



SYNTHESIS REPORT

Building Capacity to Accelerate Climate Change Adaptation in Canada – State of Play

October 14, 2022
PNI 1276

Prepared by: Environics Research

Prepared for: Natural Resources Canada

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Table of Contents

Executive Summary	2
Introduction	5
Literature Review	6
Stakeholder Engagement	11
Recommendations	20
Case Studies – Innovative Approaches and Transferable Learning.....	24
Acknowledgements	38
Endnotes	41

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Executive Summary

The Climate Change Impacts and Adaptation Division (CCIAD) at Natural Resources Canada (NRCan) contracted Environics Research, with its partners Dr. Robin Cox and ESSA Technologies, to produce a state-of-play report on capacity building for climate change adaptation. The objectives of this study were to provide NRCan and key stakeholders¹ with:

- A high-level common understanding of the current state of climate change adaptation capacity building and skills development in Canada, including current drivers and barriers;
- Information to inform a path forward on what is needed to strengthen the climate change adaptation system across the country, with a focus on the next five years (2022-2027); and
- A set of real-world examples (case studies) that demonstrate how sectors, organizations and associations are making progress to better equip the current and future workforce, decision-makers and industry members with the knowledge and skills needed to take adaptation action.

The Project was conducted in three phases 1) literature review, 2) stakeholder engagement and 3) case study development.

The literature review presents a framework for how Canada's workforce can achieve adaptation readiness to implement adaptation action. This conceptual framework shows that a climate-ready workforce requires the presence of three inputs: 1) **information and knowledge**, 2) **skills and competencies**, and 3) **leadership** (i.e., social and systems influence). Capacity development aims to build competencies in each of these three areas and strengthen the connections between them. With these three elements in place, the Canadian workforce will have what it needs to drive the **collaboration** and **innovation** necessary to achieve the systemic and transformational change required to successfully adapt to climate change

The stakeholder engagement research concluded that progress is being made in building capacity for climate change adaptation in certain areas, including: creating resources and knowledge products; embedding adaptation in policies; expanding communities of practice through training initiatives; and, building awareness and urgency for implementing adaptive measures. However, the consensus is that much more needs to be done when we consider what needs to happen in Canada to successfully adapt to climate change.

Gaps and priorities for future capacity building fell into five key themes:

- **Preparation** – filling in gaps in technical solutions (information and tools) such as old or poor-quality data, or data for northern, remote or Indigenous communities; expanding the pool of adaptation experts, including training a wider net of individuals, pushing adaptation expertise (and responsibility) throughout an organization, and knowledge transfer to smaller or less well-resourced organizations or communities.
- **Planning** – thinking ahead, by setting in place adaptive policies (particularly procurement policies) and by educating and empowering leaders to view decisions through an adaptation lens.

¹ Key stakeholders: all those with a vested interest in advancing climate change adaptation in Canada, including all levels of government, national Indigenous organizations, universities and colleges, professional and industry organizations and non-government groups.

- **Implementation** – putting knowledge into action and facilitating the uptake of adaptive actions through regional and cross-sectoral collaboration.
- **Evaluation** – identifying approaches that produce the desired adaptation outcomes (and avoid maladaptive ones), including best practices and lessons learned, as well as monitoring progress in building adaptive capacity.
- **Funding** – underpins the ability to build capacity; participants advocated for sustainable long-term support that is flexible to the adaptation needs of the community or organization.

There is overlap between themes, such as between developing policy (planning) and evaluating it, or between educating the next generation of climate adaptation specialists versus the current cohort of decision-makers. For each of the five themes, there are opportunities for incremental or shorter-term transitions.

In addition, stakeholders raised the need for structural or systemic transition. The impacts of climate change will be too great to rely on tried-and-true solutions; Canada needs the capacity to imagine and plan for a future that will look completely different. In particular, efforts to build technical capacity need to be balanced with capacity to address the culture and societal aspects of adaptation. The risk of not doing so is that we design ourselves into a corner that doesn't address our needs.

Indigenous peoples and communities are facing some of the greatest constraints to building adaptation capacity. At the same time, their Indigenous knowledge system and connection to the land offer the opportunity to learn and create a new, more holistic narrative about climate change and adaptation – building capacity for the time and space to share these perspectives will be of benefit to all.

The stakeholder engagement phase underscored how building capacity to enable climate change adaptation action involves multiple elements which are overlapping and not necessarily sequential in nature. Through the engagement phase, the following priority needs were identified:

- Adaptation roadmap to allow for identification of priorities, actions and responsible actors, as well as monitoring and evaluating success of capacity building actions
- Prioritized support and resources for equity-deserving and marginalized communities, as well as low-capacity and remote communities
- Increased awareness of, and value placed on, climate adaptation activities by organizations, industries, associations and sectors, to drive higher demand for adaptation skills
- Integration and mainstreaming of climate change adaptation into post-secondary education in all disciplines, as appropriate, to drive higher supply of adaptation skills
- Coordinated access to adaptation data and information, so it is easy to locate appropriate resources to help implement adaptation initiatives within organizations, industries and communities
- Apply innovative forward-looking, even radical and transformational ways of thinking about the changes needed to achieve climate adaptation, moving beyond conventional approaches
- Sustainable and flexible funding support for adaptation initiatives

The report also identifies recommended actions within each of these priority categories that, if undertaken, should drive progress in building climate adaptation capacity over the next five years.

Finally, we developed five case studies to shed light on important initiatives building capacity for climate change adaptation among professions (engineering, forestry), across a level of government (municipal/local government) and through systems (learning networks) and intergenerational (internship) approaches. These initiatives illustrate some of the complexities of building a climate ready workforce, such as the need for a foundation of data and knowledge on climate change impacts and adaptation options, some agreement on standard skills and competencies required to turn knowledge into action, and norms and institutions that can perpetuate the status quo. The case studies also highlight the important role of champions or adaptive leaders in mobilizing funding, networks and other resources to create and grow their capacity building initiatives, and the successes that result from their hard work.

Introduction

Background

The Climate Change Impacts and Adaptation Division (CCIAD) at Natural Resources Canada (NRCan) led the implementation of the Building Regional Adaptation Capacity and Expertise (BRACE) Program (2017-2022). This program, supported under the [Pan-Canadian Framework on Clean Growth and Climate Change](#), addressed a critical barrier to adaptation action in Canada: knowledge and tools exist, but the capacity to use them is limited.

BRACE contributed significant momentum around capacity building for climate change adaptation in Canada. The program funded 20 projects focused on training, knowledge-exchange activities and practical action designed to increase the capacity of organizations, professionals and small-to-medium sized businesses to undertake climate adaptation actions. The initiatives were regional in nature; addressed key gaps identified in collaboration with each Province; and were delivered by organizations best placed to reach target audiences including engineers, planners, local governments and recent graduates.

As the BRACE program wrapped up, and with demand for adaptation expertise accelerating across sectors, CCIAD contracted research to support developing a roadmap to strengthen the climate change adaptation system² over the next five years (2022-2027).

Objectives

The objectives of this study were to provide NRCan and key stakeholders³ with:

- A high-level common understanding of the current state of climate change adaptation capacity building and skills development in Canada, including current drivers and barriers;
- Information to inform a path forward on what is needed to strengthen the climate change adaptation system across the country, with a focus on the next five years; and
- A set of real-world examples (case studies) that demonstrate how sectors, organizations and associations are making progress to better equip the current and future workforce, decision-makers and industry members with the knowledge and skills needed to take action on climate change adaptation.

The research was conducted in three phases:

1. **Literature review**, providing a conceptual framework based on existing literature for understanding the different components of capacity to achieve adaptation readiness to implement adaptation actions.
2. **Stakeholder engagement**, involving discussions with a multi-disciplinary group of experts working to make our communities and economy resilient to a changing climate.

² The National Adaptation Strategy discussion document defines a system as “a cluster of structural and non-structural elements that are connected and organized to achieve specific objectives. Systems-based approaches look beyond individual assets and consider the interrelationships.”

³ Key stakeholders: all those with a vested interest in advancing climate change adaptation in Canada, including all levels of government, national Indigenous organizations, universities and colleges, professional and industry organizations and non-government groups.

3. **Case study development**, to provide practical examples of how sectors, organizations or associations are building capacity to integrate climate change adaptation into their decision-making.

The Project was conducted by Environics Research, in collaboration with Dr. Robin Cox at Royal Roads University, and ESSA Technologies.

Literature Review

The following illustrates a conceptual framework for how Canada's workforce can achieve adaptation readiness to implement adaptation action. Central to a climate-ready workforce are three **inputs**:

- 1) The first is **Information and Knowledge**, and answers the question: *does the Canadian workforce have the information and knowledge needed, in their desired formats, to understand climate change, the risks and impacts posed by climate hazards, and the adaptation options available to minimize or mitigate such risks?* In this regard, information and knowledge are the curriculum on which capacity must be developed.
- 2) The second is **Skills and Competencies**, which speaks to our applied understanding of climate change risk, vulnerability and adaptation, and answers the question: *does the Canadian workforce have the skills and competencies necessary to effectively translate the available information and knowledge into concrete risk reduction measures and actions?*
- 3) Finally, the third input relates to **Leadership** – both as a unique competency, but also as a process of social influence that maximizes our collective efforts to achieve national climate resilience. This input addresses the question: *do decision-makers within the Canadian workforce demonstrate the leadership necessary to leverage knowledge, practice, and social connections to catalyze transformational change?*

Provided these three inputs are in place, the Canadian workforce can help drive both the **Collaboration** and **Innovation** necessary to achieve the systemic and transformational change required if we are to successfully adapt to climate change. These concepts are elaborated below.

For the purposes of this simplified model, capacity development includes connecting the three inputs, moving from one input to the next, starting with *understanding*, progressing through *practice*, and culminating with *leadership*. If applied iteratively, with leadership helping to inform and influence new information needs, practice areas and skills and competencies, this framework can help identify the gaps, barriers, drivers and synergies characteristic of Canada's current learning system for climate change adaptation.

Information and Knowledge

Information and knowledge provide the foundation upon which Canada's adaptation learning system must be built. In essence, it is the content, or curriculum, on which capacity must be developed (or strengthened). Without a sound and comprehensive understanding of the climate system, how changes in this system will impact natural and socio-economic systems, and the types of measures that can reduce a system's risk and vulnerability (while optimizing efficiencies and/or opportunities), we have no basis from which to build capacity on. Historically, the responsibility for information and knowledge generation has fallen primarily to researchers and academics, although this is changing with increased focus on learning-by-doing and adaptive management.

Currently, research on the state of climate change (i.e., how the climate is changing), climate impacts (i.e., how changes in climate hazards will impact different natural and socio-economic systems) and adaptation options (i.e., how to limit loss and damage, and take advantage of opportunities) are clear and plentiful.ⁱ However, our knowledge and understanding of what works and what doesn't when it comes to reducing climate risks and enhancing climate resilience in specific contexts is ever evolving, and globally, is still quite nascent.ⁱⁱ While a lack of knowledge of climate impacts and/or adaptation options is no longer a defensible reason for inaction, a robust, comprehensive knowledge base is indeed a prerequisite for achieving scale through capacity development efforts.

As an example, the Engineers Canada [Infrastructure Resilience Professional \(IRP\)](#) designation would not have been possible were it not for the understanding of infrastructure vulnerability and risk assessment methodologies tagged to specific climate hazards that are core to the [PIEVC Engineering Protocol](#) (on which the IRP designation is based). While the PIEVC Protocol has been under development since before 2007, newer methodologies on natural asset valuation, for example, may not be mature or advanced enough to warrant comprehensive capacity development efforts just yet. Indeed, the Canadian community of public and private-sector service providers of both climate and adaptation information is growing in response to demand for general and customized climate change datasets and knowledge products.

In this category we also include information management, decision-analytic, and decision-support tools as means to guide action and help organize and manage data in a way that is meaningful and useful. For adaptation, despite an ever-growing abundance of decision-support tools related to hazard identification and risk and vulnerability assessments, there is still limited understanding by practitioners of which tools to use, when, and how.ⁱⁱⁱ Calls for greater consistency and standardization of how tools are described and/or categorized can help users more easily identify what tools exist, and can inform what types of decisions should be made based on the level of need (e.g., basic, intermediate or advanced).

Skills and Competencies

While *skills* refer to the developed capacities an individual must have to be effective in a job,^{iv} *competencies* describe how a person combines those skills together with behaviours, attitudes and knowledge, to effectively perform their job. With respect to adaptation, skills and competencies help frame how we apply our understanding of climate risk and climate vulnerability to effectively safeguard the organization, people, resource or asset for which we are responsible.

Globally, the skills required to succeed in today's world of work are rapidly changing.^v For example, technological advances characteristic of the current Fourth Industrial Revolution (IR4.0) require skills involving analytical thinking, innovation, active learning, complex problem-solving and critical thinking to match increasing jobs in big data, Artificial Intelligence (AI), machine learning, and process automation.^{vi} As a result of this shift, trends in the emerging future of work indicate an increasing focus on *skills* and mapping jobs to their specific skillsets in an effort to better understand skill shortages and labour market needs.^{vii} Closing this critical information gap will help governments, academia, training providers and other labour sector stakeholders, to design better policies and programs that can help meet the changing needs of workers, employers and service providers.^{viii}

In September 2021, Canada's National Occupational Classification (NOC) system was updated to improve links to Canada's new [Skills and Competencies Taxonomy](#). The objective was to better demonstrate the composition and distribution of skills across jobs and workers, thereby improving the comparability of these concepts across occupations and sectors (without reference to any specific occupation or sector, such as climate change adaptation).

Increasingly, where available, labour market information management systems can be used to track skill requirements and shortages within a job market, mapping skills to training opportunities and allowing workers and human resource professionals to build custom, individualized learning plans.

Adaptation Competencies

Like green jobs, adaptation and climate change resilience jobs span a range of educational backgrounds and occupational profiles. Arguably, adaptation jobs can fall into one of the following six (6) categories: researcher, practitioner, service or tool provider, funder, policy maker or advocate.^{ix}

Additional efforts have been made to distinguish the different types of actions performed as part of these jobs – from changing policy and law, to financing and investing, to building infrastructure (Figure 1). However, work in adaptation and climate change resilience crosscuts multiple industries and sectors, and the skills required to help safeguard companies, governments, and organizations against climate risks and take advantage of opportunities can be incorporated into many different types of jobs.^x

A recent survey of global climate change and sustainability professionals suggests that systems thinking, emotional intelligence, communication skills, and having vision, influence and integrity are the top skills and attributes necessary to succeed in the field.^{xi} Skills in financial management were also considered important to build a compelling business case for adaptation and resilience, while communication, facilitation, mediation and marketing skills were suggested to help bring the right people to the table while conveying the business case with conviction, urgency and efficacy.^{xii} Technical skills and risk management capacity are among the rubrics included in measuring the climate adaptation maturity scale within local governments.^{xiii} The [Climate Adaptation Competency Framework](#) is one example and a welcome development that helps workers, service providers and employers understand the knowledge, skills and behaviours necessary to be successful in undertaking climate adaptation actions.

A number of actors are involved in skill and competency development – from post-secondary institutions and professional/industry associations to businesses and governments at all levels. While a large and increasing number of climate science and climate adaptation training opportunities exist in Canada,^{xiv} Canadian workers spend less time in professional training than many other countries.^{xv} Without a detailed review of these trainings (i.e., the number of people being trained and how they are applying their new knowledge, skill or behavior in the workplace), it is hard to characterize the current state of learning on adaptation and resilience in Canada across all actors, from chartered accountants, to utility providers, to engineers or municipal staff. Procurement, human resource departments and

Adaptation Categories of Action

Measure and Learn	Monitoring changes in the climate system, gathering and analyzing data to build understanding of climate impacts and climate risk, and monitoring and evaluating actions taken to adapt to climate impacts.
Plan	Considering climate science, climate impacts, and climate risk in institutional planning.
Fund and Invest	Repurposing, leveraging, or obtaining public or private funds to finance or invest in adaptation actions.
Develop and Deploy Technology	Developing and deploying climate-resilient technologies, and technologies that enable climate resilience.
Communicate and Engage	Communicating with people and institutions the information they need to prepare for climate impacts, communicating information about adaptation actions being taken on their behalf, and engaging individuals and institutions in iterative processes, including through workforce development and trainings, to increase the effectiveness and equity of climate adaptation action.
Build Physical Infrastructure	Building new or improved physical infrastructure aimed at providing direct or indirect protection from climate hazards.
Shift Management Practices and Recurring Behavior	Incorporating climate adaptation considerations into land management, and day-to-day practice and behavior of professionals and laypeople.
Change Policy and Law	Revising, or creating new, law, policy, or regulation that requires or incentivizes adaptation action and penalizes maladaptation.

Language from the American Society of Adaptation Professionals' [Living Guide to the Principles of Climate Change Adaptation](#). Graphic by Emma Johnson, EESI

Figure 1. Adaptation Categories of Action, based on [ASAP's Living Guide to the Principles of Climate Change Adaptation](#) and summarized by the [Environmental and Energy Study Institute \(EESI\)](#)

associations are a key group missing from the discussions to date, but who play a central role in mapping organizational needs with skills, training opportunities and labour market information. The Association of Climate Change Officers ([ACCO](#)) is currently developing a toolkit to inform and engage human resource professionals about the value of adding specific climate change and sustainability elements to job descriptions.^{xvi}

Leadership

Although leadership can be characterized as a skill, competency, or personal attribute, we define leadership here as the broader process of social influence integrating a systems view that can effectively maximize the collective efforts of others to achieve a common goal – in this case, climate resilience.^{xvii} Leadership for complex, wicked problems such as climate change faces a number of unique challenges well documented in the literature.^{xviii,xix} The result is a need for a diversity of leadership functions and styles – from the ability to initiate, influence and realize policy change (policy leadership) and to forge new collaborations and working relationships (connectivity leadership), to the ability to foster joint learning and adaptability (complexity leadership) and to apply such adaptive management approaches specifically to social-ecological systems (sustainability leadership).^{xx} As a result, leadership – at the individual, organizational, sectoral or political levels – is key to unlocking collaboration, innovation, and subsequently, the systems transformation necessary to address Canada’s current resilience gap.^{xxi}

According to the American Society of Adaptation Professionals ([ASAP](#)), recognizing and activating leadership is a critical strategy for moving the needle on adaptation.^{xxii} Helpfully, Meijerink and Stiller distill five leadership functions if we are to effectively adapt to climate change (Figure 2). These include the ability to plan for and resource adaptation (the political-administrative function), the ability to generate new and innovative ideas (the adaptive function), the ability to create the

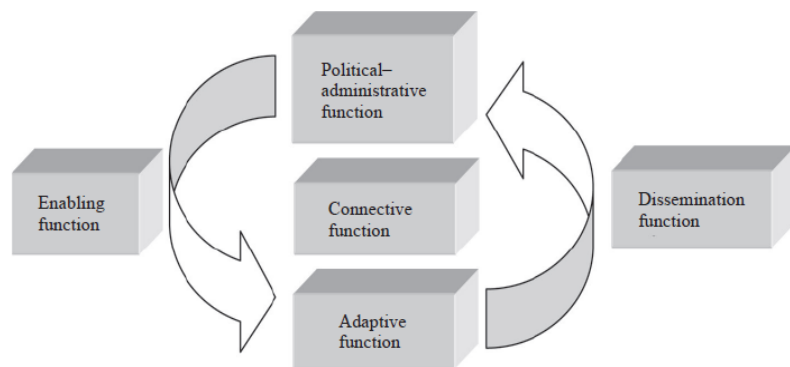


Figure 2. Leadership functions for climate change adaptation (from Meijerink, S. and S. Stiller, 2013)

right conditions for the emergence of new knowledge and innovation (the enabling function), the ability to effectively communicate this same knowledge and innovation (the dissemination function), and central to it all, the ability to bring people together, build trust and legitimacy, and forge consensus (the connectivity function).^{xxiii} While leadership is an important competency area for both positional leaders (e.g., politicians and corporate executives) and non-positional leaders (e.g., champions,^{xxiv} enablers,^{xxv} policy entrepreneurs^{xxvi}, and boundary workers), leadership for complex problems is also about process – how and through what means such diverse leadership requirements can be met.

As noted previously, provided Information and Knowledge, Skills and Competencies and Leadership are in place, Collaboration and Innovation can help drive adaptation action.

Collaboration

Collaboration is a “soft skill” that is essential for succeeding in the world of work of both today and tomorrow. Canada’s Essential Skills Framework (now known as [Skills for Success](#)) includes a number of “soft” social and behavioural skills such as adaptability, communication, and collaboration. As one of

nine core skills necessary for work, learning and life, collaboration skills ensure that people can work effectively and respectfully with others across different backgrounds and cultures.

Collaboration, networking, and learning together are perceived as central tenets of climate change adaptation.^{xxvii} Sharing knowledge and experience are considered fundamental in building capacity on climate change adaptation.^{xxviii} In their vision of what a mature adaptation field might look like in the United States, Susanne Moser, Joyce Coffee and Aleka Seville suggest that “*people need to be collaborative, and adaptive – able to function in a world of constant and potentially disruptive change; need to be networked, and deliberately sharing knowledge and resources. Social capital, inclusivity and collaborative spirit is key.*”^{xxix} They posture that sector-specific networks and cross-sector collaborations could serve as reasonable indicators to track and measure progress towards a mature adaptation field. Furthermore, knowledge co-creation and the ability to collaborate at scale are considered transformative capacities critical to catalyzing the deep systems change needed to urgently address the pace and scale of climate change.^{xxx} In 2019, soft skills training on stakeholder engagement and collaboration was identified by climate and sustainability professionals as a critical need.^{xxxi}

Adaptation Scotland’s [Adaptation Learning Exchange](#) is a good example of a coordinating hub that promotes place-based partnerships and collaborations. The Exchange facilitates organizations working towards a common goal to share knowledge and ideas, highlight best practice, facilitate peer support, and find opportunities for ongoing collaboration.

Innovation

Innovation entails the implementation of a new or significantly improved product (e.g., technology), service, process, or business model. While product and process innovation tend to dominate climate change adaptation discourse in Canada (and globally), other forms of innovation are just as critical if we are to achieve the systems-wide transformation necessary to build climate resilience. This includes innovation in the way we finance, collaborate, communicate, and build capacity for, adaptation.

Traditionally, innovation is most typically associated with advancements in the tech industry.^{xxxii} While climate tech – technology aimed at deep decarbonization and low carbon innovations – has attracted considerable investment in recent years, adaptation technologies have attracted very little by comparison.^{xxxiii} This suggests that despite an adaptation economy valued at €279 billion globally (2016),^{xxxiv} seemingly little has been done to “innovate” in the field – at least in a conventional sense.^{xxxv}

Despite limited innovation in the adaptation space globally, Canada is emerging as a leader in adaptation technologies. Technological innovations targeting agriculture, water management and health, ranks Canada as one of the top 5 inventor countries specializing in adaptation technologies worldwide.^{xxxvi} Emerging [Foresight](#)-led networks like [WaterNEXT](#) and [AgriNEXT](#), [ClimateVentures](#) (a Foresight-supported collaboration) and the [Canadian Water Technology Ecosystem Map](#), are good examples of how Canadian players are mobilizing to address today’s most pressing climate issues, despite a national rate of collaboration that has traditionally lagged that of other countries.^{xxxvii}

Beyond technological innovation, successful climate change adaptation will require innovation in the way we plan for and finance economic development. Adaptation policy, for example, can serve many purposes including but not limited to: safeguarding communities, protecting vulnerable groups/sectors, creating jobs, and spurring innovation.^{xxxviii} Transformative adaptation policy, or policy that promotes a whole systems approach to adaptation, can help deliver a larger, more sustainable, long-term change by embedding adaptation objectives alongside broader socio-economic and sustainable development objectives, such as those articulated in national net zero and SDG agendas.^{xxxix} Innovative financial instruments that can be used to finance transformative adaptation measures may include blended finance, climate bonds, or other sustainable finance initiatives aimed as systems transformation.^{xl}

In Europe, primarily in response to increasing frequency, intensity and duration of extreme weather events, the number of adaptation policy measures adopted by EU countries between 2005 and 2010 increased by 635%.^{xii} In Canada however, despite warming trends greater than global averages and economic losses from natural hazards greater than many European countries, the lack of adaptation planning and policy has been heavily criticized.^{xiii} The opportunity exists to implement new, innovative collaborations and financing models to deliver on Canada’s National Adaptation Strategy ([NAS](#)); provided the priorities of advancing “*comprehensive, inclusive and systematic approaches to adaptation*” and seeking “*synergies with other initiatives*” are fulfilled.^{xiiii} This ultimately connects back to the proposed 2030 NAS objective to have a skilled, diverse and adaptable workforce supported by education, training, and knowledge and skills development.

The subsequent stakeholder engagement phase of the Project presented an opportunity to explore how practitioners evaluate the current state of capacity and what they see as current gaps and priorities for building capacity for climate change adaptation in the next 5 years (2022-2027).

Stakeholder Engagement

Methodology

The stakeholder engagement phase began with pre-consultations involving ten (10) in-depth interviews with climate change adaptation experts from across Canada (held online via Zoom). The purpose of the pre-consultations was to gather input on the proposed engagement process for the Project, ultimately informing the final approach, and to gather their perspectives about climate change adaptation capacity building in Canada.

Drawing on the pre-consultation interviews as well as advice and feedback from Dr. Cox, ESSA Technologies and CCIAD, Environics developed a discussion guide for the stakeholder engagement sessions to ensure discussions centred on the needs and objectives of the study.

In late March 2022, Environics organized and moderated a series of seven (7) stakeholder engagement sessions. Rather than organize the sessions by profession, they were arranged around key themes recommended by ESSA Technologies to break down siloes and share information and experiences across professions (see table below).

Group 1	Resilient Communities
Group 2	Built Infrastructure
Group 3	Natural Infrastructure
Group 4	Resilient Economy
Group 5	Equipping Professionals with Adaptation Skills
Group 6	Government ⁴
Group 7	Indigenous Communities

The invitation list for each session was based on preliminary information provided by CCIAD, Dr. Cox and ESSA Technologies, and supplemented by Internet research conducted by Environics. An initial email invitation was sent to stakeholders with information about the Project and the session, and once participation was confirmed, the discussion questions were shared with stakeholders for context.

⁴ The Government session included representatives from federal and territorial governments only, as provincial representatives were included as part of the BRACE Committee session on March 3rd.

A total of 34 individuals participated across the seven groups, with between three and seven individuals in each. Each engagement session took place online via Zoom and lasted 90 minutes.

In addition, in early March 2022, an online group discussion was held with the BRACE Committee, comprised of 40 members representing project leads and provincial representatives. A shortened version of the discussion guide was used for the session, which was included within a broader meeting agenda facilitated by SHIFT Collaborative.

A list of stakeholder engagement participants from all sessions is provided in the Acknowledgement section at the end of this report.

Status of Progress on Adaptation Capacity Building

For the purposes of this Project's engagement sessions and to focus the discussion scope within the limited time available, the following definition of capacity building, developed by CCIAD, was provided to participants, while acknowledging that capacity building is much broader:

Building capacity for climate change adaptation = equipping organizations, sectors and workforces with the competencies (knowledge, skills and behaviours) needed to incorporate adaptation into their work and successfully act on climate change adaptation.

When stakeholders were asked to comment on this scoping definition, some expressed concerns that the definition was not sufficiently broad, in that it excludes additional components such as the need for human capital and financial resources and did not adequately cover:

- The capacity needs of **individuals and communities**, many of whom are “on the front lines” or experiencing the effects of climate change firsthand. This includes farmers, rural residents, young people, elders, community volunteers, Indigenous peoples and communities, and other vulnerable groups. One participant described the definition as “very urban and business and city oriented”.
- **Organizational capacity**, meaning the need to consider the “readiness” of an organization to undertake adaptation. Individuals may have the necessary skills, knowledge and behaviour but their efforts will be limited by organizational culture, structure or governance. Similarly, organizational characteristics may need to be addressed before the need for individual capacity (e.g., training opportunities) is recognized and pursued.

As a result, discussions during the stakeholder sessions focused on capacity building in the broadest sense.

Based on this broader understanding of the capacity building definition, there was consensus that the current state of adaptation capacity in Canada is “Fair”, meaning we are making progress, but much more is needed. Participants acknowledged progress in building capacity in the following key areas:

- **Creating resources and knowledge products**, such as climate data tools and maps, guides on how to conduct climate change risk and vulnerability assessments, and case studies on best practices.
- **Developing policy initiatives**, such as municipal asset management strategies or industry codes and standards that integrate future climate considerations.
- **Expanding the community of practice** beyond the traditional professions that have a duty to consider climate change risk (e.g., engineers, planners). For instance, training programs

supported through NRCan’s BRACE Program are reaching a wide group of sectors and creating regional networks.

- **Growing awareness** that climate change requires adaptation, and growing willingness to proactively plan for climate change (rather than reacting). There is a sense that momentum is building in spreading awareness, communicating urgency, and incorporating climate considerations into planning. This extends to growing the understanding that climate change adaptation is not just about infrastructure, but is also about socio-economic vulnerabilities. Despite this progress, it was acknowledged by the stakeholders that there is much more to be done.
- **Engaging Indigenous climate leaders**, including youth, who are leading conversations about climate change both within and outside their communities, as well as undertaking community-based monitoring of climate impacts.

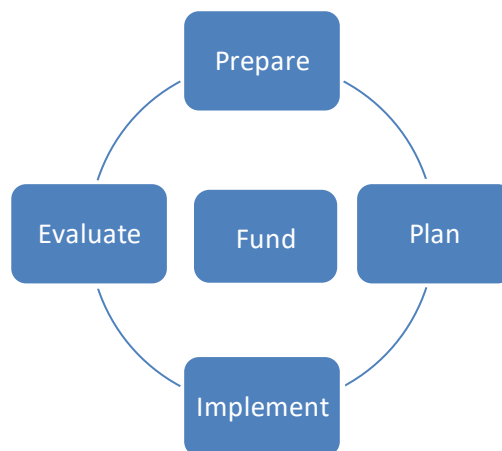
During the engagement sessions, stakeholders implied that we are still in the beginning phase of building capacity to adapt, indicating they consider this to be the early days in a longer process. For example, they mentioned that “funding is *starting* to come”, “we are *beginning* to understand that climate risk is moving risk”, and “we are *starting* to bring down silos and have multi-disciplinary conversations”.

Gaps and Priorities

Gaps and priorities for future capacity building identified during the stakeholder engagement sessions can be organized under five key themes:

- Preparation – including education, training, and developing information and tools
- Planning – thinking ahead and setting in place adaptive structures, policies and standards
- Implementation – executing the plan and accelerating action through collaboration
- Evaluation – identifying successful approaches and course correcting as necessary
- Funding – ensuring sustainable long-term support

These themes are discussed in further detail below.



Preparation

Technical solutions

One aspect of adapting to climate change is having the technical solutions which integrate future climate change considerations to support accurate planning and decision-making, such as up-to-date climate data and tools such as floodplain mapping, or codes and standards. While this is considered an area of progress, participants also identified gaps, including old or poor-quality data; lack of data particularly for non-urban, northern or remote locations; sparse monitoring or inadequate data collection activities; and lack of technical knowledge to interpret the data, particularly for Indigenous and remote communities.

“In terms of technical development, there is a lot of codes and standards work that has taken place that can inform engineers or municipalities when they're trying to become climate resilient that is very hard to apply in the Indigenous and northern context. So there's a huge gap between what's available capacity-wise for Indigenous, rural, remote northern areas of the country, who are often more at the front lines of climate impacts and need that capacity built up.”

“Part [of the gap] is data availability and part is people with the training needed to interpret and understand the data, what does it mean for the local area or region in order to build a plan around it and implement solutions.”

Expanding adaptation expertise

Being prepared to adapt to climate change also requires expanding the pool of individuals with adaptation knowledge. There are multiple directions for this expansion to occur. At one level, it is about mainstreaming adaptation throughout an organization, shifting responsibility from specific individuals (who may be working on adaptation “off the side of their desk” in addition to other responsibilities) or specific departments, to the organization as a whole.

Secondly, it is about training a wider net of people (beyond the same small circle that “show up to all these meetings”), thereby creating a greater supply of professionals who understand climate change vulnerabilities, risks and ways to adapt. In the short-term, training is required for professionals in the workforce; in the longer-term, adaptation needs to be incorporated into the secondary and post-secondary curricula so that students are equipped once they enter the job market. There is also a need to bridge the gap between theoretical knowledge and practical experience.

“One of the main gaps, for me, still remains that we need to find a way to embed climate change and climate change adaptation in the curriculum at the university...The professionals that we know are going to have to play a role, they need to be better equipped when they leave school.”

Thirdly, it involves transferring adaptation knowledge and expertise outwards from more advanced organizations or communities to smaller or poorly resourced ones.

Building awareness

A consistent theme raised throughout the discussions was that awareness (the “why”) is a key driver for building adaptation capacity and a fundamental precursor to action. The capacity gap is around communicating urgency and helping people recognize the need to prioritize adaptation (“we are in a crisis, but we are not acting like it”). Given the inadequate number of people working in this space, and the length of time it will take to train people, there is an opportunity to find allies who can amplify the message in the meantime.

“One of the things we've found both at the organization and individual level is the need to have a sustainability mindset, it's their readiness and having that right attitude that they're willing to get into this, because they understand why we have to do it in the first place.”

“I think in some people...they need to understand the need for adaptation and even the need for adaptation capacity building itself. Taking a carrots and sticks look at what would motivate them to take action, they need to know that they need to take action before they develop the skills in order to do that. So the capacity building needs to start at the awareness level of some of the benefits and the motivation for taking this action.”

Planning

Policy development

Participants identified the need to improve capacity to develop and institute the right policies as a key driver of climate adaptation outcomes. Policy levers designed incorrectly (or years ago) that do not generate the desired outcomes cannot be overcome by adding more people or organizations focused on adaptation. Similarly, there needs to be capacity to identify maladaptive policies which may create or sustain systems that undermine our ability to adapt to climate change (“what are the red zones that are steering us off course?”).

Building adaptation capacity through **procurement policy** is widely viewed as an opportunity. Particularly for infrastructure projects, adaptation needs to be consistently incorporated into the bidding process, and procurement policies help to create a level playing field, since adaptive solutions typically involve higher costs. This is one way to encourage private sector companies to increase their capacity to not only deliver adaptive solutions (and work to overcome barriers such as higher up-front costs), but also to market and communicate the benefits of resilience. Industry associations also have a role to play in “defining the norm” in terms of the adaptation capacity required within certain professions (rather than relying on individual companies to drive change). All these efforts are required to disrupt “a trend of passing the buck” between buyers and suppliers.

“Where the adaptation capacity starts to fall apart, is with a more granular knowledge of how to take all that understanding and actually translate it into meaningful things like policy. In a particular community that's dealing with high impact of heat stress, for example, what should they be looking at that will improve capacity to support, such as cooling centers and all those kinds of things that are going to be needed in the community. There's very little in the way of more granular guidance for practitioners who are actually writing policy and embedding this into their planning.”

“One of the things we've talked about is getting people to even call for [adaptation] in a request for proposals... they don't know how to ask for it and companies aren't necessarily going to offer to be more climate resilient in their proposal if it's not listed properly in the request because it in some cases will increase the cost, and so, then they won't want to go above and beyond, because they'll be afraid that they'll have a higher cost, and so they won't win the contract.”

Participants also emphasized the lack of prioritization on adequately addressing the climate change impacts being felt by vulnerable populations. The capacity gap is in part supporting them and their needs to be heard, but engagement alone is insufficient because decision-making often comes down to costs which do not favour the priorities of minority groups. There is an opportunity to build the capacity into policy, essentially mandating the protection of vulnerable communities and prioritizing their needs.

“I've heard testimony being given at municipal councils by people who belong to marginalized groups and communities and nothing happens, they are basically ignored...It needs to become almost

mandated that they are being heard and that the things that they are impacted by are prioritized...so we really can't leave it up to purely just the engagement process. That has to be embedded in the regulatory process."

"We need better buildings and we need to retrofit existing buildings, because with a higher performing building, you have passive survivability meaning that no matter what the temperature is outside, your building [temperature] will remain constant for two weeks or more, so that feeds into the national building code, so it's another way to protect our vulnerable populations."

Improving decision-making

Individuals within communities and organizations can make recommendations for adaptive policies and initiatives, but they will not be implemented if top decision-makers choose otherwise. This requires the education and empowerment of senior leaders in governments and the private sector to apply a climate adaptation lens to their planning and decision-making, and to understand it is just as critical as greenhouse gas reductions and other priorities.

Participants believe this can be achieved by helping leaders better understand risk and the cost-benefit ratio, as a way to increase urgency. The driver of change is largely building the business or economic case for adaptation measures in a way that incorporates the positive societal outcomes ("better accounting of the social benefits of resilience in decision and regulation, rather than the immediate or direct costs of adaptation").

"There's a value proposition we need to be sharing a little bit more explicitly so it can help guide the decision-makers to realize that you trying to scrimp and save and not spend the money on the adaptation work that needs to be done right now is going to cost you six to 20 times more in the future...It costs a lot of money when people have much higher rates of respiratory illnesses in the future than they do right now, it costs a lot of money when people have to be relocated from low lying areas that are going to be flooded and all of that infrastructure is lost. So we should be finding ways to capture those dollar values and that [responsibility] falls on both sides of the equation: those who are asking for those bridges and houses to be built, but also those that are building them."

"So there's an analytic gap in there, if your economic modeling is sophisticated enough to pick up future economic risk, the resilient option will often have the highest benefit-cost ratio, but you have to have the analytics to pick up the discounted future risk."

Implementation

Participants identified the implementation of adaptation strategies – that is, the capacity to act on what we already know – as a major gap. In the words of one participant, "there has been a lot of product development and not enough process development". The focus has been on short-term interventions that get a resource built and added to the growing number of adaptation resource products that are available, but ignores longer-term support for using the resources. Another participant described it as a failure in Canada to "transition to doing", particularly in the context of a small municipality, where an individual may not have the knowledge and time to take the tools that have been created and get the work done. Note that the criticism is not about the technical information itself, which is fundamentally necessary, but about the unbalanced focus on creating knowledge at the expense of developing our ability to accelerate its use.

"We stop building capacity once somebody has identified the risks or data plan, then we say you're on your own."

"I think this is where we've done a disservice by focusing efforts solely on impact identification and risk assessments...we assume that once communities and their partners have resources to implement them that'll just keep going, but there's a slew of capacity that's needed to support the governance and partnerships needed to implement these efforts."

"It's a lot harder to get resources to help our partners and stakeholders use the tools, rather than just disseminate knowledge. All of us have created a product for whom the contract ended with doing a webinar, but not the years of hand holding to say: how do I make this part of your everyday...I think that's challenging and [funding] should be built into longer periods of getting people to use things and not just making more things."

"In infrastructure, we have codes, regulations and documents, etc. But we also have technical experts working in their fields that have really no exposure to climate change, how to manage uncertainty and projections, and how to apply that information and we're getting to a point where that is becoming a major barrier to progress."

Collaboration

Another widely discussed driver of adaptation capacity is collaboration and coordination. Connecting people with adaptation expertise to communities and organizations that need it presents the opportunity to facilitate capacity development.

One priority is for this collaboration and coordination to take place at the regional level, since not enough municipalities have the capacity to address adaptation on their own. As one participant put it, "we bucket communities into separate areas when the reality is that working together probably is a better solution". This provides space to build relationships and create trust in the information provided by partners.

There also needs to be greater collaboration within communities; examples included the lack of communication between emergency management departments and adaptation professionals that was identified following flooding events. A further silo to break down is government and industry, achieving a dialogue and a more cooperative partnership with respect to adaptation.

"I think we need to go that next step of what are these expert adaptation hubs and regional representatives that can help you through your regional specific challenge and explore that solution space together. What are the solutions that worked for your neighbours, what are the solutions that you know worked for others a little further away? What were the barriers they face, what were the lessons they learned?"

"We have to recognize that all industries, including traditional industries, need to be part of the solution, but because they don't have that capacity, the starting point is getting that advice on how to go about it... connecting them with resources and professionals that could help them along the way."

"I think there's also an outward component [to adaptation capacity]. People or organizations do need to be able to think about adaptation and have the tools and the knowledge to build it into their own work, but it's often a horizontal process, they're often working with other groups or jurisdictions, and so having the capacity to represent whoever you're representing and go out and sit at tables and be part of a dialogue externally is really important, as well."

Participants also identified the need to build time and space for "co-development", collaboration, bringing together different perspectives to create a better outcome than can be achieved alone.

"[The gap] is teaching people that adaptation is a conversation. You can't do adaptation by yourself. If you're going to do that you're going to be maladaptive. So all of the silos that we're talking about,

those people need to learn that they do have a specific role and specific skills and specific expertise...but all of those things need to come together in order to make adaptation work and to have a more holistic understanding of your system.”

“Classically we look at adaptation as more of a technical field with codes and standards and technical solutions and that's obviously a huge part of it. But through some of our community work is the different focus on relationships and values and how to bring community values more broadly into planning and development. That work is really being led by communities. The gap would be creating that space to really meaningfully bring in different worldviews into how we plan and develop and relate to one another.”

Measurement and evaluation

A key gap *identified* in capacity is the lack of metrics for measuring and evaluating the impact of adaptation measures, to determine whether they are in fact producing the desired outcomes. Participants observe a lot of activity, in terms of information and tool creation, standards, codes and other policies, and training programs, but no clear determinant of success or “distillation of what’s hitting the high mark”. There is no systematic approach to identifying what works, and making activities iterative and coordinated rather than duplicative. There is an observed preference for the “new and shiny” (in part due to political pressures), that is not only limited to the infrastructure space but also exists when developing tools and data sets.

A perceived barrier is the lack of a common goal, such as exists for mitigation (net zero emissions by 2050), that everyone can rally behind and then plan for how to achieve. While a common objective is difficult given the range of localized climate impacts, measurement and evaluation can provide that strategy and direction – thereby allowing communities and organizations to “riff off success”, and ultimately “bridging the gap between planning and implementation”. Knowing what works and what doesn’t work also allows for course-correction to avoid maladaptive outcomes.

“Quantity is not quality and we see a lot of [adaptation] activity and a lot of it not being high quality and a lot of it not being even in the realm of being evaluated. We don't even know what the metrics for success are. And so we have all of this activity, there's all of this investment, and I really do fear that all of that well intentioned and well done work isn't actually creating anything remotely close to viable adaptation and part of it is because I don't think we know what adaptation actually looks like in this country.”

“We do struggle, sometimes with actually figuring out where the rubber meets the road on adaptation and where should the dollars go - what is going to have more impact.”

“...Everybody wants to make more stuff...and I think that's been a disservice for capacity building, because there's a lot of noise and a lot of websites to go to and guides to produce and this data set to look at. I think we have all the knowledge we need in various different portals but there's been so little effort put to helping to declutter that space. We need to somehow organize it so that the people we are all trying to get aren't blinded by us trying to constantly get at them.”

In addition to evaluating adaptation actions, further efforts are needed to evaluate *adaptive capacity*. What metrics tell us when an individual, organization or industry has increased their capacity to act on adaptation? This is necessary to identify where efforts to improve adaptive capacity within the workforce have fallen short and where to target further support.

Funding

Early in the discussion groups, it was acknowledged that funding is critical to capacity building, but it was intentionally excluded from the definition of capacity building for the purposes of this work to broaden the discussion beyond funding gaps to focus on capacity gaps and priorities. Yet the fundamental role of funding in building capacity was nonetheless an underlying theme in the discussions. Participants emphasized two key needs for funding: 1) that it be sustainable to build momentum and continuity in capacity over the long-term, and 2) that it be flexible to meet community or cultural needs (rather than dictating a pathway or technical need that may not reflect the capacity need identified by a community or sector).

“There is a large pool of money for some organizations or some sectors to build capacity and a complete lack of money in other areas, so I wanted to flag that actually the very beginning step is having the resources available and if those aren't available then there's no capacity or adaptation action even taking place.”

“In terms of funding mechanisms, some of the programs that work well for us...are set up in a way that gives us the flexibility and continuity to be able to carry out projects over time and I think what flexibility does is let communities direct the project in a way that may not fit a specific subject within the Federal Government, but that works for them.”

Incrementalism vs. Paradigm Change

In addition to the many capacity gaps identified, participants also pointed out that incrementalism will not be adequate to achieve successful adaptation, and that we should be looking at a paradigm change. This requires the capacity to use future climate change scenarios and projections instead of following what has traditionally been done. One participant pointed out “we are thinking in the present, not enough in the future.” This requires building capacity for vision, imagination, and a willingness to act bravely and embrace changes that are not popular (e.g., managed retreat).

“The biggest gap for us is really the long-term planning. Really stop seeing things only three to four years out and having a longer-term plan and incorporating the future risk of in that planning, instead of just reacting all the time, this is our biggest problem.”

“There are places where we have traction and others where idea that adaptation will save us is a total fallacy...so we have to get ruthless around how we evaluate and we understand these things, otherwise there's winners and losers in a way that we still can't even understand.”

“What we're talking about is a shift in our cognitive framework as a society and that work is not being done, there isn't the cultural lift being undertaken at the same time as that technical lift - even when we talk about the way in which we make kind of technical information more useful, there's a whole other realm of this that just simply isn't considered.”

Our capacity to adapt is also limited by our ability to meaningfully approach adaptation through a different perspective or worldview. Participants pointed out that Indigenous peoples and communities across Canada have the knowledge systems and resilience to adapt – offering a significant opportunity to reframe adaptation. Due to their proximity to the land and their socio-economic disadvantages, Indigenous people are among the most vulnerable populations to climate change; thus, their own capacity needs, especially from a funding perspective, cannot be overstated. There is potential to view adaptation capacity building efforts in Canada through an Indigenous lens to create new, more appropriate, and more holistic narratives:

“Whose capacity are we building?... we often think of “poor” small communities. But if you listen to other knowledge systems, you can see this differently. Capacity building can be a two-way street when we have these conversations.”

“We are in a tripartite relationship between First Nations, Settlers and the Land. It is an opening-up of ears to listen each other, and our eyes seek knowledge. We need to recognize there are different worldviews at play, and different ideas about what Land is. To find that ethical space of engagement, we need to re-empower First Nations to regain their relationship with the land and voice their views. At the same time, Canada and Ontario, and all the settler entities must allow the transformation of their land relationship to happen. That is, to realize the rigidity of the systems they have created and wake up to the reality that they are witnessing on the land. What we call climate disasters is only one of those realities.”

“[Beyond] knowledge, skills and behaviors are the values, norms and ethics that are motivating people to not just do risk avoidance (like coastal defense or to have insurance policies), but actually to think about this more holistically. There’s a lot to be gleaned from the Indigenous holistic world. The root of the problem is greenhouse gas emissions; therefore, we need to adapt our energy systems rapidly...this is the monumental task we’re faced with so we are baked in for impacts of climate change, but the extent to which those climate change impacts manifest depends on the mitigation side. So it’s a false dichotomy - there is no difference between mitigation and adaptation, it’s all adaptation and it’s adaptation of energy systems.”

The following section provides a series of recommendations for addressing the needs identified in the sessions.

Recommendations

The stakeholder sessions underscored how building capacity to enable climate change adaptation action involves multiple elements which are overlapping and not necessarily sequential in nature. The following section identifies what is needed to improve adaptation capacity in Canada including some specific recommendations for actions to support addressing these needs over the next five years.

1. Adaptation roadmap to allow for identification of priorities, actions and responsible actors, as well as monitoring and evaluating success of capacity building actions

Given the breadth of capacity building activities underway in Canada today and in the future, and the variety of individuals and organizations that need to incorporate adaptation into their work, there would be value in developing an overarching roadmap for these efforts. This would help identify who and what to prioritize, as well as provide a foundation against which to evaluate progress (i.e., what gets measured gets managed).

Recommended actions:

- Undertake a labour force analysis with the input or involvement of Employment and Skills Development Canada (ESDC). This could identify which occupations need to know how to build adaptation into their work, what skills and competencies they require to do this, and what gaps exist in building those skills and competencies. For example, the American Society of Adaptation Professionals (ASAP) has developed tools and information that identify adaptation jobs and highlight trends, needs and opportunities for the US labour force.^{xiv}

- Develop specific and measurable targets (e.g., how many people are trained, have received micro-credentials, have the necessary skills to adapt) for monitoring progress and determining where to shift resources in response to shortfalls.

2. Prioritized support and resources for equity-deserving and marginalized communities, as well as low-capacity and remote communities

Equity-deserving communities face barriers to equal access, opportunities and resources due to disadvantage and discrimination. In Canada, visible minorities, including Indigenous peoples, people of colour, and people with disabilities, are among the communities most at risk from climate change, while having less capacity to address it. Smaller communities and communities in rural, remote and Northern areas of Canada also tend to be disadvantaged in their capacity to adapt to climate change.

Recommended actions:

- Prioritize skills development and workforce training for these communities that they can immediately apply, as well as share with other community members, thereby broadening capacity exponentially.
- Adapt capacity building efforts to local contexts and cultures. This includes embracing new, more appropriate and more holistic narratives that communities themselves have input into developing, as well as different types of qualifications.
- Emphasize support for and collaboration with Indigenous communities, organizations and governments and integrate Traditional Knowledge and perspectives into capacity building efforts.

3. Increased awareness of, and value placed on, climate adaptation activities by organizations, industries, associations and sectors, to drive higher demand for adaptation skills

A driver of adaptation capacity building is awareness of the impacts of climate change, and of the policy and regulatory frameworks (e.g., Task Force on Climate-Related Financial Disclosures) being developed to reduce the associated risks to communities and businesses. As awareness grows, private and public sector and community leaders will become increasingly motivated to ensure their organizations have the necessary capacity to address current and future climate change challenges.

Recommended actions:

- Promote industry leadership and develop networks focused on spreading awareness within organizations and sectors.
- Identify and implement policies to create momentum for adaptation activities and thus create demand (pull) for these skills. A key example is procurement policies designed to encourage the inclusion of adaptation as a key decision-making factor when acquiring goods or services from suppliers.
- Engage professional associations and regulatory bodies to integrate adaptation knowledge and skills into their policies and standards, such as through licensing requirements or professional development credits.

4. Integration and mainstreaming of climate change adaptation into post-secondary education in all disciplines, as appropriate, to drive higher supply of adaptation skills

A gap identified in the stakeholder sessions was inadequate time and focus on adaptation training and skills development within programs at post-secondary institutions. The driver of growth in this area will ultimately be demand for these skills in the workforce, but waiting for increased demand will result in a delay as schools need time to ramp up their adaptation training. It is preferable for post-secondary institutions to accelerate the inclusion of climate change adaptation into their programs, to ensure today's students are prepared upon graduation.

Recommended actions:

- Use the convening power of government to bring together post-secondary institutions to prioritize adaptation into their educational offerings.
- Promote a consistent basis or framework for recognition of adaptation skills and qualifications, nationally and regionally. For example, this could include the expansion of climate adaptation competency frameworks and micro-credentialing, thereby building greater visibility and encouraging take-up of skills that will be increasingly in demand.

5. Coordinated access to adaptation data and information, so it is easy to locate appropriate resources to help implement adaptation initiatives within organizations, industries and communities

A substantial amount of adaptation resources and knowledge products have been developed; however, these are not necessarily organized nor easy for practitioners to find. The more information that is created, the more challenging it becomes to keep up-to-speed (for advanced practitioners) or to know where to start (for those new to the topic).

Recommended actions:

- Develop a central clearinghouse of information and links, focused on best practices, particularly for entry level practitioners, as a steppingstone on their adaptation journey. As individuals become more knowledgeable, they will become more adept at locating relevant information themselves.
- Collate resources for how to develop a business case for adaptation within organizations and industry sectors.
- Emphasize case studies that present practical examples and guidance on what has been proven to work, and what did not work.
- Develop and provide not only climate data, but courses, webinars and slide decks that explain how to interpret and use the data.

6. Apply innovative forward-looking, even radical and transformational ways of thinking about the changes needed to achieve climate adaptation, moving beyond conventional approaches

While this is a tall order, it reflects a key point made in the stakeholder sessions that successful climate adaptation will not be achieved by relying on existing solutions. Coming up with new solutions will require leaders and organizations to embrace new paradigms and ways of thinking.

Recommended actions:

- Train individuals on how to: create and manage structural change within organizations, optimize the process of identifying opportunities, and streamline practices that favour adaptation and remove barriers or constraints.
- Emphasize collaboration across sectors, industries, communities and levels of government to break down siloes and cross-pollinate ideas.
 - Invest in the future by supporting innovative research and thought leadership.
 - Apply a systems lens that not only considers each audience separately (e.g., professionals, organizations, industries, communities) but also how efforts between these audiences are integrated and coordinated.

7. Sustainable and flexible funding support for adaptation initiatives

The focus of stakeholder discussions was on priorities for adaptation capacity building, assuming that funding could be made available. However, there was a consensus that capacity building could not be properly discussed without emphasizing the need for ongoing funding sources to maintain and accelerate momentum in this area.

Recommended actions:

- Ensure funding is equally accessible to all communities and organizations (i.e., remove barriers and provide additional help for communities that historically have difficulties accessing funding such as Indigenous communities).
- Provide sufficient financial resources to low-capacity organizations and communities to increase their human capital and therefore capacity to take adaptation actions.
- Allot sufficient financial resources to evaluate the level of success of the capacity building efforts (e.g., did they lead to adaptation action) and to document what works well.

Case Studies – Innovative Approaches and Transferable Learning

Case Study 1: Building Capacity and a Learning Mindset to Implement a “Whole of Society” Approach to Adaptation

*** The following has been adapted from the [ALN Final Report](#) (March 2022) together with transcripts from key informant interviews with ALN program designers Robin Cox and Vivian Forssman. ***

1.0 Introduction

In 2021, the International Energy Agency reported the highest level of global GHG emissions in history. Here in Canada – thick in the grips of the global COVID-19 pandemic – the [Canadian Centre for Climate Services](#) reported that the country was warming at a rate nearly twice that of global averages.^{xlv} Globally labelled a “[code red for humanity](#)”, in British Columbia, wildfires, floods, and the heat dome event of 2021 were dominating headlines across the province. Against this backdrop, the urgent need to take action against climate change was gaining public recognition. Calls for bolder action to reduce the risk of a catastrophic future were emerging. Demands for a “whole-of-society” approach, acknowledging the role every sector, industry, community, and individual must play in adaptation to climate change, were mounting. However, turning this newfound recognition of the urgency and scale of the climate challenge into action has proven challenging. In Canada, the understanding of climate risk and adaptation is limited so the thought of a whole-of-society approach seems daunting. One initiative however, the [Adaptation Learning Network \(ALN\)](#), led by the [Resilience by Design Lab](#) at Royal Roads University, chose to take up this charge. This case study summarizes the work of the ALN and how the initiative helped prepare people at the front line of climate adaptation in BC by upskilling and applying social and technical competencies to help tackle the complex adaptation-related tasks that lay ahead.

2.0 About Royal Roads University’s Adaptation Learning Network

Operational from 2019 to 2022, the Adaptation Learning Network (ALN) was a climate adaptation capacity building program for working professionals in BC. With funding through Natural Resources Canada’s (NRCan) [Building Regional Adaptation Capacity and Expertise](#) (BRACE) Program, as well as the BC Ministry of Environment and Climate Change, Climate Action Secretariat and the Ministry of Advanced Education and Skills Training, the ALN has three objectives, to:^{xlvi} (i) develop a climate adaptation competency framework to support workforce development; (ii) create and deliver a set of climate adaptation courses through a network of top BC universities; and (iii) build a professional learning network for anyone working or interested in climate adaptation. Ultimately, the goal of the ALN was to “seed” the mindset of climate change adaptation in working professionals across all impacted industries and sectors.

By the end of its funding cycle, 576 working professionals had participated in at least one of ALN’s eleven course offerings – from [climate change adaptation fundamentals](#), to [natural assets management](#), to [financial impacts of climate change](#) and [climate policy](#). Courses were developed by six of BC’s top universities^{xlvii} based on skills gaps and learning needs identified by seven of BC’s professional associations whose work intersects with climate adaptation issues.^{xlviii} Currently, courses are available as standalone options, or can be bundled as part of an online [Climate Adaptation Fundamentals Micro-Credential](#), or the recently-launched graduate diploma in [Climate Action Leadership](#).

3.0 Conditions for success of the Adaptation Learning Network

Collaboration: ALN set out to create an adaptation mindset. The theory of change was that building workforce preparedness for adaptation at scale required a holistic and systems-based approach that empowered everyone to be part of the solution. As a result, the success story of the ALN is, in part, a story of large-scale, inter-disciplinary, multi-stakeholder collaboration. From the start, developers of the ALN set out to combine expertise in climate adaptation, adult learning, and educational delivery, together with the needs and realities of professions. These collaborations were essential to the upfront research and engagement phases, the identification of workforce gaps and development needs, and the eventual build out of strategic course offerings to fill these needs. Such was the momentum surrounding ALN that, by the end, collaborators spanned digital marketing and communications experts, network building experts, project and financial managers, Indigenous people, and many others.^{xlix} The result of such a robust and diverse network has been deep and continued interest, engagement and support for the outputs of the ALN initiative.

Skills and competencies: ALN's [Climate Adaptation Competency Framework](#) (CACF) was one of the first of its kind to describe the knowledge, skills and behaviours individuals need to adeptly adapt to the impacts of climate change. At a high level, the CACF describes 24 competencies, divided into five domains that range from Climate Adaptation Leadership to Climate Adaptation Science and Practice Literacy. The CACF was developed collaboratively (see above), with the input of hundreds of international and national adaptation experts, and based on a rigorous gap analysis of adaptation professionals skills. The CACF continues to evolve through ongoing use and application. Anecdotal evidence suggests that by identifying the knowledge, skills and behaviours necessary to build workforce readiness in the area of climate change adaptation, organizations can use the CACF to identify where and how to invest in capacity building for individual employees, as well as for the organization as a whole.

Data and knowledge: In addition to efforts to build on existing expertise in climate change adaptation and adult education, the ALN set out to fill gaps in the understanding of adaptation competencies and how to assess and build adaptation competencies within the workforce. A unique contribution by ALN was its success in communicating technical content in a way that was approachable, relatable, and more easily understood by professionals and professional organizations. A communications strategy and related tactics proved critical to the success of the professional learning network, for example. Tactics included: the hiring of a digital communications, marketing and engagement lead, a carefully curated social media presence, the use of a content calendar to create themed content in the monthly newsletter, as well as webinar and podcast production. ALN courses were developed using foundational data and knowledge related to climate change, adaptation, adult learning, and the future of work. However, it was the design and deployment of a carefully crafted communications and marketing strategy that helped to “package” these learning and capacity building opportunities in a way that was most relevant and engaging to working professionals.

4.0 Key Takeaways for Building Capacity and a Learning Mindset to Implement a “Whole of Society” Approach to Adaptation

A critical review of the achievements and challenges of the ALN over its three-year lifecycle led to three observations on the future of adaptation capacity building in Canada. These include: (i) the need for climate adaptation investments to be extended and fast tracked to keep up with the accelerating climate crisis; (ii) the need for a reflection on the complexity of climate adaptation capacity building and how

difficult it is to measure; and (iii) the need to build and sustain networks of social change if we are to achieve our adaptation objectives globally, nationally, organizationally, and individually.

From a network perspective, the ALN experience yielded several implementation and operational insights. These insights are based on ALN's commitment to tailor and customize their learning outputs to "teach the right things to the right people in the right way". The first is to take the time and make the effort to understand the landscape and the context within which you are working. For ALN, the success of any one of its outputs was entirely contingent on a rigorous gap analysis and learning needs assessment that spanned across climate-affected industries and sectors. The second is to mobilize the right people to deliver the work. Interdisciplinary collaboration is essential. By engaging leading universities, professional associations, course designers, instructors, adaptation experts, Indigenous knowledge contributors, digital marketing and communications professionals and the like, the network was primed for long-term success and sustainability from the outset.

Moving forward, the Resilience by Design Lab has set its sights on the continuation and amplification of its efforts to build a climate-informed Canadian workforce. In a new collaboration with the [Climate Risk Institute](#), the proposed [CanADAPT](#) initiative is poised to build on ALN successes to showcase and market climate-focused courses, micro-credentials and academic programs from over 200 post-secondary institutions and training organizations from across Canada.

Case Study 2: Enhancing Adaptation Readiness of Engineers Through Professional Development Hours

1.0 Introduction

Climate change is threatening Canada's ageing infrastructure. Throughout the country, loss and damage to infrastructure and their services is a top climate change risk. Climate-induced damage to homes and buildings as a result of increased flood risk could cost the country as much as \$13.6 billion annually by the end of the century, while damage to transportation and electrical systems have been projected to cost an additional \$12.8 and \$4.1 billion annually respectively.

Investing in adaptation is critical to building the climate resilience of infrastructure in Canada. An estimated \$5.3 billion per year is needed to help Canadian communities avoid the worst impacts of climate change, with sizable investments required to support climate resilient buildings, dikes, roads, among other assets. However, investment in infrastructure adaptation is not enough. Investment in asset improvements, and in more accurate, practical and universally-accessible climate risk information must equally be supported by efforts to build the capacity of architects, planners, engineers and other infrastructure decision-makers. The Université de Moncton is setting up to do just that.

2.0 About the Université de Moncton's Training and Tools for New Brunswick Engineers

To support adaptation investment and information needs in New Brunswick, the Université de Moncton is setting up to become a one-stop "hub" for reliable, trustworthy climate change adaptation resources for professional engineers. Over the last three years, and with the financial support of Natural Resources Canada's (NRCan) [Building Regional Adaptation Capacity and Expertise](#) (BRACE) initiative, the university has developed and deployed a series of webinars, technical (in-person and virtual) workshops, and courses to strengthen engineers' capacity to integrate climate risk information and adaptation measures into their practice. An Excel-based climate risk assessment tool that integrates current climate conditions and projections of future climate conditions for New Brunswick in relation to the existing infrastructure

vulnerabilities is core to capacity building. This tool formed the basis of a 15-hour certified climate change risk assessment course that can count toward engineers' annual professional development requirements. Since 2021, 30 engineers have completed the climate change risk assessment course, while the webinars and workshops attracted a total of 460 engineers across the various offerings. To help engineers and other infrastructure practitioners identify and navigate the diverse tools, training opportunities and other resources available to them, the initiative also developed an [Adaptation Resource Pathway](#).

3.0 Conditions for Success of the Engineers in Adaptation approach to capacity building

For engineers in New Brunswick, three key factors have been integral in the success of BRACE-NB and the University's ability to equip infrastructure practitioners and decision makers with the competencies needed to adapt successfully to the impacts of climate change.

Data and knowledge: Long standing work in the field of engineering provided a strong basis to develop and implement this project. Canada's leadership in assessing public infrastructure vulnerability to climate change impacts traces back to 2005, with a national engineering vulnerability assessment project and the subsequent launch of the [PIEVC Protocol](#).ⁱ Developed by Engineers Canada with the support of NRCan, the PIEVC Protocol is a tool to identify and assess the risks and vulnerabilities of infrastructure to current and future extreme weather events and climatic changes.ⁱⁱ As a regulated profession, the tool was developed in part to help meet the needs and professional obligations of engineers in identifying risks of damage to, or failure of, built infrastructure. In New Brunswick, PIEVC assessments have been completed for several assets, including the Saint John airport and ferry terminal, the Belledune Port Authority, and the highway infrastructure of the City of Miramichi.ⁱⁱⁱ

Over the years the success of the PIEVC Protocol, combined with improved access to increasingly user-friendly climate data setsⁱⁱⁱⁱ, has contributed to other significant achievements by and for the engineering profession in Canada. For example, the PIEVC Protocol underpins the training curriculum of [Infrastructure Resilience Professional](#) (IRP) credential for professional engineers^{lv}; application of the PIEVC Protocol supports meeting the requirements of Infrastructure Canada's [Climate Lens](#) assessment (see Norms below). In May 2020, the PIEVC program was assumed in part by the Climate Risk Institute (CRI) in Canada and the German Agency for International Cooperation (GIZ) in Germany in an effort to expand the use of the Protocol around the world, evidence of its high regard held within the engineering profession globally.

Skills and competencies: Professional development hours and maintaining competency levels are part of being an engineering profession. Provincial / territorial regulators require a minimum number of professional development hours per year in order for engineers to maintain their professional designation. In New Brunswick, the [Association of Professional Engineers & Geoscientists of New Brunswick \(APEGNB\)](#) requires professional engineers to undertake 80 hours of professional development annually.^{lv} Course work and resources developed under the Université de BRACE-NB project were designed to help meet these requirements and provide a "one-stop-shop" for engineers looking to strengthen the integration of climate change adaptation and resilience into their practice.^{lvi} By offering coursework and other learning opportunities that were co-created in partnership with the APEGNB, New Brunswick engineers are able to log their participation in capacity building events offered through the BRACE-NB project towards their annual professional development requirements.

Norms: In 2016, Infrastructure Canada launched the [Climate Resilient Buildings and Core Public Infrastructure Initiative](#) (CRBCPI), a five-year, \$42.5 million investment to integrate climate resilience into building and infrastructure design, guides, and codes. Under the CRBCPI, a number of Canada's

infrastructure codes were reviewed for maladaptation and recommendations put forward to strengthen the climate resilience of Canada's built environment including recommendations to amend Canada's national building, electrical, fire, and highway bridge design codes.^{lvii} Presentations and webinars on proposed updates emerging from the work of the CRBCPI were included as part of the offerings of the University of Moncton's BRACE-NB project in partnership with the CSA Group – Canadian Standards Association.

Further to efforts to hardwire climate resilience considerations into building and infrastructure design, guides and codes, Infrastructure Canada's [Climate Lens](#) – introduced in 2018 – has become a condition for funding under a number of federal government infrastructure funds.^{lviii} The Climate Lens helps decision-makers understand the climate change risks and impacts associated with the design, construction and operation of large infrastructure projects in Canada. The intent is to guide infrastructure projects towards designs that minimize greenhouse gas (GHG) emissions and are resilient to climate change. Compliance with the federal governments' Climate Lens – particularly the climate change resilience assessment criteria – has sent clear market signals to both municipal governments and engineering firms to strengthen their capacity to conduct climate risk and vulnerability assessments on all public infrastructure projects.^{lix}

New Brunswick is no exception as all projects approved for funding through Infrastructure Canada since 2018 have had to apply the Climate Lens screen – driving demand for the types of training, tools and resources available and specific to New Brunswick through the Engineers in Adaptation initiative.

3.0 Key Takeaways for Enhancing Adaptation Readiness of Engineers

Collaboration between professional associations and training providers is critical to building workforce readiness for climate change adaptation. By leveraging the APEGNB's minimum professional development hours annual requirement, together with the Université de Moncton's ability to offer a one-stop hub of relevant climate change adaptation resources available for New Brunswick engineers, the innovative collaboration offers the potential to dramatically shape the future of climate resilient infrastructure in New Brunswick. More recent efforts to embed climate risk information and resilience thinking into infrastructure funding and decision-making have driven increased demand from engineers and engineering associations for the types of capacity building efforts to be offered through a new partnership between the Université de Moncton (UMoncton) and the University of New Brunswick (UNB) for the years ahead. The long-standing work of Engineers Canada and the PIEVC Protocol, together with more readily available climate data sets, have contributed to an advanced state of knowledge and practice in the field of infrastructure vulnerability assessment from which this new UMoncton/UNB partnership can draw.

Case Study 3: Upskilling Forest Professionals Through a Climate Vulnerability and Adaptation Micro-Certificate

1.0 Introduction

Canada's forest sector faces wide ranging climate change risks from wildfire, pest outbreaks, species shifts and an overall decline in forest productivity and health^{lx}, with companies already incurring loss and damage due to warming temperatures and other climate impacts. Numerous scientific resources, tools, and protocols have been developed to help forestry professionals and decision-makers take a proactive approach to sustainable forest management in a changing climate. These include the [Canadian Council of Forest Ministers](#) climate change vulnerability assessment [guidebook](#) (2015), the [Forestry Adaptation](#)

[Community of Practice](#) (FACoP), together with a number of climate and forest modelling tools and mapped outputs, data catalogues, citizen science networks, and a database of adaptation options.^{lxi} Despite the number of tools and resources that exist for Canadian forestry professionals, a gap still exists between the science available and its application in practice.^{lxii}

Training providers are responding to an increased demand from practitioners for high quality, science-based, hands-on training in climate science, impact and vulnerability assessment, and adaptation planning. As pressure from governments, certification agencies and society on forest-sector organizations to identify and manage the physical risks of climate change mounts^{lxiii}, programs like the University of British Columbia's (UBC) [Faculty of Forestry Climate Vulnerability and Adaptation \(CVA\) Micro-Certificate](#) (CVA) can help meet the growing need for climate competencies. This case study examines how micro-certificates like the UBC CVA micro-certificate can equip both the current and future workforce, decision makers and industry members with the skills, knowledge, abilities (i.e., competencies) needed to act on climate change adaptation.

2.0 About the University of British Columbia's Climate Vulnerability and Adaptation Micro-certificate

The UBC Faculty of Forestry's Climate Vulnerability and Adaptation (CVA) Micro-Certificate is a flexible, online program (50 – 60 hours of study time) that provides working forest professionals (e.g., foresters, technicians, tree planters, policy makers) with an understanding of climate science, vulnerability and adaptation, and how to apply both the theory and the science of vulnerability assessments in a management context. A self-paced, non-credit program, the CVA micro-certificate provides hands-on, practical and applied vulnerability assessment applications, grounded by real world case study examples of adaptation action in the forest sector. The program requires the completion of four courses (three mandatory and one elective), with each course requiring approximately 15 hours of study time. Although the program was designed to be completed over an eight-week period, if necessary, learners have the added flexibility to complete all four courses within a maximum two-year period. Over 65 students from across Canada and the United States have participated in the CVA program since its launch in February 2021.

3.0 Conditions for Success of the CVA micro-certificate

Three key factors have been integral in the success of the CVA micro-certificate in equipping forestry practitioners and decision-makers with the competencies needed for the sector to successfully adapt to the impacts of climate change:

Data and knowledge: The CVA micro-certificate leverages knowledge and experience from large-scale forest sector vulnerability assessments and adaptation plans. Indeed, the program prides itself on being grounded in real-world case study applications of climate vulnerability assessments that have been completed for large Canadian forest companies like Mystic Management in northern Saskatchewan – the first company in North America to do a full-scale climate vulnerability and risk assessment.

For learners interested in climatic and ecological modelling for adaptive forest applications, the [ClimateBC](#) model at the heart of the climate science track is considered one of the best performing climate models out there.^{lxiv} In addition to facilitating climate data for specific locations (versus grid averages), the ClimateBC model uses ecological models to visualize shifts in biogeoclimatic zones as well as the resulting

shift in forest tree species distributions. The ClimateBC model continues to receive accolades from learners regarding its accessibility and remains freely available for download.

Leadership: In British Columbia, 94% of lands are under provincial jurisdiction.^{lxv} As a result, sustainable forest management is a priority for the provincial government. In 2012, the Ministry of Forests, Lands and Natural Resource Operations (now Ministry of Forests) released the [Forest Stewardship Action Plan for Climate Change Adaptation \(2012 – 2017\)](#). The goal of this plan was threefold: (i) to foster resilient forests; (ii) maintain future options and benefits; and (iii) build adaptive capacity. British Columbia continues to be a leader in promoting climate resilient forests, having recently announced record investments in BC Wildfire Services, [\\$150M for wildfire risk reduction](#) initiatives, and the establishment of an Ecosystem Forecast Centre within the Ministry of Forests, as part of its ambitious new [Climate Preparedness and Adaptation Strategy](#) (June 2022). In addition to the province's climate and forestry-related leadership, BC's [Micro-credential Framework](#) – released in September 2021 – is one of the first of its kind in Canada, responding to the surging popularity of micro credentials worldwide and the need to develop and implement a coordinated and consistent approach to meeting shifting labour and skills needs. Indeed, UBC's CVA micro-certificate was [funded by the BC Ministry of Advanced Education and Skills Development](#) as part of the province's COVID-19 economic recovery plan (i.e., [StrongerBC](#)).

Norms: With record breaking extreme weather events making headlines in British Columbia and across Canada, teaching staff within the CVA micro-certificate suggest that the increasing severity of climate change impacts and the associated media attention received by such events is helping to drive both public awareness of climate change, as well as climate action by the sector. For example, in 2022, the Sustainable Forestry Initiative's (SFI's) [Forest Management Standard](#) was updated to include new objectives on climate smart forestry and fire resilience & awareness. Across Canada, upwards of 285 million acres of forest area are certified under SFI, including almost 100 million acres in BC alone – the most of any single province or state in North America.^{lxvi} Related to increasing certification trends, private and public sector entities are facing increasing pressure and requirements through Environmental Social Governance (ESG) reporting and climate and nature-related disclosure (Task Force on Climate/Nature-Related Financial Disclosure and related developments in Canada). Organizations – including within the forestry sector – will increasingly need to respond to heightened accountability requirements from regulators, investors and stakeholders. Micro-certificates like the CVA are helping prepare the forestry sectors' workforce to respond to shifting market conditions and public scrutiny.

4.0 Key Takeaways for Upskilling Professionals using Micro-certification

The CVA micro-certificate program is, in part, a story of how an advanced state of knowledge and practice by a few leaders, can help drive workforce adaptation readiness when optimally combined with enabling policies and market drivers. For the forest sector in BC, strong provincial policies related to sustainable forest management, climate preparedness and skills development, align with global trends toward climate accountability, transparency and disclosure, social licensing, as well as the future of work and the skills-based economy. However, were it not for the advanced state of vulnerability assessments, adaptation plans, and climate models applicable to the sector, the CVA micro-certificate program may not have been as successful in leveraging such an opportune moment in time.

For the program itself, recognizing the limited time available to practitioners, considerable effort was put into finding leading experts in Canada to develop a top quality, streamlined curriculum for busy professionals. Furthermore, program designers note the importance of spending time upfront to do the

work, understand the sector, its market drivers and barriers, and to plan for the long term. Now with its own business plan, the CVA micro-certificate has become a permanent offering of the Faculty of Forestry and will be on offer twice a year.

Case Study 4: Professional Internships help build Adaptation Capacity of Future Workforce and Organizations in Prince Edward Island

1.0 Introduction

Islanders and all sectors of employment across Prince Edward Island (PEI) are at risk from climate change, with coastal erosion and flooding, post-tropical storms, heatwaves, and intense rainfall as the most significant climate hazards.^{lxvii} Several adaptation policies and measures are underway, including investing in infrastructure upgrades that build climate resilience and issuing new legislation to support sustainable water management in the face of climate change.^{lxviii} Informed by a province-wide climate change risk assessment and stakeholder and public input, the province is currently developing a climate adaptation plan. Its successful implementation will require collaboration across levels of government (federal, provincial, municipal, and Indigenous), with sectors and diverse publics.^{lxix} Indeed, for decades, collaboration within the province and across jurisdictions has been a core strategy to support progress in building the climate change knowledge base, raising awareness, and advancing adaptation decision making. The province's small population size and significant rural make-up makes building capacity to adapt uniquely challenging. In addition to collaboration, an emphasis by government on education, outreach and skills building for all citizens are ways to ensure capacity to adapt is distributed across the province.

To build the capacity to adapt of local professionals, practitioners, and recent post-secondary graduates (future workforce), the province of PEI teamed up with the University of Prince Edward Island (UPEI) in an innovative collaboration to deliver an internship program as well as a number of training and professional development opportunities. Through ClimateSense, a cohort of seventeen interns developed theoretical knowledge, skills and on the job experience, completing sector-specific adaptation projects for host organizations across the Island. This case study examines how capacity strengthening initiatives like ClimateSense that match burgeoning adaptation skills with real-world problems across sectors can accelerate the integration of adaptation thinking amongst the future workforce and within organizations.

2.0 About the Province of PEI and UPEI's ClimateSense Initiative

With the financial support of Natural Resources Canada's (NRCan) [Building Regional Adaptation Capacity and Expertise \(BRACE\) initiative](#), ClimateSense offered both a [professional internship program](#) and a [training and professional development program](#). As part of the professional internship program, seventeen interns and 15 mentors were engaged across the Island. The interns completed 6 or 12 month sector-specific adaptation projects for Island organizations, including municipalities, non-profits, research organizations, and provincial government departments. As part of the training and professional development program, local adaptation practitioners^{lxx} could access various short, climate-related training opportunities to hone their adaptation skills in an interactive learning environment. Designed to adjust to the needs of practitioners and constraints posed by COVID-19, the program integrated a number of external training opportunities from across Canada – including those hosted by other BRACE partners like the [Adaptation Learning Network](#) (Royal Roads University). The training offered through ClimateSense was an integral component of the internship program. It provided interns with the knowledge and skills

necessary to impact change, in a real-world, applied setting. The internship program resulted in the opportunity for both interns and mentors to enhance their knowledge and skills in the field of climate change and also allowed host organizations to increase their engagement and visibility in the climate change adaptation space.

3.0 Conditions for Success of the Internship Program

Three key factors feature prominently in the success of the ClimateSense program and indeed in much of the adaptation story for Atlantic Canada. These three factors include: (i) collaboration, coordination and sharing of good practices across the region; (ii) skills, competencies, and the promotion of cross-disciplinary understanding of climate change and its impacts; and (iii) data, research, and improvements to the relevance and usability of climate change information.

Collaboration: Collaboration and innovative partnership have been at the heart of Atlantic Canada's climate change work since its pioneering commitments to the [New England Governors and Eastern Canadian Premiers](#) Climate Change Action Plan of 2001.^{lxxi} In 2008, the Atlantic Environment Ministers endorsed the first [Climate Change Adaptation Strategy for Atlantic Provinces](#) recognizing that *“working together on issues of joint concern around climate change adaptation allows the four Atlantic provinces to move beyond what can be achieved individually.”*^{lxxii} In April 2010, the Atlantic Regional Adaptation Collaborative was launched with in-kind contributions exceeding \$2.8M from over 62 stakeholder organizations from across the Atlantic region.^{lxxiii}

For Prince Edward Island, recognizing the importance of a collaborative approach to adaptation, the province was one of the first signatories of the [RegionsAdapt](#) initiative – a platform dedicated to facilitating collaboration between state and regional governments to reduce the risks of climate change and build resilience, and the official platform for states' and regions' participation in the [UNFCCC Race to Resilience](#). Established in 2020, the [PEI Climate Challenge Fund](#) is a \$1M annual fund that explicitly targets innovative collaborations between *“people of different backgrounds, experiences, and expertise, who work across sectors and in different communities throughout the Island, to contribute to climate action...”*

Building on this longstanding spirit of partnership and solidarity, collaboration was a key factor in the success of the ClimateSense internship program. The partnership between UPEI and the provincial government bolstered the program and gave it a legitimacy that advanced the work beyond what would have been possible had the partnership not been formed. Collaboration can also be evidenced by the breadth of host organizations. In addition to the 'usual suspects' (e.g., government departments, engineering firms and university research institutes), other host organizations included those from the arts ([CreativePEI](#)) as well as a women's rights organization ([Action Femmes I.P.É](#)). These organizations have continued to be involved in discussions on climate change adaptation and have secured additional funding for ongoing work.

Skills and Competencies: In Atlantic Canada, the relatively small population size distributed almost equally across urban centers and rural communities, poses a number of unique challenges to building adaptation capacity across the region. Small communities have limited financial resources split across a host of budgetary obligations. The ability to engage external specialists, professionals, or scientists in community-based vulnerability or adaptation planning efforts is limited. As a result, Atlantic Canada has placed considerable emphasis on education, outreach and skills building for all citizens – from early elementary school students, through to post-secondary learners and mid-career professionals.^{lxxiv} In PEI, in a summary of [key recommended climate change adaptation actions](#) across ten sectors, the education and outreach

sectors received considerable attention, second only in number of recommendations to the water sector.^{lxxv} Education and capacity building is one of five action areas targeted by [PEI's Climate Action Plan \(2018 – 2023\)](#) with commitments to both the integration of climate change principles into more learning environments (formal and informal), and support for more climate change learning opportunities as part of professional development.

The ClimateSense collaboration responded directly to the Province's focus on cross-disciplinary learning about climate change. In direct response for example, the PEI Department of Education served as a host organization for an intern to support the integration of climate change adaptation into the secondary school curriculum.^{lxxvi} More generally however, ClimateSense interns and mentor organizations had access to a variety of training opportunities (e.g., conferences, webinars, personal development, field experiences, professional certifications, collaborative learning). To help cement intern's newly formed knowledge and understanding, interns subsequently had the opportunity to apply their learnings to help solve real-world adaptation challenges for their respective organizations. Each bringing diverse educational backgrounds, interns gained new perspectives through valued engagement with peers, as well as the opportunity to become climate change leaders within their respective host organization. The results of the ClimateSense initiative promises to foster a more integrated, holistic, and 'whole-of-society' approach to the climate challenge in PEI, and the diverse ways in which organizations will experience its impacts.

Data and Knowledge: In the early 2000s, the adaptation focus at the time was on climate information and the 'hard' science of understanding climate data, projections, modelled impacts, together with the completion of robust hazard, risk, or impact assessments.^{lxxvii} Launched in July 2021, [CLIMAtlantic](#) is one of four and the newest Canadian regional climate data hub supported by the [Canadian Centre for Climate Services](#) with a mission to provide those in Atlantic Canada with accessible, reliable, actionable climate information to address climate-related risks and to support adaptation needs. The more recent focus on capacity and collaboration (above) has taken centre stage in recent years. Still, the Atlantic provinces maintain a strong focus on improving the relevance and usability of information on climate change. In PEI, this is apparent in their commitments to advance climate change knowledge – including local knowledge - and research through improved modelling, monitoring, and storytelling methods.^{lxxviii, lxxix}

For the ClimateSense initiative, an overarching objective was to propel the idea of climate adaptation into the mainstream and help make climate data, knowledge and information available to organizations who may not typically have the resources to commit to the cause. A goal was to make all professionals, no matter the industry, aware of climate issues and promote the mindset that "all jobs are climate jobs". In developing the internship program, UPEI put recent graduates who not only possessed climate adaptation knowledge but were also passionate about the issues into industries that needed the support and resources. Interns working in the field were able to share their wealth of knowledge with host organizations, and in turn, host organizations gave interns a chance to apply their skills in the real world.

4.0 Key Takeaways in supporting Adaptation Capacity of Future Workforce and Organizations

Professional internship programs can infuse organizations and workplaces with adaptation capacity and expertise through focused, time limited assignments designed to address a specific need or interest of a host organization. Such internship programs also help to build the skills and relevant experience that will set the interns up for success in future employment in the field. Critical to the success of the ClimateSense program of Prince Edward Island was both its partnership model and its adaptive, flexible design features.

For the government of PEI, partnering with a learning institution and training provider such as UPEI brought both legitimacy and opportunity to think beyond the strength or expertise of one, or few, partners. The adaptive design of the program fostered a learning culture within the program itself – allowing program coordinators to respond, pivot and adapt, while simultaneously giving them space to embrace the unexpected and welcome new, previously unexplored, unanticipated, adaptation champions to the fore. In future, the ClimateSense experience suggests that longer internships (>12 months) can help better institutionalize learnings and results, helping to improve effectiveness of host organizations while simultaneously affording interns the opportunity to become stronger climate leaders within their organizations and communities.

Case Study 5: Learning to Account for Nature in Local Decision Making through Natural Asset Management

1.0 Introduction

Local governments in Canada are facing a backlog in infrastructure spending and are on the front lines of climate action. Municipal infrastructure is aging and may become unable to withstand the impacts of climate change, and the cost of refurbishing or building new engineered assets is increasing. As such, the ability to deliver services provided by these assets is under stress. Nature can provide a range of municipal services while simultaneously helping to meet climate – and increasingly, biodiversity – responsibilities. Natural assets (e.g., wetlands, forests, grasslands, peatlands, parks, lakes/rivers/creeks, fields, soil) can be restored, maintained, and protected to support climate, community, and catchment-level goals, often at lower costs than grey infrastructure assets. Unlike engineered (or grey) infrastructure, natural (or green) assets provide co-benefits for communities and watersheds while contributing to human and ecological health and well-being over the long term. For example, investing in protecting or restoring coastal estuaries and marshlands not only protects coastal communities from storm surge but can increase opportunities for wildlife habitat, carbon sequestration, recreation, and public education. The challenge, however, is that local governments often don't think of nature as providing value in the way of grey infrastructure. Further, disparities in funding and human resources between small and large municipalities can hinder climate preparedness.^{lxxx}

Several initiatives are now underway in Canada to urgently scale and increase local uptake of nature-based solutions and natural infrastructure.^{lxxxi} The [Municipal Natural Assets Initiative \(MNAI\)](#) is one such initiative. This case study examines how the innovative work of MNAI is helping to improve workforce readiness and climate preparedness by conferring widespread capacity for local, nature positive, climate adaptation

2.0 About the Municipal Natural Assets Initiative

The MNAI began with one project in Gibsons, British Columbia^{lxxxii}. The Town of Gibsons was the first community in North America to pass a municipal natural asset management policy recognizing natural assets within its accounting framework, and creating obligations for their operation, maintenance, and replacement.^{lxxxiii} In 2016, Gibsons became a founding member of MNAI. Now, MNAI works with local governments across Canada to identify, value and account for natural assets in their financial planning and asset management programs and develop sustainable, climate resilient infrastructure at lower cost and reduced risk. The organization's approach to building capacity for natural asset management includes providing technical assistance to local governments, assembling evidence on the feasibility and benefits of natural asset management, and supporting the creation of an enabling environment for adoption of

natural asset management (e.g., via participating in policy advocacy, standard-setting and professional development opportunities).

Since MNAI started in 2016, interest among local governments in learning about and practicing natural asset management has grown significantly. To date, MNAI has worked with over 100 local governments across Canada on natural assets projects, including supporting the development of natural asset inventories^{lxxxiv} and testing modelling tools to inform the valuation of alternative measures to manage natural assets.^{lxxxv} Drawing from evidence from local community pilot projects, MNAI has actively worked to formalize practices in natural asset management and upskill professionals, with tangible results to show for it. Examples of MNAI's success are described further below.

3.0 Conditions for Success

In line with MNAI's ultimate mission, five key factors have come together to help build momentum among local governments in Canada to understand, account for, and manage natural assets to preserve the core services they provide to citizens. Cross-cutting to all has been the critical role of collaboration among actors, institutions and levels of governance.

Data and knowledge: In Canada, the integration of asset management with municipal financial planning to improve infrastructure planning and decision-making, is a growing space.^{lxxxvi} As a result, the work of MNAI adapts existing asset management tools and methods to include and account for the novel considerations associated with natural assets. For example, MNAI's [Coastal Protection Toolbox](#) builds on existing asset management good practice to include guidance on how to develop natural asset inventories, condition and risk assessments for natural assets, and levels of service for natural assets.^{lxxxvii} In assessing a municipalities' natural assets, MNAI works with interdisciplinary providers of technical services (e.g., coastal engineers, hydrologists, ecologists, spatial analysts, modelers, economists) to connect locally-held data and knowledge of natural systems, to knowledge of how ecosystem service flows could change under different management scenarios, and finally, to dollar values assigned to each of the anticipated costs and benefits. Historically, issues of data reliability have posed a barrier to achieving the standards required for accounting (verifiable data), so MNAI has sought to raise awareness of, and build capacity in, the application of tools available to quantify ecosystem services of natural assets and accepted methods for valuation. In this regard, sharing positive and compelling examples outlining methods, results and lessons learned, and grounded in municipalities' practical experience, has proven core to MNAI's scaling strategy and expanding visibility.^{lxxxviii}

Skills and competencies: In an effort to strengthen the number of opportunities for professionals to improve their skills and competencies in natural asset management, MNAI has worked with Royal Roads University (RRU) to offer the first ever course available to professionals in Canada on natural asset management.^{lxxxix} This course is eligible as an elective as part of RRU's [Climate Adaptation Fundamentals Micro-credential](#) program. Further to this training course, and one of MNAI's main strategies to achieve scale, MNAI has worked with regulated professions to integrate considerations of natural assets in professional practice guidelines. For example, in December 2021, [Engineers and Geoscientists British Columbia](#) endorsed the MNAI document [Natural Assets Management Considerations for Engineering and Geoscience Professionals](#), alongside and complementary to its own [Professional Practice Guidelines for Local Government Asset Management](#), previously approved in July 2021.^{xc} In an effort to mimic the success of this work with Engineers and Geoscientists BC, MNAI is identifying ways to reach other professional disciplines – including planners, landscape architects, forest professionals, and biologists. To date, an analysis of barriers and opportunities within each discipline has led to the development preliminary roadmaps, each identifying a combination of guidance, professional development training,

multi-disciplinary workshops, knowledge sharing workshops and case studies illustrating good practice.^{xci} The intended result of this important work has been, and will continue to be, improved skills and competencies of a wide variety of professional actors in the area of natural asset management.

Leadership: Historically, lack of funding for conservation and environment has been a critical barrier. As a result, federal government leadership in financing MNAI projects and the application of natural asset management more generally, has been important. To date, Infrastructure Canada has supported a number of green infrastructure initiatives in part based on the work of MNAI. One such example includes watershed restoration efforts and natural flood infrastructure investments in the [City of Grand Forks \(BC\)](#) – one of MNAI’s first pilot project locations – now funded through Infrastructure Canada’s Disaster Mitigation and Adaptation Fund (DMAF) program.^{xcii}

Norms: The work of MNAI is challenging cultural norms and historical conventions related to municipal asset management. In Canada, regulations and standards are helping to drive changes in how municipal assets are defined, identified, valued and managed. In Ontario for example, local governments are required to incorporate [green infrastructure assets](#) into their asset management plans by 2023.^{xciii} While regulations are helping to drive demand for natural asset management and related services, national standards will help drive workforce readiness, ensuring those responsible for natural asset management are conforming to the highest standard of good, reliable, and credible practice – including accounting for the state of natural assets, or their potential impairment, as part of public sector financial statements, for example.^{xciv} At the time of writing, a new national standard for the development and reporting of natural asset inventories is out for public review.^{xcv} Changes in legislation, regulation and standards, are evidence of a global shift towards the improved integration of natural assets, alongside engineered assets, as a means to optimize municipal services using a whole-of-system approach – a shift which, here in Canada, has been led in part by the work of MNAI.

Innovation: At its core, using natural assets in municipal planning is itself an innovation. While globally we are hearing increased calls to protect, restore and sustainably use and manage nature in response to our climate change, pollution and biodiversity loss, proponents of the MNAI approach suggest that it has taken genuine innovation to recast such pleas as both a duty of care, and a core business obligation of both public and private sectors.^{xcvi}

4.0 Key Takeaways for Learning to Account for Nature in Local Decision Making

Within the broader landscape of nature-based solution, natural asset management has gained considerable traction and significant momentum for positive change is underway.^{xcvii} In Canada, MNAI works with local governments, testing and providing methods, guidance, and technical support to integrate natural assets as part of governments’ climate adaptation strategy, financial, and asset management planning. Furthermore, MNAI works to build professionals’ capacity both by creating demand by local governments and informing standards development. As a result, MNAI’s work has contributed to an emerging market for professional services to support comparable and replicable municipal natural asset management. Through advocacy and networking, MNAI also works on systems change, helping to erode barriers to adoption of municipal natural asset management at scale.

Moving forward, given increasing priority and urgency in this space (although still funding dependent), MNAI is looking to expand its outreach and scale and to foster new partnership and collaborations, including with senior administrative leadership team in local government, service delivery managers in

local government, procurement and supply chain professionals, information management professionals and finance and accounting professionals.^{xcviii} These goals will continue to “hardwire” the consideration of nature and the services it provides within municipal infrastructure planning and decision-making, helping to cement new social and political norms in the process.

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Group Session Participants

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Erin Taylor – Government of Prince Edward Island
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Endnotes

- ⁱ A number of [NRCan-led science assessments](#) have been completed since the early 2000s and suggest that a considerable amount of information exists to inform our adaptation planning and response measures. Globally, a number of IPCC scientists have called for a [moratorium on further climate change research](#) until governments begin to take real action (10 January, 2022).
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- ^{vii} WEF, 2019. Strategies for the New Economy: Skills as the Currency of the Labour Market. World Economic Forum (WEF), January 2019.
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- ^x [Adaptation Jobs Explainer: Understanding this Critical and Growing Workforce](#). Anna McGinn, Environmental and Energy Study Institute (EESI), September 23, 2021.
- ^{xi} ACCO and ISSP, 2019. Proceedings from the Global Congress for Climate Change and Sustainability Professionals. Hosted by the Association of Climate Change Officers (ACCO) and the International Society of Sustainability Professionals (ISSP) in Chicago, USA. December 2019.
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- ^{xiv} At last count, the Climate Change Adaptation Training Resources Compendium (developed by the Climate Risk Institute and financed by NRCan) identified 125 online and in-person learning opportunities. This number excludes formal post-secondary degree or micro-degree programs and courses offered through Canadian universities and colleges, as well as written resources such as guidance documents, reports and case studies.
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- ^{xviii} Vignola, R., Leclerc, G., Morales, M., and J. Gonzalez. 2017. Leadership for moving the climate change adaptation agenda from planning to action. *Current Opinion in Environmental Sustainability*. 2017, 26-27:84-89.
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- ^{xx} Meijirink, S. and S. Stiller. 2013.
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- ^{xxii} ASAP, 2021. [Living Guide to the Principles of Climate Change Adaptation](#). Professional Guidance Resource, American Society of Adaptation Professionals (ASAP).
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- ^{xxiv} A person who is a tireless, process-savvy organizer and promoter of the change effort. (Crosby & Bryson, 2010)
- ^{xxv} A person less involved in the process, but deploys authority, money or connections to move the change efforts forward. (Crosby & Bryson, 2010)

- ^{xxvi} Most often politicians, bureaucrats, experts or interest group representatives, who advocate for policy change and try to get specific policy solutions adopted. (Meijirink and Stiller, 2013).
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- ^{xxx} See Box 16 on Transformative Capacities, p. 61. Kresge Foundation, 2017.
- ^{xxxi} ACCO and ISSP, 2019.
- ^{xxxii} Policy Options, 2021. [A fresh look at the reasons why women and men are self-employed](#). October 25, 2021.
- ^{xxxiii} A recent report by PWC found that between 2013 and 2019 investments in climate tech increased 3750%. See: PWC, 2020. [The State of Climate Tech 2020: The next frontier for venture capital](#).
- ^{xxxiv} Climate-KIC, 2021. [Boosting climate adaptation with innovation, an opinion by Dr. Tom Mitchell](#). January 25, 2021.
- ^{xxxv} A global patent analysis for climate change inventions filed between 1995 and 2015 found that while the proportion of mitigation inventions (as a share of all inventions filed) doubled, the number of adaptation inventions (as a share of all inventions filed) had not changed in 20 years. See: Dechezleprêtre, A., Fankhauser, S., Glachant, M., Stoeber, J. and S. Touboul. Invention and Global Diffusion of Technologies for Climate Change Adaptation: A Patent Analysis. [Research Report] The World Bank. 2020.
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- ^{xxxvii} ISED, 2019. [Building a nation of Innovators](#). Innovation, Science and Economic Development (ISED) Canada.
- ^{xxxviii} Oxfam America, 2009. [The new adaptation marketplace: Climate change and opportunities for green economic growth](#).
- ^{xxxix} [Glasgow City Region Climate Adaptation Strategy and Action Plan: Choosing to Flourish in our Future Climate](#). Climate Ready Clyde, June 2021.
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- ^{xlv} Bush, E. and Lemmen, D.S., editors (2019): [Canada’s Changing Climate Report](#); Government of Canada, Ottawa, ON. 444 p.
- ^{xlvi} Summarized from the [ALN Final Report](#), 2022.
- ^{xlvii} Including Royal Roads University, University of Victoria, University of British Columbia, University of British Columbia – Okanagan, Vancouver Island University, and Simon Fraser University.
- ^{xlviii} Including Engineers & Geoscientists BC, Applied Science Technologists & Technicians of BC, the Association of BC Forest Professionals, the College of Applied Biology, BC Institute of Agrologists, the Planning Institute of BC and the BC Society of Landscape Architects,
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- liiv A series of online courses for engineers on the PIEVC Protocol, asset management, risk management, and climate change law, designed to help infrastructure practitioners strengthen the knowledge and competencies they require to advance more climate-resilient approaches for the planning, design and management of infrastructure. As of April 2022, more than [300 engineers](#) have been trained on PIEVC as part of IRP credentialing.
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- lvii While the CRBCPI ended in March 2021, the recently announced [Climate Resilient Built Environment Initiative](#) is another five-year program designed to build on the successes of the CRBCPI and support ongoing work to revise building and infrastructure codes, and develop guides, standards, tools, and technical solutions for climate resilience.
- lviii Including through the Investing in Canada Infrastructure Program (ICIP), the Disaster Mitigation and Adaptation Fund (DMAF) and Smart Cities Challenge.
- lix See, for example, the [Climate Lens Assessment services page](#) for WSP, a Canadian company now one of the largest professional engineering services firms in the world.
- lx Lemmen, D., Lafleur, C., Chabot, D., Hewitt, J., Braun, M., Bussière, B., Kulcsar, I., Scott, D. and Thistlethwaite, J. (2021): Sector Impacts and Adaptation; Chapter 7 in *Canada in a Changing Climate: National Issues Report*, (ed.) F.J. Warren and N. Lulham; Government of Canada, Ottawa, Ontario.
- lxi For a summary of adaptation tools and resources available for Canada's forestry sector, visit the [Natural Resources Canada – Canadian Forest Service's Forest Change program](#) website.
- lxii Lemmen, D., et al., 2021.
- lxiii Updates to the Sustainable Forestry Initiative's (SFI's) Forest Management Standard include new objectives on climate smart forestry, as well as fire resilience and awareness. https://forests.org/wp-content/uploads/2022_SFI_StandardsandRules_section2.pdf
- lxiv ClimateBC and other scale-free and location specific climate models developed by Dr. Wang “have over 2000 subscribers and cited for over 2000 times. They have become essential tools for climate and climate change related studies and applications. Wang et al. (2016a) is awarded as Highly Cited Paper (top 1%) in the field of geosciences.” <https://forestry.ubc.ca/faculty-profile/tongli-wang/>
- lxv <https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources>
- lxvi <https://forests.org/forestmanagementstandard/> (accessed 18th August 2022)
- lxvii Government of Prince Edward Island. (2021). Climate Change Risk Assessment. <https://www.princeedwardisland.ca/en/publication/pei-climate-change-risk-assessment-2021>
- lxviii Government of Prince Edward Island. (2018). Taking Action: A Climate Change Action Plan for Prince Edward Island 2018-2023. https://www.princeedwardisland.ca/sites/default/files/publications/climatechange2018_f8.pdf
- lxix “The development and implementation of a successful Climate Adaptation Plan requires effective collaboration with federal, provincial, municipal, and Indigenous governments, stakeholders, and the public.” <https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/climate-adaptation-plan>
- lxx Participating practitioners included: engineers, architects, land-use planners, healthcare providers, emergency management officials, conservationists/naturalists, watershed groups, builders, property developers, and academia.
- lxxi This plan was the first of its kind – an international, multi-jurisdictional, commitment to ambitious regional greenhouse gas emission reduction targets for 2010, 2020 and the longer term. In a 2017 update, the group acknowledged the importance of implementing regional adaptation strategies and an Adaptation Working Group was established ([Resolution 42-1](#))
- lxxii Atlantic Environment Ministers Meeting. (2008). *Atlantic Environment Ministers Meeting*. Retrieved from CAKE: <https://www.cakex.org/sites/default/files/documents/ClimateChange%20AdaptationStrategyAtlanticCanada.pdf>.
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^{lxxv} Arnold, S. and A. Fenech. (2017, October). [Prince Edward Island Climate Change Adaptation Recommendations Report](#). University of Prince Edward Island Climate Lab. Charlottetown, Canada. Report submitted to the Department of Communities, Land and Environment, Government of Prince Edward Island, 172p.

^{lxxvi} For more information, see <https://www.climatesense.ca/education> (accessed 13th September 2022)

^{lxxvii} New Brunswick Department of Environment, 2010. [Atlantic Region Adaptation Science Activities](#).

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^{lxxix} ACASA, 2014. Engaging small communities in Assessing their Vulnerability to Climate Change. Atlantic Climate Adaptation Solutions Association (ACASA).

^{lxxx} Bednar, D., Raikes, J., & McBean, G. (2018). The governance of climate change adaptation in Canada. Institute for Catastrophic Loss Reduction.

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^{lxxxii} <https://mnai.ca/town-of-gibsons/>

^{lxxxiii} See section 2.1 in: Mollame, L & Drescher, M. (2021). MNAI Monitoring Report. Municipal Natural Assets Initiative. Victoria, British Columbia, Canada. MNAI.ca. Copyright © 2021. Municipal Natural Assets Initiative.

^{lxxxiv} This case study illustrates the City of Saskatoon’s journey in natural asset valuation, working with MNAI and funded through the Federation of Canadian Municipalities’ Municipalities for Climate Innovation Program: <https://greenmunicipalfund.ca/case-studies/measuring-value-natural-assets>

^{lxxxv} The account of communities MNAI has supported is here: <https://mnai.ca/communities/> See section 1.0 in: Mollame, L & Drescher, M. (2021). MNAI Monitoring Report. Municipal Natural Assets Initiative. Victoria, British Columbia, Canada. MNAI.ca

^{lxxxvi} <https://fcm.ca/en/resources/mamp/asset-management-insights-planning-and-decision-making>

^{lxxxvii} E.g., <https://mnai.ca/developing-levels-of-service-for-natural-assets/>

^{lxxxviii} <https://mnai.ca/the-path-to-scale/>

^{lxxxix} <https://pcs.royalroads.ca/natural-asset-management-online>

^{xc} https://mnai.ca/media/2022/02/MNAI-Roadmap_document-dec_2021-101.pdf

^{xci} Municipal Natural Assets Initiative (MNAI). (2021). Extending British Columbia’s Engineers and Geoscientists Professional Guidelines to Other Professional Disciplines. MNAI.ca

^{xcii} In January 2019, the City of Grand Forks (BC) applied for [\\$49.9 million in funding for flood infrastructure](#) from the Federal Disaster Mitigation and Adaptation Fund (DMAF) program. <https://www.infrastructure.gc.ca/dmaf-faac/index-eng.html>

^{xciii} O. Reg. 588/17: [Asset Management Planning for Municipal Infrastructure](#), filed December 27, 2017 under [Infrastructure for Jobs and prosperity Act, 2015, s.O. 2015, c. 15](#).

^{xciv} <https://mnai.ca/natural-assets-be-included-in-canadas-financial-statements/>

^{xcv} https://mnai.ca/natural-asset-inventories-standard-now-out-for-public-review/?utm_source=rss&utm_medium=rss&utm_campaign=natural-asset-inventories-standard-now-out-for-public-review

^{xcvi} Personal communication, Roy Brooke, Executive Director of MNAI.

^{xcvii} Eyquem, J. L., Church, B. Brooke, R and Molnar, M. 2022. Getting Nature on the Balance Sheet: Recognizing the Financial Value of Natural Assets in a Changing Climate. Intact Centre on Climate Adaptation, University of Waterloo. https://www.intactcentreclimateadaptation.ca/wp-content/uploads/2022/10/UoW_ICCA_2022_10_Nature-on-the-Balance-Sheet.pdf

^{xcviii} https://mnai.ca/media/2022/02/MNAI-Roadmap_document-dec_2021-101.pdf