Climate Change Action through Co-Productive Design in Science-Policy Partnerships at Municipal, Provincial, and National Levels of Government

by

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BSc, University of Saskatchewan, 2007
BA, University of Saskatchewan, 2008
MES, University of Saskatchewan, 2010

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Supervisory Committee

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Abstract

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Why is it that the international scientific consensus on climate change has not been followed by a proportionate policy response in Canada? Perhaps the relationships between the country's science organizations and government agencies are not functioning properly. My research adopts an interdisciplinary approach (i.e. science studies and political science) to this issue, highlighting the relevant literature's underlying consensus on co-production, a norm of deliberative two-way engagement between scientists and policy-makers. I hypothesize that relationships embodying elements of co-productive design (e.g. informal communication, appointed liaisons) are more likely to facilitate climate action. To test this, I examine three cases of climate science-policy partnership in Canada by interviewing participants from both sides. The partnership between the Pacific Climate Impacts Consortium and BC municipalities exhibits substantial influence on policy, tied to a considerable degree of co-productive design. The partnership between the Pacific Institute for Climate Solutions and the Climate Action Secretariat of the BC provincial government also displays notable design characteristics, but primarily facilitates side benefits and soft influences rather than concrete policy changes. The attempted partnership between the

Canadian Foundation for Climate and Atmospheric Sciences and the federal government exhibits few elements of co-productive design and has been effectively terminated, demonstrating the prerequisite importance of political interest. The relevant literature is not sufficiently nuanced to fully predict or explain these situations, so I put forward a new theoretical model. My science-policy relationship hierarchy (SPRHi) suggests that each such case can be classified as incidental interaction, basic partnership, interactive dialogue, or true co-production. It specifies the conditions which must be met for any given relationship to improve, maximizing potential benefits and influences. Concrete policy changes seem to result only from true co-production, though, which generally requires exceptional external requirements and thus cannot be deliberately facilitated. As such, co-productive design ultimately does not offer a clear way to address Canada's climate inaction. I suggest that further research be conducted on international coordination mechanisms, public attitudes, and (especially) political leadership. However, the soft influences of science-policy partnerships may affect these broader factors in unpredictable ways, so the importance of co-productive design should not be underestimated.

Keywords: British Columbia, Canada, climate change, co-production, deliberative democracy, evidence-based policy, institutional design, multi-level governance, political leadership, public policy, research utilization, science-policy interfaces

Table of Contents

List of Tables

List of Acronyms

ADM	Assistant Deputy Minister
BC	British Columbia
BSS	Breakthrough Strategies and Solutions
CACCI	Communities Adapting to Climate Change Initiative
CAS	Climate Action Secretariat
CAUT	Canadian Association of University Teachers
CBC	Canadian Broadcasting Corporation
CBT	Columbia Basin Trust
CCF	Canadian Climate Forum
CFCAS	Canadian Foundation for Climate and Atmospheric Sciences
CFI	Canadian Foundation for Innovation
CICS	Canadian Institute for Climate Studies
CMOS	Canadian Meteorological and Oceanographic Society
EASAC	European Academies Science Advisory Council
EBP	Evidence-Based Policy
EC	Environment Canada
FBC	Fraser Basin Council
GC	Government of Canada
ICLEI	International Council for Local Environmental Initiatives
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LIAISE	Linking Impact Assessment Instruments to Sustainability Expertise
MLG	Multi-Level Governance
MPB	Mountain Pine Beetle
NDP	New Democratic Party
NEAA	Netherlands Environmental Assessment Agency
NGO	Non-Government Organization
NRCan	Natural Resources Canada
NRTEE	National Roundtable on Environment and Economy

NSERC	Natural Science and Engineering Research Council of Canada
PC	Progressive Conservative
PCIC	Pacific Climate Impacts Consortium
PhD	Doctor of Philosophy
PICS	Pacific Institute for Climate Solutions
RAC	Regional Adaptation Collaborative
SPI	Science-Policy Interface
SPRHi	Science-Policy Relationship Hierarchy
UK	United Kingdom
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
UVic	University of Victoria
WCI	Western Climate Initiative
WMO	World Meteorological Organization

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Chapter 1: Introduction

The Problem

There is a global scientific consensus that climate change will have severe consequences for the environment, society, and the economy worldwide, and that it is caused primarily by human-generated greenhouse gas emissions. The most salient example of this consensus is the Intergovernmental Panel on Climate Change (IPCC), an organization created by the United Nations (UN) and the World Meteorological Organization (WMO) in 1988 to comprehensively review the state of scientific knowledge on climate change and clarify the implications of potential policy responses, on a regular basis.[1] On the first page of its first assessment report, the IPCC declared that "several hundred working scientists from 25 countries have participated in the preparation and review of the scientific data. The result is the most authoritative and strongly supported statement on climate change that has ever been made by the international scientific community" (IPCC 1990). Since then, as the IPCC has produced subsequent reports, its processes have become more rigorous and facilitate an even stronger consensus; the mechanisms are democratic and collaborative, experts and government representatives from all WMO and UN member nations are able to participate in the review process, and there is a thorough protocol for dealing with errors (IPCC 2013). While the IPCC's reports reflect many updates and changes in the understanding of climate change, its implicit key message has remained consistent from its first report in 1990 through to its most recent report in 2014: a 'business-as-usual' scenario for emissions will lead to severe climate consequences. The earlier there is substantial policy action,

[1] Policy action on climate change can consist of mitigation (reducing greenhouse gas emissions to prevent or slow the effects of climate change) or adaptation (preparing for the effects of climate change such that their impact on society is limited). The IPCC reports discuss both, but this chapter focuses more on the former.

the more likely it is that such disaster can be averted and the easier that policy action will be (see IPCC 1990, IPCC 2014).

Despite this strong consensus among scientists (and governments) existing for nearly a quarter of a century, climate policy action has generally been very poor across the globe. This inaction is best exemplified by the failure of the Kyoto Protocol, a 1997 agreement among more than 200 nations to lower their greenhouse gas emissions, facilitated by the United Nations Framework Convention on Climate Change (UNFCCC). It was motivated, in large part, by the first and second assessment reports of the IPCC. The average target for developed countries was a reduction in yearly emissions to 4.2% below 1990 levels by 2012 (NEAA 2011). While three nations were able to meet or exceed this target in a meaningful way (i.e. the United Kingdom, Germany, and Sweden), emissions rose in many of the participating countries, and even more substantially in non-participating countries, such that, altogether, annual global greenhouse gas emissions increased by nearly 50% between 1990 and 2010 (IEA 2012). Policy-makers do not appear to be responding to the call of the international scientific consensus.

Canada's inaction is particularly notable, since it initially ratified (i.e. formally agreed to participate in) the Kyoto Protocol in 2002 but withdrew in 2011, after a change in government from the Liberals to the Conservatives in 2006. It and the United States are now the only developed countries that are not participants. Canada has been criticized for inaction on climate change and other environmental issues even under the Liberals, prior to ratification of the Kyoto Protocol. Allegedly, the federal government has taken symbolic rather than substantive action, has sought to blame inaction on other parties, has generally lacked leadership and ambition (which is tentative or erratic when it does emerge), and has been heavily condemned by other nations as a result (Macdonald 2009, VanNijnatten and Boardman 2009, White 2010, Winfield

2009). The governing style of the Conservatives, however, has led to new concerns. They have been accused of muzzling government scientists, forbidding them to speak freely to the media or public, especially when their views on climate change or other environmental concerns run counter to the government's position (Greenwood 2013). In addition, there are allegations that climate research in Canada has been strategically defunded or otherwise suppressed by the Conservative government (CAUT 2014, Cuddy 2010). Finally, while Canada appears to have stabilized its emissions for the moment (i.e. they no longer tend to increase from year to year), perhaps due in part to some minor *sector-by-sector* action (see GC 2014a), it falls woefully short of the IPCC recommendations, which support *economy-wide* approaches such as carbon pricing (see IPCC 2014, Winfield 2009).[2] The country's per-capita emissions remain among the highest in the developed world (IEA 2012) and Prime Minister Stephen Harper very recently publicly reaffirmed his opposition to carbon pricing (Payton 2014).[3]

My Interest in Climate Change Policy

The broad motivating question of my doctoral work is: Why does Canada's climate policy seem to evade the evidence of climate science? This general concern has been at the top of my mind for years, even as an undergrad in environmental studies. I became particularly interested in climate action after watching a skeptical documentary entitled "The Great Global Warming Swindle" during my master's program.[4] While the film ultimately failed to convince

[2] However, inaction at the federal level has enabled some opportunities for leadership at the provincial level. This is discussed in more detail later in the dissertation (e.g. Chapters 5 and 6 in particular).
[3] Of course, at the time of this final writing, power has just shifted back to the Liberals under Prime Minister Justin Trudeau, and a new international agreement is being negotiated. The research in this dissertation, nonetheless, was motivated largely by, and took place primarily in the context of, the period of inaction under the Conservatives.
[4] I use the term "climate action" frequently throughout this dissertation. I define it as "progressive *policy* action taken by governments to mitigate or adapt to climate change", as per its use in the above discussion. It should not be perceived as referring to broader societal actions (e.g. protests, changes in individual behaviour).

me that the climate change threat had been blown out of proportion, I had to admit that it had a persuasive air, and I was only comfortable discounting it after doing some additional research on my own. This experience really demonstrated the complexity of the climate change controversy to me. Even if scientists largely agree on the matter, it may still appear as an open question in the eyes of the media, politicians, and the public, especially since climate action often seems to imply curbing consumption or economic growth, which may prompt rejecting the conclusions of climate scientists. The controversy is further complicated by the interdisciplinary, interjurisdictional, and intertemporal nature of climate change. Identifying impacts and strategies for action requires a combination of traditionally separate natural and social sciences (and the humanities are relevant too), the necessary collective action is difficult to coordinate on a global scale, and motivating interest in the short term is challenging since the most significant effects will not occur for decades. As a political issue, climate change is both a quagmire and a minefield, incredibly complex and extremely important. How could I spend my PhD program exploring anything else?

When I first came to the University of Victoria, my plan was to address the climate change problem by interrogating the successful 2008 implementation of a carbon tax in BC for lessons that might be extracted to other jurisdictions, such as the federal government of Canada. In my first year, I wrote a term paper on factors leading to the tax's success (e.g. policy design and framing strategy), which I extrapolated from media coverage and Hansard records. When I presented the paper a few months later at a *BC Studies* conference, however, a researcher much more familiar with the issue pointed out to me the importance of the global financial crisis, which took attention away from the carbon tax as an election issue, as well as the personal motivation and influence of Gordon Campbell, the premier at the time of implementation (see

Harrison 2012). The biggest factors in the success of the BC carbon tax, then, could not be deliberately applied in other jurisdictions, unlike factors of design or framing.[5] Fortunately, as a student with an interdisciplinary background (i.e. in environmental studies, biology, and political studies) registered in an interdisciplinary program (i.e. belonging jointly to the departments of environmental studies and political science), I was afforded the flexibility to approach the issue of climate change from multiple directions. My curiosity shifted from BC's carbon tax to a broader interest in the relationships between scientists and policy-makers, which seemed to be a more direct avenue for examining the discrepancy between the international scientific consensus and Canada's climate inaction. That focus remained throughout my eventual doctoral research and is communicated in this dissertation, supplemented by an interdisciplinary mode of inquiry which acknowledges the issue as complex and difficult to analyze through a single lens.[6]

Guiding Definitions and Concepts

Even though science-policy relationships are an intuitively direct venue through which to explore climate change, they are still a fairly broad topic of discussion, and any exploration of them should be focused by clear definitions. Climate science, as it is commonly understood in terms of the debate over policy action, tends to have three characteristics: it is formal science (i.e. knowledge generated through research by academics and others as opposed to public preferences or local expertise – Ascher et al. 2010); it is basic science (i.e. pure research like the monitoring of impacts on the atmosphere and local ecosystems as opposed to applied

[5] I later learned of some additional controversy over explanations for the success of BC's carbon tax. Dale (2015), for instance, highlights the importance of synergistic intragovernmental cooperation between politicians and various government departments. This suggests a lesson that could be deliberately applied in other situations.
[6] Broad theoretical frameworks, such as Kingdon's (1984) policy streams, however, can inform a holistic and contextual understanding. A few of these are reviewed in detail at the beginning of Chapter 2.

development like the invention of low-emissions energy sources – Jasanoff and Wynne 1998); and it is predominantly natural science as opposed to social science, although the IPCC engages in both (and even the former has social elements and implications). In spite of these criteria, climate science can be conducted in numerous realms, including academia as well as government. However, government tends to have a stronger focus on informal science, applied development, and social science, so its research is less likely to fit the overall definition of climate science, not to say that it is unimportant. As such, the interactions between external (e.g. academic) science and the policy-making process within government are interesting and complex, and can be conceptualized as 'science-policy interfaces' (SPIs).

"Science-policy interfaces are defined as social processes which encompass relations between scientists and other actors in the policy process, and which allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making" (van den Hove 2007 p. 807). While this definition is fairly recent, as is popular usage of the term SPI, the study of relationships between policy-makers and researchers or experts has a rich history, exemplified by the traditional norm of 'speaking truth to power' (see Prince 2007).[7] The contemporary study of SPIs, however, tends to focus not only on the ideal flow of information from science to policy, but also on work taking place at the boundary of science and policy, the cooptation of either by the other, the salience and legitimacy of information, knowledge-brokering, and the limitations of scientific objectivity (van den Hove 2007, LIAISE 2011). Still, much of the criticism levelled at policy-makers for failing to take action in the face of scientific evidence (e.g. Canada's inaction on climate change) seems to be based on the traditional one-

[7] "Policy-makers" is a fairly broad term, including both government civil servants and high-level decision-makers (e.g. elected politicians). For the purposes of this dissertation, the term "stakeholders" is used to refer even more generally to actors involved with the policy process that are neither scientists nor policy-makers (e.g. advocacy groups, NGOs, industries). Such actors are not central to SPIs, but are peripherally relevant.

way ideal, implying that the problem is that policy-makers simply fail to listen, do not make an effort to understand, or lack the ambition to follow-through (e.g. Bradshaw and Borchers 2000, White 2010, Winfield 2009). The frustrations of activist groups may often be rooted in such a perception of the problem. This intuitive 'deficit model' is possibly an oversimplification (Lawton 2007), but there certainly exists a 'science-policy gap' between the consensus evidence and political action for climate change (Bradshaw and Borchers 2000), which must be addressed.

A focused exploration of climate science-policy interaction in Canada merits choosing a single explanatory tradition to rely upon primarily. In other words, what phenomena will generally be investigated to explain and address the problem at hand? Broad theoretical frameworks from political science, those of Kingdon (1984) and Sabatier (1988) for instance, suggest that outcomes can be explained by the competing interests of different groups, exogenous events, and the influence of individual leaders (among other causes), but SPIs warrant an approach that emphasizes institutions and their design. The effectiveness of interaction between scientists and policy-makers may be related to the way it is set up (e.g. one group is under-represented, forums are not interactive enough, meetings are rushed or too irregular) or the manner in which their roles and positions are constructed (e.g. a policy department is not expected to communicate with relevant scientists at all, a science group over-prioritizes releasing their findings to the academic community rather than policy-makers), which are often problems of institutional design. Perhaps more importantly, even when a challenge (or opportunity) is found to have a non-institutionalist explanation (e.g. a workshop is very productive due to a pre-existing amicable relationship between the participating groups), an institution-related solution is often still appropriate. For example, while amicability itself cannot be "designed" into a workshop directly, it can be indirectly fostered by facilitating more informal interaction between

the participants beforehand or by discussing areas of common ground before exploring areas of difference. Institutions are a somewhat malleable aspect of the policy process (see Goodin 1996), as opposed to, for instance, exogenous events or enthusiastic individuals of authority, which generally cannot be deliberately facilitated.[8] Thus, institutionalist explanations for problems lend themselves to solutions, which are particularly important in the case of climate change, where drastic action may be required.

In addition to concentrating specifically on the institutional design of science-policy communication, this dissertation employs further focus, in terms of the main types of institutional design that are examined. Contemporary conceptions of SPIs make it clear that science and policy are not completely separate realms, and information does not flow neatly and completely from the former to the latter. Rather, both realms tend to overlap with and influence each other in a process of co-production, hybridization, or co-evolution (Ascher et al. 2010, Jasanoff and Wynne 1998, van den Hove 2007). This concept of 'co-production' is often used to describe the reality of SPIs (sometimes negatively – see Weingart 1999), but it can also be used normatively, to prescribe a deliberative ideal for SPIs, where scientists and policy-makers (and potentially other stakeholders) engage in transparent back-and-forth deliberation to improve the production of both science and policy (Bäckstrand 2003, Sutherland et al. 2006).[9] Assessing climate science-policy interaction in Canadian institutions for co-production is a suitable way to

[8] Cause malleability is an important concept in this dissertation. Recall that one of the reasons I shifted my research focus away from the success of BC's carbon tax was because the apparent causal factors (i.e. individual leadership, exogenous economic events) were not particularly malleable and thus did not facilitate the generation of prescriptive solutions applicable elsewhere.

[9] There is a range of potential relationships between scientists and policy-makers, from minimal incidental interactions, to basic formal partnerships (or stable informal ones), to interactive back-and-forth dialogues, to true co-production with direct mutual influence. These terms (i.e. partnership, dialogue, true co-production) are used deliberately throughout the dissertation to refer to certain degrees of collaboration, though they are sometimes interchangeable (e.g. a dialogue is necessarily a partnership but a partnership is not necessarily a dialogue). There are also some generic terms that may refer to all of them (i.e. relationship, interaction, communication).

begin investigating why Canada's climate policy seems to evade the evidence of climate science.[10]

The above concepts are all relevant to the focus of my research, but their host literatures, which are thoroughly explored in Chapter 2, have deficiencies that this dissertation can address. While scholars of SPIs, evidence-based policy (EBP), and research utilization have effectively contextualized the general divide between science and policy,[11] they tend to be overly theoretical, and when they do make recommendations, they target either scientists or policy-makers alone, rather than considering improvements that could be made to interfaces themselves. The literatures on institutionalism and deliberative design are neither overly theoretical nor narrowly practical, with their principles for effective interaction and suggestions of institutional mechanisms that may facilitate it, but they generally focus on communication between policy-makers and the public rather than science-policy interaction. These two groups of literature, coming from a variety of academic disciplines, address one another's deficiencies fairly well, but the more interesting complementarity is their implicit consensus on co-production. Whether it is known as 'co-evolution' in the SPIs literature, a 'negotiated approach to problem-solving' in the EBP literature, or the 'analytical-deliberative process' in the deliberation literature, co-production as a norm is encircled by surprisingly positive, though implicit, agreement. Since normative propositions tend to be controversial, this collective enthusiasm is noteworthy. However, it has yet to be synthesized and applied in a comprehensive, empirical manner, which is precisely what this dissertation sets out to do.

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[10] While this research focuses on science-policy interfaces, institutionalism, and co-production, it remains open to findings rooted in other conceptual areas, hence the interdisciplinary approach. Both the research questions and interview questions make room for important out-of-scope considerations should they arise.

[11] I will normally use the term 'science-policy gap' to refer to the discrepancy between international scientific consensus and policy action on climate change, while using the term 'science-policy divide' to mean general tensions in communication between scientists and policy-makers.

These literatures, in general, seem to put sufficient focus on environmental issues and climate change, but their lack of attention to the Canadian case specifically is another notable gap. Many works are theoretical, failing to acknowledge the importance of context, and those that are empirical usually concentrate on Europe, the US, and Australia, or have a global focus. There is room, then, for more analysis of climate science-policy interaction and co-production in Canada, but the Canadian case can also offer some unique lessons for the broader theoretical understanding. Because Canada's federalist system of government involves a unique sharing of powers between municipal, provincial, and national jurisdictions (e.g. each level is formally constrained by the others but ultimately is capable, in practice, of taking substantial action on climate change individually), studying the science-policy interaction that occurs across the levels will necessarily be sensitive to varying governance arrangements and institutional constraints. Not only might such an approach yield lessons applicable to a broad array of other jurisdictions, but the concept of multi-level governance (i.e. that various levels of government must work together to address some problems, as opposed to relying on a separation of responsibilities by jurisdiction) is thought to be particularly important for climate change (Bulkeley and Betsill 2003, Bulkeley and Newell 2010, Gore 2010). A multi-level examination of the climate science-policy gap in Canada, informed by the consensus on co-production in the literatures on institutional design and science-policy interaction, then, acknowledges both the interdisciplinary and interjurisdictional complexity of climate change.

Objectives of this Dissertation

While my academic interests have always been motivated by a broad question regarding climate inaction, the focused purpose of this dissertation is *to determine how science-policy*

partnerships designed to embrace co-production, at all levels of government, can help bridge Canada's climate science-policy gap.[12] In attempting to comprehensively address current deficiencies in the literature as well as general inaction on climate change, such a purpose has descriptive, evaluative, explanatory, prescriptive, and comparative dimensions, which can be broken down into more focused research questions:

- What climate-related science-policy partnerships exist in Canada? How are they institutionally set up? What elements of co-productive design are present?
- How effectively does each partnership contribute to the translation of scientific evidence into policy action? What other successes or challenges are apparent?
- Are the identified successes and challenges caused by aspects of institutional design (e.g. presence or absence of co-productive elements)? What other factors are important?
- What alternative institutional arrangements or designs might realize opportunities for improvement? Can and should they be applied to other jurisdictions?[13]
- How do the answers to these questions vary with each level of government? Are any phenomena better understood holistically across the levels?

Basically, the questions assess two variables of interest (i.e. institutional design and policy success), explore their relationship with each other (and related variables), consider the broader implications for addressing climate change, and use case comparison to substantiate the analysis.

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[12] Recall that a science-policy "partnership" is more stable than mere incidental interaction. For example, it might consist of concrete meetings like forums and workshops, as well as broader institutional arrangements like networks and working groups. The emphasis on such partnerships (between at least one group of scientists and at least one group of policy-makers) as a primary unit of analysis is intended to keep the scope of the dissertation centred (i.e. they will comprise the case studies).

[13] The difference between the evaluative question (i.e. the second one) and the prescriptive question (i.e. the fourth one) is that the former merely *identifies* challenges and successes while the latter (informed by the third question) asks how challenges might be addressed and how successes might be bolstered or transferred to other cases. Answering the former may implicitly seem to answer the latter, but careful analysis that keeps the two distinct from one another is more suitable for rigorous investigation.

The general hypothesis underlying my exploration of these questions is: *the more that climate science-policy partnerships are designed to embody elements of deliberative co-production (rather than non-communication or one-way flows of information), the more effectively they will translate scientific evidence into policy action*.[14] This is a fitting approach to the research questions given the nascent consensus of the relevant literatures and the purpose of the dissertation.

In pursuing such inquiry, three cases of climate science-policy partnership are selected for examination, one at each level of government in Canada. These include the partnerships between the Pacific Climate Impacts Consortium (PCIC) and BC municipalities, between the Pacific Institute for Climate Solutions (PICS) and the BC provincial government (specifically the Climate Action Secretariat), and between the Canadian Foundation for Climate and Atmospheric Sciences (CFCAS) and the federal government of Canada. These cases are introduced in Chapter 3, along with the methods used for exploring them. The primary method for this research is elite interviews of both scientists and policy-makers involved with the various partnerships. Each is asked to describe, evaluate, explain, and suggest improvements for the partnership with which they are familiar, addressing the research questions. To a lesser extent, they are encouraged to comment on issues of multi-level governance (MLG) and broader lessons for science-policy interaction in other jurisdictions and on other issues, but much of the analysis in that vein come from the dissertation itself, in its synthesis and comparison of participant responses.

[14] While this dissertation uses a hypothesis, recall that it is interdisciplinary and aims to remain open to other causal explanations (see footnote 10). As such, it is a combination of inductive and deductive methodology, rather than merely the latter (see Chapter 3). Indeed, it is difficult to genuinely investigate the significance of co-production without considering other causal factors that could affect the success or failure of a partnership. Thus, the third (explanatory) research question may be the most important one.

The dissertation's structure is as follows. Chapter 2 reviews the relevant literature on causal frameworks for policy change, SPIs, EBP, research utilization, institutionalism, deliberative design, co-production, and MLG in order to thoroughly justify the importance of this research (and to set up a foundational analytical framework for the rest of the dissertation). Chapter 3 elaborates the hypothesis, justifies the case selection, and details the interview methods used. Chapter 4 discusses the municipal-level case, the partnership between PCIC and BC municipalities. Chapter 5 reports the provincial-level case study of the partnership between PICS and the BC provincial government. Chapter 6 examines the final, national-level case, the partnership between CFCAS and the federal government of Canada. Chapter 7 compares the three cases to make an overall assessment of the hypothesis, building more sophisticated co-production theory that acknowledges contextual factors contributing to climate policy action or inaction (e.g. public pressure, inter-government relationships) and that is applicable to other cases. Chapter 8 demonstrates the contribution of the dissertation to the related bodies of knowledge and concludes with reflections on potential avenues for future work.

In summary, climate inaction is highly alarming problem, but the same complexity that renders it difficult to address makes it a compelling area for academic research. My aim is to leverage my interdisciplinary understanding of the relevant literatures and an interjurisdictional analysis of the climate science-policy gap in Canada to meet that complexity, making an important contribution to the body of knowledge around the social and political dimensions of climate action. More peripherally, I hope to demonstrate the general utility of design principles and causal models based on the concept of co-production, for policy issues besides climate change and jurisdictions besides Canada.

Chapter 2: Literature Review

As argued in Chapter 1, the gap between climate science and climate policy leadership in Canada is an important problem, and it can perhaps be addressed by changing the institutional arrangements that shape interactions between scientists and policy-makers (i.e. so that they facilitate a more collaborative process). Several fields and sub-fields of literature are relevant to these suppositions, and should be reviewed to strengthen and focus the dissertation's research questions. As such, this chapter analyzes literature on general frameworks for policy change, SPIs, EBP, research utilization, institutionalism, and deliberative design. The first four sub-fields primarily help articulate the problem, and the latter two mainly speak to potential solutions. As each sub-field is synthesized (often by highlighting particularly central pieces of literature), it is interrogated for emerging themes, apparent gaps in the body of knowledge, and tensions or complementarities with the other sub-fields. The most important emerging observation is the evident consensus and emphasis of many sub-fields on 'co-production' as a desirable norm, so it is treated as a field unto itself. A few of the pieces relevant to this central subject delineate specific causal pathways from design factors to policy influence; I synthesize them into a broad analytical framework to frame the research questions. Finally, the literature is examined holistically for its capacity to specifically address the climate science-policy gap in Canada, supplemented by literature on MLG. This justifies the novel research in subsequent chapters.

General Frameworks for Policy Change

Explaining why policy changes (or why it stays the same) is a major focus for public policy studies, within the broader discipline of political science. In the past century, there has been much debate over the most important policy determinants (i.e. causal factors for policy

change). Researchers might see policy as the result of public opinion, ideas, competing stakeholder groups, institutions, elite interests, diffusion from other jurisdictions, economic trends, the rational choices of individual civil servants and politicians (see Howlett et al. 2009 pp. 32-48), or external events (Birkland 1997), just to name a few. A given study often selects one or a few of these explanatory traditions to draw upon in attempting to explain policy change, depending on which determinants the researchers believe are relevant to the case and which they believe are generally important. For example, Collier and Messick (1975) seek to explain the rise of old age pensions and unemployment insurance across a wide array of countries using hypotheses regarding economic trends and diffusion. Eventually, some scholars started to synthesize the literature on various causal factors. Simeon (1976) interpreted the determinants as comprising a "funnel of causality", ranging from remote causes like the socioeconomic environment to proximate causes like the decision-making process. He claims that "much of the literature has tended to focus on one end of the funnel without taking account of the other" (p. 556); perhaps Collier and Messick (1975), for instance, are an example of focusing too much on remote causes. The notion that all determinants are important has become quite influential in public policy studies, but it is still often appropriate for individual studies to draw *primarily* on one or a few causal factors, for the sake of focus.[1]

The acceptance of approximate equivalency (or at least complementarity) between the determinants has led to several frameworks or models that attempt to explain policy change by incorporating many potential causes at once. Cohen et al. (1972) put forward the "garbage can model" of decision-making, which suggests that chaotic interactions between problems, solutions, and participants (as if dumped into a garbage can and then jumbled around) result in

[1] Recall from Chapter 1 that this dissertation gives particular attention to institutions.

opportunities to make choices in an organization. Sabatier's (1988) "advocacy coalition framework" is primarily concerned with the actions of stakeholder groups, but makes allowances for external events, public opinion, institutional constraints, and ideas. One of the strongest comprehensive models of policy change is Kingdon's (1984) hypothesis, which applies the chaotic reality of the garbage can model to broader determinants such as those in the advocacy coalition framework. He theorizes the existence of three 'streams': problem, policy (i.e. solutions), and political (e.g. public pressure).[2] Policy action on any particular issue can only take place when the three streams align. For example, even if a reasonable policy solution has been matched to a well-known problem, its implementation is unlikely unless the government can gain politically from doing so. The streams may come together when 'policy windows' (e.g. crises or elections) open. Ideally, we might expect the existence of a problem (e.g. the IPCC consensus on climate change) to lead the development of solutions and the mustering of political will, but the 'three streams' model clarifies that this order is quite rare, since the causes of policy change are complex and chaotic. However, Kingdon's concept of 'policy entrepreneurs' (i.e. capable actors who set out to deliberately align the streams) suggests that the cause-effect process is at least somewhat malleable.

Although Kingdon's model includes basic science as an important input to the problem stream, there are other frameworks that afford more primacy to science as a determinant of policy change, and as such may be more applicable to this dissertation. These generally have been developed by practitioners or scholars in specific policy fields, rather than conventional political scientists. Lomas (2000) conceptualizes two major inputs to the institutional structure of

[2] The political stream is basically synonymous with the general term 'political will', which is common in later chapters. While Kingdon defines this as comprising national mood, election results, and interest group pressure, I define it more generally as "the interest and willingness of key decision-makers (e.g. elected politicians) with regard to taking a certain policy action, which may be rooted in political ideology or public opinion relevant to that action".

decision-making, information (research, media) and values (ideologies, beliefs, interests). Not only does the former allegedly influence decision-making directly, but it can also lead to changes in the latter through persuasion. Though a researcher himself, Lomas acknowledges that beliefs are very difficult to change (sandwiched between more intractable ideologies and interests), at least in the short term, and that even compelling research can only lead to major policy change during rare and temporary windows of opportunity. The model of Ascher et al. (2010) is more directly applicable to the climate science-policy gap, since it speaks to environmental information specifically. They emphasize the generation, transmission, and use of knowledge; it is *generated* by a variety of sources (e.g. academia, government, local expertise, non-profits), *transmitted* through screening and framing (i.e. it is influenced by bias, uncertainty, and institutional constraints), and then the filtered subset is *used* in the policy cycle (further limited by decision routines, legal expectations, and regulatory traditions). As such, very little of the evidence on climate change can be expected to get through this complex process and determine policy outcomes directly, but scientific inputs are far from irrelevant. For example, while the current political stream in Canada may not foster much climate action, scientists can still attempt to influence the decision process and general beliefs.

None of these frameworks suggests that climate science will neatly and directly lead to climate policy action. While the frameworks of Lomas (2000) and Ascher et al. (2010) seem more relevant to this dissertation given their focus on science-policy linkages, the frameworks of Sabatier (1988) and Kingdon (1984) discuss a wider range of potential policy determinants (i.e. they give more attention to external factors such as influence groups); there is a trade-off between scope and applicability. This is precisely why it is important to appreciate the diversity

of causal frameworks for policy change at this point in the dissertation.[3] Basing all of the subsequent analysis on only the framework with the most immediate relevance (e.g. Ascher et al. 2010) would risk the narrow-minded focus that Simeon (1976) warns against. This chapter proceeds to interrogate literature on science and institutions as causal factors of particular interest, while acknowledging the potential importance of other determinants that may arise throughout the course of the study (see the combined deductive and inductive methodology in Chapter 3). If other causal factors end up being particularly important, it may be necessary to draw upon additional bodies of literature later in the dissertation.

Science-Policy Interfaces

Despite the hyphenation, this sub-field of literature focuses more on the science side than the policy side, most of its scholars being either sociologists of science or natural scientists writing reflectively about their own field. As such, its foundations can be traced to a set of classic literatures regarding the social construction of science, which challenges the assumption that science is an objective process searching for an unalterable truth. Latour (1984) represents this discourse well. He argues that there are two ways to view science, as 'ready-made' or 'in the making', and he dramatizes this tension somewhat by assigning each perspective to one side of the two-faced Roman god Janus. For example, when Watson and Crick proposed the structure of DNA that we now accept as the basis of our understanding, did they discover the 'correct' structure, or does that structure become more 'correct' as people are convinced? Ultimately, he believes that science is not sufficiently introspective, should acknowledge its socially constructed nature, and be willing to question established paradigms. That is, he has a preference for the 'in

[3] That is, the purpose of this section is not to reveal and address any particular literature gap, unlike the following sections.

the making' viewpoint, though perhaps his main contribution is the conceptualization of two opposing viewpoints to begin with. Along these lines, another important author is Kuhn (1962), who claims that scientific understanding in any given field goes through long periods of 'normal' science, followed by short periods of growing pressure and disruption which result in a new paradigm, a process that implies social construction. The work of more recent authors has argued that science is a social institution which gets used in political ways (Lewontin 1991), that scientists have a limited rationality just like everyone else (Brunner and Ascher 1992), and that science cannot objectively settle political disputes since it inevitably becomes politicized itself (Sarewitz 2004). Overall, there is much support for the idea that science is socially constructed, and although we may informally treat science as mostly objective most of the time, it would now be rare to encounter denial of its subjective elements.[4]

Contemporary scholars have begun to examine science more specifically in the context of policy or politics (of the environmental variety in particular), pointing to problems on both sides of SPIs. For example, while the above literature is concerned with the politicization of science, other authors point to the parallel 'scientization' of politics (e.g. Bocking 2009 p. 66, Litfin 1994, Weingart 1999), that is, political debates focusing too much on factual disputes when the real issue is a disagreement over values or interests. Science is still very useful even if it is socially constructed, but policy-makers tend to make insufficient use of what is available, such that much of the literature focuses on the general science-policy divide, Lawton's (2007) work being the best example. We often assume that policy-makers do not respond to science because scientists have yet to do enough research or communicate it strongly enough, but Lawton argues that there

[4] Still, "science can and should hold some epistemological authority by nature of its use of evidence and warrant (defined, in this instance, as the assurance of truth of what is said)… This epistemological authority does not negate the inclusion of a social dimension in science, nor does the social dimension make science illegitimate" (Haack 1995 as cited in Garvin 2001 p. 446). That is, a 'gap' between science and policy can still be problematic.

are many (better) political reasons for the gap: different time-scale, lack of public support, economic cost, influence of interest groups, waiting for other jurisdictions to act, different understanding of uncertainty (also see Bradshaw and Borchers 2000), information overload, contrary political wisdom, and lack of necessary institutions. Likens (2010) would add that policy-makers often have other priorities and that there are also general communication issues, such as politicians not understanding technical terms and requiring a certain style of messaging. Despite this variety of barriers (also see Mead 2015) and the reality that many are normal features of the policy process, scientists and policy-makers still tend to blame the divide on each other (Bocking 2004 p. 12, Garvin 2001) and both groups may resist efforts at the boundary to bridge the divide (Cash et al. 2003 p. 8090). As such, the divide between science and policy has been well-articulated, and acknowledging that some barriers come from both sides is important for any potential reconciliation.

As the literature on SPIs is focused more on the science side than the policy side, it is not surprising that most of the concrete recommendations for bridging the divide are aimed at scientists. One trend concerns the types of information scientists should try to produce. Cash et al. (2002), the most widely cited authors on the topic, contend that scientific information must meet three criteria in order to be influential: it must be credible (scientifically adequate with rigorous methods and evidence), salient (relevant to the priorities and time-frames of decision-makers and stakeholders), and legitimate (follow an unbiased procedure respectful of stakeholder values). They argue that it is usually possible to make trade-offs between the standards, and that scientists, although they have a tendency to emphasize only the former at the cost of the other two, should strive to balance the three when possible. More recent authors have used their own sets of criteria (e.g. Ascher at al. 2010, Ford et al. 2013, Knapp and Trainor 2013), but they are

often very similar, or at least related, to those of Cash and colleagues. Another trend in the recommendations for scientists concerns the role they should play within SPIs. A few basic roles are established by Pielke Jr. (2007), but his main argument is that scientists should try to embody the 'honest broker' role (where they present the implications of various decisions to policy-makers but do not explicitly endorse any particular option) and be wary of the 'stealth issue advocate' role (where they appear to give an objective recommendation but it is actually based on their own biases, since science is socially constructed). Spruijt et al. (2014) are a little more nuanced in their review, concluding that different roles are appropriate in different contexts. Finally, Prins et al. (2010) propose a messaging strategy which involves connecting the recommendations of scientists on one policy issue to another, more tractable, one. Certainly, there is much advice on how scientists might bridge the science-policy divide.

Even though the body of knowledge around SPIs is capable of articulating barriers on both sides of the science-policy divide, its focus on science leaves it somewhat lacking in recommendations aimed at policy-makers or political processes. There are broad suggestions for science policy and government funding of science (e.g. McNie 2007, Sarewitz and Pielke Jr. 2007), but they do not speak specifically to issues of direct interaction between science and policy. The closest that this sub-field comes to advising policy-makers is in its broader assessment of SPIs as a whole, that is, in the recommendations it makes for scientists and policy-makers collectively. Jasanoff and Wynne (1998) observe that SPIs do not follow the traditional ideal of a one-way information flow from science to policy (i.e. "speaking truth to power"), but rather embody a process of two-way flows and co-production. This implies that the science-policy divide is not so much a failure of scientists to 'speak' to policy-makers or a failure of policy-makers to 'listen' to scientists, but a failure both to engage with the other more

meaningfully. Lomas (2000) points out that researchers and decision-makers must learn to see one another not as discrete events (i.e. a research finding, a decision) but as ongoing processes (i.e. researching, decision-making). Recognizing this gives rise to solutions like knowledge brokers and boundary organizations, which can facilitate such engagement (LIAISE 2011, Litfin 1994), but are not the sole responsibility of science or policy alone. The subject of mutual solutions and co-production are formally revisited later in this chapter since elements of it can be found in all the relevant sub-fields, which is not surprising since it straddles the middle-ground between science and policy.

Overall, this sub-field of literature effectively characterizes the challenges of interaction between scientists and policy-makers with its acknowledgement of the social construction of science and its appreciation for the political realities that can make influencing policy difficult. However, the existing recommendations are primarily targeted at only the science side of the divide and have inherent limitations (also see Newman and Head 2015). If credibility, salience, and legitimacy must be traded off for one another, how can information be generated that really embodies all three? If science is socially constructed, how can we really tell if a researcher is being an honest broker instead of implicitly favouring one recommendation based on a hidden bias? If the root of the problem is political forces inherent to the policy-making process, how can changing the way scientists present information solve it? By itself, the literature on SPIs cannot tell us how to bridge Canada's climate science-policy gap, or if such bridging is even possible. Co-production is promising, but its interdisciplinary nature means that fully understanding it requires the perspective of other fields. For instance, how does it compare to recommendations exclusive to policy-makers?

Evidence-Based Policy

While the literature on SPIs is largely from the perspective of science, the body of knowledge around EBP is primarily from the perspective of policy (though it often focuses on interactions with social science rather than natural science). The concept of EBP may have precursors in the norms of evidence-based medicine (Young et al. 2002 p. 219), the earlier policy analysis movement (Howlett 2009 p. 154), and the initial shift to quasi-experimentation in social science research (see Shadish et al. 2002 pp. 2-3), but it was ultimately popularized by government rather than by academia (unlike the concept of SPIs). EBP really rose to significance in 1997 when a Labour Party government in the UK was elected with the philosophy of 'what matters is what works' (Davies et al. 2000). Several government initiatives in the surrounding years can be associated with this EBP philosophy, including the 'Comprehensive Spending Review', the 'Modernising Government' agenda, and especially the 'Centre for Evidence-Based Policy' (Nutley and Webb 2000). Essentially, EBP seeks to put the best possible evidence at the centre of policy development (though other factors like values and resources are still considered important) and it eschews opinion-based policy, which relies on selectively used evidence, untested views, ideology, or prejudice (Davies 2004). Such evidentiary support may increase the likelihood of a policy to survive shifts in political opinion that often accompany changes in government (Farrelly 2008 p. 6)

Given EBP's development in government, we can expect many of its potential solutions to the divide between science (i.e. evidence) and policy to be aimed more at policy-makers and institutional arrangements, as opposed to the science-oriented recommendations of the literature on SPIs. The UK House of Commons Science and Technology Committee (2006) makes a number of specific suggestions for connecting science and policy, rooted in the norms of EBP.

For example, all major government departments should have chief science advisors; policy horizon-scanning should expand to include science horizon-scanning; government scientists should be involved throughout policy-making processes (e.g. in prioritizing strategic issues); all senior officials should have a basic understanding of scientific methods; scientific advisory committees should not have any lay members; and existing science advisors should be given additional independence and centrality. Some academics are also supportive of mechanisms that promote EBP, arguing that rules and transparency are needed to protect science from politicization (Rosenstock and Lee 2002) and that the most important requirement is interaction and support between researchers and users (Walter et al. 2005). Pursuing this ideal is thought possible even knowing that evidence will never be perfect and decision-making cannot be completely rational (Nutley 2003). As such, in both government and academia, there is ample support for EBP as well as some advice on how to facilitate it.

Most academics, however, appear to be quite critical of EBP. Nutley (ibid) believes that the term 'evidence-informed policy' would be more appropriate, given other influences and the inevitable combination of research with advocacy, a sentiment echoed by Julnes (2007). Marston and Watts (2003), though, are probably the most thorough in their critique. They portray decision-making as a spectrum from completely rational to completely political, acknowledging that the reality is somewhere in the middle. EBP norms, however, often seem to assume that a perfectly rational model can be achieved. The danger is that evidence, often used to make an argument, is socially constructed, so hidden assumptions may undermine the policy process. In analyzing a case study of an 'evidence-based' crime prevention plan in Australia, Marston and Watts reveal an assumption that criminal behaviour can be easily predicted, as well as biases of elitism and ageism. Under the 'veil' of EBP, then, policy elites can increase their strategic

control over perceptions of social problems (quite the opposite of EBP's intent), devaluing other forms of knowledge such as citizen voices. Other authors agree that EBP can weaken organizations in the voluntary sector (Laforest and Orsini 2005) and can put unreasonable expectations on evidence, preventing effective decision-making on issues of uncertainty such as climate change (Dessai et al. 2009 pp. 75-76). As such, most of these authors support some form of 'evidence-aware policy' that gives evidence more attention than it would traditionally get, but acknowledges its limitations and does not allow it to dominate the political process. These ideas overlap strongly with the literature on SPIs, which similarly criticizes the objectivity of science.

In addition to these normative critiques of EBP (i.e. why it *should not* be pursued), there are also criticisms of a more practical nature (i.e. why it *cannot* be pursued). Allegedly, policy analyses rarely get used even when they are deliberately commissioned (Young et al. 2002); the influence of lobbying remains ever-present even under norms of EBP (Greenhalgh and Russell 2006); multiple potential bases of evidence such as practitioner experience and political judgement complicate the process (Head 2008); simplistic and limited concepts of one-way knowledge transfer tend to persist under EBP (Owens et al. 2006 p. 635); and workers at all levels of government tend not to possess the analytical capacity necessary to implement EBP effectively, even in developed countries with advanced civil services (Howlett 2009, Howlett and Newman 2010). Most of these accounts, like the ones above, are cautionary warnings about EBP rather than outright rejections of its driving principles. They tend to see some merit to enhancing the use of evidence in decision-making, but view the issue as requiring more complex solutions than simply mandating the norms of EBP. Increasing awareness and understanding of these concerns among policy-makers, for instance, appears to be paramount.

The literature on EBP, then, provides a different perspective on interactions of science and policy, coming from the latter instead of the former. Importantly, it suggests numerous ways for policy-makers to address the under-use of evidence, such as educating themselves about social construction and institutionalizing scientists in the policy process. It provides some justification for a rational model of policy-making at the same time as it acknowledges the limitations of such an ideal, facilitating the emergence of a middle-ground consensus regarding 'evidence-informed policy', which is similar to the compromise around mutual solutions (i.e. co-production) in the literature on SPIs. Fervent support for EBP and the rational ideal can be common among scientists and policy-makers in a general sense, but is rare among those who have studied it directly. Still, this tension means that there remain some important shortcomings in the literature. If most of the specific recommendations have come from those who display an uncritical support for EBP, how can we be sure they are effective or even possible? If those suggestions are unreasonable, then what can meaningfully be done to address the science-policy gap for important issues like climate change? We know *that* EBP tends to fall short of expectations in practice, but there is room for further exploration of *why* this is so. More information about how the decision-making process fundamentally works in reality is necessary in order to identify where EBP can go wrong.

Research Utilization

While it addresses many of the same issues as the above literature, the sub-field of research utilization is rooted in academic political science and policy analysis rather than in government itself. That is, it provides a somewhat external, social-scientific lens that is focused

on explaining how information does or does not flow into the policy process.[5] The classic work in this sub-field is best exemplified by Weiss (1977), who establishes that the use of information by policy-makers can range from the immediate application of any recommendations (ideal rational model) to a general sensitization to highlighted concepts (enlightenment model). She uses interview evidence to illustrate that reality tends to fall much closer to the latter than the former; policy-makers use research generally to orient themselves toward problems when setting the decision agenda more than they utilize its specific recommendations during policy implementation. Her interviewees even tended to approve of information that challenged the status quo, although they were skeptical that others would feel the same way. Ultimately, she concludes that there is an important role for researchers in challenging political priorities broadly, but that utilization of their research would be difficult to notice in such a context.[6] Her subsequent study (1980), which characterizes the decision-making process as an emerging 'accretion' and knowledge use as an indirect 'creep' (see also Daviter 2015), verifies that policy-makers will often say that they have made use of research but then find it difficult to give a concrete example.

Other authors have supplemented Weiss by demonstrating that policy-makers often collect research for symbolic rather than practical reasons (Feldman and March 1981); that policy-oriented learning through analytical debate tends to take longer than a decade, since

[5] Lynd (1939) may be an important precursor to this sub-field. While he does not speak to the specific mechanisms through which information might influence the policy process, he was one of the first to write on the relationship between social scientists and decision-makers. He argued that social scientists have an obligation to challenge the status quo in order to help solve public problems, rather than passively perpetuating existing systems and leaving societal progress to the realm of natural science. Interestingly, Lohmann (2008) makes a very similar argument about the issue of climate change; it is not a question of understanding the physical processes anymore, but a question of how to mobilize the social changes necessary to respond to them.

[6] Her research seems to suggest that we may perceive gaps between science and policy even when there is a normal flow of evidence into the political process, since it happens subtly. Still, the climate science-policy gap is one situation, at least, where such disparity should not be easily excused (see Chapter 1).

beliefs have inertia (Sabatier 1988); and that the actual use of research is most common for fundamental decisions, though incremental and routine decisions may still draw on technical analysis and data (Lindquist 1988).[7] The last observation suggests that data (i.e. basic quantitative measurements that have not yet been interpreted) is more likely to be used than prescriptive and evaluative forms of information (i.e. research and analysis), but tends to have less influence in each instance of use.[8] Altogether, this literature indicates that norms of EBP contradict some very strong organic traditions,[9] but that important evidence use does occur, albeit in a somewhat inconspicuous fashion.

Contemporary scholars of research utilization have broadened their understanding of information and decision processes, but the central ideas of low, slow, and invisible utilization seem to remain at the core. Shulha and Cousins (1997) review the literature, highlighting emerging themes that demonstrate the inherent benefits of process (i.e. the exercise of trying to utilize research facilitates organizational learning even if little research ends up getting used); ever-present issues of non-utilization and even mis-utilization; and the importance of context (i.e. the properties of a given issue and its surrounding policy sector affect information use). Keller (2009) would add that the stage of policy-making is also of crucial importance. The realism in these accounts matches the classic models of Weiss, but for the most part it is quite difficult to distinguish between EBP and research utilization literature after EBP's rise to significance in

[7] These fundamental decision regimes are rare (i.e. policy-makers pursue minor changes far more often than major ones), just like the policy windows of Kingdon (1984). In both accounts, it seems that a certain degree of political interest is required before research will genuinely and directly inform the policy process.

[8] Lindquist's work is complementary to that of Pielke Jr. (2007), which was discussed in the section on SPIs. I interpret the two of them as collectively suggesting that there are basically three types of information communicated to policy-makers from scientists: data (e.g. predictions about increases in rainfall), advice (e.g. a list of potential policy responses), and advocacy (e.g. support for a specific policy response). Rietig (2014) also discusses establishing basic credibility through the type of scientific information produced. These concepts are utilized in the case chapters.

[9] Perhaps even EBP itself is primarily a symbolic political maneuver.

1997.[10] A recent piece by Weiss et al. (2008), for example, primarily uses language and concepts related to EBP in order to argue that the divide between research (or science) and policy can be caused by shortcomings on the research side, on the policy side, or in the linkages between them. So not only have the core ideas of the research utilization sub-field remained robust over time, but they have also become relevant to issues of EBP.

Another body of knowledge related to research utilization concerns intra-coalition policy learning. While most of Sabatier's (1988) work concerns *inter*-coalition policy learning (i.e. the outcomes of policy debates between opposing factions), he also addresses the potential for learning within coalitions as well (e.g. between a science organization and government agency that both ostensibly agree on the need for climate action). He claims that members of a given coalition continually seek to improve their understanding of relevant variables and causal relationships consistent with their main beliefs. Lindquist (1993 p. 573) acknowledges that intra-coalition learning may take this form, leading to improved tactics for furthering prevailing beliefs. However, he also suggests that, even within a coalition, dominant paradigms may be challenged and adjusted, just as they are through mediation between different coalitions. Providing further specificity, Weible (2008 p. 629) adds that intra-coalition learning is more likely to occur when the members have a similar analytical approach (i.e. disciplinary background, base understanding) or when interactive forums are utilized such that the drawbacks of any dissimilarities can be overcome. Furthermore, he provides an effective partial summary of the research utilization sub-field by identifying three types of information use: instrumental (i.e. rational – see Weiss 1977), political (i.e. symbolic or legitimizing – see Feldman and March 1981 and Sabatier 1988), and learning (i.e. enlightenment – see Weiss 1977). The concept of

[10] Newman and Head (2015 p. 384) see the two as a single sub-field, EBP being a continuation of research utilization when interest re-emerged in the 1990s.

intra-coalition learning contributes some detail to the body of knowledge around research utilization, improving its descriptive capacity.

The blurring of boundaries between the primarily prescriptive EBP literature and the more descriptive research utilization literature makes them stronger together, in terms of understanding how best to move forward in addressing the science-policy divide. Javeline and Shufeldt (2014) connect these two sub-fields particularly well, since they have backgrounds in political science, but make a recommendation for policy-makers regarding effective EBP. They believe that the best way to make policy decisions for issues under scientific uncertainty is to conduct a survey of experts. Decisions should be weighted appropriately toward the majority or the consensus, if there is one, rather being based on a sub-set of expert opinion (perhaps in the minority) selectively chosen to support a position previously arrived at by the decision-maker. This is a robust recommendation, which helpfully is more precise than general calls to utilize evidence better, but its emphasis on science inputs also indicates further overlap with the literature on SPIs. Another example of overlap is the parallel development of policy analysis and the sub-field of SPIs; the former has shifted from 'positivism' (the belief that perfectly objective truths can be discovered through the correct methods) toward 'post-positivism' (Howlett et al. 2009 pp. 21-30) while the latter has embraced social construction over 'ready-made science'. Each of the three sub-fields of literature is an effective complement to the other two, and they are much more informative when considered collectively instead of individually.[11]

So what does the research utilization literature tell us, especially in the context of the literature on SPIs and EBP? For one thing, it provides potentially the strongest descriptive model of information flows into the policy process, explaining that information is most used by policy-

[11] Also, the EBP and research utilization sub-fields primarily speak to social science, so it is important to combine them with literature on SPIs if they are to be applied to the natural science of climate change.

makers in an indirect or symbolic manner over time, which is difficult to observe. The literature on SPIs and EBP supplements the descriptive model with prescriptive suggestions for addressing some of the problems with that process, aimed respectively at the science and policy sides. However, the former recommendations tend to accommodate, rather than challenge, the root political barriers and the latter ones are rooted in an extreme view of EBP that over-privileges scientific input. The method of Javeline and Shufeldt (2014) is a more nuanced mixture and would probably be supported by both the 'co-production' and 'evidence-informed policy' camps. However, it still requires substantial political interest in scientific input and neutral decision-making to begin with, so there are opportunities for further work in all the relevant sub-fields. Together, these bodies of knowledge contextualize the divide between science and policy very effectively, highlighting the importance of social construction, different types of evidence, subtle influences, and the overall complexity of policy-making, but they do not yet provide a particularly cogent suggestion for how progress might be made on Canada's climate science-policy gap. Although some of the above pieces speak to environmental issues and even climate change, they do not do so in the context of Canada, and Shulha and Cousins (1997) have shown that such context is of paramount importance. What are the specific yet significant changes that could be made to an interface itself, rather than on either side of it? This question requires the input of sub-fields concerned with process design, even if they do not specifically address science-policy relationships.

Institutionalism

The study of institutions has a rich history in the discipline of political science. While institutions were traditionally seen as merely arenas where political behaviour occurs (March and

Olsen 1984), they are now defined as formal or informal patterns of socially constructed norms, roles, or procedures that constrain political action, shaping preferences and motives for the individuals taking that action (Goodin 1996, Hall and Taylor 1996). Institutions can range from physical, concrete, or written to less tangible conventions or norms (e.g. organizational cultures). This definitional shift mirrors the movement from classic institutionalism, which largely focused on describing institutions, to new institutionalism, which is more explanatory, viewing institutions as autonomous, interdependent with society (March and Olsen 1984), and deliberately designed rather than just emerging from socio-cultural forces (Lowndes and Wilson 2001 p. 632). This new institutionalism can mean seeking to explain how and why institutions emerge and develop (Goodin 1996), or it can mean exploring the way they shape or cause political outcomes (March and Olsen 1984). Basically, the analytical lens can view institutions as either an effect or a cause, but it is primarily the latter that is relevant to this study. That is, how do institutions affect policy action and the science-policy divide? Finally, the focus can be narrowed further, drawing on, for instance, rational choice (i.e. incentives and transactions), historical (i.e. power and path dependency), or sociological (i.e. symbols and legitimacy) institutionalism, depending on what is most appropriate for the policy issue under analysis (Hall and Taylor 1996, Reich 2000). Essentially, institutions matter, their design is important, and there exist diverse lenses through which to examine their effects.

In addressing the science-policy divide, this study is most interested in how the related institutions might be designed to mitigate some of the barriers to effective interaction. Indeed, a 'normative' (i.e. forward-looking, solutions-focused) institutionalism is a natural supplement to the classic 'positive' (i.e. backward-looking, descriptive and explanatory) institutionalism (Wendt 2001 p. 1022). In this vein, several scholars have written specifically about institutional

design. Moe (1984) for instance, points out that the incentives created by institutions are always affected by the disparity in motivations between principals and agents, which can lead to gaming of the system and moral hazard if such institutions are not designed effectively. However, the most central author in this area is Goodin (1996). He argues that, while institutions can change by accident or organic evolution (see also Pierson 2000), design is present in some form (i.e. perhaps a failed design and perhaps not a single designer) for nearly all kinds of institutional change. As such, design is very important, though it is always a moral judgement to claim that an institution and its design are successful.

He believes it is possible to generalize about a few design principles that tend to improve institutions, though; effective institutions are flexible (open to experimentation, learning-by-doing, and revision), robust (adaptable to situations without undergoing fundamental changes or falling apart), accountable (defensible to other institutions and the public), and accommodate a mixture of individual motives (through checks and balances or a strong model of trust). For example, the "adhocracies" examined by Desveaux et al. (1994) are special planning groups with the capacity to transcend existing bureaucratic boundaries and routines, often involving a public consultation component and collaboration across multiple departments, created in order to address new policy challenges (i.e. they are arguably flexible, robust, and accountable). For the purposes of this study, it seems that institutional design may be an appropriate starting point, specifically supplemented by Goodin's generic principles. For example, is there something problematic about current incentives for scientists or policy-makers?

Goodin's principle of flexibility merits particular attention, since it is similar to some important institutional characteristics discussed by other scholars. Orton and Weick (1990) review the concept of loose coupling, which paradoxically suggests that institutions have

elements that are coupled (i.e. connected, stable) and elements that are loose (i.e. autonomous, spontaneous) at the same time. Roughly, this is comparable to the distinction between organizational exploitation (i.e. using acquired expertise) and exploration (i.e. experimenting), as well as the distinction between aligned capacity and offline capacity (see March 1991 and Lindquist 2009). Regardless of the specific terms used, scholars tend to argue that both stability and flexibility are important for institutions, but that enhancing one usually comes at the cost of the other. This trade-off is complicated by the reality that stability is favoured due to standard inertia (i.e. change is often resisted), more obvious short-term benefits (i.e. the benefits of exploration are longer-term and difficult to predict), and recent pushes for organizations to become more efficient and lean (ibid). Thus, flexibility must be explicitly pursued, even in spite of pressures against it, for institutions to be effective in the long term. For example, institutions can embed themselves in broad networks, building external connections with other organizations that may facilitate the spontaneous sharing of expertise in the future (Lindquist 2009), even if no immediate benefits are apparent.[12]

Many scholars of SPIs discuss institutions as well. Prewitt et al. (2012 p. 49) observe that institutional arrangements may be the most important factor in improving the connections between science and policy (e.g. government researchers and policy-makers can be co-located). In reference to all of the science-targeted recommendations that have been made in the literature on SPIs, Brunner and Ascher (1992 p. 325) believe that the self-discipline of scientists will be insufficient to ensure such changes take place, and institutional changes are needed, in addition, to incentivize the desired behaviour. Finally, Cash et al. (2003 p. 8089) note that communication,

[12] Newman and Dale (2005) examine a comparable stability/flexibility relationship, but specifically for networks rather than individual institutions. They use the terms ‘bonding ties’ and ‘bridging ties’ and similarly warn that the former may be favoured over the latter, even though both are important.

translation, and mediation between scientists and policy-makers can be enhanced if institutionalized in boundary organizations. This important overlap in the relevant literatures, then, confirms the pertinence of an institutional focus for examining Canada's climate science-policy gap, not to suggest that broader factors (e.g. see Kingdon 1984, Sabatier 1988) are irrelevant. Overall, though, the institutionalism literature is not quite specific enough for this study. Broad issues of legitimacy, disparate incentives, and tradition all matter for the science-policy divide, so what institutionalist lens would be most appropriate for analyzing it? How might the generic principles of design translate into specific recommendations for the institutions surrounding interaction between scientists and policy-makers? What would a 'flexible' science-policy partnership look like? Answers to some of these questions can perhaps be found in literature that is more practical and specific.

Deliberative Design

There is a broad set of literature on deliberative theory, but what matters here is the subset that can be applied to institutional design. The general concept of *deliberation* can be defined as debate aimed at producing reasonable and well-informed opinions, where participants are willing to revise preferences and there is an overarching interest in justifying outcomes to all stakeholders affected by the debate (Chambers 2003). Much academic study in this area has focused on *deliberative democracy*, which broadly transforms deliberation into an ideal system of government that focuses on discussion instead of voting, sees legitimate political order as that which is articulated and justified to citizens, values reasoning that is accessible and mutually acceptable, and leaves decisions open to challenge in the future (ibid, Gutmann and Thompson 2004). In practice, the processes that come closest to this ideal are deliberative polls, where

citizens are randomly selected to learn about and evaluate some topic of policy (see Fishkin 1997 appendices A and D), and issues forums, where specific relevant stakeholders are recruited to a similar process (see Hendriks et al. 2007); experts are often involved in an educational capacity throughout. As a departure from all of this, *deliberative democratic theory* is, like institutionalism, a lens of inquiry. It studies deliberative spaces, arguments, attitudes, and relevant rules of law (Chambers 2003). While this sub-field tends to focus on the interaction of policy-makers with the public, it does acknowledge that deliberation can take several forms and recognizes a role for experts, so it is quite possible that it may yield some specific design suggestions for interaction between policy-makers and scientists.

Several scholars of deliberation have made recommendations for effective deliberative design. Regardless of the type of deliberation, forums should embody: a two-way dialogue (not just one-way consultation or transmission), accountability of each party to the other, a cooperative perspective, respect and civility, a commitment to informed debate, and periodic reflection on and renewed justification of the process (Anable et al. 2006, Dryzek 2010, Gutmann and Thompson 1997 as cited in Chambers 2003). While these guidelines are more specific than the overarching values of deliberative democracy, they are still quite generic and not much more applicable than Goodin's principles. As such, the work of Edwards et al. (2008) is particularly informative, as they outline nearly 40 specific criteria for evaluating effective deliberation, ensuring to consider not only the process itself, but also its inputs and outputs. For example, participants should be able to influence the agenda beforehand, moderators should be trained in facilitation, the atmosphere should be amicable, discussion should be open to broader issues, various learning styles should be considered, and new networks should result from the process. These types of recommendations are specific enough to apply to partnerships between

climate scientists and climate policy-makers in Canada, and most of them, with perhaps some exceptions (e.g. amicability), can be directly facilitated through design.

Another important aspect of deliberative design is that it is particularly well-suited to address issues of environmental inaction. This observation is common among deliberative democracy theorists. Dryzek (2000) and Backstrand et al. (2010 pp. 5-6) argue that the requirement of mutually acceptable reasoning encourages participants to reflectively enlarge their own thinking and more holistically consider other interests that are relevant, including the environment itself and future generations. Traditional democracy, in the view of Laslett (2003) and Baber and Bartlett (2005), specializes in short-term problems that fit neatly into jurisdictions, and gives rise to strategic politics which often discount the environment. Opening up the process through deliberation may be the only way to reconcile our existing democracy with environmental concerns. Smith (2003) points out that barriers to environmental action are often rooted in the different fundamental values of stakeholders and decision-makers (e.g. sustainable development, conservationism, preservationism) and that deliberation can engage productively with this pluralism, in contrast to mechanisms like cost-benefit analysis that attempt to settle such disputes objectively. Most importantly, it is argued by Sutherland et al. (2006 pp. 625-626) that addressing environmental concerns requires a form of EBP that not only makes use of the best available science, but involves all key stakeholders throughout and makes all relevant evidence fully accessible to them, comprising an ‘analytical-deliberative’ process. Although these authors do not always focus on the potential discourse between specifically scientists and policy-makers, they indicate that deliberative design is a natural lens for examining environmental policy issues like climate change.

On the whole, literature on institutions not only provides an appropriate tradition of inquiry on which this study can be based, but it also offers important prescriptive principles. While the literatures on interactions between scientists and policy-makers are unable to give many concrete recommendations for interfaces themselves, the sub-fields of institutionalism and deliberative democratic theory suggest system and process changes (rather than mere adjustments on either side of the science-policy divide), along the lines of accountability, for example. Even the most specific criteria from scholars of deliberative design, however, focus more on the interaction among various stakeholders or between policy-makers and the public than on science-policy relationships, so there is still a shortcoming in the literature. Can the same principles of deliberative design be applied to partnerships between scientists and policy-makers? Are they general enough to inform institutions and interaction much less formal than the forums for which they have traditionally been used? If no real dialogue, formal or informal, appears to exist yet, how can we start to bridge the gap? Each body of relevant literature in this review has individually answered some questions while raising others, but the productive overlap between the sub-fields is also quite obvious, so they should be considered collectively. Perhaps the most important emerging themes across these bodies of knowledge will be able address the open questions.

Co-Production

Recall the partial emphasis on co-production in the literature on SPIs. This concept tends to exist, in some form or another, in each of the sub-fields covered so far. To begin with, Jasanoff (2004) appears to be the most central author on the topic, and can be credited with popularizing use of the term. In her view, "co-production is shorthand for the proposition that the

ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (p. 2). More specifically, "the realities of human experience emerge as the joint achievements of scientific, technical and social enterprise: science and society, in a word, are *co-produced*, each underwriting the other's existence" (p. 17). Essentially, co-production is, for Jasanoff, a descriptive and explanatory concept suggesting that science and policy (among other aspects of society) are inseparable, each playing an important role in producing the other. Carolan (2006) would agree with this descriptive element, demonstrating that gaps between science and broader society, for any given issue, do not get resolved until each inevitably accepts the knowledge of the other and agrees to interact. However, there is a normative element in his suggestion that the exchange is more efficient if interaction is nurtured from the start, even if it is inevitable. Co-production, then, can be both a descriptive and normative concept (also see Wyborn 2015).

It is some form of the normative element that tends to appear in many of the above sub-fields. Besides the obvious parallel between co-production and two-way deliberation, much of the emerging nuance and less controversial suggestions in the literatures on science-policy interaction (i.e. SPIs, EBP, and research utilization) are related as well. Firstly, many terms, such as the 'co-evolution of science and policy' (van den Hove 2007), 'making sense together' (Hoppe 2010b as cited in LIAISE 2011), the 'analytical-deliberative process' (Sutherland et al. 2006), 'ongoing linkages' (Lomas 2000), a 'negotiated approach to problem-solving' (Head 2008), and the 'blurring of boundaries' (Guston 2001 in LIAISE 2011) refer to the same basic ideas embodied by co-production (and to a lesser extent, as does 'evidence-aware policy'). Secondly, and more specifically, each of the relevant literatures has examples of prescriptive suggestions along the lines of co-production. For the literature on SPIs, Sarewitz and Pielke Jr.

(2007) contend that effective allocation of science funding is most likely when information users and producers are connected through a variety of feedback mechanisms (pp. 12-13). Walter et al. (2005), exemplifying the EBP literature, demonstrate that the best way to enhance evidence use is to ensure producers and users engage in interactive partnerships (also see Nutley 2003 pp. 10-14, Rosenstock and Lee 2002 p. 16). From the research utilization literature, Shulha and Cousins (1997) note the importance of immersing intended users in processes of knowledge generation, which has side-benefits even if it fails to increase information use (p. 199). There basically seems to be a consensus across the literatures in favour of inclusive, participatory, deliberative methods for producing science and policy.[13] Prescriptive propositions tend to have thorough critics (e.g. EBP), so this implicit consensus might indicate the vast potential of co-production, though it is admittedly an immature concept.

The pieces of literature in the above sections generally mention elements of co-production only as a side note. There are, however, several works besides that of Jasanoff (2004) that consider co-production more centrally, many of them emphasizing the importance of strong networks between science and policy. Both Tuinstra et al. (2006) and Lemos and Morehouse (2005) would argue that direct, ongoing science-policy relationships (i.e. boundary work) with high levels of interaction and iterative back-and-forth dialogue tend to generate higher quality information and lead to more innovation and impact.[14] Because it focuses on the boundary, this analysis is more relevant to the science-policy divide than the recommendations for scientists

[13] The overlap between these sub-fields is often quite noteworthy. For example, some documents that support EBP include a surprising degree of recommendations for deliberation and co-production (e.g. European Academies Science Advisory Council 2011, Government Office for Science 2010, Industry Canada 2000). These are precisely the sort of sources that are used to develop a detailed co-production hypothesis in Chapter 3.

[14] Lemos and Morehouse use the precise term 'science-policy co-production' and apply it prescriptively. Although this is rare, it is the same perspective taken by this dissertation, which will generally use the term 'co-production' to mean 'prescriptive science-policy co-production'. As above, many authors use different terms with similar meanings, apply the concept of co-production to society more broadly, or use it descriptively.

common in the literature on SPIs, but Rietig (2014) shows that an understanding of co-production can also improve those very suggestions on the science side. Concluding her analysis of international environmental negotiations, she observes that scientists can embed themselves in science-policy networks for the long term using pro-active entrepreneurial strategies, such as approaching government representatives to volunteer knowledge or seeking to join government delegations. The idea of co-production improves our understanding of prescriptive solutions to the science-policy divide.

Perhaps more importantly, several scholars of co-production contend that it should be institutionalized, which brings in the literature on institutional design to supplement the consensus among the other relevant sub-fields. Cash et al. (2003) are the best examples in this regard. Having previously established the three criteria for useful scientific information (i.e. credibility, salience, legitimacy), they find that there are several strategies of 'boundary management' (i.e. co-production) that can simultaneously enhance all three, rather than requiring them to be traded off with one another. For example, it is important to facilitate active, iterative, and inclusive communication, as well as ensure opportunities for translation (i.e. between the different jargons and levels of expertise) and mediation. These strategies can be institutionalized in 'boundary organizations'. Such organizations do not have be formal or discrete (as per the definition of institutions), as long as the appropriate functions are broadly fulfilled. Ascher et al. (2010) make similar comments about institutionalizing 'knowledge hybrids' (see Ch. 7), and St. Clair (2006) would add that the IPCC is a good example of a boundary organization that facilitates the co-production of science and policy in this manner.[15] So while the sub-field of institutional design does not consider the ideals of co-production to the same extent as the other

[15] Even the allegedly co-productive IPCC has not led to effective policy implementation and follow-through. Still, the potential of co-production is worth exploring in more depth for other situations.

literatures (although there is perhaps some overlap with Goodin's principle of flexibility), it still overlaps with the concept.

All of the literatures related to science-policy interactions, then, appear to coalesce around the norm of pursuing co-production through institutional design, or 'co-productive design'. The gaps in each sub-field are addressed, in part, by the collective. The emerging recommendations do not depend on either scientists or policy-makers, in isolation, to address the gap, and are targeted at the institutional level of the 'boundary' or 'interface' itself. They are fairly specific and allegedly mitigate the often necessary trade-off between information credibility, salience, and legitimacy. Their breadth indicates that they can be applied to many types of co-production, from informal to formal, and any combination of (natural or social) science, policy, and society.[16] Finally, the underlying understanding acknowledges the reality on both sides of the divide, and can be rooted in a rigorous tradition of institutionalist inquiry. These literatures, when synthesized, put forward some strongly supported propositions about addressing the science-policy divide. However, the various design principles of the unified literature have yet to be applied in practice (i.e. how will the specific recommendations of deliberation and co-production interact?), and it is important to move from general theoretical research to specific empirical research in many of these literatures (Spruijt et al. 2014 p. 23).

[16] Richards et al. (2013) observe that there are also science-public and policy-public divides, similar to the science-policy divide. Co-production is a broad concept that could apply to such areas. One might analyze science-society co-production (i.e. through the classic view of Jasanoff), policy-society co-production (i.e. through deliberative democratic theory), co-production between disciplines (see Lawton 2007, LIAISE 2013), co-production across government departments (see McDonald 2010), or even a purposely broader conception of co-production that considers science, policy, and society all at once (see Backstrand 2003, Garvin 2001).

Specific Causal Pathways of Co-Productive Design

This dissertation aims to investigate the potential of science-policy co-production to influence political outcomes, but most pieces of literature in the above discussion are fairly peripheral to such inquiry. Only four of them, all from the co-production sub-field, explicitly outline precise causal pathways from co-productive design to policy influence. This section will review such pathways in detail, giving rise to a broad analytical framework that helps contextualize the research questions. Cash et al. (2003), using cases on agricultural productivity, aquifer depletion, climate forecasts, ocean fisheries, and air pollution, claim that three institutional features (i.e. treating boundary management seriously, boundary managers being accountable to both scientists and policy-makers, joint production of boundary objects like models and reports) improve boundary management (i.e. communication, translation, and mediation between scientists and policy-makers), leading to higher quality scientific information (i.e. that is credible, salient, legitimate) more likely to be used by policy-makers. Drawing upon a case study of regional climate assessment, Lemos and Morehouse (2005) show that science-policy relationships lead to greater innovation and societal impact when they embody iterativity (i.e. stakeholders are involved, interdisciplinarity is fostered, usable science is produced), which depends, in turn, on the availability of resources, the flexibility of participants, and the fit between knowledge production and application. Tuinstra et al. (2006) use a case of negotiations over air pollution to demonstrate that the effectiveness of an assessment (i.e. a scientific study) is determined by its perceived quality (i.e. credibility, salience, legitimacy), which is affected by not only the characteristics of the assessment itself but also historical context and the

characteristics of the potential users of that assessment.[17] Boundary work (i.e. reports, tools, intermediaries) can shape the relationship between those three factors. Finally, informed by a case of international climate negotiation, Rietig (2014) claims that if scientists are perceived as neutral, use entrepreneurial strategies, and are involved in policy networks over time, their expertise is more likely to be considered relevant and useful by both civil servants and decision-makers. See Table 2.1 (on the next page) for a diagrammatic summary of these causal maps.

Although all of the pathways emphasize some element of co-productive design and some form of policy influence, there are important differences between them. First, there is a range of malleability across the various causal factors highlighted. Some are external conditions like historical context and resource availability, some are institutional traits like stable networks and participant flexibility, and some are particularly malleable strategies or design characteristics (e.g. treating boundary management seriously, involving stakeholders, entrepreneurial strategies). There is also substantial variation in the types of outcomes emphasized by each pathway, from quality of information, to types of use by policy-makers, to ambiguous influences on effectiveness or influence. Finally, some pathways are simple (e.g. X causes Y), while others have multiple steps or branching causal flows to explain the relationships between many factors. Collectively, these pathways highlight a wide range of considerations, but none of them can individually answer my questions about the potential influence of co-productive design on policy. Rietig (ibid) is the only one to really attend the policy process itself, but she focuses more on scientist behaviours than design characteristics for the science-policy relationship.

[17] They deliberately leave "effectiveness" undefined, claiming that it depends on the goals of the assessment. For the purposes of this dissertation, though, the pressing problem of climate change suggests that effective outcomes are ones which increase the likelihood of concrete progressive policy action on the issue.

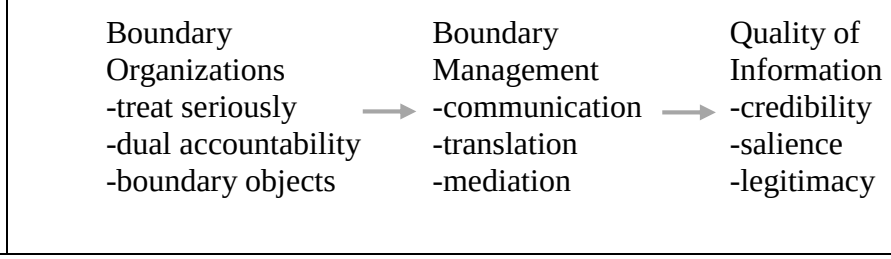
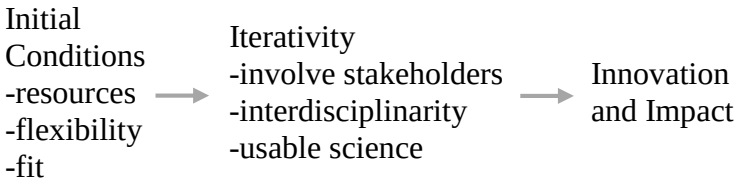
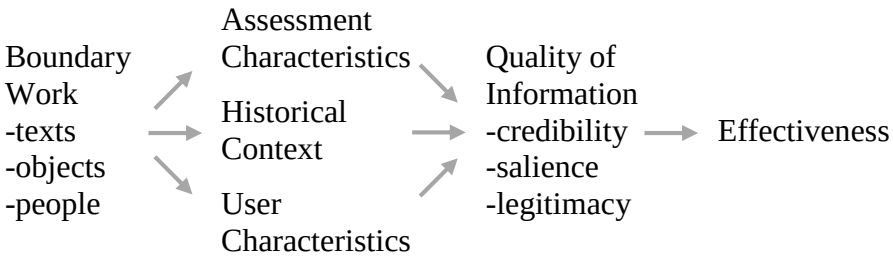
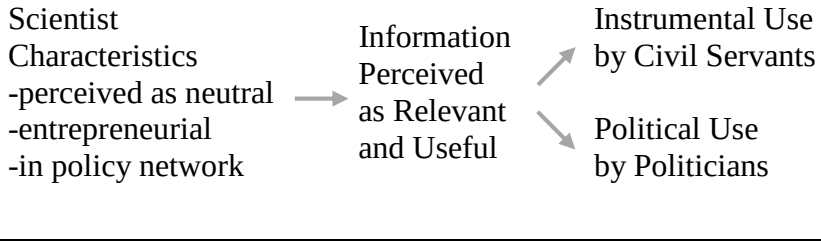
Cash et al. (2003)	
Lemos and Morehouse (2005)	
Tuinstra et al. (2006)	
Rietig (2014)	

Table 2.1 – Diagrammatic Summaries of Causal Pathways for Co-Productive Design in Four Pieces of Literature

Together, these pathways can form the basis for a broad analytical framework more useful for the purposes of this dissertation. It seems that any sophisticated causal pathway from co-production to policy influence will include: malleable design characteristics for co-productive

science-policy partnership, the potential outcome effects on policy, the major causal mechanisms allowing the former to affect the latter, and non-malleable external conditions that may constrain or enhance the relationship. Factors highlighted by the pathways above can be classified into these four categories, as can relevant variables touched upon in the more general literature. For example, the deliberation literature (e.g. Edwards et al. 2008) contributes potential design characteristics, the research utilization literature (e.g. Weiss 1977) contributes an understanding of possible policy influences, and the general frameworks on policy change (e.g. Kingdon 1984) contribute the conceivable effects of external conditions. See Table 2.2 for a diagram of this comprehensive analytical framework.[18]

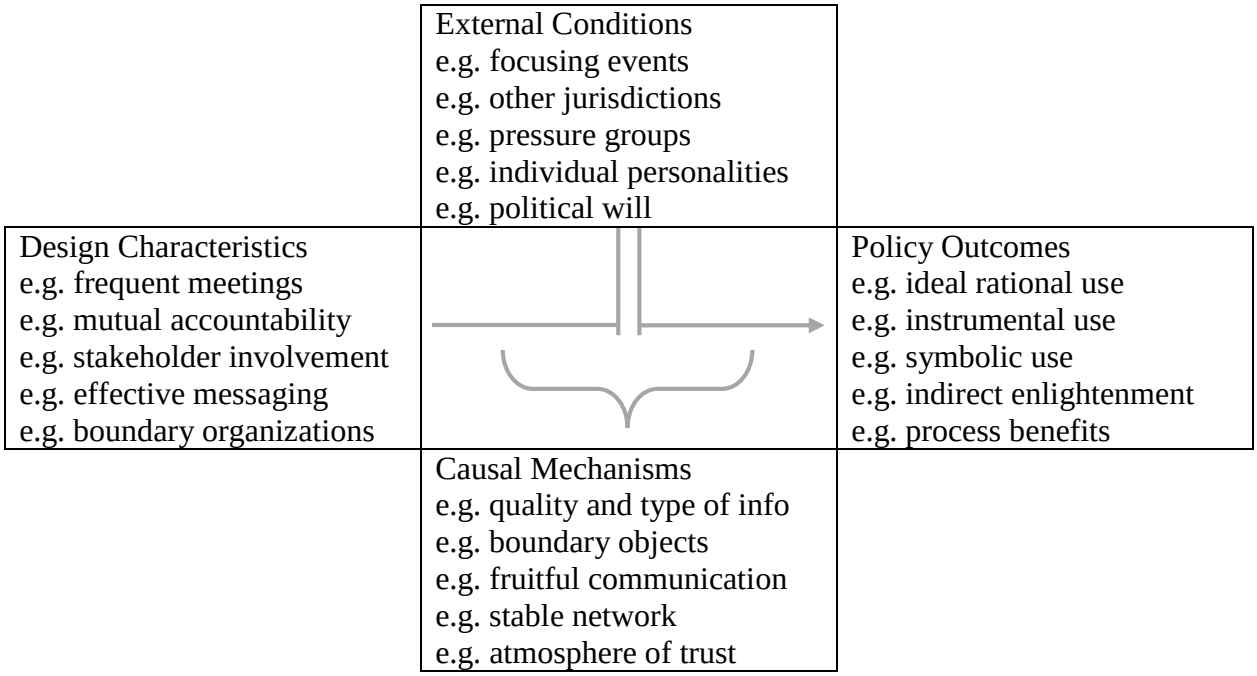


Table 2.2 – Diagram of a Broad Analytical Framework for Co-Productive Design

[18] Hypothetically, any of the pathways discussed above could be mapped across this framework. For example, Rietig's (2014) pathway would highlight entrepreneurial strategies as a design characteristic, quality of information as a causal mechanism, political receptivity as an external condition, and instrumental use as a policy outcome. The framework is meant to accommodate all such possible pathways, but with less specificity.

Such conceptualization clarifies the potential relationships between co-production and (climate) policy action, justifying the research questions of the dissertation (see Chapter 1). Indeed, to reach a thorough understanding of the causal pathway for a given science-policy partnership, we must know what design characteristics are present (i.e. descriptive inquiry), what the policy outcomes are (i.e. evaluative inquiry), the causal mechanisms between the two and whether the latter is caused by the former or by some external factor (i.e. explanatory inquiry), and which causal factors are malleable such that they can be changed to improve the outcomes (i.e. prescriptive inquiry). Also, delineating this analytical framework reveals a competing generic hypothesis that contextualizes my investigation of co-production. That is, for any given science-policy partnership, are the outcomes better explained by malleable (co-productive) design characteristics or by non-malleable external conditions? The research utilization literature and the general frameworks for policy change would argue the latter, but much of the literature on SPIs, deliberative design, and co-production hints that the former is a possibility. Interrogating these contrasting traditions is a key concern for the case studies. Each case of science-policy partnership will be different, which is why this dissertation also draws upon a thread of comparative inquiry.

Relevance of the Literature to Climate Policy in Canada

Presumably, all of the reviewed literature will have unique implications for environmental issues, specifically climate change, and even more specifically, the Canadian climate science-policy gap. Recall the deliberation literature's focus on environmental issues above. Many authors in the other sub-fields also put some focus on the environment in general (e.g. Bocking 2004, Cash et al. 2003, Lawton 2007, Likens 2010), and a portion of them consider

climate change directly (e.g. Anable et al. 2006, Edwards et al. 2008, Javeline and Shufeldt 2014, Sarewitz and Pielke Jr. 2007, St. Clair 2006). This again demonstrates the suitability of these fields for examining climate action. However, as noted above, many of these pieces are more theoretical than practical, and additional empirical research on environmental issues would be valuable to every sub-field.

The more glaring deficiency in these bodies of knowledge, as they stand, is their lack of attention to the Canadian case. As established in Chapter 1, Canada has a unique history of climate policy (or lack thereof), and its notable inaction merits academic attention. However, only a few of the above authors speak to Canada, and their accounts do not fully analyze the climate science-policy gap. Laforest and Orsini (2005) demonstrate the negative effects of EBP norms on Canada's voluntary sector, but do not comment on EBP in Canada more broadly or discuss environmental issues. Focusing on EBP directly, Howlett (2009) and Howlett and Newman (2010) argue that Canada's civil service does not have the appropriate capacity to effectively implement EBP, but actual instances of (or attempts at) EBP are not considered, and the environment, again, goes largely unmentioned. Bocking (2009) discusses SPIs in Canada in the context of the environment, but his work is more theoretical than empirical, and climate change is not a focus. Desveaux et al. (1994) examine Canada's environmental policy in one of their case studies, touching on aspects of institutional design and deliberation, but do not speak to the influence of researchers outside of government and are too dated to discuss the unique challenges of climate change. In a more comprehensive piece, Ford et al. (2013) empirically evaluate information in Canadian climate SPIs, but do not go as far as examining the institutional arrangements around the communication process (e.g. whether elements of co-production are present) or policy outcomes. In contrast, Jones et al. (1999) analyze the decision impact of

climate change information, but for policy *related to* climate change (e.g. dam management) rather than climate policy itself, using narrower criteria than the guidelines of co-production, and with less emphasis on interaction. Also, their case study is in the Pacific northwest of the US, so it matches the environmental context of Canada but not the policy context. These pieces consider some of the overlapping issues relevant to this study from a Canadian perspective, but ultimately each has its shortcomings. The potential of the Canadian case remains largely untapped.

Canadian Federalism and Multi-Level Governance

Before delving into an analysis of Canadian science-policy institutions, the constitutional context in which they are embedded must be appreciated. Understanding the unique aspects of Canada's governance structures will further demonstrate that the lack of attention to Canada in the above sub-fields is a weakness. The country is a federalist system, which means that the provincial governments are not fully subordinate to the federal government; both levels derive their authority directly from the constitution and neither can abolish the other (Mintz et al. 2015 p. 301). Through a "division of powers" outlined in the constitution, each level is afforded jurisdiction over certain policy sectors. For example, the federal government has law-making authority for foreign affairs, fisheries, trade and commerce, and Aboriginal land, while provincial governments are responsible for natural resources, public lands, property rights, and municipalities (ibid p. 302). Federalism is related to the more contemporary concept of MLG, which broadly addresses overlapping relationships across different governmental levels (Stein and Turkewitsch 2008 pp. 8-9). Type I MLG means delineating clear jurisdictions and roles for potentially overlapping levels of government so that they complement rather than complicate one another, and type II MLG refers to the deliberate and flexible intersection of levels such that

problems too complex for a single authority can be jointly attended (Hooghe and Marks 2003). The former embodies an obvious overlap with federalism, but Stein and Turkewitsch (2008) clarify that, while both seek to divide power effectively (p. 12), federalism refers to formal arrangements and type I MLG refers to informal ones (p. 27). Thus, MLG might have some lessons to offer Canada's traditional federalism.

The reason that these concepts are particularly important to this dissertation is because MLG may be necessary to address climate change effectively. While all of the divided powers listed in the above paragraph are related to the environment, neither the federal nor provincial level has been given explicit jurisdiction over environmental policy,[19] which can lead to confusion (or strategic political excuses) over responsibility for climate action. This is exacerbated by some other norms of Canadian federalism, as evidenced by stagnant national negotiations over greenhouse gas emission targets. They were "consistent with the very tenets of Canadian 'executive federalism', whereby provinces (and territories) have come to expect extensive consultation with the federal government before the latter takes any significant policy departures and are thought to possess a certain veto power" (Rabe 2007 p. 432). MLG, on the other hand, would entail a clearer delineation of responsibilities (i.e. type I) or a more deliberate collaboration between government levels (i.e. type II). More broadly, many authors have argued that climate change, as a global problem, can only be effectively dealt with through type II MLG, either because climate change transcends jurisdictional boundaries and therefore intuitively requires interjurisdictional cooperation (e.g. Ingold and Fischer 2014), or because the inclusion of multiple levels provides a greater check on "free-rider problems" that are inherent to collective action (e.g. Ostrom 2009). Not only is MLG likely necessary to address climate

[19] This is probably because most of the powers were distributed in 1867, long before the environment became a standard policy concern.

change in general, then, it also may be particularly essential for Canada's role in doing so, due to issues related to the country's federal system.

Another set of researchers goes beyond climate policy's theoretical need for MLG and puts forward more specific suggestions regarding how MLG can be helpful, demonstrating its benefits. The most commonly proposed function of MLG is to use lower levels of government as experimental laboratories for testing climate policies or demonstration projects that might later be adopted at higher levels. Rabe (2007) discusses this potential for regional-level governments (i.e. provinces and states), arguing that the reason US states have made more climate progress than Canadian provinces is precisely because they have been more willing to experiment with a diversity of approaches, rather than stagnate in national-regional negotiations. Many scholars argue that municipalities are even more capable of performing the laboratory function, since there are more of them and they often have greater flexibility than the other levels, although their demonstrations will be on a smaller scale (Broto and Bulkeley 2013, Bulkeley and Betsill 2003, Gore 2010, McAllister 2009). Even though they do not have formal constitutional powers (at least not in Canada) and may have limited political influence (Gore 2010), cities have jurisdiction over a number of policy sectors relevant to climate change: transportation, land use, building requirements, and waste management (Bulkeley and Betsill 2003). Basically, lower levels of government can contribute much to MLG arrangements for climate policy. This body of literature is important primarily because it furthers an appreciation of what will be necessary to make progress on climate change in Canada, helping to justify and contextualize the research to follow in subsequent chapters. However, given the emphasis on collaboration by MLG scholars (e.g. Broto and Bulkeley 2013, Ingold and Fischer 2014), there may also be some interesting

synergies with co-production. Perhaps MLG might be considered another malleable design characteristic.

Overall, this literature review has demonstrated that the most appropriate lens through which to examine Canada's climate science-policy gap is one focused on the facilitation of co-production through institutional design (i.e. co-productive design). However, existing work has yet to apply a synthesis of the relevant sub-fields, with sufficient empirical depth, to the Canadian case of climate change. Such shortcomings justify the purpose of this study (i.e. to determine how science-policy partnerships designed to embrace co-production, at all levels of government, can help bridge Canada's climate science-policy gap). This purpose has been broken down into a subset of research questions using the broad analytical framework. These questions, as well as methods for addressing them empirically, are explored in greater detail in the next chapter.

Chapter 3: Research Design

The previous chapters have demonstrated the problem of inaction on climate change; the relevance of literatures on institutions and science-policy relationships for addressing it; the deficiencies in those literatures; their noteworthy agreement on the norms of co-production; the importance of a broad analytical framework for highlighting various factors that may affect the relationship between co-productive design and policy action; and the suitability of Canada as a case for further exploring all of this in an empirical and comparative manner. To review, such observations give rise to a targeted purpose for this dissertation, five research questions (comprising descriptive, evaluative, explanatory, prescriptive, and comparative aspects), and a guiding hypothesis (see Table 3.1 on the next page for a summary). Based on these driving ideas, this chapter describes the overall research design of the project in detail. First, it elaborates the hypothesis, identifying specific indicators for measuring both co-productive design and policy action, based on the analytical framework and broader literature. Second, it explains the research methodology (i.e. a comparative approach with both deductive and inductive elements) and justifies the selection of cases for comparison. Third, it describes the specific methods used, detailing the recruitment, interview, and coding processes.

Hypothesis Indicators

Recall that this dissertation uses a normative version of science-policy co-production, defining it as a "deliberative ideal for science-policy interfaces, whereby scientists and policy-makers (and potentially other stakeholders) engage in transparent back-and-forth deliberation to improve the production of both science and policy" (see Chapter 1). The latter part of this definition is the most important. A partnership is only *co*-productive when there is an attempt to

Purpose	To determine how science-policy partnerships designed to embrace co-production, at all levels of government, can help bridge Canada's climate science-policy gap.
Questions	What climate-related science-policy partnerships exist in Canada? How are they institutionally set up? What elements of co-productive design are present? (Descriptive) How effectively does each partnership contribute to the translation of scientific evidence into policy action? What other successes or challenges are apparent? (Evaluative) Are the identified successes and challenges caused by aspects of institutional design (e.g. presence or absence of co-productive elements)? What other factors are important? (Explanatory) What alternative institutional arrangements or designs might realize opportunities for improvement? Can and should they be applied to other jurisdictions? (Prescriptive) How do the answers to these questions vary with each level of government? Are any phenomena better understood holistically across the levels? (Comparative)
Hypothesis	The more that climate science-policy partnerships are designed to embody elements of deliberative co-production (rather than non-communication or one-way flows of information), the more effectively they will translate scientific evidence into policy action.

Table 3.1 – The Purpose, Questions, and Hypothesis which Frame the Design of this Study

establish some capacity for *both* sides to influence the other in a meaningful way. Compare this to more traditional one-way models of science's flow into the policy process (e.g. see Ascher et al. 2010, Lawton 2007, Lomas 2000), which generally expect that science is produced essentially independently and policy responds only to research that eventually overcomes various channels and barriers. Co-production entails more immediate interaction whereby policy-makers can give some input on the research direction and scientists can directly communicate some of the policy implications of their work, even if subtly or indirectly through deliberative discussion. Any

aspect of institutional design that works to facilitate this sort of co-productive relationship can be considered an 'element of co-productive design' (e.g. a high frequency of in-person meetings).[1] However, the presence of one element does not necessarily mean that a partnership can be considered an instance of co-production. Frequent meetings increase the likelihood of mutual science-policy influence, but they do not guarantee it. They may merely be evidence of a maintained or productive relationship, not a *co-productive* relationship. As such, even though this chapter identifies many 'elements of co-productive design', it is their collective function that really matters for any given partnership. This is interrogated for each of the cases in the subsequent chapters.

The hypothesis suggests two important sets of variables, co-productive design characteristics for climate science-policy relationships (i.e. the independent variable) and climate policy action (i.e. the dependent variable).[2] This is a simplification of the broad analytical framework (see Table 2.2), which outlines four sets of variables. It does not explicitly acknowledge intermediate causal mechanisms or the effects of external conditions, and implies that only concrete policy changes (i.e. instrumental or rational uses of information) would qualify as successful outcomes.[3] The notion that co-productive design, alone, can facilitate

[1] There is a difference between "co-production" and "co-productive design". The latter refers to institutional characteristics that may facilitate the former. For example, participants being enthusiastic and amicable simply because of their individual personalities is a potential indicator of co-production but not co-productive design. Indeed, individual personalities are listed under external conditions in the analytical framework, not under design characteristics (see Table 2.2). One implication of these definitions is that aspects of co-productive design can come from either side in a science-policy partnership. For instance, if a science organization makes a deliberate effort to use language accessible to policy-makers when producing reports, it may help facilitate overall co-production, even though only one partner is responsible for the particular characteristic.

[2] I am aware that while co-production refers to attempts at mutual *science-policy influence*, the dependent variable is primarily concerned with only the resulting *policy influence*. This makes sense given that the problem being investigated is that policy is lagging behind the science (rather than vice versa). Basically, the hypothesis is suggesting that science cannot effectively influence policy unless it is part of a mutual relationship whereby policy also has some influence on science!

[3] That is, in terms of Table 2.2, it privileges everything in the left box, only two things in the right box, and nothing in the upper and lower boxes.

concrete policy changes based on science is extremely idealistic. However, it is still a useful guiding hypothesis for this study. While the analytical framework is more realistic and comprehensive, attempting to investigate every variable within it at once would be an unwieldy task. Similarly, a more specific hypothesis endeavouring to explicitly accommodate the various components of the analytical framework (e.g. specific design characteristic A will lead to specific policy outcome B through specific causal mechanism C under specific external condition D) would also be inappropriate. None of the relevant causal pathways in the existing literature on co-production have been sophisticated enough to generate such a hypothesis (see Table 2.1), so supposing one at this point risks overlooking important factors. It is better to start with the two most important sets of variables and, keeping the broader analytical framework in mind, investigate the complex relationship between them (i.e. discovering the relevant causal mechanisms and external conditions) through new research.[4] Thus, a simple hypothesis that focuses on co-productive design and policy action is appropriate for this study.

In order to measure these two variables, many potential indicators of each must be identified. A high frequency of scheduled in-person meetings might indicate co-productive design, while the declaration of action items or future plans at such meetings could suggest a resulting influence on policy action. These sets of variables can each be explored at the level of specific meetings between scientists and policy-makers or at the level of broader institutional arrangements surrounding the partnership. The above examples, for instance, are at the meeting level, but in terms of institutional arrangements, co-productive design might be indicated by scientists and policy-makers belonging to the same organizations or networks, while the use of information inputs across the policy-cycle (i.e. for agenda-setting, decision-making, and

[4] This approach is a combination of induction and deduction (see the methodology section below).

implementation) could mean high policy influence. If it were not so imprecise, the term 'dimension' would be more appropriate than 'indicator', because each of these elements implies a range of possibilities. Measuring one of these factors is not, for example, as simple as determining whether action items were or were not declared, but rather there is a spectrum of commitment to action items and follow-through onto which partnerships fall. As above, it would also be an oversimplification to attempt classifying relationships as either co-productive or not. Altogether, assessing co-productive design, policy action, and the connections between them is a complex and richly detailed process. This section revisits some of the relevant literature in an attempt to identify indicators relevant to exploring the hypothesis.

With regard to co-productive design, recall Edwards et al. (2008) and the approximately 40 separate criteria they have devised for effective deliberation. Not all of them are relevant; some are not related to co-production, some apply more to policy-public than science-policy interactions, and some are too specific to matter for institutional design. Still, they are an excellent starting point for identifying potential elements of co-productive design. For example, they suggest that meetings be accessible to a diversity of participants,[5] that moderation be shared among the participating groups, that facilitators have formal training, that presented information be tailored to its audience, that equitable participation be encouraged during meetings, that discussion be open to a range of broader issues, that there be opportunities for reflection and feedback, that enough participants regularly attend, and that a general atmosphere of trust and amicability be pursued. Other relevant works often agree with some subset of these criteria (e.g.

[5] This is a particularly interesting element of co-production, since it implies that, by including third-party actors, science and policy actors can more effectively influence each other. Consider, as well, the possibility of partnership between a third-party and only one of either scientists or policy-makers. While this would not be an example of science-policy co-production (although it might qualify as another kind of co-production), it could have some influence on the missing actor through the same mechanism as co-production. For example, a partnership between a science organization and public interest group would probably have more influence on policy than either one acting alone, even though neither may be engaging in direct interaction with policy-makers.

Ascher et al. 2010, Carolan 2006, Garvin 2001, Jasanoff and Wynne 1998, Lemos and Morehouse 2005, Weible 2008), and several of them imply suggestions that can supplement the list. To name a few, participating groups should be accountable to one another; participants should be stable but not stagnant (Goodin 1996); they should be open to both solicited and unsolicited advice from each other (Industry Canada 2000 p. 6); connections should endure over time even when benefits are unclear (Lindquist 2009); transparency should be balanced with the privacy sometimes required to deliberate freely (EASAC 2011 pp. 6-7); and the roles and responsibilities of participating groups should be clearly defined (Government Office for Science 2010 pp. 8-9). Overall, there is a vast set of meeting and institutional characteristics that arguably indicate co-productive design in science-policy partnerships.

As for indicators of policy action and science utilization, there is no single piece of work that is particularly informative, but the body of knowledge around research utilization from political science collectively offers a number of potential indicators. For instance, high policy action might be implied by genuine as opposed to political or symbolic use of information (see Feldman and March 1981, Weible 2008); by actual application of scientific recommendations instead of simply a heightened general sensitivity to their broad context (see Weiss 1977); by influence on fundamental or incremental decisions rather than merely routine ones (see Lindquist 1988); and by effects throughout the policy cycle as opposed to on one stage of it (Keller 2009). A few of the criteria from Edwards et al. (2008) are ‘outcome’ criteria and might add that the formation of new networks or partnerships can also indicate policy influence. These characteristics are not totally separate from each other (e.g. a new network could be formed during the implementation phase of the policy cycle due to a genuine and direct application of a scientific recommendation), but the important thing is that they are different angles from which

to assess policy activity, which is important for the interview questions later in this chapter. There is, then, a fairly rich suite of indicators that can signify policy action and use of science, other than obviously publicized progressive activity conspicuously based on science. However, the melange of literature relevant to both the co-production and policy action indicators is not direct or comprehensive enough on its own. Rather, this dissertation has interpreted and synthesized it, and supplemented the gaps with additional intuitive characteristics (e.g. some of the causal mechanisms from the analytical framework in Chapter 2 have been interpreted as elements of design). Table 3.2 (on the next page) summarizes various indicators that can be measured through empirical methods to investigate the hypothesis.

Although these indicators are only a general guide for the subsequent research, it is possible to conceive of the more specific pathways they might help to reveal. For instance, perhaps the more stakeholder groups that are engaged in a given science-policy partnership, the more influential the network around the issue-at-hand will be with the public and high-level decision-makers. As another example, perhaps the more that information and presentations are tailored to their audience, the more likely participants are to assess the interaction positively and apply what they have learned to their own work. Keeping the broad analytical framework in mind, important external conditions and other details might be discovered for these pathways (although, as above, the study does not probe for any in particular). For example, the influence of a network (i.e. involving scientists, policy-makers, and other stakeholders) may be affected by general public opinion, while the effectiveness of presentations might be complicated by conflicting information from pressure groups outside the partnership. Similarly, the broad analytical framework can help to reveal competing hypotheses that explain policy outcomes without reference to co-productive design. Perhaps what really matters, for instance, is the

CO-PRODUCTIVE DESIGN	POLICY ACTION AND USE OF SCIENCE
for individual science-policy meetings:	
-meetings occur and frequently	-action items declared/plans made
-diversity of stakeholders involved	-new networks/discourses generated
-all groups attend consistently	-info use genuine (not symbol/political)
-pre-meeting background/briefings	-more application than awareness
-create atmosphere of trust/amicability	-influences fundamental decisions
-facilitation shared (and trained)	-participants respond positively
-more discussion than lecture	
-equitable participation encouraged	
-presentations tailored to audience	
-open to broader discussion/questions	
-solicits feedback for/from all groups	
-tries to resolve confusion/disagreement	
-free deliberation/transparency balanced	
for broader institutional arrangements:	
-belong to the same institution	-policy activity is high/progressive
-participate in the same networks	-science cited as reason for change
-joint projects (e.g. co-authorship)	-many policy stages affected
-clear roles and responsibilities	-diffusion to other jurisdictions/levels
-ample (non-meeting) communication	
-distribute information to one another	
-objectives/mandates consider the other	
-partnerships open to improvement	
-accountable to one another (and others)	
-partnerships enduring over time	
-members stable but not stagnant	

Table 3.2 – Summary of Indicators for Investigating the General Co-Production Hypothesis

individual personalities of participants in a science-policy partnership. It might be that enthusiastic, communicative people facilitate success even without co-productive design and that stubborn, strict personalities can counter even the most careful institutional design. I do not mean to favour any particular pathways within the co-production hypothesis or to specify any promising competing hypotheses in particular, since it would be premature to do so at this point; these are merely examples of the sorts of pathways I hope to reveal as important.

Methodology and Case Selection

Generally, quantitative studies of a large number of cases are most suitable for *testing* theories in a *deductive* fashion, while qualitative studies of a small number of cases are more appropriate for *generating* theories in an *inductive* fashion (Ragin 1987 p. 69). This research is guided by a hypothesis emerging from the relevant literature, but is not entirely an exercise in deductive theory-testing. Since the hypothesis is general and idealistic, it is not yet appropriate to attempt applying it to a large number of cases. Small-N (or 'case study') research is more suitable for studying contemporary phenomena for which the existing understanding may be underdeveloped (Yin 2013). Co-production is new concept, and it is not yet clear how it might be measured effectively, not to mention that climate change is a relatively recent policy problem. More importantly, large-N approaches tend not to have the capacity to examine more than a few variables at a time, which means that they often fail to consider important cause-effect relationships outside of the theory being tested (Mahoney and Rueschemeyer 2003). This is a particular concern for exploring the complex issue of climate change policy (see Chapter 1) and acknowledging the broad analytical framework of factors that may affect science-policy interaction. As well, there are certain benefits to focusing specifically on jurisdictions within Canada (see the latter sections of Chapter 2), which also limits the potential number of cases. Given all of this, a small-N case study approach makes sense.

As above, small-N approaches are often associated with inductive theory generation. However, this dissertation has already shown that the existing literature can be synthesized into a promising, though tentative and general, hypothesis about co-production, which warrants testing through a deductive approach. As such, my research adopts a combination of inductive and

deductive methodologies.[6] That is, the hypothesis guides the research, but is not meant to constrain it. Causal relationships completely external to the hypothesis are considered if they emerge as particularly important. Such an approach is similar to the 'grounded theory' style of case study research (see Strauss and Corbin 1990), but it seeks additional rigour by attempting to establish general empirical relationships across a number of cases, using a more comparative methodology, though without turning to a large-N, quantitative design (see Lijphart 1971). If conducted correctly, small-N research is just as rigorous and useful in developing the broader theory (Eckstein 1975, Yin 2013). What this means is that the subsequent chapters (i.e. those comprising the case studies) are driven primarily by their investigation of co-production as a cause of policy action, but will expand part of their analysis to other potential causes as they arise (i.e. in answering the third research question about additional causal factors), generally drawing upon the policy determinants literature (e.g. Simeon 1976) and analytical framework introduced in Chapter 2. Overall, this mixed methodology has been chosen to match the particular requirements of the research questions.

There are also a number of considerations relevant to case selection. First, small-N approaches are more prone to selection bias, since they examine only a subset of potential cases, which are chosen by the researcher in a necessarily subjective manner (Geddes 1990, Lijphart 1975 p. 172). It is possible that cases may be selected based on their ability to demonstrate the researcher's opinion rather than to accurately represent reality. However, this potential bias is apparently not a problem for most small-N studies, which are generally sufficiently thorough in justifying their choice of cases (Mahoney and Rueschemeyer 2003 p. 18). The important lesson

[6] It seems to fall into the middle of Eckstein's (1975) spectrum of case studies. It is not merely a 'plausibility probe' for an entirely new theory, nor is it a 'crucial' test for a well-established theory. Rather, it seems to fall between a 'heuristic' study (i.e. building theory) and a 'disciplined' study (i.e. applying and developing theory).

is that small-N research should always present justification for its case selection. Second, in order to test a hypothesis with any real rigour, the chosen cases must have maximum variation on the independent variables and minimum variation on other (i.e. control) variables, while variation on the dependent variable should not be considered (Lijphart 1975 p. 164). Finally, recall that Canada's unique federalism suggests an opportunity to explore the additional variable of governance arrangements (see the latter sections of Chapter 2) by selecting cases that also vary by level of government. The sophisticated comparative approach implied by these considerations further demonstrates why a combined methodology is appropriate.

Ultimately, three cases of climate science-policy partnership in Canada were chosen for analysis. This number is appropriate for an inductive approach, but facilitates greater opportunity to comparatively test the hypothesis than would a single case study. As well, it is just enough cases to cover each of the major levels of government in Canada (i.e. municipal, provincial, and federal), which allows for variation on the secondary variable of governance. The selected cases are: the various relationships between PCIC and BC municipalities (municipal case), the more formal partnership between PICS and the Climate Action Secretariat (CAS) of the BC provincial government (provincial case), and the attempted but fleeting connections between CFCAS (now known as the Canadian Climate Forum) and the federal government of Canada (national case).[7] Each case has both a science and a policy partner, the former always being a research organization, and their focus is on broad relations rather than discrete meetings or sets of meetings (there would have been too little material to explore with such a focus), although such relationships do encompass a number of individual interchanges (e.g. regular meetings). More importantly, the interactions in these cases seem to embody variation on the primary independent

[7] A more detailed description is provided for each case at the beginning of its corresponding chapter. The brief account provided here should be sufficient to understand the case selection.

variable, co-productive design. As above, one partnership is informal, one is formal, and one is unstable, but the actual degree of co-production cannot be known until the analysis is complete.

In selecting cases, it is important not to consider their potential to confirm the hypothesis. I have attempted to mitigate such selection bias in a few different ways. The cases had to meet certain criteria for inclusion, which had little to do with the hypothesis indicators, and which left few cases to choose from, such that I could not further limit my selection by choosing only those which appeared to support the hypothesis. First, they needed to be climate science-policy partnerships as defined in Chapter 1.[8] This led me to reject the National Roundtable on Environment and Economy (NRTEE) as a potential national case, since, as determined by a preliminary conversation with a key informant (see below), its focus was much broader than climate change and it did not include many climate scientists. Second, I wanted the cases to form a nested set so that they could contextualize each other and speak to MLG. As such, I rejected Ouranos (a consortium on regional climatology and adaptation to climate change) as a potential provincial or municipal case, since it is located in Quebec, unlike the other potential lower-level cases. Third, the cases had to be salient (i.e. significant and fairly well known) examples of partnership. This led me to expand the municipal-level case. Initially, I was going to focus exclusively on PCIC's relationship with the City of Vancouver, but that would not have provided enough data, due to insufficient potential interviewees. The cases were ultimately chosen because they embody a natural set. PCIC and PICS are headquartered in the same building at the University of Victoria and receive substantial funding from the same provincial endowment (PCIC 2013 p. 12, PICS 2014a). PICS and CFCAS have engaged in funding partnerships and have some overlap in their directors (CCF 2014a, PICS 2014b). All three organizations are

[8] Recall that these 'partnerships' may also qualify as 'dialogues' or 'true co-production' depending on the level of interaction uncovered by the research methods.

basically part of the same climate science community and have similar mandates, but manifest at different scales, which leads to some helpful overlap in understanding the broader context of each. The three cases, then, are an intuitive trio, but they also happen to meet the needs of the purpose, research questions, and hypothesis of this project. Potential support for the hypothesis was not a conscious factor in their selection.

Methods

A case-oriented, small-N methodology merits qualitative (i.e. non-numerical, non-statistical) methods, in order to appreciate the complexity of the various factors under consideration (see Ragin 1987, p. 67), such as those identified by the analytical framework. Interviews, as a research tool, offer many benefits in this regard: they allow access to publicly unavailable information; they are a quick means of knowledge gathering; they provide insight into the context or atmosphere surrounding the issue-at-hand; they can interpret decision-making processes; and they can lead to further sources of information and other contacts through 'snowballing' (Bogner et al. 2009, Richards 1996). Not only, then, can the complex issue of climate science-policy relationships benefit from the application of expertise and interpretations from those immersed within them, but because the relevant partnerships tend not to include the public, specific information about them is often not widely available and can only be gathered by speaking with those who are directly involved. As well, the efficiency of interviews in collecting information and revealing additional contacts is pertinent to the perhaps ambitious nature of this study's combined inductive and deductive methodology. It makes sense to choose interviewing as the primary method of data collection if it seems it will be able to bring together more data or better data at less cost than other strategies (Dexter 1970 p. 11).

Even though interviews are an efficient research method, they are not a 'short-cut' to information, where the interviewee simply lectures the interviewer about the topic-at-hand, but rather they should be seen as a conversation between a quasi-expert and an expert (Pfadenhauer 2009). That is, the researcher should have some ability to evaluate the interviewee's statements and perspective against prior information, expertise, or common knowledge, catching the broader significance of what is said during the interview (i.e. listening with the 'third ear') rather than merely recording verbal behaviour (Dexter 1970 pp. 13-20). In addition, prior knowledge establishes the credibility of the interviewer and can impress the interviewee, triggering the provision of additional information, broader research advice, and other potential contacts (Richards 1996 pp. 201-203). While the theoretical background from the relevant literature afforded me some of this capacity, additional preliminary methods were pursued to ensure that the subsequent interviews were as informative as possible.

First, I conducted a brief document review on climate science and policy developments in each of the three jurisdictions (Canada, British Columbia, and Vancouver as a proxy for BC municipalities) and internationally, constructing a rudimentary four-level timeline starting at the time climate change became an international issue in 1988. Since documents are often authored by immersed experts and serve as a record of events that cannot be directly observed by the researcher (Stake 1995, p. 67), a general review of them provided me with some background familiarity. This was more of a generic archival exploration than a content analysis searching for specific themes. The main function of the review was to help me identify potential cases to pursue with other methods (i.e. I actually started this process before deciding on the specific cases). However, it was an iterative and flexible procedure. While it was the first avenue I pursued, it was not necessarily complete before any other methods were initiated, but rather was

used to supplement the research process throughout, as needed. For example, I also conducted specific reviews immediately before each interview to (re-)familiarize myself with the particular interviewee and their organization.

Second, and much more importantly, a number of preliminary conversations (as early as May 2013) were coordinated with 'key informants': well-informed and well-connected individuals capable of linking the researcher to other experts as well as providing advice on upcoming events, who to approach, and how to approach them (see Dexter 1970 p. 8). One or more of these contacts was enlisted (sometimes through my personal or professional network, sometimes through a cold call) from many of the organizations I identified as relevant through the document review (i.e. PCIC, PICS, CAS, CFCAS). However, none could be recruited for BC municipalities (too diverse) or the federal government of Canada (too inaccessible). In addition to providing me with context and background information, these informants were crucial to the recruitment process, case selection,[9] and even developing the interview questions themselves. Most of these key informants were approached again later for formal interviews, since they belonged to the same organizations that ended up being selected. This process was also iterative. I did not set out to contact one person from every possible case all at once, but rather began with those that were easiest to contact and expanded from there until I had collected sufficient information to move forward.

Third, I was able to attend and observe one instance of a climate science-policy meeting in-person, a briefing for BC provincial government staff on the IPCC's fifth assessment report in October 2013, jointly coordinated by PICS and CAS. This opportunity arose through the efforts of key informants and provided additional background for the provincial-level interviews. I

[9] For example, one key informant was familiar with the National Roundtable on the Environment and the Economy, and the decision not to include it as a case was partially based on the information they provided.

pursued a few additional observation opportunities, but ultimately none manifested during the timeframe of the project. The dearth of such opportunities, combined with the fact that I could not obtain permission to record the IPCC briefing (not to mention that it was essentially a one-way presentation rather than a co-productive deliberation), meant that I could not pursue personal observation of science-policy meetings as a formal method, which would have allowed me to investigate certain elements of co-production much more closely. Overall, though, I was able to achieve the level of background expertise warranted by the complexity of the problem prior to the interviewing phase.

Between January and April of 2014, potential interview participants were recruited from a combination of recommendations from key informants and publicly available staff or members lists. They were approached via email and given a brief description of the project, those without a publicly available email address being contacted through a key informant. After indicating their interest, they were provided with the interview topics and a consent form agreeing to keep their responses as anonymous as possible.[10] Most people who were approached agreed to an interview (i.e. 20 people), such that it is only possible to speculate on why a small minority (i.e. less than five people) was unable or unwilling (see Goldstein 2002). Both scientists and policy-makers can allegedly be uncomfortable with boundary work (Cash et al. 2003 p. 8090), so it is possible that those who did not respond had a less favorable view of existing climate science-policy relationships, leading to slight positive bias in the responses. This is unlikely, however, given the generally high response rate and the fact that several interviewees had a fairly critical perspective. In ensuring the credibility of the collected data, all that can really be done by the

[10] Surprisingly, the initial description of the research was sometimes much more important than the topics themselves. Some interviewees paid little attention to the list and preferred to discuss the general issue at length, and others attempted to frame all of their answers in reference to the broader topic. One interesting take-away is that the initial 100-word description is absolutely crucial to getting the most out of the interview process.

researcher is to use their network and available contacts as thoroughly as possible (Richards 1996 p. 201). Since essentially every known and available expert involved with each of the cases was eventually contacted, and because some of the latter interviewees ended up seeming less immersed in and knowledgeable about the cases (by their own admission), the potential pool of participants was likely effectively exhausted after the 20 interviews (see Table 3.3 for a summary of participants). Even so, a combination of interviews with key informants, other central authorities, and more peripheral experts is thought to be the most effective for obtaining a full understanding of any given issue and its context (Dexter 1970 pp. 8-9).

CASE	REPRESENTING SCIENCE	REPRESENTING POLICY
municipal (7 total)	2 scientists (PCIC) 1 intermediary (other organization)	3 planners (various municipalities) 1 intermediary (provincial government)
provincial (7 total)	2 scientists (PICS)	5 civil servants (CAS)
federal (6 total)	3 scientists (CFCAS)	2 former civil servants (federal government) 1 former politician (federal government)

Table 3.3 – Summary of Interview Participants

The interviews themselves (one-on-one, oral, recorded) followed a semi-structured, open-ended format. Participants were provided with a set of topics beforehand but were not expected to adhere strictly to those topics or discuss them in the same order. This strategy is particularly suitable for expert interviews, since it allows respondents to ‘teach’ the interviewer about the situation (ibid p. 5), often telling a more consistent chronological story (Richards 1996 p. 202) and organizing answers within their own frameworks. Such data may be harder to analyze neatly (Aberbach and Rockman 2002) but is ultimately more honest and complete. A more open interview structure was important for the inductive aspect of this research. It enabled participants to explore the complexity of the issue more broadly (e.g. if they thought some factor besides co-

productive design was more important for facilitating policy action, then they could spend more time talking about that). As well, the scope of the study was quite ambitious and led to a cumbersome set of interview topics (see below), so the semi-structured style allowed myself and the interviewee to group subjects together and downplay less important topics in order to make the most of the hour (or less) for which the latter was available.

In order to address this study's purpose and hypothesis directly, the interview topics (not that they were always strictly adhered to) followed the general structure of the research questions. After a brief introduction, interviews would cover a description of the partnership being discussed (identifying elements of co-productive design), an evaluation of its performance (recognizing successes and challenges), an explanation of what caused those successes and challenges (whether co-production or something else), any recommendations for improvement or general lessons that could be applied elsewhere, and broader issues like connections to other jurisdictions and levels of government (see Table 3.4 on the next page). The descriptive questions drew on the indicators of co-productive design from the hypothesis, while the evaluative questions relied heavily on the outcome indicators. Because scientists and policy-makers tend to have trouble identifying specific instances of science influencing policy, even when they believe it is influential in general (Weiss 1980 p. 385), there was a particular focus on 'example-type' questions and 'prompts' for additional information (see Leech 2002). I planned many of these prompts ahead of time, consulting a list of potential interview topics and sub-topics nearly twice as long as the one given to interviewees (several of the hypothesis indicators were expressed there but not in the lead questions). For instance, when discussing "how often communication occurs" in the given partnership, many interviewees were prompted to comment on the level of formal versus information interaction. As acknowledged above, there is some

1. Introduction:
   -Please take a brief moment to introduce yourself, your position, and your background.
   -Briefly describe the given 'science-policy dialogue' and surrounding institution(s) in general.

2. What are the specific (design) characteristics of the 'science-policy dialogue'?
   -What is its history?
   -Who participates? How diverse are the participants? How consistent?
   -How often does communication occur?
   -How much focus is put on back-and-forth discussion versus information dissemination?
   -Who facilitates the interaction (e.g. runs meetings)? Is this a shared responsibility?
   -In what ways are the participating groups accountable to one another?
   -How close is the relationship between the participating groups? Is it positive?

3. What does it achieve in practice? What are the associated successes or challenges?
   -To what extent does the dialogue achieve goals set out for it (and goals of the institution)?
   -How frequently does interaction result in plans being made or 'action items' being declared?
   -How is communicated information generally used by the groups that receive it?
   -In what ways do you, personally, benefit from this dialogue?
   -More broadly, are climate policy actions taken by this jurisdiction sufficient and effective?
      -How often do scientific findings appear to be the main reason for such action?
   -What other successes or challenges are associated with the dialogue and institution?

4. How are the identified successes and challenges tied to design of the dialogue and institution?
   -*For each one*, what is the likely cause? Above aspect of design? Another factor? Unknown?

5. What alternative institutional arrangements or dialogue designs might be considered?
   -What are the main design changes that could address the identified shortcomings?
   -What sorts of difficulties might be encountered in bringing about these changes?
   -How might other jurisdictions or dialogues change to realize the same identified successes?

6. Conclusion:
   -What role does the public play in this dialogue and institution? Should it be involved?
   -In what ways is climate policy action in this jurisdiction connected to other jurisdictions?
   -Broadly, how effectively do you think climate science is translated into policy action?
   -Overall, what is needed to ensure a productive translation?
   -Do you want to add anything else? Further elaborate on any earlier answers?

Table 3.4 – Guiding Interview Topics Sent to Potential Participants[11]

overlap in the indicators, which led to some overlap in the questions, but this often facilitated additional opportunities to 'prompt' respondents to give additional details. Generally, the interview topics were well-suited to the overall research goals.

[11] I was using the term 'dialogue' not 'partnership' at that point in the study (see the definitions in Chapter 1).

Finally, the collected interview data was coded. That is, pieces of data (i.e. quotations and paraphrases) were extracted from each recording, compared to one another, and grouped into more accessible and understandable conceptual themes (see Corbin and Strauss 2008). While essentially every major idea communicated by the interviewees was extracted, special attention was paid to themes emerging across the interviews (see Aberbach and Rockman 2002) and answers that deviated from the majority, either addressing a novel idea or disagreeing outright (see Dexter 1970 pp. 6-7). The more participants there are, the easier it is to identify emerging themes rigorously and the more likely it is that important exceptional ideas will be brought up by at least one of them. This is why it was important to exhaust the pool of potential participants. The extracted paraphrases and quotations were first grouped by case and broad question area (e.g. all the answers related to the descriptive aspects of the PCIC case were put together). Since such categories were known prior to the data analysis, this was a process of 'coding down' (see Lockyer 2004). It was fairly straightforward, since the interviewees usually followed the listed order of topics, or at least addressed the same major ideas. Then, within each of those sections, emerging themes were finalized and used to group the data (e.g. one of the themes for the descriptive elements in the PCIC case was 'user feedback') in a procedure of 'coding up' (ibid). Every such theme or 'code' represented a major idea revealed by the collective interviews, with the potential to address the purpose, research questions, and hypothesis. That is, each one generally warrants about a paragraph of discussion in the following chapters.

Having established the detailed hypothesis, methodology, case selection, and methods, this dissertation focuses its subsequent chapters on answering the research questions with the resulting analyzed data (i.e. with the thematic codes). The next three chapters respond to the descriptive, evaluative, explanatory, and (to a lesser extent) prescriptive questions for the three

cases (i.e. one chapter per case). Each begins with an overview of the relevant organizations, based on information gathered through preliminary methods. The particular case is contextualized within the analytical framework as I attempt to predict some of the specific variables and pathways (i.e. including causes besides co-production) that will be important. The bulk of each chapter discusses the results of the interviews, ending with an assessment of the hypothesis, which compares the influence of co-productive design to other causal factors (i.e. external conditions). Each chapter utilizes interview data in a similar way, using select quotations and paraphrases as necessary to make arguments about the case. Since there are many reasons that an individual quotation might be useful (see Aberbach and Rockman 2002 and Dexter 1970 above), I attempt to indicate, for each idea extracted, whether it seems to represent a common opinion across the participants, an original opinion of a single interviewee, or an exceptional opinion that conflicts with others. This helps preserve some of the data in a rawer form so that it is not only presented through my own interpretation. Chapter 7, besides answering the final comparative question directly, draws the findings together to more comprehensively address the research questions, particularly the explanatory and prescriptive ones, generating lessons that might apply more broadly.

Chapter 4: The Municipal Case of PCIC – Ideal Co-Productive Influence

This chapter discusses the relationship between PCIC and BC municipalities, an example of productive interaction with important effects on local climate adaptation. I first contextualize the case by providing an account of climate-related problems faced by municipalities in BC and the general governmental framework through which they are encountered, as well as a brief description and history of PCIC. This results in some predictions about potential causes of the partnership's success, based on the analytical framework (see Chapter 2). For the bulk of the chapter, I draw upon interview responses in order to answer the research questions for this case. That is, I *describe* elements of co-productive design in the partnership; *evaluate* it by assessing successes and challenges; attempt to *explain* the causal origins of the successes and challenges (i.e. whether they are due to co-productive design or other factors); and present some emerging *prescriptive* suggestions for improvement. To conclude, I start to examine the significance of this case for the co-production hypothesis (see Chapter 3), but much of that discussion is reserved for Chapter 7 where it can be bolstered by the other cases. Broadly, I find that the partnership has many co-productive elements (i.e. it certainly qualifies as a 'dialogue') but does not cleanly fit the definition of true co-production (see Chapter 1). However, perhaps this is not a shortcoming after all, since the partnership's design leads to a number of successes anyway, and there is little obvious opportunity for further improvement.

Background

Located on the west coast of Canada in the northern end of the Rocky Mountain Region, the province of BC is environmentally defined by its islands and coasts, mainland mountains,

and forests throughout. As such, many impacts of climate change that concern its municipalities are those that manifest through oceans and forests. For example, the coastal city of Vancouver (the largest in the province) is at risk for sea-level rise and coastal flooding, which is particularly problematic given that the natural capital of its coastline "has defined the social, cultural, and financial value of the city" (Keenan and Yan 2011 p. 23). Another major concern is the recent outbreak of the Mountain Pine Beetle (MPB), an invasive species which has been able to expand its range to formerly unsuitable areas in BC due to rising temperatures facilitating brood development (Carroll et al. 2003). In the worst years of the outbreak, greenhouse gas emissions from widespread tree mortality were approximately equivalent to 75% of those from all forest fires across Canada in an average year (Kurz et al. 2008), which means that the MPB outbreak is not only caused by climate change, but contributes to it as well. Perhaps the most important thing to understand about climate change in BC is that its impacts vary considerably by region and municipality, and thus merit different adaptation decisions. For example, by 2050, summer rainfall in Vancouver is expected to decrease 15%, while it will remain largely unchanged in the city of Prince George (PCIC 2015a). The local environmental context of each municipality is important, and they cannot be treated as a homogeneous collective entity.

BC municipalities are also shaped by a governmental context, which manifests in bodies at the national, provincial, regional, and municipal level. The federal government of Canada is involved with municipalities to a considerable degree, despite the lack of constitutional formality for such arrangements. In particular, it has funded various municipal-level environmental initiatives related to clean air and water, urban sprawl, and general sustainability, primarily through the Gas Tax Fund (GC 2014b). These have dwindled somewhat under the Harper Conservatives and there remains a general lack of national leadership with regards to climate

change (see Chapter 1 and Jones 2012 pp. 1247-1249), leaving substantial room for locally-led action. At the provincial level, the BC government has pursued a suite of progressive policy actions in response to climate change since 2007, including a carbon tax, standards for vehicles and buildings, and a new energy plan. These represent a "turning point" or "dramatic shift" in the context for municipalities (Burch 2010 p. 290), especially since the province explicitly seeks partnerships with them through a "joint approach" (Jones 2012 p. 1258), primarily embodied in the Climate Action Charter (Government of BC 2015a). Provincial political leadership on climate change has diminished since 2007, however, perhaps due to changes in public opinion or party leadership, and the government has re-focused on the economy, jobs, and the development of liquefied natural gas, while halting further increases of the carbon tax (Hoekstra 2013). Higher levels of government, then, present (perhaps fleeting) opportunities for municipal partnership but also leave substantial room for initiative at the local level in lieu of leadership from above. As well, Canadian cities (including those in BC) have a high general capacity to deal with climate change due to their strong economies, highly educated populations, and systems of legitimate governance (Burch 2010 p. 288), arguably having direct or indirect control over 52% of domestic greenhouse gas emissions (Jones 2012 p. 1252). As such, it is no surprise that several BC municipalities (e.g. Vancouver, Surrey, Prince George) have been developing sustainability plans with some climate change focus since as early as the mid-2000s (see Burch 2010).

Municipalities, especially small ones, do not have the same independent capacity as provincial or national governments, so their action on climate change is often supplemented by external bodies. While the provincial government may occasionally fulfill this support role in BC, there are also regional organizations that have a substantial impact. For example, the International Council for Local Environmental Initiatives (ICLEI) is a non-profit organization,

with a Canadian branch, that provides consultation and training to municipalities across the country (ICLEI 2014). Similarly, the Columbia Basin Trust (CBT) is a regional organization of smaller municipalities in southeastern BC (e.g. Kimberley and Revelstoke) which, through its Communities Adapting to Climate Change Initiative (CACCI), supports members with advice and expertise on climate adaptation (CBT 2014). As a final example, the Fraser Basin Council (FBC), a non-profit organization with a focus on sustainability in the Fraser Basin area (as well as across the province), facilitates collaborative solutions and exchange of expertise among municipalities, with regards to climate action (FBC 2014).[1] Such organizations are thus important actors in municipal responses to climate change, and they are particularly interesting for this research because they often have an interest in facilitating dialogue and providing scientific advice.

In this context, it is not surprising that many municipalities in BC have direct or indirect (i.e. through a regional organization) relationships with PCIC, a non-profit scientific research organization with a focus on climate change in BC. In general, PCIC seeks to bridge the gap between climate research and its application, make practical information (e.g. quantified local impacts of climate change) available, and stimulate collaboration among various climate stakeholders. Its research themes include regional climate impacts, climate analysis and monitoring, and hydrologic impacts. As such, the staff of about 20 people is comprised primarily of climatologists, data analysts, and hydrologists, supported by a few administrators and communications personnel (PCIC 2014, PCIC 2015b). The organization was officially

[1] The latter two of these organizations cover a jurisdiction defined by environmental, rather than political boundaries. This is interesting because part of what makes environmental issues complex is that they transcend political boundaries, so these types of jurisdictions may be more effective in dealing with them. They are not necessarily any more effective in mitigating against climate change, however, since greenhouse gases are unconstrained by both political and environmental boundaries.

established in 2008 (after several municipalities had already begun developing climate-related sustainability plans) when base funding became available through a provincial government endowment supporting climate initiatives led by the University of Victoria. The endowment interest comprised 62% of PCIC's revenue in its first year, while research contracts with various government and community partners made up most of the remainder (PCIC 2009). More recently, specific outputs of the organization have included collecting historical weather and climate observations for BC (covering the last 140 years); developing more detailed climate maps and data sets for all months since 1972; providing projected future changes by region through online tools; developing regional climate summaries for BC's resource regions; translating contemporary climate research to a form more accessible for local users; participating in presentations about such information; and contributing to the broader academic understanding about climate change (PCIC 2013, PCIC 2014). As evidenced by these examples, PCIC has been able to develop many free tools for users (e.g. municipal governments), even while maintaining the level of financial support from research contracts at about 40% of overall revenue (ibid). The organization works with both municipal and provincial partners, but the former is the focus of this chapter.

Besides the mandate's focus on "bridging" and "stakeholder needs", PCIC documents often use co-productive language such as "two-way dialogue", "plain language", and "two-way exchange" (e.g. ibid). Unsurprisingly, then, there are several ways in which PCIC and BC municipalities engage in climate science-policy interaction. For example, PCIC often makes presentations to community planners about how to use one of the online tools, Plan2Adapt, which predicts changes in precipitation and temperature (among other things) for various regions in BC (e.g. the Greater Victoria area) for the 2020s, 2050s, and 2080s. It can be used to

determine priorities for climate change adaptation, informing policy decisions. Another good example of partnership is the longer-term contracts PCIC enters with individual municipalities (or groups of them) to support and review the development of adaptation strategies over several years. Such contracts lead to ongoing relationships between community planners and PCIC scientists, who then engage continually in less formal exchanges of expertise. Finally, every two years the organization hosts user meetings on each of its major research themes, which involve presentations, feedback, and discussion (see ibid). These examples are not exhaustive, but they suggest that some degree of co-productive design is apparent even from preliminary document review. They also provide context for the interviews, since they are precisely the sorts of mechanisms that participants were asked about.

Based on this background information, what factors (i.e. from the analytical framework and broader literature) might be most influential for the science-policy partnership between PCIC and BC municipalities, as well as the associated policy outcomes? External events might be important, with the MPB outbreak providing some impetus for policy change at this time. Other jurisdictions may matter; that is, the provincial government's role as a coordinator could improve networking opportunities and incentivize municipal action. Similarly, other institutions (e.g. ICLEI) likely play a role, strengthening the science-policy network surrounding the case, and perhaps having greater influence than PCIC does. The type of information produced by PCIC might be relevant; it seems to focus on basic data, which may be more likely to see uptake by policy-makers than prescriptive advice or advocacy (see Lindquist 1988). Finally, the language in PCIC's mandate and documents indicates some deliberate attempts at co-productive design for its partnerships with municipalities.[2] While the last factor is my primary interest (i.e. it is the

[2] These variables of interest could serve as a basis for more sophisticated predictions, drawing on the analytical framework. For example, I could hypothesize that PCIC's openness to user feedback improves the quality and

focus of the descriptive research question), the others are good examples of the causal dynamics I hope to discover or verify using the interviews (i.e. when answering the explanatory research question). The interviewees, of course, are actual participants in this case of science-policy partnership, and as such are more capable of identifying the relevant determinants of policy action than I can through an external lens. On the science side of the partnership, I spoke to two staff members from PCIC and one intermediary from a regional organization who utilizes PCIC research in communicating with member communities. On the policy side, I interviewed three planners from different BC municipalities and one intermediary who works with various municipalities through the provincial government. The remainder of the chapter uses data from these interviews to address the dissertation's research questions in the context of this municipal-level case. As such, it follows the same basic structure as the interview topics, which were also based on the research questions.

Elements of Co-Productive Design

In general, interaction between PCIC and BC municipalities occurs quite frequently and involves a fairly diverse group of stakeholders or users. According to the collective experience of interviewees, any individual partnership with a municipality (or a group of them) is usually initiated by one or more in-person meetings or presentations. If the partners engage in a formal project (e.g. PCIC is contracted to do more specific research on a particular region or help develop and review an adaptation plan), they would tend to communicate at least monthly, and

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relevance of their information, which is then more likely to be used instrumentally by municipal planners, resulting in more effective climate action. A competing hypothesis might be that climate policy action in a given municipality is most strongly predicted by the severity of local climate impacts that have affected it in the past few years, which can lead the public to demand a substantial response. While these are the sorts of pathways I hope to reveal through the interviews, trying to outline every relevant one at this point would be an exercise in unfocused speculation. As argued in Chapter 3, it is better to use the general hypothesis indicators (i.e. on co-productive design and policy outcomes) as a guide, and discover the other important causal factors inductively.

would continue do so informally every few months even after the project was concluded. The frequency varies for each partnership, depending on the time, capacity, and personality of liaisons on each side. As well, PCIC deals with many municipalities at the same time and also interacts indirectly with anyone who accesses its free online tools and information (e.g. CBT uses these to instruct member communities as part of the CACCI program). While it is hard to know who, exactly, is making use of the online information, it is primarily municipal planners and NGOs that pursue in-person communication. Engineers, the public, municipal politicians, and stakeholder groups are sometimes involved, but usually interact with PCIC only through the facilitation of planners and NGOs. The interaction, then, is quite regular and reaches a fairly diverse audience, but the design characteristics that support it, as identified in the interviews, are perhaps more interesting. PCIC emphasizes user feedback, is strategic in its presentation of information, focuses on maintaining its scientific credibility, and provides only base data rather than advice. The remainder of this section explores these four characteristics.

PCIC's openness to receiving feedback on tools and information was emphasized by most of the interviewees, not just those who work for the organization. Broadly, they pointed out PCIC's "needs-driven nature" or "client focus" and that its Program Advisory Committee is meant to provide advice on stakeholder requirements. Interestingly, participants seemed to highlight this focus to a far greater degree than does the formal mandate of the organization. For example, one staff member said: "We make a project happen and in the process of delivering everything that we deliver, there's active back-and-forth in us learning, [under a] user needs kind of definition, and we learn from every single one of those projects". In addition, one municipal planner saw PCIC as "really making the effort" to keep information accessible. Specifically, interviewees highlighted both formal feedback, such as the review workshops that take place

every two years for each major research theme, and informal exchange, like that which occurs naturally during project partnerships or emerges from lasting relationships that have become more collegial. A good example of the latter was given by one of the planners:

> Certainly I feel like we email each other outside the scope of purely direct services to each other. Like certainly say I needed quick advice on some piece of a policy article I was writing, if I was referring to the science correctly, I would send it to him, and vice versa. I think if he read some piece of local government law that he didn't get and needed to know for a different meeting, he might email me, so it's beyond the realm of just advice purely on something that we need directly associated with our relationship.

The back-and-forth nature of this interaction, where both partners benefit, is a good example of minor co-production. A staff member added that the flexibility offered by informal interaction is a necessity given the needs-driven nature of PCIC and the variability among its users. According to them, it was precisely this sort of feedback that led to developing the Plan2Adapt tool. After working with some of the larger municipalities earlier on, PCIC realized that it would not be able to maintain such a relationship with all BC communities at once (not to mention that many would lack the resources or capacity to engage directly), so a free online resource was created that could be used without its direct involvement. Not only is there a broad emphasis on feedback, then, but it is genuinely considered and often implemented; it certainly indicates co-productive design.

Another way that PCIC focuses on user needs is through its presentation strategy, which prioritizes accessibility, not only for information communicated in-person, but also for that presented online and in written reports. In general, this involves translating complicated climate information (often from global models) into a form that is relevant to local users and can be used for decision-making. In doing so, overly technical language must be avoided, and PCIC has

improved at this since its creation (according to at least two interviewees). One intermediary described a good example:

> That's actually why the Plan2Adapt tool is interesting, because it presents the same information in four different ways, and that's based on discussions, primarily with planners, about "what works for you?" And, of course, they said "we like graphs" and "we like words" and whatever. So that's an attempt, really, to address different communication styles.

Providing accessible information entails more than merely determining what material to present. How it is presented also matters. As the above quote demonstrates, visuals can be important. A different participant went into much detail about the types of graphs and animations that are most effective. Another strategy, elaborated by a couple of interviewees, is to begin with more basic contextual information, and move to greater detail and complexity later. This is applicable on the scale of both individual presentations and relationships over time. PCIC's most interesting tactic for presentations, however, is to recruit experienced users to participate in co-presentations. They can relay their experience with PCIC tools or information and use the best language for speaking to other planners. A quote from one PCIC staff member about a webinar on Plan2Adapt exemplifies the co-productive nature of this approach:

> I really wanted it to be not the climate scientists telling other people how to do it… So I asked [a planner] to actually present on more of a peer level, and she presented "this is how [a municipality] used Plan2Adapt and here's an example" and she walked through it, and I was just there to answer questions. She kind of set me up with a couple of questions, and I also answered questions from the audience.

Another staff member from PCIC pointed out the balancing act in making information accessible; simpler information may also be less useful and seen as less credible. As such, PCIC provides a range of tools for users with different needs (e.g. Plan2Adapt is easier to understand but less detailed than the 'Regional Analysis Tool'). Each of these efforts at presenting information were only mentioned by a few participants, but collectively they embody an

emerging theme of accessibility, which reinforces the underlying user emphasis of the above focus on feedback.

The concern with balancing accessibility and credibility points to a broader effort by PCIC to maintain the latter, which was mentioned by a number of interviewees. Several internal review strategies are used by the organization ensure the quality of presented information. For example, PCIC draws extensively on peer-reviewed literature, every report is assessed by the director and an internal peer-review process, and representation of its data in municipal reports is checked. In terms of external review, ICLEI, the University of British Columbia, BC Hydro, CAS, and Environment Canada have all provided evaluation or feedback at some point in time, and an effort is also made to publish in academic journals that undergo peer review. Consider this remark from a PCIC staff member:

> We've been doing a lot of work to publish in peer-reviewed literature, so that we can say "okay, this is the technique that we have used" or "these are the several techniques that we have used, and we chose them because someone else used them and we just want to replicate them here, or we chose them because they were a good method and that was proven by this study"… So we don't just do things and then provide data. We're also really rigorously testing our methodology and getting it approved by our peer scientists.

So PCIC utilizes many specific review mechanisms to ensure its credibility, but it also maintains a positive reputation more broadly by bringing together a staff which, as a team, has scientific credibility, climate literacy, enthusiasm, and communication skills (i.e. traits that benefit users). Participants both from within and outside PCIC made this observation independently. An intermediary said:

> There are people working for PCIC that are passionate about what they do, and that are committed to being useful, basically. They have a mix of people. They have their director who's really science-oriented and then other people who really understand that it's about working with users, trying to communicate. So that's probably good, to have that range. I think it's kind of a combination of scientific excellence and communication skills – and credibility.

While all of these credibility issues tended to get mentioned more by the interviewees from PCIC itself than by others, at least one planner noted that the organization's reputation definitely mattered for their municipality's confidence in the data, especially since there can be tension between the more sophisticated future models of PCIC and the standard historical extrapolation that might traditionally be used by city engineers. Even though credibility is not directly related to user needs, then, it is still important. It can perhaps be viewed as a basic standard that must be met before more expressly co-productive strategies can be effectively pursued.

The final major co-productive characteristic of the partnership between PCIC and BC municipalities is that the former refrains from giving direct advice about climate-related planning, instead focusing on the provision of base data. Every single interviewee identified this separation, emphasizing that PCIC's role is to communicate the science, stressing that it is not PCIC's mandate to give policy advice, or simply stating "that is not what PCIC does" in response to the question. One participant commented:

> That isn't a very useful – for researchers or for scientists – that's not how policy works and it's not really a welcomed role. There are researchers who give us policy advice, sometimes advice that we solicit, and other times unsolicited advice. Solicited advice is generally considered, but the unsolicited advice typically goes nowhere. But that's not what PCIC does.

Related to this, other interviewees noted that "PCIC does not have a messaging role" and it is "not really in a position to convince the public that climate change is happening". Its mandate is quite specific, which is why (as above) it does not tend to target the public, lest it slip into advocacy. Corroborating this sentiment, one planner noted that PCIC is quite careful about not crossing the line to direct policy advice. However, indirect advice may be more common. The interviewee from a regional organization (i.e. not PCIC itself) mentioned that a "fair bit of coaching" goes on, since community representatives will be less familiar with the science and

how it should inform their decision-making. This person did not see it as inappropriate to "plant the seed" for certain ideas, even though their presentations, like PCIC's, do not focus on advice. However, they deal with smaller municipalities than PCIC does directly, which have less capacity and may benefit more from that sort of advising strategy. According to them, it is still better for the planners, politicians, or stakeholders, to come up with priorities themselves, since they know the community best and will feel more ownership over the ideas.

The overall avoidance of direct advice would not intuitively count as an element of co-productive design under the hypothesis indicators, since it precludes the accountability of policy to science as well as broader reflective discussion. That is, while discussion does occur at PCIC presentations, it generally will be restricted to clarifying and understanding user needs and the relevant science. Even so, this constraint, as one PCIC staff member points out, exists to make the organization attractive to a range of users (i.e. if PCIC gave direct advice, then municipalities that did not want to hear such suggestions might simply not engage with PCIC or its tools), so it still complements the other partnership characteristics with their thematic focus on users. Arguably, it also matches other elements of co-productive design, such as an atmosphere of trust, clear roles and responsibilities, and a basis of frequent interaction. There is some justification for this deliberate separation between science and advice in the partnership's design.

The major characteristics of the climate science-policy partnership between PCIC and BC municipalities generally embody elements of co-productive design (e.g. frequent interaction, feedback, accessible information).[3] However, it is more accurately characterized by its user

[3] The identified characteristics are primarily under the purview of PCIC, even though both the science and policy sides are important to the dialogue. The reason for this emphasis is that this case focuses on the relationships between PCIC and *multiple* municipalities, such that it would be impractical to analyze the efforts of each municipality in engaging with the dialogue. The other cases, which examine only a single policy partner each, provide more analysis on the policy side of the science-policy interaction.

focus, which underlies all of its major characteristics, even the ones that are indifferent to or conflict with co-production (e.g. maintaining credibility, avoiding advice). As such, it perhaps does not fully meet the definition of 'true co-production' but certainly qualifies as a 'dialogue' (see Chapter 1). It could be described as having a moderate to high degree of co-productive design, which is important for testing the hypothesis of this research. Since all of these characteristics are malleable design characteristics, they could theoretically be applied to other partnerships (or removed from this one), which is particularly important for making recommendations later in the dissertation.

Successes and Challenges[4]

Overall, the interviewees gave a highly positive assessment of the partnership between PCIC and municipalities in BC. Of those who were directly involved, all described the relationship as positive, often adding that it was productive, successful, or achieving its goals effectively. One planner went as far as saying there were "no challenges" and mentioned that they had shown the PCIC tools to a number of American colleagues on the west coast, who apparently would like to create a similar service and partnership in the US. Many also made comments regarding how the partnership has improved over time (e.g. PCIC now uses less technical language) or how they personally benefit from it. The generic assessment was positive, but this study is interested in a more comprehensive evaluation, highlighting the extent to which the partnership contributes to progressive policy action on climate change. As such, the emerging

[4] It is not the goal of this section (or the chapter itself) to determine whether the dialogue is 'successful' or 'unsuccessful'. Investigating the hypothesis requires more detail than that, whereby a variety of successes and challenges are identified and explored in order to assess the potential of co-productive design. For example, strong climate policy action on either mitigation or adaptation ideally would be facilitated, but any action at all could be considered a success, while any unrealized potential for further action could be perceived as a challenge.

themes explored in the rest of this section include concrete effects on policy action, broader effects on climate awareness, side benefits created by the partnership, communication challenges, and general limitations of time and capacity.

In terms of concrete influences on climate policy action, even though PCIC deliberately avoids giving direct advice (as above), one of its goals is still to "reduce vulnerability" (PCIC 2009), which implies some influence on policy decisions with regard to climate adaptation. One PCIC staff member called it the "holy grail" when planners "actually use future climate projections and do something different as a result". The best example of such influence is some planning decisions made by the municipality of Castlegar based on PCIC information, which two participants mentioned. One of them said:

> One of the vulnerabilities that they identified was flooding issues from intense precipitation events, and they had a look at their existing infrastructure and realized that one of the things they could do inexpensively, was to simply clean out the culverts more often, and they did that. And the following year, they had the extreme precipitation event… they had the 80 millimetres in a day, or whatever it was, and because they had increased the frequency of the maintenance of the stormwater system, it was able to handle it. So it was a real success story of really going after the low-hanging fruit and, within a year, it paid off.

Most instances of PCIC influence on community planning, however, are not nearly so concrete. Often, a third party facilitates the input of PCIC information into municipal planning decisions, so it is difficult to fully credit PCIC for any resulting influence on policy action. Collectively, participants gave examples of Prince George being influenced by a local university researcher, Saanich by a consulting company, Kaslo by the CACCI program, and ten communities in the Columbia Basin by the CBT. Even when PCIC has a more direct influence, interviewees tended to describe it as "helping" or "informing" the development of plans, rather than motivating action to begin with. One planner from a coastal municipality said that PCIC helps determine how high dykes should be built (i.e. an instrumental use of information), but that action on

adaptation would have happened whether it was involved or not. Another thought that PCIC was helpful for developing their broad adaptation plan, but not for its implementation. Along these lines, one participant mentioned an ICLEI evaluation of PCIC:

> We had ICLEI interview the people we provided information to, and then also they did a compare and contrast between – so they have these projects going across all of Canada… one of the main conclusions was that yes it [PCIC] did identify some impacts that they might not have thought of… but the biggest thing was actually prioritization… it really helped say "okay, we have an easier job identifying what are the things we need to be concerned with" then figuring out what's the relative magnitude.

Determining the precise extent of PCIC's influence is difficult. Not only is it hard to accurately predict what a community would have done in the absence of PCIC, but municipal representatives may also be (understandably) wary of giving PCIC too much credit over their own planners and politicians. As well, while the interviewed planners were all from larger municipalities, it is possible that impact on smaller municipalities is greater; this seemed to be the experience of the interviewee from a regional organization. Still, PCIC appears to influence its municipal partners to some extent, even if the effects are often difficult to distinguish.

Besides influencing individual municipalities, PCIC's efforts may also have an important effect on the broader awareness of climate change and the importance of adaptation. Several of the interviewees used the terms "general awareness" or "mainstreaming" to describe PCIC's influence. One planner perceived a norm being created for the future, where municipalities do not need to create separate strategies for adaptation because it is integrated into city planning by default, partly due to staff being familiar with organizations like PCIC and individually accessing the relevant tools when necessary. However, PCIC's influence on awareness-building is generally more difficult to delineate, as illustrated by this quote from another planner:

> I think that [PCIC information] is a really important piece of the puzzle for helping people understanding the risks and the motivation to act, I think, for sure.

> I don't know that everyone always then links it back – "oh wow, there's this great organization that puts it together for BC" – but certainly the information is really helpful for providing a kind of motivation to act.

As above, interviewees are confident that PCIC has influence in this regard, but finding examples where PCIC awareness has actually motivated some community to act is difficult (see Weiss 1980). The more obvious effect of this broader awareness is its capacity to leverage a network across communities with regards to climate adaptation. Because planners from different municipalities talk to one another, PCIC's reputation can facilitate further partnerships. One PCIC staff member said that about half of the people who approach the organization with a question or project proposal do so because of some other project they were aware of. As such, PCIC seems to indirectly facilitate the diffusion of adaptation planning through municipalities, which is an important impact. The community network is also strengthened by PCIC's presence, as one planner illustrates:

> If I was using PCIC and I knew that my Delta friends were using some other group and I knew that Surrey was using some other group, that would take away from the relationship. Knowing that we're all getting information from the same source and that we're all confident in PCIC certainly helps build the relationship.

PCIC, then, has a variety of influences on policy action, some direct and many indirect. An intermediary summarized this well by pointing out that PCIC has influence "across the range" of initial planning to eventual implementation. Some of the comments in the above paragraph confirm this too. Although the interviewees emphasized different effects, it is clear that PCIC affects policy action in a number of important ways.

The relationship between PCIC and BC municipalities also results in several peripheral benefits that are unrelated to policy action. First, partnerships are learning opportunities for both sides. As mentioned in the descriptive section, PCIC seeks feedback, which allows it to develop the science communication skills of its staff members (e.g. recall the movement towards more

accessible language) and better fulfill its mandate. The interviewed planners and intermediaries reported a similar benefit, developing climate literacy and science translation skills themselves (e.g. for talking to other departments in their municipality) as they learn the best way to make use of PCIC information and tools. One of them noted that PCIC adaptation workshops are also a rare opportunity for city departments to come together on an interdisciplinary problem and learn about one another. Secondly, two of the planners pointed out a benefit in terms of efficiency. Because PCIC has put together the relevant information, city staff do not have to do nearly as much (potentially redundant) research and synthesis themselves. That is, while PCIC may not be the primary motivator for municipalities to take action, it saves them time and money as they do so, which means more adaptation can happen sooner. This quote from a planner demonstrates the potential of these benefits to efficiency:

> I think they'll be an incredible resource for broadening so that – I am, at the moment, I am pretty much the conduit for every question to do with future climate and sea level, whereas I'm hoping, by reference to the PCIC resources and perhaps building relationships between, say, a sewers engineer and their hydrological expert, that I won't have to hold that knowledge just myself.

Finally, the network among municipalities (as above) benefits PCIC in terms of promotion, increasing the number of potential contracts and projects the organization can engage in as part of its mandate. Interacting with policy partners has helped PCIC build an international reputation quickly (recall that BC municipalities have advertised PCIC to American colleagues).

While the partnership has seen many successes, it has also faced a few challenges. The most obvious of these are related to communication. Occasionally, political considerations lead municipalities to misuse or underuse information from PCIC. One planner pointed out that policy-makers without climate literacy sometimes make overly general statements about PCIC findings, while city staff (e.g. engineers) who are used to collecting and using data in a certain

way may resist PCIC information altogether. Another said that politicians may overreact or underreact to certain events (e.g. an isolated winter of particularly heavy snowfall) even when information from PCIC suggests a different course of action. Some aspects of these problems are inherent to the complexity of climate change information (e.g. long-term trends, uncertainty, complicated models), but perhaps others are due to shortcomings in PCIC's communication strategy. Interviewees suggested that the organization should promote itself more publicly, work on communicating uncertainty more effectively, and use less academic language (this is still a complaint despite progress to date). One planner illustrated the interplay between inherent and more solvable communication issues:

> Decision-makers can be over-reactive perhaps, sometimes, and in other cases not anticipating where we need to go… Those of us who have taken an interest in it become the interpreters of the information, try to explain to decision-makers or councillors or even our own senior admin people of why should we even care about this stuff. That's where there's a bit of a challenge, but that's not PCIC's fault, but I have told them in the past that when they do their reports, make them less academic.

None of these problems are easily solved. As one intermediary pointed out, people always want certainty in information. Scientists, however, can only go so far in reducing uncertainty or communicating it more effectively. Even simplifying technical language has costs, so these challenges remain for the moment.

Other challenges fall into the more general category of limits on available time and capacity for interaction. As established in the above paragraphs on successes, PCIC's reputation has grown, as has the demand for its services among various municipalities. Because it is a fairly small organization, and its endowment funding per year is a fixed amount (i.e. evidently contract revenue cannot cover all the costs), it can only partner directly with so many municipalities at once. Consider these two quotes from the interviews:

> Something that could have reduced some of the challenges and helped feed the successes would be for them to have the capacity to provide more in-person or one-on-one organizational support. If they were able to have come into our organization and provided a presentation for all of the engineers and planners who eventually are going to be using this data to inform our decisions, as opposed to always going through myself, then I think that could have been of huge value. [municipal planner]

> We're trying to take a step back and figure out how we can work our program so that we don't spend so much time with individual people, one-on-one, but build things that have use across the board, that multiple people could use, just because we're fairly small and we don't have time to work one-on-one with everybody. [PCIC staff member]

There is an amusing tension here, where municipalities would like more interaction with PCIC, but as a result, PCIC cannot interact with each individual community to the same degree as before. This highlights the very nature of time and capacity limitations (i.e. of course climate change would be easy to solve if we had unlimited time or money at our disposal). One PCIC staff member remarked that it takes a lot of time to make sure all of PCIC's information is credible (recall the internal review process), which means it is difficult to simply produce more information with the same resources. Similarly, a planner expressed a desire to interact with PCIC more and provide more feedback, but acknowledged that their own time was limited as well. While it may be possible to bend some of the limitations through improvements in efficiency or re-prioritization (e.g. one interviewee suggested PCIC might do less pro-bono work), such challenges can really only be addressed by increased funding to climate adaptation research and policy initiatives, an issue much broader than the partnership.

Overall, the interaction between BC municipalities and PCIC has seen an array of successes and challenges. While interviewees all saw the relationship as highly positive, their collective enthusiasm was measured, as it is difficult to extract many concrete examples of PCIC influencing policy action. Despite their optimism, they were able to identify a number of

remaining challenges. Some of these successes and challenges have fairly obvious or intuitive explanations and potential solutions, which participants mentioned as they identified them, so they were discussed above. However, this dissertation emphasizes broader issues of causation, especially the question of whether co-productive design (or the lack of it) is responsible for any of the above successes or challenges. Such discussion is the focus of the following section.

Important Causes of the Level of Success

Recall that this dissertation adopts a combined inductive and deductive approach. That is, it is open to exploring a wide range of factors, but emphasizes a hypothesis about the relationship between co-productive design for science-policy partnerships and climate policy action. This section provides a link between the previous two, focusing on how the identified design characteristics may have caused the identified successes and challenges, particularly with regards to the effects of co-productive design on policy action. The inductive character of the research suggests that other potential causes for the successes and challenges should also be explored, which the interviewees were asked explicitly to consider. As such, this section explores a number of important causal factors including co-productive design, other institutions, individuals, political will, events, and the inherent divide between science and policy.[5]

Many elements of co-productive design were identified as key causes of success. PCIC's focus on users (i.e. responding to feedback, working to understand practical needs, presenting clearly with the audience in mind, acknowledging a variety of user types) was explicitly

[5] There is quite a bit of overlap here with the predictions made at the outset of this chapter. However, the interviewees did not put any particular emphasis on the influence of other jurisdictions (e.g. the provincial government) and they added the causes of individual personalities and the science-policy divide. PCIC's provision of data rather than advice (see Lindquist 1988) seems to have been a deliberate strategy, and thus counts as a characteristics of co-productive design rather than as an external cause.

mentioned by at least three interviewees (i.e. one PCIC staff member and two planners) as a major factor, and its importance is illustrated well by this quote from a planner:

> I have a lot of interaction with academics, and academics doing projects, projects that they think will be practical, and I really value that PCIC – maybe I'm wrong referring to them as academic; I'm only saying that because they're housed at UVic – but I really see them as genuinely trying to get feedback from practitioners on what would be useful and then following through. And that makes me want to help them and it makes me interested in keeping the relationship going because I think it will be useful for me.

One of the planners also said that PCIC's clear communication at some early meetings with city staff was a "catalyst" for bringing people together on adaptation. In addition, a range of participants pointed to the independence of PCIC research as a factor that makes it attractive to potential partners. That is, PCIC avoids advocacy and is structured to be separate from government (even though it has received provincial funding) and the educational goals of the university. The endowment funding also facilitates independence, so that the organization does not need to rely entirely on contracts. PCIC allegedly obtains some crucial credibility through this approach, which is related to the credibility it acquires from doing quality research to begin with. Building an effective team that can conduct rigorous research as well as communicate it clearly was identified as important by several interviewees. It is particularly interesting that one planner, who did not put much emphasis on PCIC's scientific credibility in the descriptive segment of the interview (potentially because the questions did not really probe for it), said that the credibility of PCIC's research is what really drives the interaction with BC municipalities. Finally, at least two participants commented on PCIC's general presence and accessibility. The relevant information being available at the right time (e.g. when a crisis occurs or politicians become interested) is crucial for policy action to take place. Many different aspects of co-productive design, then, are important for explaining the successes of the partnership, even if

they do not all match the definition of ideal co-production precisely. Based on the interview responses, it is reasonable to suggest that the partnership's design (and its emphasis on co-production) is the most important factor in explaining the success of the relationship.

Another causal factor that has played a notable role in the partnership's level of success is the influence of other institutions. Every participant pointed to at least one external organization that has positively affected PCIC's relationship with BC municipalities. The most obvious of these are the regional organizations mentioned at the beginning of this chapter. Only the largest municipalities have sufficient capacity to enter contracts with PCIC on their own, so interacting with smaller ones requires facilitation by organizations such as CBT and the CACCI program, which were involved with adaptation planning in Castlegar, for instance. This quote from a planner describes the effect of ICLEI's influence on the PCIC partnership:

> ICLEI Toronto actually brought PCIC formally into a meeting with the six municipalities out here on the west coast that were in their adaptation initiative which was a pilot for them which started in 2010. They had a part to play in it for sure, this non-profit ICLEI who was running this adaptation initiative based on this workbook they were piloting and their workbook called for science input and I believe that ICLEI may have paid for one meeting with PCIC.

PCIC would have had more difficulty connecting to potential partners without the efforts of such institutions. Besides the regional organizations mentioned above, several others have had some impact on the partnership as well. For example, Natural Resources Canada (NRCan) has matched municipal contributions to the process involving PCIC and ICLEI; CAS has occasionally funded related projects and events; and the BC Regional Adaptation Collaborative (RAC – coordinated by CAS and FBC with funding from NRCan) has been instrumental in facilitating adaptation planning for the city of Prince George (which also involved PCIC). The efforts of a broad range of institutions have affected municipal-level adaptation planning in BC, but that should not downplay those of PCIC, which are interwoven with them.

Internal features unrelated to co-production or design are also major factors explaining success, namely the individuals who happen to be participating on each side of the science-policy partnership. Several of the respondents directly involved with the partnership said that the success is partially due to a good match in personality between representatives of both sides, such that positive personal relationships can be built. Consider this quote from a planner:

> Part of it is personality-dependent. I mean, I had interactions with [PCIC staff member] right at the beginning of my project – I found him incredibly easy to work with and so I reach to him very informally, often, and vice-versa… I really value the relationship I've built with [PCIC staff member], in which we can get information back and forth.

One participant also noted that the frequency of (informal) communication between PCIC and its community partners is dependent on personalities. Related to this, the existence of someone from the policy side that is willing and able to act as a "champion" or "point-person" and can liaise effectively with PCIC appears to be a prerequisite for productive interaction. In the opinion of one planner, even with the accessible information provided by PCIC, some interpretation is usually still necessary to make it relevant for any given municipality. This task will fall to a member of city staff who has some science literacy, such as an engineer or planner. It would be difficult, for instance, to establish a productive relationship if the primary contact were a politician or administrator, or if there were no primary contact at all. One planner said:

> In terms of the direct relationship with PCIC, there's usually kind of like a point person for each municipality… there's a one-to-one relationship. Then we take that information and translate it into whatever format we then bring to our staff that are helping to develop the plan and implement the plan, which was upwards of 35 staff… For the actual development of the strategy, we consulted with stakeholders… We would take the most relevant information from PCIC and present that to them. The dialogue between PCIC and the city happened through myself and my office, and then we had a dissemination role back out to different stakeholders and staff.

Finally, on both sides of the partnership, it helps for individuals to have a general interest in adaptation. On the science side, an intermediary described PCIC as comprising of "passionate people committed to being useful". On the policy side, one planner remarked that it was "entirely their own initiative" to contact PCIC. The creation of PCIC itself was also heavily dependent on the personal interest of two people working for the provincial government, according to one interviewee. Overall, the influence of individuals has been substantial.

Political will is a broader causal force responsible for some of the partnership's successes as well as some of its failures, and it matters on both sides of the relationship.[6] The interviewed PCIC staff members and provincial civil servant highlighted the importance of the provincial endowment in getting PCIC off the ground, providing it with lasting financial security, and keeping it from becoming too dependent on individual projects. One of them described PCIC as a "public good" which cannot reasonably be expected to arise without government backing. The provision of this funding required that the provincial government have substantial political interest in climate change, at least at one point in time. On the other side of the partnership, all of the interviewed planners noted the existence of considerable political will in their respective municipalities.[7] This is a necessary condition for the formation of a science-policy partnership, as one PCIC staff member illustrated:

> They had, for some reason, within the people who were sitting on council that particular year – they had a lot of buy-in towards climate change. So the city of Prince George, they had a really big flood that happened… So there was this particular incident that kind of sparked the interest and then they were able to get money to go towards hiring us and to do the work that we did and it was a fairly

[6] Recall that political will has been defined as the general interest of decision-makers (perhaps rooted in ideology or public interest). Ideally, political will would respond to the scientific evidence presented through science-policy dialogues, but much of it is independent of this influence (hence the climate science-policy gap), which is why it must be presented as a separate cause from co-productive design.

[7] Such political will is also shaped by the provincial (and federal) context. Recall, for instance, the BC government's Climate Action Charter, mentioned in the background section. These sorts of intergovernmental influences are discussed further through comparison with the other cases in Chapter 7.

> large chunk of money, I think, for a municipality. And then now… there's been a change in government and they're not as interested in it and new people are in power and they have other priorities.

One planner also mentioned that the broader organizational culture of their department, namely its subscription to norms of EBP, had a positive effect. While these influences of political will clearly contribute to the partnership's success, they may also explain some of its limitations. For instance, the challenges of time and capacity mentioned in the above section are caused primarily by the limits of political will. PCIC could be even more effective with further funding from the provincial government, and planners could better engage in the science-policy relationship with more commitment from their municipalities. The importance of political will for any policy issue may seem fairly obvious, but it should be contrasted with partnership design as a competing causal factor.

Another broad causal force of some importance is the occurrence of local events that can be linked to climate change. Two interviewees (one PCIC staff member and one planner) spoke about this in detail. When people see more extreme wildfires, floods, or storms occurring locally, it can motivate them to take the threat of climate change seriously and "believe in it more" (i.e. the long-term and global nature of the broader problem often keeps individuals from becoming engaged). Perhaps the most important event along these lines in BC is the MPB outbreak, as this quote from a planner shows:

> What happened, of course, back in 2001, the pine beetle comes through, and that's what really started – that was one thing, evidence really in our environment around us, that we could see trees turn red and die, that something was up… It was very helpful for us to be able to, to then have the information there to say, when people observe these things – and then they would get the idea that there was a reason for the pine beetle… something to do with a change in climate-related impacts… the pine beetle has affected the economy, that's an ongoing thing so that's a big deal… the pine beetle was a very political opportunity.

These events are also related to some of the other causal factors. They certainly influence political will (see the quote in the previous paragraph), but their effect also depends on the availability of information that can connect them to the broader problem of climate change, as mentioned in the above paragraph on co-productive design. Both of the participants who highlighted such events also credited PCIC's information for "being available at the right time". Politicians and the public might respond inappropriately if no one successfully puts the situation into context for them, as one planner mentioned. Even though these events are largely unpredictable and non-malleable, they are an important causal factor affecting the partnership's level of success.

Finally, the inherent tensions between science and policy (see the section on SPIs in Chapter 2) explain some of the challenges as well, particularly the communication difficulties described in the above section. To begin with, consider this quote from a planner:

> The communication link between the science and the policy-making is just so critical, and is often – I mean we have all these great universities that are doing tons of really good research, and we have lots of well-meaning people in local governments and other jurisdictions that are trying to prepare for climate change, but there's often – and this is in all fields, not just climate planning, for sure – there's often a bridge that's missed.

Science and policy traditionally exist in separate silos, so there is some inertia that limits the pursuit of cooperation between them. This inertia is mitigated by PCIC's very mandate to engage (and norms of EBP in some municipalities), but it still causes problems, as when politicians overreact or underreact to events or research without genuinely consulting the science. Climate change is a particularly complex issue, leading to science-policy tensions around certainty, time-scale, and complexity itself. One planner said that municipalities see climate change as a "can of worms" and so are reluctant to explicitly consider it, and another noted that both on-the-ground staff as well as high-level politicians are concerned primarily with the short term, and may feel

"pulled away" from their "real work" (i.e. only mid-level planning staff have a concrete incentive to take action). The lack of scientific certainty in predicting the future climate can then be used as a reason not to act, even though such uncertainty is considered perfectly acceptable in the realm of science. As argued in the above section, many BC municipalities are generally pursuing adaptation pretty effectively through their partnership with PCIC, but these tensions may explain why more is not being done faster. At least one intermediary thought that all communities could probably be performing better with regards to adaptation and mitigation. On the other hand, one scientist's experience has been uncharacteristic:

> My experience has been quite positive around the level of acceptance from community politicians and staff. I expected more push-back in many cases, but for the most part, I think people are getting it, that this is an issue that we're going to have to pay attention to… or maybe people are just keeping their mouths shut – I don't know.

Still, the general science-policy divide manifests as specific causal factors for this municipal-level partnership, as the literature would predict.

There is a rich interplay of causes that determine the level of success for this climate science-policy relationship. All of them are important, but the interviewees collectively implied that PCIC's user focus is probably the single most important factor. It also links up with other elements of co-productive design, in that it may encourage the organization to foster an atmosphere of individual enthusiasm and have high standards of scientific credibility, such that users can be better served. Political will (on both sides of the partnership) also deserves to be highlighted since, even though it was not emphasized to the same extent at PCIC's user focus, its prerequisite nature means that the other causal factors are largely irrelevant without it. That is, without commitment from the BC provincial government, for instance, PCIC would not exist in its present form and so could not pursue co-productive design or anything else. Political will is

also a very important determinant for the level of policy action. With a description, evaluation, and explanation of the relationship between PCIC and BC municipalities extracted from the interview responses, the final sections of this chapter conduct a synthesis, generating some prescriptive recommendations and revisiting the hypothesis.

Preliminary Prescriptive Recommendations

Identifying some causes of successes and challenges for this partnership facilitates the generation of recommendations for improvement. That is, how can we maximize the causal influences giving rise to successes and minimize those leading to challenges? Recall the concept of malleability from Chapters 1 and 2; some causes are easier to manipulate than others, which is why the primary focus of this dissertation is on co-productive design. It is a relatively malleable cause in comparison to more external factors like events and the actions of other institutions. Accordingly, the simplest recommendations arise from the causal relationships between the partnership's elements of co-productive design and its successes and challenges. Most of the specific suggestions from interviewees were along these lines. However, it is very important to acknowledge the numerous other identified causes, even if they appear less malleable and thus less likely to give rise to useful recommendations for improvement. As such, this bulk of this section discusses some of the concrete design suggestions offered by interviewees, as well as potential limitations thereof. Then, the other causal factors (i.e. those besides co-productive design) are interrogated for additional possible improvements, although these are much more speculative. Further recommendations might be offered by co-production theory, but these will be identified in Chapter 7, after the hypothesis has been thoroughly examined in all three cases.

As discussed in earlier sections, the partnership between PCIC and BC municipalities already embodies many elements of co-productive design, and is already quite successful as a result. As such, interviewees could not identify many areas for potential improvement in its design, but they did nonetheless provide a few recommendations. Collectively, participants suggested that PCIC should develop or update existing accessible tools like Plan2Adapt (so that they remain useful to municipalities after the first stage of adaptation planning); simplify technical language even further (i.e. for tools besides Plan2Adapt, which is already quite accessible); acknowledge that not all municipalities will have a science-literate liaison or champion, and thus provide more support (e.g. one-on-one communication) for those communities; re-allocate funds away from pro-bono work to meet rising demand; and pursue more self-promotion and public outreach. On the policy side, while less of a focus for this case study, at least one interviewee admitted that they should know a lot more about PCIC and how it functions, given its relationship with their municipality.[8] These ideas all came directly from the participants, rather than from my own analysis or extrapolation.

Implementing these various recommendations is not necessarily a simple matter. They have limitations. First of all, there is obviously some tension between the suggestions that PCIC make its accessible tools more sophisticated and make its sophisticated tools more accessible. To some extent, there is always going to be a trade-off between comprehensibility and rigour, so they have to be balanced against one another. However, PCIC appears to have struck this balance already, through its range of tools targeted at a variety of users. Perhaps the only potential improvement in that vein, then, is to ensure users are aware of that range and PCIC staff are

[8] Notably, this interviewee benefited from the interview itself. They said: "Maybe interestingly academically or not, I'm going to go back and read their mission and figure out who funds them and what they're supposed to be doing. Maybe I could get a heck of a lot more from them because they're excellent".

using the right tools for any given project or presentation. In terms of providing a higher level of service, including more one-on-one communication, the organization has limited resources. While funding could hypothetically be re-allocated from pro bono work, this would cause PCIC to lose some of its 'public good' nature, perhaps limiting its ability to engage with smaller municipalities. However, such suggestions do strengthen the case for further funding from higher levels of government. This would depend on political will at those levels, which is not easily manipulated. More self-promotion and public outreach would be beneficial, but is probably precluded by general funding and capacity limitations in a similar fashion. Increasing the general interest from the policy side of the relationship is also likely to depend on less malleable factors like the given individuals involved and political will. Since the shortcomings generally appear to be justifiable, there are no particularly glaring deficiencies in the partnership's design. This makes sense given the overall positive assessment of the partnership by interviewees.

Causal factors other than co-productive design, while less likely to lead to straightforward recommendations (due to lower malleability), have important implications for the partnership. First, they demonstrate that there are some limits to what can be done in improving the relationship and facilitating policy action. Co-productive design may be malleable, but it cannot erase or supplant the importance of other causes. It might be reasonable to conclude that, even though the level of municipal climate action is perhaps less than ideal, there is little more than can be done *in terms of this partnership itself* to address the problem (but I will refrain from endorsing any such conclusion until the hypothesis is revisited in Chapter 7). Second, even these causes can facilitate speculation on potential improvements, either because they do exhibit some malleability or because they are connected to issues of co-production.

So what are the implications of each individual cause that was identified? To begin with, while the partnership may not have the capacity to alleviate the general divide between science and policy, co-productive approaches can mitigate the divide's local effects. For example, perhaps PCIC continuing to provide a range of estimates for its future climate predictions helps municipalities understand that uncertainty is not a reason to delay action. The roles of individual personalities and other institutions are similarly challenging to manipulate, but organizations can seek to recruit enthusiastic people with strong communication skills (or include science-policy liaising in mandates and job descriptions) and can actively pursue partnerships with relevant institutions. Both PCIC and BC municipalities have practiced the former strategy somewhat, but possibly more could be done on the latter. The effects of other institutions have seemed coincidental, rather than purposeful, so there may be room for more active liaising on PCIC's behalf. One PCIC staff member did express a desire to have a more genuine, interactive relationship with BC Hydro, for instance. Of course, PCIC is a relatively new organization, so it is not surprising that many of its institutional partnerships have been initiated by more established bodies like ICLEI.

In terms of the least malleable causes, weather events cannot be controlled, but perhaps policy entrepreneurs (see Kingdon 1984) can plan to take advantage of such events when they occur, promoting contextualizing science and galvanizing action. PCIC may already be doing this passively, as several participants commented on it "being available at the right time". This sort of strategy is tied to the causal factor of political will, which is difficult, but not impossible to influence. Leveraging crisis events is one tactic, but general awareness-building over time, in the absence of such events, is important too (see the paragraph on broader awareness in the section identifying successes and challenges). Co-productive design is not the only causal factor

that can facilitate prescriptive recommendations, then, but even these suggestions are already mostly being pursued by the partnership. Again, this is not surprising, given the current alleged success of the relationship. The real significance of this case may be the example it sets for other science-policy partnerships, which is discussed in Chapter 7 as part of the case comparison.[9]

Summary and Implications

To summarize, the partnership between PCIC and BC municipalities possesses many indicators of co-productive design (i.e. frequent meetings, lasting amicable relationships, information tailored to its audience, feedback solicited, joint projects, informal communication, co-productive mandates) and several indicators of policy action (i.e. plans resulting from meetings, an expanding network, growing awareness, positive responses from participants, a range of policy stages affected, some diffusion of ideas to other jurisdictions). These are summarized in Table 4.1 (on the next page). More importantly, interviewees linked the two together, identifying PCIC's focus on users as the primary cause of success for its municipal relationships. This and other causal explanations can be the basis for suggesting potential improvements, but there appear to be no glaring deficiencies in the partnership design at this point, as evidenced by the positive assessment from interviewees. What does this mean for the hypothesis that this case is supposed to be testing?[10] Overall, the partnership offers it moderate support, given the degree of co-productive design, level of success, and the alleged causal relationship between the two. Once this case is synthesized with the other two in Chapter 7, it

[9] That chapter also results in general recommendations for science-policy partnerships that can be applied back to this case and are perhaps more useful than the suggestions speculated by interviewees here.
[10] Recall the premise: the greater the degree of co-productive design in a science-policy partnership, the more policy action is likely to result.

will serve as evidence of effective co-productive design, demonstrating best practices for other science-policy relationships.

OBSERVED ELEMENTS OF CO-PRODUCTIVE DESIGN	OBSERVED POLICY (AND OTHER) OUTCOMES
-meetings occur and frequently	-action items declared/plans made
-create atmosphere of trust/amicability	-new networks/discourses generated
-presentations tailored to audience	-participants respond positively
-solicits feedback for one group	-many policy stages affected
-participate in the same networks	-diffusion of PCIC service model
-ample (non-meeting) communication	-enhanced learning and awareness
-distribute information to one another	-several side benefits
-dialogue is open to improvement	
-partnerships enduring over time	
-base scientific credibility established	
-policy advice avoided	

Table 4.1 – Summary of Observed Elements of Co-Productive Design and Observed Outcomes in the Partnership between PCIC and BC Municipalities[11]

However, the partnership is not a perfectly ideal implementation of the hypothesis, since some elements of co-productive design were not present, its success had limitations, and many other causes besides co-productive design were also identified to explain the success. Importantly, the relationship between PCIC and BC municipalities appears to be missing a key feature of true co-production: mutual influence. Although there are several mechanisms through which policy-makers can give feedback on the produced science, PCIC actively avoids giving direct policy advice. However, this allegedly allows PCIC to maintain a certain credibility, which is a major factor driving all of its beneficial interaction with communities, and the partnership embodies numerous successes regardless. Perhaps, then, the definition of true co-production

[11] This table should be read in the context of the hypothesis indicators from Chapter 3 (i.e. Table 3.2). It identifies characteristics that appeared in this case, of the many predicted by the general co-production hypothesis. The entries in grey text are important observed characteristics *not* predicted by the hypothesis.

should be considered an essentially unattainable ideal. Or perhaps the hypothesis should have encompassed some other institutional design elements outside of co-production. Indeed, I am not convinced that the major limiting factor of further policy action in this case is that PCIC is not giving direct advice. Also, the assortment of additional causes uncovered in this case reveals the optimism of the hypothesis, tempering its assumption that co-productive design will be the main determinant of policy action in science-policy relationships. All of these issues are addressed in Chapter 7, and this case (in tandem with the others) contributes to a broader understanding regarding how climate science can be translated into policy action.

Chapter 5: The Provincial Case of PICS – Mixed Benefits and Limitations

This chapter covers a provincial-level climate science-policy partnership, between CAS (of the BC government) and PICS. It differs from the municipal case in not only its jurisdictional scope, but also the existence of a particular agency on the policy side and the type of information produced by the science partner (i.e. prescriptive analysis in addition to base data). Ultimately, the partnership serves as an example of 'dialogue' but definitely not 'true co-production' (see Chapter 1), since mutual influence is deliberately restricted. My account begins with a background on climate change in BC, covering influential actors and moments in the related policy history. I draw upon the analytical framework (see Chapter 2) to make some predictions about causal factors that may be important in explaining the partnership's outcomes. The body of the chapter uses interview responses to answer the research questions for this case, identifying elements of co-productive design (descriptive question), assessing the partnership's successes and challenges (evaluative question), determining whether the level of success is due to co-productive design or some other cause (explanatory question), and presenting some potential recommendations for improvement (prescriptive question). I conclude by discussing the implications of this case and the hypothesis for one another, cautioning that the building of new co-production theory (i.e. which is more sophisticated than the hypothesis) must wait until Chapter 7. Overall, I argue that the elements of co-productive design in this case facilitate substantial side benefits but little concrete influence on policy action.

Background

Both the environmental and governmental contexts of BC are important factors in understanding the potential implications of its policy action or inaction on climate change. BC is the only province on the Pacific coast of Canada, hosting a unique combination of coastal, forest, mountain, and northern ecosystems, which provide a diversity of environmental services such as flood control, timber, game, hydropower, scenery, fish, and clean water and air (Government of BC 2014a). As such, climate change will have an impact on the province in a unique variety of ways. For example, decreasing snowfall and earlier seasonal melting times will mean less summer runoff for hydropower and agriculture, storm surges and sea-level rise will exacerbate the risk of flooding for coastal communities, a longer forest fire season could mean increased damage to forest communities and more frequent air quality warnings across the province, and warmer winters could contribute to the wear and tear of roadways because of additional freezing and thawing (ibid). Of particular note is the Mountain Pine Beetle infestation, which has come about due to warmer winters that no longer keep the population in check, and kills off trees with a severity comparable to forest fires (Carroll et al. 2003, Kurz et al. 2008 – see Chapter 4). These regional impacts are in addition to the more generic ones that will affect many jurisdictions, such as increased deaths from heat waves and changes in the growing season. Several of these effects can already be seen in BC, which may provide an impetus for the province to contribute to the global mitigation of greenhouse gases. In terms of adaptation policy, on the other hand, BC will need to consider a variety of climate impacts.

Another contextual factor for climate policy in BC is the influence of Canada's federal government, as well as that of nearby provinces and states. The constitutional division of powers between the federal and provincial governments does not neatly delineate which level should

take primary responsibility for environmental policy. As such, the environment can be considered a shared jurisdiction, which may lead to governments attempting to shift the burden to the other level (White 2010 p. 120). Indeed, the federal government has viewed its role as a facilitator, rather than a leader, of environmental policy (i.e. under the formerly governing Liberal Party), putting soft conditions in place to encourage provincial governments to take action gradually – or it has outright avoided any significant policy action in the area altogether (i.e. recently under the Conservative Party), which puts additional responsibility on the provincial governments to deal with climate change (VanNijnatten and Boardman 2009 p. xviii). Even during its most progressive years on climate policy, the federal government failed to develop a concrete regulatory program or bring the provinces together in a coherent national approach (MacDonald 2009 p. 160). Not only does this lack of federal leadership place undue burden on individual provinces like BC, it may exacerbate the effect of interprovincial conflicts since the provinces are left to coordinate policies on their own (White 2010 p. 95).

Neighbouring regions have a variety of influences on BC's potential for climate policy action. Since climate change has impacts (and causes) that cross regional borders, coordination between governments is necessary to deal with it effectively. Such cooperation is often challenging since, for instance, some provinces are rich in hydropower while others are rich in oil, and it is difficult for them to agree on mitigation strategies (Harrison 2010 p. 522), especially in the absence of federal leadership. There are also instances of regional cooperation and commitments that might work against climate policy action, such as agreements between BC and Alberta on the Northern Gateway Pipeline, a project that would facilitate the additional production of bitumen (i.e. a particularly "dirty" variety of oil) from the Alberta oilsands (see Bailey and Jang 2013). However, there are a few instances of inter-jurisdictional coordination

that may positively affect climate policy in BC. In 2007, BC's premier, Gordon Campbell, cultivated a high-profile relationship with California's Governor, Arnold Schwarzenegger, centred on environmental issues. The two signed a Memorandum of Understanding on greenhouse gas emissions targets and shared a joint enthusiasm for the potential of innovative green technologies (CBC News 2007, Harrison 2012). Around that same time, BC also joined the Western Climate Initiative (WCI), a coalition of Canadian provinces and American states committed to a cap-and-trade program intended to mitigate greenhouse gas emissions (Smith 2010).[1] However, the impact of such measures has dwindled over time. BC no longer has a high-profile relationship with California, and does not appear to have participated meaningfully in the WCI since 2010 (Government of BC 2014b, WCI 2014). Other such partnerships exist (see Government of BC 2014b), but similarly seem to have little impact on BC's climate policy now.

Moving away from contextual factors, the trend of dwindling commitment is mirrored in BC's internal history of policy action on climate change. The two dominant provincial political parties in BC are the Liberal Party and the New Democratic Party (NDP), the former having a centre-right political orientation and the latter having a centre-left one. While the NDP governed throughout the 1990s, the Liberals have been in power since the turn of the millennium, leaving the NDP as the official opposition. Gordon Campbell served as the leader of the Liberal Party and premier of BC until his resignation in 2010, after which Christy Clark took his place and subsequently led the Liberals to another victory in the 2013 provincial election (see Elections BC 2014). BC's recent climate policy history begins with a period of significant leadership under Campbell in 2007 and 2008.

[1] With reference to the previous paragraph, the provinces are evidently capable of cooperating effectively even without federal coordination, but the overall lack of high-level leadership is still a problem.

The province set targets for greenhouse gas emissions reductions, mandated that all government agencies become carbon-neutral, joined the WCI, created CAS, and implemented a carbon tax that would scale up over the next few years (Smith 2010). These initiatives were pursued under the personal direction of Premier Campbell (Harrison 2012), supported by an "aligned" civil service (Dale 2015) and orchestrated through a remarkable process of co-production (not of the science-policy variety). The Cabinet Committee on Climate Action solicited input from all government staff, was open to non-governmental groups (e.g. business and youth), and utilized interdepartmental workshops. Emerging suggestions were evaluated as part of the budget process and became a central priority for government, as evidenced by the initial housing of CAS in the Premier's Office (McDonald 2010). Many scholars identify this period of leadership as a dramatic shift or turning point in BC's climate policy (e.g. Burch 2010, Jones 2012), but momentum has since faded under Premier Clark, political focus shifting to the economy and liquefied natural gas, and further increases to the carbon tax being capped (Hoekstra 2013). Nonetheless, there are still several other major climate policies in effect provincially: a clean electricity standard, building efficiency conditions, the carbon-neutral government requirement, a low carbon fuel standard (Rhodes et al. 2014), and the coordination of municipal action (see Chapter 4, Government of BC 2015a).

One of the most interesting long-term effects of BC's brief period of climate leadership was the provision of a $90 million endowment to the University of Victoria Foundation, meant to support climate-related research in the province. The interest generated annually provides base funding for both PCIC (see Chapter 4) and PICS, but particularly the latter, which has always been funded entirely by this source. Essentially, BC's spike in climate policy action led to the creation of PICS, which has a mission to partner with relevant actors (e.g. governments) in order

to research climate impacts and develop mitigation and adaptation options (PICS 2014a). The organization represents a collaboration among major research universities in the province, hosted and led by the University of Victoria. Most research is conducted not by full-time staff, but through a network of scientists, primarily at the member universities, that are provided funding to conduct and contribute studies (PICS 2015). Its formal staff consists only of two directors (with natural science backgrounds) and a few administrators and coordinators (PICS 2014a). Like PCIC, one of its objectives is to understand climate change impacts, but it also focuses on broader socioeconomic implications, policy and business solutions, and communicating the related issues outside of academia. Its research themes have included resilient ecosystems, forest carbon management, low carbon economy, sustainable communities, and social mobilization (PICS 2014c). The former two seem to embody natural science while the latter three are more social science.[2] As such, PICS conducts climate science (as defined in Chapter 1), but also attends climate policy and management.

Drawing upon this research, the organization publishes briefing notes and white papers (which are accessible to the general public), hosts seminars and forums, and offers short courses for non-academics, among other activities (PICS 2010, PICS 2014c). While the focus of the organization has stayed fairly constant over the years, there has been a recent shift away from the five initial research themes to an even more "policy-relevant" agenda focusing on coal and liquefied natural gas, grid integration, energy efficiency, transportation policy, and forest carbon stewardship (ibid). As such, there are substantial differences between PCIC and PICS. The

[2] The low carbon economy and sustainable communities research themes might be better described as issues of 'management' rather natural science or social science. In my experience, the field of environmental management is ostensibly a social science, but it is often studied by natural scientists who draw on their expertise to inform management decisions. Perhaps it can be considered to lie between natural and social science.

latter's broader focus facilitates more opportunities to provide policy advice to the provincial government, although both organizations engage with both levels of government to some degree.

PICS seeks to "build and maintain strong relationships with the BC government, primarily through the Climate Action Secretariat" (PICS 2014c p. 30). CAS was formed during BC's phase of climate leadership and has a mandate to coordinate climate action across government in view of the province's emission reduction targets. In many respects, it seems to operate as a standard government department or agency, informing higher-level decision-making with research and analysis, and coordinating or supporting relevant government programs. Accordingly, its staff (about 35 people) consists primarily of policy analysts, as well as a few managers and administrators (Government of BC 2015b). It was initially situated within the Office of the Premier, but was moved to the Ministry of the Environment two years later in 2009, signifying a decrease in influence since BC's period of climate leadership (Barrett and MacLeod 2009). In support of its mandate, CAS also engages with stakeholders and supports regional and municipal climate efforts. Most interestingly, it aims to work "with environmental organizations and the scientific community to promote a better understanding of climate change" (Government of BC 2014c). While PICS is not specifically mentioned in this mandate, it is clear that the purposes of these two institutions oblige collaboration with one another.[3] The PICS annual reports indicate that such interaction is quite central to the organization, pointing out that CAS has been involved in workshops on PICS research themes, that the Program Committee and Executive include representatives from CAS, that there is regular communication between the Head of CAS and the Executive Director of PICS, and that PICS events are frequently attended by CAS representatives (PICS 2010, PICS 2014c). Partnership between the two organizations

[3] The purposes almost seem to overlap, which is quite rare for a science organization and a government agency. This not only necessitates partnership, but may very well complicate it.

evidently has been a continual goal since the creation of PICS. As such, this case is suitable for examining potential co-production between climate science and climate policy.

This background information can be supplemented by the dissertation's analytical framework in order to predict what sorts of factors may be important in explaining the partnership's level of success. First, this case shares the same environmental context as the municipal case, so local climate impacts (i.e. external events) may similarly have a potential effect. Activities of other jurisdictions might also be influential. The continuous lack of climate action and coordination at the federal level could either motivate BC to pursue further independent leadership in contrast or could leave provincial decision-makers feeling disconnected from other actors in the collective action problem of mitigation. The latter may be true, since it is quite clear that the general political will for climate leadership in BC has been decreasing. This can preclude action, no matter how much scientific expertise is available (see Kingdon 1984). The type of information produced by PICS may be significant too. Unlike PCIC, it tends to produce analysis (i.e. prescriptive recommendations) instead of base data, which is generally less likely to be seen as useful by policy-makers (see Lindquist 1988). Lastly, it is clear that PICS and CAS desire a strong relationship with one another and interact in a number of ways. This suggests some degree of co-productive design, which the hypothesis predicts will influence policy outcomes.[4] Co-production is my primary interest in this chapter, but causes that potentially compete with it as an explanatory factor for policy action should be identified. I have attempted to do so through preliminary document review, but this is supplemented by the

[4] These various potential causes could be the basis of more sophisticated hypotheses, complementing or refuting the general hypothesis. For example, PICS largely produces external analysis, which is not particularly useful to policy-makers unless they are pursuing a fundamental policy change (see Lindquist 1988), and the BC government's current decision regimes for climate change are clearly *not* 'fundamental' ones, which suggests that PICS analysis is unlikely to be used until there is a change in political will. As argued in Chapter 3, however, the necessary inductive aspect of this study encourages a broader exploration using the general hypothesis. Specific propositions are instead attended in Chapter 7, once all the data has been presented.

expertise of actual participants in the partnership as I discuss the interview results below. I spoke to two staff members from PICS, who represented the science side of the partnership, and five civil servants from CAS, who represented the policy side. Many of the latter participants did not explicitly identify as policy-makers, but they are relevant to the policy process and had sufficient familiarity to discuss the relationship between the two organizations.[5] The remainder of the chapter uses data from these interviews to address the descriptive, evaluative, explanatory, and prescriptive research questions in the context of this provincial-level case.

Elements of Co-Productive Design

PICS and CAS communicate in a wide variety of ways, such that it is somewhat difficult to identify a typical exchange. Certainly, they interact fairly frequently and often involve third parties. Regular communication, according to the interview responses, includes phone calls or lunch meetings between certain representatives at least weekly, presentations given at CAS by PICS researchers on most weeks, and biweekly conference calls among the PICS Program Committee (which includes a representative from CAS). These regular channels, however, belie the more informal, less predictable, and perhaps more substantial engagement that may occur depending on the projects each institution is pursuing at any given moment. For example, CAS will help develop material for the PICS short courses since policy-makers are part of the target audience; PICS publishes several white papers and briefing notes each year, which are meant to be read by CAS and others; CAS staff will ask PICS to contextualize and summarize new academic research on climate change; PICS will seek CAS feedback during its theme review workshops; CAS reports often get reviewed by PICS; the two will occasionally host events (e.g.

[5] As discussed in Chapter 1, both civil servants and high-level decision-makers (e.g. elected politicians) can be considered policy-makers (also see Weiss 1980 p. 399).

seminars) jointly or at least attend those facilitated by the other; and countless other informal emails and phone calls will occur unpredictably between the organizations depending on the needs of individual staff members (i.e. some staff members are more involved with inter-organization communication than others).

Of particular note are the jointly-hosted events,[6] since they often involve other stakeholder, government, and academic groups, which signifies some broader impact. For instance, in October 2013, PICS and CAS coordinated a government briefing on the IPCC 5th Assessment Report, which was attended by representatives from across the provincial government (and included PCIC as a sponsor). In November 2013, they co-sponsored a workshop on emissions data for oil and gas, which involved industry and environmental groups. While highly varied, interaction between PICS and CAS is quite frequent and fairly far-reaching. The focus of this section is the (co-productive) design characteristics intertwined with such interaction. Four major features emerged from the interviews: the overall emphasis on partnership, the shared focus on outreach and presentation, the autonomy of PICS, and the autonomy of CAS.[7]

Both organizations appear to emphasize partnership with the other. Some of this occurs in formal institutional arrangements. For example, representatives from CAS sit on the Executive Committee and Program Committee for PICS, and are involved with its governance. That is, CAS is "at the table" (in the words of one civil servant) when PICS is going through planning

[6] The facilitation for such events is not necessarily a 50/50 split between PICS and CAS. It is common for one organization to be the lead on such a project, while the other plays a support role.

[7] The first two characteristics are noteworthy because they apply to both organizations at the same time. Such observations are a little more complex than the strategies or design characteristics of a single organization (e.g. the features noted through in the description of PCIC in Chapter 4). When important, this chapter attempts to make it clear whether specific details apply to both organizations, only PICS, or only CAS. Recall from Chapter 3 that elements of co-productive design can come from just one of the partners. They do not have to be joint initiatives as long as they potentially facilitate overall co-production.

cycles. Part of the reason for this formal exchange is because, due to the provincial endowment, the government of BC has a vested interest in what PICS is doing. As one CAS staffer said:

> With PICS it works – there are reasons to communicate because of the grant. I think in the absence of something like that, communication has to be set up as part of the relationship, irrespective of what you are communicating about, and that has happened with PICS, somewhat because the institutional terms are there.

In this instance, CAS and PICS are working together in order to ensure the latter is as effective as possible in achieving its purpose. However, the two also have formal ties outside of governance arrangements, in terms of general collaboration. As mentioned above, there are two recent examples, the IPCC briefing and the oil and gas data workshop. For the latter, according to interviewees, PICS and CAS jointly identified the problem of insufficient data informing public debate over emissions from the oil and gas sector. CAS was more familiar with the issue and initiated the workshop process, but PICS ultimately did most of the facilitation. Allegedly, the division of responsibilities for any event like this one will be "ad-hoc" based on the issue-at-hand and the strengths of each organization. Much of the partnership between PICS and CAS is similarly informal, as is evident from the examples in the previous paragraphs. Such informality requires a certain level of "comfort" based on "mutual respect". That is, both organizations clearly value each other and their differences, which leads to a good working relationship. One PICS scientist illustrated this well:

> We had to learn and respect the differences. I don't know that the CAS folks and provincial folks respect the university way of working yet – they're probably more familiar – but we have to up our game and think of ways to interact with practitioners more and engage. And this has happened – we have Ministry people sitting on students' thesis committees. Stuff like that goes a long way.

Phrases like "freely reciprocal", "two-way", "back-and-forth", and "win-win" were used by the interviewees to describe the relationship. An atmosphere of general amicability and valued partnership is a crucial component of co-productive relationships.

As mentioned above, both PICS and CAS have mandates that include outreach to stakeholders, the public, and other groups.[8] This emphasis necessarily includes engagement between science and policy, but interviewees from both sides of the partnership also pointed out their joint responsibility to inform the broader debate on climate-related issues. Such external focus seems to be particularly important to PICS, which not only provides a variety of information to a spectrum of audiences (e.g. public presentations, accessible short courses, policy-oriented white papers, heterogeneous forums), but also seeks to engage potential audiences in the (general) co-production of information. As one PICS scientist mentioned:

> We try to get, what I like to refer to as, practitioners involved in the work. And by practitioner I might mean – if a PhD student is doing research… that they will not just be touching base with a local government or a planner or an environmental engineering company… that they're actively engaged – and that that practitioner would likely be frequently contacted and be a potential receptor of the research or maybe pose the research questions.

That general focus will improve the relationship between PICS and all its potential partners, but its interaction with CAS in particular is most significant in the jointly-hosted events that seek to inform third parties. Through these collaborations, there is a shared acknowledgement that it is important to moderate discussions and presentations effectively, and a recognition that both organizations have people that are skilled at facilitation. Similarly, both institutions are strategic in choosing the right presenters based on the audience and issue-at-hand. An interviewee from CAS summarized this strategy:

> You try to get an event that flows really well. You try to get the right presenters for the audience, to generate the discussion that will meet the goals… This is so dependent on the event. And part of that is making sure you get differences of opinion raised during the presentation so you have the balance [and] part of it is making sure you have people who actually present to an audience.

[8] Recall from the hypothesis indicators that one potential indicator of co-production is "diversity of stakeholders involved". The relevant literature suggests that it improves the interaction between science and policy, even though it is ostensibly a peripheral characteristic (see footnote 5 in Chapter 3).

An example of these tactics from PICS would be the recruitment of a conservative supporter of carbon taxes for a public event, in order to reach a different audience.[9] Finally, both institutions understand the importance of information accessibility, although this is more a priority for PICS, which has a greater role in terms of information provision. One interviewee from PICS mentioned that the short courses have evolved over the years to communicate concepts in a simpler and more engaging fashion. Both PICS and CAS, then, prioritize outreach and effective communication, sometimes to one another (e.g. PICS briefing notes and white papers), and other times to third parties *through* one another.

The other major characteristics of the relationship between CAS and PICS have more to do with the limits of influence each institution has over the other. This may seem to conflict with norms of co-productive design, but, as is explored below, all interviewees admitted that both organizations must retain a high degree of autonomy in order for the relationship to be effective. Still, there is also some very slight tension in the responses. For instance, while one participant from CAS said that the secretariat's input is "fully considered" and there is "definitely uptake" by PICS, one of the interviewed scientists stated:

> We are fully independent. PICS does not, in any way – we do not feel the least bit of pressure or obligation politically to respond… it, in no way, compromises our independence. So if we come up with a result the government will not like to hear, that will not stop us from putting that result out there in front of the public. But I do make sure that everything we do is constructive.

There might seem to be some conflicting opinions here, but many of the CAS staffers recognized the importance of PICS remaining independent and not being seen as controlled by the

[9] The focus of the oil and gas data workshop was also an interesting example of strategic outreach. The issue of oil and gas development is a "pretty hot potato" (as one scientist put it), so building the workshop around data improvement allowed (traditionally opposed) stakeholders to cooperate without clashing as much on prescriptive policy questions (also see Lindquist 1988). Of course, some policy discussion in this context was unavoidable (and perhaps beneficial).

government, even though it has a productive relationship with CAS. Ideally, remaining at arms-length from other societal interests allows academia generate information in the most objective manner possible. At the same time, CAS will have a certain perception of what sort of research would be most useful to the government, which it would like to communicate to PICS. It can do so through some channels (e.g. the planning cycles above), but because PICS is independent, there is no guarantee that such suggestions will be followed. In the words of one interviewee from PICS, the role of CAS is closer to "shaping" than "dictating" (i.e. the provincial government has no access to or control over the endowment). Another example of tension is that one civil servant perceived the shift to five new research themes as partly due to CAS criticism, while a scientist saw it as entirely internally initiated. A different scientist clarified that PICS probably would have made forest carbon (for example) a research priority anyway, but at least the CAS feedback confirmed that the government was interested in the issue as well. These tensions can be barriers as well as opportunities, but everyone seemed to place a similar importance on the autonomy of PICS, seeing it as a prerequisite for effective collaboration.

Similarly, while both organizations value their partnership with the other, there is agreement about the autonomy of CAS as well. A classic understanding of SPIs (i.e. EBP) might see a linear input from science to policy, where the knowledgeable former makes recommendations to be implemented by the latter. Such a perception is not prevalent in this partnership, and is rejected by the policy side in particular, as one civil servant demonstrated:

> PICS isn't there to provide recommendation – we will develop our own recommendations, we will do our own analysis. What PICS can do is give advice on options, so we don't want to be told "this is the policy you should have" – we want to be told "here's a framework on how you might assess five competing policies" or "here are three policy options and you might consider the pros and cons of each". They would do themselves a discredit if they're perceived to be – there's a very fine line between recommending and advocating and if you cross that line, I think you actually compromise the science-policy relationship because

> people are perceived as being advocates rather than neutral evaluators and the strength of that bond, formally and informally, is that government needs to be able to trust the academic community to give unbiased advice.[10]

The PICS scientists seemed to share this understanding of the process, as they mentioned "a sensitivity to being constructive" and "being careful not to let PICS drift into advocacy". Still, every PICS white paper concludes with policy recommendations, and there is a sentiment among the scientists that more government uptake of their advice would be desirable. Clearly, there is a fine line between advice and advocacy that is difficult for a science outreach organization to traverse, and there is probably a trade-off between building trust and having influence, which may ultimately limit the effectiveness of the partnership. According to one CAS staffer:

> I would say [there is no direct channel of influence from PICS], not at this time, because we could have a minister who really really is interested in the science of it and wants to spend more time talking to them about it. I would say our minister at the moment is interested to get the elevator pitch on what PICS has found but isn't necessarily going to sit down and discuss it in-depth with researchers… but it's an input, it's evidence, it's analysis that we can use.

Another civil servant clarified that CAS has "been far more reliant on PICS in a vetting or sniff-test kind of a role, as a *non-dangerous* outsider who could take a first look at something and predict for us how it would go over with a broader audience". The partnership is sensitive to the autonomy of CAS, but it is difficult to classify this as an element of co-productive design. It reinforces the credibility of the science partner and builds trust between the organizations, which facilitates benefits like the "sniff test", but it also appears to limit the potential influence of the partnership. Still, since both sides agree that mutually respected autonomy is the only way the interaction can function, it could count as an element of co-productive design (see Chapter 3).

[10] This quote is an excellent example of how policy-makers prefer scientists to fulfill the role of an 'honest broker' as prescribed by Pielke Jr. (2007).

A general description of the interaction between PICS and CAS makes many co-productive characteristics apparent (e.g. frequent interaction, outreach focus, valuing partnership). However, the major theme identified by interviewees was the balance of influence and autonomy. Both organizations might desire to have more influence over the other, but they mutually understand the relationship as being built on the trust that both partners will respect each other's autonomy and not over-step any boundaries. While this norm could qualify as co-productive design, as discussed above, it may limit the broader impact of the interaction, and the interviewees did occasionally disagree on how much each organization does or should influence the other. As such, the partnership is interactive enough to qualify as a 'dialogue', but is definitely not an example of 'true co-production' (see Chapter 1).[11]

Successes and Challenges

The above section shows that the partnership between PICS and CAS strikes a complex but delicate balance between influence and autonomy, and this is reflected in the general assessment of the partnership given by interviewees. Not surprisingly, the assessment was generally positive, but included some significant skepticism. While the relationship was identified as beneficial, necessary, or important by most participants (e.g. one interviewee from CAS stated that there are "overall many more positives than negatives" and one scientist described it as "extremely positive"), a few were somewhat doubtful that it effectively achieves its goals. One civil servant implied that it meets its goals in some cases but not others, while

[11] However, it is unclear whether the characteristics discussed are really matters of conscious design, since they tend to apply to the partnership as a whole, rather than to just one organization. That is, it is simpler to design an institution than to 'design' a partnership, since there will be more interests and goals to consider, which must be reconciled. This may be an important consideration when it comes to prescribing improvements for, or drawing lessons from, this case.

another went so far as to say that it does not achieve its goals and that they would expect the relationship to be much more useful to them than it is (but admitted that the partnership has other benefits). A few interviewees also noted improvements that have occurred over time, such as movement away from the perception of PICS as a "pre-paid consultancy" or "granting agency" and each group understanding the other's organizational culture better. So the partnership is generally seen as positive, though not overwhelmingly so. Still, this section is about specific successes and challenges, and will explore to what extent the partnership facilitates concrete effects on policy action or scientific research, general awareness of climate change as a problem, other side benefits, and other challenges of communication.

Participants from both the science and policy sides of the partnership identified its impact on policy action as fairly low. Many perceived the relationship as beneficial, but generally could not provide concrete examples of how PICS might have influenced provincial policy. One of the scientists exemplified this nuance well:

> [In] 2010, we talked about BC's energy policy, and in those hay-days, BC was wanting to be a big electricity exporter to California. Some of us were not convinced that that was all that realistic, but we held a forum and we examined the question and tried to raise issues around it – that's no longer the dream of the province. Did the forum change the province's thinking? [It's not clear,] but that's how I see us having influence, in bringing… conversations.

Basically, PICS is thought to have some beneficial influence on policy through the partnership (i.e. civil servants are appreciative of the information it generates), but it is hard to identify exactly what the influence is. PICS interacts with civil servants far more than high-level decision-makers, generating background information to help the former advise the latter, so its policy impact is indirect and unclear, but allegedly important. One CAS staffer pointed out that white papers requested by government will always have a fairly direct influence, as opposed to PICS-initiated reports, but was still unable to provide a concrete example of real impact in that

context. One civil servant saw external assessments of policies as very useful, but was critical of PICS for not providing such information for the carbon tax, stating "it's pretty surprising that you've got to go to Ottawa to get someone assessing the carbon tax in a useful way and that PICS hasn't done really anything in that area – and that seems such an obvious one really".[12] The impact of PICS on climate policy seems to be beneficial overall, but some important effects may be indirect and difficult to measure.

Similarly, the partnership's impact on scientific research seems to be limited and unclear. As noted in the above section, a few of the interviewed civil servants believed that CAS affected the re-prioritization of the PICS research themes and has had continual influence through the forestry theme (recall that CAS is represented on certain PICS committees), which remained after the shift. While the scientists did not necessarily perceive that degree of influence from CAS, one of them observed that CAS probably helps keep PICS focused primarily on BC. Again, there are no particularly notable, agreed-upon examples of the partnership affecting research focus, but it is generally viewed as an important input. The partnership's impact on both science and policy, then, is not concrete, but is perceived as important by most of the respondents most of the time. Their expert judgement should be considered, even if tangible examples could not be identified (see Weiss 1980).[13]

Given that interviewees generally had a favourable impression of the partnership's influence but at the same time did not identify many substantial impacts, it is not surprising that they would observe broader, long-term, indirect effects on sensitivity to, and awareness of,

[12] They were referring to Sustainable Prosperity, a research network at the University of Ottawa which recently produced an assessment of BC's carbon tax.

[13] But there is room for more intense research in this area. For instance, information inputs could be traced through the decision-making processes in both the policy and science realms to determine their real impact.

climate change (i.e. 'soft' policy influences). For example, witness what one civil servant had to say about the jointly-facilitated IPCC briefing for government:

> The effect of that wasn't that somebody went to that workshop and they had a brainstorm and they were like "okay, I get this now, I'm going to go immediately back to my desk and change something" – that didn't happen. But now we have 300 people who wouldn't have paid attention to this report who paid attention to this report. Maybe, a year and a half from now, two years from now, they start working on a new policy, and they remember that there's this thing, climate change, and I've got to be thinking about that so when they start designing something new, they have information at their disposal. What they learn sits with them and they bring it to bear on their work.

So while the impact on CAS itself might not be very concrete, the partnership has the potential to build awareness in government outside of CAS. This is important, as one CAS staffer observed, because in order for CAS to move forward with climate policy action, it needs to get "buy-in" from other ministries, which events like the IPCC briefing can facilitate. All respondents saw that event as a success story. Additionally, the partnership also promotes awareness in broader society outside of government (i.e. the two organizations leverage one another's contacts and collaborate to bolster their outreach initiatives), which benefits both parties. An interviewee from CAS placed importance on social awareness:

> For governments, the wider the group of people who are aware of a particular issue, the research or the findings or the ideas – that always has an impact on policy development. So it's not just the work they do and share with us, but it's the dissemination broadly that's important. And sometimes their weekly scans, their news-scans where they're identifying policy initiatives in other places – there can be the odd specific piece they find that we haven't come across that might lead to something important.

That is, the science-policy interaction does not necessarily have to lead to direct impacts to be considered useful. It can contribute to a broad base of knowledge and awareness, which feeds back into the process as a necessary input. The last part of the quotation is also interesting, as it points out that some of the partnership's impacts are unpredictable and irregular, and would not

occur without an informal rapport. Several other civil servants noted that, while information inputs from PICS might not always be useful at a given point in time, their influence "holds the line" (i.e. encourages the government to stick with climate initiatives that have been implemented so far), maintains forward momentum in the long term, and helps prepare CAS to respond to shifts in the political climate when they occur (see Kingdon 1984). In short, the partnership facilitates external exploration (see Lindquist 2009).[14] Overall, even if CAS itself does not always immediately make use of the continual flow of information from PICS, it is important for a channel between the two organizations to be open, because it facilitates awareness-building in other areas of government (e.g. the IPCC workshop) and society as well as maximizes the chance of concrete impacts from the partnership, even though they are rare in the short term.

Aside from its impact on research direction or policy action, the partnership embodies several side benefits for both parties. First, PICS has greater access to government data (e.g. from climate and weather monitoring stations) and knowledgeable practitioners through the partnership. Academia is not the only source of raw information and expertise, so organizations like PICS can supplement their research with information from government. Perhaps more importantly, the "insider information" that comes from a positive relationship with CAS can assist PICS with outreach and messaging, as one scientist observed:

> Political winds change, so we pick up on that – we have to read the political tealeaves. And because we are so committed to trying to help, we need to get insight from CAS as to which direction the political winds are going at the present time and where they might be next week. So they kind of help us with that. [The CAS head] and I will talk often and he'll say "here's where things are going from

[14] This is especially important given the relocation of CAS from the Premier's Office to the Ministry of the Environment, which may signal government emphasis on institutional exploitation or leanness (specifically, lower interest in climate change). In this situation, the partnership with PICS provides crucial external capacity, preserving opportunities for learning and innovation that likely would not be available to a leaner CAS on its own.

> the inside view in politics" and that helps me to frame our research and we try to use the language that the politicians will understand best in putting things in front of them that we would suggest would be an appropriate pathway for BC to follow.

With a mandate to engage in outreach and have some influence on climate policy, PICS benefits from ongoing partnership with an organization that can provide feedback or give advice on the effectiveness of its message.

Second, CAS benefits from the partnership in several ways as well. PICS allegedly has more financial freedom than CAS, so it can contribute resources to joint projects like workshops, which allows the latter to pursue some initiatives it might not otherwise be able to. As well, since PICS has greater access to current research and academic literature, CAS staffers enjoy some indirect access to information they might not otherwise be able to get, or can at least acquire that information more efficiently. The most substantial side-benefit, as implied by many interviewees from CAS, is the "convening power" of PICS. Consider this quotation from a civil servant:

> Another observation I would make about PICS is that they have a convening power. They can bring people together. They can bring academics, and local governments, and federal government, and provincial government, and stakeholders… whereas if we're convening something, it's the regulator convening… if they're the convenors, they have more of a neutral stance and that means we can come as participants in the same way that other people come as participants and that means the dialogue is slightly different.

Basically, there is an optical advantage to having PICS recruit stakeholders to the table for any given event (e.g. the oil and gas workshop), since they will tend to be seen as more objective and credible than a government agency.[15] Finally, both organizations mutually benefit from the placement of PICS co-op students with CAS. Collectively, the side benefits appear more tangible than any effects on research or policy direction, and they are likely a major reason for why interviewees see the relationship as so positive, despite few examples of concrete influence.

[15] Also recall the "sniff test" function discussed in the above section. It is another side benefit for CAS.

While the major challenge with the partnership between PICS and CAS is that its impact (in terms of affecting policy action or research focus) is limited, there are a few other challenges of communication as well. For example, given the emphasized autonomy of each organization, the partnership sometimes seems uncoordinated. As one representative of CAS indicated:

> There's the core staff at PICS and then there's people at all the different universities and then there's the academics who are leading up the themes. So for a specific academic somewhere down that chain to be aware of something that PICS and CAS is planning – we've had instances of not knowing that we've both scheduled something similar in the same week and that kind of thing.

There was a sentiment coming from at least one of the civil servants that, while academic autonomy is very important, the government endowment had "remarkably few strings attached" and that if there had been a bit more direction to begin with, perhaps coordination would be simpler. However, I suspect the scientists would respond that such a trade-off is not worthwhile. Indeed, another challenge is the occasional tension in each organization's view of the partnership (including how each perceives the other's view). One scientist implied that there is still work to be done in moving away from a perception of PICS as a "pre-paid consultancy" and one CAS staffer was concerned that PICS might see the partnership as more of a "platform" than it effectively is. Having interviewed people from both sides, I do not believe either concern is a problem.[16] Everyone seems to have the same general view of the partnership and respects the other organization's autonomy. However, the existence of these impressions means that communication could stand to be more open and trusting.

A few other shortcomings were identified collectively by the respondents: PICS would benefit from greater connection to industry; CAS could know more about the structure and operations of PICS; and a broader interaction between the PICS community (i.e. not just the few

[16] Especially since tension within partnerships can drive policy learning (see Lindquist 1993 p. 573).

liaisons) and the government community that works in related areas (i.e. not just CAS) would benefit everyone. These missed opportunities also demonstrate communication challenges that should be addressed. Many interviewees also observed a rift between government and academic cultures, but this is more of a broad cause of communication problems than an inherent problem in itself, and so is addressed in the next section.

In summary, interviewees assessed the partnership of PICS and CAS as embodying many successes and several challenges. They mostly saw the partnership as positive, but this may be due to the significant side benefits (e.g. data access, convening power) rather than the partnership achieving its implicit goal of impact on policy and research direction, which is difficult to measure and appears to be happening indirectly at best. Still, respondents on both sides were confident in their identification of broader benefits in terms of awareness, availability, and ongoing (friendly) pressure. There are a few communication challenges (e.g. lack of coordination, tensions in perception), but these do not seem to undermine the benefits that were identified. As such, it is reasonable to conclude that the partnership is moderately successful overall, although its general impact (e.g. regarding policy action) is substantially limited, or at least very difficult to measure, and merits attention in the following section.

Important Causes of the Level of Success

This section explicitly links the two prior ones, focusing on the potential relationship between elements of co-productive design and policy action, to test the dissertation's general hypothesis. Interviewees were specifically asked to consider the links between the design characteristics and successes or challenges they had identified. However, because the methodology of this research is a combination of induction and deduction, cause-effect

relationships outside of the hypothesis were explored as well. That is, the interview questions also encouraged participants to think about other potential causes, besides co-productive design characteristics, for the partnership's successes and challenges. Such an approach provides a more complete explanation of what is going on in the case, so that any findings regarding co-productive design can be situated within the broader causal context (i.e. the analytical framework in Chapter 2). As a result, this section discusses an array of potential causal factors contributing to (or limiting) the success of the PICS-CAS partnership, in sequence: co-productive design, other aspects of institutional design, political will, individuals, and local effects of the general science-policy divide.[17]

As noted above, there are no particularly concrete examples of climate policy action resulting from the partnership, but rather, the more interesting alleged effect is the subtle, long-term, ongoing pressure that keeps climate change on the agenda for stakeholders and raises awareness. The co-productive emphasis on partnership and outreach assures that the relevant channels, both between PICS and CAS and between those organizations and other stakeholders, remain open. At least one interviewee explicitly identified the partnership's focus on engagement, networking, and collaboration as a key success factor, and others generally implied the same. This includes the informality and flexibility of the relationship, which some participants described as "helpful" or "good". However, at least one other noted that such informality can also be the cause of some of the broader communication challenges (e.g. lack of

[17] With reference to the predictions made in the background section, the themes emerging here have added the influence of individuals and the science-policy divide (these would have been difficult to predict or determine through document review alone). The interviewees did not give much attention to external events or other jurisdictions, although the latter merit some discussion in Chapter 7, due to its focus on multi-level governance. As for the type of information being produced by PICS (i.e. analysis instead of data), while participants did not spend much time explicitly discussing its influence, it seems to be an underlying cause of the 'mutual autonomy' consideration, and thus is covered by the paragraph on co-productive design. It is also a factor in the discussion on the science-policy divide.

coordination – see the above section). The open and informal partnership, then, leads primarily to successes, but also comes with a few challenges. Similarly, another aspect of co-productive design, the mutual respect for each organization's autonomy, has a mixture of effects. On the one hand, it enhances the credibility of both partners, which in turn allows them to reach out to other stakeholders. For example, PICS would not have the same 'convening power' if NGOs and industry groups saw it as a government subsidiary. As one CAS staffer said, "this is precisely why it's important that government is not directive to PICS – otherwise industry does not see PICS as an independent research group and therefore the value's lost". On the other hand, at least one interviewee noted that the sensitivity around autonomy can also make it difficult for the organizations to give feedback to one another, which may be part of the reason for why concrete effects on policy action or research priorities appear to be so rare.

Many elements of co-productive design for this case, then, appear to come with trade-offs. Perhaps more importantly, a common theme among the responses in this part of the interviews was skepticism that co-productive design could really make a difference in terms of concrete progress. One civil servant stated that "very little can be done structurally to make it happen" while another provided a more detailed response:

> No amount of facts or evidence is going to convince a government that's not – even a government that has been a leader in the past and is kind of on pause – you're not going to convince them with an academic paper. So I think the willingness is the first necessary condition, unless it was some kind of body that could be set up around a co-benefit that the government did care about that could then show them how climate fit in… There's the long-term horizon problem with government, but all the things government does care about like their deficits, and risk management, and health, and communities are all things that are intimately woven with climate.

Despite some skepticism, the latter part of this quote demonstrates that there may yet be hope for co-productive design to facilitate concrete influences. One scientist talked about how PICS tries

to frame its recommendations in terms of economic or social benefits, and explained that the open relationship with CAS provides the 'insider information' they need in order to do that (see the above section). Overall, though, the current co-productive design of the PICS-CAS partnership primarily leads to soft influences and side benefits.

The partnership's design also includes an important aspect that is not directly related to co-production: the endowment funding. This ensures that PICS can conduct research independently without having to worry about securing financial support through contracts or renewed government funding, which would have an effect on its research priorities and perceived independence. While the endowment came from the government, it was a one-time disbursement with "no strings attached" (as a CAS staffer noted), which keeps PICS at "arms-length" from the government (as a PICS scientist noted). One civil servant explained the importance of the endowment being a permanent commitment; in order to truly ensure the independence of PICS, there can be no provision for it to be retracted or reallocated to some other purpose. Some of the benefits from the mutual autonomy of the partnership (e.g. credibility), then, are rooted in the initial funding structure. In addition, recall one interviewee's statement that "there are reasons to communicate because of the grant" from the descriptive section. They elaborated that the grant facilitates regular conversations and a formal commitment in the medium and long term that is not overbearing. Some of partnership's emphasis on collaboration and general openness, then, may have been initiated by the endowment itself.[18] The unique funding structure of PICS has a significant (primarily positive) influence, helping to

[18] At the same time, many of the interviewees from CAS questioned its structure, wondering if there should have been more guidelines and limitations, or whether it would have been better to require that PICS slowly spend the endowment rather than simply operate on its interest, in order to "front-load" more of the research so that it might have a higher impact (i.e. be more usable for CAS). However, these were simply musings, and were not directly tied to any identified successes or challenges.

facilitate side benefits (e.g. convening power from perceived neutrality), although it would have required substantial political will from the government to begin with.

The interviewees seemed to collectively identify political will as the most important cause of climate policy action.[19] Not only is this demonstrated by the skeptical view of co-production in the above block-quote, but also by the history of climate policy in BC and general perceptions of political culture and processes. Both civil servants and scientists described BC's recent period of climate leadership as starting with political momentum, which was followed by the establishment of both PICS and CAS. The two organizations are thought to help maintain some of the forward momentum, but they cannot be considered the driving force of climate leadership, since they were created later (i.e. they are more of an effect than a cause of the active period). One civil servant even clarified that there has always been some informal interaction between the BC government and scientific or academic organizations (e.g. with PCIC's precursor organization), which demonstrates that the province may have had a particular political culture that was conducive to science-policy partnership.

Political will continues to be an important causal force even now, as the "maintenance of forward momentum" that PICS and CAS are allegedly involved with still seems to be very much predicated on political interest. One civil servant explained that the government is essentially in control of how much science will flow into the policy process:

> There's two basic forms of policy development – there's top-down, there's bottom-up… Each government, even within its mandate, will move back-and-forth between the two versions. When a government is new in its mandate, it will tend to do a lot more on the top-down, and then over time it will move more to the bottom-up, and it's on the bottom-up pieces, unless the government is extremely

[19] Recall from Chapter 1 that this term essentially refers to the given interest (in a particular issue) of those with decision-making power, often based on another external cause: public opinion. In parallel, perhaps 'scientific will' is the most important cause of changes in research priorities, but the emphasis in this chapter is more on policy outcomes than scientific ones.

> extremely strong on a file, it's on the bottom-up pieces where an organization like PICS has more relevance.

So PICS can be influential, but really only if the government wants it to be. Many interviewees from CAS commented that political needs, desires, and preferences seem to be the primary motivators of policy at the moment, rather than PICS or other academic partners. Science flows into the policy process more through civil servants than directly through politicians, and appears to be more relevant for minor questions of implementation than major questions of the political agenda, since the latter require a spike in political will and thus are rarer. This situation does not reflect ideal co-productive exchange between science and policy, but the reality is that the government has the authority and mandate to make the most important decisions. Still, the interviewees pointed out an important indirect channel of scientific influence. Witness the remarks of a respondent from PICS:

> I don't blame the politicians ever. I'd like to say politicians are just a reflection of us – we vote them in – we more or less know what we're going to be getting when we vote them in. And so one of the things that we take very seriously here is to get the information out there in the public realm so that the public will start to ask questions of the politicians or send them letters and say "hey, why aren't you doing this?" – and I really think that it's important for the public to start speaking up more.

A civil servant added that "we all need the broader public to be informed about things and that will actually make it easier to get the policies that we want". So two major observations were made about political will. First, it was the main cause of the partnership's creation. Second, it continues to be a primary determinant of climate action, with the PICS-CAS partnership only having 'soft' influences on it and on policy outcomes directly.

The above-mentioned political will is closely tied to the influence of individuals. BC's momentum during the climate action 'spike' came largely from the initiative of the premier at the time, Gordon Campbell. One interviewee from CAS stated that "it started with clear political

leadership from Gordon Campbell – let's be honest – it started with that political leadership, and without that political leadership, nothing would have happened, PICS wouldn't have happened".[20] This is a very important causal force for understanding climate action in BC, but the influence of individuals also matters greatly for the function of the PICS-CAS partnership specifically. Many interviewees credited individual relationships and personalities as a key factor in their generally positive assessments, in creating an atmosphere of trust and flexible informality, and in leading to a beneficial tension that is "friendly but critical". Several CAS staffers pointed out that the personality of the current executive director of PICS is important to the functioning of the partnership.[21] For example:

> [Communication is part of the relationship] with PICS, somewhat because the institutional terms are there and somewhat, to be honest, because of the personality of the particular executive director that they have… I do have a concern, especially over time, that the relationship could break down quite easily – not in a bad way, just that you get that distance that grows – just because the institutional mechanisms are not super strong and really it's the personalities involved that make it work.

The latter part of this quote hints that it might be possible to improve things through institutional mechanisms, but at least one other respondent was skeptical that it would make a difference:

> I think the dialogue works, at the moment, largely because of individuals and individual relationships. I think that the influence and the effectiveness of PICS will vary according to the individuals involved and according to the needs, desires, preferences of the political environment. So I think that there is very little you can do, structurally, to actually make it happen.

This perspective is important, as damning as it may seem for the hypothesis. After conducting the interviews, I believe that the executive director of PICS, for instance, may have a much

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[20] Harrison (2012, p. 389) argues that a number of factors contributed to the premier's sudden enthusiasm: witnessing air pollution on a trip to China, growing public pressure, the birth of his first grandchild, increasing climate impacts in BC, and Schwarzenegger's example. The most interesting factor is that on his Christmas vacation in 2006, he read a number of books on climate change. In that way, science may have influenced political will, although PICS was not involved.

[21] At the time of this final writing, PICS has just shifted to new executive director. My research was completed in the context of the director who served from 2009 to 2015.

greater influence on the general direction of the organization (i.e. its research priorities, the way it targets government audiences, its broader messaging to the public) than any set-out institutional mandate, though this is not to say that such direction could *not* be part of a hypothetical expanded mandate. Individuals are an important factor in the partnership's success, even though they are not a part of co-productive design.

Finally, interviewees on both sides of the partnership discussed the importance of the inherent divide between science and policy, and its specific manifestations between PICS and CAS.[22] Nearly every respondent pointed to a mismatch in timing as one barrier to greater influence. That is, academic science focuses on longer-term priorities with projects that may take many years to complete, while policy-making happens on a shorter time-scale, with the focus changing from day to day. When an academic project gets completed, it may no longer be relevant to the policy agenda, even if it was at the outset. Similarly, the chaotic, short-term priorities of a given government may not be interesting to an academic institution with long-term research interests. This quote from a civil servant illustrates the mismatch well:

> One of the problems with government is that it doesn't always happen in a structured, regimented fashion – sometimes something becomes important and then we deal with it, so one of the challenges, as we alluded to earlier, is timing. It is by chance if a PICS report comes out that coincides with a policy development piece – so often times, there is a disconnect in timing between when a report is produced and when it might be relevant, and it may not be relevant at all, for years to come.

Because this conflict between time-frames exists, the real influence of PICS on policy action is limited to situations where completed research *happens* to match a certain interest on the political agenda, which appear to be rare, especially since PICS tends to produce prescriptive

[22] This is different than the causal factor explored in Chapter 4. There, interviewees were discussing the broader problem and how it might be affecting the relationship between PCIC and municipalities. Here, comments were focused on specific science-policy tensions particular to the PICS-CAS dialogue.

analysis instead of base data (see Lindquist 1988). It does not occur in the linear fashion that might be idealized by scientists, where research findings have a strong influence on political priorities no matter when they emerge. But this result is not surprising given the contemporary theory on public policy (see Chapter 2). The way that one CAS staffer described the process matched the chaotic reality predicted by the literature (e.g. see Kingdon 1984):

> It's really hard to find something that has not been either implemented, or at least seriously thought through, by a lot of folks all over the place. And so it's more about getting the window to move. Everyone knows – all we're trying to do is move the dial – and so you look for a window in city transportation and you've got that window and maybe on that day it's a clean energy vehicle incentive that's going to get through the door, whereas there might have been other [initiatives] that would have got through the door on a different day… So it really is about coalition-building and opportunity-finding more than it is about evidence.[23]

In this situation, it might seem that there is little an organization like PICS can do to influence the causal factors leading to policy action.

However, the partnership does attempt to address the gap in a few important ways. The continuation of its very existence and its "maintenance of forward momentum" makes it more likely that the crucial factors will align when a 'policy window' does open (a rare event), and then PICS research may be able to influence the choice of action. One scientist pointed out that Alberta does not have a comparable science-policy interaction, which meant that its flood in 2013 could not immediately be put into the broader context of the provincial climate and its contemporary changes (i.e. a 'policy window' opened, but was not exploited). They also explained that PICS is trying to "swim upstream" against the traditional way of doing things in academia, by valuing pragmatic outputs of student projects instead of merely journal publications. A civil servant added that the co-op program is also a departure from traditional

[23] This quote is an excellent example of the difference between civil servants and high-level decision-makers. Although both are ostensibly policy-makers, the former looks for opportunities to influence the latter (just like scientists try to influence both of them). Such opportunities, or windows, arise unpredictably based on political will.

academia. These could be the first steps in bringing the time-frames closer together. The science-policy divide, then, is a limitation on the potential influence of the partnership, but in this case there already exist some interesting initiatives that are trying to bridge it (which reflect a co-productive approach), mitigating its causal influence.[24]

In terms of policy action, then, the causal factors that affect the success of this partnership are numerous. They are not independent but rather overlap with one another. The nature of the science-policy divide in this case makes political will a limiting element, increases in political will are often facilitated by individual leaders, the existence of PICS (along with its endowment structure) and CAS required a certain level of political will, and many co-productive elements are due to the endowment (which facilitates independence). As such, all of these causes are important, although the elements of co-productive design seem to have little noticeable effect on policy action without the more crucial requirement of ongoing political will. However, when it comes to successes outside of policy action (e.g. side benefits like data access and convening power), co-productive design is quite important, though it is hardly the only cause. Individuals, as well as the pre-existing endowment and political will, play an important role there as well. Having described, evaluated, and explained the interaction between PICS and CAS, this chapter concludes by synthesizing the presented information into prescriptive suggestions.

Preliminary Prescriptive Recommendations

Understanding causal factors for the PICS-CAS relationship's level of success is the first step in making substantiated recommendations for bolstering that success. Significant changes to

[24] Even though the science-policy divide seems to constrain the partnership's potential to influence policy, the differences between the two realms can also be beneficial. As discussed above, PICS and CAS having different priorities facilitates external institutional exploration and more comprehensive collective knowledge (see Lindquist 2009).

any of the causes discussed should, in turn, alter the impact of the partnership. Only some of them, like co-productive design, are malleable (see Chapters 1 and 2) and can be altered deliberately. As such, the most straightforward suggestions are those that apply to the partnership's design, whether they seek to address its co-productive potential, its general function, or its capacity to attend the science-policy divide. The interviewees made several recommendations along these lines. However, the non-malleable factors (i.e. the external conditions from the analytical framework), such as political will and individual personalities, must be acknowledged, especially since, in this case, they seem to be much more influential than the malleable factors. They may constrain the potential influence of changes in design characteristics or may have minor malleable aspects themselves. Thus, this section considers two things: first, specific suggestions stated or implied by the interviewees for improving the partnership (which necessarily refer to the malleable factors), and second, the implications of important non-malleable factors. Discussion of the latter topic is a bit more provisional, since it is not supported by interview evidence, and it should be considered a precursor to the more rigorous analysis that occurs in Chapter 7, based on collective data from the three cases.

In terms of malleable causes, interviewees made many direct suggestions for improving the partnership. Some referred to the partnership itself, some were targeted at PICS specifically, and some concerned the larger network of stakeholders around the partnership (see Table 5.1 on the next page for a summary). For the most part, these ideas were suggested by a single interviewee each and do not represent any sort of consensus among the participants. Although all of the ideas generated are ostensibly malleable possibilities, some are more practical than others. For instance, it is too late to change anything about the endowment structure or the general

SUGGESTIONS FOR THE PARTNERSHIP ITSELF
-protect itself from weakening due to turnover (appoint official liaisons at each organization) -a broader meet-and-greet between government and academia, coordinated by CAS and PICS -greater number of frank conversations between the two organizations -more connections between CAS and individual PICS researchers (not just through directors)
POTENTIAL CHANGES TO PICS THAT MIGHT IMPROVE THE PARTNERSHIP
-a provision for fast-tracking certain academic projects to address the time lag -co-op program could be expanded to other stakeholders, such as local governments -shift more focus from planning to delivery -stay on top of relevant opportunities, such as evaluating BC's carbon tax -keep CAS staffers 'in the loop' for the new research priorities -pursue stronger ties with industry groups -provide information on economic tools for adaptation -increased ability for government to shape the operation of PICS -bounds around the endowment (e.g. provisions to use the principal instead of just the interest)
SUGGESTIONS FOR THE BROADER COMMUNITY
-continue moving away from perception of PICS as pre-paid consultancy or granting agency -civil servants could be better educated about the structure and processes of PICS -academics need to be careful not to cross the line into advocacy -academics should see practitioners as a crucial source of expert knowledge -academics could place more value on directed research

Table 5.1 – List of Interviewee Suggestions for Improving the PICS-CAS Partnership

authority held by the government over it and PICS.[25] Similarly, the suggestions directed at the broader community are not really under the control of PICS or CAS. For instance, there is nothing more that can obviously and immediately be done by either organization to change general perceptions in academia (i.e. PICS is already "swimming upstream" on this issue – see the above section). Most of the potential changes for PICS and the partnership itself, however, are issues of institutional design that could conceivably be altered by the two organizations (i.e. roughly the top half of the table). Even so, many of the suggestions for PICS, largely provided by interviewees representing CAS, appear to take the form of criticisms and thus might not see agreement from both sides of the partnership, especially given the emphasis on mutual

[25] These suggestions were usually phrased in the past tense (e.g. "it might *have been* better if…"). As well, even if the endowment structure could be altered, its current form keeps government at arms-length from PICS, which facilitates many benefits, as discussed above.

autonomy. Only the ideas about fast-tracking projects and expanding the co-op program come across as friendly pieces of advice that might see uptake. The suggestions for the partnership itself are probably the most useful, since they concern malleable characteristics of institutional design and avoid the controversy of targeting only one side of the relationship. Interestingly, they are all matters of co-productive design, even though they came from the interviewees and not the hypothesis. There are, then, a few interesting potential improvements for the PICS-CAS partnership (not that it is clear which organization should pursue them), but it is difficult to imagine that they would have a major impact on the policy relevance or general success of the partnership, given the more important causal factors that have been identified.

What about implications of the non-malleable factors, then? First, political will is a vital cause, but is extremely difficult for the partnership organizations (and anyone who is not themselves a high-level decision-maker) to manipulate. Rather, the most appropriate course of action is to anticipate and prepare for 'open policy windows'. The previous section illustrated that both PICS and CAS are already aware of this. More broadly, it may be possible to facilitate 'soft' influences on political will, indirectly and over the long term, by promoting broader awareness. Again, both organizations are already making an effort in this regard, with their twin focuses on outreach. Second, the effect of individuals is similarly difficult to manipulate. Gordon Campbell's climate leadership, for instance, was not something that could be orchestrated, but rather simply happened. In terms of politicians, this science-policy partnership can really only play the same 'waiting game' as it does for political will in general. However, the individuals involved in the organizations themselves were also identified as a positive influence. Although individual personalities are not something that can be 'designed', one of the interviewee suggestions was to avoid turnover problems with a stronger institutional commitment to open

partnership (e.g. in written job duties). The identified importance of these less malleable factors, then, offers some very important general lessons about the limitations of scientific influence, but since PICS and CAS are generally already aware of them, no particularly new courses of action are implied for the case.

There is one other prescriptive lesson that should be considered, independent of the specific interview responses; perhaps this partnership would function better if PICS emphasized data instead of analysis (see Lindquist 1988). The immediate problem is that there would then be too much overlap between PICS and PCIC. Because PICS incorporates social science and concentrates on prescriptive analysis, it is able to pursue a very different mandate, which includes educating the broader public. As well, CAS civil servants do seem to see some value in external advice being made available (e.g. decision frameworks for assessing competing policies, as mentioned in the section on elements of co-productive design), even if they do not concretely make use of it very often. Finally, although prescriptive analysis might get used less often than base data, it may well have a greater impact when it *does* get used. If a policy recommendation from PICS were followed, that would be a more significant and specific influence than a piece of data being used in policy-making. So even this predicted causal factor, based on the analytical framework, cannot offer a substantiated suggestion for the case. Overall, while the PICS-CAS partnership has a low level of policy impact, there appear to be no significant opportunities for improvement in its overall design at this point. Anticipate that the broader lessons synthesized in Chapter 7 will be more instructive.

Summary and Implications

This chapter has attempted to address the study's research questions, in the context of a provincial-level case of climate science-policy partnership, using interview data. Regarding the descriptive question, it is clear that the PICS-CAS relationship embodies several elements of co-productive design (e.g. frequent meetings, a diversity of participants, joint projects). The partnership endures due to a mutual respect for autonomy, but this characteristic may preclude further co-productive initiatives. Regarding the evaluative question, the partnership faces a few communication challenges (e.g. minor tensions between the two organizations) and ultimately has low policy influence, but offers significant side benefits (e.g. insider information and convening power) and may have indirect or long-term impacts on policy. These observed characteristics are summarized in Table 5.2. With regard to the explanatory question, the elements of co-productive design are the primary cause of the side benefits, while policy outcomes are best explained by the less malleable factors of political will and individuals. With

OBSERVED ELEMENTS OF CO-PRODUCTIVE DESIGN	OBSERVED POLICY (AND OTHER) OUTCOMES
-meetings occur and frequently	-minor examples of action
-diversity of stakeholders involved	-new networks/discourses generated
-create atmosphere of trust/amicability	-participants respond positively
-facilitation shared (and trained)	-enhanced learning and awareness
-presentations tailored to audience	-many side benefits
-participate in the same networks	
-joint projects	
-ample (non-meeting) communication	
-distribute information to one another	
-partnerships enduring over time	
-mutual influence restricted	

Table 5.2 – Summary of Observed Elements of Co-Productive Design and Observed Outcomes in the Partnership between PICS and CAS[26]

[26] Like Table 4.1, this table should be read in the context of the hypothesis indicators. Again, the entries in grey text are important characteristics that were observed but *not* predicted by the hypothesis.

regard to the prescriptive question, since the most important causes of policy influence are not malleable, no substantial recommendations can be made. Participants suggested some minor changes to co-productive design, but these would likely only affect the side benefits of the partnership. Overall, the partnership between PICS and CAS is an example of co-productive design leading to side benefits, rather than policy change. Ostensibly, it does not support the general hypothesis.

The implications of this case for the hypothesis merit further discussion, however. To begin with, while the partnership does not appear to facilitate any concrete policy influences, it is difficult to estimate the impact of the alleged 'soft' influences on broader awareness. Similarly, the importance of preparing for 'policy windows' cannot really be determined until a major political opportunity arises and is successfully (or unsuccessfully) exploited with entrepreneurial strategies (see Kingdon 1984). So the policy influence of the partnership seems low, but it may have great potential. If so, this case would provide more support for the hypothesis. As for co-productive design, although PICS and CAS exhibit many elements of it, the partnership does not qualify as an example of 'true co-production' since the mutual respect for autonomy precludes genuine mutual influence (it is, however, interactive enough to count as a 'dialogue' – see Chapter 1). Although this autonomy is allegedly a vital factor in the relationship's stability, a greater degree of co-productive design could theoretically have been attained. The hypothesis might imply that such an ideal would have to be pursued in order for significant policy changes to emerge. Since the premise is that more co-productive design means more policy influence, it is not surprising that this case of 'moderate' co-productive design would lead to 'moderate' policy influences. Interpreted in this manner, the PICS-CAS case supports the hypothesis. However, this is an overly generous interpretation. There are other causal factors at play in this

case (e.g. political will), such that a simple and direct relationship between co-productive design and policy influence is an unrealistic expectation. These factors would have to be acknowledged by sophisticated theory about co-production and policy outcomes (i.e. a refined version of the hypothesis). Perhaps such theory would also be able to offer better prescriptive suggestions than "pursue more elements of co-productive design" for overcoming the tension between PICS and CAS that prevents the sharing and receiving of feedback. These are the sorts of concerns that are attended in Chapter 7.

Chapter 6: The National Case of CFCAS – Failure plus Potential

The case discussed in this chapter is the relationship between CFCAS, now known as CCF (the Canadian Climate Forum), and the federal government of Canada. Since it is a national-level case, it may be particularly relevant to the driving question of this dissertation, regarding Canada's inaction on climate change. In comparison to the other two cases, however, it essentially serves as an example of *attempted* partnership,[1] since interest from the policy side has been low, resulting in very limited success. The chapter begins with background on the effects of climate change across Canada, a survey of international and provincial influences, a brief history of national climate policy action (or lack thereof), and an outline of how CFCAS has factored in to the national situation. I use the background to make some predictions about what factors will be important for understanding the relationship's outcomes, based on the analytical framework (see Chapter 2). The body of the chapter addresses the dissertation's research questions, using data from interviews with experts on the relationship between CFCAS and the federal government. One section is devoted to each of the relevant questions (i.e. the descriptive, evaluative, explanatory, and prescriptive questions). At the end, I directly examine some implications of this case for the general co-production hypothesis, acknowledging that a thorough assessment must involve a comparative analysis of the three cases, to occur in Chapter 7. Throughout the chapter, I argue that, while this case includes some attempts at co-productive design by the science side, it can only be considered a 'basic partnership' during its most

[1] Throughout this chapter, I often use the term 'partnership' to refer to the case, even though it may be too generous a label.

functional years, and currently qualifies as merely 'incidental interaction' (see the definitions in Chapter 1), due to shortcomings on the policy side.

Background

Canada's physical environment is an important contextual factor for national climate policy action. The large continental land mass and northern location facilitate a naturally variable climate, which contributes to high energy use for both heating and cooling. Low population density leads to long travel times and high demand for freight transportation, which similarly cause increased greenhouse gas emissions. As well, natural resources associated with emissions, such as oil and gas, are plentiful, and a significant portion of the economy is based on their extraction (see GC 2014a p. 3).[2] These characteristics may give Canada's governments some incentive to resist climate change mitigation. For example, Prime Minister Stephen Harper has promoted the country as an "energy superpower", based on private development and low government regulation of the Alberta oilsands (Way 2011).[3] However, the potential effects of climate change on Canada's environment may provide an opposing incentive, or at least an impetus for adaptation. In addition to the international impacts experienced by all countries (e.g. increasing air and ocean temperatures, rising average sea level, widespread melting of snow and ice), the country may face the following: thawing permafrost, risk to livelihoods of northern indigenous peoples, controversy over Artic resources and security, lower quality and quantity of ice roads, constrained winter recreation, decreasing water levels in the Great Lakes, drought risk to farm income, and loss of forests due to pests and wildfires (EC 2015, GC 2014a, NRTEE

[2] See Chapter 1 for a contextual discussion of Canada's emissions in comparison to other countries.
[3] The fact that the oilsands are located in Alberta is also important, since the province is a base of support for Stephen Harper's political party, the federal Conservatives (e.g. his current parliamentary seat is in Calgary, Alberta's largest city).

2010). In fact, northern Canada has warmed 2.5 times as fast as the global average since 1940 (GC 2014a p. 10). These impacts will also have important economic implications (see NRTEE 2011), so adaptation to climate change and the reduction of greenhouse gas emissions should be central political concerns for the country.

The federal government does not act in a vacuum, though; the behaviour of other governments matters greatly. International pressure from the IPCC and the challenges of global collective action have already been discussed in Chapter 1. In that context, Canada has been criticized for lack of action at several UN climate change conferences (VanNijnatten and Boardman 2009 p. xiv) and is now facing potential trade pressures from the EU, which has led domestic industry to call for oil and gas regulation so that it will have 'social license' to sell outside the country (Chung 2014a). The federal government has often blamed its own inaction on that of the neighbouring US, but now that even the US has made concrete commitments to emission reductions (i.e. 26% below 2005 levels by 2025), this excuse has become much less applicable (CBC News 2014a), if it were even legitimate to begin with (i.e. it has been characterized as "historical revisionism of a brazen kind" – see White 2010 p. 122). International influence seems to be pushing the Canadian federal government largely *towards* taking action, though it has not had much impact yet.

Provincial governments, on the other hand, have had a much stronger influence over time. Canada's federal system, already discussed in Chapter 2, can lead to blame-shifting for inaction (McGregor 2015, White 2010 p. 120) or credit-stealing for action (see McDiarmid 2014). It also means that any concrete national approach appears to require agreement between the federal government and all of the provincial governments (MacDonald 2009), or can at least be framed that way as another excuse for federal inaction. In Canada, climate change "has

become a political football… [raising] all of the regional and continental aspirations and conflicts that have plagued the Canadian federation since 1867" (White 2010 pp. 95-96). Although negotiations have taken place (i.e. over implementing the Kyoto Protocol), the surrounding institutions have never been strong enough to keep parties at the table; Quebec, Alberta, Ontario, and the federal government have all, at various times, refused to abide by agreed-upon outcomes (MacDonald 2009 p. 161). Alberta, in particular, has acted as a 'veto state', lobbying against the 1990 Green Plan, protesting the Kyoto Accord signing in 1997, leading provincial resistance to its ratification in 2002, and generally refusing to regulate its own oil and gas sectors, instead pushing the ineffective solution of voluntary action (ibid p. 159).[4] The relationships between Canada's governments, then, have generally been a barrier to progressive climate policy, although provinces have started to take independent action in recent years (e.g. carbon pricing is being pursued in some form by BC, Quebec, Alberta, and Ontario).

Shaped by these contextual influences, Canada's climate policy history is generally characterized by a lack of genuine action, even though the federal government has been under the control of different political parties over the past few decades. As a major political issue, climate change first received global attention in the late 1980s. At the time, Canada's federal government was under majority control of the Progressive Conservative (i.e. PC) Party of Prime Minister Brian Mulroney. In 1993, the Liberal Party formed a majority government, with Jean Chrétien as Prime Minister. This lasted until 2003-2004, when Paul Martin became the leader and an election reduced the party to a minority government. In 2006, another election shifted minority control to the Conservative Party of Canada (i.e. a merger of the PCs and the other major conservative party) under Prime Minister Stephen Harper. Later, the election of 2011 gave

[4] Things may change, however, under the newly elected NDP government in the province.

them majority control (Parliament of Canada 2015).[5] There was some climate action under the Mulroney PCs, who put forward a national Green Plan with climate provisions (MacDonald 2009 p. 159), but climate change was still a relatively new political issue at the time, and little lasting progress was made before the government changed. As discussed in Chapter 1, the Liberals took symbolic action but made no concrete changes to actual policy, and the Harper Conservatives have done even less, which is particularly problematic, since the scientific case for climate action has only gotten stronger over the past decade. Overall, Canada's successive federal governments have not been willing to set ambitious goals or use stringent regulation to reduce greenhouse gas emissions (VanNijnatten and Boardman 2009 p. ix, Winfield 2009 p. 59).

Despite this history, Stephen Harper's government has attempted to portray itself as taking appropriate steps. It describes itself as "committed to addressing greenhouse gas emissions while keeping the Canadian economy strong" and supports this claim with the evidence that, since 2005, emissions have decreased by about 5% while the economy has grown by about 10% (EC 2015). These numbers are neither sufficient to meet the IPCC's recommendations nor necessarily the result of federal action alone. Routine improvements in technology, exogenous economic forces (see IEA 2012 p. 7), and provincial initiatives have a substantial impact on emissions and growth. Regarding the latter, the federal government has allegedly taken credit for phasing out coal plants in Ontario, which was a regional initiative (McDiarmid 2014). Numbers do not, by themselves, prove that federal action has been appropriate. What matters is the existence of actual policy initiatives. The main instrument used by the Harper Conservatives is a "sector-by-sector regulatory approach" (see GC 2014a). However, these directives are incomplete (e.g. promised regulations for the oil and gas sector are

[5] At the time of this final writing, a recent federal election has awarded majority control back to the Liberals under Prime Minister Justin Trudeau. Again, my research took place during the prior period under the Conservatives.

three years late – Chung 2014a) and weak (e.g. some do not come into effect for several years).[6] Perhaps the most important indicator of the government's disinterest is its strategic defunding of climate science and muzzling of government scientists, already discussed in Chapter 1. This has resulted in an anti-Conservative campaign from a union of public servants (see Huffington Post 2014) and coordinated criticism from foreign scientists (see Chung 2014b, Nature 2012). Despite the other negative influences on Canada's climate action (e.g. weak federal-provincial institutions), the primary problem appears to be deliberate disinterest under the Harper Conservatives.[7]

It seems that the recommendations of scientists (e.g. the IPCC) have gone unheeded by the federal government. The above discussion provides some explanation for the perpetual lack of concrete action, but a more direct exploration of the science-policy gap would be valuable. The institution most salient to such an investigation is CFCAS (now known as CCF). CFCAS was founded in 2000, funded by a $60 million grant from the Government of Canada (i.e. under the Liberals) with a goal to "strengthen Canada's scientific capacity to address climate and atmospheric science priorities" including providing the scientific basis for "policies to address the consequences of extreme weather, climate change, and air quality" (CFCAS 2001 p. 3). Its main function was to provide grants for climate science research at universities (ibid p. 7), but it would eventually focus on some outreach activities as well, such as online press conferences and webinars (see CFCAS 2012 p. 15). The organization was supported by about five administrative staff and a board of about ten trustees, consisting primarily of researchers from various Canadian universities (ibid p. 7).

[6] In fairness, allegedly there also has been an investment of $10 billion in green technology and infrastructure since 2006 (see GC 2014a).

[7] Even the Liberal Party, which has just won this year's election, seems to prefer more of a non-interventionist approach that relies primarily on provincial action (see McGregor 2015).

In 2004, CFCAS received a second grant of $50 million from the Government of Canada (i.e. also under the Liberals), which allowed it to remain in operation until 2012 (ibid p. 33). Representatives met with the House of Commons Finance Committee twice in 2011 to make the case for further funding, but the federal government's support (i.e. under the Conservatives) was ultimately not renewed (ibid p. 21). As such, CFCAS ceased being a granting institution. However, it transformed into CCF, with a renewed mandate to "accelerate the uptake of weather and climate science by Canada's key decision makers" as a "science-to-policy organization" (CCF 2013 pp. 2-4).[8] It has since emphasized outreach and collaboration by hosting symposia, developing issue papers, issuing press releases, producing briefs for the federal government (CCF 2105a), and meeting with other levels of government and non-government entities, including industry (e.g. the energy and finance sectors) and First Nations (CCF 2014b, pp. 2-6).[9] Overall, the organization has always given some attention to science-policy influence, but it became a notable priority after the transition.

Given the existence of this organization and its mandate, it has presumably interacted with the federal government during the past many years that climate change has been an issue. However, skepticism about the degree of interaction would be reasonable, since the government's action has been very limited. It is difficult to find specific accounts of interaction between CFCAS and the federal government, though there are a few. For example, the organization was designed to have three representatives from the government on its board of directors (CFCAS 2001 p. 4), but these positions were left vacant in the later years of CFCAS. The meetings with the House of Commons Finance Committee, mentioned above, were used as

[8] The staff was also essentially reduced to just a single executive director, although the board of directors was basically retained in the same form.

[9] There appears to be a movement from basic research (i.e. data collection) under CFCAS to more prescriptive analysis under CCF (see Lindquist 1988). In this sense, CFCAS is roughly comparable to PCIC and CCF to PICS.

an opportunity to highlight the issue of climate change, albeit unsuccessfully (CFCAS 2012 p. 4). A recent federal government report on climate change specifically refers to CFCAS in a list of research initiatives, but only as a granting agency (GC 2014a p. 171). Other than that, relevant documents only contain general indications of interaction. For instance, there are generic government commitments to "developing the science" (see EC 2015) and "building the knowledge foundation" (GC 2014a) for climate change decision-making. If there are few actual examples of such allegedly important partnership, is this simply political posturing? The relationship between CFCAS and the federal government merits further investigation. Clearly, it is not an exemplary case of co-production, but there seem to be some attempts at co-productive design by the science side, and perhaps lessons can be extracted about the conditions necessary for science-policy engagement. This "partnership" is likely the best example that exists at the national level anyway, given the federal government's disinterest.[10]

Before turning to interview data for a more thorough depiction of the case, it would be prudent to first return to the analytical framework (see Chapter 2) and make some predictions. What factors does this background suggest may be important for explaining the policy outcomes of this case? First, the environmental (and economic) threats of climate change, as well as the related international pressure, have not motivated federal action yet, so there is little reason to expect that they will be important factors in the relationship between CFCAS and the federal government. It is similarly difficult to speculate on the importance of the type of information produced by CFCAS, since the government appears uninterested in any external scientific inputs at all. The most important causal factor is almost certainly political will, including the governing

[10] Recall the explanation in Chapter 3 for why the National Roundtable on the Environment and the Economy (NRTEE) was not chosen. Also, although its funding was similarly discontinued by the Conservatives, it ceased to exist in any form afterward, which would make it more difficult to investigate.

style of the Harper Conservatives, their defense of the oilsands in the heartland of their support, and a general ideology of economic non-intervention. This is likely to hamper any efforts at climate science-policy co-production. Also, complications with the federal system and the posturing of provincial governments could mean that federal-provincial relationships are a greater determining factor than science-policy relationships. However, since many provinces are now taking more significant action than the federal government, this may be less of a problem than it once was.

In light of such seemingly crucial political factors, any co-productive design attempted by CFCAS probably will have little effect on policy outcomes. Perhaps minor influences or side benefits may result, though, even without genuine interest from the policy side. Co-productive design might also have facilitated some more substantial successes under the Liberal government, when political will was a bit higher.[11] Investigating these complex concerns requires the expertise of those who are involved with the relationship. On the science side, I talked with three scientists from the CFCAS/CCF board. In comparison, I was only able to recruit people *peripherally* related to the policy side, which is perhaps unsurprising given the political reality discussed above. I interviewed two former civil servants that could speak to channels of information feeding into the policy process (one natural scientist and one social scientist), and one former politician who was active during some of the political history explored above. All of them were familiar with CFCAS. The remainder of the chapter discusses their responses, following the same basic structure as the research questions and the interview questions (i.e. describe, evaluate, explain, prescribe).

[11] As in the other case chapters, sophisticated causal propositions based on all these predicted factors can be imagined, but at this point it is more appropriate to instead investigate the general hypothesis.

Elements of Co-Productive Design

As discussed above, despite the mandate of CFCAS/CCF and the purported importance of climate science to the federal government, interaction between the two appears to be quite rare, especially since the change in government in 2006. It is difficult to identify what a typical interaction would be. Still, the most salient example might be the three positions on the CFCAS board of directors that were intended for government representatives (e.g. Assistant Deputy Ministers, usually scientists themselves). When the government was active in keeping these positions filled, there was a direct channel between CFCAS climate scientists and federal climate policy-makers, since the board would meet on a monthly basis. In theory, scientists would have been able to discuss priorities and messaging with people of some influence in the government, and policy-makers would have been more familiar with the climate research being conducted, with an opportunity to provide input on the research agenda as well. Other than this bridge, interaction would typically have been indirect. For example, CFCAS/CCF hosts about one conference or workshop a year and participates in many others, to which representatives of government are also often invited, perhaps resulting in the exchange of knowledge. As evidenced by these limited opportunities for interaction, the elements of co-productive design involved are generally one-sided, tending to be efforts of CFCAS/CCF rather than the federal government. From the interviews, three themes of co-productive design emerged: some limited focus on direct policy influence, emphasis on outreach and presentation, and science-science collaboration.

Most importantly, CFCAS embodied a few institutional mechanisms that seem specifically designed to increase the organization's policy relevance. A central example of this is its basic mandate, which an interviewee summarized well:

> It was not specifically set up as a policy shop, but I wanted it to be connected to policy… We wrote into the terms of references for the foundation, when it was established, that it would consult with the Minister of Environment Canada at least annually, and the minister would feed back or discuss with us, after consultation with the cabinet minister's colleagues as to what were the priorities of the government for climate science and weather-related science. We also put into the terms of reference that the board of directors for the foundation would be 12 people, of which 6 would were academics – there was to be 3 members of the board of directors, not appointed by the Minister of Environment Canada, but based on the nominations of the minister.

There were initially some formal ties between the two partners. This facilitated occasional informal interaction as well. For example, CFCAS would invite the Minister of Environment Canada to attend and present at all meetings of its parent organization, the Canadian Meteorological and Oceanographic Society (CMOS), though they usually did not come. It also sent annual reports to the Minister, and would tend to receive a response during the early years, but generally not after the change in government. As evidenced by the above quotation, CFCAS was not really meant to provide policy advice but (as another interviewee mentioned) also did not necessarily see it as something to be avoided. It is difficult to speak about the implications of climate change without implying certain recommendations for policy action. After the transition from CFCAS to CCF, however, the organization more explicitly embraced the goal of influencing policy and political discourse. Witness the comments of one participant:

> The important thing of CFCAS[/CCF] is to generate interest and understanding in climate and weather problems and to bring these to the attention of government, both government scientists and, of course, government officials. And we're hoping that the meeting we're having next April in Ottawa – that we'll get a good attendance from government people. So I guess you could say we're not out there setting policy, but to provide evidence and knowledge available, which can be used for policy development.

CCF has an increased focus on science-policy co-production, but interest from the policy side has waned, and was arguably low to being with. Even under the Liberal government, CFCAS was only able to meet directly with ADMs, rather than elected politicians (i.e. regular

communication with the Minister seems to have been more symbolic than influential); as one interviewee said, "their actual investment in that was really not that high". However, respondents were definitely in agreement that political interest was much lower under the Conservative government. Basically, the partnership was set up with a few co-productive mechanisms, but the policy side went from low interest to no interest. At the same time, the science side was only incidentally interested in policy influence at first, and once it started to become more of a priority, many of the channels to government had closed. As such, some attention was given to direct mechanisms for science-policy influence by both sides, but it was ultimately quite limited.

Besides specific influence, a number of factors have allowed CFCAS/CCF to pursue a mandate of general outreach, to government as well as industry and the general public, about climate change and climate science.[12] Firstly, some of the non-government members of the board have had experience with the federal civil service and are familiar with strategies for effectively communicating policy advice to politicians (e.g. that they prefer 'big-picture' framing). This capacity was bolstered by the (fleeting) presence of government representatives on the board, who could advise the CFCAS scientists on how to present information to government decision-makers in an acceptable and understandable way (e.g. being more cautious when the information contradicted the government's current ideological stance). As well, CFCAS/CCF members have occasionally attended workshops on how to communicate science effectively and have consulted communications experts from media agencies (e.g. learning to focus more on impacts than the basic science). The organization has attempted to leverage this communication capacity with outreach to a wide-ranging network of groups. Having a strong relationship with CMOS connects it to a broad community of climate scientists. The private sector, NGOs, the general

[12] Recall from Chapter 3 that broader outreach can count as a characteristic of co-productive design (i.e. "diversity of stakeholders involved"), even though it does not address a direct connection between science and policy.

public, and the government have all been intended audiences for CFCAS communiques. As one representative of the organization stated:

> CFCAS did help sponsor – yes so we did, actually, we did have meetings, because I remember one of the last ones was on water as a resource – I do remember that was in Ottawa – that was about 2, 3 years ago. So that was toward the end of the days of CFCAS. So we didn't have a lot of public meetings, but we definitely had one on water resources and that was an important one… It was open to everybody and we even had a few Members of Parliament come. Because usually what would happen was it was always the Opposition that comes.

As mentioned above, CCF has a renewed focus on dissemination to an even broader audience and building a more diverse network. For example, a scientist from CFCAS/CCF described the shift that started to occur at the end of the CFCAS mandate:

> We gave out our last million about two years ago now, I guess, and we basically gave them out as communication grants. We sent a note to all the people who received money from us and said "you've received money from us – give us proposals on how you would communicate the things you've found" – that kind of thing. So, get some short reports, prepare videos – we actually funded people to prepare videos appropriate for public audiences.

So the organization is aware of the importance of effective messaging and has tried to maintain a network that includes non-science groups (e.g. the board has often included members from the private sector), but these objectives are much more central under CCF than they were under CFCAS. However, as CCF has much less of a relationship with government than CFCAS did, it is hard to say whether that capacity can really be exploited.

Since the direct connections between CFCAS/CCF and the federal government have been very minor, indirect mechanisms are important, such as collaboration within the science community during the CFCAS years. Science-science interaction, as opposed to the science-policy variety, can theoretically be an important part of co-productive design (i.e. based on a broad interpretation of the "diversity of stakeholders involved" characteristic from Chapter 3), especially if interdisciplinary and deliberative. CFCAS benefited from being embedded in a

network of scientists through CMOS, which allowed it to have a different approach to funding research than traditional federal funding agencies (e.g. NSERC). If several groups were to request funding for the same sort of project, the general approach of CFCAS would be to get those applicants to form a network around a single collaborative proposal, instead of simply picking one of the initial applications, perhaps resulting in better research (which could hypothetically inform policy). This general emphasis on collaboration also affected the interaction between government and non-government scientists. The government representatives on the board of directors facilitated productive relationships between CFCAS and the scientists of government agencies such as Environment Canada, the Department of Fisheries and Oceans, Natural Resources Canada, Agriculture and Agri-Food Canada, and Health Canada. One government scientist gave a good example of this:

> Both government and university scientists are involved in developing these tools. When CFCAS was running, often the university scientists were using Environment Canada's climate model on Environment Canada's computer, so there was in essence a community modelling capability in a community computing facility. All of the technology was being developed on those machines, so it was easy for that technology to be transferred and to be used. So some of the things that were produced – we have a seasonal forecasting system in Canada – that was developed, in large part, through a joint academic-government effort… There's lots of examples that you could point out.

Another interviewee also noted that there was very little conflict between government and non-government members on the board, probably since the former also had science backgrounds and shared a similar mode of thinking. Finally, CFCAS recognized the importance of interdisciplinary scientific collaboration for an issue as complex as climate change. One representative said: "We tried to, where it would make sense, to link across, so that you didn't have somebody doing only climate change, somebody else only air pollution, somebody else only extreme weather – they're not separate issues". As another stated:

> I think one of the things that – the policy directions that were put into play – was very much looking at the interactions of the scientific investigation, so it's the interaction between, for example, the oceans and the atmosphere, as opposed to looking at one or the other… that struck me as being something that was more prevalent in the latter part of the CFCAS mandate than it was in the initial part… if we're talking about the Liberal government.

This quotation makes it particularly clear that interdisciplinary interaction within the science community may have had spillover effects on the science-policy relationship. For example, perhaps the holistic and interdisciplinary nature of the research is more palatable, and possibly the relationship with government scientists could be a channel to broader government relationships. So science-science collaboration was emphasized even in the early days of CFCAS, and appears to qualify as an element of co-productive design.

The relationship between CFCAS/CCF and the federal government has had some potential for productive and influential interaction at certain times, and certainly embodies a few elements of co-productive design, though they are primarily efforts of the science side. CFCAS/CCF has set up regular channels for communication with the government, emphasized outreach and presentation, and maintained effective science-science collaboration. However, except for the initial funding commitment from the government, political interest has generally been too low (under both the Liberals and the Conservatives) for such potential to be effectively realized. In essence, a key ingredient for co-production, mutual interest in the relationship, is missing. As such, this case qualifies as only a 'basic partnership' under the Liberals and merely 'incidental interaction' under the Conservatives. Using it to examine the hypothesis directly will thus be difficult. Nevertheless, exploring this relationship can still demonstrate the importance of initial mutual interest and may suggest important strategies for science organizations to pursue when the other side of the potential partnership is not willing to engage (undoubtedly a very common situation for environmental controversies).

Successes and Challenges

Given the low degree of interaction between CFCAS/CCF and the federal government, it is unlikely that the policy communication goals of the former have been meaningfully achieved. That is not to say that the organization as a whole is necessarily unsuccessful; it has had other goals such as facilitating climate research and engaging the public. In this regard, the interviewed representatives of CFCAS/CCF had a few good things to say about the partnership, but they were not particularly positive on the whole. Some perceived that the relationship had little influence on government decision-making to begin with while others expressed disappointment in the declining interest of the federal government over time. The collective response was lukewarm. There are four specific themes worth exploring to characterize this evaluation in more detail: influence on concrete policy action, broader effects on general awareness, side successes and challenges, and coordination issues.

In terms of concretely affecting government action on climate change, CFCAS/CCF representatives were quite skeptical regarding the level of influence even during the most functional years of the partnership. For example, one said that they could not "recall any noticeable change" and another suggested that there was "not a lot of influence". Furthermore, in the rare instances where there was some uptake, respondents observed that "it usually would have been an indirect effect" and was often "a philosophical influence with no real follow-through". These comments provide a generic characterization of the low level of influence, but the comments of interviewees on the policy side of the partnership clarify the specifics. Witness these remarks from an ex-politician and a former government scientist, respectively:

> We weren't discussing any papers put forward by any organization on the science… generally they were negotiating meetings, not lecture meetings… I've said the science didn't really matter very much, but you always had to talk about the latest science because everybody else had read about the latest science in the

> headlines, newspapers – so you could never really say "well, we don't have to discuss that anymore" – you have to say "well, there's been some interesting new science" but fundamentally, you're just going through the conversational mode.
>
> At the time, we [Environment Canada] didn't have a capability that said that you could consider certain policy action and turn that policy action into changes in emissions… there are other parts of Environment Canada where there's expertise on the economic implications of climate policy, for example, so those groups might have had more influence on decisions that were taken under the Kyoto process. I wasn't aware that there was a great deal of opportunity or great deal of direct input from climate scientists.

These quotations illustrate the surprisingly limited role of general scientific inputs in the climate policy process, which implies that CFCAS, as well, had little observable influence. Interestingly, these pessimistic accounts from the policy side of the partnership are both in the context of the Liberal government, which the CFCAS/CCF representatives reported to be more engaging. They were able to identify a few very minor examples of potential influence from that period. First, there was perhaps a shift in the government's perspective towards looking a climate issues more holistically (e.g. considering the ocean and atmosphere together – see the quotation in the above section). Second, one interviewee from CFCAS/CCF pointed out that a drought study done a few years ago may have led to new government recommendations for farmers about which crops to plant, but they were unsure. These exceptions are quite insubstantial, though, so the influence on concrete climate policy action was ultimately very low under the Liberals, and essentially nil under the Conservatives.

The effect of the partnership may have been greater in terms of raising broader awareness, but such an indirect and vague impact is even more difficult to assess accurately. For example, consider the cautious remarks of one former civil servant:

> For climate, it's a bit more difficult, because they're [climate scientists] providing information that is certainly used on an everyday basis in Canada, but it's not information that changes very quickly. It has an indirect feed into policy primarily, rather than a direct feed, in the sense that it contributes to the body of

> knowledge that's available, and capability that's available globally to support things like the IPCC report… it's more of an indirect feed in sustaining the flow of information that's required so that policy analysts have reliable information that they can use to advise up the line.

They added that any scientific knowledge feeding into the Kyoto targets and mechanisms under the Liberals would not have come directly from CFCAS (or even Environment Canada), but rather from the broader body of knowledge, to which organizations like CFCAS, Environment Canada, and the IPCC *may* have contributed. It is apparent that the produced science is important to the policy process, and perhaps needs to exist in some form or another (e.g. CFCAS or IPCC) as a necessary precondition to climate policy, but it is not clear precisely *how* important it is or through what exact mechanisms it might be influential. Still, no interviewee was willing to dismiss the importance of the science altogether. Participants from the policy side made comments such as "you cannot always be sure of how much science you are going to need", "it is important that the relevant information be available to Canadians" (even if not being used at a given point in time), and "you can never have the population too convinced". A former politician clarified the indirect influence of science on the policy process:

> I hope I was not too negative about the role of the scientific advisors. They were, of course, coming up with some very interesting research, but from a policy point of view the government had a strong case for action by the Toronto conference of 1988. That situation did not change, although perhaps the urgency became more obvious as time went by and new scientific work was completed.

These comments from policy experts are very interesting when considered alongside those of the CFCAS/CCF scientists. The latter identified a few additional examples of effects on awareness, namely, a symposium on water (facilitated by the organization), which garnered substantial uptake in the media, and the regular briefings of senior civil servants that sat on the board (as discussed in the above section). Despite the seemingly direct link provided by the partnership

between CFCAS and the federal government (i.e. the composition of the board), then, the more substantial influence apparently occurred indirectly, independent of the relationship.

However, influence on policy action and climate awareness is not the only important factor in evaluating CFCAS/CCF's interaction with the federal government. There are also some peripheral successes and challenges. For instance, government representatives on the board could assist scientists with their messaging strategies, as discussed above, which was beneficial, since it could improve subsequent communication with other audiences too. Another success that has already been touched upon is the research collaboration between government and university scientists, which has led to more effective modelling tools and also, as one interviewee observed, allowed some of the former to become quite prominent in the field, since they were working with leading academics and publishing "some very fine papers". However, there are at least two major side challenges related to the relationship between the government and CFCAS/CCF. Firstly, support for university-focused organizations like CFCAS appears to have come at the cost of the government's internal research capacity. The 1990s recession prompted the federal government (under the Liberals) to curtail funding for research, both within and outside the government. When the economy recovered, support was restored for the latter but not the former. Comments from a CFCAS/CCF representative summarize the problem:

> They created CFI [Canadian Foundation for Innovation], they created the Canada Research Chair, they pumped money into NSERC, and they eventually put money into CFCAS – all this to build up the university community. But there was no money put into the government science community, and we had no science councils… So what I said to the [Finance] Minister is "it's really good that you're funding universities, I'm not objecting to that at all, I'm an academic" – at the time – but I said "the reality is you have greatly diminished your internal research capacity, and there are no science-policy mechanisms in Canada that seem to function, that will allow you to take the benefit of all this research you're funding in universities, in a formal way".

This is exacerbated by the defunding of climate research under the Conservatives. Secondly, funding for CFCAS (and similar organizations) existed for several years and then was terminated, which has caused some disruptive effects. Government funding for CFCAS went from nearly $10 million a year (CCF 2015b) to nothing at all when its mandate expired. Another interviewee from CFCAS/CCF illustrated the damaging effects on the research community:

> Once you get a sustained funding group, of course, you develop an appetite for good research, good money, support for research – and when it's taken away, it's a) very discouraging, but b) it's also resulted in a loss to Canada, because some very good scientists – we had Canadian-born and bred scientists – have left the country because of a lack of support for research. I know one outstanding researcher who went to England, another outstanding researcher who went to Australia. So we've lost some good people because of the cuts in funding.

This sentiment was elaborated by another respondent, who spoke to a general feeling of discouragement across the scientific community (i.e. in government, academia, and the private sector). If decision-makers do not show interest in the policy-relevant research being produced, the motivation to produce such research (even if it has other implications unrelated to policy) will falter. The CFCAS partnership, then, is tied to broader challenges with the interfaces between science and policy in Canada.

There are several broader problems with the general coordination between climate science and climate policy in Canada, which affect the functionality of CFCAS/CCF. The most permanent of these issues is the general lack of appropriate 'translation mechanisms' for facilitating scientific inputs into the policy process, touched upon in the quotation on the above page.[13] One respondent added:

> There isn't quite the specific mechanisms out there to bring the rather diverse and multiple players together – there are organizations out there that are trying to do similar things, and I think one of the challenges will be to find mechanisms so that

[13] The very relationship between CFCAS/CCF and the federal government could theoretically be an interesting exception to this, which is why it has been the focus of this case study. However, as discussed above, even it seems to embody more challenges than successes, which points to a systemic problem.

> we effectively collaborate on getting the message out, as opposed to either duplicating the message or having conflicting messages out there.

There is a particularly salient example of this lack of coordination, which one former civil servant spoke to at length. An organization called the Canadian Institute for Climate Studies (CICS) existed at the University of Victoria from 1993 to 2006.[14] It was similar to CFCAS in that it had a national mandate to further understanding of the climate system and was charged with managing a network of climate researchers (CICS 2006). However, its ties to the federal government were a little more direct. Some of the research was explicitly meant to improve one of Environment Canada's climate models and one of its chairs was specifically chosen to increase its policy relevance (i.e. they were a social scientist). In the end, the organization never really succeeded in meeting the policy part of its mandate and (perhaps related to this) the government basically chose to fund CFCAS instead, and "a lot of people associated with CICS were very disappointed in that". In addition, attempted collaborations between the two organizations apparently did not work out. While it is not surprising that two organizations with similar mandates would compete for federal funding, it is interesting that the government was unable to coordinate their efforts more effectively, given that it was supporting both of them (e.g. perhaps they could have been combined in some manner).

A more recent failing of the federal government (i.e. under the Conservatives), at least in terms of the science-policy engagement, is the alleged 'muzzling' of government scientists.[15] While discussed elsewhere in this dissertation (e.g. see Chapter 1), the specific effects of

[14] It was the precursor to PCIC (see Chapter 4), interestingly enough. Without CICS, PCIC never would have emerged. Without PCIC, British Columbia would never have been interested in providing the endowment to PCIC and PICS (as one interviewee argued). So the initial injection of federal funding into CICS had a very important long-term effect, even if support was later shifted toward CFCAS.

[15] I included this as part of the general theme on coordination challenges, but given its deliberate nature and severe effects, describing it as simply a 'coordination issue' is probably an understatement.

muzzling on the influence of CFCAS/CCF should be illustrated here. Witness this illuminating account from one of its representatives:

> They also, as has been evident very recently, put a muzzle on scientists, who are not allowed to participate in conferences. I mean, the Canadian Meteorological and Oceanographic Society [meeting], as I think I said earlier, was in Saskatoon last spring… There was something like 80 papers that had to be cancelled because the government scientists… were not given permission to travel. Anyway, that's happening all the time now – the Canadian Climate Forum… is holding a workshop – a symposium on climate change… and we have an impressive list of speakers – we have a list of people who are government scientists who we would love to have speak, who all want to speak, but they so far – we can't publicly say who they are because they do not have approval and they may not get approval, and if they get approval they'll get it the day before the conference opens.

Another scientist added that "it's a very sinister world out there for science – it must be very discouraging for government scientists". Issues of coordination plague the attempted partnership between CFCAS/CCF and the federal government, and they appear to be primarily the fault of the latter.

Ultimately, if the main goal of the partnership is to facilitate mutual influence between climate scientists and policy-makers (which it is for the purposes of this analysis), it cannot be considered particularly successful, a sentiment shared by all of the participants. While there may have been some indirect influence on general awareness, it was difficult for interviewees to specify the exact mechanisms, and any examples of concrete effects on policy action were very minor, with several respondents expressing skepticism that there was any direct impact at all. In terms of successes and challenges peripheral to the partnership's main goal, although there were a few examples of emerging benefits (i.e. collaborative tools and scientist networking), the apparent problems are far more significant. The government's funding decisions have left its internal scientific capacity somewhat diminished and have demotivated university research. At the same time, there is a lack of translation and collaboration mechanisms between science and

policy in Canada. Even worse, the muzzling of government scientists hinders their capacity to interact with researchers outside of government. Many of these challenges also have implications that reach much further than just CFCAS/CCF. The altogether lukewarm assessment of the interviewees is quite understandable. It would seem that many of the above issues are shortcomings of the federal government, but the next section will investigate various potential causes of these challenges (and successes) more deeply.

Important Causes of the Level of Success

The above two sections comprise, respectively, a description of the partnership between CFCAS/CCF and the federal government (particularly its co-productive elements) and an assessment of its successes and challenges. This section will explore potential links between the design and the outcomes, especially with regard to climate policy action, attempting to determine whether successes were caused by the presence of co-productive elements in the science-policy partnership and whether challenges were caused by their absence. Interview participants were asked explicitly to consider the causes of the various successes and challenges they previously identified. Importantly, the interviews discussed causal factors besides co-productive design (e.g. recall the analytical framework from Chapter 2) at length, which is required in order to really evaluate the co-production hypothesis.[16] This section, then, not only considers scientific influence (including co-productive design) as a potential causal factor, but also other themes

[16] Given the low degree of interaction between CFCAS/CCF and the federal government, many of the interview discussions focused on causes of policy change at the federal level rather than causes of specific successes or challenges for the partnership. There is some overlap between the two, since a successful science-policy partnership should ideally affect policy change, but the partnership itself is less central here than in the corresponding sections of the other case chapters.

emerging from the interviews: political will, intergovernmental relationships, and the importance of individuals.[17]

Firstly and most importantly, the effect of the partnership's degree of co-productive design on its potential policy influence must be explored. Recall that interviewees were able to identify several co-productive characteristics – for example, direct science-policy linkages through the board, attention to political messaging and outreach, collaborative and coordinated research through a credible network (i.e. associated with CMOS), and policy-conscious goals. These facets were assessed as very positive by representatives from CFCAS/CCF, but their real influence on policy action can only be truly evaluated by respondents from the policy side of the partnership. One fairly positive account was given by a former politician:

> We realized that we needed some more focal point. You couldn't say "well there's this great guy down at Queen's who knows a lot about this – really you should listen to him"… so you did need to bring things together… it didn't really matter what mechanism you chose – you needed some way of coordinating the science activity… to have an authoritative voice, so you could say "look, we've assembled the best team of people we can – they say that the chances of climate change occurring are 97.69% – I don't know whether they're right or wrong – I'm not a scientist, but nor are you – so come on guys, let's have a starting point somewhere, and it makes sense to start where they told us is the right place to start – now let's get on to the policy of this".

Perhaps the most important thing about CFCAS/CCF, in terms of policy influence, is simply that it is a coordinated and authoritative resource on climate change in Canada and was available for decision-makers to draw upon when political interest arose (see Kingdon 1984). It seems that the production of credible science was a necessary precondition to science-policy partnership in this

[17] The causal factors identified by interviewees closely match the ones predicted at the beginning of the chapter, except that the influence of individuals has been added, but that would have been difficult to predict from document review. Perhaps these predictions were more accurate, in comparison to the other cases, because there is more information (e.g. news articles, books) broadly available about the activities of the federal government. The most salient feature of this case, the current government's lack of interest (e.g. muzzling, defunding), has been widely discussed in academia and the media.

case.[18] As the quotation says, the 'authoritative voice' did not need to be CFCAS, and other interviewees implied that the IPCC might have been sufficient for that purpose (although it would not have been as relevant to the Canadian context). There was some marginal optimism about CFCAS/CCF's policy influence in the interviews, then, but the more common sentiment was skepticism.

All three respondents from the policy side argued that barriers to further policy action on climate change have very little to do with scientific certainty or consensus, and that any of the baseline science that *was* necessary would be available through the civil service. Witness the comments of one participant:

> The problems with implementing climate change policy have very little to do with the science of it. The science of it was established in a series, you know, going back to the 1820s… it was felt it was too speculative to – by 1980, that was over – they knew all they needed to know, and we had a conference here in 1988 in Toronto, which was preliminary to the 1992 global summit. That conference had 44 nations, and everything we needed to know was there for policy planning… the actual basics of it was pretty fundamentally understood… You don't need 99% accuracy for policy. A legal presumption of a balance of probabilities is almost all you need.[19]

That is, there have been times in the past when Canadian politicians would debate over the possibility of climate change (and there are other places in the world where this may still happen), but it is not a controversy in the bulk of the policy process anymore.[20] The barriers are now much more political. Overall, the co-productive elements in the partnership between CFCAS/CCF and the federal government may be beneficial, but they are not as important as the

[18] The other case chapters make a similar observation about their respective science organizations.
[19] Another interviewee, a former civil servant with training in the natural sciences, clarified that general data may be sufficient for making decisions about climate *mitigation* (i.e. where all politicians really need to know right now is that emissions must be reduced further), but that specific data is necessary for matters of *adaptation*.
[20] The former politician that was interviewed even suggested that research communities may have hurt the climate change movement by requesting further funding, since it made the scientific understanding look quite uncertain, even though it was already quite well established.

general credibility, coordination, and authority of the available scientific understanding, or the political facets of the policy process.

Political will (i.e. the general interest in climate action of whatever party is in power), is a causal factor of obvious importance for explaining the partnership's level of success. CFCAS/CCF, and thus also its partnership with the federal government, would never have existed without the grants of 2000 and 2004, afforded by the Liberals. At the time, the government must have had enough interest in climate change to justify such an expenditure. Although, one of the interviewed former civil servants believed that CFCAS was basically financed by year-end opportunities of the government to transfer funds (i.e. there was extra money in the budgets), which might suggest that it was not a major priority. Much of the above discussion indicates that political will was not particularly high, even during the more productive period under the Liberals (i.e. they were interested in CFCAS research in only a philosophical and holistic manner). Another former civil servant provided an account that was particularly demonstrative in this regard:

> Going back into the 90s, it wasn't obvious to government that acting was something that was going to have political support – there were going to be costs, there were going to be losers, and there wasn't a whole lot of motivation to act. I can remember, at UVic one day, in a session that Andrew Weaver [a climate scientist] and a few others had brought about, where Paul Martin, then Minister of Finance… came out… [they] put on a very good presentation as to what was happening… and basically what Martin said in his reply was "well, that sounds very important, but what you scientists have to do is you have to get out there with the Canadian people and rouse their level of interest in these issues… because we are not hearing a great deal of concern about climate change… until we start to hear something in a big way, we're – don't expect too much government action".

This quotation demonstrates that the Liberals did not have a particularly high motivation to act on climate change, but it also points to another causal factor, public support, and it is understandable that governments may not want to take action until that support reaches a certain

level.[21] One scientist agreed that the only way the (current) federal government would change its view on climate change would be if they were to hear it "loud and clear" from the electorate.

The public is definitely an important facet of political will, but there *is* some significant variation between different parties that form government. While the motivation to act may not have been particularly high under the Liberals, respondents were much more negative about the Conservatives. The lack of renewed funding, the failure to fill the CFCAS board positions reserved for government representatives, and the muzzling of government scientists were all ostensibly due to the newer government's political ideology. One interviewee stated that the gradual decline of interest in climate change had "everything to do with the change in government", while another said that the Conservative government is currently the biggest barrier to progressive climate policy and that it would be "impossible" to see action under them without pressure from a strong international agreement (which does not yet exist). One final aspect of political will, that would affect any governing party, is the nature of the electoral cycle, as one participant pointed out:

> The other thing that strikes me as a disconnect between – the length of an electoral cycle and the span of time over which you need to pay attention to this issue in order to make some good headway on the issue, particularly on the mitigation side – mitigation decisions are inevitably going to be expensive, they inevitably have paybacks that occur long in the future as opposed to in time for the next election – and they're of a nature that the incremental damage that's caused by delaying the decision by one, two, or three years, so that it becomes part of the mandate of the next government – [at] any one particular time that perceived incremental cost is relatively small.

[21] However, I also had the opportunity to attend a more recent talk at UVic ("Short-Termism and Democracy" – June 2, 2014), where Martin was a speaker. He argued that political leaders can bring issues to public attention, allow public pressure and awareness to grow, and then have a legitimate mandate for action. In his view, any leader can make this happen if they really want to, which somewhat contradicts his comments from many years prior. Related to this, the former politician that was interviewed opined that the "raison d'être" of political leaders does not have to be "satisfying interest groups". They can have other goals, which might require telling unpleasant truths. Indeed, before the ratification of Kyoto, that person was tasked with building public support for it, which required visiting universities, newspapers, and chambers of commerce to stimulate discussion.

Political will, then, is a very important causal factor in the success of this science-policy partnership. The lack of leadership from both the Liberals and Conservatives (the latter more so), insufficient public pressure, and the limits of the electoral cycle have all had an impact. This not only outstrips the influence of co-productive design in science-policy partnerships, but may mean less interest in those partnerships to begin with.

Another key barrier to action is one that is unique to this national-level case, the complications of intergovernmental relationships. As mentioned early in this chapter, the fragmentation of authority over environmental issues in Canada facilitates a norm whereby agreement from nearly every province is expected before genuine country-wide action can be taken. This is further complicated by the very nature of climate change as a collective-action problem, which means that individual countries have little incentive to act until a similar agreement is reached at the international level. If all the relevant decision-makers were to agree on the science and have the political will to act, figuring out *how* precisely to proceed would still remain a major impediment, as summarized by one former civil servant:

> Even if we do come to a common understanding, turning that into an agreed action on greenhouse gas emissions reductions is a really difficult thing to do, because there are lots of other things to discuss as a consequence: Who should reduce greenhouse gas emissions? At what costs? Who should take responsibility for past emissions? Who should take responsibility for damages, pay for adaptation? That kind of thing. So lots of things subsequently need to be discussed, and the evidence is that we haven't been that successful.

That account illustrates the basic nature of the negotiation problem, but the specifics of how it has affected climate policy action in Canada were provided by the former (Liberal) politician who participated in the study. For example, they described discussions with provincial governments:

> I heard and heard and heard, time after time, "oh, your government did so little on climate change because emissions increased" – well, of course they increased,

> because in that period we had to go through what is necessary in Canada, which is constant negotiation with interest groups, with provinces, even with municipalities, within government departments we had to negotiate between Agriculture Canada and Environment Canada – you have to go through all that in Canada to ultimately emerge with consensus policies… you could never put a policy in place that affected provinces in a differential way unless you'd gone through full, fair consultation, negotiation, discussion, et cetera.

This quotation corroborates the barriers explored at the beginning of this chapter, identified in the literature on Canadian environmental policy. The interviewee added that government representatives from Alberta "mastered the art of sabotage and delay" to defend the resource industry during the negotiations.

They went on to explain the difficulties of international negotiation (e.g. in deciding on the goals of the Kyoto Accord). Even once all the involved countries agreed to act on climate change (i.e. scientific uncertainty is allegedly not much of an issue at that level of policy-making), each still had strong political incentives to push the burden onto others. For example, countries would want credit for mitigation actions they were already doing or were going to do anyway, independent of the accord (e.g. due to the decline of oil and coal in Europe, some countries were planning to transition to natural gas, a shift unmotivated by climate concerns). This led to a somewhat distrustful atmosphere, and some decisions were made "virtually by subterfuge" rather than genuine consensus (e.g. the decision to include agriculture and forestry in the measurements was forced through late at night by a meeting chair who felt negotiations had already gone on too long). Whether international agreements have been effective or not is a separate question, but it is clear that both internal and external negotiation have complicated Canada's capacity to take climate action. Like political will, this can limit the influence of, and interest in, science-policy relationships.

The final potentially important cause of the partnership's successes and challenges is the influence of individuals. This has affected the interaction of CFCAS/CCF and the federal government in two main ways. First, many of the scientists on the board of the organization have experience working within government (e.g. as Assistant Deputy Ministers), which gives them access to certain networks as well as some understanding of effective political messaging. The CFCAS/CCF chair was particularly notable in this regard. One respondent described them as "exactly the type of person that was so helpful" due to "having been in the bureaucracy long enough" that they knew how "to provide the big picture". They may also have been responsible for the inception of CFCAS, having suggested, while still in government, deliberate funding for climate research at universities. Another pointed out that the chair was personally asked to attend certain meetings and provide briefings about climate change (to Prime Minister Martin, for example), and it is unclear whether this was due to their position as CFCAS chair or simply due to their former position as an ADM. Still, it seems that the specific individuals on the CFCAS/CCF board are important factors in the organization's (minor) influence.

Second, individual personalities on the policy side of the partnership can also be very influential. Interviewed scientists reported that their relationship with the federal government was generally very good under the Liberal Ministers of Environment Canada (i.e. Anderson and Dion) but essentially non-existent under the Conservative ones (i.e. Ambrose, Baird, and Kent). However, Minister Prentice, under the Conservatives, was a very notable exception – witness the comments of a CFCAS/CCF representative:

> Then Jim Prentice was the next Minister, so I was wondering "wow another one" and we drafted up a quick letter, sent it off to him – within 24 hours, I had a phone call from his office saying "When can you meet with Minister Prentice on the Hill? How about tomorrow?" – and I went up to Ottawa like a bang… He had to, every now and then, run up to make a vote and then come back – I mean he could have easily terminated the meeting but no, he said "I want to talk to you"

> and we talked regularly through this time. He tried very hard to get us additional funding… The only [Conservative Minister of Environment Canada] who really responded and worked with us was Minister Prentice… so as the three-year membership of board members expired, then no one was appointed to replace them, except those who happened to come up during the time Prentice was there.

This respondent also clarified that Prentice helped extend the organization's mandate. That is, while no new funding was provided, he acquired the permission necessary for CFCAS to spread the remainder of its grant over one additional year of operation. Thus, it may be appropriate to generalize somewhat about the political will of different governing parties, but the variation between members of a given party is also very important. In this case, however, the positive influences of individuals were not sufficient to make the relationship genuinely co-productive.

Clearly, a rich network of causal factors plays into the success of the partnership between CFCAS/CCF and the federal government, as well as Canada's climate policy action in general. Perhaps most importantly, some degree of public interest in climate change and a high level of political will to act on it (or to assume leadership on the issue even without substantial public pressure) seem to be necessary preconditions to effectively fund climate research and initiate a science-policy partnership around it.[22] In order for that relationship to work effectively, the science organization must first be credible and authoritative, and then, so that the information can filter into the policy process effectively, there must be either institutional mechanisms of co-productive design (e.g. formal ties to government on the board of directors) or strong relationships among individuals on each side. This allows interested political actors to claim that there is an impetus for action and provides a starting point for intergovernmental negotiation (if individual governments lack the leadership to act alone). However, complications in the negotiation process may also prevent policy action from occurring. This was a major barrier

[22] Recall, from the discussion in Chapter 5, that political will is both a crucial cause and a potential effect (ideally) of successful science-policy partnership.

under the Liberals, while a lack of initial political will may be the primary problem under the Conservatives. In both situations, the existence of CFCAS/CCF has maintained the possibility of science-policy partnership, so that it would not be the limiting factor for action (see Kingdon 1984). As such, co-productive design, the focus of this dissertation's hypothesis, may be important in facilitating necessary linkages between science and policy, but it must be complemented by credible and authoritative science to begin with. Furthermore, political will and intergovernmental relationships appear to be determinants of much greater importance.

Preliminary Prescriptive Recommendations

It has become clear that the partnership between CFCAS/CCF and the federal government as a whole, and thus also any elements of co-productive design, have a very limited influence. Broader forces such as political will and intergovernmental relationships appear to be far more important, and they are non-malleable (see Chapters 1 and 2). This means that prescriptive recommendations for this case are unlikely to be both possible (i.e. based on a malleable characteristic) and influential (i.e. not made irrelevant by some other causal factor). Still, perhaps the side benefits or broader awareness facilitated by the relationship, or rather by CFCAS/CCF alone, can be improved. Indeed, interviewees made some direct suggestions. It is also important to consider the implications of the non-malleable factors for the way the partnership is set up, even if they cannot be changed themselves. Thus, this section first evaluates the specific design recommendations of the respondents and then interrogates the significance of broader causal factors for the activities of CFCAS/CCF.

Collectively, the interviewees (directly or implicitly) suggested the following potential changes to the relationship: it should have been possible to fill the vacant board positions meant

for government representatives even without nominations from the Minister;[23] the funding model should have avoided abrupt termination (e.g. through gradual decline, a provision for when funds expire, or a permanent endowment); there should have been more genuine engagement and follow-through when the policy side *was* interested in the relationship; the government should support internal, not just external, research capacity; the government should support basic, not just applied, research (i.e. through NSERC); the government should end the 'muzzling' of its scientists; CFCAS/CCF should develop more short communiques for policy-makers; and there should be greater quantity and quality of coordination between organizations with similar goals to CFCAS/CCF.

Most of these potential recommendations have clear limitations. The first three are obsolete, since they refer to the CFCAS years (i.e. using the phrasing "should have been"), although they do highlight some lost opportunities, which can be considered lessons applicable to similar cases of science-policy partnership. The three referring to activities of the federal government are not practically malleable under the Conservatives, since they have ideological and political reasons for their current approach and would not be incentivized to change it by alleged benefits to science-policy interaction. However, the government itself could also benefit from some such changes. For example, allowing government scientists to speak freely mitigates the potential danger of media commentators engaging in speculation when interpreting new findings themselves (see CBC News 2014b).[24] Still, I do not believe such benefits would be sufficient to counter the broader political motivations of the Harper government. The only

[23] It is ideal for the Minister of Environment Canada to be involved, but including a provision for the potential loss of potential interest or other break-down in communication or would have increased the 'robustness' (see Goodin 1996) of the partnership.

[24] Also, recall the benefits of exploration (see Orton and Weick 1990). The Conservative government may have focused too much on exploitation, which would be harmful to it over the long term.

practical suggestions are the last two (i.e. regarding communiques and coordination), which are clear matters of co-productive design. As discussed previously, though, such strategies are already being pursued by CCF.

However, one interviewee, the former politician, did make a very interesting broader suggestion, arguing that social science should play an increased role in conversations around climate change. Specifically, they said:

> If you want to spend money on research, money should be spent on psychiatric studies about why people will not accept a rational scientific argument – what's wrong with the scientific method so that it's not accepted by the public – it seems to me that "why is there such a sophisticated lobby against us?" – that would be a political science question, economics question.

On one hand, this might mean increased government funding for social science related to climate change (and implies that the NRTEE should have been preserved), but as per the above discussion, such a shift would be unlikely under the Conservatives. On the other hand, this argument also implies that social scientists would be very valuable on the board of CCF. There do not appear to be any right now, although the board is fairly diverse and includes representatives from industry (see CCF 2015c). Even representatives of CCF admitted that natural scientists are often not "legalistic" enough to communicate with policy-makers effectively about certainty. The organization's new mandate might benefit from a different mix of expertise, then. Retrospectively, perhaps the government appointees to the CFCAS board could also have been more diverse, so that the partnership's formal mechanisms were not merely natural scientists talking to other natural scientists. Aside from the potential inclusion of more social scientists on the board, then, CCF is already essentially pursuing co-productive design as effectively as it can. Its relationship with the federal government is limited far more by the lack of political interest.

As discussed in the previous section, the most important limiting factor in the function of this case is political will. What are the implications of it and the other non-malleable factors for the relationship's design and the strategies of CFCAS/CCF? Any political interest in climate change, if it were to arise, would necessarily have some origins in scientific understanding. However, it is difficult to imagine ways that an individual organization or partnership could have a greater *direct* effect on it.[25] The causes are broader and more indirect, rooted in public discourse and the individual understandings of influential decision-makers. CFCAS/CCF has partially contributed to the general conversation simply by facilitating climate research, and may have greater influence with its new mandate of public outreach. That is, if policy-makers are going to claim they lack the required public pressure to take action, it may be more effective to simply target the public rather than attempt to convince them to act without broad support.[26]

As for intergovernmental relationships, since they take place in the political realm, it is hard to imagine how a science organization might become involved. By helping to provide a credible and authoritative statement on the science, for political actors to use as a starting point for negotiation, CFCAS/CCF has basically already done all it can to affect this causal factor. Finally, the influence of individuals is also important and similarly is challenging to control. If the governing party is interested in climate change, it could ensure to appoint successive Ministers of Environment Canada who are committed to engaging with CFCAS/CCF, but this requires political will to begin with, is contingent on the very existence of such individuals, and cannot be affected by the science side of the partnership. The organization *can* aim to appoint

[25] For example, the influences on Premier Campbell, discussed in Chapter 5, could not have been deliberately coordinated. Many books on climate change had been available to the public, and Campbell just happened to read some of them.

[26] Based on the "diversity of stakeholders involved" characteristic, I still consider this to qualify as co-productive design. However, it may be more accurately labeled a 'co-productive strategy' in this context.

board members with government experience (if available), but it is already doing so. The most important causal factors are not easily manipulated or accommodated, then, confirming that the problem of Canada's federal inaction on climate change is complex and cannot be solved by mere changes in the design of this science-policy partnership. Broader outreach continues to be the most appropriate role for CCF in such a context.

Summary and Implications

In summary, the main sections of this chapter have (respectively) endeavoured to answer the descriptive, evaluative, explanatory, and prescriptive research questions of this dissertation, as they apply to the climate science-policy partnership between CFCAS/CCF and the federal government of Canada. Specifically, the interview process revealed that while CFCAS/CCF has pursued some elements of co-productive design, the lack of genuine interest from the policy side means that relationship can only be considered a 'basic partnership' under the Liberals and merely 'incidental interaction' under the Conservatives. It has seen little success in terms of achieving its policy-relevant goals, though a few side benefits were identified (see Table 6.1 on the next page for a summary of these characteristics). This outcome, as well as the general level of federal climate action, is largely explained by the realities of political will, intergovernmental relationships, and individuals, which suggests that the only way CCF might increase its influence now is to engage in broader public discussion, rather than pursue a direct science-policy relationship with a largely disinterested party. The precise effects of such outreach are difficult to determine (see Chapter 5), but it seems to be the best option for the organization. In pursuing this, CCF might bolster its efforts through greater collaboration with social scientists. Even though some interesting co-productive strategies are now available to the organization, and there

OBSERVED ELEMENTS OF CO-PRODUCTIVE DESIGN	OBSERVED POLICY (AND OTHER) OUTCOMES
-meetings occur and frequently	-minor examples of action
-presentations tailored to audience	-participants respond positively
-clear roles and responsibilities	-enhanced learning and awareness
-ample (non-meeting) communication	-symbolic use
-accountable to one another	-a few side benefits
-base scientific credibility established	
-government scientists included	

Table 6.1 – Summary of Observed Elements of Co-Productive Design and Observed Outcomes in the Partnership between CFCAS and the Federal Government[27]

were some elements of co-productive design in the original partnership, attempts at co-production seem to have little overall effect on the policy outcomes. Thus, the hypothesis, in its current idealistic form, is not supported by this case.

If the hypothesis were to be refined into more sophisticated co-production theory, however, what would be the implications of this case for it? What observations from this chapter would need to be accommodated? First, consider how the hypothesis would have applied to the more functional years of the partnership, when there was some political interest under the Liberals, but CFCAS was not deliberately pursuing co-productive strategies to the same extent as it later would. The hypothesis implies that a greater degree of co-productive design at that point could have facilitated policy action. Such a hypothetical effect cannot be investigated or measured now, but it illustrates that the base assumption of the hypothesis (i.e. that co-productive design can improve policy outcomes) may still be applicable in some situations, as long as it acknowledges prerequisite political factors. The vital requirement of a more developed theory about co-production and science-policy relationships is that it be able to specify the

[27] Like Tables 4.1 and 5.2, this table should be read in the context of the hypothesis indicators from Chapter 3. Again, the entries in grey text are important characteristics that were observed but *not* predicted by the hypothesis. The table refers to the organization during its most functional years (i.e. otherwise there would be very little to report on the right side of the table).

interplay between malleable design characteristics and non-malleable external conditions, including crucial political will. It would need to explain how different combinations of co-productive design and political interest can lead to the various qualities of science-policy relationship: incidental interaction, basic partnership, dialogue, and true co-production. This would clarify which situations are amenable to improvement through co-productive design and when science organizations should instead pursue broader co-productive strategies with other actors (e.g. outreach to the public). In the next chapter, I compare the three cases to build more nuanced co-production theory that attends these concerns.

Chapter 7: Synthesis – Improving Co-Production Theory

So far, the cases have been examined independently, as mostly separate from one another. However, the major advantage of selecting three cases is that it allows for a more comparative and rigorous test of the dissertation hypothesis, which is, to review: "the more that climate science-policy partnerships embody elements of deliberative co-production (rather than non-communication or one-way flows of information), the more effectively they will translate scientific evidence into policy action". Although each of the preceding chapters touched briefly on this hypothesis, the purpose of this chapter is to synthesize and compare the three cases in order to test it more comprehensively and build better co-production theory. Similarly, while the previous chapters primarily answered descriptive, evaluative, and explanatory research questions for their respective cases, the focus here is the prescriptive and comparative questions of the dissertation (see Chapter 3). The emerging theoretical model will offer suggestions for bridging Canada's climate science-policy gap, and for attending science-policy issues in general. In order to effectively synthesize findings from the three cases, though, they first must be summarized individually.

Synopsis of the Case Studies

Chapter 4 explored the partnership between PCIC and municipal governments in BC. Many municipalities are currently working on climate adaptation planning and thus stand to benefit from partnering with scientific experts who can estimate future trends in the regional climate. These interactions embody many elements of co-productive design. For instance, PCIC has been very proactive in seeking feedback from municipal users and attempting to meet their specific needs. Interestingly, policy advice is deliberately avoided so as not to undermine the

organization's credibility and accessibility. This clashes with the theoretical definition of co-production (see Chapter 3), which emphasizes mutual influence. Still, interviewees evaluated the focus on users very positively and identified it as a key factor in PCIC's impact on the policy success of municipal climate adaptation. For example, the community of Castlegar used PCIC tools to identify flooding as a vulnerability and adjusted the maintenance schedule of their stormwater culverts, which minimized the impact of an extreme rainfall event less than a year later. The responsive nature of the partnership likewise leads to side benefits such as municipal planners acquiring information more efficiently and the promotion of PCIC's services. However, other causes of success (and challenges) were also identified by participants, such as political will in different municipalities, focusing events (e.g. forest fires), and the influence of individual planners acting as 'champions' or liaisons with PCIC. The existence of these causal factors suggests that co-productive design is not the principal determinant of policy action, as the hypothesis implies. They also make it difficult to recommend improvements to the relationship. For example, if the main barrier to further action is the lack of broader public and political interest (i.e. outside the partnership), then changes to the partnership's design seem unlikely to make much difference. This chapter attempts to determine whether the influence of co-productive design is really so limited. Nevertheless, the partnership between PCIC and BC municipalities exemplifies some of the policy improvements that can come from co-productive design in science-policy partnerships.

In Chapter 5, the partnership between CAS (of the BC provincial government) and PICS was examined. The former is involved with both adaptation and mitigation initiatives at the provincial level and thus can be supported by the natural and social scientific expertise of the latter. PICS has more of an explicit policy advice mandate than PCIC and thus the nature of this

partnership is different. Since policy-makers do not always value external advice, there is a bit more tension between the two parties, leading to a delicate balancing act where each is somewhat interested in influencing the other but must be careful not to overstep boundaries and compromise the relationship. While quite a few elements of co-productive design still exist (e.g. regular meetings, informal communication, jointly-hosted conferences), interviewees were unable to provide strong examples of policy changes that resulted from the partnership. The indirect and side benefits of co-productive design, such as broader climate awareness among civil servants, the convening power of PICS, inside information granted by CAS, and jointly hosted events drawing on the resources of both partners, were more significant. Participants mostly saw the partnership as a positive mechanism overall, but believed political will (i.e. the interest of political decision-makers above CAS) to be the far more important cause of climate policy action. Thus, it was difficult to identify potential design improvements that would nonetheless increase the partnership's policy influence while not also disrupting the mutual autonomy of PICS and CAS, though many ideas were proposed by the interviewees. Overall, this case embodied less co-productive design and less policy action than the municipal-level partnership, but it would be premature to assume the latter is caused by the former, given the importance of other identified causal factors like political will. By itself, the partnership between PICS and CAS does not lend much obvious support to the hypothesis, but it is a good example of valuable side benefits that can be facilitated by co-productive design.

Chapter 6 investigated CFCAS, now known as CCF, and its fleeting relationship with the federal government. This case is quite different than the other two since, although CFCAS was initially funded by the government, it was designed primarily to be a granting agency for research rather than a contributor to science-policy interaction. Government civil servants did sit

on the board of directors during the early years, but policy advice was not a major part of the organization's mandate. As CFCAS grew more interested in science-policy collaboration over time, the government did the opposite, primarily because the governing party had changed (i.e. from the Liberals to the Conservatives). Eventually, the initial funding expired and the organization became CCF, which no longer has any formal ties to government, but is more focused on policy issues than before. Throughout this history, there were some elements of co-productive design (e.g. messaging strategies), but major challenges (e.g. complete disengagement by the policy partner) greatly outweigh minor successes (e.g. slightly increased urgency to take climate action in the early years). Political changes were identified as a crucial factor in the breakdown of the partnership, but the influence of individuals was also important, and even the very structure of government (i.e. norms of federal-provincial relations) limited progress under the Liberals. Conceivably, many co-productive improvements could have been made during the early years, but they probably would not have been able to maintain the partnership under a government arguably opposed to its very existence. Since the formal relationship no longer exists, most potential advances at this point have more to do with broader outreach than with partnership design. The interaction between CFCAS and the federal government is essentially an example of failed policy influence even though some co-productive design was attempted, which challenges the assumptions of the hypothesis. Addressing Canada's climate science-policy gap will evidently require changes that are more complex than simply improving co-productive design in the relevant partnerships.

Together, the cases respectively comprise one example of functioning partnership leading primarily to policy influence, one example of functioning partnership leading primarily to side benefits, and one example of non-functioning partnership. Such variety and complexity means it

is all the more important to synthesize the findings in this chapter. As for the hypothesis, the cases have collectively offered little support for it in its idealistic form. In general, co-productive design does not seem to have a strong and direct effect on climate policy action, which rather seems to be determined by less malleable causes such as external political will, individuals, focusing events, and government structure. However, all of the cases identified side benefits arising from co-productive design, and suggested that it might have an indirect and long-term effect on climate awareness among decision-makers. The basic thrust of the hypothesis still has some promise and should be discussed in greater depth in order to build theory, with reference to all three of the cases as well as some of the relevant literature (see Chapter 2). As such, this chapter revisits the hypothesis indicators referring to co-productive design and policy outcomes (see Table 3.2); considers implications, for broader theory, of other causal factors identified in the case studies; develops a theoretical model based on the analytical framework (see Tables 2.1 and 2.2) and applies it to the three cases; and finally suggests some ways forward for Canada's broad science-policy gap. The nature of this chapter means that some themes and quotes echo those in the case chapters, while others are new. That is, some concepts that did not appear significant to the individual cases *do* seem important collectively (e.g. the effects of other jurisdictions and the potential of MLG). Essentially, I hope to show that co-productive design is worth pursuing in Canada's climate science-policy partnerships, even if its direct impact on policy action is low.

Revisiting the Hypothesis Indicators of Co-Productive Design

The dissertation's descriptive research question asked: "What climate related science-policy partnerships exist in Canada? How are they institutionally set up? What elements of co-

productive design are present?" There was quite a bit of tension between design characteristics expected by the literature and what was observed overall. For example, PCIC deliberately avoids providing policy advice to its municipal partners, protecting its base credibility and reputation, which creates a foundation for partnership. However, scientists forgoing opportunities to advise policy-makers seems to go against the very definition of co-production (i.e. a capacity for both sides to influence each other). So, does that aspect of the municipal partnership qualify as co-production or not? Should it be added to the list of potential elements of co-productive design? Is it beneficial or not? Several discrepancies such as this emerged from the case studies (see Table 7.1 on the next page for a summary). There is, then, an important conversation to be had between the co-production literature and the empirical observations of the cases examined. Thus, this section will discuss the following topics in order: characteristics that were predicted but not observed, which perhaps should be discounted in building broader theory; characteristics that were observed or desired but not predicted, which might be accommodated by theory; and characteristics found to be far more important relative to the others than the literature implied, which should be emphasized in broader theory. The discussion should result in a better understanding of what co-productive design looks like in practice and what can be reasonably expected of science-policy partnerships.

The hypothesis indicators were intended to be broad, based primarily on the extensive list of Edwards et al. (2008), such that a range of co-productive possibilities could be investigated in each case. However, the implication of this breadth is that some predicted indicators will inevitably turn out to be unimportant or absent. For instance, "all groups attend consistently", "equitable participation encouraged", "tries to resolve confusion", "partnerships enduring over time", "clear roles and responsibilities", and "members stable but not stagnant" are all fairly

ELEMENTS OF (CO-PRODUCTIVE) DESIGN	OBSERVED IN PCIC CASE	OBSERVED IN PICS CASE	OBSERVED IN CFCAS CASE
predicted at the meeting level			
-meetings occur and frequently	✓	✓	✓
-diversity of stakeholders involved		✓	
-all groups attend consistently	✓	✓	≈
-pre-meeting background/briefings			
-create atmosphere of trust/amicability	✓	✓	
-facilitation shared (and trained)		✓	
-more discussion than lecture			
-equitable participation encouraged			
-presentations tailored to audience	✓	✓	✓
-open to broader discussion/questions			
-solicits feedback for/from all groups	≈		
-tries to resolve confusion/disagreement			
-free deliberation/transparency balanced			
predicted at the institution level			
-belong to the same institution			
-participate in the same networks	✓	✓	
-joint projects (e.g. co-authorship)		✓	
-clear roles and responsibilities			✓
-ample (non-meeting) communication	✓	✓	✓
-distribute information to one another	✓	✓	
-objectives/mandates consider the other			
-partnership itself open to improvement	✓		
-accountable to one another (and others)			✓
-partnerships enduring over time	✓	✓	
-members stable but not stagnant	✓	✓	
not predicted			
-base scientific credibility established	✓		✓
-mutual influence restricted	≈	✓	
-government scientists included			✓

Table 7.1 – Possible Elements of Co-Productive Design Predicted by the Relevant Literature Compared to Those Observed in the Three Case Studies[1]

[1] The left column is largely a reproduction from Table 3.2, while the other columns are based on the case findings. The '≈' symbol indicates a partially present element. The bottom section refers to important characteristics observed in the cases but not predicted by the relevant literature (which should not necessarily be considered to fall under the definition of co-production). Also, the characteristics shown for the national-level case refer to its most functional years. I acknowledge that there are very few elements of co-productive design in the current non-functional state of the partnership (though it is better at including a "diversity of stakeholders" now). Finally, this is a simplified summary. The text of the previous case chapters (along with their respective summary tables) gives a much more accurate description of the co-productive elements in the individual cases.

obvious requirements of any functioning partnership between institutions or organizations, regardless of co-productive goals. Similarly, "pre-meeting background/briefings" seems redundant with the wider characteristic of "distribute information to one another", while "more discussion than lecture" overlaps somewhat with "presentations tailored to audience". Thus these potential elements did not get discussed much in the interviews and similarly merit little analysis. The criteria identified by Edwards et al. (ibid) were meant to be applied to a single "deliberative event" (i.e. meeting) and so do not translate perfectly to inquiry at the level of broader relationships that involve multiple meetings and other channels of interaction. On the other hand, some characteristics not fully present in any of the cases are nonetheless highly relevant to co-production: "open to broader discussion/questions", "tries to resolve disagreement", and "objectives/mandates consider the other". These would indicate a high degree of co-productive design, where the science and policy partners are expected to disagree and debate over each other's domains. However, partnerships that are able to pursue these elements without compromising respect, trust, and credibility appear to be rare (e.g. I expect that even the one-way feedback in the PCIC case is exceptional). Recall this quotation from the municipal case:

> [Policy advice] isn't a very useful – for researchers or for scientists – that's not how policy works and it's not really a welcomed role. There are researchers who give us policy advice, sometimes advice that we solicit, and other times unsolicited advice. Solicited advice is generally considered, but the unsolicited advice typically goes nowhere. But that's not what PCIC does.

This demonstrates that policy-makers are not usually interested in policy advice from scientists, and some tension over its provision can be expected.[2] Finally, for a few of the indicators not

[2] It is certainly possible to imagine, however, a science-policy relationship that truly values disagreement and tension. For example, a government agency tentatively opposed to climate action might still appreciate the input of climate scientists who support action. Similarly, a partnership where both the science and policy partner ostensibly agree (e.g. that action should be taken to mitigate climate change) might benefit from the input of a third group on the other side of the debate. This might be more likely through the 'corporatist' networks common in European countries (see Howlett et al. 2009 pp. 41-42). The topic of 'inter-coalition learning' (i.e. as opposed to the 'intra-coalition learning' discussed in Chapter 2) is also relevant to this possibility (see Sabatier 1988).

notable in any of the cases, "free deliberation/transparency balanced" and "belong to the same institutions", their importance remains unclear.[3] Neither characteristic ultimately appears particularly central to co-production theory. Several of the co-productive characteristics predicted by the hypothesis, then, should be discounted when building broader theory, and a few others should be acknowledged as unlikely ideals.

Even though the initial list of co-productive elements was intended to be fairly comprehensive, several additional design characteristics were observed to be important. This implies some shortcomings in the emphasis of the existing literature (or at least in the way I originally synthesized it for the hypothesis). For example, the element of "base scientific credibility established" was emphasized in both the municipal and national cases.[4] In order for science-policy partnership to occur, the science organization must have a good reputation for research and synthesis (see Cash et al. 2003), such that the potential for productive knowledge exchange is clear to both partners. In both the municipal and provincial cases, "mutual advice/influence restricted" was a crucial design characteristic, as it facilitated the more common sharing of base data (see Lindquist 1988) and helped establish foundational trust for the partnership (see Rietig 2014), which is allegedly more important than the benefits which might potentially result from being more open to influence. Also, the element of "government scientists included" was important in the national case. It meant that more actors on the policy side had a

[3] The former could matter if meetings are meant to be accessible to the public or include a diversity of groups such that there are tensions between some of them, but most of the actual meetings in the cases included only the science and policy partners; other groups were usually involved in an indirect manner. Also, external science organizations and their policy counterparts belonging to the same institution would generally be impossible or at least inappropriate given the alleged importance of maintaining independence.

[4] In hindsight, I would identify this characteristic as present in the provincial case too, but it was not emphasized by the participants in the same way as it was in the other cases.

familiarity with natural science, and it allowed for interdisciplinary research collaboration among government and external scientists, who have access to different resources.[5]

While these characteristics were *observed*, several others were clearly *desired* in at least one of the partnerships. In the national case, for instance, the eventual 'strategic defunding' and 'muzzling' of climate science associated with the government's waning interest in climate change was described by one interviewee as creating "a very sinister world for science", whereby even scientists not involved in science-policy partnership feel discouraged. As such, "basic science protected" should be considered a crucial prerequisite element for co-productive interaction. All three cases elicited discussion suggesting that "social scientists included" is an important characteristic for moving forward with climate policy action (see Lohmann 2010), particularly with regard to economics and psychology. Consider these remarks from a representative of CAS:

> It's like a doctor saying "you've got cancer" but not understanding the psychology of the patient… One of the problems I find is nobody has actually told me how do I move from the economy as it is today to what it needs to be in order for us to keep to two degrees. What does that look like?… I find that there's far too much emphasis on the science and not enough emphasis on the "so what" from an economic perspective, because that's why politicians aren't listening to PICS – it's because they have economic issues they have to deal with.[6]

Finally, participants in all the cases implied that "coordination with other levels" (i.e. MLG) could be a promising element of co-productive design. A larger collaboration between governments can mitigate barriers to inaction (e.g. municipalities being hesitant to act without coordination from above) and facilitate benefits (e.g. supporting an argument for national action

[5] This element can only be utilized in cases where the government is large enough to employ its own natural scientists (e.g. national governments). However, even the engineers typically employed by municipalities might be included in a similar manner.

[6] This is a particularly interesting quote since, of the three science organizations examined, PICS is the only one to pursue a genuine combination of natural science and social science, but allegedly the latter is still under-attended.

using regional examples of climate impacts and adaptation). Although some of these characteristics do not cleanly embody co-production on their own, they are important as facilitators or prerequisites and thus merit inclusion in more sophisticated theory.

Another limitation of the hypothesis indicators is that all the listed elements of co-productive design were implied to be equally important, but the case studies demonstrate that some are particularly critical. First, the characteristic of "diversity of stakeholders involved" turned out to have many facets and implications. Not only could the individual elements of "government scientists included", "social scientists included", and "coordination with other levels" (mentioned above) arguably fall under it, but also the resource industry groups involved in the provincial case (i.e. participants in the oil and gas data workshop) as well as the financial and energy industry groups that CCF hopes to partner with in order to strengthen its arguments for policy action. Interviewees in both the provincial and national cases placed particular emphasis upon outreach to the general public too, which can also be considered a stakeholder. Witness this quote from a CAS civil servant:

> You just can't have successful policy implementation if there isn't a broad public understanding of what the issues are, what the options are, and why you might go for one option versus another, so I think it is actually very helpful to have – the relationship isn't just between government and PICS and the academic sector – we all need the broader public to be more informed about things and that will actually make it easier to get the policies that we want.

Scientists from both PICS and CCF articulated a slightly different role: convincing the public to support climate policy action puts pressure, in turn, on political decision-makers to directly pursue action or at least engage with science organizations. This is one of the only elements of design that science organizations can pursue when the policy side is not already interested in partnership. Second, discussions around the characteristic of "presentations tailored to audience" focused on general messaging strategies with the potential to improve communication from

scientists to policy-makers (and from scientists to the public). A scientist in the federal case provided an illustrative example:

> One, for example, recent study, a couple of years ago, dealt with the future of outdoor skating rinks and hockey rinks in Canada. And this received a lot of press… we found that over a 55-year period, the skating season on average has shortened… This implies that the future of hockey as an outdoor sport is going to be limited – it could be by the mid-century this will stop. So I had, along with my colleague who's had many interviews on radio, television, and so on – for explaining how the climate has impact, is something that has very practical importance to Canadians, especially young Canadians. So, many of us are concerned about the future of climate so we take it upon ourselves to never turn down a chance to explain or provide interviews to the press.

Several potential messaging strategies like this one (i.e. emphasizing climate impacts on everyday activities) emerged from the cases: linking current impacts of climate change (e.g. storms) to the long-term problem; linking local impacts (and personal experiences) to the national or global problem; employing the language of 'risk' instead of 'uncertainty' so as not to excuse inaction; using the more politically tractable issue of adaptation as a stepping stone to mitigation (also see Prins et al. 2010); focusing on success stories of climate adaptation; and perhaps letting policy recommendations emerge implicitly from discussions and presentations rather than providing direct advice.[7] Some of the listed elements in the hypothesis indicators, then, should be acknowledged (by co-production theory) to have several sub-elements, in order to illustrate their true importance.

Altogether, investigating theoretical indicators of co-productive design through the three cases has allowed a more realistic understanding to emerge. For example, the characteristic of "pre-meeting background/briefings" can be discounted and the characteristic of "base scientific

[7] For example, the intermediary from the PCIC case expected resistance when making a presentation in Sparwood, since it is a coal-mining community, but found climate adaptation to be a persuasive "segue" into discussions about mitigation. That same interviewee also found that asking workshop participants to share their own impressions of climate change over their lifetime was an effective method of engagement, even among skeptics. It allows them to "take ownership" of the process and connect to the broader reality of climate change.

credibility established" must be acknowledged. This new set of elements will inform the theoretical model developed in the penultimate section of the chapter. Some of these elements do not intuitively embody co-production (and may seem to compromise it instead), but recall that any design characteristic which can *help facilitate* co-production can be considered an element of co-productive design (see Chapter 3). As such, even "mutual advice/influence restricted" might qualify, since it may establish the base trust required for a productive partnership, laying the groundwork for subsequent (perhaps indirect) influence. What really matters is whether a design characteristic can benefit the overall function of a science-policy partnership. The new model will focus on this, clarifying which elements are essential and which ones are merely beneficial. As a side note, the discussed characteristics may manifest differently at different levels of government, just as they varied across the cases. For example, the smaller institutions in municipal governments may mean less formality, perhaps making it easier for other stakeholders to join the partnership and for outside-of-meeting communication to take place. On the other hand, higher-level governments might be more likely employ natural scientists that can act as translators and more able to institutionalize lasting partnerships through formal mandates. To summarize, the case studies show that effective co-productive design can generally be expected to embody base trust and credibility, frequent meetings, capacity for the involvement of (or outreach to) other groups, messaging strategies, avenues for feedback, joint responsibilities, and ample informal communication.

Revisiting the Hypothesis Indicators of Policy Outcomes

The dissertation's evaluative research question asked: "How effectively does each science-policy partnership contribute to the translation of scientific evidence into policy action?

What other successes or challenges are apparent?" As such, the cases were compared to ideal manifestations of policy influence suggested by the hypothesis indicators (and the literature on which they are based). Despite the level of co-productive design in the first two cases, it was clear that neither of them resulted in the conspicuous policy influence optimistically expected by the hypothesis, although the concrete policy outcomes in the municipal case were not insignificant. The interviewees in all three case studies focused more on side benefits and 'soft' (i.e. indirect, subtle, or long-term) influences, which appear to be the likelier consequence of co-productive design. This means that the initial outcome indicators were ultimately not very useful for predicting the benefits of co-productive design in the case studies (see Table 7.2 for a summary), although they were helpful in developing and framing the interview questions.

INDICATORS OF (POLICY) INFLUENCE	OBSERVED IN PCIC CASE	OBSERVED IN PICS CASE	OBSERVED IN CFCAS CASE
predicted at the meeting level			
-action items declared/plans made	✓	≈	≈
-new networks/discourses generated	✓	✓	
-info use genuine (not symbol/political)			
-more application than awareness			
-influences fundamental decisions			
-participants respond positively	✓	✓	✓
predicted at the institution level			
-policy activity is high/progressive			
-science cited as reason for change			
-many policy stages affected	✓		
-diffusion to other jurisdictions/levels	≈		
not predicted			
-enhanced learning and awareness	✓	✓	✓
-ample side benefits	≈	✓	≈
-symbolic use of information			✓

Table 7.2 – Possible Indicators of Policy Influence Suggested by the Relevant Literature Compared to Actual Influences Observed in the Three Case Studies[8]

[8] This table generally follows the same conventions and limitations as 7.1 (see footnote 1), except that the left column is largely a reproduction of the *right* column from Table 3.2.

Generally, the hypothesis indicators were far too idealistic. For example, one was "more application than awareness" (i.e. policy-makers actively using scientific findings rather than just becoming broadly informed), but the cases inevitably turned out to demonstrate more awareness than application, not to mention that broad awareness should still be considered a successful output, as participants pointed out. It seems more appropriate to mainly rely on the expertise of the interviewees, who were generally very capable of assessing policy influence without the assistance of theoretical indicators. Because these outcome indicators are far less helpful than the co-productive indicators in the above section, this section follows a different structure. Rather than analyze the specific indicators systematically, it synthesizes the actual outcomes and benefits identified in the interviews: some limited direct policy influence, more significant indirect influence, and side benefits for both scientists and policy-makers. It concludes by discussing the relative importance of these outcomes and why some elements of co-productive design seem to facilitate them better than others.

One of the main lessons to take away from the case studies is that co-productive design appears to have had very little direct influence on concrete policy action. Interviewees were skeptical about stronger links between science and policy having much impact. Recall that one participant from the provincial case said that "no amount of facts or evidence is going to convince a government that is not already interested in climate change" and a respondent from the national case claimed that "by 1980, the necessary science to justify climate change mitigation was already established". Basically they criticize the 'deficit model' claim that more science will lead to more action (see Chapter 2). However, this model is less nuanced than co-production, which *does* seem to facilitate policy impacts in some situations. For example, the co-productive relationship between PCIC and BC municipalities has led to changes in culvert

maintenance and dyke height, and an evaluation by ICLEI confirmed that PCIC generally helps communities prioritize which potential climate impacts merit the most attention. Similarly, the PICS-CAS relationship may have influenced BC's policy on electricity export, while the ties between CFCAS and the federal government (under the Liberals) perhaps led to changes in official recommendations to farmers about drought-tolerant crops. These are only minor illustrations of influence, and the latter ones are merely suppositions, but they should be considered alongside the generally positive assessment of co-productive design given by the interviewees. Policy-makers seem to have the general impression that science-policy relationships are useful, even if they cannot give many examples of using scientific research (also see Weiss 1980). The combination of existing examples (albeit minor ones) and favourable expert judgement suggests that co-productive design does have some potential to concretely influence policy outcomes under certain conditions.[9]

Conspicuous policy impacts are separate from, but highly dependent on, 'soft' policy influences, which is probably what interviewees were really praising with their positive generic assessments. For instance, a policy-maker might become more familiar with a certain potential impact of climate change through an exchange with scientists (e.g. frequency of thawing and freezing temperatures), and might later propose a different implementation of policy as a result (e.g. timing or degree of road maintenance), but they would probably be unable to trace the influence back to that specific exchange. This could be considered general 'enlightenment' (see Weiss 1977), 'policy-oriented learning' (see Sabatier 1988), or 'external exploration' (see Lindquist 2009). Soft policy influences basically include anything that may push decision-makers toward a specific action or increase the likelihood of them taking that action, but does not

[9] But perhaps those conditions were only really present in the municipal-level case. This is discussed in the sections to follow.

have a direct and immediate policy result. Participants used terms such as “mainstreaming”, “sensitization”, “maintaining momentum”, “raising awareness”, “a baseline for negotiation”, “familiarization”, and “network-building” to characterize such effects. These influences were not really incorporated in the hypothesis indicators, but the case studies clarify that they are an important benefit of co-productive design. For example, as a growing number of BC communities partner with PCIC, they become more connected to one another, at least in terms of climate planning, and are more likely to share expertise and approaches. Also, the joint projects of PICS and CAS have raised awareness within the BC government civil service (e.g. through the IPCC briefing) and in the private sector (e.g. through the oil and gas data workshop), which might, in turn, influence higher-level decision-makers. Many interviewees in the provincial and national cases believed the most important function of these soft impacts is that they “hold the line” even when other conditions (e.g. the political party in power) are not conducive to climate action, such that action is more likely when conditions do (unpredictably) change (i.e. because the necessary learning has already occurred beforehand – see Kingdon 1984). Soft policy influences matter and are worth facilitating through institutional design.

Some of the most important effects of co-productive design have nothing to do with influencing the direction of policy (or science), but rather are side benefits. Some of the literature argues that what really matters for institutional arrangements is not the obvious observable outcomes but the process itself (see March and Olsen 1984 and Shulha and Cousins 1997). The hypothesis indicators focused on conspicuous policy influences, since co-productive design would ideally facilitate them, but the case studies illustrated that side benefits are much more common and perhaps a more important consequence. Demonstrably, science organizations can benefit from co-productive design in the following ways: policy-makers may provide direct

advice on communication strategies; feedback from policy-makers can indirectly improve messaging efforts; policy-makers may promote the science organization (or its findings) to other governments (e.g. in the PCIC case); and greater access to government data (and scientists) can benefit the organization's research. Benefits for policy-makers may include: improved science literacy and translation skills; efficiencies from using the science organization's findings rather than having to conduct redundant research within the government; greater access to (interpreted) information normally restricted to academia (e.g. journal articles); more resources for joint projects like workshops; and increased credibility for convening stakeholders that may not see the government as neutral (e.g. in the PICS case). The latter benefits are particularly important, because they mean that governments have some reason to engage in new science-policy partnerships even when not currently interested in taking policy action on the given issue.[10] Much of the discussion around co-productive design has been about how it can influence policy, whether immediately and obviously or eventually and indirectly, but policy-makers are unlikely to be interested in *being influenced*. They might be attracted to the side benefits, however, which could be a stepping stone to policy influence.

Having outlined the most salient characteristics of co-productive design that are likely to be observed in practice, as well as the most important benefits that can reasonably be goals for science-policy partnership, what really matters is the link between the two. That is, what practical elements of co-productive design lead to what realistic benefits? Which characteristics are the most important to pursue, facilitating successes without creating challenges? A brief comparison of the three cases will be instructive. First, the relationship of CFCAS/CCF and the federal government had some elements of co-productive design at one point in time, but it did

[10] That is, they should be interested in building capacity, not merely pursuing policy priorities of the day (see Lindquist 2009).

not last and was not originally concerned with policy influence anyway, so it only led to minor side benefits and soft influences. The PICS-CAS partnership, on the other hand, has been much more enduring and does have some interest in mutual impact as well as informing the general public. There are more channels of influence than in the national case (e.g. greater frequency of formal and informal interaction, jointly-held workshops with broad audiences), facilitating substantial soft influences and side benefits. However, direct influences on policy and science are deliberately limited, which precludes concrete changes to policy but helps maintain base credibility, interest, and trust, allowing the relationship to last. Finally, the partnership between PCIC and BC municipalities is similarly co-productive, but there are explicit opportunities for feedback (at least in one direction), enabling concrete impacts on policy action. In contrast to the provincial case, this one is able to preserve the necessary base credibility even while being open to 'hard' influences.

Stability and feedback, then, are perhaps the most important characteristics.[11] However, the differences between the provincial and municipal cases hint at some remaining questions. That is, why is one partnership able to get closer to the ideal of co-production than the other? What external conditions and constraints might affect the potential or capacity of each partnership? The next section explores causal factors besides co-productive design.

[11] For simplicity, this section has almost exclusively discussed benefits and successes, even though important challenges were also identified in all of the case studies. A separate analysis of the challenges, however, would only reinforce the conclusions of this discussion. Dialogues with a substantial degree of success experienced fewer challenges, and vice versa. That is, determining how the national and provincial cases might get to the same (or a greater) level of co-production and success as the municipal case, which I attempt to do in the following sections, will simultaneously show how to mitigate challenges experienced in the former but not the latter. For example, closer and more productive relationships are likely to be longer lasting and partnerships open to feedback are less likely to experience communication problems.

Implications of Other Causal Factors for Co-Production Theory

The dissertation's explanatory research question asked: "Are the identified successes and challenges causes by aspects of co-productive design? What other factors are important?" While the hypothesis operates under the idealistic assumption that co-productive design in science-policy partnerships will be a primary determinant of policy action, realistically other causes will also be important. As such, the interviews included a segment devoted primarily to causes of partnership success and policy action, in order to contextualize the real influence of co-productive design. In this section, though, the focus will not be a broad survey of all possible determinants of climate action (e.g. those listed by Howlett et al. 2009), but rather a discussion of how such contextual factors constrain and enable the relationship between elements of co-productive design and policy outcomes (or other benefits from science-policy partnership). For example, the transition from the Liberals to the Conservatives in the federal government had a major impact on the political influences of CFCAS/CCF, seemingly shutting the partnership down altogether. This is a severe constraint, but it does not merely imply that co-productive design matters little. It also suggests some more interesting questions. That is, what changes to co-productive design might be beneficial in light of influential external factors that cannot themselves be altered? Under what conditions is co-productive design most likely to be useful? This dissertation is aimed at identifying practical prescriptive changes that can address the climate science-policy gap, not simply explaining how the gap came to be (recall the concept of malleability from Chapter 1). In that light, this section explores a range of causal factors from remote (e.g. events and political will) to proximate (e.g. individuals and institutional design), following Simeon's (1976) funnel of causality.

The most remote causes also tend to be the least malleable. It is difficult for any single science-policy partnership to affect the general interest of high-level decision-makers and the public. Similarly, events which might galvanize climate action, such as severe storms, occur somewhat unpredictably and obviously cannot be controlled. These factors can essentially be treated as givens. Neither is malleable but both are very influential. For instance, consider the visible damage done to forests by the mountain pine beetle, which encouraged a response in some BC communities (see Chapter 4). The change in public opinion that led to the election of the Conservatives and the subsequent demise of CFCAS is another example. Such conditions cannot realistically be influenced, but science-policy partnerships can still respond to them effectively. Recall this insight from a representative of CAS:

> It's more about getting the window to move. Everyone knows – all we're trying to do is move the dial – and so maybe you look for a window in city transportation and you've got that window and maybe on that day it's a clean energy vehicle incentive that's going to get through the door, whereas there might have been other [initiatives] that would have got through the door on a different day… So it really is about coalition-building and opportunity-finding.

They are essentially describing the 'policy windows' concept of Kingdon (1984). Certain conditions (i.e. public mood, understanding of the problem, available solutions) have to align before any given policy action can take place. In the absence of a necessary condition (e.g. public support, a galvanizing event), it is still important to bring other factors together with co-productive design (e.g. link science to policy and problems to solutions) so that policy windows can be readily used when they do open. This is why soft policy influences are so much more important than the hypothesis indicators suggest; they increase the likelihood that policy actors will find and use policy windows. Another mechanism of co-productive design relevant to these non-malleable factors is public outreach, which may have some influence on the political will of high-level politicians in the long term. Consider a PICS scientist's quote from Chapter 5:

> I'd like to say politicians are just a reflection of us – we vote them in – we more or less know what we're going to be getting when we vote them in. And so one of the things that we take very seriously here is to get the information out there in the public realm so that the public will start to ask questions of the politicians or send them letters and say "hey, why aren't you doing this?" – and I really think that it's important for the public to start speaking up more.

This observation suggests that public outreach and including other stakeholders are particularly important elements of co-productive design, since they may allow for some influence of political will, a causal factor that is generally not very malleable.[12]

A few determinants of success could be considered to embody a medium degree of separation from the partnerships themselves, neither remote nor proximate. Other relevant institutions can have an effect, for instance, the municipal case being a particularly good example. The relationship between PCIC and BC communities was strengthened by influences of the Columbia Basin Trust, the International Council for Local Environmental Initiatives, the Fraser Basin Council, CAS, and Natural Resources Canada. Similarly, other governments can matter too, but seem more likely to manifest as a constraining factor. For instance, certain provinces created barriers for the climate negotiations mentioned in the national case,[13] while some BC municipalities may be hesitant to act without additional information and leadership coming from the provincial government (as one PCIC scientist observed). An interviewee from CAS illustrated the extent of such inter-jurisdictional impact:

> The critical barrier is a lack of global agreement on this, isn't it? The federal government won't act until the states act, and the states won't act until there's a global agreement and blah blah blah. I mean, if it comes to the mitigation side of things, until you've got a global agreement, it's very hard for a provincial

[12] Also, recognize that political will can manifest in many forms. Political decision-makers can be actively opposed to action on a certain issue, indifferent to action on that issue, open to bottom-up policy advice from the civil service, or actively making top-down policy themselves. One interviewee observed that science organizations have the most influence during the "bottom-up" mode, unless decision-makers need scientific guidance in calibrating "top-down" policy.

[13] This challenge is exacerbated by the very structures and norms of governance. Provincial consensus is a de facto prerequisite for the implementation of federal climate policy. This constrains the potential for action and complicates the role of science, which can occasionally become a subject of negotiation.

> jurisdiction to move things. BC's done a lot considering that fact that – what are we – point zero something of the world's population, point zero something of the world's emissions.

The nature of climate change as a collective action problem means that any given science-policy partnership will be strongly affected by the (not particularly malleable) governments external to it. Nonetheless, an intermediary from the municipal case hinted at a potential course of action:

> We [the provincial government of BC] observe that… most of the things that are affected by climate change are the responsibility of local government, therefore if we're going to advance adaptation in BC, we need to engage local governments, so it's that kind of thinking, and they you just go about finding partners in doing that. Ideally, we are brokers.

That is, even though a partnership cannot easily influence other institutions and governments, it *can* shape its own relationship with them. Relevant institutions, lower levels of government, and adjacent jurisdictions can be contacted and brought into the partnership, while higher levels of government can be lobbied for assistance or leadership. This approach is similar to how the MLG that may be necessary for addressing climate change (see Ostrom 2009) would ideally work. Ultimately, these observations demonstrate the further importance and potential breadth of "diversity of stakeholders involved" as an element of co-productive design.

The most proximate causal factors, aside from co-productive design itself, are generally a little more malleable from the perspective of a science-policy partnership, although such malleability can vary substantially. First, there are individuals (see 'rational choice theory' in Howlett et al. 2009) such as the champions and liaisons in the municipal case, the varying ministers in the national case, and the considerable influence of former premier Gordon Campbell in the provincial case. Sometimes these effects are not controllable. For example, the malleability of a high-level decision-maker is similar to that of political will, discussed previously. However, organizations participating in a science-policy partnership can explicitly

assign people as official champions or liaisons, hiring or appointing only those with a certain level of personal interest. Second, there is the inherent divide between natural science and policy (e.g. see Lawton 2007). This was well characterized by an interviewed civil servant from CAS:

> The basic nature of the research scientist who's grown up through a graduate program, has chosen to go to a PhD, and then chosen an academic track, is one who dives into extreme detail, one who is very interested in a certain aspect. Policy is interested in what they need to do at that moment. And because of that, it's a fundamentally different – two different cultures… The scientist… has to be independent and has to be completely unfettered in their work, where policy work, by nature, is fettered.

A single partnership cannot do much to address the general divide itself, but it might be able to mitigate the effects of that divide in its particular instance. For example, the user feedback sought by PCIC allows the organization to avoid using overly technical language in its tools, which is a classic barrier between science and policy. Similarly, recognizing the inherent divide (as many interviewees in the provincial case did) and facilitating conversations around it could lead to solutions that might better 'sync' the timing of policy needs and research projects, by fast-tracking academic research or working together to anticipate future policy issues. Third, there is a level of institutional design slightly broader than the co-productive design of partnerships themselves. Consider, for instance, the endowment funding for PCIC and PICS. It offers stability, independence, and a formal link to the provincial government. This factor is malleable in the sense that such design decisions can be made when a new organization or department is established, but non-malleable in the sense that those same decisions often cannot be easily altered in the future and may have been predicated on some level of political will to begin with. Still, it suggests that formal connections and other supports established at the outset of the partnership can be an important contributor to its success. Thus, there are several ways in which partnerships can adapt to these more proximate and malleable causal factors.

Regardless of its co-productive design, then, a climate science-policy partnership is more likely to be successful (e.g. facilitate progressive action) if: a relevant recent event has occurred to galvanize discussion and action; political will (i.e. public opinion and the ideology or interest of high-level decision-makers) for the issue is high; other relevant institutions are available for collaboration; other governments and jurisdictions create opportunities instead of barriers; relevant individuals are highly competent and enthusiastic about the issue; and the relevant organizations or departments have been broadly set up in a manner that facilitates stable partnership. Ultimately, a particular constellation of conditions is required in order for genuine policy action to occur (see Kingdon 1984). One municipal planner illustrated this well:

> A few things lined up for us – pine beetles, snow management, [an interested university researcher]… I was available. I had a budget… [a regional partnership] came along at the right time. We were ready because we already had an adaptation plan, so we could roll right into that. The [sustainability plan] was happening… and our [official community plan] was updating. All of that just fit into place one thing after another, so it was kind of luck, in a way, that worked out the way it did for us… It wasn't something that was front and centre.

The notion of 'luck' suggests that many of the factors that lead to partnership success are outside the control of the participants themselves (i.e. non-malleable). The CFCAS relationship met with failure because of insufficient political will and individual interest on the policy side,[14] while Gordon Campbell's leadership not only provided the lasting endowment funding for PCIC and PICS, but also created CAS as a permanent institution. Similarly, perhaps the reason that the municipal case has been more successful than the provincial case is not chiefly because of differences in design, but rather differences in the very nature of the relationship. PCIC interacts with multiple municipalities, such that none have any perceived authority over it and thus being completely open to feedback carries few risks. PICS is similar in size and scope but deals

[14] In my judgement, these two conditions are more important than the others discussed in this section.

primarily with a single provincial government, which *does* have some general perceived authority over it and is perhaps under greater political scrutiny than any given municipality; preserving independence seems more important, so open feedback and influence is constrained. However, this section has shown that even these external factors are often somewhat malleable or at least can be adapted to, and other sections have shown that co-productive design matters too. The above quotation refers to "having an adaptation plan ready", which suggests that even when necessary conditions are not present, it is important to prepare for their potential occurrence.[15] Essentially, both malleable and non-malleable factors are important.

Developing and Applying New Co-Production Theory

The above sections have synthesized the three case studies in order to identify, for science-policy partnerships in general, the most important aspects of co-productive design, the most realistic outcomes and benefits that may ensue, and contextual factors that affect causal pathways between the two. Merely listing these various elements, however, is not that useful for understanding science-policy partnerships. Informed recommendations cannot be made for any of the cases without appreciating the sophistication of relevant causal pathways, as illustrated by Chapter 2's analytical framework. That is, effective co-production theory must acknowledge the variety of design inputs, policy outcomes, causal mechanisms, and external conditions that have been revealed by the case studies. Accordingly, the first purpose of this section is to transform the original hypothesis indicators, which are narrow and idealistic, into a theoretical model of specific pathways (or conditions) that accommodate these factors. This section's second purpose

[15] In other words, co-productive design seems to have little control over Kingdon's political stream, but it may still be worthwhile for it to couple the problem and policy streams, in preparation for eventual changes in the political stream that cause policy windows to open.

is to apply the model back to the cases in order to make prescriptive recommendations for improvement and answer the corresponding research questions more thoroughly. Basically, I suggest that science-policy partnerships can be classified into a hierarchy of types based on their level of co-production, such that the potential mechanisms required for improving any given partnership become clear (see Table 7.3 on the next page). I call this the science-policy relationship hierarchy (SPRHi) theoretical model.

While the entire model is interrelated, it can be roughly divided into four distinct pathways corresponding to a hierarchical classification of science-policy relationship types (i.e. network, base partnership, dialogue, true co-production). In an attempt to synthesize my research findings and leverage the literature and analytical framework from Chapter 2, each one includes a group of related design characteristics, the outcomes they are likely to facilitate, and external (i.e. non-malleable) conditions necessary to link the two.

Conditions for a Supplementary Network

A relationship with a greater diversity of participants beyond merely academic natural scientists and government policy-makers (e.g. government scientists, academic social scientists, other relevant institutions, other levels of government, other societal stakeholders, the public) is likely to have a higher degree of soft policy influence (e.g. raising awareness about the given issue, broadly educating policy actors, expanding influential coalitions, finding windows of opportunity, maintaining momentum) since the network will embody more expertise, connections, and opportunities. Messaging strategies can be used to recruit and connect with the various groups. This is dependent on the very existence of such participants to begin with, as well as their willingness to participate. Importantly, this causal pathway can still be pursued

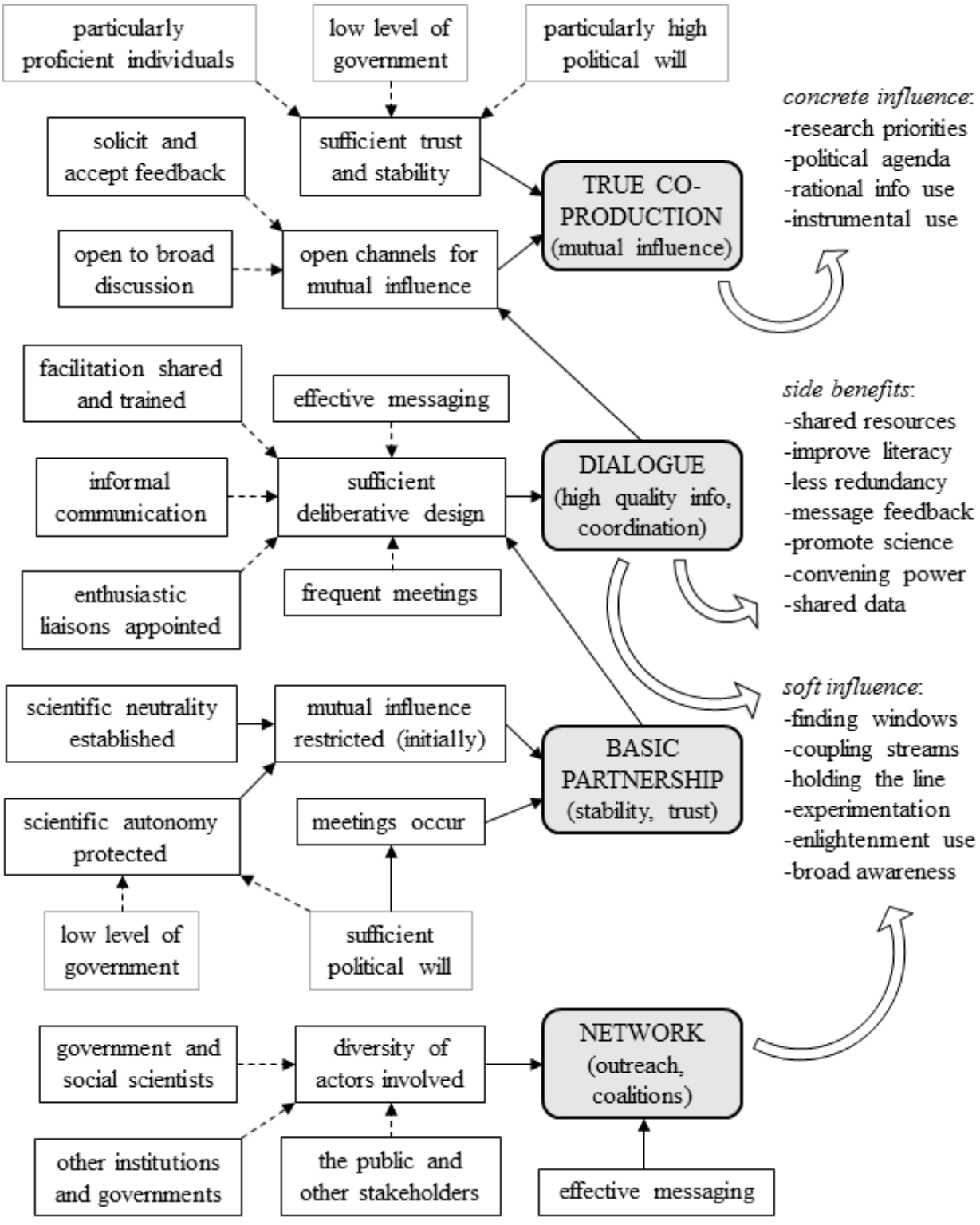

Table 7.3 – The Science-Policy Relationship Hierarchy (SPRHi) Theoretical Model[16]

[16] The bubbles shaded in grey represent four different classifications of partnership and should be treated as headings for the table, to be read from the bottom (the 'network' classification is independent from the others). The black-outlined boxes indicate potential design characteristics, while the grey-outlined boxes indicate non-malleable

when no science-policy partnership has been established; other forms of partnership (e.g. scientists plus the private sector) can still have soft influence.

Conditions for a Basic Science-Policy Partnership

A science-policy partnership cannot begin to function unless certain requirements are met. First, the science partner must be seen as credible and neutral, such that it is worthwhile for the policy partner (usually civil servants from a government agency rather than elected politicians) to engage. Second, there must be a guarantee of protection for basic research and academic freedom, such that it is safe for the science partner to engage (this may be more likely at lower levels of government where there is less of a power dynamic at play). Together, these characteristics may manifest as a mutual restriction on direct advice and influence, facilitating an atmosphere of trust. Third, actual meetings must occur in some form. All of these characteristics are dependent on external commitment in favour of maintaining the partnership. This could come from a formal institutional obligation, general organizational culture (perhaps dependent on the level of government), enthusiastic individuals on both sides, or general political will (perhaps reacting to recent relevant events). Ultimately, there are no immediate benefits (other than symbolic ones perhaps) that directly result from meeting these prerequisites, but they facilitate the stability and trust necessary for dialogue to occur.

Conditions for an Interactive Science-Policy Dialogue

Once a basic science-policy partnership has been established, it can become a dialogue by employing deliberative elements: informality (i.e. contact outside of meetings, sharing

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external factors that may be essential for certain types of partnership. The solid arrows indicate necessary requirements, the dashed arrows indicate potential contributing factors, and the wide arrows indicate a final outcome. This table should be considered merely a visual summary of the model, and is heavily supplemented by the surrounding text.

information, cordial interaction), messaging (i.e. using accessible language, linking ideas together, highlighting success stories), and others (i.e. frequent meetings, shared facilitation, appointed liaisons). These characteristics facilitate cooperation, the sharing of quality information, coordination (i.e. joint projects), and general amicability, which naturally lead to side benefits for both scientists (e.g. access to government data, promotion of research, improved messaging) and policy-makers (e.g. research efficiencies, access to academic information, resource sharing, convening power, improved literacy), as well as soft policy influences. This pathway can, intuitively, be strengthened by the presence of competent individuals, flexible institutional structures, or constructive organizational cultures.

Conditions for Genuine Science-Policy Co-Production

If a dialogue between scientists and policy-makers incorporates elements of genuine co-production (e.g. hold one another accountable, open to broad discussion, solicit and accept feedback from one another, identify and resolve disagreement), it opens channels for direct and concrete mutual influence. This can lead to actual changes in policy (e.g. adjustments to implementation, prioritizing different issues, even official legislation), depending on the available windows, assuming there are no external logistical barriers (e.g. from intergovernmental relationships). It may also change the direction of scientific research. The chief limitation of this pathway is that opening channels for influence inherently challenges the basic trust and credibility that are prerequisites for the partnership to begin with, particularly if the science organization primarily provides explicit advice rather than base data. Thus, in order to pursue such outcomes, the relationship must be particularly secure (perhaps dependent on the level of government), involve particularly proficient individuals, or be based on particularly high

political will. Opening channels of influence will also be easier if initiated by the desire to receive, not give, feedback and advice, since it is less likely to violate trust.

Although a substantial amount of information is present within the theoretical model itself, I will provide some further contextual description. To begin with, the pathways form a hierarchy. For any given science-policy relationship, the partnership conditions must be satisfied before the dialogue conditions, which must in turn be met before the co-production conditions. The network conditions are independent and can be satisfied regardless of where a given science-policy relationship falls in the hierarchy.[17] For example, if relevant policy-makers are not interested in partnership (or in the given issue at all), a science organization might engage other actors (e.g. other stakeholders, other governments) using strategies of issue-expansion (see Cobb et al. 1976) or venue-shopping (see Albæk et al. 2007).[18] Really, the network conditions are relevant to an expansive range of activities that seek to influence politics. They are much more abstract than the other pathways, which are more of a focus here, but provide vital context for them as an alternative route to policy change.[19] External conditions play a substantial role in the conditions for partnership and the conditions for true co-production, but also have some influence throughout the model. One important contextual feature that would intuitively help to enable all pathways is a general government commitment to, or culture of, EBP. However, the most central external consideration relevant across the conditions is the level of government

[17] However, a partnership belonging to a broader network does not necessarily imply that additional stakeholders are present at every interaction. Indeed, maintaining trust and stability between the science and policy partner may require that some interactions involve only a few people and occur in private.
[18] These pieces of literature were not introduced in Chapter 2. They are not centrally relevant to science-policy interfaces, but are helpful for understanding the broader context of political advocacy.
[19] Sabatier (1988) provides a much more nuanced characterization of coalition activities, since they are the focus of his work rather than a mostly contextual factor.

being engaged with. I suspect that it may generally be easier for science partnerships to maintain partnerships with lower levels of government, although the potential impact may be reduced.

The SPRHi model is also meant to be fairly comprehensive, accommodating various factors highlighted by the literature and analytical framework (see Chapter 2). For example, policy change, research utilization, policy learning, and loose coupling are present under soft influence, while institutional design, deliberative democracy, and co-production are included in the conditions for dialogue. Many aspects (e.g. liaisons) are based only on the empirical data from the case studies, however, rather than the pre-existing literature. It should also be clear where various minor factors might intersect with the model, whether they are elements of design, outcomes, or external influences. For instance, "accountable to one another" falls under "solicit and accept feedback" and "tries to resolve disagreement" overlaps with "open to broad discussion". Basically, the model makes room for the broad variables that could be relevant to any given science-policy relationship (i.e. it has the same purpose as the analytical framework in Chapter 2 and the mixed methodology in Chapter 3), though it focuses on those most likely to be influential. Despite their comprehensiveness, the pathways can also be interpreted and used in a more general manner. For example, the conditions for a network leading to soft influences are useful on their own, independent of the rest of the model. Similarly, the design principles associated with the dialogue conditions can be considered best practices for existing partnerships (facilitating side benefits), without requiring the context provided by the rest of the model. The following paragraphs will more concretely demonstrate the SPRHi model's utility by using it to generate suggestions for the three cases.

Regarding the relationship between CFCAS/CCF and the federal government, recall that most of the recommendations implied by interviewees were not practically relevant, since they

apply to the now-defunct CFCAS (e.g. flexibility for board positions and funding structure) or are predicated on a completely different political inclination (e.g. stop defunding basic research, stop muzzling government scientists). The only meaningful strategies that CCF could pursue under the Conservatives would be coordination with other non-government organizations and the incorporation of social science. The SPRHi model has the capacity to predict and explain this situation. If the federal government is disinterested in science-policy cooperation, the basic partnership conditions cannot be met, which precludes meeting the conditions of dialogue or true co-production. Only the network conditions (i.e. recruiting other stakeholders and experts) could be pursued by CCF, and they have the potential to increase its soft policy influence.

The pathways can also explain the CFCAS years, where the relationship qualified as a basic partnership moving slowly toward more interactive dialogue as CFCAS became more interested in policy influence. Since political interest eventually dwindled, this was a missed opportunity to implement many elements of deliberative design (see the dialogue conditions) similar to those suggested by the respondents in retrospect. This supports a general lesson for other cases. Since political will is essentially non-malleable, it must be utilized when it does arise and science organizations should plan for the possibility of its decline. Of course, policy-makers and politicians also stand to gain from the side benefits of science-policy dialogue, even when they are not interested in taking action on the given issue, so perhaps an effective partnership would be able to withstand fluctuations in political will and public opinion. The four pathways, then, are capable of offering similar suggestions to those of interviewed experts, with less specificity but more context and breadth.

In Chapter 5, most of the recommendations made by interviewees for the partnership between PICS and CAS were controversial (e.g. that PICS should shift from planning to delivery

and provide information on economic tools for adaptation). That is, I was skeptical that they would be supported by both sides, given the delicate balance of autonomy that characterizes the relationship. Still, some of the suggestions about deliberative design seemed applicable (e.g. appointing official liaisons, broader meetings between government and academia). In terms of the four pathways, the PICS-CAS relationship qualifies as a dialogue, given the level of interest on both sides, the established mutual trust, and the interactive elements that are present. As such, deliberative improvements can be expected to lead to further side benefits and soft influences.

The far more interesting implication of the model is that PICS and CAS have not yet achieved true co-production, since although they are ostensibly open to feedback from one another, direct mutual influence is highly constrained. As the conditions for true co-production state, opening channels of influence naturally challenges the trust and credibility necessary for a basic partnership. For instance, if PICS were no longer seen as independent from the government, how could it educate the public objectively and lend its convening power to joint events? This is precisely why so many of the interviewee recommendations seemed controversial. The key concern is whether further channels of influence can be opened without compromising the foundation of the partnership. Such changes should be approached slowly and carefully, perhaps through meetings which, at first, encourage feedback only slightly franker than what is usually communicated.[20] Also, proposing such meetings will probably be received more positively if centred on the desire to receive feedback (as in the PCIC case) or mutually provide feedback rather than the desire to give feedback, since it respects the other side's

[20] I believe interviewees from both sides were more forthright regarding their assessment of the other side with me than they would be with each other. If they were to have the same conversations with one another, it might mitigate some of the tension and negative perceptions (e.g. CAS staffers were worried that PICS scientists saw the relationship as a 'platform', but my impression is that the latter are incredibly sensitive to respecting the boundaries of the partnership).

autonomy, regardless of which side is the initiator. Ultimately, the SPRHi model is able to contextualize and incorporate the direct recommendations of interviewees from CAS and PICS while proposing a clear option for potential improvement,[21] though it is not specific enough to unambiguously determine whether that option can or should be pursued (which requires the judgement of actual participants). Perhaps the nature of the relationship (i.e. type of information, level of government) means that, at best, it can satisfy the dialogue conditions.

The relationship between PCIC and BC municipalities was observably the most successful of the three cases. Although interviewees were able to generate recommendations when prompted, most of those would require a greater base of given resources (e.g. PCIC should provide additional support for individual communities). Only a few minor suggestions seemed to be truly practical, and perhaps even those are already being pursued informally (e.g. PCIC should ensure users are familiar with its range of tools). There were no glaring deficiencies reported for the relationship; it appears to be essentially meeting its potential, given the underlying resources. An application of the SPRHi model would, for the most part, agree with the assessment of the interviewees. To begin with, the dialogue conditions could generate a similar set of minor deliberative suggestions (e.g. sharing information and using accessible language). More importantly, there seems to be some true co-production between PCIC and BC municipalities, given the former's receptivity to feedback and influence, which explains why it is the only case with concrete examples of policy influence.

However, the conditions are only partially satisfied, since the channel of direct influence only operates in one direction (i.e. PCIC scientists avoid giving policy advice), which means

[21] There were also some suggestions about the broader institutional design and funding structure, which are not particularly central in the model.

there is some potential for additional benefits to be captured.[22] Indeed, the examples of influence provided were quite minor. Facilitating direct policy advice from scientists could, however, undermine the credibility and perceived neutrality of PCIC, which is similar to the potential trade-off in the provincial case. I was given the impression that scientists often have additional advice to give, which could be helpful, but refrain from stating it outright in order to maintain an air of neutrality (e.g. interviewees instead used terms like "coaching" and "planting the seed of ideas"). From PCIC's perspective, communicating a desire to receive feedback is not an option for initiating mutual influence, since the organization is already open to that. Perhaps another option for careful and incremental change is to conclude meetings by having PCIC scientists simply ask, after all the basic science has been communicated, if planners would like to hear their opinion or advice on priorities or potential actions for the given community.[23] This approach is non-presumptuous and may be able to preserve credibility. Only the actors involved can really judge whether it would be worth attempting. The SPRHi model is not only able to contextualize the municipal case, then, but also offers a potential opportunity for improvement that was not obvious to the interviewees themselves.

Applying the model to the three cases has demonstrated its utility. Ideally, it should be possible to classify any given science-policy partnership onto the hierarchy of conditions, explain its level of success, and offer prescriptive recommendations for improving its current form (i.e. basic partnership, dialogue, true co-production) or shifting to a more ideal one. The

[22] It could also incorporate the other elements of design listed under the conditions for co-production. However, many of those are predicated on the existence of two-way feedback to begin with, and others may not be appropriate given the multiple relationships (e.g. how could PCIC include a specific municipality in its mandate?).
[23] Another potential incremental change would be to shift from the role of a 'science arbiter', which provides clarified information and answers questions, to the role of an 'honest broker', which attempts to list various policy options and the science-based implications but does not advocate one over another (see Pielke Jr. 2007). That is, perhaps PCIC needs to be wary of 'advocacy' but not 'advice'. This measure might be able to increase direct influence without compromising neutrality and trust.

original hypothesis turned out to be somewhat true; the closer a partnership gets to the co-productive ideal, the more substantial the side benefits and (mostly soft) policy influences. However, the case studies illustrated that certain external factors are necessary in order to pursue certain design characteristics, particularly for the partnership and co-production conditions. Depending on the nature of the relationship and the level of political will, it may not be possible for a case to satisfy the former or to shift to satisfying the latter from satisfying the conditions for dialogue. As suggested by the provincial and municipal cases, perhaps it is not feasible to fully satisfy the co-production conditions without wholly undermining a given relationship, which would mean the perfectly co-productive ideal does not exist in reality (although the PCIC case is a good model for the time being).[24]

Importantly, the external conditions may depend on the level of government involved. In the cases explored, a lower level of government meant more success. As discussed in a previous section, science organizations may feel that they have more freedom in relationships with lower levels of government, since higher levels may have actual or perceived authority over them (e.g. control of their funding) and other relevant stakeholders.[25] PCIC, for instance, with its many municipal partners, probably does not need to be nearly as careful as PICS, with its single provincial partner, to maintain perceived independence and credibility. This demonstrates the great importance of the endowment funding, which ensures academic freedom. Opportunities for

[24] Or perhaps it means that science organizations have to choose between influence from within (e.g. dialogue) and influence from without (i.e. network), and cannot realistically achieve the ideal combination of dialogue and direct advice (i.e. true co-production). This would be consistent with the argument of Spruijt et al. (2014) that science organizations must choose between different roles depending on the situation.

[25] There may be a few other reasons that lower-level governments are generally easier for science organizations to partner with. First, the basic reality that there are more lower-level governments than higher-level ones means that the potential risks of compromising any one relationship are much lower for the former. Second, higher levels seem to be under greater public scrutiny and more likely to employ top-down directives, which may raise the probability of political will becoming a barrier. Third, lower levels are more likely to address climate adaptation (a tractable local problem) than mitigation (a controversial global problem), which also affects political will. There is also the complication of federal-provincial negotiation in the CFCAS case.

such broad institutional design are rare and should be utilized to facilitate both stability and flexibility. Similarly, opportunities to take advantage of high political will should not be squandered, as demonstrated by the CFCAS/CCF case. The SPRHi model supplements the original hypothesis with all of these considerations regarding external conditions, allowing for a much more realistic characterization of science-policy partnerships, which not only offers analysis for the given cases, but can apply to others as well.

Addressing Canada's Climate Science-Policy Gap

The SPRHi model can contextualize and make recommendations for individual science-policy relationships, which is helpful for the three cases themselves, but what lessons can be offered to the broader problem of climate inaction in Canada? Even if PCIC, PICS, and CCF were to, for instance, follow all possible recommendations generated by this dissertation, political will for climate action would still be very low at the federal level, and arguably insufficient at the other levels. This highlights a deeper problem, one that is not very malleable. However, recall these quotations, from a municipal planner and CFCAS scientist respectively:

> The communication link between the science and the policy-making is just so critical, and is often – I mean we have all these great universities that are doing tons of really good research, and we have lots of well-meaning people in local governments and other jurisdictions that are trying to prepare for climate change, but there's often – and this is in all fields, not just climate planning, for sure – there's often a bridge that's missed.

> There isn't quite the specific mechanisms out there to bring the rather diverse and multiple players together – there are organizations out there that are trying to do similar things, and I think one of the challenges will be to find mechanisms so that we effectively collaborate on getting the message out, as opposed to either duplicating the message or having conflicting messages out there.

There is a broad opportunity for connections and coordination. Facilitating genuine climate action on a national scale will require extensive network-building, preparing for much more

critical windows of opportunity than the internal ones discussed previously. A broad interpretation of the network conditions could refer to this cooperation, involving any available policy actors at all levels of government, multiple science organizations, and a diversity of stakeholder groups. The principles of MLG (e.g. see Hooghe and Marks 2003), and its necessity for addressing climate change (e.g. see Ostrom 2009), could apply, even if some relevant governments are not involved. A representative of CFCAS confirmed MLG's relevance for climate change:

> Any mitigation decisions that you take – you have to take that decision locally or nationally, but it has global implications, and it only affects global greenhouse gas concentrations and global climate, so that's not a particularly detailed or fine decision that you have to make at a local or regional scale. The other aspect of the solution is adaptation, and that mantra is that adaptation is something that happens locally… if you anticipate that it's going to be two degrees warmer in the future than it is at present, and extreme precipitation is going to be 10% heavier or something like that, then you can start thinking about what stormwater-handling infrastructure around your town might look like, change building codes.

That is, adaptation *tends* to seem like more of a local or regional issue, whereas mitigation *tends* to seem like more of a national or global issue; multiple levels of government must be recruited to action if both aspects of the climate change problem are to be addressed. A particularly capable actor (i.e. a policy entrepreneur – see Kingdon 1984) might be able to initiate such coordination, although it may lead to them being perceived as an outright advocate, which, as shown above, is something many of the relevant actors have good reason to avoid. While the specifics are outside the scope of this dissertation, general network-building could be a promising avenue for addressing the problem of climate inaction in Canada, in the absence of changes in political will.

Ultimately, significant changes in policy tend to require changes in public opinion and political interest. Sufficient political will (e.g. at the federal level) could lead to direct policy

action, engagement with science organizations, or the coordination of MLG arrangements. Contextualizing this, many interviewees commented on the norm that in order to influence policy, scientists must wait for policy windows to open, policy-makers (i.e. civil servants) must wait for direction from their "political masters" (i.e. high-level decision-makers), and politicians must wait for a window of opportunity with the public (who, in turn, wait for events). It is no surprise, then, that political will always seems to be such a non-malleable given. This is particularly problematic for climate change, since the public may not react to the problem sufficiently until it is too late to take action, as evidenced by this quote from a CFCAS scientist:

> The implications of climate change – they're long-term in essence. It's difficult to get people to focus on it unless they start seeing it happening, and where you start to see it happen is in the more frequent severe events, whether that's droughts, floods, or whatever, or ice storms. That's when people start to say "wait a minute, something is happening here – this is not the weather I would normally expect, so what's happening?" – that's when you start to get their attention a little more.

However, consider "leadership" or "entrepreneurial" strategies that might break this pattern by relying less on public pressure, as suggested by one ex-politician:

> Many ministers believe that satisfying interest groups is their raison d'etre… In political terms, that's not necessarily wrong… we do play this business of satisfying interest groups, and I shouldn't pretend that I did none of it. On the other hand, that was not my main goal, certainly on climate change. Our job was to tell some unpleasant truths to the people who would prefer not to hear them… I was used to being the [one] who said no.

This matches up with the influence of Gordon Campbell in the provincial case (i.e. BC's leadership on climate change was more due to his personal interest than public demand) and the more recent comments of Paul Martin noted in Chapter 6 (i.e. he argued that political leaders absolutely have the ability to bring issues to public attention). Perhaps it is possible to pursue progressive action notwithstanding the lack of external conditions that would normally be required, just like there are reasons for government departments to pursue science-policy

partnerships (i.e. side benefits) regardless of the level of political will for the issue at hand.[26] Similarly, dialogue participants should consider increasing their receptivity to feedback and advice, even *without* a mutual commitment from the other side, since it will indirectly increase their own influence (e.g. PCIC's openness to feedback from users increased the likelihood that its tools would be used). As such, while the new theoretical model effectively explains the outcomes of the three cases by highlighting the importance of external restrictions, it may be possible to overcome such constraints.

The suggestion that many external restrictions are somewhat malleable after all brings us back to the broader body of theory supporting this dissertation. Chapter 2 highlighted two competing traditions in the literature, one claiming that policy is largely determined by non-malleable characteristics and one suggesting that improved science-policy mechanisms will affect policy outcomes. The theoretical model developed in this chapter attempts to accommodate both traditions, so it will have implications for the relevant sub-fields of literature. It presents science-policy relationships (and their surrounding context) as far more complex and nuanced than any individual pieces of pre-existing literature (or even the dissertation hypothesis) would suggest. A conversation between the broader literature and the dissertation findings may also reveal further phenomena that must be understood in order to bridge the gap between international scientific consensus and climate policy action. This is the primary focus of the final chapter.

[26] One interviewee did point out, however, that it can be difficult to market the benefits, even from one policy-maker to another, since they are not immediately obvious and relationships take time to establish.

Chapter 8: Conclusion

This dissertation opened with a characterization of the gap between international scientific consensus and global policy action on climate change. An intuitive explanation for this gap is that there is some problem with the information channels between scientists and policy-makers. Much of the relevant literature suggests that science-policy partnerships can be improved through institutional design that facilitates deliberative co-production (i.e. genuine two-way exchange resulting in mutual influence). As such, I set out to study existing relationships between science organizations and government institutions in Canada, a country that has been particularly slow to take policy action on climate change. Hypothesizing that science-policy partnerships embodying a greater degree of co-productive design would consequently have higher direct policy influence, I interviewed expert participants from cases at the municipal, provincial, and national levels.

I found that science-policy relationships can generally be categorized into a hierarchy based on their level of engagement. A given relationship may qualify as either incidental interaction (e.g. the national case currently), a basic partnership (e.g. the national case initially), an interactive dialogue (e.g. the provincial case), or true co-production (e.g. the municipal case).[1] Each of these is associated with certain design characteristics, various outcomes, and external conditions. Essentially, I transformed the hypothesis into a theoretical model (i.e. SPRHi) that explains the success of science-policy partnerships in a more nuanced manner, not merely in terms of co-productive design and concrete policy influence. This has prescriptive implications for malleable aspects of the individual cases examined (see Chapter 7). For instance, co-

[1] The municipal case would be more accurately described as falling in between the latter two categories.

productive design seems to be particularly important for turning basic partnerships into interactive dialogues, which appear to facilitate soft policy influences and side benefits. However, most of the other types seem to be determined primarily by broader factors such as the level of political will, that is, the interest of the relevant government institution in science-policy exchanges. Concrete policy influences appear to result only from relationships embodying true co-production, and even then they generally comprise technical improvements rather than major changes to policy direction.

The SPRHi model, then, does not say enough about how to address the broader problem of climate inaction in Canada. As above, co-productive partnerships between scientists and civil servants can sometimes be an important ingredient in creating effective climate policy (i.e. by facilitating technical improvements to initiatives), but the more crucial requirement is the political will necessary for the issue to be seriously considered to begin with. Generally, this dissertation has treated public opinion and political leaders (i.e. two facets of political will) as non-malleable factors that science organizations cannot alter directly. Thus, the appropriate role for scientists seems to be one of vigilance, remaining involved with existing science-policy partnerships (and open to the creation of new ones) in case political will for climate action surges, perhaps while exerting soft influence on the public and politicians through outreach and network-building, such that they might possibly have some invisible long-term effects on political will itself. While this may be a realistic characterization, it is not a particularly satisfying answer to the initial problem identified by this dissertation, since bridging the gap between scientific consensus and the level of climate policy action in Canada will require *substantial* changes in political will. We still need to determine how to leverage scientific

expertise to influence public opinion and political leaders directly. That is, how might those seemingly non-malleable factors be meaningfully addressed?

As such, this chapter considers the larger problem of climate inaction by revisiting the broader literature in light of the dissertation findings.[2] First, it explains specific contributions to the body of knowledge around science-policy relationships (i.e. more sophisticated causal pathways; realistic and comprehensive design characteristics for science-policy dialogues; a contextual distinction between natural science and social science; recognition of soft policy influences and side benefits; a contextual distinction between government civil servants and high-level political decision-makers; and the inclusion of government level as an essential variable). Second, it discusses general contributions relevant to literature on policy change (i.e. an appreciation for the diversity of temporal tensions between scientists and other actors; a contextual distinction between climate mitigation and climate adaptation; messaging strategies for scientists; and an acknowledgement of political will as key external condition), addressing some gaps while also revealing further questions. Third, the chapter concludes by considering avenues for further work (i.e. specific supplements to this study; mechanisms for global collective action; research on public attention and persuasion; and possibilities for political leadership independent of external pressures). Through this analysis, I hope to demonstrate the dissertation's broader significance.

[2] Not every relevant sub-field of literature is explicitly revisited here. While all of them have been incorporated into Chapter 7's theoretical model, some of them (e.g. intra-coalition policy learning and general institutional design) have merely been corroborated by or applied to my research, rather than transformed or critiqued through the process. This chapter speaks primarily to the sub-fields to which my findings can offer a clear contribution.

Specific Contributions about Science-Policy Relationships

The comprehensive analytical framework developed in Chapter 2 (see Table 2.2) aimed to accommodate a wide range of variables identified by relevant sub-fields as pertinent to science-policy relationships. It implied that any sophisticated causal pathway from science through partnership to policy influence should include: malleable co-productive design characteristics, potential outcome effects on policy, causal mechanisms that allow the former to affect the latter, and other non-malleable factors affecting the relationship. No piece of existing work attends all of these concerns in a particularly effective manner. For example, the research utilization literature (e.g. Weiss 1977), while it provides realistic explanations of how information flows into policy-making, tends not to highlight malleable characteristics that could be manipulated to affect the process. The four pieces of co-production literature that present explicit causal pathways (see Table 2.1), upon which the framework was ultimately based, are no exception. Among other potential shortcomings, Cash et al. (2003) and Tuinstra et al. (2006) fail to outline specific policy outcomes at the end of their pathways, while Lemos and Morehouse (2005) and Rietig (2014) focus on only the science side of relationships, overlooking co-productive design characteristics that involve policy-makers.

The SPRHi model developed by this dissertation (see Chapter 7), on the other hand, attends the four requirements of the framework. For example, the conditions for dialogue propose that deliberative elements such as informality, which facilitates coordination and amicability, will lead to soft influences and side benefits, more so if particularly enthusiastic individuals are present. The relationship between the pathways reinforces their attention to variables in the framework (e.g. for a given case, the dialogue conditions cannot be satisfied until the partnership conditions are, which requires some level of political interest). Another

contribution is that, even though they were developed through case studies on climate change in Canada, the sets of conditions are phrased in the abstract, highlighting variables that could be relevant to other policy issues in other jurisdictions. Overall, the theoretical model, if it holds, advances a more comprehensive understanding of science-policy relationships, bringing together several traditions of literature, and thus offering both descriptive and prescriptive strength.

Specifically, the SPRHi model identifies important elements of co-productive design for science-policy partnerships. Recall the broad set of deliberative design characteristics put forward by Edwards et al. (2008), upon which the initial hypothesis was based. They suggest about 40 criteria for effective deliberative events, including, for example, involving a wide variety of stakeholders, encouraging equitable participation, and creating safe but transparent spaces for discussion. While these were more comprehensive and practical than the narrow characteristics described by literature on SPIs (e.g. the "interactional expertise" of Carolan 2006), they were meant to support policy-public dialogues, rather than science-policy dialogues (e.g. the provisions for transparency), and were more applicable to individual meetings, rather than broad relationships (e.g. the recommendation that equitable participation be encouraged). The model developed by this dissertation excludes such design characteristics for being irrelevant or redundant for most science-policy relationships, and acknowledges prerequisite characteristics that are necessary for partnership but not ostensibly deliberative or co-productive on their own, such as establishing base scientific credibility (see Chapter 7). As such, it combines the breadth of the deliberative design literature with the relevance of the SPIs literature, resulting in a list of design characteristics that embodies best practices and specific prescriptive recommendations for partnerships, summarized in Table 8.1 (on the next page). Compared to the

inventory of Edwards et al. (2008), this list is more relevant to science-policy relationships, and each characteristic is associated with a particular type of relationship and its likely outcome.

True Co-Productive Elements Potentially Leading to Concrete Influences	organizations are accountable to one another
	participants are open to broad discussion
	participants solicit/accept feedback from each other
	disagreement is identified/resolved
Dialogue Elements Mostly Leading to Soft Influences and Side Benefits	meetings are frequent
	there are informal aspects to the dialogue
	participants use effective messaging strategies
	meeting facilitation is shared/trained
	individual liaisons are appointed/specified
Prerequisite Elements Necessary to Establish Partnership	basic scientific freedom protected
	scientific credibility established
	mutual influence restricted (initially)
	meetings occur
Network Elements Primarily Leading to Soft Influences	both natural/social scientists included
	both academic/government scientists included
	the public/other relevant stakeholders included
	other relevant organizations/institutions included
	other governments/levels of government included

Table 8.1 – Summary of 18 Design Elements for Science-Policy Relationships

One of these design characteristics, the inclusion of both natural and social scientists, was a common suggestion from interviewees, despite being fairly rare in pre-existing work. The literature on SPIs focuses almost exclusively on natural science. Likens (2010), for instance, suggests that environmental chemists must improve their communication skills within the science-policy process, and even goes so far as to make comparable suggestions for other important actors such as journalists, industry, politicians, and teachers, but makes no mention of social scientists. On the other hand, the literature on research utilization focuses primarily on social science. For example, Weiss (1980), in arguing that research tends to inform policy slowly and indirectly, specifies that she is referring to social science research. These two sub-fields investigate very similar issues, and the tendency of one to use the term “science” to refer to

natural science while the other uses the term "research" to refer to social science, even though both of those generic terms could refer to either, demonstrates that there is further overlap. Despite this intersection, the sub-fields remain distinct from one another, implying that science-related policy issues (e.g. food and health policy) and social policy issues (e.g. justice policy) are completely different. This is an unnecessary separation, since the concepts of one sub-field often seem applicable to the other (e.g. it is my impression that natural science flows into the policy process slowly, just as Weiss observed for social science). More importantly, some policy issues, such as climate change, are necessarily interdisciplinary and thus involve both natural and social science (not to mention the humanities). Scholars of SPIs (e.g. Likens 2010) often lament the barriers between climate scientists and policy-makers (e.g. poor communication from scientists, short-term thinking of policy-makers) without acknowledging that collaboration with social scientists, who are more likely to understand the policy process itself as well as the social implications of suggested policy changes, would help to address the issue. Since the SPRHi model includes a design characteristic that acknowledges natural-social collaboration between scientists, this gap in the literature is attended.[3]

Besides additional contributions in terms of the "design characteristics" aspect of the analytical framework (see Table 2.2), this dissertation also offers further insights associated with the "policy outcomes" aspect. Mainly, it acknowledges soft influences and side benefits, unlike some of the SPIs literature. Bradshaw and Borchers (2000) suggest that the science-policy gap for climate change can be bridged if policy-makers perceive uncertainty in the same way that scientists do (i.e. as a necessary part of the research method, not as a lack of information). They imply that once this change is made (if it can be), climate policy action will follow. Similarly,

[3] I am not the only one to recognize this gap, however (see Lawton 2007 p. 468, Lohmann 2008). It is merely a specific example of how the design characteristics advance the existing literature.

Likens (2010) claims that if environmental scientists improve their communication skills and learn more about the policy process, they will have greater policy influence. However, the research utilization literature (e.g. Weiss 1977) suggests that scientific information flows into the policy process slowly, indirectly, and unpredictably, *even if that information is communicated clearly and not hindered by uncertainty*. The interviews revealed that employing elements of co-productive design in science-policy partnerships generally does not lead to concrete policy action, but rather improves the overall function of that partnership, leading to side benefits and greater soft influence (see Chapter 7). The SPRHi model based on those interviews does makes allowances, though, for conditions that may give rise to more direct policy influences (see the conditions for true co-production). Ultimately, this dissertation highlights the full range of possible beneficial outcomes from co-productive design, neither privileging nor discounting concrete policy changes, making a more nuanced case for science-policy interaction. It also clarifies that partnerships realistically will be insufficient, on their own, to facilitate the major policy changes necessary to address climate change (this is discussed further below).

Highlighting the distinction between civil servants and high-level decision-makers is another contribution from this dissertation that is related to policy outcomes. The SPIs literature often treats these two very different groups as homogeneous "policy-makers". For example, the framework of Lomas (2000) attempts to specify various inputs into the policy process alongside research (i.e. media, ideologies, interests), but portrays the decision process itself as a 'black box' that simply turns inputs into outputs. He uses the terms "policy-makers" and "decision-makers" interchangeably and without defining them. As such, his recommendation that researchers acknowledge political and institutional factors when disseminating information to policy-makers is imprecise, since it is not clear whether he is referring to civil servants or

politicians, which would warrant different approaches. My research has revealed that science-policy partnerships tend to occur between scientists and civil servants, rather than high-level decision-makers like ministers or councillors. The case studies, particularly the provincial one, showed that it is often fairly easy to establish links between scientists and a relevant government agency, but that concrete policy change is often precluded by gaps between that agency and its political masters (i.e. a policy-politics gap). Thus, the SPRHi model recognizes the importance of broad political will, and suggests that soft influence of elected politicians occurs *indirectly*, through civil servants or through broader outreach to the public. Overall, the dissertation demonstrates that it is necessary for the SPIs literature to treat civil servants and high-level decision-makers as separate entities.[4] As a last example, the various science-policy barriers listed by Lawton (2007) could be sub-divided into difficulties between scientists and civil servants (e.g. institutional inadequacies) and between scientists and high-level decision-makers (e.g. influence of external interest groups), which should be attended separately since they are unlikely to merit the same solutions.

A final clear contribution of this study is related to the "external conditions" aspect of the analytical framework. I have demonstrated that, for any given case of science-policy partnership, the resulting success and influence may depend on the level of government involved. Much of the existing literature on the role of science in the policy process fails to attend this factor. Lawton (ibid), for instance, suggests approximately ten potential barriers that might explain the gap between environmental science and policy action. To name a few: solutions may require international agreement that has not yet been reached, science may contradict dogmatic political

[4] Some pieces of literature already do a good job of this. Recall that Rietig (2014), for instance, clarifies that civil servants tend to use information instrumentally, while politicians tend to use it politically (see Table 2.1). Newman and Head (2015) are also exemplary.

beliefs, 'institutional failure' may be present (i.e. the decision-making structures are unsuitable and there are contradictory policies in different parts of government), and politicians may believe there is insufficient public support for action. His goal is to determine how ecologists can and do influence government policy, and he does so specifically in the national context of the UK. But given that municipalities are important actors for climate policy (see Bulkeley and Betsill 2003), how might Lawton's barriers manifest differently at the local level?

Perhaps municipalities are less concerned with international agreement, less affected by political ideology and party lines, small enough to avoid some of the institutional failures, and less fettered by public and media scrutiny. The results of this dissertation seem to hint that some of these differences may be at play in making science-policy partnerships easier to establish and maintain at lower levels. However, the most important factor is likely that the policy partner has less (perceived) authority over the science organization in such a context (see Chapter 7). In addition, there is substantial variety among the sizes and governing capacities of different municipalities. The municipal case suggested that it is best for science organizations to deal with small communities as regional groups or through intermediary institutions. At the same time, the national case and the network conditions imply that coordinating with other stakeholders may be necessary to influence larger governments. It seems that some sort of 'capacity-matching' may be necessary for science-policy interaction to be effective at any given level. Thus, the dissertation demonstrates that paying attention to the level of government can generate additional insights in the relevant literature.[5]

[5] As for the concept of multi-level governance, only very minor instances were discovered in the case studies. Certainly, municipal adaptation planning is supported by provincial initiatives and national funding, but there does not yet seem to be a concerted effort to facilitate mutual coordination among the levels in Canada. However, principles of multi-level governance were incorporated into the network conditions of the SPRHi model.

General Contributions Raising Questions about Policy Change

Much of the relevant literature (e.g. Lawton 2007, Weiss et al. 2008) points out that scientists and policy-makers operate on separate time-scales (i.e. the latter prioritize short-term concerns), which is a particular concern for climate policy. The dissertation supplements this by demonstrating that there are different temporal tensions between scientists and politicians, scientists and civil servants, and scientists and the public. The relatively short length of electoral cycles provides little incentive for politicians to seriously pursue the investments scientists claim are necessary to address climate change (and other long-term issues), since they will not really 'pay off' for many decades. Those electoral cycles are comprised of even shorter policy cycles. Unlike academics, who may spend several years on a given research project, policy-makers must respond to issues-of-the-day arising from unpredictable events and changes in public demand. Civil servants are often more preoccupied with concrete and immediate problems than long-term (and seemingly uncertain) concerns like climate change. The general public, in turn, also seems to prioritize short-term concerns (see Downs 1972 and Marx et al. 2007), which complicates the long-term actions scientists are recommending. The implication of this is that once the severe effects of climate change start to be felt, it will be too late to adapt to or mitigate them. This dissertation offers a bit of guidance on how temporal tensions between scientists and civil servants might be addressed (e.g. continual communication allows science organizations to anticipate upcoming concerns), but does not address these broader complications. How might the limitations of short electoral cycles be overcome? How might the public be convinced to take a long-term view?

The distinction between climate change mitigation and adaptation policy decisions is sometimes overlooked in the literature. For example, while Edwards et al. (2008) seem to

implicitly focus on the former and Lemos and Morehouse (2005) seem to implicitly focus on the latter, neither work explicitly states which aspect of climate policy it is addressing, which leaves the applicability of their proposed models somewhat unclear. My research revealed some of the contextual differences between mitigation and adaptation that should be attended by this literature. For instance, if mitigation and adaptation *tend* to be dealt with by different levels of government, then the barriers to policy action that they face will be dissimilar, as per the discussion in the above section. Mitigation is also a collective-action problem, where the benefits of one jurisdiction's policy action are distributed globally, while adaptation is more of a standard policy problem, where the benefits of action will be captured by the jurisdiction taking that action. Exacerbating this, there are often perceived tensions between emissions mitigation and the (fossil fuel-dependent) economy (Meadowcroft 2009 p. 329), whereas adaptation can be framed as "investing in the future" or "lowering risk". Basically, the latter generally appears to be more politically tractable.

It is also possible that, in terms of natural science, adaptation planning requires very specific technical expertise (e.g. the probability of getting 20cm of rain in one day over the next five years), whereas mitigation needs only general evidence for action (e.g. the recognition that greenhouse gas emissions are too high). Of course, mitigation policy might benefit greatly from specific social science expertise (see the above section). Perhaps climate science organizations (i.e. natural scientists), then, may be more successful in establishing science-policy links if the basis is adaptation rather than mitigation. However, the two are linked, and the potentially higher tractability of adaptation policy can lead to increased political interest in mitigation policy. There is still more to know about the political distinction between adaptation and mitigation though. Namely, even if we know how to facilitate effective science-policy relationships around

technical aspects of adaptation (e.g. PCIC), how can we address the broader political barriers (e.g. collective action problems) to mitigation policy?

Connecting a politically tractable issue (e.g. climate adaptation) to an intractable issue (e.g. climate mitigation) is an example of a messaging strategy that scientists might use to exert soft influence on political will, whether they are communicating with policy-makers or the public. Such strategies are sometimes suggested in the literature on SPIs. The above is referred to as the "oblique approach" by Prins et al. (2010). Much of the literature only generically implores scientists to "present findings clearly" and "understand policy-makers" (e.g. Likens 2010, Lomas 2000), however. My research revealed a range of specific strategies.[6] One perspective I encountered favoured a re-focusing toward "impacts and implications" (e.g. recall the quote about outdoor hockey rinks from Chapter 7). This approach could also entail taking advantage of extreme weather events, being careful not to attribute any individual occurrence to climate change, but perhaps portraying them as "tell-tale" signs (the words of one former civil servant) or at least using them to get people thinking about climate. Another promising approach is to focus on "success stories" of climate adaptation. Possibly the example of Castlegar (where a science-policy dialogue on adaptation spurred better maintenance for culverts and prevented some severe flooding less than a year later) could motivate action from additional communities. Local impacts, in particular, can help to facilitate public interest in certain situations, since they are more concrete. Depending on the context, it may also be better for scientists to avoid explicitly arguing for specific policy change, and instead let important conclusions emerge implicitly and organically. These messaging strategies (see Table 8.2 on the next page for a simple summary) are likely applicable to issues besides climate change, but as it stands they are

[6] These strategies were touched upon and summarized in Chapter 7, during the discussion about design characteristics. This paragraph demonstrates the broader relevance of science messaging.

facilitate audience ownership of problem/solution
highlight impacts on everyday activities
use language of "risk" instead of "uncertainty"
link politically tractable issues to intractable ones
highlight success stories of addressing the problem
link short-term impacts to long-term problem
link local impacts to national/global problem

Table 8.2 – Summary of 7 Science Messaging Strategies Identified through this Research

merely untested suggestions, and we do not know which ones are effective within science-policy partnerships.[7] More importantly, can they be used to influence political will through broader outreach to the general public and high-level decision-makers?

The single most important gap revealed by the dissertation is that much of the relevant literature fails to take into account broader political factors (i.e. the "external conditions" of the analytical framework), such as political will. For example, Cash et al. (2002) argue that scientific information must meet the criteria of salience, credibility, and legitimacy in order to be useful to policy-makers. However, even assuming that scientists are able to communicate that information directly, civil servants and politicians may still be unwilling or unable to act on even the highest quality of information, due to ideology, public opinion, or interest group pressures. My interview data suggests that, for policy action on climate change, the quality of scientific information is not

[7] This project was not intended to investigate messaging in much depth, but it may be instructive to postulate their potential application to the science organizations in the three cases. The first three strategies in Table 8.2 are general ones that could probably be used for any science-policy issue in nearly any scenario. Indeed, all three science organizations have been involved with workshops and might benefit from facilitating audience ownership (although I only know of that strategy being used in the municipal case). As for the second and third strategies, I am only aware of their consideration by CCF, so it is possible that both PCIC and PICS may stand to gain from their use (interviewees from the former case spoke to issues of certainty but did not explicitly discuss potential changes to messaging). The fourth and fifth strategies require additional expertise that may only be available to certain organizations. Those that are part of science-policy dialogues might have access to inside information about policy priorities (e.g. PICS and potentially PCIC with its larger partners) and those with a local focus might have more knowledge of relatable success stories (e.g. PCIC). In order to gain the latter, organizations with a national or global focus (e.g. CCF) may need to partner with others. The sixth and seventh strategies embody opportunistic policy entrepreneurship, requiring that events occur and then are leveraged. They are perhaps more likely to be used by organizations with more of a political focus on mitigation (i.e. CCF and PICS but not PCIC).

the limiting factor. Other authors suggest that broader changes to institutions or government would allow climate change to be addressed: appointing science advisers and giving them substantial authority (House of Commons Science and Technology Committee 2006), facilitating an "analytical-deliberative" process that incorporates many stakeholders and substantial evidence (Sutherland et al. 2006), creating boundary organizations to institutionalize science-policy co-production (Cash et al. 2003), or coordinating MLG to attend the interjurisdictional nature of climate change (Ingold and Fischer 2014). These major structural changes similarly cannot affect climate action without a sufficient level of initial political will.

That is, there is little difference between asking a government to respond to climate science and asking it to adopt norms of EBP, co-production, or MLG *so that it will then* respond to climate science.[8] The Harper Conservatives, for instance, are unlikely to be interested in either. As such, the SPRHi model identifies what causal characteristics *are* malleable (i.e. from the perspective of a science organization or perhaps civil servants) under different levels of political will (e.g. dialogue conditions vs. co-production conditions), suggests strategies for when there is none at all (i.e. network conditions), and explains why policy actors should be interested in science-policy dialogue (i.e. side benefits). My research shows that political will is essential, but does not offer much insight on how to influence it (i.e. convincing politicians and the general public to see climate change as a priority). How can the political interest required for genuine action, mitigation in particular, be brought about?

Overall, this dissertation has made several contributions to the body of knowledge around science-policy relationships. In general, research on how science flows into the policy process

[8] Besides, it seems like major institutional changes can only be made at certain times. For example, the spike in BC's climate leadership created CAS, but it would be very difficult to change the basic structure of the department now. These might be considered "institutional windows" in contrast to Kingdon's (1984) "policy windows".

should explain causal pathways more thoroughly (i.e. attend the four facets of the analytical framework). In doing so, it should consider a broad but practical range of potential design characteristics for science-policy partnerships (e.g. informality, messaging strategies, network-building); acknowledge policy outcomes besides instrumental or rational use of information (i.e. soft influences and side benefits); recognize external factors like level of government, public opinion, and the interest of politicians; and explicitly attend to the specific differences between natural science and social science, civil servants and high-level decision-makers, and (when in the context of climate change) adaptation and mitigation. However, understanding relationships between climate scientists and policy-makers (primarily civil servants) is not enough to address inaction on climate mitigation in Canada and elsewhere. That is, even the most co-productive science-policy partnerships are unlikely to precipitate sweeping policy changes in the absence of political will from public pressure or the interest of individual politicians. Since the initial problem driving this dissertation has not been satisfactorily addressed, more research on barriers to mitigation, government systems, public persuasion, and political leadership is required. What specific avenues might be most fruitful?

Potential Avenues for Further Research

Returning to some of the general literature on policy determinants, recall that Kingdon (1984) argues that three 'streams' must align in order for policy change to take place: a problem must be recognized and understood, a potential solution must be identified, and there must exist sufficient political will to apply the solution to the problem. Based on this theory and the findings of the dissertation,[9] I believe there are four potential criteria that must be satisfied to

[9] Recall from Chapter 7 the perceived norm that scientists must wait for policy windows to open, policy-makers (i.e. civil servants) must wait for direction from their "political masters" (i.e. high-level decision-makers), and politicians

initiate substantial policy action on climate mitigation in Canada and globally: the underlying science of climate change must be understood and available to the policy process (i.e. the problem stream), an effective mechanism for international collective action must be implemented (i.e. the policy stream), the general public in individual countries must offer sufficient support for participation in the global effort, and high-level decision-makers must be similarly interested in taking action (i.e. the political stream).

My research has focused primarily on the first criterion. While the scientific understanding itself is already sufficient to warrant mitigation efforts, the SPRHi model explains how to improve its link to policy-makers, suggesting that science organizations be vigilant in maintaining potential connections as they prepare for movement on the other criteria. There are several ways that future research might supplement this specific study.[10] Additional interviews could focus on the factors now known to be most important rather than probing inductively; other qualitative methods (e.g. meeting observation or iterative interviews) might be used to provide more detail on investigated design characteristics and trace the *real* effects of soft influences (i.e. not just the *alleged* effects uncovered here and by Weiss 1977); the theoretical model could be tested more rigorously with large-N methodology and quantitative methods; and a greater number of high-level decision-makers might be recruited for interviews (especially

must wait for a window of opportunity with the public. It was also argued by interviewees that the lack of a global agreement was a "critical barrier" to action.

[10] Some of the study's findings are relevant to the research process itself, and can be applied here. First, even research about co-production can attempt to be co-productive. For example, while I did engage in preliminary conversations with key informants (most of whom I ended up interviewing formally as well) to help me craft the research questions and interview topics, I tended not to ask them directly for feedback on what sorts of findings would be most useful (to them or in general), which would have been a more genuine form of co-production. A study that attempts this will likely end up being more immediately applicable to the cases investigated, with greater uptake by practitioners rather than just academics. Second, the provincial case demonstrated that academic studies are often completed too slowly to be helpful to policy actors. Perhaps executive summaries should be produced and informally distributed before the academic report (e.g. thesis, book, or article) is finished, or maybe studies could be divided into stages (i.e. like manuscript-style dissertations) such that each one can be completed and distributed without requiring the others to be finished.

given the demonstrated importance of political factors). Still, the problem stream for climate change mitigation is relatively well understood and is not the most limiting factor for mitigation, so there is likely more to gain from studying the other criteria.

The policy stream for climate change mitigation involves the various policy instruments that might be implemented to reduce greenhouse gas emissions (e.g. carbon taxes, cap-and-trade, technology investment). In my view, these national-level instruments are fairly well understood and are available for governments to use if political will is high enough. The real challenge for this stream is the lack of a strong mechanism for coordinating international (and interprovincial) collective action. Without one, there is less incentive for individual countries to implement national-level instruments. As discussed in Chapter 1, the Kyoto Protocol has failed to provide such a mechanism, so this is an area deserving of further research. Some scholars have suggested, for example, that compliance mechanisms must be strengthened (i.e. Gardiner 2004) and that complications around 'sinks' and 'permit trading' should be addressed (i.e. Victor 2001). However, a unique facet of international collective action problems is that there is no world government that can simply make these changes. They must instead result from negotiation, which complicates them greatly and makes them far less likely. As such, broader research about motivations for compliance is necessary. For instance, can international reputation pressure countries to do their part (see Wu 2009) or might we require a formal mechanism with more creative incentives like technology-sharing agreements (see Richards 2015)? My research might suggest that the possibility for co-productive relationships at the international level (e.g. between the IPCC and the UNFCCC) be investigated (see St. Clair 2006). Further study in such areas could help address the major barriers in the policy stream, but it is also worth noting that some individual governments (e.g. the UK, Germany, and Sweden)

have managed to take substantial action for mitigation even under weak global agreements. If this is true, then perhaps a mechanism for international coordination is not really a *necessary* criterion for action (though it would be helpful). The other criteria may be more crucial.

The first potential criterion in the political stream is public support. In this regard, climate change mitigation faces unique challenges as a policy issue. The general public (and the media) tend to process information in an 'experiential' manner, as opposed to the 'analytical' mode of scientists (i.e. they react to what *is* happening rather than anticipating what *might* happen), which means they tend not to pay much attention to future climate change (Marx et al. 2007). It may also be difficult to get the public to care about climate impacts that will occur outside their own regions (see Perrings and Hannon 2001), which is a problem since the countries that have historically contributed the most to greenhouse gas emissions are generally in the global north, and will experience less severe impacts than equatorial nations. In addition, mitigation policies are often framed as requiring trade-offs with the fossil fuel-based economy, which conflicts with standard public support for economic growth and stability in energy prices (see Rabe 2010). Given all of these challenges, we need research to develop messaging strategies for convincing the public (e.g. Prins et al. 2010, BSS 2012), determine which such strategies are most effective (e.g. Nisbet 2009, Pralle and Boscarino 2011), and understand how the public internalizes and responds to convincing information (e.g. Campbell 2011, Lorenzoni et al. 2007). This dissertation has proposed a few potential messaging strategies and has suggested that network-building may be a critical step in advancing awareness (see Chapter 7), but ultimately there is quite a bit of scholarship in the area already, as evidenced by the amount of literature cited in this paragraph. This criterion is important, but research on it is not lacking.

High-level political decision-makers do more than just respond to public demands, which is why political leadership is a separate criterion from public opinion. Different politicians will require different amounts of pressure from the public and other stakeholders before they take action on climate change mitigation (e.g. they may require more if they have a pro-business ideology). More importantly, this dissertation has revealed that it may be possible for decision-makers to act even without clear public support or interjurisdictional coordination (see Chapters 6 and 7), Gordon Campbell's leadership on climate policy in BC being an excellent example (see Chapter 5). Since this criterion may be sufficient to precipitate action without the previous two, I believe it is the most important one. However, it seems to be the least attended by researchers, since the only example of other scholarship in this area that I am aware of is the work of Compston and Bailey (2013). This strengthens the case for further research. It would be helpful to know how individual politicians might pursue necessary but unpopular policy action without losing too much public support (e.g. perhaps this is more likely earlier in the election cycle), how they might navigate elite interests that oppose action through funding and lobbying (e.g. through transparency requirements and campaign finance reform),[11] how to convince them to pursue such strategies (and whether science-policy partnerships might be a catalyst), and how they might leverage entrepreneurial strategies to build broader support (see Kingdon 1984). The concepts of "representative government" and the "trustee model of representation" (see the philosophy of Edmund Burke), which propose that elected officials should act for the common good rather than simply do what they think the electorate or elite groups want, may be relevant contributions from

[11] Power politics perhaps could be considered another barrier or stream that is crucial to address in order for sufficient climate action to occur, but I believe it is accommodated by the public opinion and political leadership streams. Perhaps elite interests (e.g. certain members of the oil and gas industry) can be convinced in the same manner as the public, and if not, then we need to know how political decision-makers might evade any undue influence coming from them.

political theory.[12] Overall, this criterion appears to be the most promising avenue for advancing our understanding of policy action on climate mitigation.

In the end, this dissertation has contributed to the body of knowledge around only one of four criteria that likely must be satisfied in order to bridge the gap between international scientific consensus and global policy action. Perhaps research is more urgently needed on the subjects of international coordination, public attitudes, and political leadership. Still, direct links between scientists and policy-makers may be essential for action, and it is thus crucial that science organizations remain open to them (even if political interest is low at the moment) until there is progress on the other criteria. My research offers a sophisticated causal understanding of such connections, as well as practical design characteristics and strategies for science-policy partnerships. Most importantly, the potential of these co-productive relationships should not be underestimated, since their soft influences may have unpredictable but very important effects on political interest, which may cause the necessary 'streams' to align.

[12] There are also the related concepts of public reason (see Baber and Bartlett 2005) and citizen preferences (see Sagoff as cited in Dryzek 1997) from deliberative democracy theory.

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