Scenarios

STFPP Research Report # 6

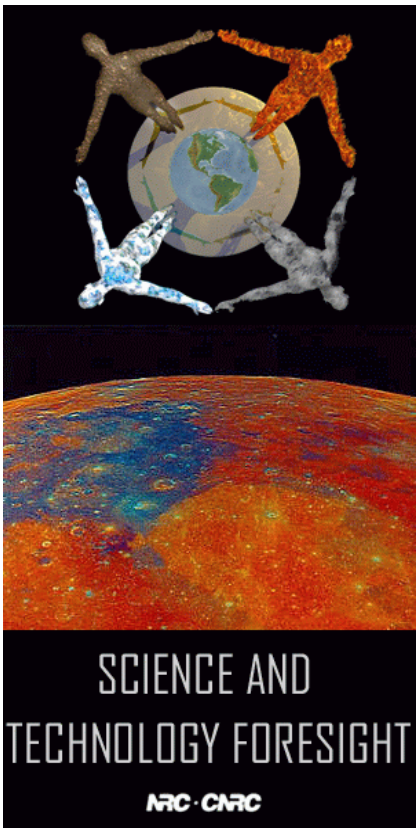
Science and Technology Foresight
Pilot Project

A Research Report of the Science and Technology Foresight Pilot Project:
A Partnership of Federal S&T Organizations

Scenarios

Looking Ahead to 2025

(Process and Outcomes of the STFPP Scenarios Workshop held March 19-20, 2003)



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Science & Technology Foresight Pilot Project
Research Report

June 2003

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Sponsoring Departments and Agencies

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FOREWORD

This research report is part of a series of several reports that have been produced for the benefit of sponsors, participants and professionals interested in how emerging and prospective developments in global science and technology might impact Canada's future.

The Science and Technology Foresight Pilot Project originated with a proposal made by NRC to the community of federal Science Based Departments and Agencies in March 2002, offering NRC's support for a collaborative pilot project to explore the application of foresight tools. Goals of the pilot project were to help stimulate longer term thinking, and to build shared R&D awareness and capacity for engaging broad challenges for which the federal S&T community should be better prepared.

Thirteen federal Departments and Agencies joined together to create a limited duration (i.e. six months) partnership that sponsored 20 events and at least 30 meetings. The partners and their colleague networks of scientists and industry-academic collaborators contributed over 400 days of professional time to developing the Project's methodology, panel and workshop events and in drafting and reviewing the Science and Technology Foresight Pilot Project findings.

It is useful to recall the definition of S&T Foresight that was used to define the scope and focus for this Pilot Project:

> *S&T Foresight involves systematic attempts to look into the longer-term future of science and technology, and their potential impacts on society, with a view to identifying the emerging change factors, and the source areas of scientific research and technological development likely to influence change and yield the greatest economic, environmental and social benefits during the next 10-25 years.*

S&T Foresight is necessarily speculative, creative and analytical simultaneously because it must rely both on the interpretation of S&T change drivers and on how and when these could become significant factors in Canada's prospective social, economic, and political realities. Since these are highly uncertain, foresight is inherently about attempting to understand, dimension and reduce or at least prepare for significant risks.

The following statement has been used to caution foresight participants and stakeholders not to take these reports as fact or prediction. They represent collaborative research that was conducted primarily for learning purposes, with the understanding that if a strong consensus emerged regarding possible application of insights to an actual funding program, then these domains might eventually warrant inclusion in one or more future S&T funding initiatives.

The approach we are taking relies upon consulting a wide range of expertise, with the expectation that through our collective experience, imaginative abilities and interactive knowledge of technological development pathways, we can begin to construct a coherent view of ***some of the major developments that can be anticipated within a 10-25 year time horizon.*** *Foresight is therefore research which can inform the reality of planning, policy and strategic choice amidst uncertainty. This is the nature of foresight - creating a range of plausible future elements that in their diversity should alert readers to the kinds of issues and perspectives they may not have initially considered in longer term research planning and contingency thinking.* ***Accordingly, this report reflects the combined views of the participants, and the best wisdom and creative thinking that we could stimulate with the tools of foresight****, but it clearly does not represent an official view of the Government of Canada or any of its Departments and or Agencies.*

Jack Smith
Leader, Science and Technology Foresight Pilot Project
May 2003

INTRODUCTION

Table of Contents

Background and Acknowledgments

This report summarizes the process and outcomes of the NRC Scenarios Workshop, held March 19-20, 2003 at NRC's Sussex Drive Laboratories in Ottawa. The workshop was the culminating event in the Science and Technology Foresight Pilot Project, which took place from October 2002 to April 2003 and is explained in other reports from the NRC Office of Technology Foresight.

Our goals in this workshop were twofold:

- First, we aimed to create a set of well-grounded yet thought-provoking scenarios - integrating the knowledge, experience, and imagination of our diverse attendees. As a flexible policy planning tool, scenarios encourage the realistic development of contingent future situations.
- Second, we designed a process to encourage participants to move from their constructed scenarios toward defining a set of R&D and policy implications for Canada today.

These are challenging goals insofar as they call for the scenario builders to not only draw upon their imaginative and creative abilities, but also to be analytical and evaluative in linking scenarios back to the present - to derive implications showing how policy, R&D, and economic factors may not be providing sufficient flexibility to meet plausible future conditions.

In this report, you will find a section covering each of the 10 scenarios that attendees worked on. This represents our synthesis of hundreds of pages worth of raw source material generated by our enthusiastic participants. In total, close to 90 well-qualified volunteers participated.

Based on the individual group analyses, we have developed specific opportunities for R&D investment and collaboration, primarily but not limited to a federal S&T perspective. We also suggest prospective investments in future Foresight activities, informed by lessons learned from our pilot workshop.

We would like to acknowledge all the sponsoring government departments and agencies, as well as the individual participants who contributed to making the Scenarios Workshop 2003 a success. Their enthusiasm, insight, and willingness to think outside the box was crucial to generating informed scenarios and R&D and policy implications. Organizations and individual participants who consented to be identified are listed in an appendix.

Finally - a good way to digest this work is to consider the diversity of the scenarios as representing the areas of uncertainty which may have to be planned for. Sometimes in scenario construction and analysis, the best insights are those which are within several scenarios, in potentially varying ways - these can signify robust contingencies that should be anticipated or prepared for through R&D.

A BRIEF PRIMER ON SCENARIOS

by Arden Brummell, Global Business Network Canada (brummell@gbncanada.org)

What, When, Why, and How?

> *Few companies today would say they are happy with the way they plan for an increasingly fluid and turbulent business environment. Traditional planning was based on forecasts ...*
>
> *Forecasts are not always wrong; more often than not, they can be reasonably accurate. And that is what makes them so dangerous. They are usually constructed on the assumption that tomorrow's world will be much like today's. ..*
>
> *(The problem is) in anticipating major shifts in the business environment ... the way to solve this problem is not to look for better forecasts ... the right forecast. The future is no longer stable; it has become a moving target...*
>
> *The better approach, I believe, is to accept uncertainty, try to understand it, and make it part of your reasoning. Uncertainty today is not just an occasional, temporary deviation from a reasonable predictability; it is a basic structural feature of the business environment.*
>
> Pierre Wack
> "Scenarios: Uncharted Waters Ahead"

What Are Scenarios?

Scenarios are creative (and by necessity simplified) descriptions of complex environments. They are stories, images or maps of the future. They are internally consistent stories describing paths from the present to a future time horizon. Good scenarios are rooted in the past and present: they provide an interpretation of past and present events projected into the future.

The key focus of scenarios is uncertainty. The objective is to identify the major uncertainties affecting the strategic decisions facing organizations - to chart the waters ahead so that the consequences of today's decisions can be played out, evaluated and tested against the uncertainty of the future.

That is the logic. The reality is more subtle. Again quoting from Pierre Wack:

> *"Scenarios help managers structure uncertainty when (1) they are based on a sound analysis of reality, and (2) they change the decision makers' assumptions about how the world works ... their mental model of reality."*

The objective is to expand the envelope of our thinking, to expand the limits of our mental maps of the future. In that respect the process of scenario development is as important as the final product. And the more people involved in the process, the greater is the impact.

Scenario Characteristics

Scenarios may be very broad or very focused. They may emphasize long term trends or the dynamics of key variables over time. They may explore key themes or ranges. But in strategic planning exercises there are five common characteristics of scenarios worth noting.

1) **Multiple Views**: Scenarios always involve more than one view of the future. That is their explicit objective. A single view is a forecast. Good scenarios often develop different logics of how the world works. For example, one scenario may be based on the primacy of market forces; another might emphasize social or political forces.

2) **Qualitative Change**: Scenarios are most appropriate when dealing with complex, highly uncertain situations in which qualitative, non-quantifiable forces are at work. Social values or technological change, which can lead to major structural change, are examples.

3) **Objective**: In business settings, the objective is to describe what could happen, not what we want to happen. Objectivity also requires that scenarios be internally consistent and feasible. If scenarios are viewed as impossible or not feasible, then they are rejected. The challenge is to broaden our thinking without trespassing into the unbelievable.

4) **Open-Ended**: Scenarios are stories. They do not provide precise details. Challenging and engaging scenarios allow the reader to add details which bring the scenarios alive, and permit them to extrapolate to other examples beyond the bare description.

5) **Relevant**: Scenarios must be relevant to the situation at hand. They must highlight the uncertainties and driving forces relevant to strategic decisions facing an organization or country.

When Are Scenarios Most Useful?

Scenarios are most useful when the external environment is complex and uncertain and the internal decisions involve major long term investment or have long term consequences. Complex environments typically involve non-quantifiable factors, where structural change is a component of the uncertainty and where systems have complicated feedback loops. Increasingly, systems thinking, which recognizes how behavior within systems can lead to unanticipated feedback, is an important part of scenario thinking.

For situations in which most of the variables are known and quantifiable, scenarios as described here are not very useful. Similarly, for decisions with relatively short term outcomes or involving modest investments, scenarios are usually not appropriate.

Why Scenarios?

As Pierre Wack indicated in the opening quote, scenarios are an approach to thinking about the future that focuses on key uncertainties facing managers in making strategic decisions. Scenarios are a means to an end, not an end in themselves. Developing scenarios involves taking a wealth of information about the past and present, identifying patterns, and structuring coherent stories of the future. An organization can then use the scenarios to think through their strategic options.

The value of scenarios involves two parts: the value of the product and the value of the process.

Scenarios:

- provide coherent "mental maps of the future"
- make explicit key assumptions
- force consideration of alternative futures
- provide context for developing and testing strategic options
- increase awareness of the broader environment
- provide a vehicle for communication
- highlight uncertainty and risk in decision-making

The Process:

- encourages strategic and systems thinking
- provides a forum for sharing views from all parts of an organization
- allows unconventional views and new ideas to surface
- stimulates communication
- encourages learning and adaptation to change

In sum, scenarios provide insight. And while the process is designed to produce scenarios, learning in the process may be more valuable than the specific scenarios developed.

> *"The evolutionary race goes to the adaptable, not to the well adapted; to those who can learn, not to those who know."*
>
> Kenneth Boulding

Characteristics of Good Scenarios

Since scenarios are not predictions, how do you evaluate whether they are "good" or "bad"? The criteria are largely subjective, but relate to the characteristics and objectives of scenarios. Good scenarios are:

1. **Plausible**: Are the scenarios believable?
2. **Grounded**: Are the scenarios linked to events in the past and present?
3. **Challenging**: Do the scenarios challenge our thinking? Do they expand our mental maps?
4. **Relevant**: Do the scenarios throw light on important strategic issues facing us?
5. **Internally consistent**: Are there contradictions in the logic or outcomes within a scenario?

And the greatest of these is: Do the scenarios challenge our concepts of the future and lead us to "the right question"?

> *"The only relevant discussions about the future are those where we succeed in shifting the question from whether something will happen to what would we do if it did happen"*
>
> Arie de Geus

FROM 2003 TO 2025 AND BACK - IN 2 DAYS

A Reporter's View of the NRC Scenarios Workshop

by Lynelle Spring and Catherine Morrison

If someone with X-ray vision had looked into the National Research Council's historic Sussex Drive building anytime during March 19 and 20 this spring (2003), they would have seen representatives of Canada's scientific human capital hard at work - as well as some of the most creative futures-oriented thinking being done in this country at the moment.

On those two blustery wet days, more than 80 scientists, policy analysts and experts in foresight techniques from across the country and the United States assembled in Ottawa. They came to take part in a technology foresight scenarios-building workshop that would cap off a six-month federal Science and Technology Foresight Pilot Project.

The Science and Technology Foresight Pilot Project had been launched several months earlier when Dr. Arthur Carty, President of the NRC, "offered to establish a pilot project to explore the potential application of foresight techniques to longer term collaborative S&T-innovation building capacity within the federal Science Based Departments and Agencies".

Prior to the March Scenarios Workshop, over 200 individuals - a majority from the federal government science-based departments and agencies, as well as many university and industry representatives - had been involved in the work of 10 scoping and technical panels (which produced two topic-specific synthesis reports), a web conference, monthly meetings of the Interdepartmental Working Group, and ongoing weekly work by the Project Team.

The Scenario-Building Process

The goal of the Scenarios Workshop, as set out in the *Workshop Workbook,* was "to create a set of well-grounded yet thought-provoking scenarios, integrating the knowledge, experience, and imagination of our diverse attendees. We are laying the groundwork for establishing long-term technology foresight capability in Canada."

Scenarios creation is a tool that is being used increasingly by both private and public sector organizations around the world, as a support tool for strategizing about the future. The Foresight Scenarios process was influenced by two scenarios exercises in particular.

In the early 1990s, the scenarios methodology was used in South Africa to bring together disparate interests to develop storylines about how the future of South Africa might unfold. Led by a Canadian expert in scenario-based strategic planning, Adam Kahane, the Mont Fleur project (as it came to be known) was instrumental in assisting South Africa's modernization efforts and supporting the shift to majority rule by avoiding consequences that were identified through the scenarios process.

In 1999, under the U.S.-based Proteus project, experts from academe and industry, from civil, environmental, and law enforcement agencies, and from several U.S. Intelligence Community

organizations were brought together. They were tasked to develop scenarios for "problem spaces" that the US might face in 2020, which in turn could be used to help develop an advanced research strategy.

Principles and methodology from both those exercises were used to construct the intensive two-day scenarios-building event entitled *Science and Technology Foresight - Looking Ahead to 2025*.

Setting the Stage

Imagine an experiment. Imagine a small theater filled with 80 bright, creative, and possibly skeptical leaders from science and business organizations. Imagine that those accomplished individuals have agreed to come together to peer into the future using a new - and largely untested - methodology. And now, imagine that you are standing in front of that confident, sharp, eager and possibly cynical audience charged with the responsibility of both framing their enquiry and stimulating their creativity. You need to turn this set of individuals into teams that will challenge, think and cooperate so that in two short days you have harnessed their collective training and experience. Two short days to extract and formulate the creative concepts of 80 minds.

That was the task of the Foresight Team organizers, Jack Smith, Glen Milne and Don Simpson in the plenary session that kicked off the two day event. Here's how they approached it.

Jack Smith, Leader of the Office of Technology Foresight, set the stage by linking the current challenges for the project to the successful Mont Fleur Scenarios undertaken by the Global Business Network in 1991-92. (Jack is the Project Leader and Senior Corporate Strategist for NRC. His last assignment was leading the NRC Vision 2006 team.)

In Canada, the value of the Foresight process is being tested as a contributor to future policy development. No borders have been set for the range of uses of the data, but benefits are already apparent in the blooming of new linkages and networks within the participant community, for the creation of bridges across disciplines and for the richness of the ideas that are generated.

Bearing the innovative title of *Process Architect, Glen Milne* outlined a process that would place individuals with an appropriate mix of disciplines and experiences into groups to explore each of the scenarios. He urged the groups to trust their intuition, treasure new ideas and build on each other's strengths - all within a demanding framework of 12 structured sessions that would require organized thinking, significant outputs, and public presentations at the end of each day. (Glen is an architect and policy facilitator who has worked in the Trudeau PMO, and consulted widely within the federal government, NGO sector, and business on future strategies.)

Clearly, this wasn't going to be a walk in the park for the volunteer participants…Here's a summary of the expectations:

> "Come together, instantly build a team, meet your facilitator, take turns as a recorder, be an active participant, be creative, be respectful, share ideas freely with others during the meal times and "networking sessions", and with your new team members, write, produce and present your ideas to your peers at the end of each day. And while you do

this… have fun… although remember that it is a competitive process and there will be prizes awarded."

While the energy and eagerness in the room was still evident, at the end of Glen's outline, there was no disguising the anxious glances and nervous laughter from some audience members.

There is no such thing as a free lunch, and *Don Simpson's* challenge was to place the needs of the client front and center. As the imaginary *Undersecretary to Cabinet* and keeper of the Planning and Priorities Committee, he would represent both authority and accountability - and the final product of each group's work - a Memorandum to Cabinet - would be presented to him at the end of the process. (Don is a former Director of the Centre for International Business at the Ivey School, University of Western Ontario, and is currently head of the Innovation Expedition. He is the architect of the Challenge Dialogue - a tool for collaborative strategy development.)

While acknowledging the "game and fantasy" elements of the workshop, he emphasized the seriousness of the process by linking innovation and creativity to survival. He charged participants with developing a report to Cabinet that would outline a pathway to the scenario being presented. What decisions taken in 2003 and beyond would lead to the scenario presented? What decisions should *not* be taken, to avoid negative scenarios? What policy and R&D recommendations are offered to get Canada ready for the conditions of the team's envisioned future?

He urged the participants to accept that the world is both complex and ambiguous, and to understand that stability is not the best defense against anxiety. Encouraging them to give their ideas free rein, he said, "Scenario planning is not about certainty, but about imagining real possibilities. Bring us your possibilities."

There was brief applause from the group, and then a rush to the doors. It was a big job, and participants were anxious to get started.

Reflections on Day One

9:00 a.m. Day 2. Participants are trickling in to the auditorium for the plenary session, *"Reflections on Day One"*. There is the usual knot of workaholics crowded in the lobby outside, giving frantic last-minute instructions to subordinates and colleagues back at the office. And there is evidence that at least one goal of the Foresight exercise is already achieved… it's clear from the buzz in the room. Several knots of people are chatting animatedly. A few are whispering more intimately, and a couple of loud cheerful bantering comments are tossed across the room. It seems a day of forced intimacy, shared anxiety and collective creativity have already forged some new relationships.

Meanwhile, down on the stage, the Foresight Team is huddled in intense discussion. Last minute negotiations are taking place on what worked - or didn't - yesterday. Proposals for remedial changes to the groups or the structure are debated.

9:10 a.m. Jack Smith steps up to the mike, choosing to start the day with words of praise and encouragement.

"Good morning, and thank you all for coming back for Day Two. From what I saw yesterday, we are already well on our way to our goals for this project, and let me remind you again of the five outcomes we hope to achieve:

1. We want a robust list of research, technology and policy ideas to help enable government to explore future collaborative opportunities.
2. We want rich stories - scenarios - that can help form the framework for future discussions.
3. We want integrative policy thinking - it is useful to think beyond the boundaries of your home organization.
4. We want to develop networks among communities that will cross disciplinary and mission boundaries.
5. And we want to further develop the practice and exploration of tools for technology foresight."

A round of further introductions reveals some audience celebrities… including Jerome Glenn of the United Nations University, who offers a modest and brief outline of his global think tank effort, the *Millennium Project*. After a quick plug for his new CD on futures research, Dr. Glenn yields the floor to Glen Milne.

Glen's task is to re-focus the participants back to the work at hand. The Foresight Team's end-of-day analysis the night before had brought out some anxieties regarding perceived unevenness in the group results. Some were forging ahead, "on-time, under budget" and meeting the targets set out in the workshop structure. Others were less focused and seemed to be challenged by internal dynamics. Glen needed to address ambiguity in the process, and provide encouragement to pull a couple of the teams back on course to deliver a usable end product.

"Today's challenge," he began, "is integration." You have taken the scenarios as given and fleshed them out to further develop your worlds to the year 2025. You should have your sector technologies and policies in place, and we hope you have given some serious thought to the implications for Canada. Now," he said, looking over his glasses at the rows above him, "is where the rubber hits the road. How did we get here? And what are we going to do about it?"

He quickly walked through the day's exercises… "Back-casting" - taking the future vision created the day before, and working backward to the present day to infer key actions and technologies that contributed to the team's scenario. Thinking through the R&D policy implications - identifying the how and what of policy and technological development that would be necessary to create the vision. "Don't be afraid to be dramatic - scour your stickies and boards to find patterns. Borrow shamelessly from other groups," he counseled.

As a final incentive, he outlined the award categories for the Scenario Presentations:

Best Scenario
Most Proactive Scenario
Most Entertaining Presentation
Best Interview

"There is a reason for these valuable prizes," he smiled. "Nothing like a competition to sharpen focus."

Don Simpson, the "Undersecretary to Cabinet", stood up amidst the laughter following Glen's comments.

"There is an old Sufi proverb" he said, "It goes like this… Said father to double-seeing son, 'Son, you are seeing double'. The son replied, 'Father, if that were true there would be four moons, not two'."

"I tell you this today, because I want to challenge all of you to see differently in this process… to force your minds beyond your customary categories and to make new categories… Let's not suffer from hardening of the categories," he added.

Don noted that yesterday's work had taken different forms in each group… and that some groups had drilled down into the scenario while others had exploded the concept and reconstructed it. He challenged the groups to continue to make quick, quality team decisions while continuing to defend individual contributions and ideas. "Innovation is not just a set of ideas, but ideas put to work to successfully improve performance."

He noted that each of the three scenario types had engendered some discomfort reactions. The "beautiful people" scenarios had some folks worried that they were focusing too strongly on those people who have the resources to protect themselves, and ignoring the "have nots". The "disaster scenarios" were downright uncomfortable for some… especially when they came to seem too plausible or real. And even the "idealistic scenarios" seemed too far-fetched, prompting some participants to push for more realism.

"Bring your ideas to your group, share them and grow them. Employ systems thinking, collaboration and trust, and we might just produce scenarios that have value and meaning," he said. "I urge you to take your Report to Cabinet seriously. These ideas have weight. They can influence us as individuals - they may influence our organizations, and help suggest future choices for our country."

OUR SCENARIOS

About the Scenarios

The Science and Technology Foresight Pilot Project team put together a set of ten "stimulus scenarios", covering a range of potential situations - utopias, dystopias, and points in between. Drivers include security, technological advancement, social capital and intentionality, environmental factors, and other key high-level observables that define the state of our world. The suggested or stimulus scenarios form a well-distributed sampling across this space of drivers, with intriguing yet plausible situations like *Gaia Strikes Back*, *Insecure Cocoon*, *Agility Canada*, and *Techno-Mania*.

Of course, each scenario as presented to the group was just a starting point, which they fleshed out and explored from a variety of perspectives during the two days of the workshop. Toward the end of the workshop, each group worked backward from the detailed scenarios to current-day policy and R&D implications.

The first section of each scenario section is the stimulus for each scenario, in the form of a 1-page prose description (meant to be informative, enticing, and thought-provoking). A few key assumptions of each scenario are **in bold type**; it was suggested that participants leave these unchanged, so that each scenario retained a distinct identity.

Each scenario is also rated by three categories relative to today's world:

- ECO - Material well-being.
- ENV - Natural environment, energy resources.
- SOC - Social capital and cohesion.

Each axis value is represented by arrows (↘, →, ↗ for worse, same, better relative to today's world respectively).

The second section, "Constructed Scenarios", summarizes the scenarios as constructed by the group of 8-10 people over the two-day workshop. This includes key technologies, events, drivers, and strategic perspectives in the constructed world, as developed by the group. The goal was to construct a self-consistent world that respects the small set of axioms suggested in the initial 1-page description, and to explore what the implications of that world would be, from a variety of analytical perspectives.

Finally, the third section, "R&D and Policy Implications", summarizes specific suggestions of each group based on their scenario. The question asked of each group was this: given your scenario world of 2025 as you have constructed it, what actions would you suggest taking in the present day to achieve the positive aspects of your scenario - or to avoid the negative aspects of your scenario?

List of Scenarios

1. Agility Canada - *Canada makes good.*

2. Apocalypse Redux (Gaia Strikes Back) - *Environmental and social collapse.*

3. Insecure Cocoon - *Crime and terrorism on the upswing.*

4. Muddling Along - *Business as usual.*

5. O Say can you C (Merger USA) - *Canada becomes a de facto U.S. state.*

6. Techno-Ban - *Backlash against technology.*

7. Techno-Ethics - *Life in balance - appropriate and sustainable technology.*

8. Techno-Mania - *Anything goes, as long as you can pay for it.*

9. Virtual Avatar - *Cyberspace becomes dominant mode of human interaction.*

10. You Are What You Invent - *Skunk-works group, designing technology proposals.*

Participants took these as starting points, and then fleshed out and modified each scenario in Day 1, with much spirited debate and discussion. Once scenarios were designed, the next step (in Day 2 of the Workshop) was to work backward to the present day, and come up with specific policy suggestions for present day policy-makers.

AGILITY CANADA

ECO - ↗ ENV - ↗ SOC - ↗

(Address of the Prime Minister to the nation on July 1, 2025.)

My fellow Canadians - in this year 2025, we can all feel proud that Canada has reached maturity as an agile and competitive "True North Strong and Free".

We are an **economic success story**, both in relation to our neighbor to the south and the world at large. Our free-trade pact with Europe in 2008, along with the business links throughout the world forged by our first and second generation immigrant business communities, have led to the longest sustained expansion in Canada's history. We are a truly global trading nation, and an emerging hub of international commerce.

Our status as a mid-size nation means we cannot dominate all markets - hence we have wisely chosen to focus on those markets and niches where we can be the best. Environmental technologies, alternative energy, photonics, and genetic medicine are just some of the sectors in which we are acknowledged world experts. Our support for R&D commercialization - in financial, regulatory, and human terms - has led to virtually all commercialization of products developed from domestic R&D taking place on Canadian soil, under Canadian management and ownership.

We have **capitalized on our people**. Our education and training investments of the early 21st century are now paying off, as our scientists, engineers, and artists compete with the world's best. We now have some of the foremost universities in the world - UWaterloo in computational modeling and mathematics, UToronto in medicine and genomics, and UBC in environmental science and technology. The University of Toronto was recently ranked second in international reputation in North America - behind only Harvard, and closing fast.

We are a model for the world in social terms. Our multicultural mosaic is a reality of life - my own ancestry includes immigrants from Taiwan, India, France, and Mexico, and the best aspects of all these are included in being proudly Canadian. Our ability to **work through cultural differences and come to a consensus on shared values** is known and respected around the world - giving us a degree of moral respect that we must continue to work hard to deserve.

We have succeeded in redesigning our government to be proactive, not reactive. Our success is measured in economic terms, but also in terms of **social capital and Canadian values**. A decades-long effort in medical informatics and biotech has paid off with an **excellent health system** that is emulated by many nations. While taking advantage of opportunities for growth and development, we have acquired the wisdom to solve the problems that come with new technologies - and to know the difference between what is possible and what is desirable.

My fellow Canadians - it's no myth, but a fact that we can all be proud of, that we live in the best country in the world. Now - let's party!

Constructed Scenario

Cultural differences are used to our advantage, yet shared values hold us together. We have a strong economy - our diversity of cultures is part of a global network that harvests new ideas and exploits business opportunities. Canada has established a unique cultural identity, despite being the recipient of many cultures and being next door to USA - we appreciate and relate to positive aspects of cultures from around the world, and through descendants of immigrants have business and informal connections to virtually every country on Earth.

Education is tuned to its highest performance. New learning techniques work efficiently and effectively, and all motivated people are educated to their fullest potential - maximizing return on our human capital. Immigrants are brought up to speed and integrated quickly.

Canadians are excellent cooperators. We are expert at "organizations that work" (including our own government and institutions). Again, our multiple cultures are a great asset. Canadians are globally recognized and make a lot of money as organizers, mediators and partners.

Government is reality-based, collaborative, and efficient at providing services. Fundamental to this is the technology of true-value costing (in the language of economics, external costs are accounted for). Thorough scientific knowledge of Canadian ecology, biology, climate, social structure, and so on is supported, so effects of decisions are assessed objectively. There is a balance between intellectual property and common knowledge. Public trust is high in government and corporations because clear laws and customs are in place to ensure responsible, ethical behavior.

Our environment is well-managed. We take advantage of renewable resources, and use our ecosystem knowledge to better develop oceans and manage waters; climate change is partly accommodated through making the arctic more arable. Agriculture, forestry, and fisheries are managed with a closed-cycle resource management attitude, recognizing that "you don't get something for nothing". Aquaculture accounts for as much as 25% of world protein (which has played out in an interesting dynamic in Canada with environmentalists and harvesters finding workable tradeoffs). Full cost analysis including externalities accounts for unseen but real resource usage and effects.

In Canada, government is a full player and not shunned as in the US - similar to the European model. We accommodate frontier spread of population along a thin line through cost-effective transport policy and managed northern development. In 2025 there is an aging but happy population. Excellence vs. "caring for everyone" is still an issue, but one dealt with in a rational and foresighted way.

Canada has achieved R&D Success in several strategic areas: nanotechnology (e.g. nanotech-based environmental remediation), post-genomics medicine, niche manufacturing, photonics, regenerative technologies, and automated translation (with consequent benefits for the bilingualism debate). Our competitive intelligence is among the best, and we ID emerging technologies early enough to meet future needs. We balance niching ourselves in technologies (effectively becoming service oriented) against leading in specific novel commodities and scarcer high valued specialty niche markets. We have positioned ourselves as a small but vital part of the "brains" of the planet. IP flows through a handful of countries in 2025…and Canada is among them.

Ethics of the S&T framework have been dealt with. There are established mechanisms and pathways to address ethical issues effectively, and protocols embraced in Canada and worldwide. Government is "reality based" - and due to powerful immersive computing, activities of the PM are largely virtual.

Is small beautiful in 2025? Knowledge management supersedes information or data management. In a system where knowledge is pervasive (distributed intelligence) leadership is more internalized and the nature of leadership has different characteristics.

Geopolitics and effects of 'New World Order' realities affect us, as everyone else, but we've managed to maintain friendly relations with the US while bridging the cultural and political divides with the EU and Asia. Moving beyond "naive capitalism" to a capitalism which incorporates and promotes long-term public good is a main driver, as manifested through changes in the US.

Several critical challenges and opportunities face us beyond 2025. Due to Canada's success, control of immigration and the potential for overpopulation are concerns. There is a continuing search for niches in global trade, and a constant lookout for "wildcards" that could affect us. It will take continuous sustained effort to keep the agility and momentum going and growing...

Strategic Perspectives

International Relations
- Global focus in markets and intelligence - we have an internationally-oriented open society.
- Key moral and cultural role in world - Hollywood without the guns and provincialism.
- Strategic partnerships with power blocs - not just US.

Federal / Provincial / Municipal / Aboriginal Relations
- Focus on international issues makes internal problems fade into the background.
- Let the domestic model unfold as it will, while the nation focuses on global excellence.
- Downplay, not display, differences.
- Rights and responsibilities are better balanced.
- Growing role of cities is acknowledged and key challenge areas are funded.
- Legislative resolution to some problems due to split jurisdiction (e.g. mining and forestry).

Demographics
- Projected population 42M in 2025.
- Key policy concern is to affect the distribution (not the number) of people.
- Immigration is a major factor in increasing population.
- Senior citizens policy.

Multiculturalism – Immigration
- Selective (but flexible) immigration policy, based on demographic analysis and economic requirements. We tailor immigration according to needs – not just high-end jobs.
- Higher investment in quality of Canadian workforce; education system has a subsystem to effectively train and integrate immigrants. Goal is to use the high-end immigrants as soon as possible – i.e. not to force engineers to drive taxis.

- Balance of shared values with individual cultural values.
- We've moved from a bilingual country to a multilingual country.

Haves – Have Nots
- Guaranteed quality of life in certain areas, like education and health.
- Widespread access to business opportunities and capital markets.
- There is international trade enforcement (for smaller and developing countries along with the powerhouses). Canada specializes in dispute resolution.

Public Good – Private Good
- New concepts of ownership are better enunciated.
- Created new institutions / mechanisms / ways to collect individual ideas and ownership of intellectual property to benefit all contributors – from community cooperatives to multinationals.

Potential events and wild cards

- US $ or new global currency adopted worldwide.
- Northern Arctic Nations city state accord and funding.
- GM organisms in wide use.
- Victoria-Vancouver signs first city-state accord with Seattle&Portland and Fairbanks.
- League for preservation of local culture formed.
- Cities reach critical mass and assume power from provinces by 2010.
- Integration of city states occurs by 2020.
- City States lobby federal government to amend NAFTA to deal with all US blocks.
- US decentralizes and sees Canada as an even more valuable trading partner.
- SE Asia Federation decides to use Canada as a gateway to US.
- FTA with Europe by 2008.
- Strong FTAs with other trading blocs (rivals to Cdn/US FTA) from 2015-2025.
- Canada a partner with Chinese in moon colony (or Artemus society) by 2016.

R&D and Policy Implications

Sector Technologies

Nature

- "Biological Survey of Canada" – needed to manage systems and inventory Canada's extensive and valuable resources, in areas of ecology, biology, biodiversity, and land use.
- Bio/nanotech: remote sensing, pest control, water filtration, disease detection.
- Breakthrough in ligno-cellulosics (turn trees into sugar – the "Holy Grail").
- Bio-based and renewable resource economy in Canada.
- Marine biotechnology (genomics and resource provides food and materials); aquaculture 30% of protein supply.
- Seabed technology for broad exploitation of ocean and northern spheres; oceanographic real-time, 3D observational capability.
- Northern S&T for renewable resources.

Infrastructure

- Thermal-mechanical engineering applied to new system for energy.
- Low-carbon and renewable energy technology - local heat and cogeneration, solar, geothermal, wind (and perhaps fusion).
- Smart clean resource extraction and cradle-to-grave product responsibility.
- Niche manufacturing, e.g. auto parts not autos.
- Deep understanding of complex systems (such as networks and self-organizing systems).
- Distributively-generated renewable energy technologies (e.g. off-grid; shoe-powered computers).
- Local technologies for energy wherever available, to assure security.
- Deployable army of sensors to gather data and manage systems.

Health

- Personalized preventive medicine technologies; system-wide shift to prevention instead of just fixing after the fact.
- Recognize the importance of the spirit in health and human well-being.
- Human/computer interface most advanced for the disabled
- Wireless personalized health-net; widespread transplant availability, optional monitoring and health-support implants (with visual remote treatment opportunities).
- Clean air through emission control.

Safety

- Preventive security technologies.
- National and global disaster quick response (protocols, expertise networks, virtual teams).
- Internet security.
- Intelligence sharing; technology for border and illegal immigration control.
- Canada can develop technologies that integrate and promote co-operation.
- World-renowned reconstruction corps (de-mining, biochemical disasters, oil spills, etc) using our advanced technology.

Mobility

- High-speed trains; zero / low emission transport.
- Reducing urban sprawl, and stimulating remote communities.
- Speech recognition and natural language translation options in at least 50 languages (moving beyond bilingualism).
- "Telepathic" communication methods, teletransportation technologies seen as future possibilities after 2050.

Fun

- Elite tourism, and a complementary leisure industry to occupy the unemployed.
- Enjoyment is an underpinning of our society. It's okay to have fun! Lots of time off.
- Creativity is essential, so consciously promote it.
- Moon colony feasible if markets / government can afford it (potentially funded by entertainment and tourism, e.g. the Artemis Society). Virtual tourism, possibly holographic.
- Pornography and illegal gambling controllable with advanced technologies.

Knowing

- A real science of learning – all people learn to their maximum potential. Learning as technology (science leads to integrated models and methods).
- Chemical and bio-based learning technologies emerge.
- Knowledge network – connect people in different locations to enable them to work and learn together. Critical mass is not necessarily physical.
- Education linkages, continuous learning, learning disabilities, news objectivity.
- Systems thinking – more generalist approach, with ecological factors internalized.
- Assumption that knowledge is a free good can turn it into a productive and sellable good or service (a la Linux model).
- "True-value costing" technologies (data collection and analysis for better policy decision making, less BS and smooth talking 'medicine men'); establishing externalities.
- Satellite-enhanced networks become pervasive and trusted.
- Management science ("we're expert at making organizations work").
- New decision-making technologies developed, e.g. adaptive cognition, brain-computer links.

Governance

- Collaborative learning and problem-solving. Simulation technologies are used to teach ethics train managers, and try out policy options.
- Move to "city states" reduces importance of provinces. Regionally integrated networks, with central technologies to hold them together.
- Objective understanding of people in groups. (Political and management "science" finally become real sciences.)
- Limit of terms of office. Centralized leadership, distributed execution.
- Corporate responsibility is enforced.
- Tax what you don't want, based on "external" cost.
- National capital market formed.

Policy Advice

- Evidence and reality based government policy developed. Decisions based on real data, objective analysis includes external as well as internal costs
- Massive renewable energy technologies program (Kyoto, secure 'other energy' policy developed)
- Social/psychological development policy (maximizing Canadian Intellectual Capacity, integrating immigrants and other diverse groups)
- Biological Survey of Canada formed to maximize resource opportunities and assess costs of environmental actions: ecology, biology, biodiversity, land use
- Better development and access to the Evernet-City Net
- Spam control + Global accord on internet regulation
- Policy for developing a Canadian Cultural Industry
- Deep knowledge of Canada-specific environment: arctic, boreal forest, fresh-water lakes, northern oceans.
- Ocean management strategy developed across government departments (e.g. mapping)
- Closed-cycle resource management (forests, fisheries, farms)
- Niche technology (clean energy, automated translation, knowledge extraction, bio environmental remediation)
- Satellite-enhanced network ties all of Canada together
- Remote health care and education (diagnostics, specialty medicine, aboriginal, rural/urban)

Our strategy for 2025 is to have a globally competent outward looking Canada that leverages its competitive advantages in pluralistic society, efficient organization management, environmental technologies and learning capabilities. Our recommendation is to continue leveraging components of existing strategies using an incremental approach, while introducing new programs that ultimately lead to accelerated development of disruptive systems. This strategy will require significant capital investment with a medium to long term payback.

Many partnerships will be necessary. Within the government, we'll need to strengthen Federal-Municipal relationships, and do a consultative process with departments to deal with internal differences. Within Canada, we'll need to educate government/business/public sectors on the implementation of the strategy, and eventually have "opinion pools" that track the ideas and opinions of knowledgeable stakeholders on an ongoing basis. Academia, public and private research institutions, and business councils will all need to be part of the consultation network External to Canada, partnership development includes the EU, APEC, Latin America, and Africa.

Recommended Short-Term Strategy

- Build a permanent "Office of Alternative Futures".
- True value costing needs to be implemented early.
- Use new $1 billion reallocated budget to start this process.
- Increase support for multilingual language training.
- Fund FINE and NCE Programs.
- Fund viable options from key technologies list.

APOCALYPSE REDUX (GAIA STRIKES BACK)

ECO - ↘ ENV - ↘ SOC - ↘

Fossil fuel use has continued unchecked for two decades. Rising sea levels, increased severe weather activity, temperature increases with concomitant droughts - all the worst-case predictions of climate change forecasters are coming true.

Genes from genetically-modified organisms have contaminated large swathes of key ecosystems, leading to a drastic increase in mutations and super-resistant weeds. Crop failures and birth defects from accumulating environmental toxins are daily news fare. **Entire ecosystems teeter on the brink** - with sub-Saharan Africa already collapsed into a blighted wasteland inhabited by corpses and roving tribes.

Overpopulation, pollution, and loss of ecosystem capacity have created nightmare megalopolises of 20 and 30 million, where islands of affluence live among oceans of squalor and despair. Massacres in wealthy enclaves have become a near-regular occurrence as those with nothing left to lose - lacking even clean air to breathe - give vent to their rage. It is no longer enough to have private guards - the gated communities of many nations hire small armies with high-powered weaponry. Those who have the option are fleeing the worst-affected nations...a siege mentality exists between rich and poor at the level of communities, countries, and whole continents.

Rising levels of disease have reversed the previous century's trend toward increasing life expectancy. TB, malaria, and AIDS kill millions each year, and the slow but relentless spread of a new class of transmissible neuro-degenerative disorders like Creutzfeldt-Jakob Disease has led to millions of cases of premature dementia and death. Travel and trade have been severely curtailed.

Unconstrained overconsumption has continued apace. Lack of government incentives and venture capital in the sustainable-technology sector has left promising technologies like solar energy and fuel cells still in the pre-commercialization phase. Most investment is now going into remedial technology in a desperate effort to shore up failing environmental resources. President George Bush IV's declaration of a "War on the Environment" has been greeted with derision and contempt throughout the world. "He and his predecessors have already been carpet-bombing our ecosystem for decades," declared the EU's Environment Minister Alain Beausoleil bitterly. "Why don't they just declare a nuclear strike on the world's tropical forests and get it all over with?"

Even in the developed world, a widespread mood of pessimism and despair is rampant. Suicide levels among young people are at an all-time high, and many youths join the Green Fundamentalist movement which promotes direct violent action against polluters. Green terrorists have assassinated oil executives and blown up chemical factories, and it is rumored that the Extreme Green radicals are working on a simultaneous release of several deadly infectious diseases in an attempt to reduce by 90% the human population, which their manifestos describe as a "cancer on the Earth". Driving an SUV means courting the wrath of potential lynch mobs.

The world staggers on, wondering how much further it can be to the "tipping point" past which the ecosystem will fail in a global crash...

Constructed Scenario

This is a dark scenario indeed. How could it have come to this? On the environmental side: population growth, climate change and consequent weather instability, and resources such as fossil fuels and aquifers being depleted without sustainable replacements. Although fuel cells have been developed, their environmental benefit has been less than was hoped.

On the institutional side, economic and market demands continued to outweigh longer term environmental benefits, having as both a cause and an effect impotent political and civil institutions. A shortening time horizon for decision making led to a breakdown of institutions to look after the long term good . Lack of social inclusion and cohesion played a part, accelerating a widespread breakdown in sense of community. Islands of small, self-protected colonies arise – outside is hell in a hand-basket.

Unconstrained consumption continued apace at the beginning of the century until consumption was reduced by necessity. As prices for many commodities and products rose, the majority of citizens became underprivileged and standards of living declined. This exacerbated the distinction between elites and others, making social tension a far more influential driver of societal change.

A smaller number of humans on the planet are benefitting from available technology. Reliance and confidence on technology will diminish as fewer see the benefits of it - e.g. people prefer to grow their own foods. There is not enough impetus to support on-going research, due to fighting immediate fires – the loss of knowledge and wisdom is similar to the situation in the dark ages...

Social environment

- Rich vs poor, haves vs have-nots, all unaware of implications of what they are doing – linked to the poor rising up.
- Haves and have-nots are affected differently - only small pools of affluent people. Insufficient customers, so pharmaceutical firms fail, affecting health (especially for evolving diseases).
- Drought, food shortages more frequent.
- Populations relocate from dry, flooded, diseased, violent areas (we're already seeing reactions to changes in the environment). These relocations are in turn countered by epidemics and travel barriers, creating a fortress mentality. "New crusades" – major war, possibly religious, but with recurring underlying causes; energy and water shortages are constant threats.
- Transportation of goods will be affected. Globalization is the vision now, but in a "lifeboat scenario" the goal is oases of self-sufficiency - making globalization seem unrealistically utopian.
- Balance changes between community responsibility and individual rights, which may lead to "might makes right" - hence individual rights appear to be fading. On the dark side, roving tribes are at loose in many nations, where rights and responsibilities mean very little.
- Problems abound with social inclusion: social capital gone, social institutions weak and helpless.
- Global institutions fail – e.g., UN, WHO. At UN level we keep dealing with symptoms – hence high donor fatigue. There is also large institution failure, with a cascading effect to lower levels – the further down you go, the less influence you can have on global problems, causing tension between global and regional approaches.
- Nuclear disasters make areas uninhabitable, and cause diseases - this affects willingness of population to support nuclear energy supply development, despite clean energy shortages.

- Increasing terrorism; resource conflicts and ecoterrorism intensify.
- Sub-Saharan die off will have begun well before 2025 – expect them to have identified "life boat" approaches to coping. Urban dwellers are most susceptible given their dependence.
- Potential dictatorship in US, where relentless addiction to "growth" remains the nation's assumed privilege.
- Superstition and supernatural explanations increase; more cults and cult mentality. Fearful and overstressed population will listen to the voice/individual of he/she "with the solution" (e.g. astrology in pre-Hitler Germany).

Natural Environment

- Global warming underlies many issues – tied with rising water levels, more tropical diseases, volatility & severe weather changes. Arctic will be affected, Sahara may be affected.
- Question – in 25 years, what will global population be? Where will it be? Possibly 7 or 8 billion bodies, with longevity reduced in many areas.
- Toxicity of air, water & soil increase - poor sanitation in many areas.
- Biodiversity will change and will decrease – more monocultures. Marine resources – major source of protein is fish.
- Water resources – we may have enough for 2020 in Canada (but with regional scarcities and quality issues). Aquifers are affected (possibly gone) – results in pressure to move water, e.g., canals to draw water off James Bay.
- Interior of North America also influenced, which will affect capacity for growing crops.
- Energy – coal and nuclear dominate, with a scattering of solar, hydro, geothermal (particularly in specific regions).
- Nature conservancies and national parks are under stress, and many have been appropriated by government / corporate world to resolve pressing issues (e.g. oil extraction in Arctic).

Economic environment:

- Insurance protection minimal, feeding survivalist vision; relying on each other and government.
- International solutions and agreements will have failed – e.g. NATO, world food program.
- Enormous stress on resource allocation - in Canada, rich provinces don't share with others.
- So many troubles that we cannot cope with causes – spending more attention on treating the symptoms, but unable to affect causes. Government and corporate sectors have let us down.
- Need for more energy to desalinate / purify water – but no cost-effective technological solution (except perhaps nuclear energy, which comes with problems of its own).
- Market forces continue to dominate - but barter markets return where the market has failed. International trade and many large companies collapse, impacting economic productivity – everyone is poorer, feeding subsistence model.
- Nuclear energy may be gone, oil will be far more expensive; hence will need to lean on coal and hydro, accelerating global warming and weather instability. Hydro generation has negative side effects on local ecosystems (e.g. 3 Gorges Dam).
- Fuel use trajectory has changed over the last 20 years, due to supply side limits.
- Corporatism drives education, and makes individuals less capable of dealing with changes.

Strategic Perspectives

Federal – Provincial – Municipal

- Tensions between have and have not provinces; fewer transfers between provinces likely.
- Movement of power between levels of government - power might be deployed further out to municipalities.
- However, there is also the possibility of centralizing under the federal government, via deterioration of provincial power under large stress – Canadians will tell provincial premiers petty in-fighting is a barrier to real solutions.
- May not require national entities. Look for coalescence of communities with shared issues – e.g., freshwater interests in south Quebec & Ontario combined with northeastern US states.
- May need changes to Canada's constitution.

Haves – Have nots

- We will be a "have" in terms of water and many other natural resources.
- People will want to move in or take resources - will affect immigration and commerce.
- Continued widening of disparity between haves and have nots.

Demographics

- Changing health care system will be difficult – pressure to keep it national – big difference with US.
- Reduction in immigration; checking of potential immigrants and visitors for health concerns.

Security

- Continental integration will be driven by immigration, trade, and security – and disease prevention.
- Linked to natural resources (e.g. Thomas Homer-Dixon's work).
- Americans will strengthen their boundary, leading us to align more closely with US to make the boundary more permeable. This leads to greater military, environmental, and economic integration with US (common currency?), and consequent reduction in Canadian identity.
- We are privileged – therefore more pressure from US on immigration and security of common or strategic perimeters, and on issues of commerce.

International Perspectives

- Protective border – protect your assets and protect your access.
- We're well endowed but under threat – a greenhouse surrounded by a desert
- In health issues, Canadian regulations around generic drugs mean Canadian costs stay substantially less than US costs, making us a target for interest by pharmaceutical industry.

R&D and Policy Implications

How did we get here?

As we proceed toward this dark scenario, resource bottlenecks will restrict access to the few. limiting market size – things that would have been commercially viable are not viable. This will limit new technologies, except those associated with defence. The well-off drive a trend to privately owned communities, and a complementary decline in investment to long-term public goods. Credit and insurance systems cannot cope with increasing breakdowns in society at large; the "survival of the fittest" mentality underscores a need for adaptation of our social systems.

Almost all current-day economic systems are run by fiat systems, and not really underpinned by any commodity like gold or silver. Everyone talks about money – at root, it's only a number, tied to real and perceived power. This scenario posits a shrinking pool of resources and increasing population - but given physical limits to growth and the hierarchy of human necessities, justifications based on economics and notional $ value miss the point. If there is a shrinking pie of land, natural resources, healthy environments, and so on, then increasing the GDP doesn't directly make any more for anyone - living standards must go down unless technology substitution effects keep up with the rate of decline, which we should not depend on forever.

Two key trends contributed to Apocalypse Redux. First, the natural trends that we can already see in evidence: climate change, fuel shortages, disease, drought. Second, a trend to global war and military instability – e.g. "the new crusades" against terrorism, with social capital breaking down. Both of these lead to the four horsemen: war, famine, pestilence, disease. The key implication for society can be summed up in a word: fear. Demands by frightened societies for environmental, economic, and physical security lead to a fortress mentality - with divisions at the global, continental, regional, and individual level.

Sector Technologies

Nature

- Food grown locally – low-tech only in many locales, with unsustainable increase in fishing and hunting. Human caloric inputs to agriculture increase. Disease-resistant and drought-resistant crops in high-tech areas.
- GM of plants and animals (the group disagreed over whether or not there will be GM products in the "worst case" scenario). Expect GMOs in some segments but not others.
- Local purification of water, using UV and boiling (energy challenges to do this).
- Environmental monitoring - e.g. microsatellites, in situ sensors for crops.
- Nanotechnology solutions for climate change may be available or sought after.
- Nuclear and long-lived chemical pollution insoluble due to long half-lives.

Infrastructure

- Nuclear regains some degree of acceptance (e.g. slow-poke reactors providing energy in local areas). Much coal and wood use.

- Plants used to desalinate water, produce Hydrogen.
- Need for smaller, cheaper equipment; trend toward local self-sufficiency in energy.
- Climate modification technologies – controlling local weather in protected areas.
- Manufacturing done more locally. Limited nanotechnology for manufacturing.
- Resource exploitation using non-environmentally friendly technology.
- Heterogeneous infrastructure – survival thinking causes wide variance in local conditions.

Health

- Personal health monitors and telemedicine emerge as essential innovations - for those who can afford them.
- Low-tech medicine, lack of research for new medicine continues to prevail for the general public.
- Pollution monitoring systems in demand to deal with pollution increase from heavy use of coal.
- Outbreak reaction support. Persistent illnesses recur, with organizations designed to resist (e.g. combating spread of SARS-like illness through redundancy and strict quarantine).
- Privatized health care – targeted to well-off, who have access to GM pharmaceuticals / vaccines. Rest of population is prone to lifestyle fads and pseudo-scientific "cures".

Safety

- Large developments in security systems, concentrated on protection solutions - individualized security solutions, localized defence, networks of communities for self-support.
- Widespread monitoring of people and communities, and personal identification and tracking. Limited mobility and freedom, both institutional and private.
- Multiple dangers due to desperate people and poor public security services - private armies / police to protect rich enclaves.
- Personal privacy technology blocks some abilities (e.g, public health, genetic code inference).

Mobility

- Transportation will focus on disease prevention and ecosystem protection. But transport is more costly and local – less transportation volume leads to more isolated communities.
- Poor roads, nearly no air travel due to cost and security risks. Bicycles make a comeback, but highwaymen are a threat.
- Technology exists for supersonic air travel and nuclear power transit solutions – but there is noplace safe to go, and few who can afford or want to go.
- Web diffusion is curtailed, but videoconferencing / telepresence are more popular than travel.

Fun

- Local self-sufficiency and less travel implies local art and entertainment - society gets unplugged. Children will play but with fear – conflict play. Adults will dance, sing, revive oral traditions.
- Reality terrorism – Who Wants to Marry a Terrorist? Criminals offered freedom if they survive TV shows.
- Simulated environments, fewer natural experiences for urban dwellers.

Knowing

- Education is largely local and home schooled, to keep kids safe from disease and crime – supported by an AI infrastructure.
- Practical trades more important – reversion in some locales to paper texts and oral tradition.

- Higher education is reduced, ameliorated by distance education and "learning AI". Research is limited by reduced funding, and has short-term horizons.
- Access to information and advanced knowledge reduced, especially where perceived as risky (e.g. potential terrorism or accidents). Co-operation remains in monitoring state of world.
- Computer intelligence closes on human levels, as a byproduct from military developments.

Governance
- Local councils in small communities, self-organizing for survival.
- Large-scale transparency is dying, as is democracy. Breakdown of national and international structures; might makes right.
- Decision-making technologies largely for the few elites. Search for supernatural assistance in some areas leads to decision making by astrology.
- Increased reliance on word of mouth and oral tradition.
- R&D effort to understand climate change - co-operation driven by fear.
- Stress of individual rights vs communal responsibilities; technology to support cooperation helps. Networking communities of common interests; virtual co-ops and eUniversity.

Commerce
- Challenge to currency regimes will erode confidence in currency. This will promote return to barter, and reduce access to technology.
- Tension between generalization and local self-sufficiency in important sectors vs achieving global leadership through specialization in niche areas - balance shifts toward generalization.
- Local currencies may arise if national currencies fail, creating new market for interchange between many more currencies.
- Larger heterogeneity in customer pools, in local environment, customs, and living standards.
- E-Commerce becomes more pervasive, but mediated by ecological pressures and ability to pay.

Policy Advice

Our objectives given this scenario are to suggest policies in the present day to prevent what is preventable, to mitigate what cannot be prevented, and to adapt to what is inevitable. The options are i) a continuation of the status quo – short term policies dealing with short term effects, and marginal incremental initiatives – or ii) a proactive, long-term, sustained, comprehensive, multilevel approach. We suggest a hybrid approach, with aspects of each – phasing out short term vision and transforming to a long-term approach.

A key is to move from dealing with symptoms to underlying causes - to continue to support the safety net aspects of current policies (e.g. hospitalization of evolving diseased individuals) but recognize we need to phase this out while an alternative long-term strategy is put into place (e.g. an integrated approach to disease prevention).

With respect to the environment, proactive technology solutions are necessary (as listed in sector technologies section). A rebalancing must take place of health and environmental regulatory regimes, to incorporate the entire life cycle of ecosystems. Complementary to this is a shift to ecological economics, and "taxing bads, not goods" – government must go to total cost accounting that includes

environmental indicators and integrated national accounts. There is a need for better emergency preparedness, and an enhanced capacity to react to events which affect large communities (including environmental and health impacts).

In order to counteract tribalism and Le Pen ism, we need a policy that supports flexibility and agility in schooling systems. We must also strengthen support to others, especially in the developing world, if only from enlightened self-interest - in areas such as transmissible disease and refugee prevention. Support is necessary for strong, national health institutions – and a complementary movement from clinical to preventive medicine. The common good requires redefinition of the social balance from individual rights in favor of communal rights and individual responsibilities. In certain cases, communal benefits may outweigh needs for personal privacy – based perhaps on a key incident or outbreak.

In the economic sector, insurance sector meltdown is a real threat if events run too far ahead of our risk analysis and management tools. While a strong Canadian identity can continue, there is a risk of impoverishment due to obstruction of exports to US markets if we move too far apart; hence we must maintain ties to the US and NAFTA. A common border policy is necessary to deal with common risks: terrorists, and disease from animal, plant, and human sources (including both travelers and immigrants).

For free movement of goods, we need NAFTA regulatory systems for food, drugs, resource products, health, and environmental protection. However, expanding NAFTA risks cultural assimilation, if it broadens to health, education, and resource management - we must carefully consider benefits of sovereignty in each area vs benefits from common co-operation. Perhaps a formal North American Free Trade and Security Agreement would be a natural expansion of NAFTA - not forgetting to also include Mexico to provide a counterweight to the US giant. Building coalitions with global institutions is also necessary (e.g. the UN for health, economics, and the environment). One goal of our policy is to maintain our quality of life for the long run, by looking for sustainable decisions and business practices.

We have suggested a number of specific technologies above. In developing technologies, we must keep in mind that many sectors are naturally international in scale, and enhance our international benchmarking and co-operation. From a governmental science point of view, it is crucial that public good research be funded – efficient, decentralized and diversified technologies that mitigate, prevent and adapt our society to a new context . Potential Canadian niches are in resource management, remote sensing, and a universal and preventative health system.

To implement such sweeping changes, there is a need for education and citizen engagement – to initiate fundamental changes in social structures and behavior. Entrenched power elites may resist policy changes and IP in key public good areas may be hard to share; personal and corporate greed will be an obstacle to change. But despite the seeming expense, general belt-tightening may need to be accepted in some areas - to save us from a far more serious expense in the long run.

Media presentations and publicly-available simulations will help to prepare Canadians, by pointing out the importance of preventive measures and describing potential scenarios. This will pave the way for announcements on investments in sustained R&D. Canada has a chance to take the lead on environmental issues and risk-reduction measures – to "create a coalition of the willing" for tackling a challenge that threatens the long-term survival of our civilization.

INSECURE COCOON

ECO - → ENV - ↘ SOC - ↘

For millennia, governments have been at war with syndicates with, shall we say, more flexible ethics and organization. In the last couple of centuries, it appeared that a general sense of well-being was spreading to more and more of the population, leading to a loss in profits for The Business. Let me tell you how we reversed that unfortunate state of affairs.

First, we quietly provided heavily-laundered funds to several of the most extreme terrorist groups. There's nothing like **bombs exploding** and buildings collapsing to frighten people and encourage strong measures in response. While an untutored observer might think that heavy state control is bad for The Business, in the long run fascist states tend to be full of potential consumers. And the modern fascist state sees the value of soma to keep the masses happy.

So, what the proletarian news outlets called **"terrorism" took its toll**. We didn't have to do much, as so many groups were already at odds with each other - just a subtle nudge now and again. Crime and social breakdown were also encouraged through whitewashed donations to legislators who would vote against public goods and social services. The resulting world of gated communities and **polarization between rich and poor** served to accentuate societal differences.

Of course, we indirectly owned many of the security and prison corporations that benefitted from the increased level of crime. Travel and tourism dropped, but we knew that would happen and pulled our assets out of that sector in advance - and even benefitted nicely from a little trading with that effect in mind. A world that travels and trades less is one that is more suspicious and insular - promoting **global military instability**, and making life easier for our transnational syndicates.

As **crime and violence increased**, people retreated to the safety of their guarded homes, and the fantasy worlds within. Our monopoly on the ensuing boom in the delivery business, while expensive in men and money to achieve, paid off handsomely as most urban dwellers became too afraid to even go shopping in an unfamiliar neighborhood. The media business boomed as never before, with consumers willing to pay top dollar for fantasies to help them escape their miserable and frightening real-world lives.

Our security companies developed advanced technological devices, such as biosensors and biomimetic materials. Of course, we always kept the best for ourselves, and ensured that there were opposing technologies available to the criminal and terrorist elements - creating the conflict and supplying to both sides, as it were. The profits gained from technologies that seemed to provide a security advantage were remarkable - the rich were willing to pay top dollar for a sense of safety.

Environmental disasters and long-term pollution effects created a great deal of anger and insecurity, especially among dwellers of developing countries. Developed countries close their doors ever more tightly, while the citizens of developing nations clamor ever more loudly for escape from cities where even breathing clear air carries a price. While this has also provided opportunities for handsome profits, we may have to rein in polluters and even invest in sustainable technologies - if environmental degradation progresses much further, our customer base may actually start to shrink...

Constructed Scenario

Economic insecurity is ubiquitous - low social support and inadequate welfare have reduced Canada's vaunted safety network to a few tattered strands. Laissez-faire and "market irregulation" is the order of the day. Labor markets are characterized by large pools of workers with marginalized skill sets, as even the high-tech workers and professionals find that technological advances or insufficient market demand has made their skills redundant. Internal instability is high and rising.

Internationally, a collapse of cultures and civilization is underway. Destabilizing Middle East governments have initiated a new Cold War in the region, which threatens to flare into open warfare at any time. The rise of religious fundamentalism is hardening attitudes and causing clashes with modernization around the world, promoting widespread intolerance.

International trade relations have polarized into two (some say three) large trading blocs: the Americas on one hand, Asia on the other hand, and an EU which trades largely with Asia in between. China is the world's manufacturing center; India is its service center. A strict North American security perimeter has greatly reduced international travel and made external trade more expensive; international authorities are increasingly willing to intervene to block trade and travel elsewhere, for both health and security reasons. Sovereignty of nations is questionable in some areas, as weak governments become largely corporately driven. No more UN security council – multi-lateral (dis)agreements are the order of the day.

Technological development is largely driven by "Maslow rage" – concerns over safety, housing, food, water, public health, and security. Surveillance is ubiquitous in most societies, with wire-tapping and computer oversight so common as to be an unnoticed fact of life. Civil ID techniques are everywhere, from relatively low-tech fingerprinting and eye scans to far more sophisticated access controls for every sphere of life. Decontamination services are a booming industry, as are advanced sensors able to detect potentially dangerous pathogens and disease conditions from a distance; the vast majority of citizens with transmissible illnesses voluntarily self-identify to the government, allowing the ubiquitous monitoring networks to isolate them from proximity to other citizens. Restricted rights of assembly and "preventive imprisonment" without charge for security reasons are likewise tolerated under the now-permanent War Measures Act. Centralization of media has continued, with the corporately-owned media now self-censoring all stories with the advice of "public information assistants" provided by the government.

Although there is increasing globalization of citizenship for the fortunate few with desirable skills or wealth, society as a whole is becoming more family and tribally centered. Some areas have seen the status of women slip backward significantly, as fear and fundamentalist tendencies drive a return to the "old ways". There is a bright side for Canada, as it has become perceived as one of the most exciting and desirable cultures on the planet, due to its plentiful natural resources and relatively good security and tolerance - but these are under threat, as society becomes ever more suspicious and fearful of "dangerous outsiders".

Higher education has become largely for the rich - most citizens receive info-babble and fun media, with plenty of knowledge bites but little real knowledge. A growing information gap is exacerbated by security-driven control of information, and rigid controls over public education. Mis-allocations of brainpower and budgets are common, with government policies and programs not properly targeted -

a government constantly reacting to multiple concurrent threats feels unable to invest in prevention and innovation for the future...

Strategic Perspectives

International Relations
- Increased, sustained lobby for international regulation (e.g. limits on financial transactions).
- Strategies for pubic engagement strategies to obtain input from citizens to Canadian positions related to international regulatory bodies.
- International security body (like UN Security Council) to act as a global dispute mechanism.
- Droughts affect North American bread-basket. Water becomes a key commodity, and Canada has capitulated to US demands to sell large amounts of water.
- 3 billion Asians form close to half of humanity.

Aboriginal
- Continued economic decline of reserves, and conflicts over energy and resource management.
- More pressure for legislation; claims provide resources for some growth.
- Relative Aboriginal inequality still growing, despite some entrepreneurialism.

Federal
- Reduction in power.
- North American security perimeter; threat of annexation of regions by USA.
- ICT implies reduction in sovereign power of nations.

Provincial
- Evolution of powers & fiscal authority; less money for administrators.
- Potential creation of super province(s), e.g. “Atlantica”.

Municipal
- Growth of megalopolises, e.g. mega-Toronto covering Golden Horseshoe.
- Efforts to consolidate; pressure to reduce duplications.
- Decline of infrastructure continues.

Demographics
- Declining birth-rate and increasing mortality rate implies insufficient replacement.
- Increased mobility (both immigration and emigration) of economically-desirable jobs and people.
- Ever-increasing urbanized population puts pressures on infrastructure.
- Problematic distribution of skills across age-groups.
- Geographical distribution of population drivers: security, basic needs, economic exigencies.
- Timely growth of affordable & available housing is increasing issue.
- Need for services for mental health in face of lagging development of community supports (tied in to problem of pace of demographic shifts).

Multiculturalism & Immigration
- Pluralism vs multiculturalism: pressures for conformity and identity.

- Common security perimeter for North America.
- Selective immigration from outside of the Americas, only able to accommodate a fraction of the huge and growing demand for safe refuge.

Developed vs Developing World
- Superpowers: US / North America, EU, China.
- Much of developing world faces economic failure, depleted resources, and continued instability; havens for terrorists and destabilization continue to arise as conditions deteriorate.
- Ascending small countries: Korea, Malaysia, Taiwan have competitive advantage in niches.
- Issues of alignment with trading partners, and emergence of blocs / cartels.

Values
- Erosion of values in many spheres of life.
- Justice: requires pluralism, threatened by increasing gaps between haves and have-nots. Collective vs individual, public vs private goods are under extreme tension.
- Questions about effect of common perimeter for security and attitude toward rest of world in North America. Replicated on a smaller scale with gated communities vs social cohesion.
- Who benefits and who faces risks?
- Privacy and accountability curtailed. Erosion of transparency diminishes informed choice.
- Only those with money have access to higher education.
- Health has become marketized: universal services for basic benefits only.

Points of Debate, and Opportunities

The group had several points of debate: What would the future concept of sovereignty be, and how closely would geo-political issues need to be examined? What is driving this scenario - i.e. what are the root causes of all the insecurity? What assumptions should be made about demography and energy availability, given the unexpected changes that have happened in both trends in the latter half of the 20th century? And finally, would increasing information flow necessarily be beneficial?

Opportunities for the dystopian Insecure Cocoon world of 2025 to improve its future are manifold - even in the darkest times, hope remains:
- Foresight process developed to 2075 - vision of sustainable economic futures.
- Redress environmental damage: ecosystem and toxin bioremediation, control of pollutants.
- Restore social communication and integration; reconcile people and nations across barriers (addressing both technological and social hurdles). Arms control - reduce global tensions.
- Alternative hydrogen economy; weather and climate control.
- Robotics replacement model – return to new renaissance of arts and culture.
- Close gaps in living standards: increase middle class, stabilize components of everyday living.
- "Take back the street": improve security and crime levels, restore optimism and hope.
- New government: rich and ubiquitous media for planning and decision support. Promote immersive learning and challenging knowledge work.

R&D and Policy Implications

How did we get here?

Terrorist events provided justification for many radical societal and governance changes, but more than terrorism has driven this scenario.

Lack of trust and cooperation has flowed from fear among nations. A disease pandemic provided the catalyst to further accentuate terrorism and terrorist networks - linked to this was a rise in religious fundamentalism. Corporations became power bases, as states destabilized.

Economic
- Impact of war and peace.
- Global regulatory regime – wrong balance of control and non-control.
- Increased global competitiveness; eroding ROI.
- Retention of oil as an economic bottleneck.
- Lack of investment in socially-beneficial S&T.
- Excessive consumerism.

Security
- End of sovereignty.
- Revolt from the rich – limitation on wealth creation.
- Fear - both justified and not.
- Disease pandemic.

Political / Culture
- Ignorance of ecology – scientific illiteracy.
- Regional differences and immigration.
- Cultural and religious opposition to economic frame of mind – political ideology.
- Social classes clash; emergence of economic caste system.
- Potential unexpected apocalypse (e.g. space cataclysm).
- Security / Insecurity – especially homeland. Canada-US "nervous continent".
- Loss of transparent accountability; democratic deficit.
- Geo-political – e.g. China hegemony over Asia, challenges US.
- China/India start new arms race (along with ongoing India/Pakistan).

Social
- Ignorance of history. Ubiquitous but non-reflective media.
- Calculated risks, militaristic diplomacy.
- Skills-marginalized workers. Impact of demographics.

Sector Technologies

(Note - because of the somewhat dystopian nature of this scenario, many of the technologies are not an improvement over those of 2003, and many may in fact be worse. It is still of interest to see what paths should *not* be pursued in technological development...)

Nature
- Deforestation extensive. Agri-soils depleted and contaminated; pesticides in heavy use.
- Crop failures; food-value diminished, nutritional content down.
- Fish stocks depleted.

Infrastructure
- Energy is largely polluting, and still based on fossil fuels.
- Environmental threats: tanker spills, pipeline sabotage, climate change.

Health
- Wonder drugs for basic ailments. Super drug-delivery chip, based on basic ailment. Lifecycle Evolution, timed self-activated release.
- Shortage of health professionals; new and rampant diseases.
- Remote Care. Wireless chip implant, for tracking, assessment, and diagnostics.
- Termination / Right to Die; cloning is reality.

Mobility
- Decentralized high-security P2P wireless infrastructure that can protected by state authorities – cost goes up as compared to a more centralized and open network.
- Non-state actors create their own P2P wireless networks; emergence of new cryptology techniques from quantum computing gain importance.
- Global transport infrastructure degrades - interaction shifts to work in virtual places.

Safety
- Security: ability to track and profile behavior - social, consumer, and travel. Consequent erosion of privacy, mobility and autonomy.
- Improved detection / mitigation for bio and food threats with traceability, biosensors.
- Precision in weaponry. Ability to wage "smart warfare" where the objective is not human life but paralysis of enemy infrastructure and operations.
- Alternatives to expensive and slow criminal justice system. More predictability of offences and more precision / easier determination of guilt. Integrated approaches to crime detection, prevention and corrections - with less administrative backlog and lower costs for infrastructure and staffing. More creative (and ruthless) alternatives in sentencing and corrections.
- Advanced Facial Recognition.

Fun
- More disposable time for fun.
- Activities with robotic aids become possible.
- Escape from reality. Virtual tourism, virtual family, primitive holodeck.
- Multi-lingual translator. Global community and culture for entertainment (but not travel).

Knowing

- Virtual reality becomes a reality. Immersive learning technologies – multi-sensory and real-time knowledge and information systems. Knowledge management and integration capabilities from diverse streams of data.
- Intelligent agents for seeking out and delivering information on a timely basis. AI techniques continue to develop and find new real-world applications.

Governance

- IT development: not E-government but E-surveillance.
- Relating to Mobility, a transport infrastructure that provides general security against urban threats and is economically viable.
- Surveillance technology to watch non-state networks. (They can knock out conventional satellites, so need for micro-satellites.)
- Commando-style conflict marked by use of advanced technologies (e.g. X-ray goggles).

Policy Advice

Holistic Manhattan Project of 6 points:

Promote popular entertainment as a Canadian industry

- Mobility travel: video games: e-Textiles and other fun diversions.
- Establish indigenous 3D products for VR entertainment.
- Canadian "edutainment" industry, for fun learning products.

Security (Siege and Herding)

- Vision - maximal security for population, without fascism.
- Security technology and "benevolent surveillance"; mastery of cryptography.
- Analyze what might cause semi-catastrophic conditions (and what has caused them elsewhere). Rethink areas of government responsibility; emphasize emergency preparedness (for both natural and man-made catastrophes). Include preventive measures in cost-benefit analysis.
- Better tracking and understanding of non-state actors.
- Ongoing preparation for and prevention of use of nuclear / biological / chemical weapons of mass destruction. Sustained policy for WMD decommissioning.
- Financial reforms of corporate governance, accounting practices, and corporate ethics. No safe havens for corrupt companies and monies.

Informatics communication and telecommunications

- Emphasize connectedness: wireless networks, mobile computing, person-to-person connections.
- Widespread telecommuting and videoconferencing.
- Reduce the digital divide.
- IP – new forms of protecting and rewarding the creators of IP – new value exchanges.

Sustenance and Wellness: Physical and Mental Health

- Bionics and prosthetic advancements will greatly aid quality of life, especially for elderly.

- Viagra, Prozac, etc as precursors to advanced biochemical solutions to mental health; neuropharmacology.
- Genetic therapy and xenotransplantation; real-time blood screening and bio-monitoring.
- Urban architecture in balance.

Self of the Future
- Sense of metaphysics and history.
- Widespread recognition of "tomorrow's human capital".
- Conscious consideration and balance of soul / values / ethics, integrated into public life.
- News – less corporate and international control, more choices. Freer flow of views.

Planetary and Mother Earth
- Awareness of the biosphere; Virtual World Holodeck, biosphere monitoring network.
- Respect for life as motivating force against war, disease, pandemics.
- Environmental security.

MUDDLING ALONG

ECO - → ENV - → SOC - →

I guess being a public servant hasn't been so bad. Now that I've put in my 40 years, it's time to retire with a comfortable pension. Seems like half the country is retired folks these days...

Comfortable - hmmm, that could almost epitomize our nation, couldn't it? "Canada: The Comfortable Country!" Don't know how many tourists it would attract, but it's actually a pretty good slogan in this day and age, what with all the retirees worldwide looking for nice spots to settle down in. Comfortable - it ain't great, but it could be a lot worse.

That goes for being a public servant too. Long as I can remember, **our government has been competent but reactive**, with the occasional flash of brilliance that saves us from stagnation. As one wise old veteran told me in those change-the-world days of my youth: "We steer the ship of state to avoid icebergs, not to seek out sunny climes."

It's a good thing we've been consistent in our investments in R&D, though; that saved us from turning back into a commodity-based economy. Not that natural resources aren't still a mainstay for us, but at least we do have a few world class companies which attract some of our brightest grads, like Northern Nanotech - although all **too many young people seek out greener pastures in the US, Europe, and East Asia**. Our **ever-increasing elderly population** is focused on health concerns first and foremost, but we've managed to keep the "health gap" between the active rich and unhealthy poor from growing too large.

Seems like we could almost write having a constitutional crisis into our constitution - it's hard to believe how long the same old English-French issues have been around. Why, I was reading through the memoirs and Web archives of some of the old 20th-century senior public servants, and some of the entries could have been written last year! And of course now we've got that join-the-U.S. independence movement, along with lingering aboriginal claims. Well, they all seem to be on the back burner for now - so our constitutional sword of Damocles is trussed up for the moment.

One change for the better, at least, has been the gradual strengthening of Canadian identity. You talk to kids these days, and they have a strong sense of their shared values. I'm old enough to still feel proud at the rainbow present in any teen crowd, a phenomenon which the kids don't even notice - until they travel overseas and realize that ethnic differences still matter elsewhere. That identity does seem a little weaker at the institutional level, though...it's frustrating to see **our "leaders" acting like followers** on the international stage. They just don't seem to have the ability to tell the unique Canadian story to the rest of the world.

The U.N. still ranks us among top 5 countries in which to live - a fact that's become almost a tradition for Prime Ministers to emphasize. On the other hand, there's just no denying now that we've slipped on the economic scale to **a strong but second-tier economy**. Not that we've done badly - others have just done better.

I guess we can't complain...

Constructed Scenario

Canada has successfully diversified trade and maintained its standard of living despite mediocrity. Environmental decline and climate change continue; continuing pressure on the environment requires technological innovation to monitor and deal with problems, but so far Canada has managed to "run fast enough to stand still", in this and many other areas.

Increasing urbanization and specialization continues within Canadian society. Globally, a multi-polar world has emerged with three major trading blocs - and no single superpower. Technological and economic change is driving policy, and private-public partnerships are on the upswing. A stable economy has managed to maintain living standards despite mediocrity of many choices and institutions, partly through luck and abundant natural resources.

Despite increasing globalization and competitiveness, global economic and security stability is fortunately relatively non-threatening. Astute observers suggest that inertia has set in – a feeling that "this is the way we are and likely to stay". Maintenance of Canadian values through a publicly funded health care system has continued, although few other national dreams have materialized...

Socio-Economic

- Open world, global standards and stability.
- Ongoing dependence on U.S. - discussion on adopting $US continues. Our companies source most new technologies from abroad.
- Rise of China - multi-polar world (50% trade with China, 40% with US, 10% with EU). Energy transition - changes to infrastructure, costs, and static vs non-static power sources.
- Effects of virtual world on technology-based population.
- Huge opportunities with retirement of boomers, combined with challenges from aging population (e.g. social policy choices on immigration / diversity). Risk of drifting toward stagnation.
- We continue to suffer a technology commercialization gap (insufficient capital and experienced management). However, Canadian openness and cultural diversity is an asset - flexible, can exploit foreign opportunities. Dissemination of Canadian Values and ideas is a major export and brownie point earner.

Environment

- Pollution is a growing issue. Some advances on environmental remediation and cleanup using new technologies.
- Environmental degradation, and great stresses on natural resources / parks. Canada continues as ecotourism world leader – but hard to maintain as it threatens environment.
- Pressures for our resources, e.g. US wants water – increasing exponentially.
- Poor understanding and control of ocean and our arctic territory and resources.
- Climate change has led to different ecosystems – Canadian prairies arid, have to develop drought resistant crops. Reaction to Climate Change has been, well, reactive.
- Sustainable Development is the overarching policy framework, through necessity. Environmental cost accounting has stabilized environmental decline, although restoring lost ecosystem capacity is a challenge for future generations. Sustainability becomes a core value.

Politics

- NGO type S&T infrastructure to feed political system - Parliamentary S&T fellowships and internships, significant Canadian S&T associations/societies.
- Political will to fund excellence (versus a bit to all regions) does not materialize. Tension between value of broad access to education and excellence / specialization / elitism.
- More self-regulation - government enforces.
- South East Asia is greatest political force in the world. US clearly a declining power in relative terms, suffering economic depression, inefficient factories, low outputs, and older technologies.
- US still a great consumer - has not learned lessons of environment and economic sustainability.
- E-governance is a Canadians success story: slows down decision-making, but good decisions reflect educated populations views. There are few great decisions.
- Federal - provincial - municipal jurisdictional and financial tensions continue. Status quo re Quebec and Aboriginal peoples; definition of Separatism expands.
- Stabilization of other locations is a key foreign policy driver.

Education

- Issues are funding, standards, and privatization.
- Canada is one of the most highly educated countries in the world (technology grads are increasing).
- Canada has 5-6 world class universities with world class chairs, but still lack focused support for universities. We don't drive one of our universities to be the flagship world class MIT equal.
- Canada still does not have a national education system.

Health

- Fitter population. Elderly population is bigger than before, but more energetic.
- Some preventive managing of pandemics and screening, but preventive / lifestyle medicine still has room for growth. Advanced therapies are improving quality of life for Canadians.
- Still a largely public system. Canadian values of universal health care are respected, but parts are now delivered by private sector. Massive aid programs for poor funded by private schemes.

Strategic Perspectives

International Relations

- Adjustments in size and role - expansion of "honest broker" status. Canada a "helpful fixer" - we're not a threat to anyone.
- Key role in brokering international standards, by example.
- Loss of middle power status - gradually overtaken by other emerging nations.
- Trade diversification.

Federal / Provincial / Municipal / Aboriginal relations

- Federal-Provincial status quo.
- Rise of more independent city-states.

Demographics / Multiculturalism /Immigration

- Large and growing ethnic Chinese communities - tie-in to global expat trading networks.

- English firmly established as global language - Spanish increasingly important relative to French.
- Aging populations and skills requirements imply competition for well-educated immigrants.
- Re-engineering of social policies, structures, services to match changing population structure. Social cohesion challenges.

Haves - Have Nots
- Aboriginals from have nots to haves.
- Reduced but still significant inequalities in regions, peoples, sectors, gender.
- Incremental adjustments at a faster pace.

Public Good – Private Good
- New technology allows for the more efficient delivery of public goods.
- Effective application of economic instruments to achieve public policy goals.
- Redistribution of decision-making and grievance resolution process.
- Evolution toward better muddling...

R&D and Policy Implications

A number of critical challenges face the Muddling Through Canada of 2025, which help to frame the context in which sector technologies have been and are being developed:

- Globalization: trade liberalization and democratization, exploiting multi-cultural diversity.
- Climate change; carbon sequestration, nuclear fusion development.
- Depletion of fossil fuels; hydrogen economy, the "clean car".
- Management of catastrophic events (terrorism, possible mass extinction event).
- Development of the "northern" economy, and other northern issues (e.g. Arctic sovereignty).

Sector Technologies

Nature
- Sensor networks.
- Artificial simple ecosystems.

Infrastructure
- Energy efficient homes - built to world-class standards (perhaps defining such standards).
- Global satellite system, monitoring ecosystems and events in real time.
- ICT (UHS Internet, complex databases, quantum/grid computing…).

Health
- 24 x 7 health monitoring.
- Population-based medical informatics.
- Technology to assist public understanding of "wellness".
- Cheap technology for state-of-the-art technology assessment.

Safety
- Plant and animal monitoring (remote and sophisticated).

Mobility
- Highest adoption of hybrid vehicles in the world.
- Lightweight nano-materials (for e.g. transportation and construction).
- Amsterdam style in-city transportation (bicycle and pedestrian infrastructure).
- GPS and adaptive optimization for traffic control systems.

Fun
- Ice fishing, lobster boils.
- Pick-up hockey revival

Knowing
- Global village – but bigger and busier.
- Improved distance learning, and rapid learning techniques.

- Personalized learning, customized to needs.
- Virtually unlimited computer power for researchers.

Governance
- Real-time, interactive, on-line government.
- Canadian success in E-government.

Cross-sector technologies
- The second (or third) industrial revolution.
- Near-real reality (as opposed to merely virtual).

Policy Advice

Our goal is to suggest niche S&T policies which contribute to enhanced quality of life while respecting core Canadian values. These policies will help us to do better over the next 20 years than just Muddling Through.

There are three strategic options of which we recommend the third:

1. Status Quo (no changes to the current structure), or
2. Focused World Class Strategic Initiatives, or
3. Comprehensive Strategic Approach.

The foundation of S&T is a well-educated population. Our policy therefore presupposes sustained training and learning in S&T - at the K-12, post-secondary, and adult levels.

Government Support of Research
- Improved R&D process.
- Incubator expansion.
- Change in V.C. culture.
- Gaps study, to identify under-invested opportunities.
- Integrated niche technology development.

New Funding and Structure Scenario
- 1.8% to 3.5% S&T Investment to GDP by 2025.
- Restructure federal departments; federal - provincial - municipal S&T partnering initiatives.
- Enhanced assistance for companies.
- Seed funding to initiate international partnerships.

Commercialization of Technologies
- Direct efforts to niche areas, with market size in mind.
- Sustained growth to build domestic large-scale companies.
- Promote incubators and microclusters.

Risks in Strategy

- Insufficient funding; lack of focus and co-operation, difficulty getting people to work together.
- Wasted effort, leading to a money pit with no productive results. Evaluation and performance management; peer review, competency, and process transparency.
- Haves and Have Nots in strategic investments (at industry, university, government, and city levels). Effective resource allocation.
- Well-funded industry or interest groups buy influence (or silence).
- Ramping up new funding over a number of years.

Stakeholders and partnerships for our strategy include industry, universities, governments at various levels, and public / interest groups. Consult throughout with stakeholders and the public - work throughout with partners. Results must be effectively communicated to the public, including criteria for selection of initiative targets.

O SAY CAN YOU C (MERGER USA)

ECO - ↘ ENV - → SOC - ↘

Canada still exists, but is **fading fast**. Our border is porous, and we're informally integrated into the USA as the three newest governance units: West Canada, Ontario, and East Canada.

Economic dependence has proceeded apace - over 90% of Canada's exports now go to our southern neighbor. US companies are everywhere, and **Canadian companies are being bought up** - especially the mid to large size Canadian companies (which are small by US standards). Small companies supporting local niche markets survive, but otherwise our commercial landscape is dominated by our neighbor to the south.

Cultural separation has been gradually eroded to the point of near-insignificance. Funding for made-in-Canada movies and televisions was slashed when the Canadian Alliance-Conservative coalition came to power, and never restored after they left.

There is strong pressure on the Canadian government to consider changing the constitutional framework. A vocal and growing minority supports the abolition of the Canadian government entirely, and incorporation of Canadian provinces into the U.S. as American states - bolstered by the 40-cent Canadian dollar, and **U.S. living standards far superior to those of Canada.**

Migration to the U.S. has increased dramatically, and over half of the graduating classes in the best universities now go on to American graduate schools or companies. As one UWaterloo CS grad put it: "Since the Democrats came to power in the U.S., it's not so different from Canada in policy terms. And I can double my salary by moving south. So why would I stay here? My classmates and I hate to say it, but to be honest we think that anyone who stays in Canada is a bit of a loser."

Many smaller countries have closed their Canadian embassies, referring consular inquiries by Canadian citizens to the U.S. office. "They're practically an American protectorate anyway, and **toe Washington's line** on every international issue of significance," said one diplomat who asked to remain anonymous. "Why should we bother spending millions of dollars to keep up the fiction that Canada matters?"

Canada long ago adopted a harmonized immigration policy with the U.S., prompted by threatened tariff and customs barriers. As a result, immigration levels dropped by two-thirds, with a resulting reduction in population growth - in fact, population has just started to decline in Canada, for the first time in recorded history. The **demographic bulge of elderly people** is starting to feel the lack of young taxpayers to support their standard of living...

Constructed Scenario

Canada relied too much on the US economy, and finally became engulfed by it. Less and less FDI presaged a slow but steady economic decline, leading to a lower tax base and limited government budgets.

The nation has been left behind in provision of world-caliber international services, and is unable to compete effectively in the unforgiving winner-take-all economy. It has become habitual to follow the lead of others - neither vision nor resources exist to carry out bold home-grown policy initiatives.

Less and less R&D is being done at all levels, as increased foreign ownership uses Canada as a branch-plant resource. VC money still flows in modest amounts, but startup companies almost universally sell out to large foreign companies as early as possible; Michigan buys up the entire Canadian fuel cell sector as hydrogen-powered vehicles start to take off. No Canadian companies are in the top 100 globally.

On the regulatory front, de facto authority has been ceded on many fronts to the U.S., as understaffed departments find it easier to harmonize or simply copy policy. Environmental rules are virtually identical, except for certain areas where Canada has looser standards in an attempt to woo industrial plants.

NAFTA has been superseded by NAMU: the North American Monetary Union. The name is deceptive, as along with a common currency, NAMU rules cover customs, common border and immigration policy, guaranteed equal access to natural resources, and a host of similar core issues. The downloading of responsibilities to cities has continued, to the extent that most large urban areas now see their provincial government as almost irrelevant.

Our health system has moved toward a U.S. model, with private providers making inroads everywhere as overstressed governments are unable to maintain budgets. Immigration of skilled workers into Canada has gradually fallen - those at the top of the skills pyramid demand a good economic environment, with public health care levels less important than tax levels. Conversely, emigration of skilled workers has gradually risen, as the brain drain siphons off intelligentsia. Canadians want to come back if things improve, but who knows when that day will come...

Strategic Perspectives

International relations are largely US-centric; Canada is becoming a global afterthought and a semi-offiicial US protectorate / satellite. There are serious questions about Supreme Court and Central Bank representation, and the future of Canadian citizenship rights. A cultural void exists in Canada; much less Canadian content is to be seen, as even the venerable CBC is replaced by PBS.

Demographic age pressures and continuing out-migration along with the lack of immigration is driving widespread use of robotics. Quality of life suffers as multicultural diversity becomes less dynamic. US exerts increasing control over Canadian immigration policy and border controls.

Public goods are suffering, due to less support for R&D and limited state services. Canada simply cannot afford as much as before. The political focus is no longer on excellence, but rather on regional equity, as regions compete over whose standards will decline the least. Private goods are financed from serving global and continental markets; the private sector gives partial provision of previously public services, for those who can pay.

Federal-provincial relations are put on the back burner, as more and more is downloaded to municipalities and the three main regions; large amounts of federal financing now go directly to cities. Rural Canada is falling further behind, mirroring a wider gap nationwide between have and have nots - quality of life is substantially worse for the poor and middle classes. Linguistic issues are dormant, but First Nations problems remain over quality of life and resource controls over land claims. More local cottage and craft industries have sprung up, and individual entrepreneurship and self-reliance has increased out of necessity - but without advanced training and access to substantial capital, these local industries cannot compete in the international market.

How did we get here?

The 40-cent Canadian dollar arose from both domestic and international factors. A government spending crunch from earlier deficit financing along with reduced corporate income taxes and an aging population and health care pressures were factors.

Foreign buyout of the biotechnology industry meant Canada missed out on the next great wave of investment. Lack of commercialization of discoveries in Canada helped lead to the brain drain; even embassies leave Canada as domestic firms move to the US or are taken over by US competitors.

More inflation than the US along with fiscal deficits and weaker Central Bank independence damage the currency. The rise of the Euro and repatriation of US dollars drives down North American currencies relative to the rest of the world. We become even more focused on US trade, as the multilateral trading system and WTO fall by the wayside and Canadian firms abandon other markets; this is exacerbated by the rise of protectionism in other export systems as trade blocs develop.

A tsunami and earthquake hit Vancouver, Seattle and LA / San Francisco, and also knocks out west coast oil drilling platforms. Recurring wars in global conflict zones and the concurrent rise of international refugee flows and terrorism drives Canada toward the U.S. for mutual support, as does a growing global demand (backed by military threats) for natural resources. More and more natural resources are exported to the U.S., and governments quickly become dependent on these revenues.

There is a real and continuing threat of Canadian disintegration. Less prosperity and increased social divisions make the U.S. seem more attractive. Several high-profile cases of terrorist immigrants lead to a common and restrictive immigration policy with US; leading Canada to lose talented immigrants; the U.S. temporarily blocks exports of crucial technologies to Canada."for security reasons". A trade dispute over lumber escalates and leads to blockades of car imports from Canada, after which the government quickly capitulates.

R&D and Policy Implications

How could we avoid getting here?...an R&D policy perspective

Key policy issues to avoid a Merger USA scenario include financing, institutional, perspective, and US relations categories. A co-ordinated approach aiming for generation and commercialization of world-class domestic R&D is crucial.

Financing

- Better financing for Canadian R&D innovations and commercialization.
- Consider impact of bank mergers; improve access to startup finance via merchant banks.
- Govt funding for risky projects from industry? Who decides where R&D priorities lie?
- Modernize VC system for better R&D milieu; no subsidies but better merchant banking
- No more regional development funds as part of wider wealth gap?
- ROI as key criterion for commercial excellence, not regional equity.

R&D Institutions

- Receptor capacity for new graduates and inventions; challenge to improve in future? Expand base of human capital and more entrepreneurs (despite brain drain)
- MBA grads to startup firms with new tech discoveries. More efficient healthcare system? Aging population drivers
- Business and academic linkages for commercialization need to be stronger. Address challenges of finding a business sponsor and sustaining partnerships.
- Convergent, compatible, harmonized IP and competition policies with the US in 2025 Canada? (also harmonized immigration and border controls)

International Perspective

- Need for political vision to see place in this world.
- Decreasing Canadian ownership needs to be addressed.
- Local partners for commercialized discoveries.
- Avoid domestic focus; become internationally oriented in future (avoid navel gazing).

US Relations

- Move closer to US, and gain funding from them for mutually-beneficial Canadian innovation?
- NAMU with Mexico and AFTA? Best deal in North American bloc.
- Become integral part of North American R&D, financing, business networks.
- Migration and immigration challenges to stem brain drain; compare US university foundations / endowments with Canadian equivalents.
- Need to get rid of US trade retaliation (failure to do so partly explains 40 cent US$ in 2025).
- Resource revenues to offset loss of corporate income taxes; lower personal taxes and consumption taxes.
- Regulatory role and niches for Canadian governments if there is harmonization with the US.

Sector technologies

Safety
- Security Perimeter technologies; sell to others and track items of interest.
- Surveillance and distributed communications technologies niches with next generation satellites.
- Flip side - develop surveillance avoidance technology?
- Participate on F-35 and satellite projects for spinoffs from "pay to play".

Governance
- Dilemma of how to employ population - more services, but how many McJobs?
- Lead by higher standards so others need to catch up, rather than race to the bottom.
- More VC funding rather than tax offsets?
- Outsourced R&D network.

Infrastructure
- Wealth generation from new technologies: sewage and water treatment, hydrogen fuel cells.
- Better, faster access to offshore resources in extreme environments.
- Mining (and nano-medical) robots.
- Canada competes with Brazil for mid-level manufacturing; continued outsourcing of manufacturing.
- Modern, distributed cottage industries, mass customization.
- New materials.

Mobility
- Plug into North American ICT network-infrastructure; Canadian provision of information content, news.
- GPS and integrated transport service.
- Producing more services; collaborate on shared, compatible standards.
- Build an all-purpose future wireless device that matures by 2025 - analogue to the cell phone.

Health
- Distributed medical (and educational) technologies.
- Genetically modified foods with pharmacological qualities; pharmacogenomics.
- Progression towards advanced food-pharma combinations, genetic testing and targeted medications; new bio-stealth technologies to avoid detection?
- Health and ICT drive each other; assume nanotechnology is underlying and pervasive.
- Remote diagnosis, operations, medicine.
- Partially privatized healthcare is a driver for biotechnology.

Nature
- Develop enhanced energy, cold ocean drilling, clean water and detection evasion technologies.
- GPS and RPV / UAV drones and robotic submarines.
- Decision to export water will be contentious, especially US demand for our water.
- Green certification niche for Canadian resource exports.
- Green technologies - remedial environment supported by SDTC.
- New energy fuel cells.

Knowing

- Provide technology content in tourism, entertainment, and virtual education.
- Education industry future for Canada; add supplier of brains to hewers of wood and drawers of water; less public funding so more user-pay education fees.

Policy Advice (Memorandum to Cabinet)

Dear Prime Minister and Privy Council Members:

This memorandum lays out a vision for Canada in 2025. We forecast a dire situation in 2025, where Canada is in severe decline, and will suggest options to ameliorate this prospect. Our vision is ensuring a secure and prosperous future for Canadians.

There are three strategy options:

1. Status Quo: continuing on the current path towards a weaker, economically declining Canada, with a severe brain drain, wider income gap between rich and poor, and a declining and aging population by 2025. Canada will have less sovereignty and prosperity, and be too impoverished to provide equalization payments and support R&D.
2. More Integration via Merger USA: participating in regional conflicts in coalition with US, requiring increased defence funding. This is the price to be paid for continued US market access, enhanced prosperity and national security. Federal and sub-national governments' policy autonomy and sovereignty are reduced, with policy harmonization (e.g. immigration) as a result.
3. Autonomy involves a revisited Third Option. Trade and investment dependence on the US is offset with more trade and investment with the EU and Asia. This option assumes there is a revived multilateral trade system.. Immigration policy autonomy is retained with this option as skilled immigrants can work in Canada and sell services or products to the US. However, security and prosperity are at risk with this sovereignty-retaining option.

Recommended Strategy Elaborated:

- Canada's government should be more proactive to manage and structure economic integration with the US for prosperity and national security, while maintaining some policy autonomy.
- Canada's government must harmonize regulatory policies in a common market, enhance common border security, continue supplying natural resources and selected manufactures to US market.
- Canada's government should consider participating in a North American monetary union and help develop a common currency.
- Consultations with stakeholders (citizen engagement) will need to raise the prospect of a referendum to support monetary union, common currency, and further integration.

Stakeholders include provincial, territorial governments; Business, First Nations, labor, environmental, academic, cultural, and new immigrant groups in both Canada and the US. Canada will have to partner with northern border states, US interest groups, and government agencies in exploring an accelerated FTAA.

We acknowledge the many risks for Canadian immigration, monetary systems, border controls, national defence, health, and sovereignty. Constitutional status of provinces and territories will be affected by closer integration; perhaps three regions will evolve in Canada. We will lose leverage on managing immigration of skilled HR with US, and face similar problems in other areas of shared sovereignty.

However, we could gain enormous opportunities for new industries, and for jobs for well-trained Canadians. This eventuality would lead to wages and incomes that are higher overall, and that can maintain our social, health, and educational systems in ways that could remain more equitable than those of the mainstream U.S.

The Canadian and / or American publics may not readily accept changes to Canada's identity arising from closer integration with the US. However, we believe that despite the risks this is still the best policy option. Our goal is to generate strong internal Canadian markets and companies where possible, while sharing resources with the US where mutually beneficial.

A future disaster or conflict may force Canada to consider such closer ties. We recommend conducting research now to determine how best to negotiate closer integration in the future, and where such integration would be beneficial; our scenario analysis has pointed out many potential areas of future co-ordination. Now is the time for high level future planning!

Sincerely,
O Say Can You C Foresight Team

TECHNO-BAN

ECO - → ENV - ↘ SOC - ↘

The Crash was not a single event, but a whole linked **series of catastrophes** that have collectively taken on near-mythic proportions - similar to the feelings evoked by The Flood and The Holocaust in earlier generations. Bitter experience has taught us that technological development does not represent movement forward, and is in fact almost invariably the opposite in the long term.

Let me review for the accused a few of the horrors that technology brought to us. Even back in the mid-20th century, the specter of nuclear war cast a pall over the entire world. Knowing that a strategic miscalculation could lead to the destruction of much of humanity was an existential shock that could be ignored, but never fully accepted. The meltdown of a large nuclear facility in North Korea in 2008 dwarfed the impact of the earlier Chernobyl event, and led to millions of deaths over the ensuing decade in the Korean peninsula.

The release of smallpox by a still-unidentified terrorist group caused tens of millions of deaths before vaccines could be mobilized - shattering the sense of security enjoyed by North American and European citizens. Additional **plagues** occurred, some inadvertently released by irresponsible researchers. A society hit by one catastrophe after another no longer trusted technocrats and scientists, who kept pushing further scientific development to fix the very problems they had caused.

But those scientists were wrong. How horribly wrong, we were to find out on February 29, 2016, when the Nanotech Catastrophe happened. On that infamous day, the grass came alive, turning itself into more and more self-replicating sensors - all due to an improperly-programmed experimental device that escaped unnoticed from a government lab. All plant material was fair game to these devices, which converted 65% of the plant biomass of the North American continent (and more in scattered regions elsewhere in the world) into huge masses of writhing sensors. We could do little to stop the spread - except be thankful that they didn't target *all* organic material...

The resulting famines and atmospheric depletion killed an estimated 80 million, and **traumatized an entire generation**. Order was only restored through the Prudence Coalition - a religio-political movement that took control of a fragmented society with the promise that such catastrophes would never occur again, supported wholeheartedly by a terrified electorate.

And we have kept our promise. **No development is allowed in banned technologies**, which are clearly posted in all public places. Our prudence and wisdom have guided all educational and technological activity in this continent for many years, and you see that no disasters have reoccurred. We have not had much trouble convincing the rest of the world to follow suit since many other countries have undergone similar catastrophes, and remain committed to our doctrine of Preventative Prudence - backed of course by the largest military force in the world.

You see now why your research in genetic vaccines is not only a crime against the legal code but a crime against humanity. While we have allowed some misguided souls the opportunity for rehabilitation, your attempt to sell your research on the technological black market warrants no mercy. Accordingly, you are sentenced to summary execution, to be carried out immediately...

Constructed Scenario

Events have produced a worldwide lack of confidence in scientists, leading to global constraints on and approval of acceptable research technologies. As a result of this control, there are two streams of research: one open stream approved by states or international bodies, and the other underground stream led by scientists whose disciplines are forbidden.

The international community is under the leadership of a "silicon socialist dictatorship", which has effective control and surveillance capability of the global population independent of nation states. There is substantial tension between the controlling elite, and the intellectuals and other population. This enables the underground technologies to flourish with the support of certain international commercial interests and criminal and terrorist organizations. However, most commercial interests find it expedient to operate within the technological restriction regime.

In Canada, the government is aware of underground S&T advancement, but pretends not to notice as long as the research is considered ethically and socially correct. There is increased centralization and less acceptance of provincial dissent in core areas. Federal power has been transferred up to a supra-national government, but also devolved down to provinces in non-core areas. Provinces devolve some powers to municipal government, and communities take power from municipalities.

State-approved technologies are all directed at enabling continued state control and placating the rest of the population. Economic interests involved in state-approved research are all closely aligned with the dictatorial power structure of the state and supra-national government. There is no universal system of public health and education, even on a state basis - resources are primarily directed to maintaining peace and order, and suppressing banned technologies.

Approved vs Underground Sector Technologies

State-approved Technologies

Nature: – No biotech – back to 2000; carbon sequestration, Kyoto round 3; "clean" and green agriculture; greenhouse agriculture.

Infrastructure: - Exclusive coalitions are common; Energy – solar, wind, tidal, fuel cells, anti-gravitation; Water purification technologies.

Health: - Human parts replacement (not bio-engineered); Physical barriers (masks, filters, suits); quarantine technologies; disease sensors (for ruling classes only); euthanasia and implanted death drugs.

Safety: - (inability to manage safety/security long term); electronic surveillance – global and centrally controlled (loss of individual human rights); more bio-metrics; surveillance and access technologies for class-segregated gated communities; chip implants for all members of population.

Mobility: - (travel severely limited, highly scrutinized and very expensive); Virtual tourism, and virtual

visiting; controlled movement on the internet; full biometric control and disease sensors; electronically-enabled grassroots collaboration other than in banned technologies; hydrogen engines; trackless mag-lev vehicles; space travel for state-sponsored bio and genetic research.

Fun: - weaving and carpentry; virtual reality, totally immersive entertainment (audio / visual / smell / touch / movement / sensation); extreme "sports" and reality experience including death risk; soft drugs allowed for population distraction and control.

Knowing: - Individual aspiration controlled by education; instant media and information to whole population (but under state control); implanted sensors to know thoughts and provide thought control; direct info feed to brain and brain extension memory/processor for controlling class only; global electronic brain; quantum computation.

Governance: - (by elites and by access to energy; regulations dominate and no appeals against decisions; centralized global government; global control of regulations for international S&T; global database of all basic research); global integrated information for / on total population using brain and body internet connected implanted sensors; massive information scanning and info extraction software; Weapons technologies for human control – laser, EM, taser, etc.

Underground Technologies

Nature: - Bio-science; Nano; small scale technologies that can be kept hidden; primitive but subversive technologies (even pen and paper based algorithms).

Infrastructure: Nano-material; communications by word of mouth to avoid surveillance; non-penetrable secure messaging on independent internet.

Health: - Genetic engineering; progressive and natural health solutions.

Safety:- Electronic surveillance avoidance / mitigation; independent privacy / security technologies; satellite technologies (non-state approved).

Mobility: - Personal transport systems (mag-lev; hover); teleportation; space technologies for non-state approved research.

Fun: - Alcohol and recreational substance research...

Knowing: - Short multi-media secure messaging; network viruses and worms; intelligence gathering and infiltration technologies.

Governance: - Resistive and aggressive weapons technologies (non-state); S&T unions and organizations; community-level technology development.

Techno-Ban Elevator Speech

On behalf of your governing party, I would like to welcome you to Techno-ban Expo 2025. Thanks for coming. I know there has been a lot of curiosity about Canada's position in the world today, so I have been asked to prepare a short briefing.

As you know, the path of science and technology has clearly failed us over the last 25 years. Even though the CANDU technology was perfectly safe, the meltdown in North Korea taught us all some lessons about choosing our customers carefully. Adding in the modified smallpox plague and the nano-disaster, it was clear that decisive action was needed.

And we have acted, in concert with the world. We have joined in the international code of ethics on basic research, and the total ban on nano-, bio- and geno-research – both enforceable with extreme prejudice by the appropriate UN bodies.

We have tightened our borders through the best of motives – keeping banned technology and organisms from spreading. Yes, this had unfortunate results for the world's refugees, but these could not be helped. Our internal tourism industry is strong, with thousands visiting our many rural gated communities and buying their hand-made crafts. And the country is strongly behind our military community patrols and our techno-police.

Now, some have talked of communities of underground researchers who claim a right to freedom of thought and work. Let me make it very clear that there are no such communities in Canada's North. And if there were, we would certainly be taking action to deal with such dissent. This message goes out especially to our powerful neighbors in the Neo-Luddite Republic – we would not jeopardize our relationship with you by allowing such things to happen.

So once again, thank you for coming. A final reminder that you should not turn left on your way out of the event, as that is a half of town that is best avoided.

R&D and Policy Implications

How did we get here?

The costs of technological mistakes and impacts of major unforeseen resource disruptions shook many consumers and businesses out of complacency. Combined with consumer value changes already underway, a widespread perception arose that S&T was money-driven - not human-driven.

Ethical dilemmas from health and safety issues caused deep soul-searching. Global diseases and pandemics struck several times, jumping across border and class divides with frightening ease. Population densities and mobility allowed rapid mutation of diseases, fastest in least developed countries. The gallant yet ultimately inadequate efforts of health organizations to meet needs became a flashpoint for change - and for enacting policies designed to prevent any future super-plagues from coming into existence, whether by natural or deliberate means.

Along with health security, personal and collective security against criminal and military threats became an increasing issue, fueled by further separation between stabilized geo-political centers and parts of the developing world. The growth of global terrorism gradually created a climate of pervasive insecurity - no one knew where or how the next atrocity might take place. Enviro-crime created by the misuse of S&T was particularly new and worrisome - havoc wrought on ecosystems, networks, and human population health by bio-intruders and early self-replicating technologies was widely feared to be a harbinger of apocalyptic threats to come.

As a result, the conflict between technological progress and environmental / social conservatism escalated to become the major fault line of society, replacing the earlier left vs right distinction. A sense of threat and uncertainty, combined with the perceived reactivity of policy-makers to S&T issues, led to mass movements in favor of restricting technological development in areas deemed dangerous - and these movements ultimately achieved political success worldwide. Media portrayals and accents on catastrophes enhanced the limited-S&T social movement, and support for repressive measures that seemed to offer the promise of safety. The costs of these measures and foregone technological advancement was hidden and difficult to quantify, while explicit costs from catastrophes were clear for all to see.

Conventional wisdom came to be *"out-of-control science and technology created all our problems"* - and those few who disagreed did so privately, in fear of ostracism or worse. New weapons and defences and a few well-publicized incidents of nano / bio tech gone wild lent credence and moral justification to the neo-Luddite position, as did unsuccessful remediation of S&T failures. Lack of regulations, codes of ethics, cooperation, and transparency were seen as a root cause of all the mishaps - one that needed to be addressed forcefully and decisively.

Export of technology was restricted, especially to those countries which had not yet "seen the light" of techno-restriction. Reduced technical / military assistance to LDCs and "rogue states" was combined with increased international aid for family planning, approved educational curricula, and combating of infectious diseases - in the hope that countries with relatively healthy and well-educated populations would be less likely to generate threats in the future. It was also made quite clear that development of

technologies deemed dangerous would be construed as a direct military threat, and met with decisive and overwhelming retaliation...

Memorandum to Cabinet

(Note: this MC is meant by the team to suggest a course of action that should _not_ be taken - at least not in its entirety. The idea is that this MC represents strategies that might quite plausibly be suggested at the current time, which could eventually have unforeseen effects that would make a Techno-Ban world more likely to come about.)

Issue

How to best make Canada a world leader in science and technology (S&T) by the year 2025.

Recommendations

1. Invest in R&D to put Canada in the top three in the world in R&D investment, and in the commercial exploitation of the results and benefits of that investment.
2. Focus R&D to establish Canada as the leader in:
   a. the Bio-based economy
   b. the provision of quality health care technologies
3. Invest to improve the quality of life and the environment in which we live, sustain Canada as the best place in the world to live, work, and raise a family.

Rationale

Canada is on the leading edge of research in bioscience and organic nano-technology, when linked to our core competence in electronics, communications and universal health care systems. We have some of the best research talent on Earth and many of the government's existing investments - CFI, NRC, CRC, and Granting Councils - are allowing Canadian researchers to accelerate their research. But, to meet the goal of joining the top three in the world, much more needs to be done in the research domain itself and in the surrounding infrastructure.

We need to build the quality of our primary, secondary and post-secondary education systems to support this leadership in research, and we need to further build the capacity to move the results of leading research into the commercial domain efficiently and more quickly than our international competition. We need to use this capacity to attract the international financing to build our industrial clusters and our commercialization capacity.

The confluence of these technologies has the potential to make Canada the global leader in the emerging bio-based economy while making the Country a leader in health-care technologies – if we take up the challenge of moving aggressively and immediately.

Option 1 – Aggressive Incentives for R&D ("Techno-Mania")

- Triple direct R&D spending by federal government, by year 2004-05.
- Create new tax incentives and government seed investment for bringing new technology products to market.
- Develop new curricula for universities and secondary schools (working with the provinces) to create Canadian excellence in science and engineering studies.
- Proclaim Canada open to the world for foreign technology investment – we will match any country's incentives. De-regulation program to allow fastest possible development and implementation of new technologies.

Option 2 – Responsible Growth in Science and Technology

- Invest in S&T research while managing risks of new technologies.
- Work with scientific community and international organizations to develop codes of ethics. Harmonize existing codes.
- Create Canada Science Safety and Monitoring Agency to liaise with researchers and the private sector, including a robust database of basic and applied research.
- Focus investment on clean energy and clean water technologies.

Analysis

Option 1 will clearly place Canada in a position to reap the benefits of quantum leaps in technological achievement over the next 25 years. Benefits of this strategy will include:

- Leading in nano-organic technologies, resulting in massive manufacturing benefits through self-replication.
- Use of bioscience to create sustainable bio-food sources for the world, and combat famine.
- Biomass engineering and energy satellite technologies to provide alternatives to nuclear and oil.
- Becoming a world leader in bio-pharma and monitoring systems, and create a world-leading bio-pharma company.

By partnering with corporate Canada and the scientific community, government will be best placed to move forward quickly in supporting new technology development.

Harnessing the world economy will help. Canada will encourage all foreign investment in new technologies by pledging to match the best incentive programs currently in place. Canada will also aggressively develop new markets, especially in emerging economies where, in addition to our technologies, countries may choose to buy Canadian expertise in the safe use of new products.

Risks and Strategies

While government encouragement of S&T is necessary, government has not traditionally been successful at picking winners. Therefore we should work with a consortium of Canada's leading CEOs and scientists to ensure that funding is spent appropriately.

While new technologies can pose unforeseen health and safety risks, we are confident that self-regulation

in the Canadian context will ensure that companies' economic interests are in line with the safety of their customers.

We will rely on the leadership of the UN to ensure that developing countries have put in place necessary safeguards to meet the highest standards possible. We regret the withdrawal of North Korea from the International Nuclear Safety Program, and recommend strong Canadian pressure to reinstate these protocols for the ongoing safety and operation of the CANDU unit.

Codes of ethics have been suggested to encourage use of the precautionary principle in researching and developing bio / nano technologies. While we do not oppose this in principle, it is too early to take a leadership position before seeing where the rest of the world goes – this would compromise Canada's competitiveness.

NGOs and environmental organizations should continue to be managed so that their concerns appear to be heard.

Communications

Canadians are concerned about jobs and the economic prospects of their children. They are also concerned about the quality of health care. We will make a strong case that this strategy will create at least one million new high-paying jobs over the next four years, and new health technologies will take the pressure off health care spending.

Concerns about safety and prudence should be downplayed; any media lines should stress that we are world leaders in safe technology.

TECHNO-ETHICS

ECO - → ENV - ↗ SOC - ↗

In 2025, we **balance technology with ethics**. Innovation is still encouraged and competition flourishes - but balanced with robust foresight and risk analysis capabilities that are routinely used by politicians, businesspeople, and the public at large. Our motto could be "life in balance", or perhaps "look before you leap"!

Our cautious approach is evident in the **precautionary principle** that has been applied to every field with the potential to cause major disasters: genetically modified foods and organisms, nanotechnology, neuroenhancement, and so on. Another rule of thumb we apply was advocated by Dyson, Schumacher, and other thinkers of the last century: technology that is small-scale and distributed tends to be good for the majority of society. (Investment in technology tended to be skewed toward products for the rich until relatively recently - it's hard to believe that TB and malaria lingered on as long as they did, when the investment required to get rid of them was so low.)

A **more nuanced view of "economic growth"** has led to an increase in investment in the commons and public goods. Tools for collaborative decision-making and information sharing are now as ubiquitous as the telephone was a generation ago, with a consequent revival of the sense of community and connectedness. When we watch old movies about the Disconnected Age of the late 20th century, we wonder how they failed to see how out of balance their lives were. Through our social technologies and global networking, we've attracted world confidence and investment toward a new kind of public good - **peaceful and ecologically balanced solutions to global problems**.

Sustainability is another watchword of our times. The economic boom sparked off by the hundreds of billions of dollars pouring into sustainable-tech and renewable energy startups between 2005-2015 was even more spectacular than the previous Internet boom - but unlike that earlier expansion, the sustainable technology boom was, appropriately, a sustainable economic expansion as well. Infrastructure in our cities has, as a bonus, become much more robust with generating and water-distillation capacity being widely distributed.

It took an **international consensus on regulating technologies** to guard against techno-catastrophe - a consensus which is still a work in progress. The developed countries came to realize the dangers involved with giving all technological development free rein, and agreed to a common monitoring and oversight framework in high-risk areas - coupled with sanctions to discourage any who might be tempted to profit from venturing into forbidden areas. Impact committees, regulatory bodies, and citizen oversight panels provide a "sober second opinion" on the risk-reward ratio of new developments - and investors and developers have adapted with remarkable speed.

To date, we have managed to balance risk-aversity and advancement - competition is still very much alive, it is just bounded by more civilized and far-sighted rules than in previous eras. We're *designing* our future - not being taken there.

Constructed Scenario

A Techno-Ethical Canada

World Technology bounded by Consensus Ethical Framework to achieve Trust and Respect:

- Leadership - Influence.
- Consensus Process with Shared Values - Ownership.
- Inclusive and Integrated - Networked, SuperGoogle.
- Implementation Process - ensure achievement of shared values.
- Adaptable (Flexible) Policy Framework - dynamic, strategic.
- Horizontal, distributed decision making and resources.

Negative drivers change mindsets and consciousness:

- Idealistic world requires a crisis of ethics and technology, significant disaster or increasing disparity/greed to motivate shift from nationalist ethos to global governance.
- General support for widely accepted context for values and ethics system - new story of human role in the world is needed, with framework for tradeoffs of tech and ethics.

Drivers:

- Globalized info - knowledge, connectivity, consciousness, systems, feedback.
- Universal communication, and globalization phenomenon.
- Education - social, political; common lines of communication/language/respect.
- Economic dependence and interdependence.
- Standards for visible social conscience; shared ownership.
- Genetic engineering (and similar pervasive breakthrough technologies).
- Legitimate revised UN as global negotiator (i.e. global institution to implement ethics).

Challenges

- Legitimizing institutions: inclusive civil society, participative, continuing growth.
- Building consensus values, reflecting diverse points of view; management of artificial intelligence.
- Effective process for adapting to newer realities - includes destroying rights, changing power frameworks to build new wealth; improved strategic foresight; nurture and deal with aberrant behavior. The new system would be a constantly renewing edgy, creative environment, not a stagnating, conservative / restrictive system.
- Credible dispute resolution.
- Population growth causes demands undermining participative governance - water, food, jobs.
- Ongoing learning for society - need to demonstrate the return on social investments.
- Broadening participation in global prosperity - how to share the benefits of utopia.
- Exploring and understanding Earth and relationship to larger universe.
- Climate change; energy R&D (operational replacement for oil & gas).
- Cost of security.
- Multicultural model - if we make it work, Canada increases influence by example.
- New identity - creative, first mover opportunity as custodian to co-create.

Strategic Perspectives

International Relations - leading by influence: highlight/focus on key issues, move first to influence; opportunity - global ethics fairness framework (values inclusive, multi-polar, wide divergence, dissent rules); limits understanding of multi-ethnic make-up in deciding priorities/accepting global realities (pick our fights); greater linkages to other poles, particularly Asia/China; multinationals - policy and role in Canada; Canada needs to be a player.

Federal/Provincial/Aboriginal - Canadian consciousness; unitary state removes artificial federal / provincial boundaries; distributed governance and decision-making in both directions; integration of government services.

Multicultural / Immigration - return exchange; Canada-China-Korea Free Trade Area ; bolster links.

Demographics - cultural diversity - opportunity to show representative, responsive, fair, equitable leadership; urbanization priorities - implications/balance; global mobility (identity document?) for all.

Have / Have Nots - Access to learning, particularly have-nots; modernizing education system; services procurement system innovation-friendly, equitable; fair health, financial security (reduce disparity).

Public and Private Good - interdependent partnerships; prepare Canadians adequately (Human Resources development); integrate civil society, corporations, government; demonstrate viability of techno-ethic structure and consensus; ownership of information: public vs proprietary approach.

Technology - Canada should be a global player (partner in most, leader in some), skills development.

Sector Technologies

Nature - Policy framework; bio-tech purifying; InfoTech, Surveillance, planning.

Infrastructure - global information management system (SuperGoogle) with free access to information; integrated global energy grid; optimize human / machine production mix (ethics, AI, robots); biotech.

Health - telemedicine; policy access, equity (who pays, uses, manufactures, distributes, and traditional methods); role of policy in society, promoting wellness; genomics, proteomics; therapeutics; info management, personal medicine.

Security - financial consumer protection; strengthen first responders; universal surveillance (vs privacy - confidence, sensors, trust, restraint, embedded sensors).

Mobility - mass transit (zero emission); local human scale development / telework, community designed for walking; global communications systems, tech interface (automatic translation).

Fun - virtual reality, electronic and pharmaceutical interactive techs (convergence of mindsets); pro-active work-life balance framework.

Knowing - universal knowledge (SuperGoogle with instant, wide access; fact-based reporting; empiricism, objective inference, and validation support decisions); virtual world - simulation, diagnostics; universal translator (reading / speech); scientific literacy growth and wealth creation.

Governance - forging broad Social Policy consensus (inclusive, wide divergence, rules for dissent) for reliability / trust; global communications; policy on performance incentives and costs of responsibility; health standards with advances in government.

R&D and Policy Advice

How did we get here?...key developments and technologies

2005 Canadian Multicultural Technology Ethics Council founded. R&D in social governance issues underway, generating consensus for self-governance, distributed governance, and systems research. Responsibility of individual to innovate and effect change, and change in reward systems; build consensus for implementation to effect desired systemic and governance changes.

2010 Pollution levels are massive - deaths per year reaches unacceptable level. Means in place to strengthen International R&D networks and facilitate international SME alliances; framework for innovation connectedness over distances. Better investment climate for advanced technologies - finance, IP, international multi-sectoral R & D networks.

SuperGoogle for Info - Canadian support initiates action to create super Google resource. Virtual world simulation engine to address governance, ethical frameworks, foreign policy review. Shift in thinking bridges gap between natural and social sciences - convergence, but recognizing diversity.

2015 International Privacy Commission formed; government change attitudes on social good investment; global Biotech regime; International Space Agency.

Nano bio-technology in practice to solve pollution; cancer cure; convergence of photonics, biotech, nanotech brings new opportunities; alternative energy sources surpass gas / oil. Canadian government agreement with multinationals; SME alliances form legal regime.

2020 World patent, copyright change; multinationals accept at-cost sales to developing countries. Expand international consensus on bioethics to technology in general; international treaty on use of information, and framework for access to personal information.

US invasion or threat of invasion would be a trigger for Canada to address water or other resource shortages, encouraging and elevating ethically centered SMEs and leaders. Another triggering event: biotech crises could lead to UN lead and funding action. Clean urban air, zero-emission public transit, and increased emission monitoring.

2025 Global health - unsustainability forces shift to wellness orientation. Nanotech breakthrough on pollution. Evolving new system of world governance.

Wisdom Google - provides single considered answer to information requests.

NB: Both stimulus from negative events and sustained positive effort will be needed to achieve the necessary change.

Memorandum to Cabinet

Shaping Canada`s Future - Building the Foundation

Objective:

An opportunity exists for Canada to become a leader in developing the institutions and technology that the world will need in 2025 to achieve trust, respect, and technological growth under a consensus-based Global Ethical Framework - a framework similar in many ways to the principles embraced by the first citizens of our land, members of the First Nations. This would involve a number of steps:

1. Leadership in developing domestic institutions by creating a consensus-based process that will generate shared values, partnerships and ownership by all participants, in a policy framework that is adaptable, flexible, dynamic, and strategic.
2. Building support for development of a global ethic framework, with terms and focus based on domestic experience, that results in an inclusive and integrated networked world (with a SuperGoogle that responds to requests for information by intelligently combining the contents of multiple on-line documents); to be completed by 2025 with an implementation process to ensure achieving shared values, with horizontal, distributed decision-making and resources.

Options:

I No new action: penalty in terms of foregone growth opportunities, lack of access to new technology and increased costs for buying and partnering existing technology - plus little or no influence on key R &D and foreign policy decisions world will take in next 5 years.
II Recommended option of an ethical consensus-based technology policy, at a cost of $ 2 billion over 5 years, with benefits of at least $ 8-10 billion.
III Bandwagon, reactive, follower approach - money allocated to hot technologies, but no guarantee they will support national interests.

Recommended Strategy:

- Policy Research and Government Action to improve inclusiveness.
- Investment in Governance and Systems Research, including risk assessment and decision support, bridging natural and social disparity; increasing the effectiveness of distributed research groups.
- Knowledge and Learning technology - universal free education, distance learning; Super Google for natural and human resources information; support bio and nano-tech and sensors to provide natural resources information (bio, personal, pollution).
- Global Partnerships - Connecting Canada with world leaders in each technology and country; revisit the links each year or decade (dynamically adapt to new leaders).
- Innovation-friendly Environment - strong investment climate, commercialization, regulation; revamp IP regime; tax incentives to increase investment; matching venture capital.

- Stakeholders and Partnerships in this strategy include individual Canadians, federal / provincial / municipal governments, the private sector, academic and NGO groups, and public and private international partners.

Communications and Consultations:

Risks and Problems in Strategy
- Why Manage Disaster? - to Minimize Risks.
- Lack of International Buy-In - obtain Niche Support.
- Public Does Not Support Policy - major Consultation Effort.

Prepare Canada for tomorrow's world by building:
- Basis for ethical, inclusive governance (e.g. Multicultural Technology Ethics Council).
- Strengthened R & D.
- Innovative, dynamic investment environment.
- Linkages with world leaders, and innovation networks.
- Acceptance that global ethical framework achieving transparency and accountability provides guidelines to manage and direct legitimate expressions of greed and social friction.

Lay foundation for global ethical framework and increase influence:
- Series of international meetings.
- Investment in international research.
- Support for new international institutions.

TECHNO-MANIA

ECO - ↗ ENV - ↘ SOC - ↘

Good evening viewers! Cassie here at Naked News International - I'm the sexiest avatar on the Net! Just a reminder to our viewers that this week we're offering a half-price special on personalized interaction - so if you want to *really* add spice to your newscast, < click here! >.

In the financial news today, MSABCNN dropped 5% as shareholders digested a class-action lawsuit. Viewers of the network allege that its neurointeractive features are addictive, and can induce seizures and paralysis. Company spokesperson Melinda Williams denied the allegations: "Scurrilous rumors! Besides, **customers have the right to buy what they like**." We at Naked News would like to remind our viewers of our strict non-neuro policy - just good clean fun!

News of the company's Supreme Court victory sent GalaxyMedia shares up 12%. At issue was the right to set differential pricing rates for books and movies for library purchasers. "It's a great victory for the North American people," said spokesperson Hannah Cantu-Paz. "No longer will libraries steal the profits of hard-working artists and writers. This farsighted move will keep the economy growing and help our artistic sector thrive. Now we can move on to the issue of opening up patrons' reading habits to the private sector for legitimate marketing purposes."

The Dallas Police has become the most recent metro force to contract out management and operation to the well-respected StandOnGuard Corporation. Previous customers have reported a significant drop in expenditures, combined with innovations such as negative-feedback bracelets for prisoners and anxiety-reducing pharmacologicals in the water supply of troublesome neighborhoods. "We're confident that StandOnGuard, in combination with its sister company KeepThemSafe's prison services, can provide a superior product and help us avoid a budget deficit in coming years," said Dallas Mayor Steve Bush. "And now we can offer our citizens the option of speedier legal services for a modest premium. After all, it's only fair that **you get what you pay for**."

Cleanup continues in the nanotechnological mishap in Mauritius, an island nation which was quarantined by Global Security forces last week. While authorities have not released the extent of damage, company management states that the economic impact is expected to be modest.

Environmental terrorists struck again yesterday, assassinating executives of two forestry companies. The Earth Liberation Movement claimed responsibility, charging the companies with "logging the last remaining vestiges of our irreplaceable forests". The Secretary for Resource Development dismissed the allegations as laughable: "Oxygen recyclers and bioengineered algae do the same job more efficiently, and provide millions of jobs to boot. These despicable terrorists are committing **the ultimate sin - holding back technological progress and harming the economy**."

And now, an informative documercial - give your baby a helping hand, with genetic enhancement! Safe, easy, and effective, Genhancement promises to put your child into the 95%ile or better in appearance and IQ, with optional personality traits like obedience and aggressiveness available at a modest surcharge. We profile several parents who tell us why Genhancement is the way of the future. Doesn't your baby deserve the best?

Constructed Scenario

Technology and the rate of technological innovation are dominant drivers in the Technomania world. Specific technologies and technological priorities were discussed at the outset of the meeting because they were considered the essence of how Technomania will evolve. (See list below.)

Governments are "approvers" rather than "initiators". Governance issues emerge as technologies emerge. The motto, "Technology is Legislation" was suggested. Community leaders are designated by interest groups rather than elected by the general population. Generally government plays a less important role in the daily lives of individuals in Technomania than it does in the world of 2005.

Private good dictates policy more than public good. Money and profit are major motivators - in fact, public policy and private good may become synonymous. The private sector delivers more services than the public sector. Decisions will be based on feedback mechanisms from the public domain.

There is a pragmatic attitude toward the environment and nature. Instead of maintaining and preserving the environment because it has intrinsic value, the environment is exploited, managed, and artificially maintained in exchange for economic gain. Access to true, natural environments is limited to the elite.

The concept of the true "free market", as opposed to a managed or manipulated free market was discussed. The former is ideal but the mechanism to achieve it is elusive. The relative economic well-being of the population is superior compared to the world of 2005; however, there are still economic strata within the population. These may be better described as "have-somes" and "have- mores" rather than "haves" and "have-nots". This stratification may engender conflict even though the general "economic bar" has risen.

In Technomania, the ability to monitor citizens is extremely advanced and invasive. It has evolved to pervasive monitoring of individuals in multiple activities in their day-to-day life. The technology to do this yields multiple benefits to the individual and society in terms of education, entertainment, personal safety and individual health. However, individualism, privacy, and freedom may be undermined as the "watchers" gain greater ability to detect and censor specific behaviors and thus determine future activities of the individual.

Great strides have been made in health. Health care now focuses on prevention, the individual, and a holistic approach. It is self-serve, less invasive (in terms of procedures) and very proactive.

Concerns about personal safety and security are significant, perhaps over-emphasized. People are willing to sacrifice freedoms and privacy for greater assurance of personal safety. Homes have hi-tech security systems, and the outside world has universal, widely dispersed, intelligent monitoring systems.

Although travel (even interplanetary) is cheaper, faster, and more comfortable and personalized, it is used less. Fear for personal safety plus alternatives to travel, for both business and entertainment, are the main reasons for the decline.

Life in 2025 in "Technotopia" - Elevator Pitch

Joe lives in Regina, Saskatchewan. He works out of his house and makes money by playing in an on-line "sim-Sask" that is an entertaining version of Saskatchewan constantly updated from thousands of inputs, both from human sources and from monitors scattered throughout the land, embedded chips in cattle, international commodity data, and so on. (Sim-Sask is a subset of a larger system called Sim-Canada.) He engages in power politics in this virtual world, and is rewarded when his decisions improve certain values in the simulated model. Policy advice percolates out to both government and industry from this on-line sim-Sask.

Joe's own health is monitored and supported through sim-Sask. His clothing monitors his health and he consumes health resources in a constant, low-level, ongoing way. The old model of big hospitals as a point for health intervention is dead.

Because Joe does most of his work and has fun online, he travels less. He and the things he buys both travel less - his books are printed in the local bookstore, and he recently bought the latest 3-D printer to allow him to print household goods in his own basement. Only commodities and raw supplies move on the rails these days. But he doesn't feel isolated, because he can print the very latest toys and tools as quickly as somebody who lives in New York. In fact, Joe has merged his private augmented reality with a New York version; when he walks around Regina his VR glasses let him swap the sights and signs of Regina with those of Manhattan.

Public institutions have withered to a great extent. Most institutions that used to be public are now private. On the other hand, Joe and like-minded people from across the world find it easy to organize and to influence both business and government by forming ad-hoc political groups as needed.

Joe's virtual Saskatchewan blends seamlessly with the real one. In addition, he has a number of virtual friends who are software agents that share his interests and even do things for him when he's not around. In a sense, Joe is no longer an individual, at least inside the net, but a small crowd. He and his agents network constantly, and in order to keep his head above water he has to constantly educate himself - because everybody else is doing it too.

Joe has friends in China and Germany; he met them through sim-Sask when their farming communities came to share similar political and economic issues as Regina. In the subsequent temporary merging of the simulations, Joe met many people from all over the world. He talks to them all the time - through translation software, one friend speaks Mandarin and Joe hears him in English. There's no distance in Joe's world.

Joe has a lot less privacy than he used to; he's constantly watched and monitored by mostly automated systems. Generally he never notices--but the one time he tried to research nuclear weapons on the net he found that his version of sim-Sask subtly changed; some things he used to be able to do, places he had access to, changed. His entertainments began to change to introduce politically correct ideas into his activities; annoyed, he stopped doing the research.

On the whole, Joe is happy. He feels that he has a lot more control over his life than his parents or grandparents did. But when he talks to them they disagree. They point out that Joe has a lot less

privacy than they did; the scope of his ability to act and travel in the real world is much reduced from theirs. Much of southern Saskatchewan is a desert, and few of the remaining farmers own the land they work.

The one principle that Joe accepts is that his life is constantly changing, and there's nothing he can do about that. You have to keep upgrading your life to match the world--or you'll get left behind.

Notes

Life is local, but your actions have global consequences. Everybody knows this, but now it's practically the law. Municipal governments communicate with other municipalities across the entire world, as do individuals; it is easier for groups at all levels to spontaneously organize now. People buy far fewer products manufactured in distant places - books are printed in the local bookstore, and many people have 3-D printers that allow them to download and print parts and simple devices for use around the house. Goods travel less; so do people.

Several Canadian cities have grown to colossal size, and are effectively city-states. Much of the trade in the world takes place between these megalopolises.

Canada's multiculturalism has been a strong positive force in preserving the nation's international relations and trading success; it is easier now than at any time in history for people to retain their cultural uniqueness while participating in the world. At the same time there is great potential for conflict due to people's ability to deliberately tune out one another's messages.

Poverty has not been eliminated, but the bottom of the social strata is higher than it used to be; what people consider wealth and poverty has changed, however, and many people consider themselves poor who would consider themselves well-off in 2003.

Technological wonders have been created, such as the space elevator, which dropped the price of access to orbit to unprecedented lows. Nonetheless, people travel less than they used to. People travel online rather than physically, because virtual experiences can be as convincing as reality.

Power works differently in this world. The Federal government still exists, but its function is more as a facilitator of interests that are brought to it by more fluid social mechanisms. Consensus percolates up from the grassroots to the federal level much more easily than in the past; it is on the provincial level that government is atrophying.

Constructed Scenario

Technologies

Specific Technologies:

- space elevator
- 3-D printer
- human cloning technology
- animal protein production via stem cell technology
- human-computer integrated systems
- augmented reality
- cyber clothing
- radio-frequency tags
- human-machine intelligence interfaces
- holodeck
- cyber games
- carbon sequestration
- above weather relay (aerostacks)

General Technologies:

- health technologies
- educational technologies
- biotechnology
- monitoring / surveillance technologies for individuals and groups
- linkages between global monitoring and education systems
- wireless energy transmission technologies
- quantum computers
- technologies which generate readily available energy
- major changes in manufacturing (e.g. nano-manufacturing) and distribution
- e-government

Policy Advice

Canada requires a new vision for the future that situates us appropriately within the fast-paced techno-world of the future. This vision is:

"A Better World from Canadian-Led Technology."

<u>Key options for Strategy</u>

1. Create a National Science Academy.
2. Initiate an International Science and Technology Organization with Canada as chair.

<u>Enabling Strategies.</u>

- Maintain arms length relationships

- Create private-public partnerships - e.g. Federal - Private
- Provide financial incentives to private sector (such as tax incentives)
- Maximize knowledge exchange and sharing by freely publishing publicly funded S&T
- Assign a $1B budget to the effort
- Fund universal internet access (linked to universal health care)
- Go beyond just pure science
- Facilitate OECD / developing world access
- Promote multi-use (synergistic) commercial technologies
- Promote sustainable development

Enabling Partnerships
- Private Sector
- Universities
- Provincial Institutions
- International Institutions
- Web-enabled real-time public consultation

As an example, consider Northern communities, which are currently dependent on importing manufactured goods. But why not introduce beamed power, 3-D printers, augmented reality and full internet connections?

Now Northern communities can have the latest products as quickly as anyone else, as well as a broader variety of products. Distance will be essentially destroyed for them. However, augmented reality will permit them to edit their personal reality, so as to preserve traditions and traditional languages. We expect this to have widespread positive effects on the social fabric, environment, and local economies of our Northern regions.

Technomania Vignette

"You're lucky, ***you*** don't have to feel sea-sick because you're not actually here!" So says the director of the Canadian International Academy of Sciences as he stands swaying uneasily on the deck of a giant ocean platform. The thousand-or-so *colleagues* who are looking through his eyes and hearing through his ears have just aggregated their responses to cause a message to appear in the director's visual field, saying: "Stop leaning back and forth like that!"

What they're trying to get a look at is the thin, gleaming ribbon of black that rises from the top of the ocean platform. This ribbon goes up and up, piercing the clouds and disappearing into the sky. It's the space elevator, finally on-line and about to carry its first cargo to orbit.

He's having a bit of trouble with his networked sunglasses, though. He'd printed them out from the 3D printer in his cabin last night, but only discovered afterwards that the printer had last year's plans for netglasses in its memory. Apparently, his signal keeps dropping out. The seasickness just makes the situation worse.

"This is a great vindication of your approach," says the Minister from the Eastern Standard Tribe, the east coast's most influential ad-hocracy. "Not just business, but government, science academies and the public all investing to build a visionary bridge to the stars." The Minister sounds a bit stilted when she talks, because ***she too*** has a very large constituency gazing out of ***her*** eyes. The East Coast is keenly interested in sending its own cargoes up the elevator in the near future.

Mindful of the audience, the director says, "It's taken a long time to get here. We couldn't have made it without the creation of the National Science Academies back in 2005. Especially opening up the whole research and development process for public and corporate collaboration made a huge difference."

He smiles at the Minister, knowing he's scoring points with the whole East Coast.

Somewhere in this small crowd is another constituency, represented by another individual; it's the builders of the cargo that's going up the elevator. Northern communities in Canada formed a partnership with power companies to fund the building of orbital microwave relays. Electrical power is beamed to the north by bouncing it off these relays. They used to cost an exorbitant amount, but the one that's going up the elevator today will cost less than a tenth than an identical one that was sent up by rocket last month. Now that it's so cheap to get to space, plans are going ahead for a set of solar power satellites, which will provide nearly free electrical power everywhere and finally make the production of clean hydrogen for automobiles and homes practical.

The speeches by the old, bent-over Apollo astronauts are over. It's amazing the old guys are still alive, but they walk around monitored by the very clothes they wear and cared for by medical implants. The director's own clothing is telling him that his nausea is nothing to worry about. Its constant link to his medical records and AI doctor in Montreal ensures the accuracy of the diagnosis. But that doesn't mean he has to be happy about it.

Everyone waits with bated breath, and after a brief pause, a horn sounds. The space relay is packaged in an ordinary shipping container, which is strapped to a crawler that now proceeds to slowly rise up the thin carbon nanotube cable. Silently, it accelerates up and out of sight.

"Is that it?" asks the East Coast. She looks a bit disappointed at the simplicity and silence of the event - and so is the director, to tell the truth. The days of giant, roaring rockets are over. So are the days of separate government, private and public initiatives, when a single group could take credit for major innovations and new products. They all work together now, but this new kind of collaboration sure does work.

He watches the little black rectangle dwindle to a dot and disappear at the zenith. Momentarily inspired, he imagines everybody in Canada standing together at the top of the cable, pulling together on a long rope to haul the power relay into space. *Throw in the global human-machine interface lending a hand*, he thinks, *and that's not far from the truth.*

VIRTUAL AVATAR

ECO - ↗ ENV - → SOC - →

(presentation in grade 4 history class)

Good morning everyone! My talk today is about "Why Life has Improved Since the Twentieth Century".

First of all, they used to leave home *every day*. Can you imagine? Meeting thousands of *strangers* on the street, risking a beating or worse, breathing dirty air and germs - it's so gross!

I'm so happy that we **don't have to leave home**! They used to have these big yellow thingies called "school buses," which looked like < this >. And kids of our age would have to get into them every day and go to school and then get into them every day when school closed and come home, and they were smelly and gave out dirty gases because they ran on an "external combustion engine". But then the grown-ups realized how silly that was and made the Net, and **the Net is just like being there**, only better because you don't have to go there and come back.

They used to spend a lot of time with small boxes called "televisions", which were really stupid because you couldn't talk to them at all - the television just sat there and showed you stuff, whether you were interested in it or not. And it was ugly! Just a flat picture, like the "photographs" some of our grandparents have except the picture moved, but it didn't hardly seem like you were there at all! I don't know how they could watch them for that long - it shows < here > how they spent *hours* every day with those little boxes, and their brains were only half used and they didn't even know what was really happening in the world. Now we can find out about whatever we want just by asking, and it's all true!

And they used "PC" to mean Personal Computer, not Personal Companion like now. A Personal Computer was like a big box which was really really hard to use and it was dumb because it kept making you figure out how to use it and didn't even notice when you were getting angry, but now **your Personal Companion computes whatever you want and is like a friend to you**. And you couldn't ask it to do anything, and it wouldn't help you out when you were feeling bad or suggest fun things to do when you were bored and it wasn't friendly at all. That sounds awful, doesn't it? No wonder they were so bored and lonely.

And almost everybody in the rich countries used to fly around in airplanes to go and see other places, instead of just *Looking* there like we do now. Imagine having to actually go everywhere to do anything! Their planes would crash and they'd get diseases and stuff, but they still kept going around to see other places and meet new people. I guess that's something we still like to do, only now it's so much easier and **we make friends from everywhere**. I don't even know which country most of you are from, and after all, who cares?

That's the end of my presentation, and I hope you like it!

Memorandum to Cabinet

Background

Mr. Prime Minister, Members of Cabinet:

Canada has embarked on a number of strategies to enable Canadians to survive and thrive in a knowledge-based economy. We have invested in SchoolNet, the Innovation Strategy - the Connectedness Agenda - we have taken many appropriate initial steps.

Now is the time to connect these together.

The Avatar

Imagine a device that will increase productivity of both the public and private sector by a factor of 10 in the next 10 years. A device that will cut health care costs to a tenth of what they are now. A device that will revolutionize our social safety net, access to which will be written into our Charter as a fundamental human right. *Avatars* – personal agents that act on our behalf.

How do we get there? What science research, skills training, and regulatory policies will be needed?

Current policies are not sufficiently bold to make Canada the best place in the world to live. Consider the Romanow report, which was tabled only a few months ago. It's already out of date. Your national homecare program? It's only a bridge until the avatar is introduced.

The world that most Canadians live in will change dramatically.

You say "what is an avatar?" I say "what is electricity?" It's always there - it always works for you.

You no longer do things for people, you empower them to do things for themselves. Do you remember the McDonald's jingle from a few years ago? "We do it all for you!"
That was a myth - you still had to decide go to McDonald's, decide what you want, pay for it, pick up your tray, get your napkins, find a table, then dump your trash. No more.

It's like barn-raising. It is community self-help that transcends political ideology. It empowers individuals to help themselves and one another. It will build social cohesion and rejuvenate our communities.

We are embedding virtual entities of ourselves within a parallel reality.

It is the human helper. It allows you to reach out and help others, and help yourself. It is a self-organizing society and community.

Recommended Strategy

Here are the three crucial steps Canada must take today to prepare for our avatar society.

#1. The Content

In such an environment, content is crucial. We must develop a way to authenticate information. Millions of people around the world consult the web for health information. But how do they know the information they are getting is accurate, helpful and can be trusted? How do you know it's enough to give your child two aspirins and put her to bed? With the Canada Health Network, a site where people go to get such authenticated information, we have already started. But we must go much further.

In an environment where people are so intimately linked to their avatar, they must have the confidence to trust the information.

Mr. Prime Minister, as a first step you must found a new domain: ".ava". Anyone in the world surfing a .ava site will know that the information is accurate and can be trusted.

#2. The Brain Trust

Next, we need to bring together science from a range of fields. The researchers are dispersed, isolated in their own labs, without any strategic direction. We must bring together the neurobiologists, the computer scientists, the mathematicians, physicists, chemists and electricians. And they will converge on developing artificial brains at the nano level.

Mr. Prime Minister, you must found an Avatar Institute.

#3. The National Project

Now, consider the invention of penicillin. It had huge benefits for people who previously would have died because we dared not operate on them. We dared not operate on them because the odds were 8 in 10 that they would die of infection. Now, the neighbor who needs a new leg, the wife who needs a caesarean and her unborn child, and the father with peritonitis all live - because of penicillin. But all of a sudden we had to provide more hospitals, train doctors and nurses, and finance the system.

Today we have a technology with all the power of penicillin that will change society just as much. And we have to prepare for all the wrenching change it will bring about.

That means the institutions and regulatory frameworks must change to extract the maximum benefit from this technology. That means aligning our laws, our IP rights, our privacy regimes and health regulations. Electronic networks are as important to Canada's future as electric networks. They will be a public utility.

Mr Prime Minister, you must implement a national project. This is of the same magnitude as the cross-country railway - as medicare.

Risks and Problems in Strategy and How to Manage Them

Here are the challenges we face:

1. Implementation will fail if we are unable to mobilize the resources because of jurisdictional issues or lack of vision and imagination.

We need ownership and buy-in by all parties, and a driver who's going to knock heads and bring people together. We need a detached senior cabinet minister - who knows the system both internally and across the country, who is respected - to drive the process.

2. Implementation will fail if we don't fund it properly.

It requires budget restructuring with the potential for exponential benefit increase. You don't need to find more money, you just have to put it in the right place.

3. Implementation will fail if people's fears trump their hopes.

People don't like change.

The Canadian public must buy in. They will buy in by involving them right now. Citizen engagement is key. And we can harness our technology to do it.

Mr. Prime Minister, technology is driving us inexorably towards this future. Right now, we still have a choice. We can take control of the technology and use it to our advantage, or the technology will control us.

YOU ARE WHAT YOU INVENT

This team is a bit different from the rest. Instead of fleshing out a scenario and then backcasting, we will first focus on a detailed technical exposition of a potential technology. Then we will build a companion mini-scenario showing how Canada would change with this new technology - using a similar process for fleshing out and analysis as the other teams. Finally, we will backcast and specify R&D and resource requirements to start building the technology.

Criteria for the technologies to be considered:

- *Impacts the ordinary person's daily life - a fundamental everyday technology.*
- *Of direct benefit to a large majority of the population.*
- *Practical to build (at least in its initial stages) with near-term science and technology.*
- *Mid-size investment (say, $100 million to $1 billion for starters).*
- *Large element of "public good" - market may not provide this technology as effectively without significant public-sector support.*

AI Medical System

In the area of health, individualized medicine has become routine. A **nationwide AI medical system** called CanMed - developed by the Canadian government in partnership with a consortium of universities, teaching hospitals, and companies - has both kept a lid on rising health care prices and significantly increased the effectiveness of preventative medication and advice.

Almost everyone now has a CanMed health module in their wristcomp, which tracks vital bodily functions and alerts medical services in the event of an emergency. (Most models even give lifestyle advice, which is unfortunately still not listened to by many users.)

CanMed analysis servers run 24 by 7, constantly examining health data for the population. Searches for patterns of illness are greatly aided by the vast and ever-increasing quantities of epidemiological and diagnostic data provided by a population base of 35 million patients. Even environmental risk factors are considered...Canadians sleep better at night knowing that CanMed and its dedicated team of human analysts are ceaselessly working on improving their health...

CollabNet

Moving beyond mere transfer of data, the CollabNet was a **public system of collaboration tools** available to all, that revolutionized society. It came to form a key public good in the 21st century - one that Canada took a lead on developing - and catalyzed investment in the theory and practice of developing **peaceful and ecologically balanced solutions to global problems**.

CollabNet's benefits ran the gamut from generation of local communities to distributed problem-solving to a flexible disaster response network. Once governments and universities made collaboration and mediation technology a primary R&D focus, vast human potential was unleashed...

SmartCare

Vision

Canada is a global leader in providing Canadians better health at affordable cost through *Smartcare*: a personalized, automated, total health management system.

Rationale

- Recognition that a focus on treatment is necessary but not sufficient for personal health.
- Rising service expectations.
- Advances in medical IT capabilities.
- Increased healthcare needs of an aging population, and environmental sensitivities being manifested (particularly in younger age classes).
- Need to provide more services with less resources.

Net result: A growing gap between what people need and want, and what they are getting.

Options for Strategy

1. More of the same: unsustainable divergence of expectation and capability.
2. More of the same, but done better: still unsustainable in the medium to long term.
3. From institutional and paper-based to personal and automated: risky, but best hope for the future.

Our vision is a personalized total health management system built on the following key innovations:

- Person-based ownership of health information with appropriate privacy protection.
- Personal monitoring of health and wellness through implanted / external monitoring devices.
- Automation of information flows among principal agents in total health care, including individuals, doctors, hospitals / clinics / laboratories, and emergency medical services.
- Synthesis and analysis of anonymous data for assessing health of the nation.

Key Enabling Technologies and Policies

- AI system for collection and analysis of personal physiological and "sense of well-being" monitoring data.
- Electronic medical records, and seamless prescription / billing system.
- AI and adaptive networks for emergency service provision.
- Affordable monitors for environmental quality (particulates, toxics, contaminants).

Enabling activities 2015:

- Within 1 year: Develop a vision, principles, architecture and strategy for establishing SmartCare in Canada.
- Within 2 years: Development of standards - protection of personal privacy, data interchange.
- Within 3 years: Legislation to migrate primary responsibility for health care across Canada from provincial to federal jurisdiction, and to establish policy, regulations and a 7-year time-table for implementation within Canada.
- Within 7 years: Government will certify component enabling technologies, with market rights protected for term periods.
- Within 8-10 years: Staged phase-in of SmartCare.
- After 10 years: Disincentives for opting out.

A Day in the Life of SmartCare

To better visualize the possibilities of the system, consider a day in the life of a typical SmartCare user...

Your SmartCare monitor wakes you up after just the right number of sleep cycles, with a judicious selection of some of your favorite tunes. (Of course, the SmartCare monitor is designed with a pleasing consumer form factor, and embedded in an appropriate place in people's homes.)

In the bathroom, basic vital statistics are monitored through sensors and analysis of excretions. You get dressed, including your personal wearable health and environmental quality monitoring devices (which could be embedded in a watch, necklace, ring, or belt). Routine drugs (e.g. insulin) would be released automatically as pills, in food, or perhaps from subcutaneous implants. And to start the day off right, you consume a nutritionally balanced breakfast which is optimally balanced between your tastes and health status.

As it happens, today is one of the rare days that you're not feeling so good. Your SmartCare monitor routinely sends data to a MedServer (data storage and diagnostic center), and can often offer advice on what you might want to do. In this case, the symptoms are ambiguous and a video conference is deemed insufficient to resolve the issue, and so a an appointment with a health professional is automatically scheduled (with reference to your day's activities) to address the health issue that has been detected.

So you head off to the clinic (walking for the exercise and other health benefits). A meeting takes place with a health care professional, who brings in a specialist through video conferencing. These professionals are authorized to assemble and review your appropriate personal digital health records onto the local MedServer, from its constituent parts which are distributed across the network (stored as distinct databases in different locations across a distributed network to protect privacy of the information). Different levels of information release are possible - in this case an intermediate level, including genetic information but excluding some older history and incidents, seems to be sufficient.

It turns out to be a condition easily treatable with medication. A prescription is provided and submitted electronically to your pharmacy of choice, with charges handled automatically (direct debited from universal health insurance provided for all Canadians). No more misread prescriptions due to messy handwriting!

As you walk from the clinic to your office, an ambulance whizzes by, with all traffic lights automatically greened before it arrives to speed its way. Medical emergencies (e.g. heart attacks) are almost always detected by one's personal wearable monitor, which alerts emergency services. Response is then optimized depending on urgency of the problem, location of nearest hospital and EMS vehicle, services available, and length of waiting list.

Later in the day, activities are scheduled to attend to personal fitness, with SmartCare acting as a coach, scheduler, and reminder. Biomonitoring of exercise benefits and habits is routine, and a new automated physical stimulation system to develop muscle strength and aerobic capacity has just entered clinical trials. And SmartCare doesn't neglect the psychological dimension - it monitors your mood, and suggests activities in the day to attend to one's sense of well-being...

Risks and Partnerships

We are hopeful that the right mix of incentives and regulation will stimulate market forces that cause the technology to be created - however, this assumption must be validated, and checked during the progress of the program. Healthcare continues to be a provincial responsibility, which poses a barrier to co-ordinated federal action. Finally, individual Canadians may resist change.

Partnerships to build include federal / provincial / municipal governments, associations of health care professionals (including doctors, nurses, and other hospital staff), researchers, health insurance organizations, and IT and pharma companies.

Open-Source Learning

Vision

To create the world's first societal learning system.

Objectives

- To sustain success throughout the 21st century.
- To capitalize on investments previously made in IT, broadband connectivity, and S&T.
- To enhance the capacity of Canadians to be members of a learning society, and therefore to enhance the social and cultural development capacity of Canada.
- To gain constructive influence by sharing our expertise with the world. Our learning technology and systems will empower the developing world to make a great leap ahead in learning capabilities – and concurrently enhance our global prestige and moral authority.

Strategies

1. Develop and / or expand supportive infrastructure:
- Personal learning environments / support systems: customizable, participative, and engaging.
- "Being there" collaborative groupware and other facilitative tools, including social and cultural tools.
- Ubiquitous access (broadband, wireless) - from SchoolNet to CanadaNet.

2. Establish local centers for personal / community enhancement (where citizens learn - do - teach).

3. Establish a network of design studios to research best practices, and be a support/resource service to empower individuals and communities who wish to build learning environments for themselves.

4. Expand the definition of innovation to include utilization of knowledge in addition to commercialization of technology:
- Revise funding criteria to permit partnerships with cities, communities, and not-for-profit organizations, as well as with private-sector organizations.
- Increase funding to SSHRC and others to support increased research on social and cultural aspects of developing the societal learning system.

5. Rethink intellectual property laws to facilitate access to information and knowledge, and to promote and accelerate creative uses of that knowledge – building a strong culture of diversity and openness. Redesign laws to promote open-source production (e.g. Open Syllabi) – to promote reuse, sharing, and collaborative design. Give away syllabi and information systems to the world.

At the personal, community, design studio and national levels, contacts and collaboration will be international. In return for the collective input of people around the world, our centers will make themselves available to support communities in less developed parts of the world who are designing solutions that are appropriate to their local situations.

Key Enabling Technologies and Policies

By 2010, Canada has mandated that all curricula must be available on the web (with FAQs and metadata indicating the prerequisites and linked subjects for each curriculum). As a long-term goal, these curricula will include suggested learning paths, and knowledge about typical problem areas (derived and addressed iteratively from watching students go through the curriculum). Our curricula will incorporate authentic multi-cultural content - for which Canada is a good beta test, because of the multicultural nature of our citizens.

We see a pressing need to move learning beyond institutional delivery, to community-based learning that is non-competitive (and yet engaging enough to motivate learners to achieve to the best of their abilities). Broadband networks are one enabler, allowing multi-way communication and discussion - however, we need to develop "video engagement" and not just talking-head video conferencing.

Both synchronous and asynchronous interface tools will aid communication, which should be as multimodal and multisensorial as possible (e.g. voice/verbal, tactile (haptic learning), text, video, groupware, ...). Selection of tool sets will be based on individual learning styles and personal limitations – personalization of learning tools is essential, which from a cost point of view can be enabled through the relative cost effectiveness of technology-assisted teaching.

The key is that we are looking for technology to connect "brains to brains", as well as learning tools that provide information on anything that we are curious or uncertain about. Learning can become social outside of schools, e.g. for adult learners looking to find peers; there should be no external limits to the pace of learning. Investing in learning and human capital could provide a "social capital investment" case for ensuring rural access and equal computational learning resources across societal sectors, despite the lack of an obvious business case at present.

Lower-order technologies:

- Capture / storage / sorting / summarizing of information (reasonably well developed for text-based information, less developed for visual and verbal).
- Deceased response time to curiosity / uncertainty.
- Web logs as form of migrating expert knowledge to collective intelligence.

Higher-order technologies:

- Access to learning communities without restrictions that exist now (time, location, age).
- From Personal learning to Community learning - e.g. collaborative democracy (minimizing issues of scheduling time and place for decision-making)..
- Checks and balances on quality of information – in part based on trust of source.
- From data and information to knowledge and wisdom.
- Cognitive modeling and better links from human mind to smart networks.
- Neural functioning, brain patterns and learning technologies to capture best practices.

Challenge: How to learn more, faster; how to develop self-directed learning skills across population.

Goal: "Learning from the inside out rather than the outside in." (David Bolton)

Wireless & Space Solar Power

Vision

To undertake a program of applied research and technology development into wireless and space solar power transmission.

Objectives

- To develop in Canada the means to serve remote communities with affordable, reliable and clean electrical power.
- To donate the intellectual property to the United Nations as a cornerstone of its new foreign policy for the betterment of humankind.
- To not only meet but exceed Canada's commitments under the Kyoto accords.
- To enable not only Canada but also all other nations to cut greenhouse-gas emissions, stem global warming, and ultimately end the World's reliance on scarce energy resources.

Rationale

Canada possesses abundant sources of power (much of it renewable) and generating capacity. There are many communities in Canada that are small, remote and economically disadvantaged, which do not possess reliable access to electrical power 24/7. The proposed technology will remove a major obstacle for these communities to integrate into the Canadian mainstream.

Similarly, there are many island states that have restricted or no access to reliable sources of electrical power - which presents major problems for their political, social and economic development, and for their ability to benefit from United Nations Programs.

Finally, Canada wishes to strengthen its foreign policy in support of the United Nations Organization - and particularly to support measures to abate global warming, and advance the Organization's economic development portfolio.

We therefore propose development of the technology identified to the point of readiness for operational use at the 1GW scale. This is part of a long term progression that would eventually result in space-based solar power systems capable of delivering microwave energy to terrestrial consumers located anywhere on the globe, to space colonies, and to interplanetary missions.

Strategies

The ultimate technology involves large scale internationally owned space infrastructure that is capable of energizing communities anywhere on the surface of Earth - or indeed anywhere in the Solar System (the "Power Plug in Space"). The power delivered will be environmentally clean, reliable, limited by factors associated with the demand side and virtually unlimited on the supply side.

This is a long term view requiring research first to develop a number of technologies required to design, deploy and operate the space infrastructure. However, there are major intervening milestones that would bring significant benefits to a vast number of smaller communities all over the globe that are presently energy starved. The initial "baby steps" will be inexpensive terrestrial applications that nonetheless will bring enormous social benefits to many impoverished and isolated communities.

It makes sense for Canada to host the early development of this technology because Canada possesses both the large-scale supply infrastructure (major hydroelectric generators and numerous large-capacity power plants) and the demand (large numbers of small remote communities that do not have access to reliable and cheap power).

It will be possible to develop inexpensive distribution technology to serve many of these communities in Canada. Working in conjunction with the United Nations Organization, this technology would advance numerous smaller states and micro-economies all around the World.

So what are the investments required, and benefits of the ultimate technology and intermediate steps?

Event / Outcome	R&D / Policy Implication	Cost	Benefits
2050 – major Space Solar Power Infrastructure becomes operational	UN-led international program (See NASA/NSF Report on Space Solar Power, April 2000)	$200 B	Terrestrial power anywhere Clean, plentiful energy Exploration of Solar System
2035 – Space Solar Power System, 30GW-100GW	City-capacity power conversion Large rectenna design & construction	$20 B	Switchable service to 3-10M population remote city
2025 - Satellite Relay System, 10GW-30GW	Intermediate step toward fully space-based platform	$5 B	Service to 1-3M person remote city
2020 – Hybrid Relay System, 100MW to 1GW	Changes to regulations governing power utilities	$500 M	Service to 10-100K person over-the-horizon community
2014 – Airborne Relay System, 10-100MW	Federal - provincial - municipal MOU	$300 M	Service to 1-10K person over-the-horizon community
2008 – Line of Sight Demonstration, 1-10MW	Develop power conversion technology to 1MW scale	$200 M	Service to 100-1000 person line-of-sight community

APPENDIX 1 - MORE ON SCENARIOS

Digging Deeper

For further background reading on scenarios and long-term technology futures, some excellent references include:

The Art of the Long View (Peter Schwartz, 1996; ISBN 0385267320) - Long-term planning and scenarios.

The Canada We Want: Competing Visions for the New Millennium (John Godfrey and Rob McLean, 1999; ISBN 0773731660) - National Projects as unifying visions for Canada's future.

Engineering Tomorrow: Today's Technology Experts Envision the Next Century (Trudy Bell, David Dooling, and Janie Fouke, 2000, ISBN 0780353625) - IEEE interviews 50 top scientists and engineers on science frontiers, taking the long view, and ensuring "that technology is humane and not inane".

GBN Scenario Bibliography - Annotated list, online at *www.gbn.org/public/gbnstory/ex_bibliography.htm*

The Next Fifty Years (edited by John Brockman, 2002; ISBN 0375713425) - Eminent scientists think about science in the next half-century. Insightful discussion; will remain relevant for many years.

Principles of Forecasting (edited by J Scott Armstrong, 2001; ISBN 0792379306) - Academic survey of many types of forecasting methods.

"Probabilities: Help or Hindrance in Scenario Planning?" - Should probabilities be assigned to scenarios, or are they just inappropriate overquantification? Online at: *www.gbn.org/members/ideas/competencies/downloads/gbn_probability.pdf*

Proteus: Insights from 2020 (Krause et al, 2000; ISBN 0970688504) - Well-done effort from the U.S. National Reconnaissance Office. The scenarios are literate and thought-provoking.

APPENDIX 2 - WORKSHOP TIMELINE

SCENARIOS WORKSHOP 2003

Location: National Research Council of Canada, 100 Sussex Drive (Ottawa, Canada)

Time	Day 1 (Wednesday March 19) *"Imagination"*	Day 2 (Thursday March 20) *"Integration"*
8:30 - 9:00	Registration & Coffee	Registration & Coffee
9:00 - 9:30	*Introduction & Orientation*	*Reflections on Day 1*
9:30 - 11:00	*Building Your World* - 1A Initial Scenario Critique and Construction	*Back From the Future* - 2A Backcast events, technologies, required actions
11:00 - 12:30	*Driving Change* - 1B Causes of Change & Scenario Elaboration	*R&D and Policy Implications* - 2B Analysis of Key Actions and Technologies
12:30 - 13:30	Peer-to-Peer Lunch in NRC Cafeteria (networking and posters)	Peer-to-Peer Lunch in NRC Cafeteria (posters and networking)
13:30 - 14:30	*Sector Technologies* - 1C Design sector technologies and policies 2025	*Advice to Cabinet 2005* - 2C Write a Memorandum to Cabinet
14:30 - 15:30	*Visiting Other Worlds* - 1D Cross-Fertilization between Teams	*Backcasting Bazaar* - 2D Compare approaches and policy between Teams
15:30 - 17:00	*Strategic Perspectives* - 1E Key considerations for Canada (+ complete written Scenario description)	*The Final Draft* - 2E Create and rehearse presentations (+ feedback on workshop)
17:00 - 19:00	*"Idea Marketplace" Buffet* - 1F Reception & Buffet + Elevator Pitch	*Take Us to Tomorrow* - 2F Scenario Presentations in NRC Auditorium + Competition and Prizes
19:00 - 21:00	Self-organizing Networking informal venue - Earl of Sussex Pub	Banquet Dinner at NRC cafeteria.

Teams working in individual World rooms.
Teams interacting, and 1-to-1 activity.
1-to-all activity (i.e. talks, presentations) in auditorium.

APPENDIX 3 - SESSION GUIDELINES

Day 1 - Imagination

Your challenge for Day 1 is to construct a scenario, describing Canada within a global context in 2025.

Starting with the 1-page scenario description, you will flesh out the scenario, and use each session's theme to examine it from several perspectives. Poster templates will capture the results of each session in an intuitive format. As you go through the day, the session templates will provide a "visual working memory" that will summarize progress in your scenario (and explain it to visitors).

In addition, each team is encouraged to transfer their knowledge into written form as much as possible. This may be rough notes, point form lists, stories, newspaper columns...the choice is yours. At the end of session 1E, you will be asked to hand in your written scenario details.

Keep in mind that for many of the sessions, work can be distributed - e.g. by dividing your group into half or into pairs, and having each subgroup tackle a part of the problem. We want you to have the opportunity to make full use of your abilities!

1A - Building Your World

- Starting from initial scenario summary, converge on a detailed scenario.
- Brainstorm on all aspects of your world. Your challenge as a group is to construct a shared world description, which you can all agree to work with. Capture on wall template.
- Choose two team members to produce written output for this session (on the laptop). This can be point form notes or narrative. In each subsequent session, rotate the writing duty.

As with most sessions, rough work is done via talk, flipcharts or whiteboards, writing, and stickies. The final "output" of a session is captured on poster templates, and in writing.

Optionally, sessions 1A &1B can be run concurrently with half a group doing each one.

1B - Driving Change

- Isolate key drivers and challenges of the world - technological, social, environmental, etc.
- Divide into subgroups, each of whom looks at a subset of drivers. We suggest these categories of drivers: Economy, Environment, Government, Intentionality, International Context, Security, Society, Technology. As with all sessions, these are a starting point!

Each subgroup will combine their scenario ideas onto the wall template. As before, write down your collective thoughts as notes or narrative, if you come up with more than fits on the template.

1C - Sector Technologies

- Elicit technologies for 8 everyday sectors in your world.
- Divide into subgroups, each tackling a subset of sectors.

One of many possible sets of sector categories:

NATURE - Agriculture, Food & Nutrients, Water, Environment
HEALTH - Lifestyle, Medical Care, Pollution
SAFETY - Security, Defence, Crime, Privacy
MOBILITY - Transport, Urban Design, Communications
KNOWING - Education, Finance, Information, News
CO-OPERATING - Governance, Law, Ethics, Cohesion, Trust
FUN - Entertainment Media, Games, Tourism, Sports
INFRASTRUCTURE - Energy, Resources, Manufacturing

Systematically going through sectors will deepen each scenario, by thinking from the point of view of a variety of sectors common to governance, business, and daily life.

Along with the template, continue to add to your team's written notes - they will be handed in later this afternoon!

1D - Visiting other Worlds

- Teams will visit each other, to cross-pollinate ideas and comment on each others' work.
- Logistics: each team splits into 2 equal subgroups. In first half-hour, one subgroup goes to other worlds while other subgroup stays and talks with visitors; switch in second half-hour.

This is your chance to see what other teams are up to, and to get feedback on your progress. Each team's space will have a blank poster put up for written visitor comments - but the best feedback will probably be from conversations.

1E - Strategic Perspectives

- The scenario should be largely coalesced at this point. Now, given your scenario world, examine key considerations for Canada - these will point out challenges and opportunities.
- If your team can't agree on strategic considerations, make a note of your top choices and then either choose one or explore both. (We expect that different points of view will arise. Each team's challenge will then be to recognize diverse viewpoints while moving ahead with one or two high-probability ones.)
- **Hand in written scenario description to Project Desk** (at building security).

Strategic perspectives for Canada include:

Federal - Provincial - Municipal	International Perspectives
Haves - Have Nots	Public Good - Private Good
Demographics	Multiculturalism & Immigration
Security	Economic & Quality of Life

At the end of this session - hand in written scenario description (Groups with keen writers may have a 5-page story about their scenario done - others may have point form notes, letters, or a combination of other formats. Through the day, a different pair of people in your group was responsible for producing written output in each session, and now the collection of writing should provide a good written record of what you have achieved in a day's work.)

1F - "Idea Marketplace" Buffet

- **Give a three-minute "elevator pitch".** Each team will be asked to give a three-minute talk on highlights of their constructed world.
- Enjoy the buffet.

In the elevator pitch, be creative and communicate the spirit of what you have done. And enjoy the buffet and networking - you've earned it!

Day 2 (Integration)

We will start the day with a short session in the auditorium, reflecting on Day 1 and looking forward to Day 2. Jerome Glenn will also talk for a few minutes about the UN University Millennium Project - an ambitious exercise that combines insights from future-oriented groups worldwide.

You are now in your constructed world in 2025. Your perspectives today will be derived from that time and place. Your challenge in Day 2 is to backcast how we got to your world from 2005 - and to infer the technology and policy steps that were necessary for that evolutionary path.

2A - Back from the Future

- Backcast - work backward to infer key actions and technologies that led to your scenario. (Include advice and initiatives adopted by government and industry.)
- Generate a backward-flowing network - use whiteboard and poster templates.

The goal is to go from your constructed scenario back to specific technologies, policies, infrastructure investments, and social resolutions between 2005 and 2025 - including both opportunities seized and mistakes made.

One analytical tool will be a network of time frames, in which each 5-year time period is a box or slice, and is filled in with the events / actions / technologies that should or should not take place. Then a network is drawn backward between items, going back from 2025 to 2005. You may also wish to consider "knockouts": which events or actions must happen (or must not happen) for the scenario to occur (or to avoid the scenario)?

2B - R&D & Policy Implications

- By imaginative and analytical thinking, move from backcasts to particular implications.
- Your products from this session are particular technologies, investments, policy initiatives, and R&D projects. What would be necessary in 2005-2010 to lead to your 2025 world?
- As with session 2A, policies leading to an undesirable future world can be valuable to explore - they will suggest preventative measures for your Advice to Cabinet in the next session.

If you can identify independent R&D areas that are applicable to your scenario, split into subgroups and tackle them independently, and then combine them at the end of this session. While working, keep in mind that your goal in the next session is to come up with a short Memorandum to Cabinet - so keep a short list of your top few implications, and use these as the basis for your MC.

2C - Advice to Cabinet 2005

- Boil your morning's work down to a set of key priorities (at most 5). What would Cabinet have to do to achieve positive aspects of your scenario - or to avoid negative outcomes of your scenario? The group will need to discuss and come up with a final set of proposals by the end of this session.
- At end of this session, **hand in a written Memorandum to Cabinet** to the Project Desk at security.
- Please also hand in any notes your team has made today, including the rationale behind your recommendations to Cabinet.

Your goal in this session is to come up with a concise Memorandum to Cabinet, that has some practical advice based on all your work. Along with writing the MC, group members should start thinking about their oral presentation during this session.

2D - Backcasting Bazaar

- Now that you have spent 4 hours on backcasting and generating recommendations, you will have definite ideas on what works, what doesn't work, and why. This is your chance to share thoughts and expertise with each other!
- Same process as 1D (Visiting other Worlds) from Day 1 - each team splits into 2 equal subgroups. In first half-hour, one subgroup goes to other worlds while other subgroup stays and talks with visitors; switch in second half-hour. Compare MC's and backcasting results.

It is important to have a chance to go outside your team, and share notes and ideas with other teams. The backcasting process and subsequent inference of present-day policy is more an art than a science - we expect there to be many valid approaches and viewpoints. So think of this hour as a giant collaboration to try to collectively work out practical methods for long-term planning from scenarios.

Feel free to incorporate ideas and approaches from your exchanges with other worlds into your oral presentation.

2E - The Final Draft

- Prepare your oral presentation.
- Along with rehearsing - please **write any comments on the workshop** at this point (and give to the Project Desk at security). What did you like or not like? What are your recommendations for future events? Would you like to be involved in further work of the Office of Technology Foresight?

You will be giving an oral presentation in front of 100 people soon - these 90 minutes are your chance to prepare. You cannot compress everything you have done over two days into a 10-minute oral session - so pick some key aspects to present orally. This could include key challenges, imaginative R&D recommendations, policy advice to Cabinet, or just a vivid glimpse of your future world. Be imaginative and don't hold back!

2F - Take us to Tomorrow

- **Give your oral presentation**, and enjoy the presentations of other teams.
- Each team will have 10 minutes - a 6 to 8 minute presentation, followed in the remaining 2 to 4 minutes by an interview from a media professional. No PowerPoint - just teams and pure human drama.
- Wrap-up with blue-ribbon panel decisions and prizes.

You're on stage. Your spokesperson(s) can use a skit, panel, or any other format that gets the message across. This is your chance to show the entire workshop audience what your group has been up to over the last couple of days - so make the best of it!

Banquet

- Eat, drink, and be merry!

We will be wrapping up the event with a fancy dinner, good food, and camaraderie.

APPENDIX 4 - FEEDBACK FROM PARTICIPANTS

Kudos for the Scenarios Workshop

"It was a very innovative process - one of the best I have seen. I think the workshop produced quite a number of interesting insights. The scenarios allow us to get a better idea of the range of futures we may confront. They help to clarify the challenges, choices and implications about where and how we invest our research dollars."

- Peter Padbury, Senior Policy Advisor, Department of Foreign Affairs and International Trade

"I have to comment on the impressive planning work done to support the workshop. The depth and breadth of the work really supported the intense focus of the two-day effort. The accomplishments during the activity could not have been done without all the extensive preparatory work. I was also impressed with the caliber of participants, the range of ages and backgrounds, and their genuine interest in strategic work with a purpose.

The setting was monumental - absolutely wonderful for this activity. I felt we were bringing together noble elements of the past, present, and future visions of science and technology and the art of science and technology in this building.

I liked the range of 'technology views' to work with in the scenarios. This range sparked lots of discussion, even apprehension in some cases, making the team discussions very interesting. There was significant value in meeting and trading research and scientific 'vision' examples and mutual scientific interests.

Scenario-based planning is metaphorically like 'intellectual hyperspectral sensing' in that it allows individuals and groups to see things never seen and to consider things never before possible. It is recognized in many business organizations as a necessary element of strategic planning for investment planning and product development. Seriously practiced, often with professional assistance, it has an enormous potential to foster near-term innovation, all the while focusing on the far future.

For me - this was a significant opportunity to meet with colleagues across borders - rarely done in my line of work."

- Pamela Krause, Strategic Futures Initiative, National Imagery and Mapping Agency (USA)

"This was one of the most intellectually stimulating and rigorous group exercises that I've seen in twenty years of interdepartmental work with the Canadian government."

- Shane Roberts, Senior Analyst for Futures and Forecasting, OCIPEP, Department of National Defence

"The synergy between the NRC 2025 S&T scenarios with our work was excellent."

- Jerome C. Glenn, director, Millennium Project, American Council for the United Nations University (USA)

"Thoughtful, provocative - exceedingly well-organized with well-considered inputs. Accomplished and able staff and facilitators...Truly appreciated both the opportunity to participate in a significant event and NRC's support for my participation. It was fun and stimulating. Thanks!"

- Gary Stairs, Red Hot Learning

"The Scenarios Workshop illustrates that government organizations such as the NRC are willing to think outside their traditional boxes.

I don't plan on being around in 2025 to experience the impact of the Scenarios Workshop, but there is no doubt in my mind that NRC's activities will be more relevant to the economic and social well-being of Canadians in the intervening years than if it had not happened.

Those of us who make our living in the high technology industry should understand that there is a lot of fresh thinking going on within government organizations like NRC and we should be prepared to contribute to it whenever possible."

- Denzil Doyle, chairman of Capital Alliance Ventures Inc.

"In policy, and even more so in politics, one rarely takes the time to consider long-term strategy, much less the potential consequences of policy decisions over a twenty-year period. The Scenarios Workshop was a powerful reminder of the importance and value of long-term forecasting in government."

- Andrew Kovacs, Legislative Assistant to John Godfrey, M.P.

"In Canada, like many other places in the world, we have been too content to be reactive rather than proactive in our scientific and technological thinking. The Foresight Project is a superb example of proactive thinking and planning, and forms the basis for a good long look ahead."

- Gary Glavin, Winnipeg Laboratory, Health Canada

"Thinking outside the box; wonderful eclectic group. Lots of interaction; backgrounds of participants diverse. Liked the format. Great! Great team."

- Mary Alton Mackey, Canadian Biotechnology Advisory Committee

"The NRC-led Science and Technology Foresight Pilot Project was a unique opportunity for the Departments and Agencies which participated, and an extremely interesting and worthwhile experience for me personally. There were multiple opportunities for personal development and learning in situations which I would not normally encounter...[the project] was as useful for the process as it was for the end products.

The Scenario Development Session was very successful. At this point, I began to better understand the power of the Foresight process. By using knowledge, imagination, and creativity, the participants developed multiple "could-be worlds" consistent with the information and data that had been collected in the earlier phases of the project.

This process was a wonderful opportunity. It consisted of gaining technical knowledge, developing insights, establishing networks, and gaining an understanding of the way that Foresight can be used by [our agency] for strategic planning. There is no doubt that our participation in this project has been very worthwhile."

- Fonda Munroe, AVP of Science Evaluation, Canadian Food Inspection Agency

“I think that I was most impressed by the calibre of people that were assembled for the Scenarios Workshop. I meet people who had very in-depth knowledge about science, military affairs and security, future studies and the real world of business. The exciting part of the two days was listening to this mix of people discuss a particular scenario and meshing their ideas together into a coherent whole. We probably could have done this for several days, because as David Bohm argued in his book On Dialogue, real dialogue begins when we begin to see and appreciate the underlying assumptions that we and others make about the world around us.”

- Geoffrey Gurd, Director, Research Management and Dissemination Division, Health Canada

"The Foresight scenarios exercise was a highly useful and professional event, which has certainly helped to develop our thinking on how to integrate scenarios into the strategic planning and policy development process at HRDC. Thanks to all those who organized and ran the event for giving us an example to follow."

- Niko Fleming, Chief Strategic Analyst, Strategic Policy, HRDC

Suggestions for Future Events

"The process outputs and substantive findings would be invaluable for regions and provinces. Let's give some thought to how we can broaden the engagement base and establish an ongoing network for research pooling, collaboration, and related projects."

“I think it might be very interesting to repeat the exercise (or part of it, say 2 or 3 scenarios) with a more even split between government S&T subject-matter experts and government policy people (primarily not science policy people). Also a version with 3 equal-sized groups of people, the third being MPs' staff.”

"Have the final report distributed more widely (beyond the participant crowd!). [Include] some indications of the next steps in the process, i.e. how the scenarios will be used to get to a somewhat coherent framework for S&T policy making."

"Any possibility of getting a more diverse cultural (world view) mix? Perhaps an interjection of people in the science/legal or science ethics fields would add to the mix."

"Do something with students, to exchange views across age-groups."

"Definitely encourage informal network exchanges before, during and after the activity. These can be cyberspace exchanges to lessen costs, etc. Involvement of the UN Millennium Project is a good idea. Perhaps there are some other futures projects that would be interesting to tap into as well or have some participants involved."