

Future Ocean and Coastal Infrastructures Delphi Process Report

**FUTURE OCEAN AND
COASTAL INFRASTRUCTURES**
AN OFI PROJECT

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Executive Summary

- The views of the members of the Future Ocean and Coastal Infrastructures (FOCI) project were solicited on what they considered to be the most important actions for mitigating and adapting to climate change in Atlantic Canada and who are the key actors for achieving mitigation and adaptation goals.
- The three most important actions members identified for mitigating climate change were: providing financial resources and incentives to support sustainable upgrading; transitioning away from coal and Bunker-C fired power generation; and allocating substantial budget to implement climate change mitigation policies.
- The top three actions members identified for adapting to climate change were: adapting to extreme weather events; building adaptation and resilience into infrastructure investment decisions; and modelling urban flooding.
- The three most important actors identified by FOCI members were: Environment and Climate Change Canada, Natural Resources Canada, and the Canadian federal government.
- The three most important actors that members thought should be, but currently are not involved, were: grassroots community groups and initiatives; those whose activities create impacts which are amplified by the effects of climate change; and national environmental groups.
- Overall, there is a desire to see more involvement from community-level groups, but FOCI members were divided on how important that involvement is.

Mitigating and adapting to climate change are two of the most significant issues of the 21st century. Though climate change is often seen and discussed as a global ecological and political issue, its impacts are felt regionally and experienced locally (see Cunsolo and Ellis, 2018; Finnis et al., 2015; Greenan et al., 2019; Gupta et al., 2007). For Atlantic Canada, this means increasingly severe storms, milder and more unpredictable winters, and changing seasons that affect forestry management and agricultural harvesting (Bootsma et al., 2005), as well as rising sea level, changes in the productivity of the fisheries, and coastal erosion (Greenan et al., 2019; Thompson et al., 2009). Climate change is thus a major driver of ecological instability that will demand new more sustainable infrastructures and will shape social futures in Atlantic Canada.

There has been ample research tracking changes in the natural environment in Atlantic Canada, but far less analysis of the policies and research that are needed for achieving mitigation and adaptation goals. It is also important to take stock of the key actors involved in these efforts. Understanding such perceptions affects potential innovations in climate governance required to meet mitigation targets and help communities adapt to new ecological realities (Dunlap and Brulle, 2015). Understanding and acting on such perceptions is critical to building the infrastructure needed to navigate climate change and to fostering vibrant coastal communities able to withstand the effects of climate change.

The Future Ocean and Coastal Infrastructures (FOCI) research project focuses on supporting the development of safe, sustainable, and inclusive coastal communities in the face of climate and ocean change. Its working groups are researching a wide range of infrastructures to address climate change, including physical and built, natural, political, economic, technological, social, and cultural infrastructures. As part of this broad project, a Delphi process was conducted to consult FOCI members on the needs for achieving climate change mitigation goals and key actors for climate change mitigation and adaptation in Atlantic Canada. The FOCI research project involves people throughout Atlantic Canada who are engaged in different aspects of building safe, sustainable, and inclusive coastal communities. Consulting FOCI members was a way to involve people with a range of relevant expertise in our research.

This report describes the Delphi process we engaged and presents the results it generated. Overall, our research demonstrates a strong consensus among those who participated around the importance of infrastructure and policy in mitigating and adapting to climate change in Atlantic Canada. Governments at all levels of jurisdiction were identified as the most important actors in meeting climate change targets and goals. Despite this overall emphasis, grassroots and community groups and initiatives were identified as the key players currently missing and needed to achieve climate change adaptation and mitigation. Despite identification of the need for more involvement from grassroots groups and communities, they were not seen as particularly important by those participating in the Delphi process. This is a contradiction that may point to areas of work for the FOCI to focus upon if it aims to achieve its research and policy goals and make an impact on climate change interventions in Atlantic Canada.

Methods

This Delphi process was carried out between mid December 2020 and early May 2021. It consisted of three phases, including a solicitation phase in which participants were asked for their ideas or opinions on the question being studied, an agreement phase, in which every participant had the opportunity to indicate their level of agreement with the contributions from the other participants, and a validation phase, in which participants could provide feedback on the ranking and level of consensus resulting from the agreement phase (Hsu and Sandford, 2007). The appendix at the end of the report offers detailed description of the methods.

Results

The first two questions in the solicitation phase asked participants what is needed to achieve climate change mitigation and adaptation efforts in Atlantic Canada. Responses to the first question, which asked about the most pressing needs to achieve current climate change *mitigation* efforts in Atlantic Canada, generated 47 statements, which were grouped into three broad categories:

- energy sources and energy use (19 discrete responses)
- policy and governance (17 discrete responses)
- social and cultural change (6 discrete responses)

There were five responses that did not fit into any broader category. The second question asked about the most pressing needs to achieve current *adaptation* efforts in Atlantic Canada. Responses to this question generated 59 statements, which were grouped into five broad categories:

- social and cultural change (16 discrete responses)
- policy and governance (13 discrete responses)
- research and education (11 discrete responses)
- infrastructure (8 discrete responses)
- energy (2 discrete responses)

There were nine responses that did not fit into any broader category. While there was significant overlap between the themes raised in response to mitigation and to adaptation, a greater range of needs was identified for adaptation. Additionally, more elements of social and cultural change were highlighted as needs for adaptation, while the opposite was true for energy sources and energy use, which featured more prominently in response to the question on mitigation.

The third and fourth questions deal with who can or should address the needs identified in the first two questions. Question three asked “Based on your experience, who are the key

rightsholders, stakeholders, and organizations involved in climate change efforts in Atlantic Canada?”. Participants identified 61 actors, which were grouped into five categories:

- governments and government agencies/departments/corporations (22 discrete responses),
- industry and occupational groups (15 discrete responses),
- communities and community groups (12 discrete responses),
- educational institutions and non-governmental organizations (9 discrete responses), and
- health organizations (3 discrete responses).

Question four asked respondents to list rightsholders, stakeholders, and organizations that should be involved in climate change efforts in Atlantic Canada, but currently are not.

Responses were grouped in four categories:

- industry and occupational groups (10 discrete responses),
- communities and community groups (9 discrete responses),
- non-governmental organizations (6 discrete responses), and
- government (5 discrete responses).

Nineteen of the discrete responses to question four were also provided as responses to question three, indicating differing perceptions among participants as to who is already involved in climate change efforts in the region. One participant noted that there are groups “who are ‘involved’ but not yet ‘committed,’” while another wrote that “industry groups are involved to the extent they are mandated to be, businesses could be incentivized to be more involved, and NGOs struggle to maintain their involvement due to inconsistent funding opportunities.” Overall, the responses to question four reveal differing perceptions of who is involved and highlight different reasons for lack of involvement.

Participants varied in terms of their self-reported knowledge of climate change efforts in the region and the sector in which they work. Seven participants said they were a bit knowledgeable about climate change mitigation and adaptation efforts in Atlantic Canada, four indicated they were moderately knowledgeable, five said they were knowledgeable, and three very knowledgeable. The participants were split among the sectors involved with FOCI: six were academics, four worked in government, five in NGOs, one in the private sector, and three indicated belonging to another sector, of these one said they are a Maritime Unionist, and another said they are an activist.

In the second round of the Delphi process, the agreement phase, we sought FOCI members’ level of agreement with the statements generated through the first round. Overall, the group consensus emphasized policy and governance, energy, infrastructure, and research as the most important areas for mitigating and adapting to climate change in Atlantic Canada. Social and cultural change was rated least important despite many aspects of it being identified in the solicitation phase. Government, and especially the federal government, was seen as the most important actor in climate change efforts in the region. Interestingly, despite the

emphasis on the federal government and policy and governance issues, grassroots and community initiatives were rated as the most important actor that should become more involved. However, the participants in the Delphi process did not appear to think the interventions linked to grassroots and community involvement are currently very important.

Question one asked participants to “rate each of the following actions based on their importance for mitigating climate change in Atlantic Canada”. The ten statements with the highest degree of consensus are included in Table 1. Overall, actions related to policy and governance, and energy sources and energy use were rated as most important. The top three actions identified were: provide financial resources and incentives to support sustainable upgrading; transition away from coal and Bunker-C fired power generation; and allocate substantial budget to implement climate change mitigation policies. The three statements with the lowest consensus score all fell into the social and cultural change category: address ongoing colonialism, change systemic racism and colonial systems, and, ranked very last, end capitalism.

Table 1: Top 10 actions for climate change mitigation by consensus score

Statement Category	Specific Statement	Average	Standard Deviation	Consensus Score
Policy and Governance	Provide financial resources and incentives to support sustainable upgrading	5.70	0.66	8.68
Energy Sources and Energy Use	Transition away from coal and Bunker-C fired power generation	6.20	0.77	8.08
Policy and Governance	Allocate substantial budget to implement climate change mitigation policies	6.38	0.80	7.93
Energy Sources and Energy Use – Renewable Energy	Shift to renewable energy in the household sector	5.85	0.75	7.85
Policy and Governance	Develop policies to mitigate climate change	6.41	0.85	7.50
Energy Sources and Energy Use – Renewable Energy	Shift to renewable energy in the transportation sector	6.05	0.83	7.33
Energy Sources and Energy Use – Renewable Energy	Shift to renewable energy in the industrial sector	6.05	0.83	7.33
Energy Sources and Energy Use – Renewable Energy	Transition to renewable energy sources	6.32	0.89	7.13
Energy Sources and Energy Use - Efficiency	Increase the energy efficiency of housing	5.79	0.85	6.77

Energy Sources and Energy Use - Emissions	Emissions from personal vehicles	5.85	0.88	6.68
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Question two asked participants to “rate each of the following actions based on their importance for adapting to climate change in Atlantic Canada.” The ten statements with the highest degree of consensus are included in Table 2. They are spread across the categories other actions, infrastructure, research and education, and policy and governance. The top three actions identified were: adapt to extreme weather events; build adaptation and resilience into infrastructure investment decisions; and model urban flooding. It is unsurprising that adapting to extreme weather was identified as the highest priority, as this is an umbrella statement that captures many of the more specific actions participants identified. Again, statements to do with social and cultural change were rated by the group as relatively less important. The five statements with the lowest consensus score are all in this category, and eight of the 16 statements in the social and cultural change category are in the bottom ten. The statement with the lowest consensus score was ‘end capitalism.’ The two statements with the second and third lowest scores, respectively, were: champion democracy and freedom, and embrace sovereignty.

Table 2: Top 10 actions for climate change adaptation by consensus score

Statement Category	Specific Statement	Average	Standard Deviation	Consensus Score
Other actions	Adapt to extreme weather events	5.89	0.58	10.10
Infrastructure	Build adaptation and resilience into infrastructure investment decisions	6.28	0.75	8.35
Research and Education	Model urban flooding	5.26	0.65	8.06
Infrastructure	Budget to develop and/or restructure current physical infrastructures	5.50	0.71	7.78
Other actions	Adapt to sea level rise	5.61	0.78	7.22
Research and Education	Increase knowledge of climate impacts	5.95	0.85	7.01
Policy and Governance	Adapt government policy to be more responsive to climate change	6.16	0.90	6.85
Research and Education	Increase expertise in nature-based adaptation solutions	5.78	0.88	6.58
Other actions	Increase financial support for nature-based adaptation solutions	5.65	0.86	6.55
Research and Education	Map impacts of sea level rise and storm surge to identify at risk infrastructure	5.95	0.91	6.53

Question three asked participants to “rate each of the following rightsholders, stakeholders, and organizations in terms of their importance for climate change efforts in Atlantic Canada”. The ten rightsholders, stakeholders, and organizations with the highest consensus scores are included in Table 3. There was a clear consensus that government is the most important actor; the ten highest-rated actors are all governments or government departments and agencies. Within the top ten, there is an emphasis on the importance of the federal government; the top three actors identified are: Environment and Climate Change Canada, Natural Resources Canada, and the federal government. This point to the need for provinces to collaborate with federal partners. There was no clear consensus on which group of actors is least important. The actors with the three lowest consensus scores were: people in rural areas, people in poverty, and lastly Petroleum Research Newfoundland and Labrador.

Table 3: Top 10 most important actors for climate change efforts in Atlantic Canada by consensus score

Statement Category	Specific Statement	Average	Standard Deviation	Consensus Score
Governments and Government Agencies/Departments/Corporations	Environment and Climate Change Canada	6.22	0.81	7.70
Governments and Government Agencies/Departments/Corporations	Natural Resources Canada	5.94	0.87	6.81
Governments and Government Agencies/Departments/Corporations	Federal government	6.17	0.92	6.68
Governments and Government Agencies/Departments/Corporations	Government agencies or departments dealing with infrastructure development and planning	6.17	0.99	6.26
Governments and Government Agencies/Departments/Corporations	Government agencies or departments dealing with environment and conservation	6.00	0.97	6.18
Governments and Government Agencies/Departments/Corporations	Federal regulators	6.28	1.02	6.17
Governments and Government Agencies/Departments/Corporations	Government agencies or departments dealing with natural resources	5.83	0.99	5.92
Governments and Government Agencies/Departments/Corporations	Department of Fisheries and Oceans	5.67	0.97	5.84
Governments and Government Agencies/Departments/Corporations	Provincial governments	5.94	1.06	5.63

Governments and Government Agencies/Departments/Corporations	Provincial government regulators	5.72	1.02	5.62
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Question four asked participants to “rate each of the following rightsholders, stakeholders, and organizations who should be more involved in climate change efforts in Atlantic Canada in terms of the importance of their increased involvement.” There was much less consensus among participants on this question compared to others as reflected in the low consensus scores. The options for this question were not divided into categories as there were only 11 actors to rate. There were 30 discrete responses to question four in round one, however, 19 of them also appeared in the responses to question three. In round two we therefore decided to ask participants to only rate responses that were unique to question four. Table 4 lists these actors, ranked by consensus score. The results point to the need for civil society, local communities and municipalities to be better integrated into climate mitigation and adaptation and show potential for multi-level and multi-sector collaboration.

Table 4: Actors who should be more involved in climate change efforts in Atlantic Canada, by consensus score

Statement	Average	Standard Deviation	Consensus Score
Grassroots community initiatives	4.75	1.06	4.46
Those whose activities create impacts which are amplified by the effects of climate change, e.g. construction which contributes to runoff effects	5.53	1.28	4.32
National environmental groups	4.88	1.17	4.19
Property owners	4.76	1.20	3.97
Municipalities in Newfoundland	5.29	1.40	3.77
Marginalized communities	4.65	1.27	3.65
Local residents	5.06	1.43	3.53
Beekeepers	3.81	1.11	3.44
Children and youth	4.76	1.39	3.42
African Nova Scotians	4.59	1.37	3.34
Non-profits in Newfoundland	4.41	1.46	3.02

In the third round of the Delphi process, the validation phase, we invited members of FOCI to provide feedback on the results from the agreement round, asking whether the results reflect participants’ assessment of key needs and actors, and if not, what needs and/or actors are missing. If there was no response we considered that as a sign of consensus. Two participants said the results reflect their assessment. One of these participants also asked why municipalities in Newfoundland and Labrador were highlighted and not municipalities across

Atlantic Canada and they suggested that this might be a reflection of a sampling bias. Our team contemplated this critique, and respectfully concluded that this does not reflect a sampling bias, but rather the open nature of the solicitation phase, and the fact that, according to the participant who contributed this item, municipalities in Newfoundland and Labrador are lacking capacity that exists in municipalities in other provinces. Municipalities in general was also listed as a response to questions three and four by other participants. Another participant asked a number of questions about the Delphi process itself and how the results should be interpreted, but did not indicate agreement or disagreement with the results themselves. The fourth participant provided an interpretation of the results we shared in the validation phase, suggesting that “[FOCI] stakeholders believe communities (grassroots) have a strong role to play in climate change mitigation/adaptation, but their participation hinges on top-down supports and investments from governments” and then asked why, given this situation, it is so hard to get this investment and support. We believe that working through this issue of the role and importance of grassroots and community groups should be a core focus of the FOCI as it progresses through its work. Of the four people who responded in the validation phase, one indicated they are “knowledgeable”, two “moderately knowledgeable” and one “a bit knowledgeable” about climate change mitigation and adaptation efforts in Atlantic Canada. Three of these participants are academics and one works in the private sector. Overall, participants agreed, or at least did not indicate disagreement, with the results of the Delphi process. The results are therefore likely reflective of the group consensus on key needs and actors involved in climate change efforts in the region.

Conclusion

The results of the Delphi process show a strong consensus around the importance of infrastructure and policy in mitigating and adapting to climate change in Atlantic Canada. In keeping with these findings, governments at various levels were identified as the most important actors with an emphasis on the importance of federal actors. This highlights the importance of collaboration between federal, provincial, and municipal governments and the need for effective multi-level governance models with regard to climate change mitigation and adaptation. Grassroots and community initiatives, however, were identified as the most important groups that should become involved but who are not currently a part of adaptation and mitigation efforts. There is a desire to see involvement from grassroots and community groups, but the activities of such groups are not seen as particularly important by FOCI participants in our consultation process. Overcoming the gap between desire for involvement and recognition of importance is key to offering local solutions to climate change and is an area that FOCI needs to engage.

This consultation invited participation from people with many different types of expertise working in various sectors, and those who participated in the initial solicitation phase that determined the breadth of statements included in the process came from multiple sectors. A robust diversity of perspectives was reflected in the responses of the first phase of consultation, which covered a number of areas, from energy sources and use, through policy, to social and cultural change. The responses also ranged from concrete, very specific actions such

as “move away from updating property setbacks and towards a vertical datum value based on DEM-H models to adapt to rising sea level” through to more general actions such as “build adaptation and resilience into infrastructure investment decisions” to the very broad such as “End capitalism.” Overall, the consensus favoured actions that were general enough to be meaningful to people with different levels and types of expertise.

Consensus was achieved on actions that were not so technical or specific as to be meaningless to people not specialized in a particular area but were also concrete enough for participants to have some idea of how they could be implemented. We suspect this is why there was more consensus on energy sources and infrastructural elements over more complex social and cultural interventions, as well as the focus on government actors over the involvement of grassroots and community actors.

While the diversity of those involved in the FOCI research project, and those who participated in the Delphi process, was advantageous in that it generated a broad range of responses that could help participants develop a more comprehensive understanding of climate change mitigation and adaptation needs, it may have led to an under-emphasis on specific actions and social and cultural interventions.

Appendix A: Detailed Description of Methods

A Delphi process is a technique for obtaining a consensus of opinion among a group of experts on a topic (Faiyetole, 2019; Wright, 2006). It usually consists of a solicitation phase, in which the experts are asked for their ideas or opinions on the question being studied, an agreement phase, in which every respondent has the opportunity to indicate their level of agreement with the contributions from the other experts, and a validation phase, in which participants can provide feedback on the ranking and level of consensus resulting from the agreement phase (Hsu and Sandford, 2007). The Delphi technique can be particularly helpful for achieving consensus on a topic that spans a range of disciplines, and for informing participants of the “diverse and interrelated aspects of the topic” (Delbecq et al., 1975, p. 11), two attributes which made it ideal for the Future Ocean and Coastal Infrastructures (FOCI) research project. One of the primary advantages of using a Delphi process to generate and assess consensus, in contrast to face-to-face methods such as focus groups, is that participants remain anonymous throughout the process. This reduces the influence of external factors, such as authority figures or those who are more comfortable speaking dominating the discussion (Allen et al., 2019).

For this consultation, the sample consisted of all members of the FOCI research project. Because FOCI emphasizes research undertaken in collaboration with industry and community partners, the sample used for the Delphi process included 138 people from 66 organizations and institutions, ranging from NGOs, to government departments, to businesses and universities. It also included theatre artists, musicians, and visual artists. The university-based academics in the sample spanned disciplines in the natural sciences, social sciences, and humanities, and included students and post-doctoral fellows.

The first round of the Delphi process, the solicitation phase, consisted of six questions. It began with four open questions asking participants to list the most pressing needs for achieving current climate change mitigation goals and adaptation goals in Atlantic Canada, as well as who the key rightsholders, stakeholders, and organizations involved in these efforts are, and who should be involved but currently is not. The other two questions were both multiple choice; one asked how knowledgeable the respondent is about climate change issues, with 5 options ranging from “not at all knowledgeable” to “very knowledgeable” and the other asked what sector respondents worked in. These questions were included because those involved with FOCI may not consider themselves experts on climate change. An email was sent to all members of the FOCI research project in mid December 2020, inviting them to answer these questions through an online questionnaire. A reminder email was sent in early January 2021. 15 complete responses were recorded and four partial responses, equaling a response rate of 14%. The responses were then compiled into a master list, with any duplicate responses removed.

For round two of the Delphi process, the agreement phase, members of FOCI were invited to rate the importance of the statements generated in the first round. An email invitation, which specified that people could participate in round two even if they had not participated in round one, was sent on March 3rd 2021 to 137 people (one person left FOCI between round one and round two). A reminder email was sent on March 11th. Further

reminders were sent to FOCI Work Package leads on March 25th. This generated 18 complete responses and four partial responses for a response rate of 16%. Participants were asked to rate each statement on a 7-point scale from 'not important' to 'very important'. The average rating and standard deviation were calculated for each statement. The level of consensus was determined by dividing the average by the standard deviation. The statements were then ranked according to this consensus score. The top-ranked statements from round two are therefore the ones which the largest group of participants felt were relatively more important.

In the third and final round of the consultation, the validation phase, we sent an email on May 9th, 2021 with a written summary and tables of the complete results from round two to all members of FOCI (137 people). We invited them to provide comments on the results. We received four responses. No response was considered agreement.

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