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Assessing Policy Capacity for Climate Change Adaptation: Governance Arrangements, Resource Deployments, and Analytical Skills in Canadian Infrastructure Policy Making

Jonathan Craft
Department of Political Science, Simon Fraser University, Burnaby, BC, Canada

Michael Howlett
Department of Political Science, Simon Fraser University, Burnaby, BC, Canada

Mark Crawford
Centre for State and Legal Studies, Athabasca University, Edmonton, Alberta, Canada

Kathleen McNutt
Johnson-Shoyama Graduate School of Public Policy, University of Regina, Regina, SK, Canada

Abstract

This article examines the infrastructure policy sector's capacity to respond to climate change adaptation through an analysis of the Canadian case. It includes a three-level examination of capacity: at the macro level through a virtual policy network analysis; at the meso level through examination of the lead department's evolving mandate and resources; and at the micro level through analysis of survey data related to departmental workers policy tasks and attitudes. Four hypotheses across these three levels are set out and tested at the national and subnational levels. Together, the findings suggest that the policy capacity in the Canadian infrastructure sector will be unable to meet the demands placed upon the sector to respond to the increasing challenges of climate change adaptation.

KEY WORDS: infrastructure policy, Canada, federal–provincial relations, climate change, policy capacity, organizational routines, policy change

Introduction

Forecasted increases in frequency and intensity of extreme weather events and climate variability have direct effects on the average conditions in which most major infrastructure operates (Auld, 2008; Auld & MacIver, 2005; Infrastructure Canada, 2006). As such, climate change adaptation will require substantial changes to the large-scale technical structures that support a society, such as roads, water supply, wastewater, power grids, ports, and communications infrastructure (Auld & MacIver, 2007; Harchaoui, Tarkhani, & Warren, 2004; Larson, 2003; Lemmen, Warren, Lacroix, & Bush, 2007).

Infrastructure assets generally have the following attributes: (1) they are large networks constructed over generations, which are not often replaced as a whole system; (2) the system or network has a long and indefinite life because its service capacity is maintained in perpetuity (by continual refurbishment or replacement of components as they wear out); (3) the system components are interdependent and not usually capable of subdivision or separate disposal and consequently are not readily disposable within the commercial marketplace; and (4) the assets have a

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high initial cost and a value which is difficult to determine (Vining & Richards, 2001). Changing such systems is thus a complex and costly task requiring extensive policy capacity.[1] Yet, studies of various policy sectors in developed countries such as Canada have noted generally low levels of policy capacity at both the national and subnational levels with modern governance arrangements becoming more complex, particularly in policy areas that are cross-sectoral and multilevel, such as infrastructure (Dickenson & Burton, 2011; Howlett & Lindquist, 2004; McArthur, 2007). This poses a challenge to successful adaptation, which this article addresses.

It has been argued that a government's overall ability to adapt to climate change pressures is a function of how it and society are organized and the extent to which both are capable of altering their behavior toward more sustainable practices congruent with the dynamics of climate change (Innes & Booher, 2003; Lyall & Tait, 2004). This raises the importance of governmental policy capacity to the forefront of analysis. As in the other articles in this special issue, policy capacity is defined here as a multifaceted concept extending over at least three levels: the subsystem level, the organizational level, and that of micro-level behavior of policy workers. This study examines the infrastructure policy sector in Canada through these three lenses, seeking to better model and understand the following: (1) the nature of the policy and governance systems in terms of their ability to discern and implement appropriate directions for change (Monni & Raes, 2008); (2) the match between requisite resources and organizational mandates and what resources are required in order to move the existing systems toward more sustainable orientations or mandates (Igielska, 2008); and (3) the policy analytic capacity of policy workers in the sector. Based on this three-pronged research design, the article tests four hypotheses that address aspects of the governance arrangements, policy work, and the match between resource and mandates to address climate change, which are vital metrics by which to gage sectoral policy capacity (Edwards, 2009; Howlett & Oliphant, 2010; Howlett & Wellstead, 2012; Wellstead & Stedman, 2010; Wellstead, Stedman, & Howlett, 2011).

Climate Change Adaptation: Pressures and Effects

The pressures and effects of climate change adaptation are being felt in specific sectors in different ways. With infrastructure, at the macro level, it is hypothesized that climate change adaptation pressures have resulted in an increase in both the density and centralization of policy networks found in this sector. That is, it is expected that additional criteria such as carbon neutrality or changing infrastructure design and engineering requirements will result in new actors with common interests entering into existing policy networks—such as greenhouse gas experts, environmentalists, and others who would not have appeared in infrastructure networks in earlier epochs when, for example, engineering or power or transportation-specific interests prevailed. Moreover, at the meso level or organizational level, as mentioned earlier, it is expected that mandates in this sector will increase as climate change adaptation goals replace or are layered onto existing ones and that additional resources—knowledge, personnel, and financial—will be required in order to attain these new goals. At the micro level, the six areas (tasks undertaken, concern for climate change, issues examined, networks of contact,

perception of policy capacity, and attitudinal disposition) that operationalize policy work are also expected to change (Howlett & Oliphant, 2010; Howlett & Wellstead, 2012; Wellstead & Stedman, 2010). However, as a historically nonenvironmental and nonnatural resource sector, it is expected that changes in these areas will be less apparent in the infrastructure sector than in other more directly affected sectors such as forestry.

In summary, taking these three levels into account, four testable hypotheses are examined in this article:

(H1) the infrastructure policy network will be increasing in terms of both density and centralization

(H2) climate change adaptation will force lead department/agency mandate(s) to broaden

(H3) as the departmental/agency mandates increase more resources will be needed simply to retain existing capacity, and

(H4) as a nonnatural resource-/environmental-based sector, infrastructure policy sector policy workers will have lower levels of concern about climate change and lower levels of engagement in climate change policy tasks than their natural resource-/environment-based policy sector counterparts.

Data and Methods

This study uses a mixed-method approach consisting of hyperlink analysis of virtual policy networks (VPNs) (macro level), qualitative content analysis of government reports (meso level), and quantitative survey-based analysis (micro level) in order to examine the four hypotheses set out above.

At the macro level, policy networks can be analyzed by studying VPNs. As set out in the Introduction to this issue, VPNs are online relational patterns of Web-enabled policy communities that emerge when a policy actor publishes hyperlinks to Web sites containing policy content they consider relevant (Margetts, 2009; McNutt, 2012; Petricek, Escher, Cox, & Margetts, 2006).

Combining a structural measure of VPN density with the informative measure of nodality provides a basic taxonomy for analyzing the capacity of the infrastructure and climate change VPN. As shown in Table 1, the four permutations of network density (high/low) and nodality (high/low) suggest several basic network types.[2]

To analyze the capacity of climate change adaptation in the infrastructure policy sector, two Web crawls were conducted on May 2, 2010 and May 8, 2011, respectively. All data were collected with the *IssueCrawler*, an innovative Web analysis package designed to analyze web-based issue networks (Bruns, 2007; Rogers, 2006). Previous research suggests that VPNs tend to reproduce similar network patterns as offline policy communities with key organizations offline, typically enjoying more influence online (McNutt, 2012). To assess macro-network considerations of

Table 1. Subsystem Structures and Capacity: Theory One

		Density	
		Increases	Stable or decreases
Centrality	Increases	Stable—May require little additional organizational capacity	Enhanced—May have capacity surplus
	Stable or decreases	Require additional capacity	Require additional capacity

Source: Authors.

Table 2. Infrastructure Web Crawls

	Infrastructure	
Date	2010	2011
Nodes	65	41
Pages crawled	32,117	24,257
Total inlinks	65,919	110,372
Network inlinks	715	679

Source: Authors.

Table 3. Evaluating Departmental Policy Capacity in the Context of Altered Mandates

		Resources	
		Match or exceeds changed mandate	Mandate—Capacity gap increases
Mandates	Department or agency retains nodal position	Retains or enhances existing policy capacity	Resource-based capacity losses
	Loss of nodality	Network-based capacity loss	Significant capacity losses

Source: Authors.

capacity related to climate change, adaptation in the infrastructure policy sector hyperlink analysis was conducted with changes in structure measured over a one-year period (see Table 2).[3]

The meso-level analysis was conducted via qualitative content analysis of official government documents from the Government of Canada's lead department dealing with infrastructure, "Infrastructure Canada" (IC). Official Departmental Performance Reports (DPRs) and Reports on Plans and Priorities were reviewed for the previous ten years to assess the status of the "internal" capacity of the organization as determined through staffing (full-time equivalents [FTEs]) and departmental budgets (overall and for policy analytical staff specifically). A similar approach was used to assess the various provincial governments' approaches to infrastructure policy related to climate change adaptation. Following the logic set out in Table 3, the case study examined both shifts in departmental mandates and resources over the period in question and critically assessed how these have changed, if these changes are related to climate change concerns, and whether or not observed changes in mandates have been matched by changes in resources allowing for policy capacity to have increased to match shifts in mandate requirements.

Finally, a third level of analysis was completed to examine the microlevel policy activities, attitudes, and perceptions of policy workers in the infrastructure sector as compared with seven other sectors.[4] To probe the micro-level hypotheses set out later, a survey instrument consisting of a 70-item questionnaire was designed in part from previous capacity surveys by Howlett and Wellstead and a climate change capacity survey by Wellstead and Stedman (2011). Data were generated from a Web-based questionnaire of 1469 Canadian provincial and territorial government policy analysts working in nine provinces and three territorial jurisdictions. We follow Radin's (1997) assertion that empirical assessments of policy work should include five elements: (1) the scale and location of policy analysis functions; (2) the political environment surrounding the activity; (3) the analytic methodologies used;

(4) the availability and use of information and data; and (5) the dimensions of policy decisions (Howlett & Wellstead, 2011). Survey questions addressed the nature and frequency of the tasks undertaken by professional policy workers in government, the range and frequency of the techniques they used in their work, their concern about climate change, the extent and frequency of their interactions with other policy actors, and their attitudes toward and views of various aspects of climate change and policy-making processes, as well as questions addressing their educational, previous work, and on-the-job training experiences.

Mailing lists for the surveys were compiled, wherever possible, from publicly available sources such as online government telephone directories, using keyword searches for terms such as "policy analyst" appearing in job titles or descriptions. In some cases, additional names were added to the lists from hardcopy sources, including government organization manuals. In other cases, lists of additional names were provided by provincial or territorial public service commissions who also checked initial lists for completeness and accuracy.[5] Due to the small size of the population, a census rather than sample was drawn. This method is consistent with other expert-based studies (see, e.g., Laumann & Knoke, 1987; Zafonte & Sabatier, 1998). Unlike Wellstead and others (2011) and Howlett and Newman's (2010) broad government-wide survey, only those survey participants who worked in policy units responsible for climate change were selected. The authors implemented the survey in early 2010 using Zoomerang®, an online commercial software service. A total of 636 usable returns were collected for a final response rate of 43.3 percent. The resulting dataset was analyzed using SPSS 20.0.

Findings

Macro Level: Governance Arrangements and Network Perspective

At the macro level, it was hypothesized that the infrastructure and climate change VPN would show increasing centrality and increasing density under pressure for climate change adaptation. This was confirmed as can be seen in Table 4 and Figures 1 and 2. The level of centralization in the network has increased moderately.[6] In terms of density, this was also confirmed with a significant number of new actors circulating in the network.[7]

Provincial governments were well represented in the 2010 infrastructure and climate change VPN including British Columbia (BC) (26 inlinks), Nova Scotia (10

Table 4. Infrastructure and Climate Change VPN

	2010 VPN	2011 VPN
Number of actors	65	41
Total number interlinkages	761	679
Centralization	0.08	0.10
Density	0.17	0.41
Internationalization	4%	2%
Government of Canada nodality	0.08	0.10
Infrastructure Canada	0.01	0.01

Source: Authors.
VPN, virtual policy network.

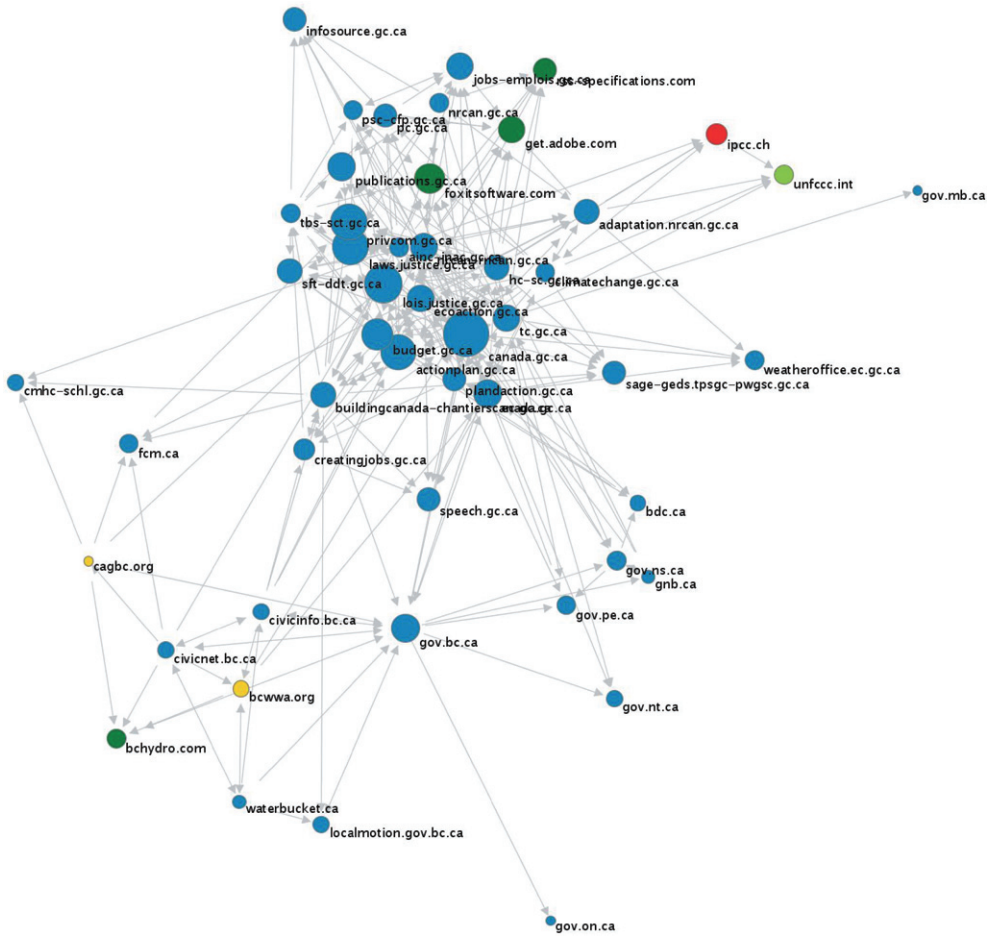

Figure 1. Infrastructure and Climate Change 2010 Virtual Policy Network

inlinks), Northwest Territories (nine inlinks), Newfoundland (nine inlinks), Nunavut (9 inlinks), Prince Edward Island (8 inlinks), Yukon (8 inlinks), Saskatchewan (7 inlinks), Ontario (6 inlinks), Manitoba (6 inlinks), New Brunswick (6 inlinks), and Alberta (6 inlinks).[8] In total, the aggregate of all inlinks received by provincial governments' main Web sites was 14 percent of total links in the network. Municipal organizations were also present in the VPN including the Federation of Canadian Municipalities with 12 inlinks, Union of BC Municipalities with 8, and Fraser Basin Council with 6. In the 2011 VPN, the aggregate inlink received by provincial governments' main Web sites was 11 percent, which was a slight drop but still includes the Government of BC (12), Government of the Northwest Territories (11), Government of Nova Scotia (9), Government of Prince Edward Island (9), Government of Saskatchewan (9), Government of the Yukon (9), Government of Newfoundland and Labrador (8), and Government of Nunavut (7). The overrepresentation of BC Web sites did not characterize the 2011 VPN nor were any municipal representatives retained. The level of internationalization in both 2010 and 2011 was very low. With the Intergovernmental Panel on Climate Change (19)

Figure 2. Infrastructure and Climate Change 2011 Virtual Policy Network

and UN Framework Convention on Climate Change (14) receiving inlinks in 2010, in 2011 only the Intergovernmental Panel on Climate Change (9) was included in the VPN.

Graphically, this situation is represented in the sociometric data presented in Figures 1 and 2.

As Hood (2007) has long argued, nodality is a key tool of government used to both detect information available in the network and effect behavior through coordination. In Web-based environments, this is particularly true as government authority may be undermined by nondomestic content or competing views and agendas. This was not however the case in the infrastructure sector as the federal government demonstrated strong leadership in the sector with extensive network resources.

This suggests that while the federal government has traditionally been characterized as weaker on many aspects of environmental policy than subnational levels of government (Harrison, 1996), in the infrastructure sector it is dominant. As detailed later, this is due to the greater availability of resources, a legacy of federal

involvement in large-scale infrastructure development, and recent federal involvement in municipal infrastructure through economic stimulus funding (Stoney & Graham, 2009).

Meso Level Capacity: Organizational Mandates and Resource Considerations

As Table 3 suggested, the general axioms of organizational structure and behavior supported by most existing literature in organization and network studies are that the more narrow and precise the mandate, the fewer resources (budgets/personnel) are needed to have high policy capacity. A review of IC's official reports over the last ten years reveals a clear shift in departmental activity related to its role in policy coordination and management (see Table 5). The department has also seen significant change related to the development of expertise, seeing a shift from a focus on departmental capacity building to one of knowledge and research generation and mobilization in recent years. Moreover, the department has also seen a growing emphasis on community-based infrastructure programming and horizontal interdepartmental partnerships. Recent and notable changes as reflected in the department's program activities and reported in their official departmental reports underscore the impact of implementing the Government of Canada's post-2007 financial crisis Economic Action Plan including increased infrastructure "stimulus" funding and the creation of a new $1 billion "Green Infrastructure Fund."

In the years leading up to the creation of the department, infrastructure programming and policy were coordinated through the Infrastructure National Office located in the Treasury Board Secretariat, a central federal government agency. The emphasis during this period was the provision of infrastructure policy and program-related expertise to various infrastructure programs housed under various program activity lines across government. In the lead-up to the creation of IC, the key emphasis was department level capacity building and significant coordination of existing programs and activity across government.

Overall, as Table 6 shows, the department has shifted from an initial emphasis on capacity and expertise development to a focus on downstream infrastructure projects and as a vehicle for economic stimulus expenditure. The official establishment of the department in 2002 marked a concerted effort to centralize all existing policy and program activity in one department. IC's first ever departmental report filed in 2002–03 notes that the organization assumed responsibility for the large volume of existing infrastructure programming and established itself as the focal

Table 5. Combined Fiscal and Human Resources: Infrastructure Canada 2000–10

Fiscal Year	Overall Department Spending (Actual, $ Thousands)	Infrastructure Specific Spending[38]	Full-Time Equivalent Staff Numbers
Pre-2000[39]	n/a	n/a	n/a
2002–03[40]	12,118	11,793	35
2004–05	253,163	217,913	179
2007–08	1,956,427	1,943,381	217
2010–11[41]	8,182,658	7,313,261	428

Source: Authors.
n/a, not applicable.

Table 6. Thematic Infrastructure Program Activity 2000–10

Fiscal Year	Managing/Advice/Coordination	Developing Expertise/Capacity	Financing	Sustainability	PPPs[42]	First Nations
Pre-2000[43]	Coordination of existing infrastructure programs across government and provision advice and support via Infrastructure National Office—Treasury Board	Department capacity building				
2002[44]	Managing infrastructure investments	Center of expertise, focal point for cities and communities	Leveraging infrastructure investments: i. community based; ii. strategic	Healthy and sustainable communities		
2004[45]	Managing community and strategic investments	Research, Knowledge, and Outreach	Leveraging community and strategic infrastructure investments	Sustainable cities and communities		
2007	Supporting Canada's economy, environment, and quality of life	Policy, Knowledge, and Partnership Development	Sun setting of existing programs, shift to long-term infrastructure funds[46]	Modernizing infrastructure, environmental, and economic sustainability	Public–private infrastructure fund	First Nations infrastructure fund
2010	Managing economic stimulus and green infrastructure	Knowledge and Research	Long-term infrastructure funds and expedited infrastructure stimulus fund	Strengthening economy delivering modern and greener public infrastructure	Public–private infrastructure fund	First Nations infrastructure fund[47]

Source: Authors.
PPPs, public-private partnerships.

point for the government of Canada's various involvement in infrastructure development. That is, the department assumed the role of a "center of expertise," serving as the focal point for all infrastructure policy and programming with a growing emphasis on city- and community-based infrastructure. With a variety of existing and new infrastructure programming, IC activity was largely conducted under the two principal rubrics of community- and strategic-based infrastructure programs (e.g., local water or waste projects, border- and security-related infrastructure). This approach based on a healthy and sustainable cities and a communities[9] focus remained in place for the first half of the decade.

IC's focus on leveraging strategic and community infrastructure investments during this period was further underscored by organizational and policy shifts in the 2003–05 period, notably around a growing emphasis on sustainable cities and communities and formalization of infrastructure-specific research and policy development activities. Official departmental reports underscore this shift beginning with the transfer of the Cities Secretariat from the Privy Council Office to IC in 2004 and subsequent policy work around the New Deal for Cities policy initiated in 2004–05. Together, these two organizational and policy focus shifts served to further focus the department's policy and program work at the city and community levels.

Table 6 further highlights 2003–04 and 2004–05 as periods dominated by a community-based and city-centric infrastructure investment and programming strategy. Several existing programs under the department's community and strategic infrastructure investment program activity lines continued to receive funding. Initial departmental reports highlight the importance of IC playing a leading role in the policy, and research expertise front and initial efforts toward this were realized through departmental capacity development. The 2003–04 period represented a formalization of research- and knowledge-based programming under the program activity priority area of "Research, Knowledge, and Outreach." Community-based infrastructure programming reached its zenith with the 2005 federal budget "A New Deal for Canada's Communities" and in February 2006, IC and Transport Canada became part of a new portfolio, Transport, Infrastructure, and Communities, reflecting further efforts to better integrate infrastructure planning with similar and overlapping policy work.

More recent shifts in the key program activity areas and mandates of IC demonstrate a clear shift toward large-scale and longer-term infrastructure via the initiation of sun setting of existing programs and the introduction of the $33 billion Building Canada Plan (2007). The Building Canada Plan includes greater use of the newly created federal crown corporation *Public Private Partnership Canada* (2007) and greater emphasis on Aboriginal infrastructure programming via the First Nations Infrastructure Fund (2007). Both are managed by departments outside of IC (Finance and Indian and Northern Affairs, respectively) but are indicative of the overarching interdepartmental infrastructure approach flowing out of the large-scale long-term Building Canada Plan. Additional shifts related to knowledge and policy type of activities are reflected in the emergence of "Policy, Knowledge, and Partnerships" as a stand-alone program activity in the department 2006–07 DPR, a trend that has continued.

Both streams of funding emphasize community- and national-based projects that have an economic stimulus effect, but a search of the DPRs for 2009–10 yields no

Table 7. Infrastructure Canada 2000–10 Policy Analytic Capacity Spending[48]

Year	2006–07	2007–08	2008–09	2009–10	2010–11
Infrastructure Canada "policy"-related program activity category	Policy, Knowledge, and Partnership Development	Policy, Knowledge, and Partnership Development	Policy, Knowledge, and Partnership Development	Economic Analysis and Research (EAR)	EAR
Actual spending ($ thousands)	13,773	12,714	8,199	4,142	15,498[49]
FTEs[50]	Planned: 73 Actual: 63	Planned: 93 Actual: 73	Planned: 62 Actual: 53	Planned: 36.5 Actual: 17	Planned: 29 Actual: n/a

Source: Authors.
FTE, full-time equivalent; n/a, not applicable.

results for projects explicitly tied to climate change adaptation. Inspection of these reports reveals that over the last decade the departmental mandate has included six key areas. These are managing/advice or coordination activities, developing expertise and capacity, sustainability, and First Nations issues. The 2009–10 official report underscores the most recent shift toward expedited infrastructure spending and emphasis on the sound management of Economic Action Plan (EAP)-related infrastructure and "Green" Infrastructure Funds. Significantly, however, recent reports indicate actual spending on these environmental programs and projects was much less than initially envisioned (Curry, 2012).

The second key metric related to meso-level governance arrangements and climate change adaptation as set out in Table 3 relates to the ability of the department to effectively match or meet mandate changes with the requisite financial and human policy resources. As Table 5 illustrates, a review of the IC's Departmental Program Activity reports (2002–10) reveals that IC has seen its budget increase steadily. A clear spike in activity is detectable in recent years due to the additional funding of infrastructure projects through the EAP and the $1 billion Green Infrastructure Funds, although, again, much of the allocated funding were not actually disbursed (Curry, 2012). These increases in department-wide funding are mirrored by steady growth in departmental human resources, which are tracked on a FTE basis. Both the departmental-wide budget and human resources spiked in 2009–10 in response to the imperatives generated through economic stimulus funding. The figures as reported in the most recent versions (2006–10) of IC's DPRs provide for particularized staffing figures along program activity lines.

Thus, clear linkages can be assessed with respect to the policy and "knowledge"-related activities of the department and its staffing contingent. As Table 7 makes clear, while organizationally the department has captured its analytical and research work under various titles, a consistency that is clear is a demonstrated shortfall of planned versus actual staff for policy-related program activity lines. That is, at the federal level, we find an increased mandate, although not all of which is related to climate change, and a consistent shortfall in resources.

Prima facie, then, one would expect IC to have experienced significant capacity losses in recent years. This finding is supported by a 2006 audit by the Federal Commissioner of Environment and Sustainable Development which concluded that:

> The government has developed knowledge through research on impacts and adaptation; however, without identified expected results in adaptation, it is difficult for the federal government to determine where to focus adaptation research efforts and how it should plan to contribute. Access to information and technical expertise on adaptation varies considerably across the country. (Environment and Sustainability Commissioner, 2006, 22)

As this quote suggests, Canada's federal system, presents opportunities for asymmetrical levels of collaboration and/or partnership between levels of government. This type of policy activity can sometimes offset losses at one level of government with gains at another or can compound the problem (Bakvis & Brown, 2010; Cameron & Simeon, 2002; Fenna, 2007). A review of the specific federal and provincial level infrastructure spending saw considerable partnership between levels of government, particularly related to the major infrastructure programs included in the Building Canada Plan and more recent green/infrastructure stimulus programs over the time period examined.

A review of provincial climate change plans and strategies, as well as infrastructure ministries' departmental plans and yearly reports, however, found limited programming and funding explicitly related to infrastructure *climate change* adaptation. As per the Appendix—Provincial Infrastructure and Climate Change Adaptation—each province did have a strategic plan or policy related to climate change (e.g., Climate Change Adaptation Framework Strategy [2008]; Towards a Greener Future: Nova Scotia's Climate Change Plan [2009]). These plans had little specific infrastructure focus, however, and largely dealt with carbon emission reduction and energy efficiency writ large. The various provincial "strategies" or "action plan" references to adaptation generally lacked specifics regarding the nature of anticipated impacts or steps taken to invest in adaptation related to infrastructure.

In general, most of the provincial infrastructure-related adaptation programming is led by ministries other than infrastructure, notably ministries of transportation, environment, and agriculture. Such sector-specific adaptation approaches focused on coastal erosion, agriculture, transportation, or water and wastewater infrastructure, for example. Generally, these mentions referred to "strategic infrastructure" and the need to invest in infrastructure more generally but without any specifics.

Provincial infrastructure departmental reporting and "action plans" however report little if any direct program-specific funding related to infrastructure adaptation. Problems with current project management practices in this area at the provincial are legion (Crawford, 2009). In the BC public sector prior to 2007, for example, critics had argued that there had been too many projects, with various inconsistent methodologies, and projects that were poorly selected and prioritized vis-à-vis overall climate change strategy. Most Assistant and Associate Deputy Ministers and Directors in the government lack a background in program and portfolio management, and the private sector vendors certified and promoted by organizations such as the provincial Project Management Institute only had portfolio and program management experience in a private sector context—and a vested interest in promoting as many projects as possible (Crawford, 2009). One ministry in 2006, for example, had 89 projects in its portfolio and ten different vendors with a disparate collection of project management methodologies, making comparison and coordination difficult (Christenson, 2009). Promoted by the vendor community and encouraged by the government, project management yielded mixed results

because of the lack of effective "program management" (i.e., expertise in implementing projects) and "portfolio management" (i.e., skill at prioritizing and selecting projects). This only began to be corrected by the creation of the Project Management Centre of Excellence in 2007, which is housed in the BC Ministry of Labour and Citizens' Services (Crawford, 2009).[10]

Two principal findings emerge from the review of provincial climate change action plans: a clear regionalization of adaptation plans and "strategies" and, second, uneven patterns of formal institutional policy analytic capacity related to climate adaptation. Partnerships between subnational levels of government and/or federal–provincial regional partnership agreements to facilitate adaptation and climate change strategies were common.[11] This highly collaborative regional planning is indicative of the multijurisdictional and multilevel nature of national adaptation planning at the strategic level. Provincial climate change plans frequently cited the importance of research or strategic planning related to the integration of adaptation imperatives. As shown in the Appendix, several provinces had formalized organizations conducting research or had joined collaborative efforts related to the development of strategic or integrated research related to climate change adaptation in general. These research and knowledge investments, were however, remained focused on adaptation more generally with limited mention of infrastructure adaptation, which remained very much a federal initiative.

Micro Level Findings: Policy Workers Activities, Attitudes, and Interactions

Evaluation of micro-level survey data related to the self-reported policy activities, attitudes, and perceptions of policy workers in the infrastructure sector further supports these conclusions.

About 8 percent of survey respondents ($n = 50$) self-identified as infrastructure sector policy workers.[12] Their responses along the six categories used to operationalize policy work (tasks undertaken, concern for climate change, issues examined, networks of contact, perception of policy capacity, and attitudinal disposition) were compared with those of their counterparts in eight other surveyed sectors (finance, forestry, infrastructure, transportation, climate change, environment, natural resource management, and water). A cross-tabulation of data provided in Table 8 supports the hypothesis that infrastructure policy workers engage in lower levels of climate change activity and policy work compared with their natural resource or environmental counterparts. While a strong majority of these policy workers reported some climate change activities, the activity levels reported were below those of their colleagues in natural resource/environment sectors, though well above those reported in some sectors, such as finance.

Table 8. Involvement in Climate Change Work by Sector

	Finance	Forestry	Infrastructure	Transportation[51]	Climate	Environment	NRM	Water
Yes	11 (17.5%)	92 (82.9)	26 (65.0)	41 (65.1)	117 (97.5)	121 (73.3)	71 (77.2)	49 (80.3)
No	52 (82.5)	19 (17.1)	14 (35.0)	22 (34.9)	3 (2.5)	44 (26.7)	21 (22.8)	12 (19.7)

Source: Authors.
NRM, natural resource management.

Table 9. Major Tasks Undertaken by Sector[52]

	Briefing	Consulting	Policy Work
Mean score	2.52	2.37	2.95
Finance	2.68	2.16*	2.98
Forestry	2.17***	2.19**	2.53***
Infrastructure	2.80*	2.61*	2.98
Transportation	2.77*	2.67**	3.14
Climate	2.77***	2.42	3.06
Environment	2.54	2.48*	3.02
Natural resource management	2.65	2.46	2.95
Water	2.71	2.51	3.12

Source: Authors (*$p < .05$; **$p < .01$; ***$p < .001$).

Table 10. Perceptions of Policy Capacity to Deal with Climate Change

	Capacity Mean
Mean score	3.14
Finance	3.21
Forestry	3.10
Infrastructure	2.96
Transportation	3.32
Climate	3.24
Environment	3.12
Natural resource management	3.19
Water	3.10

Source: Authors.

To determine what policy activities infrastructure policy workers engage in, a factor analysis from an initial list of 18 types of general policy work was conducted. It revealed that across all eight sectors three distinct areas of policy activity could be identified (policy work, $\bar{x} = 2.95$; consultation, $\bar{x} = 2.52$; and briefing, $\bar{x} = 2.37$).[13] As Table 9 shows, infrastructure policy workers were comparatively more active in policy work, scoring above the mean in all three factors.

Finally, the overall policy capacity in each sector was measured by summing the following variables: previous engagement by my management ($\bar{x} = 3.52$), engagement by networks ($\bar{x} = 3.19$), engagement by regions and headquarters ($\bar{x} = 3.21$), staffing FTEs ($\bar{x} = 3.00$), and training ($\bar{x} = 2.81$) (see Table 10). Compared with their colleagues in other sectors, infrastructure policy workers reported the lowest levels of perceived policy capacity in their sector to deal with climate change.

An additional dimension of policy work involves the interaction of policy workers with various other actors in the policy subsystem. This provides an improved understanding of with whom infrastructure sector policy workers are interacting, supplementing the macro-level assessment undertaken earlier. The data were also analyzed with a factor analysis of the frequency of involvement with others within the respondent's organization (e.g., senior management) and those outside (e.g., environmental nongovernmental organizations). There were two factors obtained ("internal" and "external" networks) with 55.1 percent of the variance explained. As Table 11 shows, policy workers from the infrastructure sector reported higher scores above mean levels for both internal and external dimensions. This underscores that in this policy sector a considerable degree of policy work involves

Table 11. Comparison of Sector Involvement in Internal and External Sectors

	Internal Network	External Network
Mean score	2.81	2.08
Finance	2.87	1.87
Forestry	2.48***	1.92**
Infrastructure	3.02	2.24
Transportation	2.92	2.11
Climate	3.01*	2.28
Environment	2.94	2.20**
Natural resource management	2.92	2.24
Water	3.03	2.26*

Source: Authors (*$p < .05$; **$p < .01$; ***$p < .001$).

Table 12. Attitudes Toward Climate Change

	Personal Attitudes Toward Climate Change[53]	Organizational Attitude Toward Climate Change[54]	Climate Change Strategies[55]
Mean score	3.97	3.35	3.96
Finance	3.47***	2.68***	3.70**
Forestry	4.14*	3.57***	4.11**
Infrastructure	4.01*	3.14	3.85
Transportation	3.85	3.04**	3.94
Climate	4.47***	3.65***	4.01
Environment	4.15***	3.58***	4.09**
Natural resource management	4.17*	3.58***	4.04
Water	4.33***	3.68***	4.13

Source: Authors (*$p < .05$; **$p < .01$; ***$p < .001$).

participation within both internal and external networks, but internal activities continue to dominate, insulating policy work from possible sources of change in the external environment.

Finally, infrastructure respondents were also assessed against a battery of questions to measure attitudinal responses. Policy studies examining capacity and policy work have increasingly found that attitudinal predispositions are important determinants of policy capacity (Wellstead, Stedman, & Lindquist, 2009; Wellstead et al., 2011). Thus, understanding policy analysts' attitudes toward policy making and how they differ between policy sectors is important. As hypothesized, infrastructure sector policy workers were found to hold attitudes that saw climate change as less of a significant issue than their natural resources/environment counterparts. While they scored above the mean in personal attitudes related to the importance of climate change, they were well below those of resource/environment sector policy workers. Furthermore, intersector comparisons reveal that respondents from this sector were also below the mean scores for organizational and climate change strategy scales (see Table 12).

Conclusion

The three-level analysis undertaken here reveals that the Canadian infrastructure policy sector faces considerable challenges in meeting the need for climate change adaptation. At the macro level, this sector faces long-term climate change chal-

lenges and the VPN-based analysis found that the infrastructure policy sector has been marked by an increase in both centrality and density as hypothesized. However, the network has also become smaller with the 2010 VPN comprising 65 organizations, while the 2011 VPN had only 41 nodes. Thus, the network overall is becoming more coordinated with strong ties among organizations and a stable to increasing level of centralization. This suggests that at the macro level, government enjoys a nodal position that bodes well for its overall capacity to govern effectively.

The organizational and resource dimensions, however, found considerable challenges to adaptation in mismatches existing between new enlarged climate change mandates and organizational resource endowments provided to meet those challenges. At both the meso level and micro level, capacity challenges were identified along several of the hypothesized dimensions. Over the last decade since its inception, the federal lead agency, IC, was found to have evolved in three phases. This pattern is

Phase 1 (pre-2000–02)—development of start-up capacity building
Phase 2 (2002–06)—extension to financing and sustainability
Phase 3 (2007–10)—extension to PPPs and First Nations

The various reports assessed indicate considerable expansion of the department's mandate across these periods, which were not matched by similar budgetary or personnel increases or final spending patterns. Overall, discounting the one-time increase in infrastructure funding occasioned by the global financial collapse in 2007–08, none of the last several years has seen that the planned policy or analytical needs of the lead federal department for infrastructure match its actual staff levels as reported in DPRs. While such findings could be argued to stem from an overestimation of departmental policy staff needs, recent audits of departmental human resources practices do not support this line of argument. The data gleaned from ten years of publicly available departmental documents point to a lack of human resources explicitly tied to analytic or policy work. It is doubtful that capacity in this area will be able to keep up with challenges such as those caused by climate change without significant budgetary and personnel increases (Lemmen & Lacroix, 2004; Lemmen & Warren, 2004).

The micro-level findings are also troubling in this sector. Existing policy workers surveyed in the sector reported the lowest perceived levels of policy capacity of any of the sectors included in the survey. Moreover, respondents from this sector reported the highest level of policy work consisting of "fire fighting" and short-term policy considerations and lower personal and organizational levels of engagement with climate change issues. Overall, therefore, the situation in this sector was found to be as set out in Table 13.

Existing studies suggest that many states or sectors facing a policy analytical capacity deficit, if not outright decline, can sometimes overcome this as older technical forms of analysis come to be replaced by newer more participatory ones (Kothari, MacLean, & Edwards, 2009; Painter & Pierre, 2005). The continued dominance of internal policy activity in this sector however supports other Canadian evidence of insular government-centered networks focused on their own departmental senior management concerns (Wellstead et al., 2011), meaning they

Table 13. Policy Capacity, Climate Change Adaptation, and Policy Capacity (Macro-level, Meso-level, and Micro-level Findings)

Levels of Analysis	Levels of Policy Capacity (High, Low)	Contributing Factors
Macro	Low	Adequate nodality in an increasingly centralized and dense policy network leading, as expected
Meso	Low	Mismatches between growing organizational mandates without the requisite budgetary or policy analytic capacity increases
Micro	Low	Predominance of short-term fire fighting policy activity Overall low levels of policy capacity Internally focused policy activity Perceived low levels of organizational concern for climate change adaptation vis-à-vis other sectors and agencies

Source: Authors.

lack capacity both for traditional analytical efforts as well as new, more participatory, ones. When coupled with mismatches between mandates and resource levels and the micro-level problems identified herein, this means that it is very likely that the sector will continue to face considerable difficulty in meeting climate change adaptation challenges in the near, medium, and long terms.

Notes

1 This is similar to the concept of an "infrasystem" put forward by Frantzseskaki & Loorbach (2010). These can be principally distributive (with an emphasis on capacity for centralization/decentralization), accumulative (with corresponding emphasis on demand curbing and alternative design), or communicative systems (concerned with efficiency improvements and/or alternative design).

2 It should also be noted that beyond these network properties, some VPNs are highly internationalized (McNutt & Pal, 2011; McNutt & Rayner, 2012) with additional qualitative consideration given to the nodality of the federal government more generally and the lead federal department specifically. Even in networks where density and centrality are high, if the nodality of the Canadian government is low, this suggests that policy capacity is low.

3 As the Web is organized topically, sectorally based VPNs are identifiable by mapping hyperlinks among Web sites publishing content on a specific policy topic area. *IssueCrawler* employs an algorithm that deliberatively crawls through the Web's link structure extracting data and mapping hyperlinkages. To locate a network, the analysts enter a list of URLs (seeds) into *IssueCrawler*, which then maps the Web graph from the outgoing links. In this project, 15 initializing nodes were gathered from a Google string search infrastructure + climate change + Canada with the top returned URLs serving as the starting points for mapping each network.

4 These seven sectors were finance, forestry, transportation, climate change, environment, natural resource management, and water.

5 The province of Quebec was not surveyed due to the absence of publicly available email addresses or contacts of provincial employees.

6 Nodality is calculated by the number of inbound links received by the most popular (i.e., linked-to) Web site divided by the sum of all inbound links received by all nodes $((k_{(max)})/\Sigma m$, where $k_{(max)}$ = the number of inlinks at the node in the network with the highest in-degree and Σm = the aggregate sum of all inbound links).

7 Density is calculated by dividing the entire population of potential ties ($n(n-1)$, where n = all nodes) by the actual population of unidirectional links ($m/n(m)$, where m = set of all edges or links).

8 BC was particularly well represented with a variety of different government sponsored sites in the network including BC Ministry of Community and Rural Development and Ministry of Transportation and Infrastructure, Civic Info BC, Government of BC-Waterbucket, BC Hydro, BC Water and Waste Association, and BC Transit.

9 See the IC 2002–03 Department Performance Report: http://www.collectionscanada.gc.ca/webarchives/20060120095531/http://www.tbs-sct.gc.ca/rma/dpr/02-03/infra-infra/infra-infra03d01_e.asp#Anchor-Ministerxs-47857

10 This experience confirms the findings of a recent major international study on Researching the Value of Project Management, which indicated that techniques for achieving strategic goals through temporary projects *do* generally add value, although in large organizations such as governments (where the ultimate product or service is not usually delivered through projects), the value of project management is likely to be viewed as tactical rather than strategic—often causing a lack of proactive investments in ongoing systems of project *governance* (Thomas & Mulally, 2008). This raises important research questions in the context of infrastructure ministries because, on the one hand like any client-driven supplier of projects, it can be expected to show much in the way of tangible benefits from the application of project management techniques. The potential for *intangible* benefits from investment in project management (improved culture, accountability, and management skills) is often not being realized and project management implementation may not fit the institutional and environmental context on a continuous basis. One notable example of a successful initiative is in the area of building standards: the Ontario Ministry of Municipalities and Housing Building Code revisions, the BC Ministry of Energy and Mines' Green Building Code, and the Alberta Ministry of Infrastructure's environmental initiatives relating to sustainable building design have all led to identifiable improvements in energy efficiency and resistance to extreme weather conditions. How much they have contributed to an optimal overall program of adaptation, however, is an open question.

11 The Ontario government in collaboration with Natural Resources Canada and the Toronto and Region Conservation Authority, for example, forms part of the Ontario Regional Adaptation Collaborative. The Prairie Adaptation Research Collaborative to cite another example is mandated to pursue climate change impacts and adaptation research in the Prairie Provinces. The Climate Change Adaptation Strategy for Atlantic Canada (June 2008) is another regional partnership between several Atlantic provinces with Natural Resources Canada and supplements the province-specific stand-alone climate change action plans.

12 A bivariate analysis of the data indicated very little overlap between the self-identifying sectors.

13 With 66.1 percent of the variance explained.

14 Based on a review of the various provincial ministries of infrastructure yearly reports for 2008–10 and provincial climate change plans and/or strategies or their yearly reports.

15 2009/10—Annual Service Plan Report, p. 11.

16 BC climate adaptation strategy, 2010:1, http://www.livesmartbc.ca/attachments/Adaptation_Strategy.pdf

17 Includes language around climate change adaptation being included in costing of infrastructure, http://www.bcbudget.gov.bc.ca/2011/sp/pdf/ministry/tran.pdf

18 Alberta Climate Change Adaptation Framework, p. 20. Based on the following: Smit and Pilifosova (2001).

19 Gallagher (2010).

20 http://www.gov.mb.ca/asset_library/en/beyond_kyoto/adapting_to_climate_change.pdf, p. 47.

21 http://www.gov.mb.ca/asset_library/en/beyond_kyoto/adapting_to_climate_change.pdf, p. 49.

22 Climate Change Action Plan Annual Report 2008–09, p. 45, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079210.pdf

23 Climate Change Action Plan Annual Report 2008–09, p. 6, http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079210.pdf

24 Ibid, p. 45.

25 Four of the 2006–12 Climate Change Action Plan, 2010:5,7, http://www.mddep.gouv.qc.ca/changements/plan_action/bilans/bilan4-synthese.pdf

26 Ibid, p. 17.

27 Ibid, p. 17.

28 Ibid, p. 37.

29 Toward a Greener Future, 2009:28, http://climatechange.gov.ns.ca/doc/ccap.pdf

30 Ibid, p. 40.

31 Ibid, p. 2.

32 New Brunswick Climate Change Action Plan 2007–12, p. 24, http://www.gnb.ca/0009/0369/0015/0001-e.pdf

33 Ibid, p. 32, http://www.gnb.ca/0009/0369/0015/0001-e.pdf

34 2009–10 Progress Report—Making Real Progress, p. 27, http://www.gnb.ca/0009/0369/0018/0011-e.pdf
35 2009–10 Progress Report—Making Real Progress, p. 29, http://www.gnb.ca/0009/0369/0018/0011-e.pdf
36 Newfoundland Climate Change Action Plan, 2005:v, http://www.env.gov.nl.ca/env/climate_change/govt_action/climatechangeplanfinal.pdf
37 Ibid, p. 17.
38 The infrastructure-specific spending figures represent program spending and do not include crown corporation or department administration costs.
39 For a good overview of recent Government of Canada infrastructure spending prior to creation of INFRC portfolio, see Table 2—from the 2002–03 Infrastructure Canada DPR, http://www.collectionscanada.gc.ca/webarchives/20060120095531/http://www.tbs-sct.gc.ca/rma/dpr/02-03/infra-infra/infra-infra03d01_e.asp#Anchor-Ministerxs-47857
40 Figures for 2002–03 are based on the 2004–05 DPR historical figures, http://www.collectionscanada.gc.ca/webarchives/20060120070614/http://www.tbs-sct.gc.ca/rma/dpr1/04-05/infc-infc/infc-infcd45_e.pdf
41 These figures are drawn from the 2010–11 Report on Plans and Priorities (RPP): http://www.tbs-sct.gc.ca/rpp/2010-2011/inst/inf/inf-eng.pdf
42 Both PPP and First Nations Funds are examples of a trend toward interdepartmental agreements flowing from the 2007 Building Canada Plan.
43 Note: This is "start-up" phase—mainly capacity building.
44 Note: This is first major phase with addition of financing and sustainability goals. *N.B.*: Shift from overall existing infrastructure coordination to strategic + cities and communities focus (broader and large-scale infrastructure + gas tax/municipal and regional infrastructure programming).
45 Note: This was a planned phase-out stage with sunset provisions. *N.B.*: The sun setting began in 2007 (and is ongoing) under the conservatives; they phased out the long-standing stream model (strategic/border/community infrastructure) and introduced the $30 billion "Building Canada Plan."
46 Sun setting here reflects the end of several existing programs, once committed spending runs its course.
47 The PPP and First Nations items are managed by other ministries (finance and Indian and Northern Affairs Canada) but are part of the Building Canada INFRC plan. The write-up as is keeps them under a horizontal interdepartmental multi-actor policy coordination theme.
48 This is just to capture the "policy," "knowledge," "research," and other analytic spending figures listed in DPRs/RPPs—Note: Some departmental reports do not include these types of figures/breakdown.
49 This figure is listed as "Planned" spending in the 2010–11 Departmental RPP: http://www.tbs-sct.gc.ca/rpp/2010-2011/inst/inf/inf-eng.pdf
50 Figures are drawn from annual DPRs; however, prior to 2006–07, FTE for "research" equivalent activities was not provided.
51 Not significant.
52 Where 1 = never and 5 = daily.
53 Where 1 = not at all concerned and 5 = very concerned.
54 Where 1 = very low capacity and 5 = very high capacity.
55 Where 1 = not at all relevant and 5 = very relevant.

About the Authors

Jonathan Craft teaches in the Political Science Department at Simon Fraser University.

Michael Howlett is Burnaby Mountain Professor, Department of Political Science, Simon Fraser University.

Mark Crawford lectures in the State and Legal Studies Programme at Athabasca University.

Kathleen McNutt is Associate Professor, Johnson-Shoyama Graduate School of Public Policy, University of Regina.

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Appendix—Provincial Infrastructure and Climate Change Adaptation[14]

Province	Provincial Adaptation Strategy?	Dept Responsible for Infrastructure and Its Mandate re: Climate Change	Infrastructure Ministries Programs Related to Climate Change Adaptation	Infrastructure Funding Explicitly Related to Adaptation ($)	Policy Analytic Capacity
British Columbia	Preparing for Climate Change: British Columbia's Climate Change Adaptation Strategy (2010)	Ministry of Transportation and infrastructure[15]	• General inclusion of planning/codes for infrastructure builds to include adaptation and resistance to climate change • Objective 4.2: The main highway system is rehabilitated on a lowest life-cycle cost basis • Integrate climate change adaptation considerations into rehabilitation design and cost • Building codes and standards reflect historical experiences; therefore some B.C. infrastructure may require repairs, retrofits, and upgrades to ensure that initial investments are resilient to climate change[16]	$441 million between 2011/12 and 2013/14 on the main highway system (roads and bridges) to maintain and mitigate the onset of deterioration in ways that maximize the return on infrastructure investment[17]	• PAC part of Climate Change Adaptation Plan (Strategy 1: Build a strong foundation of knowledge) • Unplanned Events and Conditions Reducing GHGs
Alberta	Climate change adaptation framework strategy (2008)	Alberta Ministry of Infrastructure	None found	None found	Infrastructure used to assess adaptive capacity[18] Prairie Adaptation *Research Collaborative*
Sask.	Bill 126, *The Management and Reduction of Greenhouses Gases and Adaptation to Climate Change Act*[19]	Ministry of Highways and Infrastructure	None found	None found	*Partner with* Prairie Adaptation *Research*

Manitoba	The Climate Change and Emissions Reductions Act (2008); Kyoto and Beyond—Manitoba's Green Future (2008)	Ministry of Infrastructure and Transportation	Integrated watershed management plans, flood protection is being improved throughout the province[20]	No funding figures available for these initiatives	Manitoba Climate Research Table[21]
Ontario	Climate Change Action Plan	Ministry of Infrastructure	The Ministry of Energy and Infrastructure modified its Infrastructure Planning Guidelines to require that ministries consider the impacts of climate change on infrastructure[22]	$32.5 billion commitment for general infrastructure, & $3.2B in funding related to innovative and green 21st century economy[23]	Expert Panel on Climate Change Adaptation (2007)[24]
Quebec	2006–2012 Climate Change Action Plan	Ministry of Infrastructure	Program reports indicate work related to "at risk" infrastructure and related to mass transit funding[25] March 2010 budget also included a series of other transportation & road infrastructure initiatives[26]	$55 million will have been invested to support municipalities for climate change risk mitigation (increased coastal erosion, flooding, and landslides)[27]	Research program on adapting transportation infrastructure to the impacts of climate change $3.9 million and address the vulnerability of transportation infrastructures in Nunavik due to thawing permafrost, and maritime infrastructures Research re: vulnerability of road infrastructures in the Gulf of St. Lawrence and marine estuary regions[28]
Nova Scotia	Towards a Greener Future: Nova Scotia's Climate Change Plan (2009)	Nova Scotia Department of Transportation and Public Works	• A memorandum of understanding that will address climate change mitigation and adaptation[29] • Design standards and plans for new provincial construction reflect projected climate trends[30]	None found	Adaptation Fund for research & development[31]

Appendix—Continued

Province	Provincial Adaptation Strategy?	Dept Responsible for Infrastructure and Its Mandate re: Climate Change	Infrastructure Ministries Programs Related to Climate Change Adaptation	Infrastructure Funding Explicitly Related to Adaptation ($)	Policy Analytic Capacity
New Brunswick	Climate Change Action Plan (2007–2012)	Ministry of Transportation and Infrastructure	Implement a regulatory framework to help protect the coastal environment, infrastructure and public and private property[32] Programs such as the recently announced Eco-Trust, the Canada/NB Infrastructure Program and the Canada/NB Municipal Rural Infrastructure Program are also essential and can assist in achieving the Action Plan commitments. The most recent (2007) federal budget also included a number of other initiatives that could be explored as funding opportunities for some action plan elements.[33]	No funding figures available related to specific infrastructure re: adaptation, see figures for other programs and PAC	• Atlantic Climate Adaptation Solutions Project • Atlantic provinces, municipalities and Natural Resources Canada collaboration with approximately $8.4 million between 2010 and 2012[34] • N.B. Environmental Trust Fund, $311,800 for studying adaptation[35]
Prince Edward Island	P.E.I & Climate Change ~ A Strategy for Reducing the Impacts of Global Warming (2008)	Minister of Transportation and Infrastructure Renewal	None found	None found	None found
N.L.	Climate Change Action Plan (2005)	Office of Critical Infrastructure Protection and Emergency Preparedness (OCIPEP)	Government will require that infrastructure projects receiving public funds meet a standard set of criteria with respect to climate change[36]	None found	Funding for community-based process of climate change planning studies related to selected communities risks from flood events[37]