Science Integrity Project
Synthesis of Pre-Forum Interviews

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1.1 Purpose and Scope of the Synthesis Report

The Synthesis Report is a product of interviews conducted during scoping phase of the Science Integrity Project. The goals of the interviews were to:

1. Establish a clear understanding of the scope and nature of issues around the effective and consistent use of science and evidence in Canadian public policy
2. Identify a suite of draft principles for and examples of evidence-based decision-making in Canada
3. Provide a common platform of understanding these issues ahead of the Forum on Evidence-based Decision Making in Canada held on February 2-4, 2015 in Toronto, Ontario.

The Synthesis Report is a summary of 29 interviews conducted with 30 individuals from across jurisdictions, professional sectors, scientific disciplines, cultures, and Canadian geographies. The individuals interviewed are listed in Appendix A.

1.2 Key Definitions

Several terms are used throughout the Synthesis Report that reflect that the understanding of the project Planning Committee:

By '**science'** we mean all ways in which knowledge is generated and applied using testable approaches, including but not limited to the natural sciences, social sciences, modeling and statistics. By '**indigenous knowledge**' we mean the body of knowledge that is the result of intellectual activity and insight gained in a traditional context and adapted over time to modern situations, and which includes the methods, skills, practices, and knowledge contained in codified knowledge systems passed between generations.[1]

By **'science integrity**', we mean that public policies are built upon the best available, most relevant knowledge resources and that the transfer and use of knowledge in policy and decision-making is transparent. Integrity in the use of knowledge in policy-making also requires integrity in the production of knowledge, that is, adhering to professional, ethical, and disciplinary standards in the production of scientific knowledge and codified cultural standards in the production of indigenous knowledge.

In this document, we use '**knowledge**', '**information**' and '**evidence**' interchangeably to indicate the products of science and traditional knowledge. We use '**scientist**' or '**researcher**' to denote individuals who are involved in generating scientific knowledge.

By '**science-policy relationship'**, we mean all components of the way knowledge is generated, translated and considered within policy decisions. We use '**evidence-policy relationship'**, '**evidence-based decision-making**', '**use of evidence/information/knowledge in policy**' interchangeably with this term.

A '**policy maker**' is someone involved in making decisions that influence policy, and includes members of the elected government and other government employees who have the authority and power to influence internal policies.

By '**science advising'** we mean the actions of scientists to a) provide empirical information or modeling projections that identify likely outcomes given different policy options, and b) based on this information, describe a range of implications for different policy decisions. By '**evidence-based decision making'**, we mean the actions of policy makers to transparently consider rigorous, widely-sourced information.

[1]There are many definitions of indigenous knowledge; we use one adapted from the World Intellectual Property Organization.

1.3 Methods

Interviewees were selected based on: 1) their experience and professional positions at the interface of science, indigenous knowledge, and policy in Canada; 2) geographic, sector, and disciplinary diversity; and 3) upon the recommendations of their peers. Interviewees came from most provinces and all territories; disciplines ranged from fisheries to medicine to anthropology; and professional histories from the most senior levels of government and academia to indigenous land claims organizations to highly applied research institutes. Our sample of interviewees by no means represents the full range of perspectives on this complex issue. However, our interviewees provide a diversity of views that serve as a starting point for better defining the nature and scope of the issue and potential solutions.

Each interviewee was provided a common set of questions in advance (see 1.4 Interview Questions), and interviewed in person or by phone for 60-90 minutes. Drs Maureen Ryan or Stephanie Green conducted all interviews, along with at least one member of the Project Planning Committee. Interviewees participated on a voluntary basis. All interviews were conducted between September 2014 and January 2015. A copy of the written transcript of the interview was provided to each interviewee for review and verification. Individual responses have occasionally been used as illustrative quotes within this Synthesis Report, but are not attributed to any individual or organization, as per agreement with interviewees.

For the sake of clarity and accuracy, where a majority of interviewees reflected on a certain theme, the text is framed as a statement without referencing "a majority of interviewees stated" etc. Where common themes were raised by multiple interviewees, but without strong consensus in perspectives, we note the relative proportion of interviewees.

Themes reported in this synthesis – including perspectives on the past and present of science integrity in Canada and gold standards – are drawn directly from the interviews, and are not supplemented with additional sources of research. The report authors conducted basic fact checking on names and dates in the construction of this report, but did not seek to resolve conflicting views or perspectives, or to independently verify every statement of every interviewee. (See the Science Integrity Project document *The Evolving Context of Science Integrity in Canada* for a related, referenced source.) Likewise the authors did not attempt to balance the volume or detail of input focused respectively on science and indigenous knowledge, but rather reflected the relative proportions of information offered by interviewees. Thus the views expressed here are solely those of the interviewees, and not necessarily those of the Science Integrity Project Planning Committee. The *Synthesis of Pre-Forum Interviews* is one of several products of the Science Integrity Project, which also include a *Statement of Principles for Sound Decision-making in Canada*, *Illustrative Examples of Principles for Decision-making in Canada*, and *The Evolving Context of Science Integrity in Canada*. More information on the Science Integrity Project can be found at scienceintegrity.ca. The remainder of the report from this point on synthesizes responses from the 28 structured interviews.

1.4 Interview Questions

1. What is your experience with the use of science (Science or Traditional[2] Knowledge) in policy (e.g. formal roles, experience, observations)?
2. In your geographic region or field of study, have you seen examples of change in the role or use of science (Science or Traditional Knowledge) in public policy processes over your experience?
3. Which policies or practices are working well or not working well, in your opinion?
4. What sense does that leave you with about the state of science integrity in Canada overall?

[2] Following feedback from the interviews and Forum discussions, we shifted from use of the term "Traditional Knowledge" to "Indigenous Knowledge."

5. What is the "gold standard" for the use of science in public policy, and can you offer real examples from anywhere?
6. What principles would you like to see in place to guide the effective and consistent use of Science or Traditional Knowledge in public policy decision making in Canada?
7. Are these principles already in action? If not, what are the barriers to the use of these principles in public policy decision-making in Canada?
8. In your experience, are there differences by jurisdiction?
9. What practices could be proposed to encourage the effective and consistent use of Science and Traditional Knowledge in public policy decision making in Canada?
10. What is needed for guiding principles and practices to be implemented effectively?
11. What else is needed to support the effective and consistent use of science in policy in Canada?
12. What themes or topics would you want to see included in the Forum agenda?
13. What do you see as the common misperceptions or disconnects between scientists, traditional knowledge holders, and policy makers that we should be prepared to address?
14. Are there any other key people you think we should speak with in advance of the Forum, or invite to the Forum?

1.5 Structure of this Report

Section 1: Introduction
Section 2: Perspectives on the Past and Present State of Science Integrity in Canada.
Section 3: Common Themes Arising from the Interviews, organized by four stages in the science-policy relationship:

- The role of knowledge in democratic decision-making
- Knowledge generation
- Knowledge sharing and consideration in decision-making
- The role of Canadian society in evidence-based decision-making

Section 4: What is the Gold Standard for Science Advising? Suggestions from Interviewees
Appendix A: List of Individuals Interviewed for the Science Integrity Project

2 Perspectives on the Past and Present of Science Integrity in Canada

Interviewees pointed to variably positive and negative practices related to the use of science in decision making at levels of governments over the past 50 years. The patterns and timing of fluctuations in knowledge generation, sharing, and use in policy decisions vary considerably across forms of knowledge, among disciplines, and across jurisdictions in ways that are not easily generalized. However, two dominant and somewhat different patterns have been identified regarding the relationship between policy making and science on one hand, and between policy making and indigenous knowledge on the other.

2.1 Relationship between Science and Policy Making at the Federal level

Many interviewees described an evolution in the role of science in public policy making at the federal level, marked by several phases and key events, including the following:

- *An upswing in the use of scientific evidence in policy in the 1960s and 1970s* with the science-oriented popular interest of the times, when processes were in place for federal governments to vet science in policy and decision-making.
- *Changes in the structure of the relationship between science production and policy making during the late 1970s and 1980s* associated with (a) the disbanding of multiple scientific advisory institutions, panels, and committees that had been relatively independent of political

bureaucracies (e.g. Fisheries Research Board) and (b) the migration of federal agencies to come under civil service rules where the chain of command included political appointees.

- *A low point in the use of evidence in policy making in the early 1990s.* During this period, several key events brought the federal government under criticism for ignoring the advice of scientists in making policy decisions (e.g. collapse of the Atlantic cod fishery; scandal over tainted blood that lead to the Krever Commission). Resulting public attention to the perceived breakdown of the evidence-policy relationship resulted in the creation of the Council of Science and Technology Advisors, which was external to the government and reported to Cabinet.
- *A period of improved science-policy engagement that some describe as the "Renaissance of Canadian Science" from 1998 to 2006*, when many federal departments had science advisers and a National Chief Science Advisor position was created. During this period, interviewees reported that policy makers actively requesting information from academic and government scientists to inform decisions, and that there was a process to identify experts who could contribute disciplinary knowledge to policy and decision-making.
- *A general decline in the use of science to inform policy since the mid-2000s* that included: federal cuts to scientific funding, analytical capacity, and government personnel; diminished ability of government scientists to work within their areas of expertise; increased administrative duties for government scientists relative to scientific duties due to cuts to support staff; reduced availability of information across departments; and, a decline in the use of science in decision-making. Interviewees stated that the pattern of decline precedes the current federal government [2006-current]. Most interviewees felt that declines in scientific capacity started with cutbacks to research budgets. Many interpret the initial rationale for these cuts as budgetary rather than ideological. However, continued erosion of the use of science and evidence in decision making is perceived as having become more ideologically oriented over time, particularly with the 2006 shift to a Conservative government.
- *A steep decline in the use of scientific evidence in policy since 2011, coupled with an increase in the degree of politicization around science*. The 2012 federal omnibus budget Bill C-38 is specifically described by a few interviewees as a watershed moment that imposed large, unevenly distributed cuts to science-based federal departments, reducing the ability of government to generate and share policy-relevant information. These cuts are interpreted as having resulted in a substantial loss of analytical capacity, specialized expertise, and long-term institutional knowledge, and precipitated a decline in morale within the federal public service. The cuts are also perceived by many interviewees to have occurred without a strategy for maintaining institutional knowledge (systemic knowledge held and passed on by experienced individuals through professional and departmental networks) and scientific knowledge (long-term data storage, maintenance, organization, and access). Cuts that began with research budgets also extended beyond scientific research capacity to the elimination of positions that facilitated (a) the presentation of information and (b) the uptake of science in policy making. Changes in research capacity also overlapped with a major period of deregulation. At the same time, many interviewees noted a sharp, generalized decline in outreach from policy makers to scientists. Several interviewees interpret this combination of events, which has resulted in reduced ability to use evidence in federal policy, as the result of an ideologically based strategy grounded in a belief in small government and limited regulation, which sought to perfect the case for privatization by defunding the public service and rendering it ineffective.

2.2 Relationship between Science and Policy at Territorial, Provincial, and Municipal levels

The relationships between scientific evidence and policy making at territorial, provincial, and municipal levels of governance do not necessarily fit the same trend. Instead, they vary over time and geography according to the visibility of impacts of the public, engagement of local interests, and personalities of

individuals within the science community and those within government overseeing a particular policy topic. Interviewees highlighted cases where the use of science translated into stronger evidence-based policy making, or at least efforts to do so (e.g. Ontario's efforts to implement provincial endangered species legislation; co-management integrating science and indigenous knowledge in regions of the Canadian North; Vancouver's intravenous drug harm reduction policies). Overall the relationship between evidence and policy is thought to fluctuate less in the provinces and territories, in large part because few provinces and territories have much evidence-based advisory infrastructure to begin with.

2.3 Relationship between Indigenous Knowledge and Policy Making

Interviewees working in the context of indigenous knowledge (i.e., indigenous knowledge holders, or scientists or policy makers who work closely with Aboriginal communities) describe a different pattern in the relationship between information and policy. The dominant historical pattern reported by interviewees is one of systemic barriers to the recognition, sharing, and consideration of indigenous knowledge in policy processes, particularly at the federal level. Positive counter-examples exist within local governance and (rarely) at provincial and territorial levels, reflecting a slow but generally positive trend that some describe as a rudimentary foundation for the application of indigenous knowledge to policy. In particular, interviewees describe the necessity of a key step away from integrating indigenous knowledge into a science framework, and towards the recognition of indigenous knowledge as a legitimate body of knowledge that is distinct from science, and thus requires unique but parallel processes for uptake into policy. The consensus pattern includes the following key points:

- *Historical absence of consideration of indigenous knowledge in policy making* at scales beyond local communities or regions.
- *Initial efforts to integrate indigenous knowledge into scientific information, which was then used in policy making starting in the 1970s.* This occurred through social science surveys or questionnaires. Such initiatives almost always failed to provide a role for Aboriginal communities in collecting or interpreting the data or drawing conclusions. As a result, communities frequently lost access to this information, and generally feel that indigenous knowledge was often misinterpreted and used against them in policy decisions.
- *A slow shift away from integration and towards reciprocal translation between indigenous knowledge and science starting in the 2000s*. In theory, this approach increases the linkage between indigenous knowledge and policy by sharing and considering indigenous knowledge alongside, rather than in series with, information generated by science in policy decisions.
- *A significant positive shift in the relationship between science and indigenous knowledge, especially in parts of Northern Canada, since the mid-2000s*. Some interviewees consider something unique to be happening in Canada in this regard. For example, interviewees working in Inuit communities felt that there has been a substantial positive shift in the recognition of indigenous knowledge within the Canadian scientific research establishment, as compared to other regions of the circumpolar Arctic (e.g. Russia, Greenland). These interviewees suggest that this may be related to the status and leadership of Aboriginal people in Canada in long-term rights struggles and land claims success. These interviewees also surmised that personal experiences working with indigenous knowledge holders have influenced a generation of researchers in fields ranging from biology to anthropology to glaciology. As a result, these individuals are adapting research approaches in collaboration with Aboriginal knowledge holders. Interviewees felt that relationships in which knowledge is co-produced create a foundation for mutual support in calling for the use of both forms of knowledge (science and indigenous knowledge) in policy making. Despite these trends in the North, advancements in the science-indigenous knowledge relationship are generally felt to be less robust in southern Canada where the scientific research community as a whole is less directly engaged with communities and where communities are

generally larger, structures of governance are more complex, and Aboriginal communities are less empowered.

- *Successful knowledge-policy relationships are currently taking place at the level of communities, but there are significant barriers to the use of indigenous knowledge in policy making at broader scales.* Interviewees noted that there are very few, tenuous examples of good process at the provincial or territorial level, and no good examples of the use of indigenous knowledge in policy at the federal level.
- *Continuing need for a significant cognitive and practical shift in how indigenous knowledge is recognized, and how it enters the information flow to policy makers beyond the community level*. Needs include:
    - Community-based and community-relevant methods of information gathering that are broadly recognized as legitimate
    - Community involvement or leadership in research design and data interpretation
    - Attenuation of expensive and time-consuming translation of indigenous knowledge into a scientific framework, which is an excessive and often prohibitive burden for many small communities, and a process in which relevant information is often lost
    - Relationship building and knowledge exchange processes through which decision makers can learn about indigenous knowledge and trust can be built to facilitate the flow of information between Aboriginal communities and decision makers
- *Continuing major deficiencies in trust between Aboriginal communities and policy makers, exacerbated by internal federal, provincial, and territorial government policies that frequently allow flawed consultation processes to be accepted* (i.e. permits granted based on incomplete or inaccurate information), including processes which violate treaty or court-articulated rights.

2.4 The Current Moment in Canada

At the federal level, many interviewees cite common concerns and experience with the current relationship between evidence and policy in Canada. Two consensus perceptions are that there is: 1) a general misunderstanding by elected federal officials about how evidence is generated and could or should be used in decision-making, and 2) disinterest in obtaining and considering information in the policy making process. In the view of many interviewees, disinterest in evidence includes disinterest in hearing the views of scientists (both academic and government), indigenous knowledge holders, and the public service at large. It also includes the rejection of both specific information and of the role and utility of evidence in policy making in general. As a result, interviewees felt that lack of understanding and interest in evidence have fostered a growing disconnect between the federal government and knowledge holders, resulting in: 1) a dramatic decline in the use of information within federal policy decisions across departments, and 2) severely reduced capacity to generate and share scientific information both within and outside of the government.

Interviewees noted that conflicts between public service scientists and elected policy makers over science integrity (or a perceived lack of science integrity) have resulted in several high-profile cases such as the resignation of the Chief Statistician of Canada following the elimination of the long form census in 2010. The majority of interviewees identified the last two years (since 2012) as marked by a range of federal policy actions that most view as greatly eroding the relationship between evidence and policy. Specific examples mentioned by interviewees include regulatory changes (e.g. changes to the Fisheries Act, prior to which no advice was sought from Department of Fisheries and Oceans scientists), de-funding scientific research stations such as the Experimental Lakes Area (ELA) and the Polar Environment and Atmospheric Research Laboratory (PEARL), and a host of other direct funding and personnel cuts affecting scientific capacity. Among those working in an indigenous knowledge context, the consensus among interviewees is that the already poor relationship between Aboriginal communities and federal policy makers has been further eroded in recent years.

In general, there was a near-universal perception among interviewees of having been blindsided by the pace, magnitude, and extent of federal policy changes that have reduced capacity for knowledge generation and uptake into decision making processes themselves. Beyond a lack of understanding or interest in evidence, interviewees generally attribute these changes to a variety of factors including: an ideologically-based desire to cut government spending and decrease regulation; political recognition that science can complicate the implementation of political agendas; and a decrease in public demand for evidence-based decision making. Interviewees offered two quite different explanations for these trends:

- Some interviewees suggested that these trends are not coincidental, but reflect a broader ideological campaign to undermine public trust in science. These interviewees held the view that the current federal government has actively tried to suppress the dissemination of information and to actively undermine its use in policy. A minority of interviewees specifically suggested that the culture of scientists, which includes the ability to speak out independently, is viewed as a threat to the current government's emphasis on "message control." Likewise, some interviewees see the ethics and values that are integral to indigenous knowledge as a threat to current federal political and economic agendas.
- In contrast, other interviewees felt that that while interest in evidence by elected federal officials has declined, this is not unusual in politics and should not be misinterpreted as malicious in intent. Instead they suggested that the main drivers of the decline in the use of evidence are weak leadership within the public service and a lack of demand or concern among the general public for evidence-based decisions. Most of these interviewees indicated that there is an interplay between politics and leadership, and that the current government has been appointing individuals who are unlikely to advocate strongly for the use of evidence.

Overall there is broad consensus among interviewees that the current use of evidence in decision-making in Canada at the federal level is at an historical low point. Descriptors range from "not optimal" to "dismal", "worst ever", "all time low", "overwhelmingly bad", "the system is broken", "most anti-science government in Canadian history", etc. Interviewees point to three primary outcomes of these recent shifts in the science-policy relationship:

1. a substantially reduced use of evidence in policy making across sectors such as food safety, health, education, drug policy, climate change, environment, criminology, and others,
2. a sense that Canada is nearing a state of affairs that threatens the system's basic effectiveness, and
3. a sense that it will take substantial time to recover the capacity for generating scientific information that has been lost in the past few years.

Finally, several interviewees addressed the longer-term context of this current moment with respect to broader changes in the role of science in social wellbeing and its alignment with dominant economic and political powers. Specifically, several argued that the relative success of science in influencing policy in the 1970s has led to 1) the realization that community groups working with scientists have power to influence policy and shape regulatory structures, and 2) an elevated legal role of science in regulatory processes and risk management. These interviewees felt that two major adjustments have been made over the past several decades as a result: (a) industry increasingly alter decision frameworks involving science (through lobbying and privately hired scientists), and (b) polarized camps of experts with ideological orientations have emerged and gradually "taken chinks out of the credibility of the scientific enterprise as a neutral place." In particular, some interviewees felt that ideologically polarized scientists have leveraged the role of uncertainty in science (and the public's uncertainty in how to deal with it) to successfully obscure strong scientific consensus (e.g. on issues such as climate change). Additionally, increasing gains in control by Aboriginal Peoples in Canada over governance processes, and recognition of the value and legitimacy of indigenous knowledge by non-Aboriginal sectors (e.g. academia, courts)

are shifting the power dynamic around how indigenous knowledge is or might be used in policy processes. This process is highly variable depending on location, what formal agreements or case law are in place, the issue at hand, and the capacity of both public and Aboriginal governments to engage with each other.

3 Common Themes arising from the Interviews

Twelve common themes emerged from the interviews related to how evidence is generated, shared, and considered in policy decisions. Generally, the themes presented here were identified and discussed unprompted (except by interview questions) by >10 of the 30 interviewees. Themes have been organized according to four key components of the knowledge generation-to-policy process, and the broader social context supporting evidence-based decision-making. Included in each theme statement are a series of bullets that outline the main points made by interviewees. Where complexity warrants, these points are further explained in the text.

3.1 What is the role of knowledge in democratic decision-making?

3.1.1 Theme 1: The role of knowledge in democracy, and the multiple cultures of knowledge generation and policy development

The majority of interviewees spoke about the fundamental role of evidence in democracy. Science and indigenous knowledge are seen as essential sources of information from which citizens judge the likely outcomes of decisions, and how outcomes relate to social values. Many interviewees emphasized the following:

- Information does not speak for itself, i.e. it requires a messenger
- Democratic processes for considering information require an enormous amount of often-inefficient work
- Discourse about the relationship between science, indigenous knowledge, and policy must include the general public and institutions of civil society
- The Canadian citizenry generally assumes that evidence is being used in decision-making even if it is not

Regarding the last point, several interviewees compared citizen perspectives in Canada to that of Japan pre-Fukushima. These interviewees expressed concern that awareness of disconnect between perception and reality of the use of evidence in decision-making may arise through crisis or catastrophe. (One interviewee referred to Canada as an ‘ad hoc nation’ in this respect.) There is precedent for this model within Canada; for example, an HIV epidemic among intravenous drug users in Vancouver in the 1990s lead to increased public support for the implementation of harm reduction measures that were strongly supported by public health science. Several interviewees also spoke directly about the disproportionate influence of private industries on “the democratic conversation” in Canada, expressing specific concern about the influence of fossil fuel development.

In reflecting on the use of evidence in democratic decision-making, most interviewees spoke about the different cultures and roles of scientists, indigenous knowledge holders and policy makers, and how these roles are shaped by the normative views of each group. Most interviewees emphasized some version of the following statement:

- Scientists, indigenous knowledge holders, and policy makers are diverse groups of individuals, yet there are generalizable distinctions in the views of each group regarding the role and use of evidence in decision-making, and the role of values in the production of knowledge

All interviewees discussed the boundaries and distinctions between science and indigenous knowledge. The majority of interviewees agreed that an important role of science is to provide quantitative advice that identifies likely outcomes given different policy options, and to describe a range of implications for different policy decisions. Likewise, a majority saw the realm of policy as using that information, along with other factors, to make decisions that take trade-offs among multiple social values into account. There was a common sentiment that:

- Government should look at evidence from all sources
- Where decisions involve science, the base of evidence should be communicated in a way that the general public can understand
- Evidence is interpreted through the values lens of decision makers, which are assumed to be an extension of broader societal values
- Science is only one of several bases of policy decisions

Interviewees generally felt that elected governments have the right to make decisions, some of which will conflict with evidence, and that the goal should be an open and transparent flow of information rather than science dictating policy in all cases. However, some interviewees felt that many scientists have an exaggerated sense of the role that science should play in determining policy – i.e. that policy should do what science says – alongside an underdeveloped sense of the complexity of policy making. While views varied with respect to the boundaries on open speech for government scientists (see below), all agreed that there is a fundamental distinction between the analytical functions served by scientists, and the decision-making authority of elected government.

Interviewees working within the context of indigenous knowledge held views that partially overlapped but were also distinct from those within science. In communities where indigenous knowledge is strongly linked with governance and policy, the roles of individuals who generate information and have decision-making authority may be less distinct. More broadly, those working with indigenous knowledge pointed to the explicit role of human values in the generation and transfer of knowledge, which differs from the more detached ideal of the "honest broker" espoused by some (but not all) scientists. In contrast, interviewees who work with indigenous knowledge emphasized that this source of knowledge includes both highly technical ecological knowledge and also broader cultural practices that are intrinsically informed by values. In practice, the connection of indigenous knowledge to policy is tangible, based on the implications of decisions for territorial waters and land, traditional foods, and identity. Interviewees from Aboriginal communities emphasized that role of values in indigenous knowledge, and how these relate to cultural priorities, cannot be dissociated in the process of developing policies based on indigenous knowledge. As a result:

- Sharing indigenous knowledge—in terms of understanding the kinds of knowledge held by members of different traditions, how it is acquired, and how it is applied to decisions— requires trust, continuity of relationships, and commitment to shared problem solving

A central challenge in linking indigenous knowledge to policy making at most jurisdictional scales is that the timeframe and social means required to build relationships and understanding is often incompatible with current decision-making processes. There is a sense that Inuit, First Nations, and Métis communities are bringing a broader suite of knowledge (and with it, questions about the role of values) to the public discussion surrounding evidence and decision-making. However, at the same time, Aboriginal communities are sometimes pigeon-holed and stereotyped for doing so.

Several interviewees also reflected on the challenge faced by many academic scientists, in contrast to indigenous knowledge holders, in acknowledging or articulating their position within a particular

worldview and value system. Regarding value systems, many interviewees emphasized the need to break down the "false dichotomy" between science and indigenous knowledge, and the associated stereotypes of science as reductionist, "objective", and value-free, and indigenous knowledge as holistic and value-laden.

Interviewees from both knowledge systems emphasized the need to reframe thinking around the co-production of knowledge, mediated through direct experience with each body of knowledge. Interviewees with experience in this realm identified that there is often no direct translation of indigenous knowledge and science concepts, and that the two sets of knowledge sometimes reach different conclusions. Discussion of collaborations and distinctions regarding intellectual property are addressed in sections below.

Finally, all interviewees acknowledged the need for increased interaction among indigenous knowledge holders, scientists, and policy makers. This stems from the common observation that:

- Distinct cultures and geographical barriers between indigenous knowledge holders, scientists, and policy makers create obstacles in the flow of information and mutual understanding that must be addressed to improve the evidence-policy relationship

For example, interviewees note that policy makers do not always know that they have access to world-class scientific experts who are willing to discuss the relevance of their research to policy. Also, geography comes into play at the federal level because of the distance between where indigenous knowledge and scientific information are often generated (regions, communities) and where most decisions are made (Ottawa). Further, scientists and indigenous knowledge holders are often unfamiliar with policy making (including timelines of policy, which aspects of research are policy-relevant, and the need to provide succinct information). For indigenous knowledge holders, these barriers are often exacerbated by historical violations and a contemporary lack of trusted relationships with policy makers above the level of communities. Overall there is a recognized need among interviewees for increased consultation between policy makers and scientists and indigenous knowledge holders in areas of their expertise, and more effective means of communicating scientific and indigenous knowledge to policy makers.

3.2 How is knowledge generated?

The following themes centre on the production of knowledge. Who generates knowledge, by what process, and with what funding? Who defines the critical information needed? Who sets the priorities? What are the mechanisms to ensure integrity in the production of knowledge?

3.2.1 Theme 2: High quality science insulated from political influence

Interviewees across sectors agreed that a fundamental role of government is to fund excellent science – both basic and applied science – conducted both within and outside of government. Nearly all interviewees agreed that:

- Canada needs to reinstate and increase public capacity (funding, personnel, institutions) for science and analysis to support government decision-making at federal, provincial, and territorial levels
- Public institutions that fund and/or generate scientific information, both within and outside government, must operate free from political influence

In particular, institutions of government science must operate free from the influence of political bureaucracies that may be tempted to manipulate the process or reporting of science. Several interviewees stated that their concerns were grounded in the history of bureaucratic and political interference in government-administered science in Canada (e.g. Atlantic cod fishery management) and recent allegations of politically motivated interference. In addition to "arms-length" government science institutions, many interviewees stated a need for independent research boards with good links to government (such as the Fisheries Research Board of the past), and to reinstate watchdog organizations and policies that have been disbanded (e.g. Oceans Policy).

Many interviewees felt that government scientists continue to play a key role in generating high-quality information, but a few expressed concerns that retention of top scientists is low due to increasing restrictions and administrative loads that act as a disincentive. In the environmental sector, some interviewees expressed concerns that scientists conducting assessments often lack sufficient expertise to do their jobs appropriately. This concern stemmed from a perceived trend away from full-time science positions within government, which have high educational and experience requirements, toward part-time or contract science positions for the same work, but with less rigorous criteria. In general, interviewees felt that Canada needs information-gathering standards across sectors to ensure the integrity, quality, and utility of information being generated for use in decisions. (See Themes 3 and 6 below.) Several interviewees also expressed concerns that:

- Publically-funded science is being skewed away from the broader public interest and toward industry interests, and away from sustained long-term research programs towards short-term projects

Several interviewees note that the requirement of private funding partners to be eligible for government grants is implicitly allowing industry to set research priorities. One interviewee expressed this concern thus: "Research that is funded is for problems already known for which some company or government agency will sign on, so these are all past problems."

Overall there is concern for the diminishing pool of funding for basic research and in particular for long-term science in the public interest that cannot be conducted on an academic schedule (i.e. 2-4 years) and thus requires sustained government investment. This led to the common conclusions that:

- While science should operate free from political manipulation, a portion of government-funded science should be responsive to public needs
- Monitoring programs should be put in place to collect baseline information prior to and over the course of industrial projects

A few interviewees mentioned the need for foresight and scenario planning exercises. These recommendations ranged from formal foresight and scenario-planning exercises across sectors, to identifying knowledge areas in the public interest for which the government should provide sustained, and in some cases, legislatively mandated research funding. The rationale for these suggestions are that they would help avert crisis-based policy responses, create a basis for sustained research in the public good, and signal the importance of information and evidence as a core aspect of Canadian democracy and governance.

3.2.2 Theme 3: Guidelines of science integrity, ethical practice, and mentoring

Most interviewees stated that Canada needs stronger information gathering, reporting, and use standards across sectors to ensure the integrity, quality, and utility of information being generated for use in decisions. Many felt that:

- Having a clear set of principles for science integrity would be useful and important step in helping embed practices of science integrity within government, although such a document alone is insufficient to solve the current challenges to science integrity

A large number of interviewees specifically mentioned the 1999 Science Advice for Government Effectiveness (SAGE) document as an excellent starting point, which for a time became policy of the government (i.e. was adopted by the federal Cabinet) and became somewhat embedded in operations. Principles within SAGE are also seen as very similar to those applied in New Zealand, the United Kingdom, and Australia. The Framework for Science & Technology Advice (2002) from Industry Canada, Council of Science and Technology Advisors (committee) and COSEWIC's Canadian Science Academy Secretariat documents were also mentioned as excellent Canadian resources for science-policy principles and practice. Another document specifically mentioned was the US Environmental Protection Agency's scientific integrity practices, which covers aspects of science integrity with regard to knowledge production and sharing.

Related to the issue of ethics in the production and reporting of science:

- There was a considerable range of views among interviewees regarding appropriate constraints (or lack thereof) on the communications of scientific findings by government scientists

Most interviewees agreed that there are differences in the latitude of research questions addressed by academic scientists versus government scientists. In particular, many interviewees held the view that government science mostly supports a policy mandate, while academic research is mostly curiosity-driven. Most agreed that some limits on direct criticism of government are reasonable for government scientists. All agreed that constraints must be clear, applied minimally, and not in conflict with the public interest.

Where views differed was in the question of whom the public service serves. A minority of interviewees felt that it is reasonable for the government to require government scientists to stay "on message" and made analogies to corporate intellectual property. Differences of opinion seemed to stem from different interpretations of the Public Service Act of Canada Values and Ethics Code Section 1.2, which states that "public servants shall uphold Canadian democracy and loyally carry out the decision of Ministers." Some interpret this as meaning that scientists represent the department and government in power, rather than the public. Some felt a small tweak in the wording could (and should) shift accountability from the current government in power to the public and Parliament of Canada. Others emphasized the obligation of taxpayer-funded researchers to speak to share their findings publicly, regardless of the elected government they are serving, even if that implies criticism of current policy. The latter pointed to the effective use in the US of specified clauses that allow government scientists to distinguish their individual views as scientists from those of government.

With respect to communications and the highly politicized issue of federal government "muzzling" of scientists in Canada, all agreed that there have been examples of political interference. A small minority felt that the issue had been overblown in the media, while the majority felt that this issue was of major concern. A few interviewees highlighted that the general communications policy has not changed since the Chrétien government, but that the current federal government is enforcing the policy more rigorously. Furthermore, some note that changes to communications policies were intended to clarify the rules and facilitate greater integration of science and policy (e.g. by requiring plain language), but that these changes have been misused in some cases. A small number of interviewees expressed concern that the issue of muzzling has been a distraction from more important issues around science integrity, such as the

need for stronger means to integrate scientific evidence into the policy process. More generally, on each point below, several interviewees noted needs for:

- Ethical standards supported by mentorship
- Ethical standards supported by guidelines for professional behavior within the government and within the institutions that govern the behavior of professional scientists
- Empowering scientists, particularly those within the employ of government and industry, to issue grievances in cases of violations of ethical conduct and science integrity practices
- Individual support for private-sector scientists working in politicized science environments
- Increased mentorship for young scientists in developing applied science questions and techniques during their academic training
- Development and enforcement of a set of principles of professional and scientific conduct for both government and private-sector scientists, particularly as environmental and other assessment processes are increasingly conducted by non-government employees

On the last point, several interviewees specifically mentioned the College of Applied Biology (CAB, British Columbia), which governs the professional activities and standards of 2,200 biologists and technologists, and is legislatively mandated in British Columbia. Several mentioned the perception of a conflict between professional biologists' roles as managers and the code of practice and ethics for scientists. A few interviewees stated a need for guidelines based on real world scenarios faced by private-sector scientists, such as: ethics around giving advice for applied reasons; balancing business motivations with professional ethics; working and speaking within areas of expertise; handling conflicts; negotiating reasonable constraints of confidentiality agreements; and developing contingencies around the ability to share information. Other interviewees cited problems with regulation regarding what is expected of private-sector scientists, how the information gathered by these scientists is used, and transparency at the individual level. The current situation – specifically, the lack of training, mentoring, and a community of practice regarding ethics – in the words of one interviewee "leaves people isolated with moral struggles and struggles with courage."

3.2.3 Theme 4: Partnerships, interdisciplinary science, and cross-sector collaboration

The theme of partnerships was fundamental throughout several aspects of many interviews. In particular, interviewees highlighted these points:

- There is a need for more interdisciplinary training programs within and across government and academia
- There is a need for partnerships between scientists and those who are affected by policy decisions, to identify types of evidence needed to inform policy making
- Partnerships and collaborative projects across jurisdictions and between types of knowledge will build trust, mutual respect, and understanding, and facilitate the co-production of policy-relevant information
- There are many promising collaborations underway, particularly in Northern Canada, among indigenous knowledge holders and scientists

The forms of partnerships mentioned by interviewees ranged widely and included such ideas as:

- Interpersonal partnerships among scientists and indigenous knowledge holders
- Interdisciplinary collaborative programs developed within universities
- Institutional collaboration among granting institutions such as among the Natural Sciences and Engineering Research Council of Canada (NSERC), Social Sciences and Humanities Research Council (SSHRC), and National Research Council of Canada (NRC)

- Collaborative teams of university and government scientists, co-located on campuses
- Graduate students located within government labs (e.g. model of Experimental Lakes Area [ELA])
- Monitoring and compliance run as a partnership with local communities
- Formal and informal partnerships between researchers and communities directly affected (e.g. InSite (supervised injection site) drug harm reduction policy and public health program)
- Citizen science to fill research and capacity gaps, which requires the development of due diligence guidelines
- Greater collaboration amongst Canada Research Chairs

With respect to research capacity, many scientist interviewees mentioned the strength of institutions like the Experimental Lakes Area for generating excellent science and also hosting interactions between government and academic researchers. There was concern that many interdisciplinary programs have recently shut down or that there have been attempts to close them. This contrasts with the expansion of interdisciplinary programs at universities.

In terms of broader engagement, interviewees stressed that close partnerships in some sectors such as drug policy are essential not only for effective policy making, but for identifying the base of knowledge needed to address the primary challenges. In these cases direct engagement with affected communities is an essential step in designing effective, policy-relevant research and public policy. Especially with respect to partnerships, interviewees stated that:

- Individuals must be willing to step outside of their comfort zones to consider alternative forms of knowledge, ways of knowing, and means of communication; and to put in the time to develop relationships across disciplinary, cultural, and geographic divides

In some cases, stronger infrastructure and support mechanisms are needed to address the fear of de-legitimization and marginalization that many individuals feel in crossing disciplinary boundaries and engaging with alternative forms of knowledge. Overall, many interviewees emphasized the power of person-to-person relationships in bridging intellectual cultures and setting the foundation for the effective co-production of knowledge from different traditions.

3.2.4 Theme 5: Memory: Institutional knowledge and long-term research

A strong theme among virtually all interviewees working in the realm of science was the need for stronger mechanisms to preserve information. There are widespread concerns about the loss of information and institutional knowledge. These include the absence of a government database to retain data collected at taxpayer cost; lack of systematic preservation of data or physical samples collected by government scientists; and changes in work flows within Libraries and Archives Canada. One interviewee described the latter thus: “There has been a big restructuring in Libraries and Archives Canada that has resulted in de-professionalization and a lack of autonomy for researchers. In the past, each could work within their area of expertise but now most are focused on some aspect of a conveyor belt of process like taking in information, archiving, etcetera… and feel like a concierge service to industry.” Also mentioned was the restructuring of scientist classifications; sudden cuts and calls for early retirement that rapidly remove the most experienced researchers; strategic, politicized cuts to departments and funding; and the mandatory 2-3 year rotation of Assistant Deputy Ministers (ADMs) that results in many ADMs governing areas far outside of their expertise. It is hard to overstate the level of concern expressed regarding the systemic loss of institutional and scientific knowledge in recent years, and the negative effects these have had on morale within the public service (as summarized by interviewees). These concerns yielded the following key points:

- Canada needs to better preserve information and knowledge in a consistent and reliable format
- There is a need to recognize long-term information within indigenous knowledge sources and use it in application to the assessment of baseline conditions
- There are increasing needs for science information technology (IT) capacity within government, and limits to the centralized model currently being used for IT support

As mentioned above, there is a sense of losing capacity to conduct long-term research, and need to use formal measures to ensure the collection of science essential to the public interest. A few interviewees mentioned a need for legal mandates (e.g. such as is seen in continuous funding to deal with the nuclear legacy). An issue raised by one interviewee was the centralization of information technology services, which is not able to meet the needs of the many specific and diverse science communities within government.

3.3 How is knowledge shared and considered in decisions?

3.3.1 Theme 6: Structures of governance and mechanisms of evidence-based advising

The majority of interviewees cited a fundamental need to improve the structural science advisory mechanisms of Canadian government through which information is exchanged and advice is provided to policy makers. Many made statements along the lines that:

- Canada lacks the embedded science advisory mechanisms and base of institutions of many Western nations that support good practices for the use of evidence in policy

Interviewees did not reflect upon any formal advisory mechanisms for indigenous knowledge beyond the community level, presumably reflecting a perceived near-complete absence of these mechanisms (see below).

Due to the lack of embedded science advisory mechanisms, there is little structure to hold practices of good use of evidence in place. As a starting point, nearly all interviewees mentioned the need to reinstate a National Chief Science Advisor to government who reports directly to Cabinet and provides advice that is not funneled through departmental bureaucracies. This person would serve as a science champion and focal point; the position would symbolically signal the importance of science to Canadian society. A large number of interviewees pointed towards the UK as having an excellent model, with a Chief Science Adviser and a network of science advisors within each department, who interact and trade best practices. An alternative to the UK model mentioned was the "Swedish model" with very small ministries under a minister and politically oriented staff, but with most of the scientific work done quasi- or actually independently via public funding. More generally, many interviewees mentioned that:

- The Canadian Parliamentary system has little separation between executive and legislative powers, and this presents challenges to maintaining consistent approaches for the use of evidence in policy making

The weak history in Canadian Parliament of putting science front and center is seen as both cause and effect of the dearth of well-grounded governmental institutions that provide independent advice to policymakers. In contrast to the historical continuity of national science advisory institutions of government in the United Kingdom (Chief Science Adviser since 1966), the United States (Office of Science and Technology Policy since 1976), Australia (positions since 1989), the pattern in Canada is one of somewhat erratic creation and destruction of institutions and panels to support science advising. As a result:

- Canada has historically designed good federal processes to connect scientific information with policy makers, but these processes were often undermined

Some describe this pattern as repeated episodes of re-inventing the wheel with little long-term learning. As one interviewee put it, "everyone wants to create something new without learning from the old." These experiments range from an Office of the National Science Advisor to various public committees and advisory councils (e.g. National Round Table on the Economy and Environment).

One of the more prolonged and successful experiments named by multiple people was the Science Council of Canada (created 1966), which was well respected but was disbanded in 1992. Increasingly public commissions are seen as "cobbled together" in ways that lack the legitimacy of previous efforts. Further exacerbating the problem, interviewees reference a lack of political will to follow up on action items, and the tendency of government to simply defund initiatives that contradict its agenda. This leaves a sense that there is nothing in the system of governance to "hold the government's feet to the fire" when it comes to the use of evidence. While the notion of science integrity has become political, there is also a sense among interviewees that the issue is nonpartisan from an historical perspective. A minimum identified step would be for parliamentarians to have daily, weekly, or monthly access to information on science and technology with implications for policy.

Another facet of the challenge identified by a few interviewees is that Canada's public service is modeled after the British, which has a generalist culture. For example, most Deputy Ministers come from the policy stream (e.g. economists, business people) and it is rare that people in senior level positions have training in science. Several interviewees mentioned a glass ceiling for scientists at the level of Assistant Deputy Minister. As a result:

- Understanding of science is weak within the federal government and relatively few scientists hold high-level bureaucratic positions. Likewise, few members of parliament have any science background.
- Frequent movement of senior bureaucrats among departments, and appointments of officials without subject matter knowledge, further undermines the government's ability to support evidence-based decisions at the federal level
- Many interviewees expressed a desire for more public scrutiny regarding the influence of senior-level bureaucrats in management of Canada's natural resources

Several interviewees expressed concern that natural resource department scientists are often regarded as being aligned to the resource extraction side of government, and see their jobs primarily as facilitators of resource extraction.

Another very common concern was the trend towards increasing confidentiality in the use of advice and evidence in governmental decision-making. There is widespread concern about decreased transparency associated with the delivery of evidence. Barriers to accessing government information are prohibitive for most citizens. As a result, it is difficult to determine how evidence or advice was used to inform any particular decision. Specifically, many interviewees discussed the Science, Technology and Innovation Council (STIC) and the fact that its advice is confidential to both the public and the public service bureaucracy. All interviewees who discussed STIC felt that it is not free of vested interests. Some felt that STIC was specifically created by the current government to avoid listening to science advice. In response, most interviewees reflected that:

- Scientific advice shared with ministers should be on public record before and after ministerial use

- The recent shift towards confidentiality is negatively impacting the integrity and use of evidence in decision making, and is new in Canadian history

Many interviewees contrasted STIC to models in other Western nations, where science and technology committee members are primarily research council members, academics, chairs of scientific societies, etc. STIC is also perceived as being primarily focused on science as it relates to innovation and economic development, rather than science as a whole. Because the work of STIC is mostly kept confidential, there is no way to counter these perceptions, resulting in a reduced trust in STIC.

SAGE and other science integrity principles and practices mentioned in Section 3.2.2 address processes for sharing (as well as generating) information and for providing advice. Several interviewees felt that, in addition to improving decision-making, following such procedures can provide political protection for policy makers because they 1) can show they received advice, 2) can show the information and in some cases advice on which decisions were based, and 3) this process gives their decisions a stronger sense of legitimacy. With regard to processes that are working well, several interviewees noted that the Department of Fisheries and Ocean's Canadian Science Advisory Secretariat (CSAS) is still providing publically available science advice (though ease of access is low). At the provincial and territorial scale, many interviewees pointed out that:

- Promising evidence-based governance structures and practices are in place or developing in some provinces and in the Territories, particularly Quebec and Yukon.
- Because there are few formal science advisory positions, much of the most important learning regarding how to give effective science advice is happening at the individual scale and day-to-day on the job.

Some interviewees discussed Quebec as an example of successful evidence-policy structures, because it has a provincial Chief Scientist, as well as science advisory positions within government and organizations outside of government that have been successful in providing leadership to government within certain domains of science. These institutions have been able to demonstrate added value in the use and transparency of evidence in the policy making process. One of the messages from Quebec is that science advisory positions are opportunities for ministers to promote cooperation (versus competition) among science funding agencies. Positions such as a CSA can also streamline the advising process by having a single point person with a network of contacts. The CSA can help lead broader plans for research and innovation as well as policy advice. Effective science advising appears to be reliant on trusted relationships that facilitate information flow through multiple channels.

Outside of Quebec, interviewees noted several other promising experiments including Alberta's Innovation Council and Social Innovation Endowment; Ontario's efforts to support science outreach and culture; and British Columbia's considerable experiments with clean energy and other emerging technologies. In the Territories are multiple progressive examples of experiments in governance that integrate indigenous knowledge and science. All interviewees recognize that challenges vary with the population size, complexity, and geography of different jurisdictions, but pointed to a role for smaller scale efforts in leading and pushing the feds.

The challenges faced in science advising from the perspective of science are generally compounded when it comes to the application of indigenous knowledge to federal, provincial, and territorial advising. Overall, scientists and indigenous knowledge holders working in Aboriginal contexts report that:

- There is weak or no understanding of what indigenous knowledge is or how to work with it in policy making processes at provincial, territorial, and federal levels

Outside of local and territorial governments, there are no formal advisory structures for integrating indigenous knowledge into policy. Further, a number of methodological mismatches and biases work against Aboriginal communities. For example, large data generating agencies like StatsCan are geared towards centralized, highly populated regions. Data from such agencies present a very different picture, compared with what interviewees felt was occurring at the local level. Several interviewees noted that assessments are conducted based on methods that do not yield accurate data when applied to Aboriginal communities, particularly in more remote regions. The implications are great due to the direct link between data accuracy and allocation of federal, provincial, and territorial funding for civic resources and local capacity building. There is also an issue regarding the scope of data interpretation. For example, in evaluating food security, food in Aboriginal communities has physical, cultural, and social aspects that are frequently not captured in provincial and territorial assessment processes. Many other important variations are obscured in regional, provincial, and territorial scale processes that do not account for different pockets of experience based on local histories like relocation.

Interviewees also note an important distinction in the role of transparency and intellectual property between science and indigenous knowledge. Within Aboriginal communities, the degree of transparency and form of knowledge sharing are considered case-by-case based on when and how the community wants to provide information. This creates complexities for scientific data management and funders' expectations that data be provided open access. Overall, most interviewees felt that:

- There is not a sufficient base of connections, nor a single set of principles and practices – beyond good communication and collaboration – that could be applied universally to diverse Aboriginal communities

There are territorial models for bridging groups of people and knowledge. For example, Nunavut's Inuit Research Advisors bridge communities and researchers and advise a range of people, from Inuit organizations to mayors to scientists to universities on how to work together. For larger jurisdictions (especially provincial, territorial, and federal), several interviewees suggested, as a first step, creating spaces for people to ask questions, think, reflect, talk again, and ask more questions. Another individualized mechanism is to recruit indigenous knowledge holders into leadership positions and onto boards.

Finally, several interviewees expressed frustration that:

- In some places excellent processes designed to incorporate indigenous knowledge, science, and local community input had been designed, but then undermined by politics

For example, the Pacific North Coast Integrated Management Area (PNCIMA, now MaPP, Marine Planning Partnership for the North Pacific Coast) promised to have "one of the best management systems in the world with a mix of science and traditional knowledge" that included local co-management of marine resources on the coast of British Columbia, but it was never implemented. Likewise, the Federal Oceans Act came into existence but wasn't implemented. In contrast, in the words of one interviewee: "We currently have a gold standard of what not to do."

3.3.2 Theme 7: Science and advocacy

All interviewees were comfortable with the idea of advocating for the use of science and evidence, but perspectives differed on advocacy for particular policies based on science. Generally stated, interviewees felt that:

- It is appropriate for scientists to advocate for the use of evidence in policy making processes

- There are unresolved differences within the scientific community regarding advocacy for specific policy positions, and the influence of advocacy on scientists' credibility and therefore weight of evidence

Many interviewees noted a generational shift among younger scientists towards greater comfort in advocating for particular positions based on science, which some consider positive and some negative. On one hand, some felt strongly that scientists should only present data and information as objective assessments of a range of policy options, and without giving perspective on which is "right" or preferable. To take the additional step to advocate for a certain policy in light of evidence, by this view, is considered to be over the line, risking 1) the perception of scientists as yet another stakeholder with a vested interest and 2) letting politicians off the hook for making decisions and articulating the basis of those decisions. Others felt that in cases where evidence was overwhelming and a perceived moral issue is at play (most pointed to climate change), it is acceptable for scientists to state their opinion, but to clearly differentiate that they were speaking as a citizen rather than scientist only. While there was no consensus on what standards would look like, interviewees from the science tradition generally concurred that scientists must develop standards and clear boundaries for their role as experts delivering informed opinion based on scientific evidence (i.e. constituting good advice), and their roles as private citizens delivering values-driven personal opinions.

3.3.3 Theme 8: Political barriers to the use of evidence in policy making

Many interviewees noted that the general public's apathy about the value of information, science, and evidence yields the perception that there is no political cost to devaluing scientific advice (nor incentives for using evidence in decision-making). As a result, the political perception is that vocal minorities in a core voting block can have significant influence and drive government strategy. Several interviewees mentioned that key swing voter demographics in Canada appear to be less engaged in policy and current affairs than the average citizen. These interviewees surmised that while the majority of Canadians may want evidence-based policy, they are not motivated to make it a political issue. Many interviewees noted that other structural changes such as the creation of advisory positions and science integrity documents will not have much influence unless there is an underlying culture of respect for science among the general public. Overall, interviewees highlighted two paradoxical observations about Canadian culture:

- The use evidence in policy making has declined in part due to the lack of a public demand for government accountability in the practice of using evidence
- Canada has both a strong science culture and rule of law, which could combine to support the strengthening of political support for evidence-based policy making

In a recent study, Canada performed well on indicators of science culture and many interviewees reported a sense that more could be done to connect the public's interest in science with science and evidence-based policy. Canadians are also viewed as relatively law abiding. Therefore laws, once created, generally enjoy public support. Additionally, one interviewee pointed out that despite recent austerity measures and budget cuts, Canada still has fewer wealth-related barriers to implementation of evidence-based policies than many nations (e.g. resources for facilities, training, research, etc., can be made available to support implementation of new laws). However, since political barriers may functionally subvert existing laws (e.g. by placing undue burden on implementation), understanding local barriers to implementation is essential for evidence-based policies to function as intended.

3.4 How does Canadian society support evidence-based decision-making?

3.4.1 Theme 9: Functions of civil society: Media, education, philanthropy, advocacy, think tanks, industry

In general, interviewees indicated that arguments for the need to strengthen the use of evidence in policy making must be brought to civil society to enlist their support. Many interviewees felt that a large portion of Canadians are unaware of the decline in the use of evidence in policy, and those who are aware have not yet rallied an effective response. In summary, interviewees reported that:

- There is a need for broader civic engagement on the issue of science integrity
- Overall, mechanisms of civil society discourse in Canada are somewhat disabled
    - The media are not currently effective in communicating information or challenging the government for not using evidence in decision-making
    - Institutions of higher education are beginning to play a stronger role, but could do more
    - The philanthropic and charitable sector is constrained by politics
    - There is a weak but growing advocacy for science integrity in Canada
    - There is a need for more private sector, non-ideological think tanks in Canada
    - There are opportunities for industry engagement that are complex and underutilized
- The general public has more capacity to understand risk and uncertainty than they are given credit
- Many good things are happening at municipal and regional scales that deserve attention

Media: A common criticism among interviewees was the weakness of the mainstream Canadian media in questioning decisions by government that are inconsistent with evidence (compare, for example, to the Australian media), and in failing to distinguish political operatives from scientists (e.g. "false equivalence"). This is attributed to cuts of experienced science journalist staff, and to a lesser extent fear of political retribution. One interviewee stated bluntly: "Governments are acting with impunity because the public doesn't know, doesn't care, or doesn't understand." Several interviewees suggested providing trainings to media on science and indigenous knowledge. One specifically suggested supporting a science-and-indigenous-knowledge-literate commentariat who can relate science and indigenous knowledge to social values and broaden the public discussion of the topic.

Education: Most interviewees in some way discussed the role of educational institutions, and public education more broadly, in improving Canadians' awareness of and demand for evidence-based decision-making. In particular, interviewees felt that universities have multiple unique and essential roles to play as places of knowledge generation; sites of experimentation, collaboration, and integration of different knowledge sources; and as respected institutions that can counter political misinformation (by protecting intellectuals via the institution of tenure). Several interviewees noted a recent positive trend in academics being more willing to question narrow disciplinary assumptions; view critically their own traditions; and accommodate and incorporate other traditions such as indigenous and other forms of local knowledge. Bridging formal education and broader public education, several interviewees discussed a need for education specifically focused on concepts derived from complexity science (such as risk evaluation, the role of uncertainty, and the potential for sudden shifts) and the capacity to work with multiple forms of knowledge. These educational efforts set a long-term goal of expanding the consciousness of the Canadian general public to embrace and be able to work with complexity and multiple perspectives.

Philanthropy & Charities: The few interviewees who discussed philanthropic and charitable sectors indicated that they are currently unable to meaningfully hold government accountable on science integrity due to political threats. Some charities and funders have been audited or intimidated regarding their tax status and this is an impediment to their role in pushing governments to a high standard. A longer-term challenge is that traditional philanthropy in Canada is not strongly interested in science and there are few scientists working in grant-making foundations. One interviewee mentioned that new models are emerging, however – a "new philanthropy" based in technology funding – which is more interested in science and more likely to engage in multi-scale thinking.

Advocacy: While there are many strong advocacy-based NGOs in Canada, advocacy for the use of science has traditionally been missing. This has created a scenario in which there is little organizational backdrop for a science advocacy response to lapses in the use of evidence in policy. Some interviewees feel that something strange and unprecedented is happening in Canada in response to the recent "crisis." They point as evidence to the mobilization of new institutions such as Evidence for Democracy (E4D), and stronger actions by the Professional Institute of the Public Service of Canada (PIPSC) (e.g. attempt to codify science integrity principles in collective bargaining agreements), and ACFAS (Association francophone pour le savoir). These organizations have responded in a self-organizing way that is considered unusual in Canadian history, and is interpreted as a shift from apathy amongst the scientific community to advocacy. There is a collective sense that these efforts are increasing impact and that there is room for more organizations that can provide advice on policy and research investment.

Think Tanks: Several interviewees mentioned a need for more private sector think tanks to support analysis, and suggested that government should put some funding aside without strings attached to support private sector research. This would provide some capacity outside of government to address issues in which the government does not have sufficient expertise, and would provide analyses on important issues in the public interest.

Industry: Interviewee reflections on the role of industry were complex and multidimensional. On one hand, many note that industry understands regulations and risk management systems, knows where science inputs are, and often works to influence and manipulate scientific decision frameworks to fit private agendas. Some interviewees felt that tactics have been employed to inflate uncertainty generated by industry science and present scientific views that are contrary to the majority of evidence. They observed that this serves to create an unproductive my-scientist-versus-your-scientist dynamic that undermines high-quality discourse and decision-making and confuses the public. In contrast, there is also recognition that in some cases industry has lead positive changes (e.g. in acid rain regulations) and that there are good partners with whom it may be possible to find opportunities to co-produce high-quality knowledge. A few interviewees noted the need for clear delineation of the role of industry versus government in generating and interpreting information, and a sense that this line has become overly blurry. One interviewee highlighted the opportunity to engage business leaders in talking about why and how publically funded science has supported innovation and jobs (e.g. citing Mariana Mazzucato's book *The Entrepreneurial State*).

A small number of interviewees highlighted tentative opportunities to partner with corporations on data gathering and sharing. There is a sense that companies see themselves as adding social value, and their scientific efforts as a mix of operational needs and desire to be a good corporate citizen at the local level. However, the few people who spoke on this felt that information does not filter up in any kind of transformational way to higher levels of corporate decision-makers. There is therefore an implicit tension in many of these conversations (e.g. oil companies providing climate forecasting resources to communities, which also allow companies to more effectively extract oil, thereby exacerbating climate change).

3.4.2 Theme 10: Leadership across sectors

Many of the interviewees felt that failing leadership across sectors is a major contributor to the current decline in evidence-based decision-making. Many made statements such as "I can't underscore the leadership issue enough" in relation to a variety of contexts. Three aspects of this issue were highlighted:

- There is a leadership void within the public service, public institutions of science, and elected officials in strengthening the flow of information into policy making

- Canada needs more academic and private sector scientists advocating for public science, and for the use of science in policy making
- Fear and the "crisis of ambition" impede leadership among some scientists

A few interviewees noted that part of the role of the public service leadership is to hold government accountable for using evidence, and they are currently failing to do this. There is a sense that in the face of diminished demand for information, Canadian public service leadership is letting the supply of evidence fall and not pressing elected governments by demanding attention to issues as they have in the past. Interviewees attributed this situation in part to a lack of challenge from appointed leadership to elected officials, and in part to fear by public servants about job security in the face of questioning the decision processes of elected officials. While the risk of political retaliation is considered to be real by many interviewees, there is also a sense that some of the perception of risk is overblown. In one interviewee's words, "they can't fire the whole public service". A few interviewees strongly expressed that leadership from the public service in questioning the use of evidence in decision-making would improve the situation, in that even without formal procedures more evidence would be used. The limited number of people with strong science background in management and leadership positions within government is seen as exacerbating the problem.

There is a general sense that elected politicians primarily respond to penalties and rarely lead. However, some interviewees note that in the past a combination of personal and political traits drove leadership on particular issues and were able to make the politics work despite opposition. One interviewee cited a need for more "backbenchers" talking to leaders' offices to motivate stronger initiatives and better implementation of existing laws, as well as private members' bills, op-eds, and speaking out in caucus on issues of science integrity. In the past, there were "fixers" under previous federal governments who would take good science forward. The general sentiment now is that there are no messengers, and no one willing to fill that role.

Many interviewees reflected that the Canadian scientific community has also been apathetic historically. Currently, there is a sense that scientific leadership (granting councils, scientific funders, etc) have been silent because they are afraid of losing funding, and that this is different than in the past, where the formal leadership used to respond to cutbacks and rejections of evidence. The fear factor for questioning the use of evidence in decision-making processes is considered legitimate by many interviewees with respect to the current federal government, but they note that there are other, more subtle ways to address the issue, and still little effort to do so. One interviewee noted that this behavior is known in science-policy scholarship as "prudential acquiescence" (from *The politicization of science*, Joseph Haberer 1972 Science article). An underlying concern is that, in addition to fear of retaliation, scientific leadership is thinking too small, not believing in the possibility of change, and not trying to coordinate. This was reflected by another interviewee also as a "crisis of ambition" among scientists, particularly those in the conservation sector. Interviewees point to three specific needs: 1) Scientific leadership needs to make comments about science integrity an integral part of speeches and lobbying efforts, 2) scientists in general must engage in significant capacity building around science integrity, and 3) scientists need to present a positive vision of how greater science integrity will improve the lives of Canadians.

3.4.3 Theme 11: Independent scientific societies

Nearly all interviewees reported that:

- The Royal Society of Canada could play a much stronger role in promoting science integrity

Many see a stronger role for the Royal Society of Canada (RSC) in conducting expert panels, writing white papers from highly respected sources, and providing independent policy advice documents, as a

strong complement to the model of chief science advisors embedded within Ministries. However, many are concerned that the federal government will attempt to diminish the role and capacity of the RSC. Several interviewees pointed to the fact that most advanced countries have some expert body tied to the Royal Society or National Academy that does assessments and makes recommendations. Canada created the Council of Canadian Academies (CCA) to produce assessments but not recommendations. The CCA is perceived as being very different from the past Science Council of Canada that provided analysis and recommendations for government.

- Views of the Council of Canadian Academies vary greatly from relatively positive to strongly negative

Of the interviewees who mentioned the CCA many perceived its receipt of funds from Industry Canada as problematic due to concerns about conflicts of interest (although it is common for governments to provide block based funding for expert reports, e.g. to the National Academy of Science and the Royal Society of London). However, several interviewees pointed to the CCA as one of the few functioning ways in which the federal government receives science advice. The majority of interviewees who spoke about the CCA considered their reports to be erratic in scientific quality.

3.4.4 Theme 12: Canada in a global context

- There is a perception that Canada's international reputation as a science leader is changing for the worse

This change is seen as the result of the rejection of evidence for decision-making regarding climate change, natural resource extraction, and other science-related issues. Many interviewees indicated that there is an increasing flow of pressure, petitions, and letters from outside of Canada calling for stronger evidence-based decision-making within Canada (e.g. letter signed by 800 international scientists in Fall of 2014). Some view this kind of pressure as sometimes more effective than advocacy efforts from the inside of Canada. These calls are coupled with the breakdown of some international initiatives (e.g. Commission on Environmental Cooperation with Mexico/CA/US has been disbanded and defunded).

On the positive side, several interviewees noted that:

- Canada has an opportunity to develop excellence and demonstrate global leadership in the incorporation of indigenous knowledge into policy making

There are many examples from the Canadian North of successful partnerships linking indigenous knowledge holders, scientists, and policy makers. Interviewees working in collaboration with both scientists and indigenous knowledge holders report that many efforts are successfully creating greater trust, mutual respect, and understanding of the forms of knowledge held by the different traditions. Many of these interviewees felt that these collaborations, particularly in the Canadian North, could serve as leading examples of the co-production of knowledge and co-management. More broadly, within several academic institutions within Canada there are partnerships that combine co-creation of knowledge with application to large-scale challenges such as climate change and biodiversity loss (e.g. at Université du Québec à Montréal, Simon Fraser University, University of British Columbia). An example mentioned by two interviewees is Future Earth, which engages climate scientists, social scientists, and lay groups on ways to demonstrate the impact of climate change on villages and people.

Finally, interviewees point out that there are lessons to be learned from other nations and from the European Commission, which has put substantial funding into research and information gathering to address issues and connect them with policy. Linking to these efforts would yield ideas on how to

improve science advisory capacity in Canada. At the same time, many interviewees emphasized that any process needs to be uniquely Canadian and take into account that some institutions that support science integrity elsewhere do not exist in Canada. For example, in the US, major research institutions like Scripps, Woods Hole, and Lamont-Doherties are all privately endowed and drive oceanography & climate research. This resource base doesn't exist in Canada.

4 What is the Gold Standard?

In response to the question 'What is the "gold standard" for the use of science in public policy, and can you offer real examples from anywhere?' many interviewees specifically mentioned the United Kingdom's model. This model includes a National Chief Science Advisor and a chief science advisor in each department at the federal level, with direct contact and coordination among departments to support sharing of best practices. Several interviewees also specifically called for the recreation of the Council of Science and Technology Advisors, with both institutions (CSA and CSTA) adapted to the current context of wider citizen engagement and social media. A few interviewees emphasized that Canada's "gold standard" will need to be a kind of hybrid since Canada is bilingual and the structures of government are different in French than in English Canada. Beyond advisory structures, interviewees also named a number of needs related to public mobilization around science, government relations, and institutional capacity. The following is a summary of common interviewee responses.

4.1 Gold Standard for Science Integrity

- **Knowledge generation**
  - Clear separation of science and policy: arms-length organizations of government science with adequate funding for high-quality monitoring, research in the public interest, and long-term data storage and management
  - High-quality monitoring to establish baseline data, and recognition of indigenous knowledge as a legitimate form of baseline data
  - Dialogue among key stakeholders in cases where such engagement is essential to define the base of evidence needed to make good policy
  - Co-production of knowledge with Aboriginal communities
  - Interdisciplinary and cross-sector research collaborations and engagement of independent academic institutions and the Royal Society of Canada on science in the public interest

- **Knowledge sharing**
  - Open and timely communication about scientific findings with protections for scientists
  - Opportunities for mutual exchange of knowledge and perspectives across cultures of knowledge (science, indigenous knowledge, policy making) with adequate time, space, and continuity for people to ask questions, think, reflect, talk again, ask more questions, and build trust over time
  - Communicators with regular opportunities to speak with the public within all departments
  - Government leadership knowledgeable about science, and about their domains
  - Engaged science leadership across institutions

- **Knowledge use**
  - National Chief Science Advisor and science advisory positions within each department
  - Policy makers aware of the evidence available, with access facilitated through designated nodes or offices to facilitate science-indigenous knowledge-policy exchange

4.2 Gold Standard for Science Integrity specific to the context of science

- Codified Principles & Practices of Science Integrity, including how to handle scientific uncertainty and risk
- Publically available data and long-term data management
- Continuity of funding for long-term science essential to the public interest (gold standard is areas of legal mandate)
- Independent, arms-length reports serving as intellectual referees

4.3 Gold Standard for Science Integrity specific to the context of indigenous knowledge

- Local capacity to do science
- Decentralization of data collection with indigenous knowledge holders involved in all stages of the work
- Case-by-case sharing of information and intellectual property practices developed with communities
- Proper and transparent consultation practices, conducted in native language

5 Conclusion

This report summarizes the perspectives of 30 individuals interviewed for the Science Integrity Project. We thank all of the individuals who took the time to share their thoughts and experience on this issue.

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9 Contact Information

Please visit scienceintegrity.ca for more information about the Science Integrity Project.

Appendix A. Individuals Interviewed During Scoping Phase of the Science Integrity Project
Current affiliations are listed for identification only. All individuals were interviewed in their personal capacities reflecting perspectives developed across their entire careers.

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One name withheld