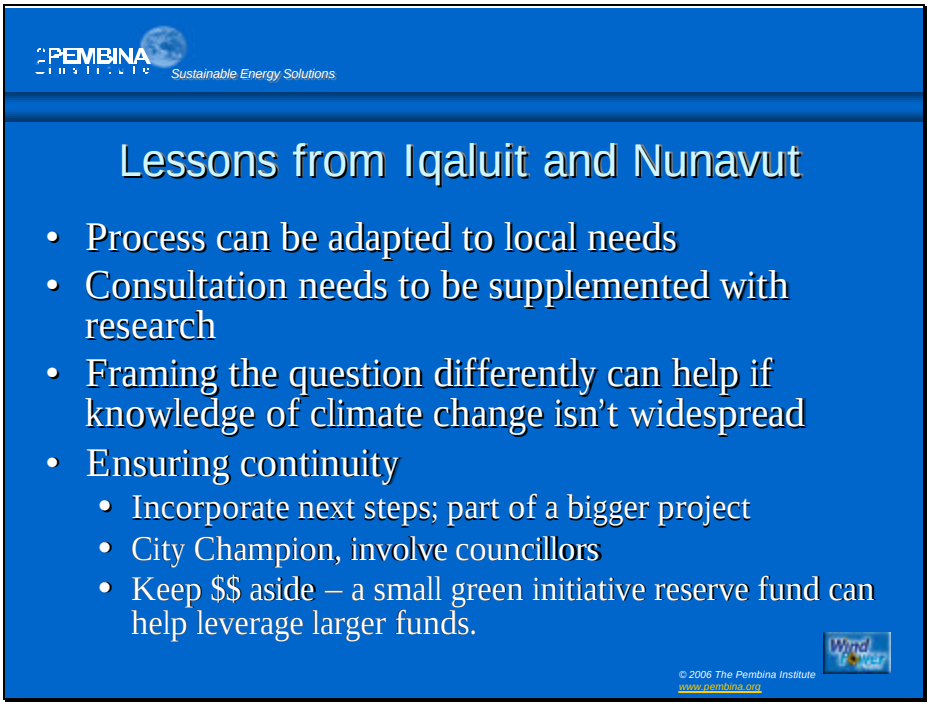

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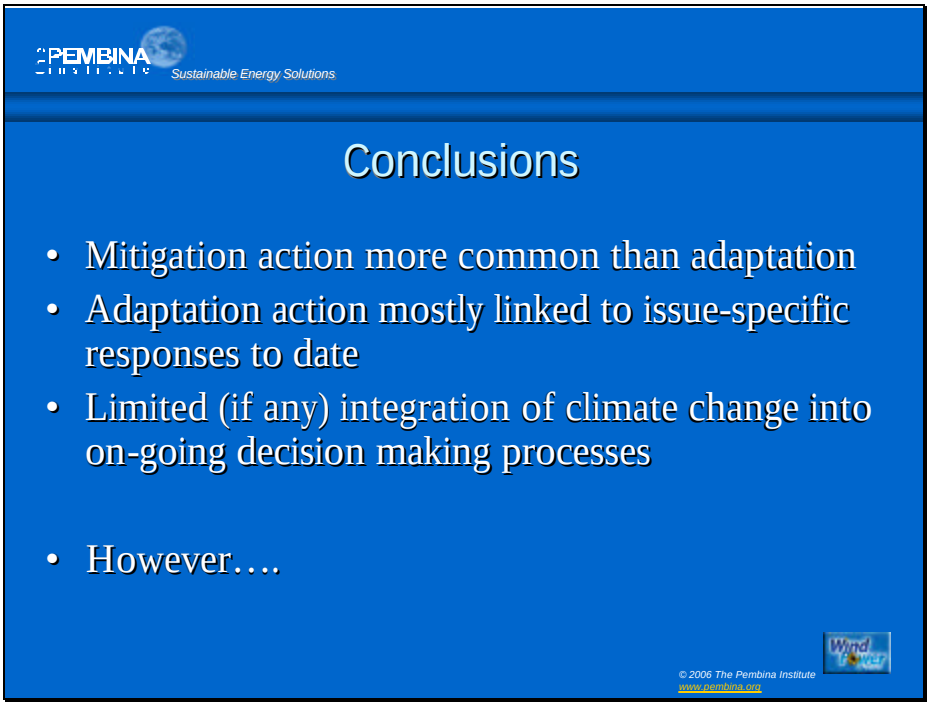

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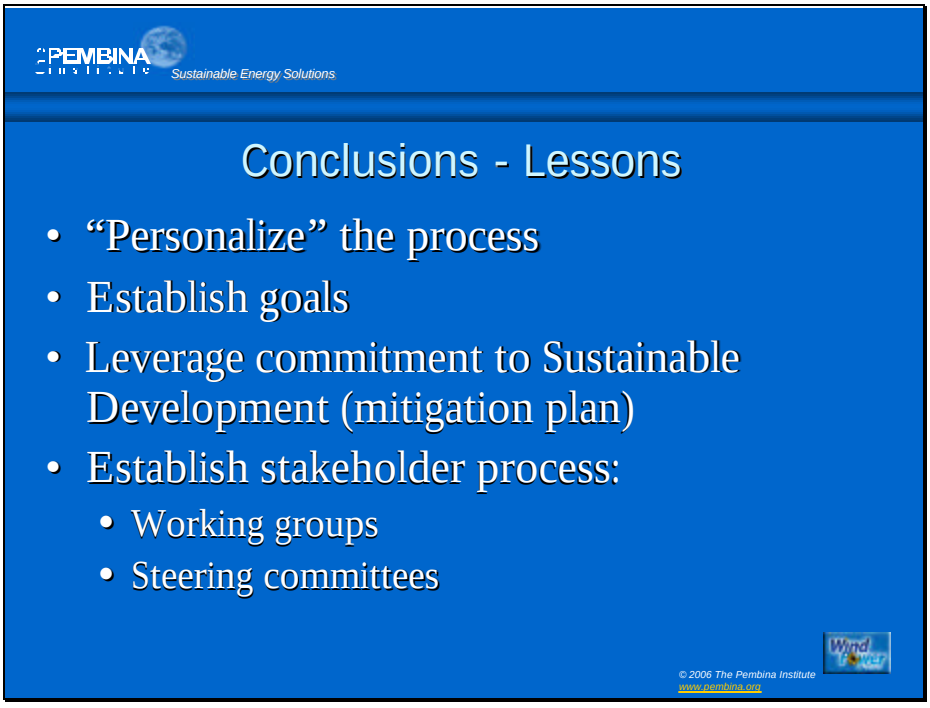

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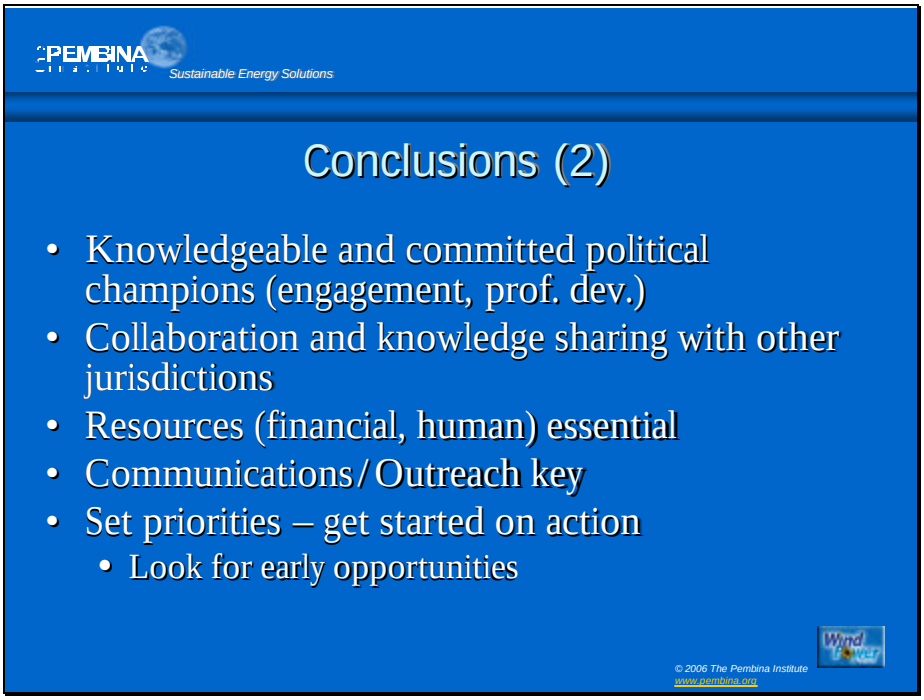

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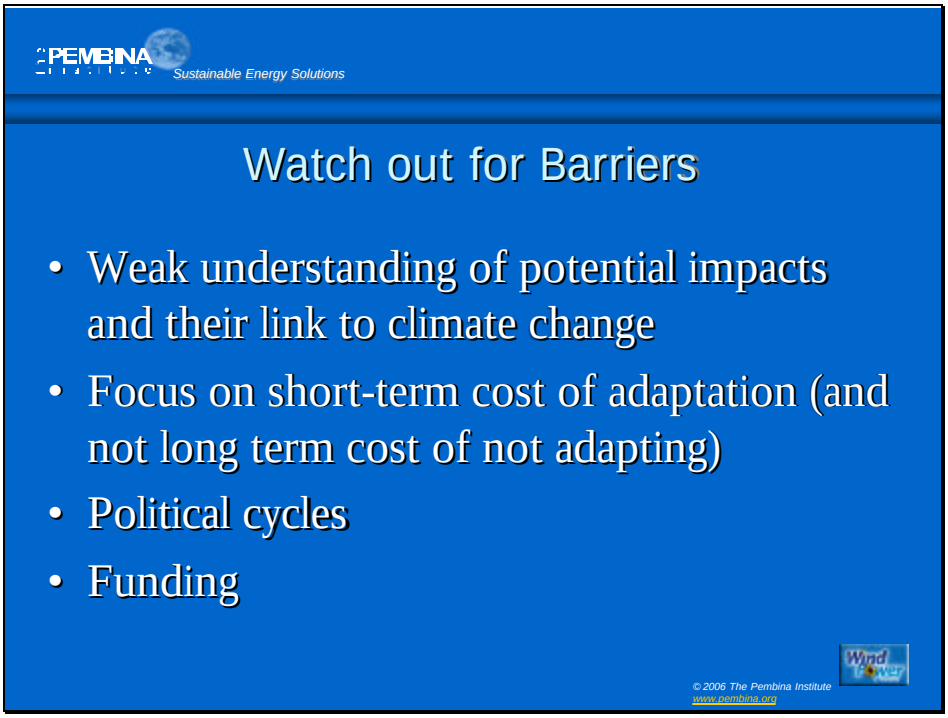

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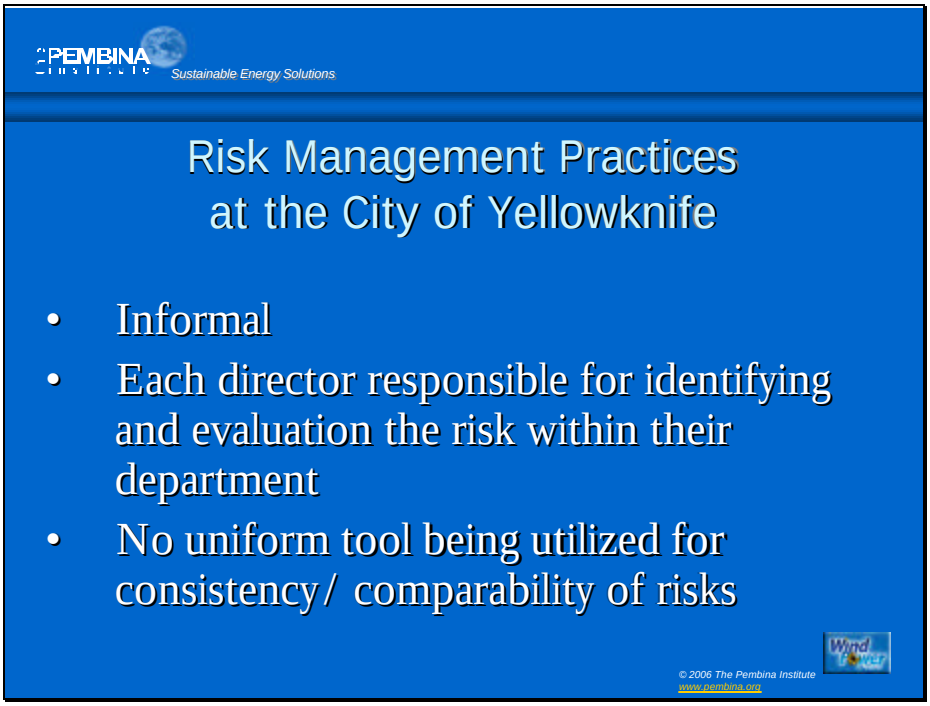

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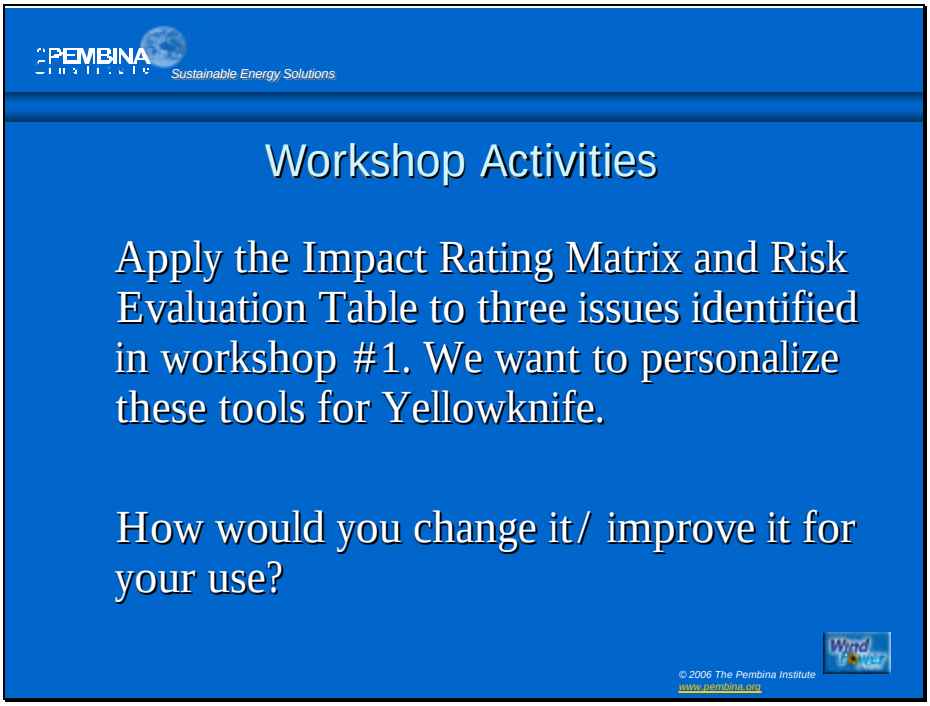

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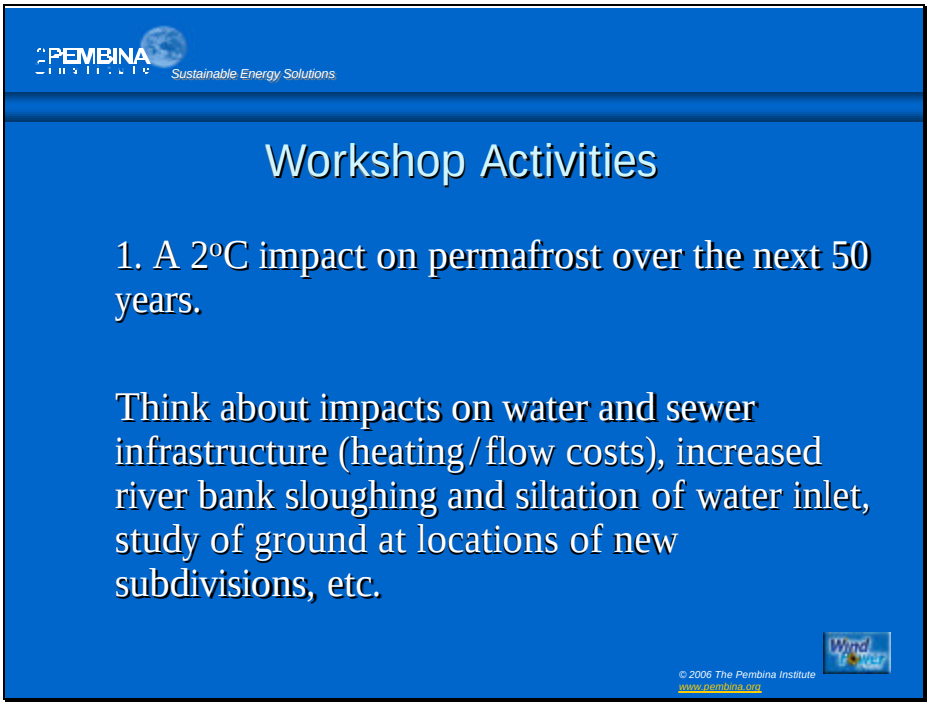

the PEMBINA institute

Sustainable Energy Solutions

Creating a More Resilient Yellowknife: Climate Change Impacts & Municipal Decision Making

Report of Workshop #3: Decision Making Triggers & Implementation

Tuesday April 10th, 1pm-5pm,
Downstairs Boardroom, Yellowknife City Hall

Submitted by Jake Pryor, Director Sustainable Municipalities
Submitted to Mark Henry, Energy Co-ordinator, City of Yellowknife

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Appendix A

Presentation slides.

1. Backgrounder & Summary

Community resiliency to the impacts of climate change requires the development of adaptation strategies that reduce the risks to community resources and infrastructure. By pro-actively increasing the coping capacity of community systems, the risk of these impacts on the community can be reduced to an acceptable level.

Building adaptive capacity involves the identification of future climate change impacts, assessing the vulnerability of community resources and infrastructure, and putting in place the decision making process to address them proactively. Funded by Indian and Northern Affairs Canada, this project aims to build adaptive capacity within the governance and administration of this northern community.

This report summarizes the results of the second of 3 workshops with City of Yellowknife elected officials, administration and stakeholder representatives to develop the tools to address emerging climate change impacts. The process of the workshops is as follows:

Workshop #1: Climate Change Impacts & Current Response Capacity
Objective: Create a common understanding of climate change adaptation and what it means for Yellowknife. Engage participants in identifying climate change impacts and how to improve the City's response to impacts.

Workshop #2: Building Capacity - Risk Assessment, Decision Making and Strategic Application
Objective: Develop risk assessment and decision making criteria, structure, and model for Yellowknife. Identify how to strategically leverage its application to add value to other planning processes.

Workshop #3: Decision Making Triggers & Implementation (revised)
Objective: Content of workshop 3 was revised to ensure the overall objectives of the process were achieved and maximum value obtained for participants (see Sections 4 & 7).

It should be noted that the City of Yellowknife is already actively engaged in climate change *mitigation* measures with the implementation phase of its Community Energy Plan. These climate change *mitigations* and *adaptations* compliment each other by creating a holistic approach to protecting community assets by reducing the risk of significant impacts. *Mitigations* (reducing greenhouse gas emissions) essentially aim to reduce the degree and duration of climate change impacts by reducing our contributions of atmospheric greenhouse gases, and hence the resultant changes in climate. *Adaptation* aims to insulate our community systems from the climate change impacts we now know are now likely to occur despite our efforts to mitigate further.

Summary of Findings for Workshop #3

Decision making triggers that flag the need for climate change adaptation to be considered fall into two categories:

1. The revision of plans and policy tools that provide the formalization of climate change adaptation in decision-making. This would include high level planning documents like the General Plan, by-laws, design standards, tenders and building codes.
2. Project specific approvals for a wide range of planning and engineering projects where the future climate will affect the lifecycle, maintenance or safety of infrastructure or facility.

The opportunities for incorporating adaptation into new policies and practices to ensure adaptation is given appropriate significance in decision-making reflected the ideas cited above.

1. Participants recognized the limitations of revising key planning documents with already established review periods (e.g. the general Plan), but pressed for *ad hoc* revision of existing implementation tools to integrate adaptation into current practices in a more timely fashion (e.g. tender process, building by-law).
2. Participants recognized the need for more prescriptive local standards and codes (over and above established national standards) to achieve an acceptable level of risk.

Key areas where ongoing support is needed for implementation were identified.

- Resource constraints that will challenge financial sustainability
- As an ongoing process, adaptation should have its own budget line in the municipal operating budget
- Public buy-in will be key to implementation (political support)
- Process needs to be streamlined into existing tools to be 'good enough'.
- An intuitively prioritized schedule for reviewing design standards etc needs to be established.

The degree of agreement amongst the participants was the defining success of this workshop. The common understanding and capacity developed amongst the stakeholders during the entire workshop process was evident in the unity of support for issues identified.

2. Workshop #3 Objectives:

i) Identify the core elements of an accountability framework to ensure climate change risks and adaptation are considered in all relevant municipal decision-making.
ii) Foster momentum and conditions for continued commitment to stakeholder collaboration on adaptation.

3. Desired Outputs:

1. A list of types of municipal decisions that should require consideration of climate change risks.
2. A list of opportunities for incorporating new policies and practices that will ensure the risk management tool is used.
3. Identify the need for ongoing support for implementing the tools.

4. Workshop #3 Agenda

Note: The agenda for workshop #3 also included a page title 'Perspectives on Workshop #2' intended to give participants some additional clarity on the direction the workshops were going. The text and agenda are included on the following pages.

Perspectives on Workshop #2

Thank you for dedicating the time and energy to workshop #2. The level of engagement and recommendations for improvement to the suggested risk management tool were invaluable. Working through the necessary changes can be challenging, but the value of undertaking the process was evident in the sophistication of the discussion by the end of the afternoon.

Unfortunately we didn't get through the whole agenda, which left a few people wondering how the tool would be applied. To help explain this, I have summarized our progress and tasks for workshop #3 below. I hope this helps everyone understand how I am being responsive to the workshop feedback while achieving the objectives of the project.

Workshop #3 will focus on items 6 and 7. If we have time, we can discuss item #8, but I suspect the answer to this will become self-evident as we work through the process.

1. Examine the historical climate data and scenarios projected for Yellowknife's climate in the future [Done - Workshop #1]

2. Identify the climate change impacts that have been observed or are expected as a result [Done - Workshop #1]

3. Examine the strengths of historical responses to these impacts and identify opportunities for improvement [Done - Workshop #1]

4. Review case studies from other jurisdictions [Done - Workshop #2]

5. Develop a risk management support tool that would allow climate change risks to be evaluated to determine appropriate action [Done - Workshop #2]

6. Identify what kinds of decisions at the municipal level should require a consideration of these risks [Workshop #3]

7. Identify and recommend the policies and practices that need to be put in place to ensure that the risk management tool is referred to when these decisions need to be made [Workshop #3]

8. Identify the need and sources of continuing support for ongoing implementation [Workshop #3 or follow-up]

The intent is for the risk management tool to create a library of information that will help inform future decisions that should take into account climate change impact risks, and drive action on critical items. New policies and practices will determine when and how that information is used and by who.

Creating a More Resilient Yellowknife:
Climate Change Adaptation & Municipal Decision Making

Workshop #3: Decision Making Triggers & Implementation
Tuesday April 10th, 1pm-5pm, Downstairs Boardroom, Yellowknife City Hall

Objectives:

- Identify the core elements of an accountability framework to ensure climate change risks and adaptation are considered in all relevant municipal decision-making.
- Foster momentum and conditions for continued commitment to stakeholder collaboration on adaptation.

Desired Outputs:

1. A list of types of municipal decisions that should require consideration of climate change risks.
2. A list of opportunities for incorporating new policies and practices that will ensure the risk management tool is used.
3. Identify the need for ongoing support for implementing the tools.

Agenda

1pm	Welcome & Introductions Review of workshop #2 and the revised risk management tool.
1.30pm	Workshop Activities to Address Key Questions • When should climate change impacts and adaptation be considered in municipal decision making? • What constitutes appropriate significance?
3.15pm	• What policies and practices are necessary to ensure appropriate significance? • What ongoing support is needed for implementing the tools?
4.15pm	Summary of workshops
4.45pm	Next steps / project reporting and recommendations.
5pm	Wrap up.

5. Workshop Attendees

The following individuals were present for all or part of the workshop session:

- Gordon Van Tighem, Mayor
- Paul Falvo, Councillor
- Kevin Kennedy, Councillor
- David Wind, Councillor
- Dave Devana, Director, Corporate Services
- Jeffrey Humble, Director, Planning & Lands
- Greg Kehoe, Director, Public Works
- Mark Henry, Energy Coordinator
- Craig Scott, Climate Change Programs, GNWT
- Eleanor Young, Ministry of Municipal and Community Affairs, GNWT
- Aleta Fowler, Indian & Northern Affairs Canada
- Jake Pryor, Facilitator, Pembina Institute

Regrets:

- Dennis Marchiori
- Dennis Althouse, Superintendent, Operations & Maintenance, Public Works
- Mark Heyck, Councillor
- Grant White, Director, Community Services
- Shelagh Montgomery, Councillor
- Shirley Cook, Dene First Nation
- Peter Neugebauer, Director, Economic Development
- Dennis Kefalas – Manager, Public Works
- Doug Ritchie, Executive Director, Ecology North
- Greg Cousineau, Transportation, GNWT

6. Record of Proceedings

1pm Welcome & Introductions

The facilitator presented a review of Workshop #2 and the revised risk management tool to ensure the suggested improvements were accurately recorded and provide clarity on the direction the process would take from this point forward.

1.30pm Workshop Activities to Address Key Questions

Participants self-organized into groups of 4-5 to answer each of the following questions. Participants largely remained in the same groups throughout the afternoon with some participants having to leave and later return after attending to other meetings. In each case the groups discussed the question and wrote short answers on flip charts. After 20-30 minutes discussion on a question, the facilitator collected up the responses, and a 10 minute plenary followed were they were discussed. This plenary session gave everyone opportunity to learn from the suggestions of others and add any remaining thoughts. A synthesized summary of participants' sentiments follows, along with the raw responses.

Q1. When should climate change impacts and adaptation be considered in municipal decision making?

Participants developed a recognition of the far reaching implications of climate change impacts and adaptation on a wide range of decisions. The nature of these decisions ranged from the approval and funding of major capital projects, to the review and revision of key planning documents and policy tools for more systemic implementation. The budgetary implications of many of these decisions is huge, especially where durable infrastructure is at issue. The Yellowknife General Plan (2004) was identified as being a key document that relies on a 30 year historical average climate as a basis for future decision making, and not accounting for a different climate future. The recently completed Infrastructure Deficit Plan upon which the city bases its infrastructure maintenance and replacement budget did not consider the impacts of climate change on that infrastructure either. This is not a criticism of the way the City of Yellowknife has developed these plans, but rather a striking indication of the new and evolving discipline of climate change adaptation. The infrequency of review of many municipal plans will limit aggressive adaptation to 'issue specific plans' for significant weather events rather than foster wholesale integration into municipal decision-making.

Raw responses:

- Review of the General Plan
- Land acquisition and development schemes
- Land use zoning
- Building by-laws
- Long term capital plan

- Water and sewer infrastructure projects
- Roads maintenance planning and network design
- Drainage lift stations
- Landfill and sewage lagoon
- Engineering standards for all of the above.
- Water treatment and sewer provision
- Technology availability, labor and training issues
- Land development decisions
- Transportation planning
- Emergency planning
- Capital budget project prioritization
- Budget criteria & tender process
- Insurance & risk management decisions
- Financial eligibility for projects
- Review of codes and standards
- Anything affected by climate
- Buildings – bylaws
- Capital decisions – infrastructure and buildings (city)
- Infrastructure and facility maintenance planning
- Lands planning – subdivisions, roads, machinery, utilities
- Recreation & tourism
- Winter power failure
- Forest fire risk – summer
- Regulation reviews/ updates (building bylaws, land use zoning, emergency response plans)

Q2. What constitutes 'appropriate significance'?

The facilitator gave a short presentation providing suggested guidelines for determining whether appropriate significance had been given to climate change adaptation in decision making. These included consideration of the following questions. Does the decision:

1. Limit present day or future climate change adaptation options? (Limit climate change 'headroom'?)
2. Affect the ability of other decision makers to manage the consequences of climate change?
3. Address the climate change risks identified by positively increasing coping capacity?

A discussion followed that highlighted the need for this significance to still be weighed against other factors affecting a decision. These three questions aim to ensure the decision makers are aware of the consequences of a course of action with respect to climate change. Even then, the decision may still not be made in their favor, but the rationale will be transparent, and the decision makers will be accountable for how they decide.

3pm BREAK

3.15pm Workshop Activities to Address Key Questions (Cont.)

Q3. What policies and practices are necessary to ensure appropriate significance?

The review of by-laws, design standards and building codes gives some formal teeth to any revisions made to planning tools. It was recognized that the General Plan is not due for review until at least 2009, delaying any wholesale consideration of climate change. It is therefore important to prioritize the review of policy tools to maximize the opportunities for *ad hoc* integration of climate change adaptation until such time that high level planning documents are revised. Once this is achieved, the door will open to more aggressive and timely integration in all implementation tools that are in place to support the General Plan.

Some progressive ideas were shared including the consideration of natural capital in decision making, building relationships with insurers to provide incentives for pro-active adaptation design (public facilities and private buildings) and providing a climate forecast (scenario) universally acceptable by key stakeholders upon which to base coordinated responses.

Raw responses:

- Strong planning tools: 5 year review of the General Plan
- Ongoing reviews of land use zoning, Building By-law, SMART Growth Redevelopment Plan
- Develop standards based on risk – current standards are in place but do not consider climate risks, e.g. water treatment, sewage treatment, engineering standards for roadways, water/sewer and facilities.
- Develop procurement & budget policies – could be ad-hoc by memo to council
- Overarching policy on climate change
- Communication tools for Council and all staff to become aware of the issues
- Documentation of decision making (for accountability and future learning)
- Progressive leadership engaging other agencies
- Periodic evaluation of overall policy and individual projects
- Long-term planning criteria
- Maintenance of risk management library
- Updating the climate forecast
- Natural capital decision-making
- Consideration of climate change in all city decisions
- Access to best practices
- Memos to council with risk management library attached

- Climate change procedures manual
- Interdepartmental review of reports and projects
- Public marketing (use of risk management library)
- More prescriptive local standards (higher standard than national)
- Develop relationship with insurers to get breaks for better designed buildings (public and private)

Q4. What ongoing support is needed for implementing the tools?

This question was addressed in a plenary format to encourage the feeding of ideas. A number of key issues arose that were common concerns. The agreement between stakeholders on these issues demonstrated the value of the workshop process in that a common understanding and basis for progress had been established.

- There are resource constraints that will challenge the financial sustainability of this adaptation process
- This is an ongoing process and so should have its own budget line in the municipal operating budget
- Public buy-in is essential. The City of Yellowknife may need external support for this
- We must be able to streamline this process into existing tools to be 'good enough'.
- An intuitively prioritized schedule for reviewing design standards etc needs to be established.

The facilitator discussed the scope of this project and the support available from the Pembina Institute to assist in the implementation of recommendations resulting from this project.

4pm Summary of workshops

The facilitator gave a short presentation showing just how much had been achieved during the short 3 afternoons of meetings with participants. During that time, participants had:

- Reviewed past historical and future climate scenarios for Yellowknife
- Undertaken a high level scoping of anticipated future impacts
- Reviewed responses to climate change impacts to date and identified opportunities for improvement
- Reviewed case studies from other jurisdictions
- Introduced risk management and evaluation tools, applied the tool to anticipated future impacts, and revised them for Yellowknife's needs
- Identified when climate change impacts should be considered in municipal decision making
- Identified where policy and practices need to be revised to include climate change impacts in these decisions

- Reviewed the workshop process and what to expect from the project report

The energy and motivation brought by participants to the workshops facilitated a great deal of learning and capacity building within a short space of time. This was evident from the scores logged by participants on the project feedback forms (see Section 8).

4.30pm Next steps / project reporting and recommendations.

The facilitator suggested that the final project report should be complete by the end of May 2007. The report will include further research beyond that shared during the workshops and provide recommendations for implementation of the tools into municipal decision-making.

4.45pm Wrap up.

Participants were thanked for their ongoing engagement in the process and invited to complete workshop evaluation forms.

7. Facilitators Observations

Time spent up-front reviewing workshop #2 and clarifying the direction of the process restored focus to the workshops. However, the agenda for Workshop #3 had to be changed to accommodate some tasks not completed in Workshop #2. This was a function of the limited contact time available with participants and the complex nature of the issues at hand. The result was that the initial objectives of this last workshop were met as collective spirit developed in the room. Comments from participants included; "Very useful to have Council and Administration in the same room", and "Admin were a bit of a mystery to me until now."

The workshop experience and time dedicated to these tasks have furnished participants with a consistent and rational approach to addressing climate change risks. As ambassadors for adaptation, Yellowknife has a strong team of elected officials and professionals whose shared experience of the workshops will strengthen their responses immeasurably. While not all participants will choose the same path (this was never the intent of the project), they now all progress from some key common ground and shared understand of the significance of the issues and how best to consider their solutions.

8. Workshop Evaluations

At the end of a workshop, participants were invited to complete a workshop evaluation form. Ten forms were returned completed. Participants were asked to rate the following aspects of Workshop #3 from 1 to 5, with 1 being 'very unsatisfied' and 5 being 'very satisfied'. The average scores for each aspect of the workshop is shown below.

Degree of organization	4.3
Workshop materials	3.9
Clarity of presentation	3.9
Workshop pace	3.35
Breakout groups	3.9
Plenary discussions	3.78
Quality of facilitation	4.2
Confidence in the outcomes/ progress	4.0

Written responses to the remaining questions are summarized below.

Q. Did the workshop meet its objective?

"Yes"
"?"
"So far, so good"

"I believe so"
"Generally the objectives appear to have been achieved, although it is not exactly clear what the next steps of Admin/ Council will be"
"OK"
"Yes, well organized"
'I think so"
"Too soon to tell"
"Yes"

Q. What was the most valuable part of this workshop for you?

"Candid discussion on climate change and getting administrations views on how some of these ideas are implemented"
"Valuable to have council and administration and other government folks in the same room devoted to this topic"
"Interaction of Council, admin & 'outside'"
"Sharing of info between differing backgrounds"
"Confirmation of climate change issues & discussions"
"Learning about risk assessment"
"The distinction between climate adaptation and prevention/ mitigation requires a shift in mindset and the exercises demonstrated the need for planning, strategy and implementing a climate adaptation approach"
"Mix of participants good"
"Learning about potential climate change impacts. Working through the risk model. Talking about implementation ideas"

Q. What aspects of the workshop would you have changed?

"More time to participate –my schedule not a working (?) schedule"
"Very process heavy – especially workshop #2. Could have benefited by first discussing concepts further with admin so more finely homed when brought to group"
"More written materials? More advance notice of meeting times"
"Needed more guidance for breakout groups"
"Can't think of anything"
"More background material/ case studies"
"More pre-workshop material may help"

Q. Any additional comments?

"Good facilitation for a vague and evolving issue. Hope to bring a lot of lessons from this to GNWT. Looking forward to the report"
"Perhaps inclusion of further invited participants. Group is biased towards bureaucrats – some 'on the ground' people might be good?"
"Well done – thanks!"
"Thank you"
"Need to quantify most probable future based on climate change threats and impacts to get buy-in from Council, staff and public. Key component to success"
"Great facilitator"

Page 2 of the evaluation asked participants to evaluate the impact of the workshops on their understanding of climate change adaptation and ability to address the issues. Participants were asked to circle a number to rate their personal evaluation of what they gained from these workshops. From 1 (Strongly disagree) to 5 (strongly agree).

Compared to before the project started. . . . . .

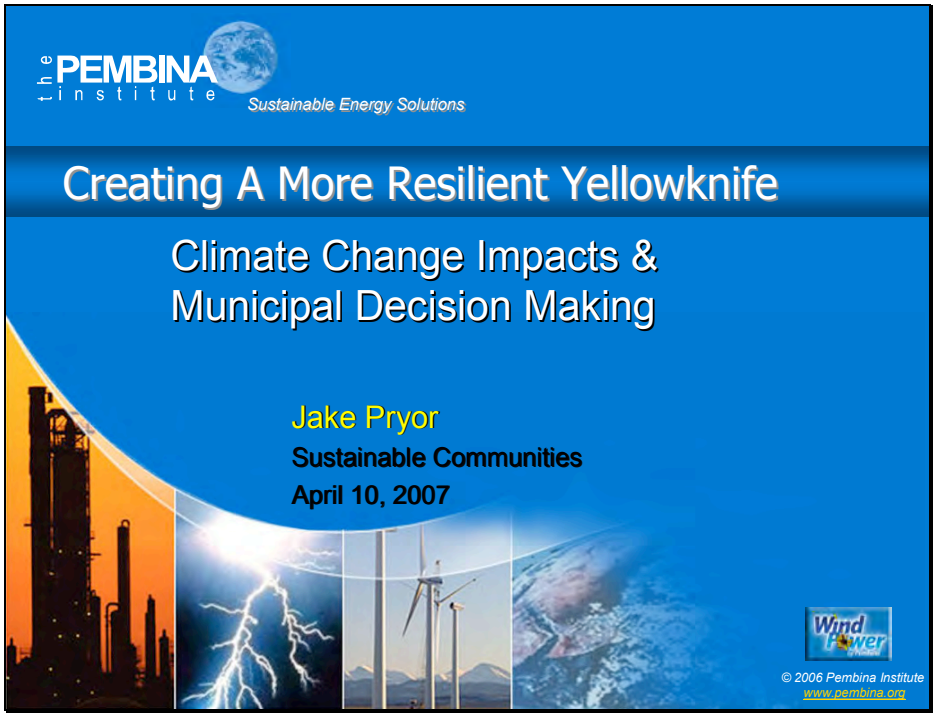
You have a better understanding of Yellowknife's climate and climate change impacts	(4.0)
Your knowledge of climate change adaptation approaches, their value and limitations has increased	(4.0)
You know when to include adaptation issues in decision-making	(3.9)
You have a better understanding of what questions to ask when faced with such a decisions	(3.8)
Your understanding of risk management tools has increased	(3.9)
You feel the tools the project will provide will be effective in incorporating climate change adaptation into municipal decision-making	(4.1)
Your overall ability to address adaptation has improved	(3.9)
You feel the group workshops have provided some valuable common ground for participants	(4.5)
You are confident of keeping adaptation on the 'agenda'	(4.1)

Any additional comments?

"Looking forward to final report & next steps"
"Climate change although new, is not something that existing public policies tools are incapable of handling. The key issue is flagging this issue as one that needs more attention"
"Thanks for the healthy snacks

Appendix A: Presentation Slides

Slide 1



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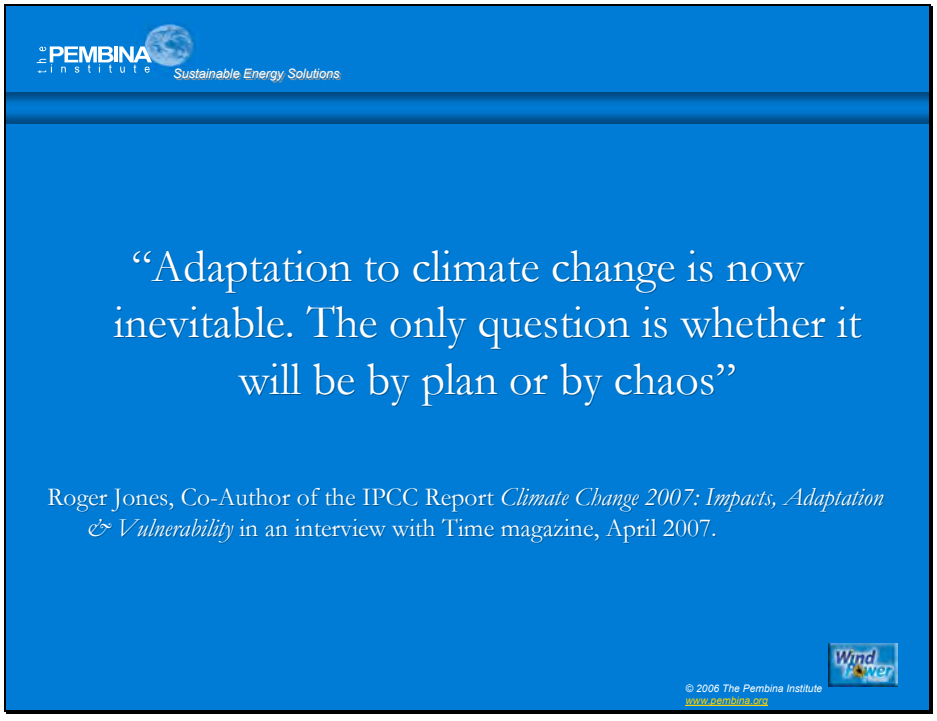

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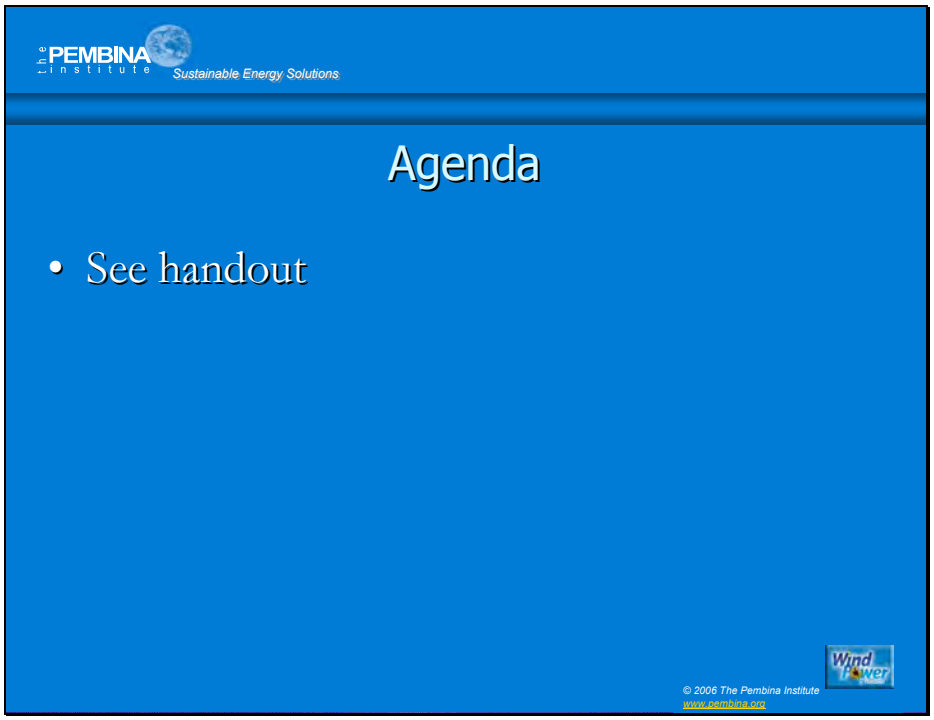

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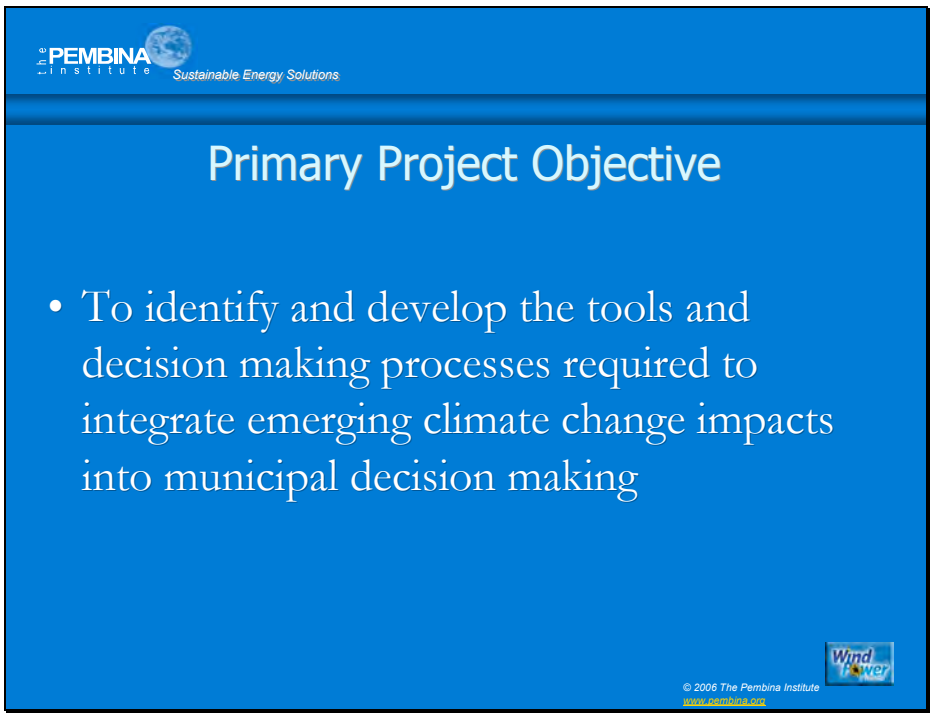

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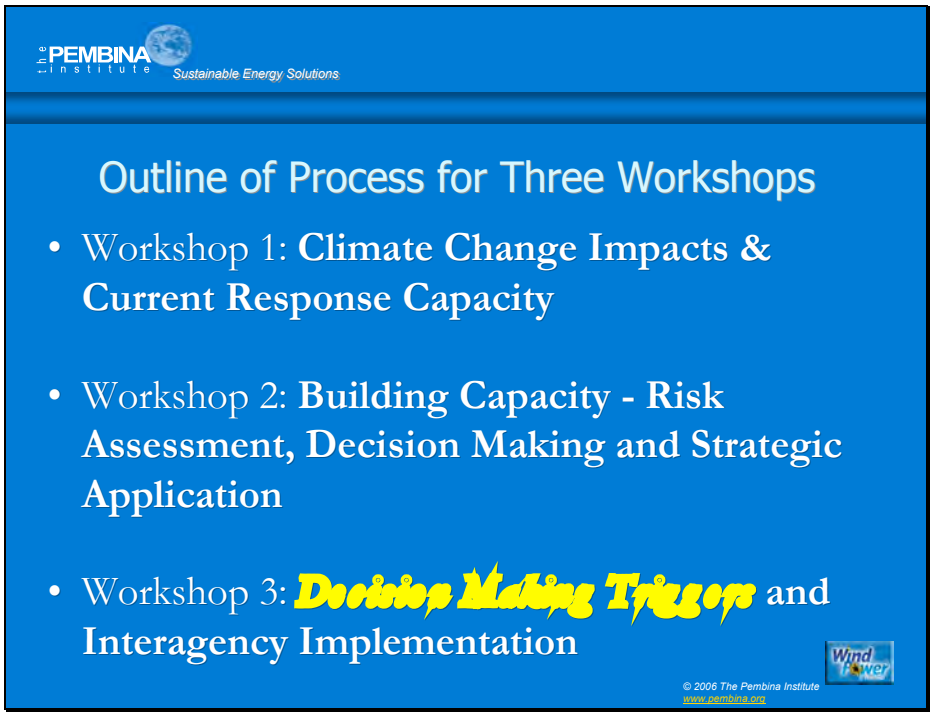

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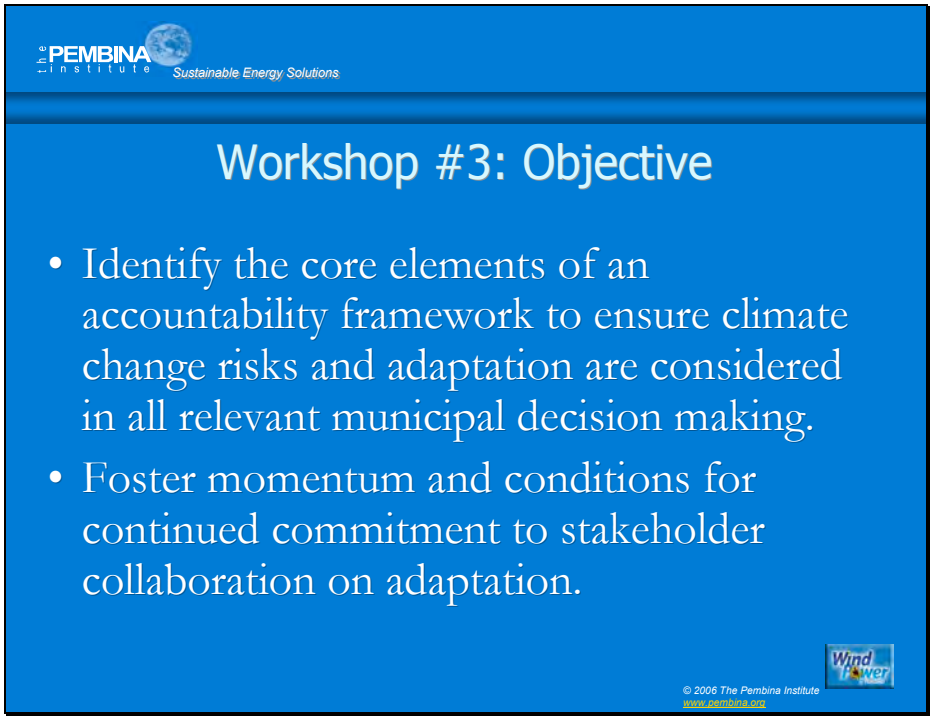

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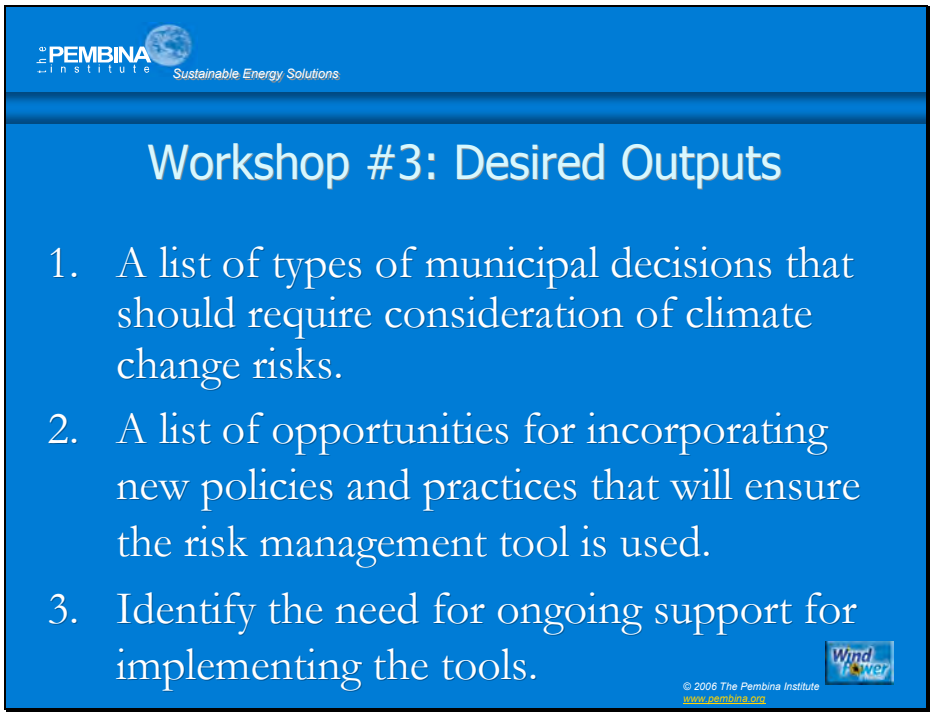

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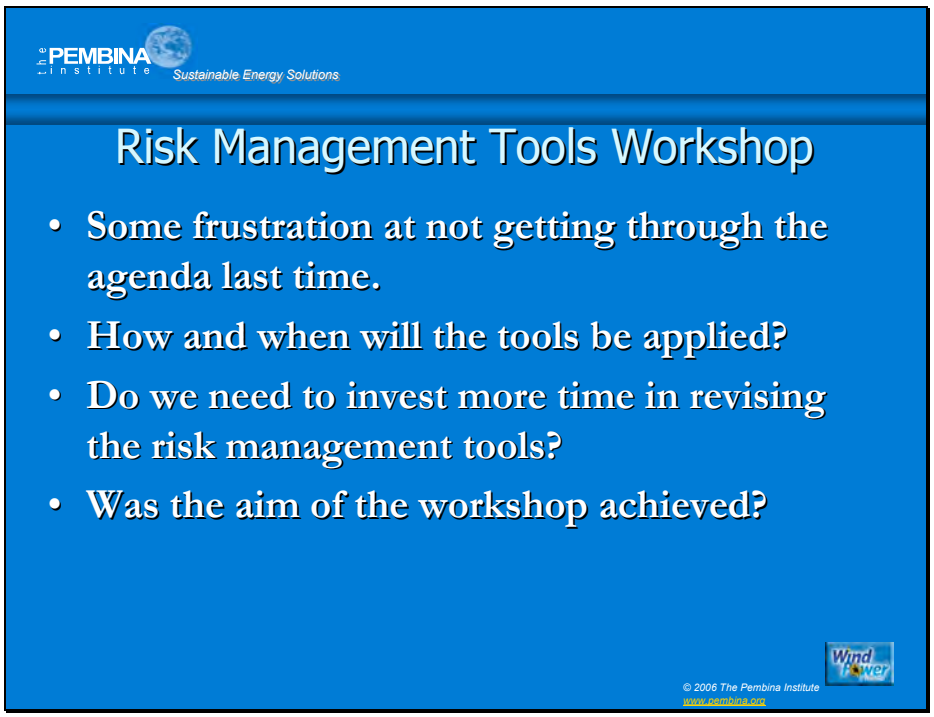

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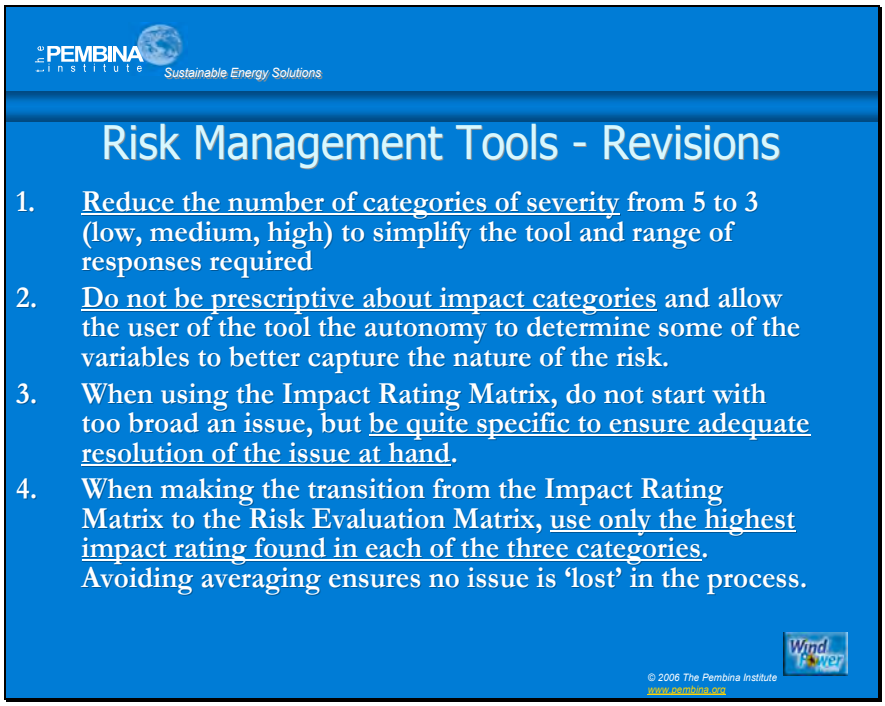

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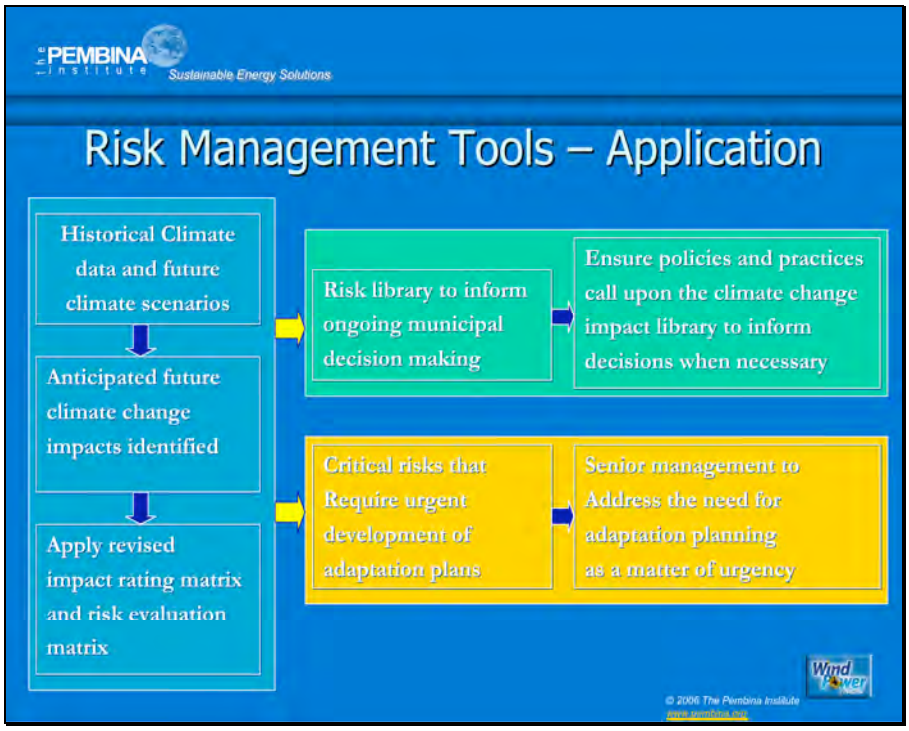

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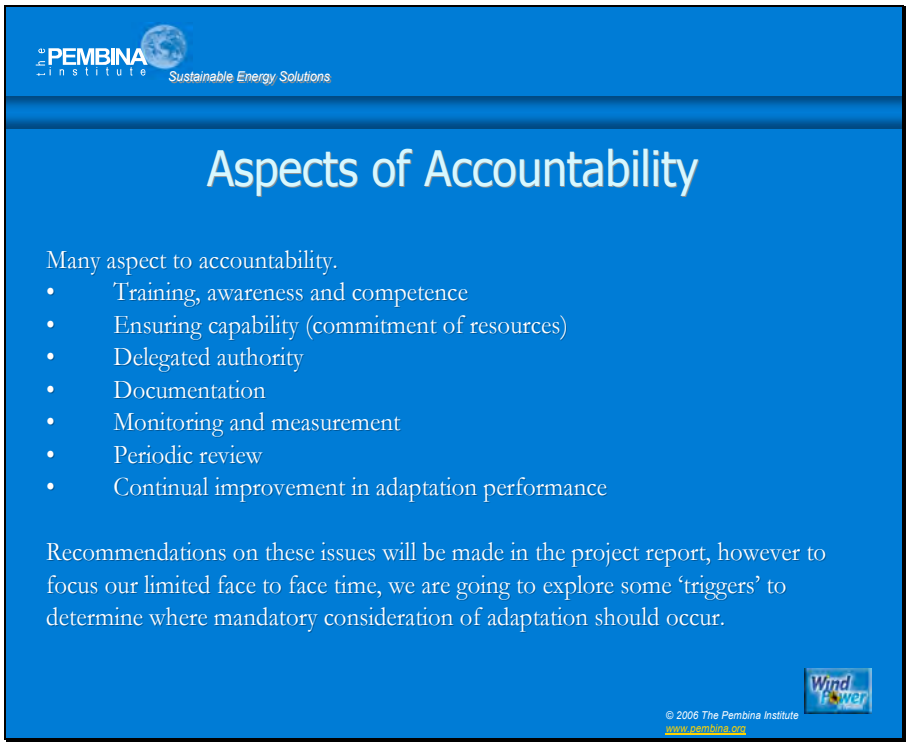

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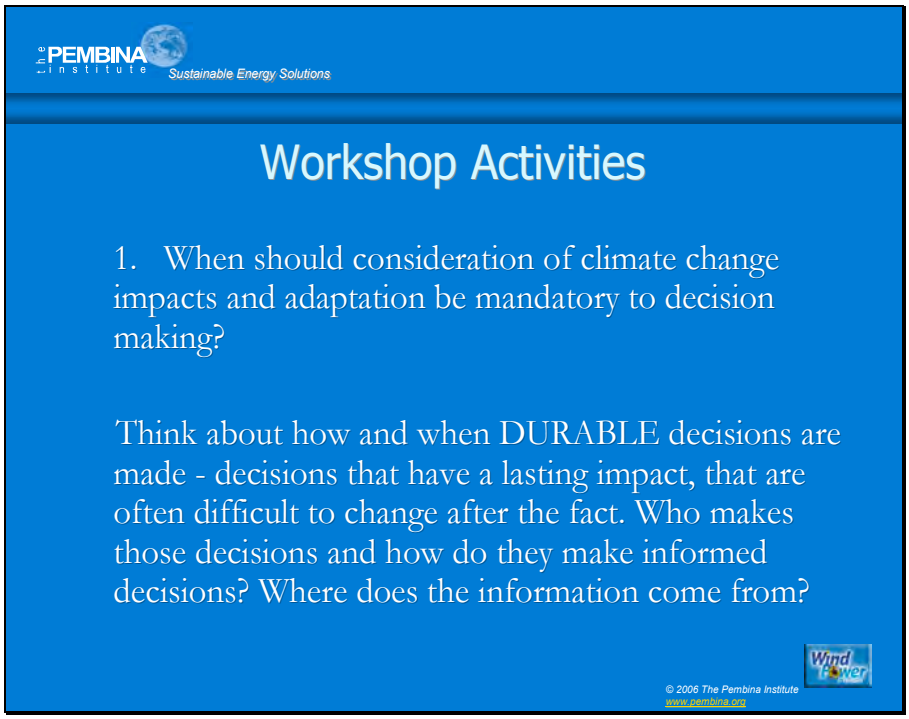

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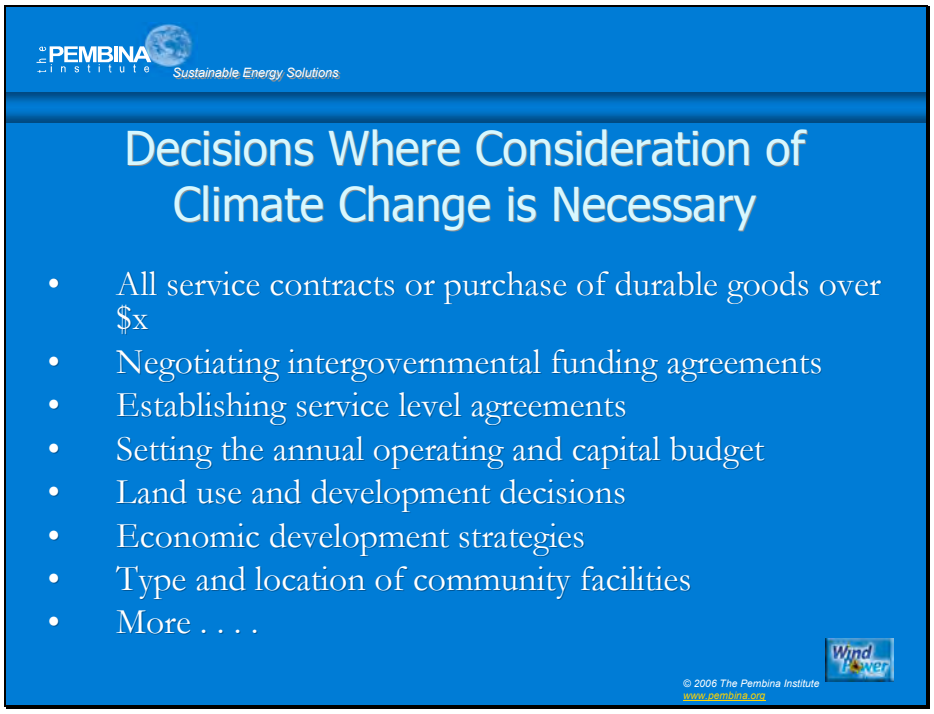

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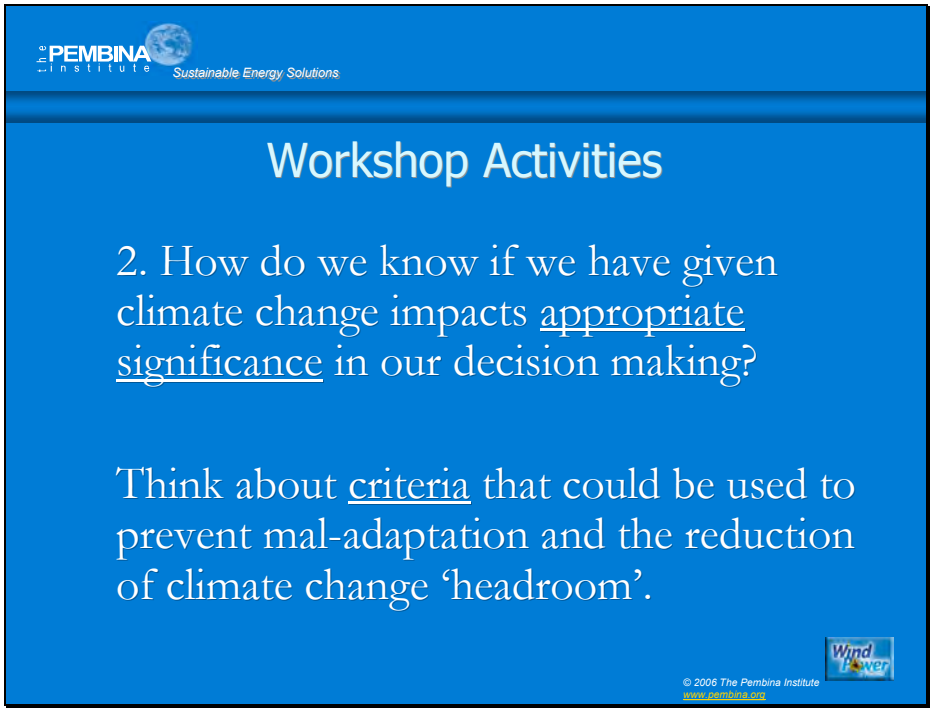

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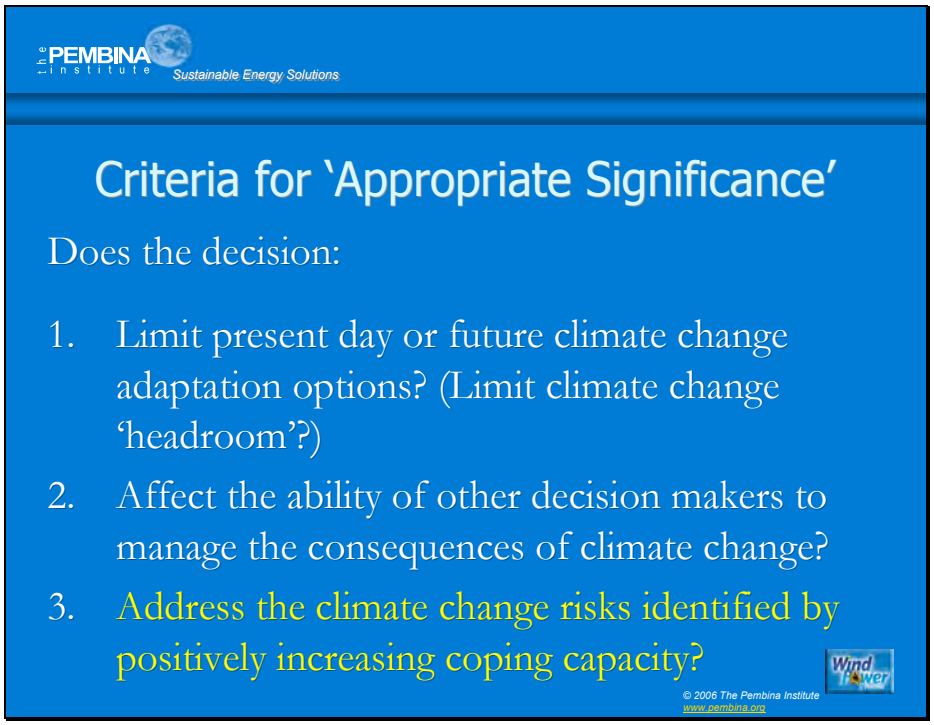

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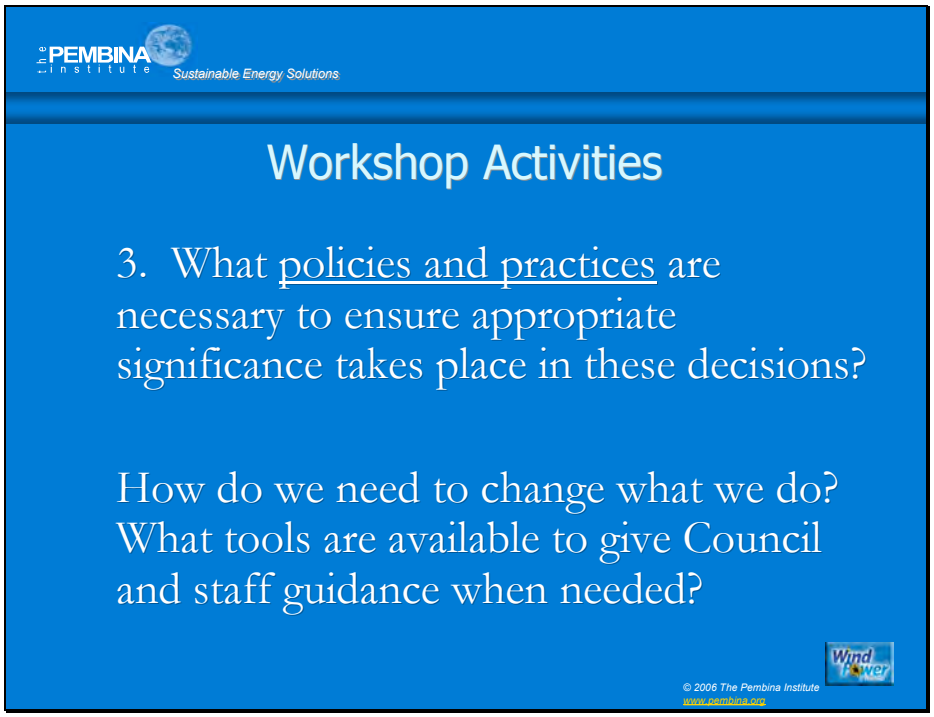

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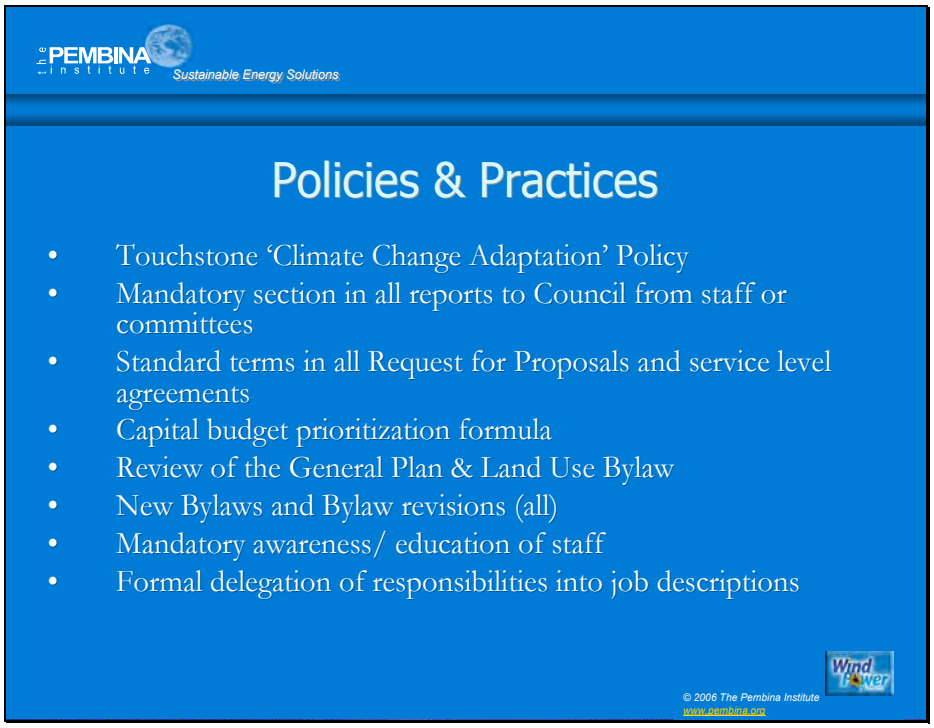

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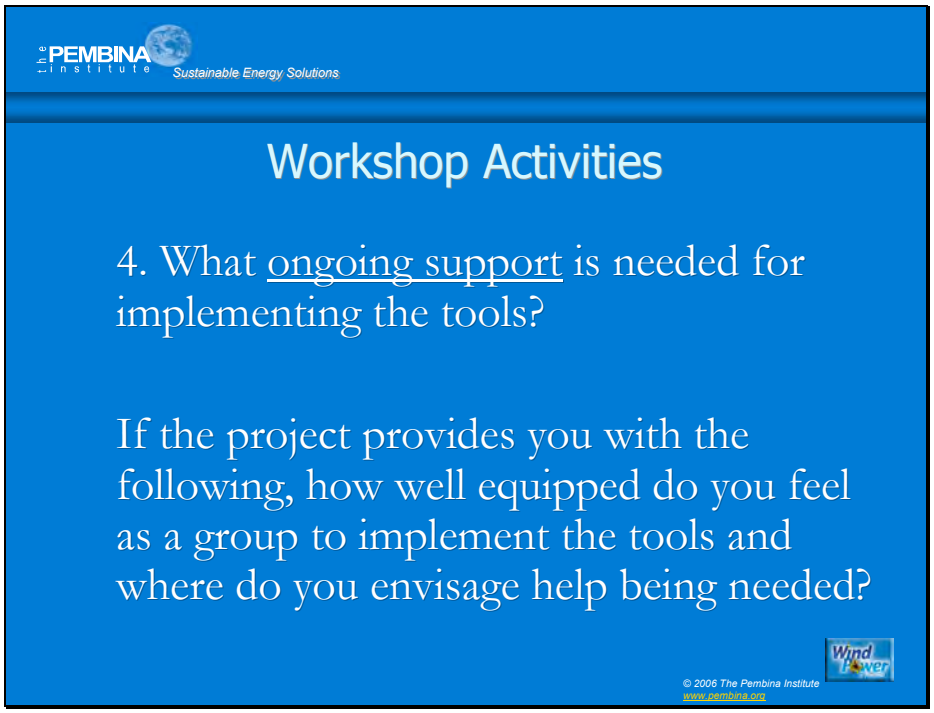

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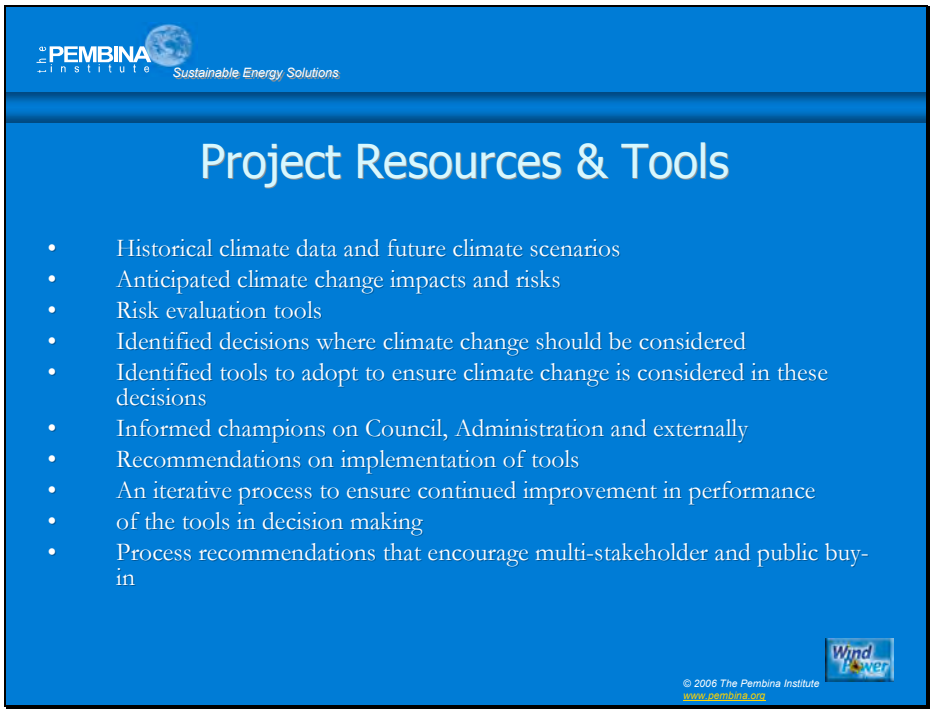

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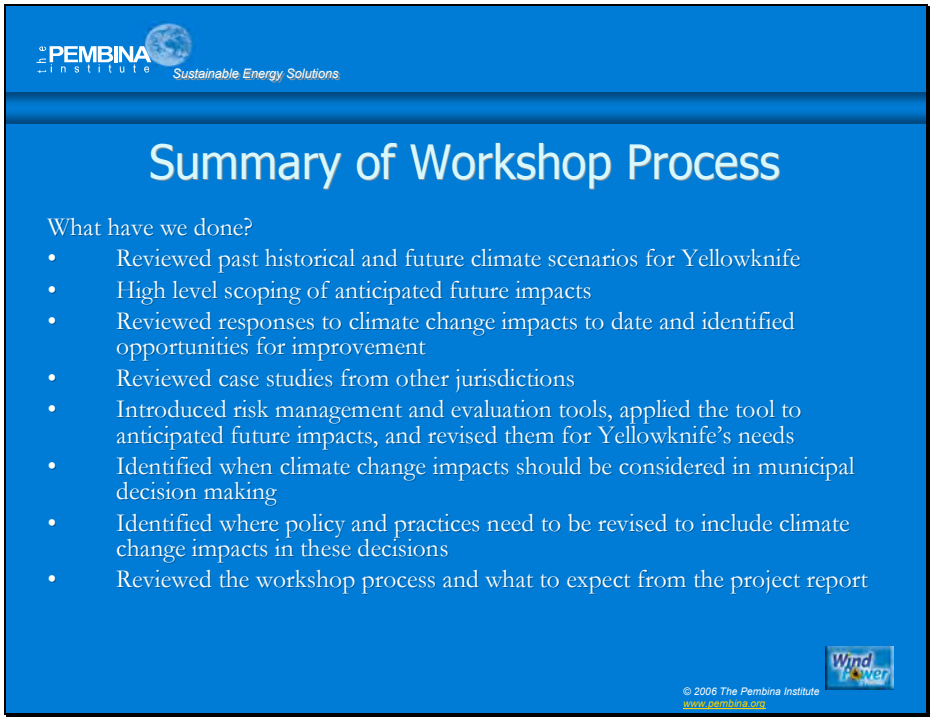

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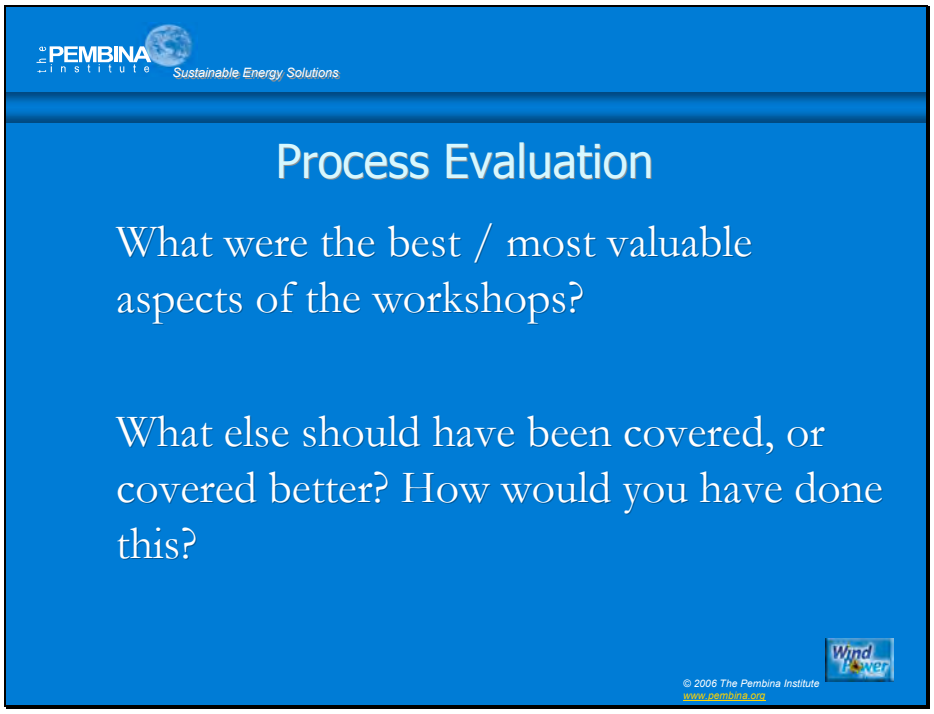

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