Net-Zero Pathways
Initial Observations June 2021

Net-Zero Advisory Body

Table of Contents

PATHWAYS SUMMARY

ANNEXES

Introduction

There is a global imperative to achieve net-zero greenhouse (GHG) emissions by 2050. Achieving this world-wide target is necessary to limit global warming to 1.5°C and to avoid the most catastrophic and irreversible impacts of climate change. Climate change is already having significant impacts on communities and people's livelihoods, in Canada and around the world.

To support Canada's contributions to this effort, the Minister of Environment and Climate Change announced the Net-Zero Advisory Body (NZAB) on February 25, 2021. With fourteen members from across Canada, we are proud to be mandated to engage with Canadians and to provide independent, constructive, and forward-looking advice on pathways to achieve net-zero emissions by 2050.

Inaugural Members

CO-CHAIR
Marie-Pierre Ippersiel
President and CEO, PRIMA Québec

CO-CHAIR
Dan Wicklum
President and CEO,
The Transition Accelerator

Catherine Abreu
Executive Director,
Climate Action Network – Réseau Action Climat Canada

Kluane Adamek
Yukon Regional Chief,
Assembly of First Nations

Theresa Baikie
Impact and Benefit Agreement Coordinator,
Nunatsiavut Government

Linda Coady
Executive Director,
Pembina Institute

Simon Donner
Professor, Department of Geography, University of British Columbia

Sarah Houde
CEO, Propulsion Quebec

Peter Tertzakian
Deputy Director, ARC Energy Research Institute

Gaëtan Thomas
President and CEO,
Conseil Économique du Nouveau-Brunswick

Kim Thomassin
Executive Vice-President and Head of Investments in Québec and Stewardship Investing,
Caisse de dépôt et placement du Québec

John Wright
Former President, SaskPower

Yung Wu
CEO, MaRS
Discovery District

Hassan Yussuff
President, Canadian Labour Congress

The Minister has given us clear direction to provide advice on critically important issues, including:

- The most likely pathways for Canada to achieve net-zero emissions by 2050;
- Emissions reductions milestones leading up to 2050, and identifying near-term actions and key building blocks that support this long-term target; and
- Measures to catalyze long-term, low-carbon economic growth across the Canadian economy.

As part of our initial mandate, we will provide advice on actions Canada can take now to ensure a strong economic recovery while laying the foundation for net-zero emissions by 2050. We have begun our work as Canada faces an extremely challenging period of combating and recovering from the COVID-19 pandemic. COVID-19 has put the structural inequities of society into sharp relief. Similarly, we know that climate change will **disproportionately impact** those who are already structurally marginalized. Canada's strategy for economic recovery from COVID-19 must be compatible with our climate ambition and rooted in climate justice. There is an opportunity now to manage and reduce the risks of a climate crisis and ensure a fairer, more secure future for all.

Canada must also continue to build on its areas of strength to attract long-term investments. In doing so, it can accelerate the adoption and scale of the most promising Canadian innovations designed to materially reduce GHG emissions.

To start on the right path, the NZAB was tasked to deliver a summary of existing domestic and international pathways to net-zero within the first three months of our mandate. This document lays out what we have learned so far.

We begin by setting out the context and momentum for net-zero commitments in Canada and internationally. We then offer ten key observations on net-zero pathways: five are foundational values and five are design principles. These observations resonated with our diverse expertise and experiences. They will guide our work to engage and advise on net-zero pathways. The observations are interconnected and should be read together; prioritizing some to the detriment of others will not lead us to most likely pathways. A concluding section then provides an overview of our plan for the remainder of this year. Finally, two annexes describe how we approached this summary, including who we heard from in our first three months, and what resources informed our early thinking.

Terms of Reference

Our full mandate is available online, including direction on engagement, analysis, and research activities:

NZAB Website: https://nzab2050.ca/terms-of-reference

ECCC Website: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/net-zero-emissions-2050/advisory-body.html

It is equally necessary for us to explain what this summary is not. Given scope and timelines, this summary does not delve into some essential work. It does not, for instance, incorporate Indigenous Knowledge Systems or fully explore issues of equity and inclusion. It is not based on an engagement process, nor is it an analytical comparison or study of all net-zero pathways. Instead, it is a summary designed to be more accessible and digestible for Canadians who want to better understand how to create the most likely pathways to net-zero.

How We Approached Developing This Summary

See Annexes 1 and 2 for more information.

Our first priority was to connect with domestic and international groups that have already developed robust pathways to net-zero or deep decarbonization. This step was critical in order to hear from experts on foundational topics, methodologies, key considerations, lessons learned, and limitations. This initial phase was targeted, and conducted over a relatively short timeframe. We recognize that there are many more voices and perspectives to hear and this will be a priority as we proceed with our work, particularly on the issues facing Canadians that economic models do not take into account.

Members discussed and reflected on what we had heard and learned. From there, connections across these pathways became clearer, and we agreed that our summary should highlight key observations from across the different pathways that align with our objectives. Respecting our mandate, the resulting summary is designed to be foundational and directional. We encourage readers to review the source reports for their rich details and differences.

While many things will inevitably change over the next 29 years, this report sets a foundation that we can continue to refine as the NZAB engages Canadians, conducts analysis, and develops concrete pathway recommendations.

Core Definitions

It was critical for us to define some of the key terms in our mandate, which will help ensure clear communication and build a common understanding among Canadians. Building on the insights from our initial work, the NZAB will use the following definitions:

NET-ZERO emissions means that "anthropogenic emissions of greenhouse gases (GHGs) into the atmosphere are balanced by anthropogenic removals of GHG from the atmosphere over a specified period." [1]

- Canada's net-zero commitment includes all GHGs and is geographically bounded to emissions generated within Canada across all sectors. This definition is consistent with international GHG accounting standards in which each country accounts for emissions produced within its borders. Emissions from GHG-producing exports are accounted for in the country of use.

A **PATHWAY** connects where we are today with where we want to go. But it is not just a line on a graph. A pathway captures all the elements required to transform a system to better respond to societal needs and meet net-zero emission goals (e.g., the character, magnitude, and sequence of changes in technologies; infrastructure; business models societal practices; mindsets; governance structures; investments; reporting requirements; and, policy or regulatory frameworks). A pathway has a clear beginning and end, with connecting steps that will be refined over time based on learning.

[1] *This definition is consistent with that included in the proposed Canadian Net-Zero Emissions Accountability Act.*

Context

GLOBAL MOMENTUM

Catalyzed by the **Paris Agreement** in 2015 and the result of decades of work by scientists, Indigenous peoples, civil society, and citizens, an international consensus has emerged for strong climate action to limit global average temperature increases. Under the Paris Agreement, Canada and 194 other countries committed to limiting global average temperature increase to well below 2°C and to pursuing efforts to limit temperature increase to 1.5°C.

In 2018, the Intergovernmental Panel on Climate Change (IPCC) released its **Special Report on Global Warming of 1.5°C**, which clarified the importance of keeping temperature rise to 1.5°C and intensified the urgency of decreasing GHG emissions by 2030 and reaching net-zero emissions by 2050. The IPCC estimated that the remaining carbon budget to give us a chance of keeping average global warming below 1.5°C is extremely limited.

In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range).

— IPCC Special Report on Global Warming of 1.5°C Summary for Policy Makers, 2018

Key Milestones on 2050 Ambition

2015 Paris Agreement

2016 Canada's Mid-Century Strategy

2018 IPCC Report

2019 Launch of Climate Ambition Alliance

Canada Sets a Net-Zero Target

2020

NOVEMBER
Net-Zero Legislation

DECEMBER
A Healthy Environment and A Healthy Economy

2021

FEBRUARY
Launch of NZAB

APRIL
U.S. Leaders' Climate Summit

Since the 2018 IPCC report, net-zero by 2050 has become the globally accepted standard for climate ambition, paired with strong nearer-term Nationally Determined Contributions (NDCs) under the Paris Agreement. Over **120 countries, 708 cities, 23 regions, 2,162 businesses, 127 major institutional investors, and 571 higher education institutions** have made commitments to net-zero to date, with numbers growing daily. Commitments so far represent around half of both the world's GDP and global CO_2 emissions, and include notably the totality of the G7 and a majority of the G20 countries.

While net-zero commitments can vary in **scope and robustness** (i.e., in terms of geographic boundaries and which GHGs and activities they include), there are increasing efforts to define standard minimum criteria. For example, the United Nations Framework Convention on Climate Change's (UNFCCC) **Race to Zero Campaign** requires all of its non-state members to meet a defined 'starting line' including a net-zero pledge and a plan of action. National commitments to net-zero range from legislated targets (e.g., United Kingdom) to aspirational targets in policy statements (e.g., South Africa, Japan). Canada currently has proposed legislation, the **Canadian Net-Zero Emissions Accountability Act**, before Parliament to formalize its commitment to net-zero by 2050. This legislation would cover all anthropogenic GHG emissions and it proposes a statutory basis for the NZAB.

Many of the countries with net-zero commitments have launched their own climate change advisory bodies or commissions, such as the United Kingdom's **Climate Change Committee**, France's **Haut Conseil pour le Climat**, and New Zealand's **Climate Change Commission**. We plan to continue to engage with international advisory bodies to learn from their experiences, discuss our mandates, and find shared interests.

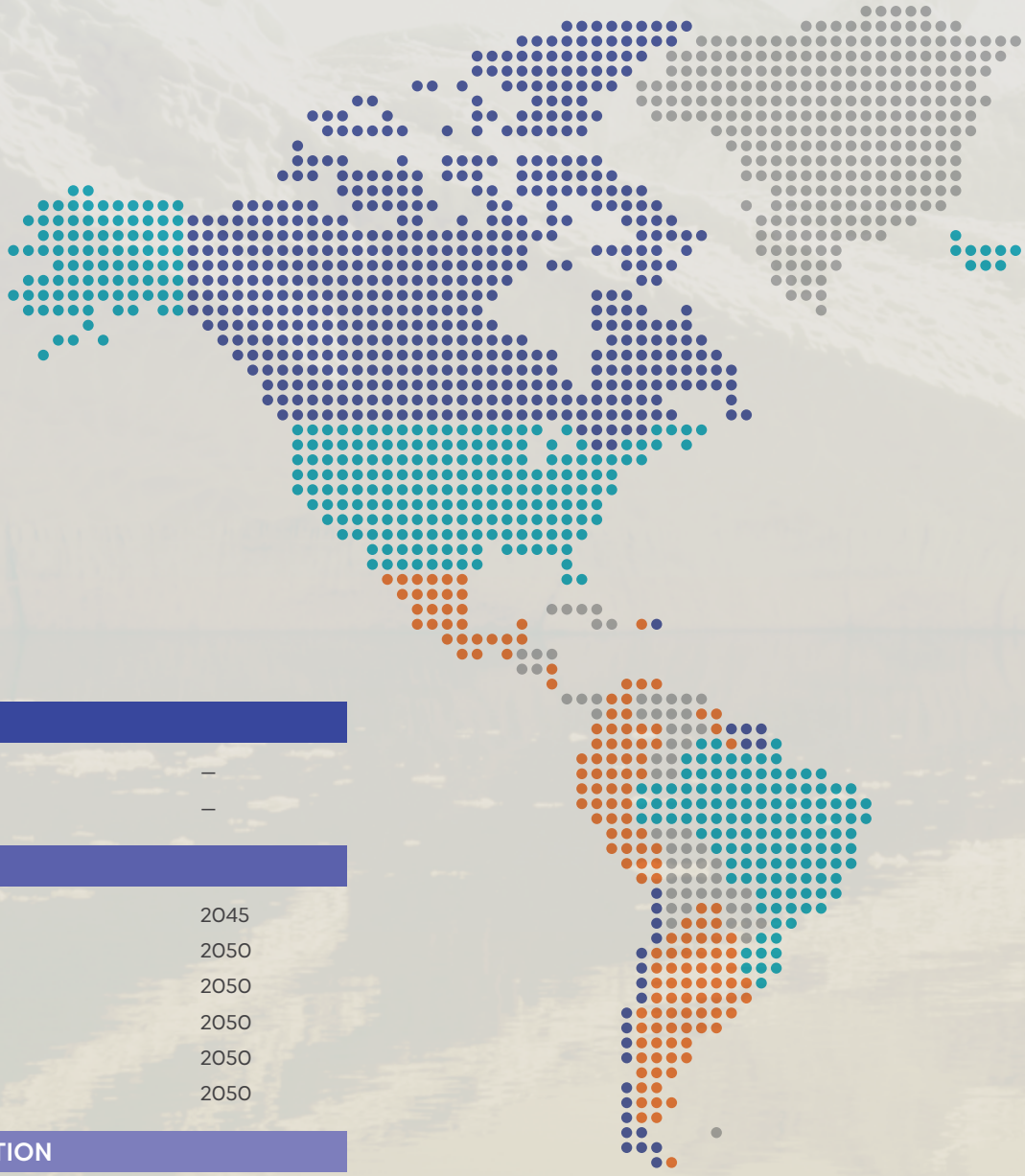
Achieving net-zero will require profound changes to how people move, live, think, and do business. It can seem like a daunting task, especially with current projections showing that even with the growing number of net-zero commitments, the world is not on track to limit temperature rise to 1.5°C. Countries cannot continue with business as usual. Canada and the rest of the world must take further action and show that net-zero is achievable. This will be vital to building hope and support. Getting to net-zero involves contributing a fair share in the global effort to confront climate change; avoiding some of the worst consequences of the climate crisis; and taking advantage of the opportunities for innovation, new jobs and improved wellbeing.

CONSEQUENCES OF INACTION

Human activities have already caused approximately **1.2°C of global warming above pre-industrial levels**. According to **Canada's Changing Climate Report** (2019), Canada is warming at twice the rate of the global average—experiencing a temperature rise of about 2°C in the same time period while northern Canada has been warming at close to three times the global rate, with a 3°C temperature rise above pre-industrial levels. With **variations by region**, Canada will continue to experience more extreme heat, less extreme cold, longer growing seasons, shorter snow and ice cover seasons. These changes will increase the likelihood of

Countries with Net-Zero Commitments

Based on Net Zero Tracker | Energy & Climate Intelligence Unit



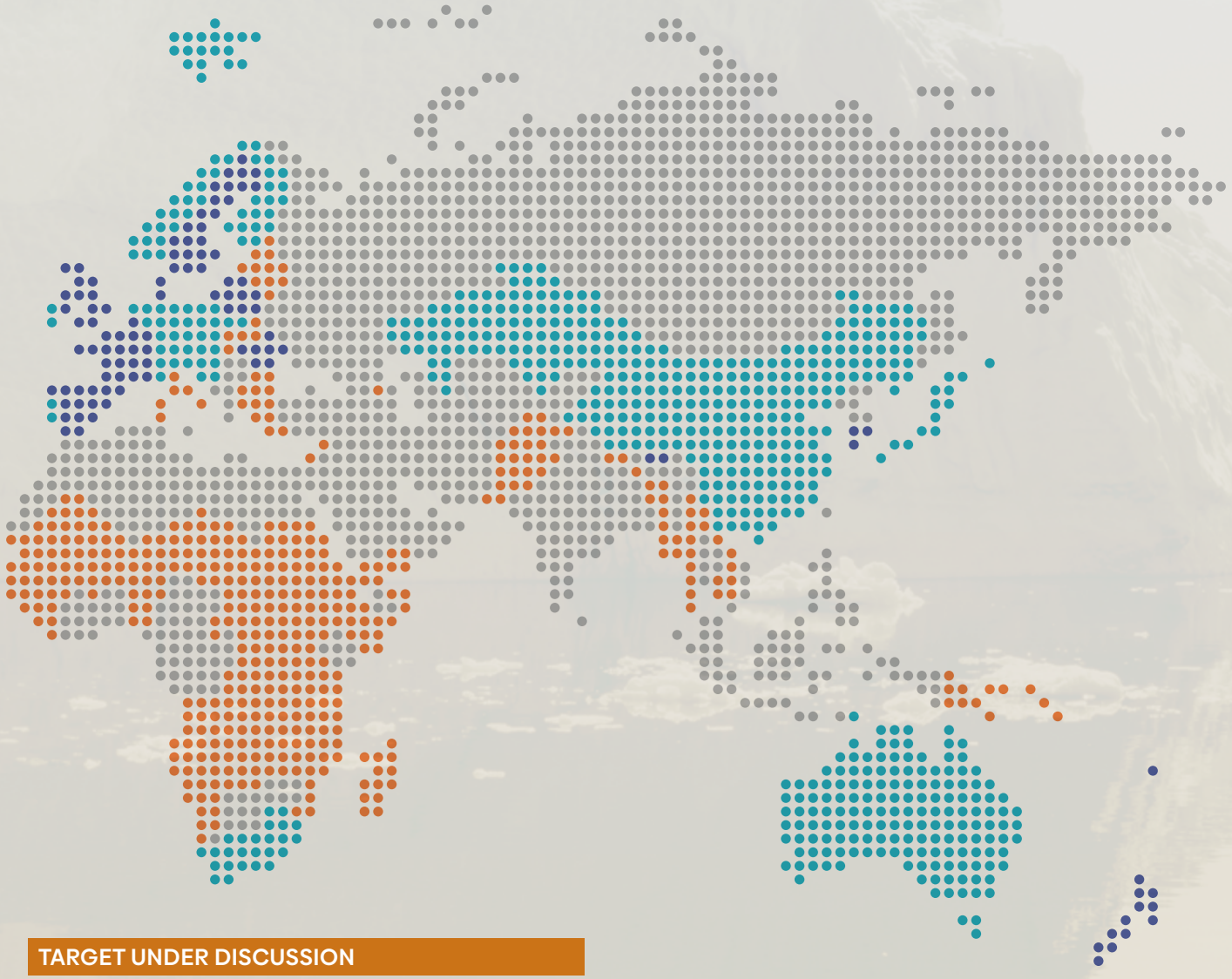
ACHIEVED	
SURINAME	—
BHUTAN	—

IN LAW	
SWEDEN	2045
UNITED KINGDOM	2050
FRANCE	2050
DENMARK	2050
NEW ZEALAND	2050
HUNGARY	2050

PROPOSED LEGISLATION	
EUROPEAN UNION	2050
CANADA	2050
SOUTH KOREA	2050
SPAIN	2050
CHILE	2050
FIJI	2050

IN POLICY DOCUMENT

FINLAND (2035)
AUSTRIA (2040)
ICELAND (2040)
GERMANY (2045)
UNITED STATES (2050)
JAPAN (2050)
SOUTH AFRICA (2050)
BRAZIL (2050)
SWITZERLAND (2050)
NORWAY (2050)
IRELAND (2050)
PORTUGAL (2050)
PANAMA (2050)
COSTA RICA (2050)
SLOVENIA (2050)
ANDORRA (2050)
VATICAN CITY (2050)
MARSHALL ISLANDS (2050)
CHINA (2060)
KAZAKHSTAN (2060)



TARGET UNDER DISCUSSION

URUGUAY | ITALY | MEXICO | THE NETHERLANDS | BELGIUM | ARGENTINA | COLOMBIA | PAKISTAN | BANGLADESH | CZECHIA | ROMANIA | PERU | GREECE | ECUADOR | SLOVAKIA | ANGOLA | DOMINICAN REPUBLIC | ETHIOPIA | MYANMAR | LUXEMBOURG | CROATIA | BULGARIA | TANZANIA | LEBANON | LITHUANIA | DEMOCRATIC REPUBLIC OF CONGO | SUDAN | LATVIA | ESTONIA | NEPAL | UGANDA | YEMEN | ZAMBIA | CYPRUS | CAMBODIA | SENEGAL | TRINIDAD AND TOBAGO | PAPUA NEW GUINEA | AFGHANISTAN | LAOS | MALI | JAMAICA | MOZAMBIQUE | MALTA | NAMIBIA | MAURITIUS | BURKINA FASO | MADAGASCAR | NICARAGUA | ARMENIA | BAHAMAS | SOUTH SUDAN | CHAD | GUINEA | BENIN | HAITI | RWANDA | NIGER | MONACO | MALAWI | TOGO | MALDIVES | MAURITANIA | BARBADOS | SOMALIA | SIERRA LEONE | GUYANA | LIBERIA | BURUNDI | DJIBOUTI | LESOTHO | TIMOR-LESTE | ERITREA | CENTRAL AFRICAN REPUBLIC | CABO VERDE | BELIZE | SAINT LUCIA | ANTIGUA AND BARBUDA | SEYCHELLES | GAMBIA | GUINEA-BISSAU | SOLOMON ISLANDS | COMOROS | GRENADA | SAINT KITTS AND NEVIS | VANUATU | SAMOA | SAINT VINCENT AND THE GRENADINES | DOMINICA | COOK ISLANDS | TONGA | MICRONESIA | SAO TOME AND PRINCIPE | PALAU | KIRIBATI | NAURU | TUVALU | NIUE

floods, thinning glaciers, thawing permafrost, and rising sea level, as well as changes to precipitation patterns. Many of these environmental impacts create feedback loops that accelerate climate change: for example, permafrost currently acts as a carbon sink, but as it thaws it releases carbon dioxide and methane, contributing to further warming, which leads to more permafrost thaw. Canadians are already feeling the impacts of climate change, and these impacts disproportionately affect Indigenous peoples and those who are already structurally marginalized.

At a global level, two 2019 IPCC Special Reports, **Climate Change and Land** and **The Ocean and Cryosphere in a Changing Climate** found that climate change will lead to severe impacts on land and water around the world, with likely disruptions to food security and the availability of freshwater. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services has similarly published vital **findings** on the connections between people, biodiversity and climate change.

The changing weather patterns and increasingly frequent and severe natural disasters that result from climate change will cause fundamental changes to economic structures and social wellbeing globally. In Climate Change and Land, the IPCC states that both extreme weather and changing temperatures and precipitation may lead to increased displacement and migration as people's livelihoods and homes are impacted, and contribute to exacerbating stresses behind conflicts, resulting in greater geopolitical instability. Within Canada, socioeconomic impacts include damage to critical infrastructure and disruption to supply chains from extreme weather events; increased housing insecurity; changing property values as a result of flooding and coastal erosion; and shifts in agricultural production that could result in increased food prices, and changes to supply. There are also significant health and safety risks to communities and individuals, including from air pollution, extreme heat and vector-borne diseases. For example, **Health Canada** estimates that air pollution, including that produced by burning fossil fuels, was responsible for 15,300 premature deaths, 2.7 million asthma symptom days, and 15 million acute respiratory symptom days, each year, with impacts valued at $120 billion per year.

These impacts will be costly: the Canadian Institute for Climate Choices' report, **Tip of the Iceberg: Navigating the Known and Unknown Costs of Climate Change for Canada** finds that the number and cost of catastrophic weather events in 2010-2019 were twice as high as those recorded in Canada during the previous three decades combined. Insured losses totaled over $18 billion between 2010 and 2019, with disaster costs rising to between 5-6 per cent of annual GDP growth. As the report notes, there is significant uncertainty about the potential future costs of climate change. Key areas of uncertainty include how impacts will interact with each other and with other sources of vulnerability like inequality and environmental racism, and how to understand costs that are not easily quantified, like the loss of land-based traditions and practices that are important to the mental, emotional and spiritual wellbeing of many Indigenous peoples.

What is clear is that if these challenges are allowed to accumulate and compound on each other, they are likely to lead to profound global geopolitical and financial instability, and undermine human security.

CANADA MUST ACT

Canada must act decisively. The urgency of the problem and the severity of potential impacts are a call to action and a clear case to do more. Canada is part of an integrated and complicated world, and must keep pace with global momentum. Much of the world is currently moving faster than Canada. As the world economy is rapidly being re-built around a green economy, inaction will result in lost opportunities for new jobs and sustainable prosperity for Canadians.

Examples of Net-Zero Action Around the World

UNITED KINGDOM

In April 2021, the United Kingdom **adopted its sixth carbon budget**, with a target to reduce emissions by 78% below 1990 levels by 2035. For the first time, it has included the UK's share of international aviation and shipping emissions. This will bring the UK more than three-quarters of the way to net-zero by 2050. To support achieving this target, and ultimately, net-zero, the UK has introduced a **Ten Point Plan for a Green Industrial Revolution** which includes targets for advancing offshore wind energy, developing low carbon hydrogen, and decarbonizing transportation and buildings.

AOTEAROA (NEW ZEALAND)

In 2019, Aotearoa New Zealand legislated its net-zero GHG target (excluding biogenic methane), established a system of emissions budgets, and created an independent Climate Change Commission to provide expert advice and monitoring. This Commission states that it will **work in partnership with Iwi/Māori** and incorporate te ao Māori (Māori world view) into its work and advice. Similarly, the Government of New Zealand works with a Māori-led climate initiative, **Te Ihirangi**, to raise awareness of climate change, collect data, and gather advice. New Zealand is relying on a domestic **Emissions Trading Scheme** introduced in 2008 and strengthened in 2020 to help it reduce GHGs.

GERMANY

Following an April 2021 court ruling that its climate legislation was insufficient, Germany has **increased its climate ambition**, committing to reduce its emissions by 65% below 1990 levels by 2030 and to achieve net-zero by 2045. Its legislation had already defined annual sectoral GHG targets to 2030. Germany's **COVID stimulus package** dedicated €7 billion to hydrogen development, increased targets for expansion of offshore wind, and provided additional funding for its green retrofit program for residential, municipal, and community buildings. In March 2021, Canada and Germany signed an **agreement** to work together on clean energy, with a particular emphasis on bilateral cooperation on hydrogen.

Examples of Net-Zero Action Around the World (continued)

UNITED STATES

In April 2021, the United States hosted a Leaders' Summit on Climate, at which it committed to reducing its GHG emissions by 50-52% below 2005 levels by 2030, and achieving net-zero by 2050. This commitment followed announcements on concrete actions to expand climate-friendly infrastructure, energy, and transportation in President Biden's January **Executive Order on Tackling the Climate Crisis at Home and Abroad** and his proposed **American Jobs Plan**.

CHINA

China is the world's largest GHG emitter, and so its pledge to achieve net-zero by 2060 and to have its CO_2 emissions peak before 2030 has the potential for significant impacts. To **support the achievement of these goals**, it has set targets to increase sales of new-energy vehicles to around 50% by 2035, to increase its non-fossil fuel share of primary energy to 25% by 2030, and to increase the total installed capacity of solar and wind to 1200 GW by 2030.

Canada has a responsibility to act. It is one of the top ten global emitters of GHGs as of 2018, in the top ten in cumulative GHG emissions over time, and in the top three emitters on a per capita basis. While most other G7 countries have successfully reduced their emissions from 1990 levels (e.g., Germany has **reduced its emissions by 35.7%** from 1990-2019), Canada's emissions remain well above 1990 levels. According to Canada's latest **National Inventory Report**, emissions across Canada have only decreased by 1.1% over the past 15 years, despite the measures already introduced. Canada's emissions trends and projections have consistently shown large increases in the oil and gas and transport sectors and smaller decreases in other sectors, such as electricity and heavy industry. It is clear that Canada needs to make a focused effort to reduce its emissions, particularly in the sectors where emissions continue to rise, in order to contribute to curbing global climate change.

Leadership on climate change also presents an opportunity for Canada to leverage its strengths to develop new markets and drive job creation in a new net-zero economy. Indigenous leadership will be imperative to Canada's net-zero transition. Indigenous-led climate strategies developed at the community, regional, and national levels, including by **Inuit Tapiriit Kanatami (ITK)** and the **Assembly of First Nations**, are important **catalysts** to these efforts. The opportunities may vary by region, but each part of Canada has resources and expertise that can be deployed to build a net-zero

economy. For example, across the studies we examined, Canada's relatively clean electricity grid and potential for expansion was consistently noted as a strength. Also highlighted were Canada's reserves of the critical and strategic minerals that will be essential to clean technologies, highly educated and skilled workforce, and strong record of innovation. These advantages can be leveraged to develop climate-safe products, technologies, and solutions.

The actions of other countries will present significant opportunities to work together with mutual environmental, social and economic outcomes. In particular, renewed U.S. climate leadership presents a significant opportunity for collaboration on solutions across highly integrated economies. These actions will also influence Canada's most likely pathways to net-zero. For example, President Biden's **American Jobs Plan** outlines proposals to expand the electric vehicle market in the United States by investing US $174 billion, installing 500,000 new public charging stations across the US by 2030, and using federal procurement to electrify the federal fleet. Given the integration of the North American auto market, this sends a clear signal that, for light duty vehicles, electric vehicles (EVs) are likely to dominate over fuel cell vehicles or biofuel-based pathways in the integrated North American auto market.

Global markets for sustainably produced resources and green technologies are anticipated to grow substantially over the coming years: Export Development Canada *expects global clean technology activity to exceed $3.3 trillion by 2022 and Canada's clean tech sector is already generating $17 billion in annual revenues.*

As Canada recovers from the COVID-19 pandemic and begins to chart its path to net-zero, it is the ideal moment to be strategic. Canada must make investments to support innovation, scale domestic businesses and supply chains, and grow employment opportunities for underserved communities. Doing so should create an increasingly climate-friendly economy. Reflecting on the gendered-impacts of both COVID-19 and climate change, it is clear that women and girls continue to be uniquely vulnerable. Policies and programs for both should be rooted in climate justice going forward.

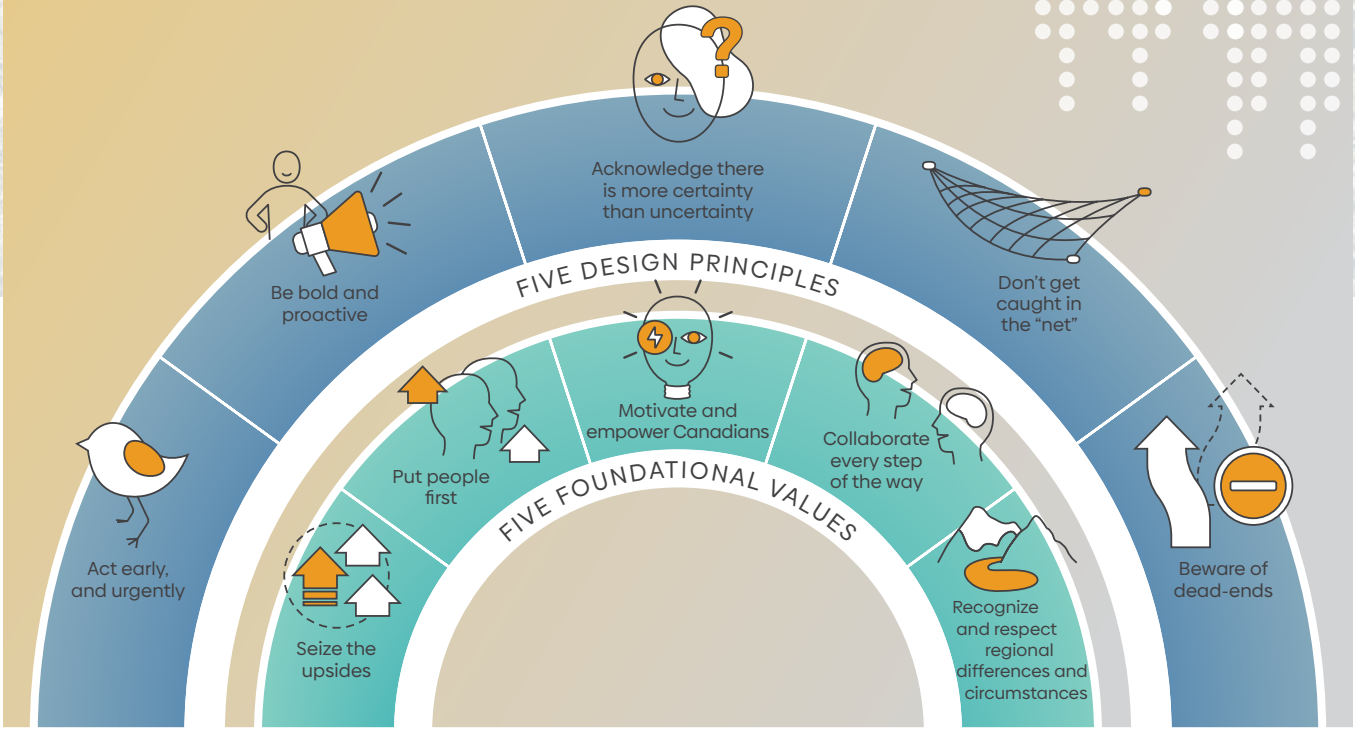
The window for more ambitious climate action is now. Canada's imperative to act is also its opportunity.

Sustainable Finance Action Council

On May 12, 2021, Canada's **Sustainable Finance Action Council** was launched. The council's principal mandate is to make recommendations on critical market infrastructure needed to attract and scale sustainable finance in Canada, including: enhanced assessment and disclosure of climate risks and opportunities; better access to climate data and analytics; and common standards for sustainable and low-carbon investments.

We welcome this announcement and look forward to working closely with its chair and members to help ensure climate considerations are reflected in public and private financial decision-making through pathways to 2050. Our two complementary bodies will connect on our respective priorities, work plans and perspectives.

Foundational Values and Design Principles for Pathways to Net-Zero



Observations to Guide Our Work

TO ENGAGE AND ADVISE ON NET-ZERO PATHWAYS

The NZAB is beginning its work during a period of active and ongoing expansion of knowledge on net-zero pathways, in Canada and around the world. The number of pathways to net-zero is infinite—but not all are equally likely. Nor would many of them be right for Canada. During the first three months of our mandate, we explored numerous domestic and international analyses of net-zero pathways. Together, we discussed and reflected on their commonalities, differences, and their strengths and weaknesses. This was an essential starting point to allow us to learn from the insights and experiences of the organizations that had already begun this work. In the sections below, we distill what we believe to be essential values and principles for our mandate.

FIVE FOUNDATIONAL VALUES FOR PATHWAYS TO NET-ZERO

1. Seize the upsides

There are major economic, environmental, health, and social benefits that are directly linked to climate action. Conversely, there are real and rising costs of inaction. It is more affordable to invest in action now than to delay. Looking forward to the post-pandemic recovery, large upfront investments will be required to achieve emissions reductions and realize economic benefits. Climate action is a net creator of jobs and economic benefits, and has the potential to advance justice, if done right. We must do the hard work necessary to ensure equitable access to the benefits of a net-zero transition. In order to realize these benefits, the rights and self-determination of Indigenous peoples must be respected. That is true both for governments and for the private sector, who need to work with Indigenous nations and organizations as full partners in securing benefits for their communities and all Canadians. The private sector will also have a key role in investing in climate solutions. Environmental, social, and governance criteria are steadily gaining traction. These criteria can be important net-zero drivers when well-designed and independently verified.

The most likely pathways are those that have the broadest benefits – for individuals, families, workers, businesses, and society as a whole.

Indigenous Climate Leadership

2,107 to 2,507

INDIGENOUS CLEAN ENERGY PROJECTS ACROSS CANADA

SOURCE: *Indigenous Clean Energy's Report: Accelerating Transition: Economic Impacts of Indigenous Leadership in Catalyzing the Transition to a Clean Energy Future Across Canada*

1,700 to 2,100
RENEWABLE POWER GENERATION (SMALL)

197
RENEWABLE POWER GENERATION (MEDIUM TO LARGE)

19
ELECTRICITY TRANSMISSION

72
BIOENERGY

127
ENERGY EFFICIENCY

Working towards Inclusion, Fairness and Justice in Climate Action

Advocated for by Indigenous rights, labour and environmental justice movements.

2016

Recognized in the Paris Agreement preamble: *"the imperatives of a just transition of the workforce and the creation of decent work and quality jobs."*

2016

Iron & Earth formed as a worker-led non-profit with a mission to empower fossil fuel industry and Indigenous workers to build and implement climate solutions with a just transition to a net-zero emissions economy by 2050.

2018

The Task Force on Just Transition for Canadian Coal Power Workers and Communities engages and releases its report with 10 recommendations.

2019

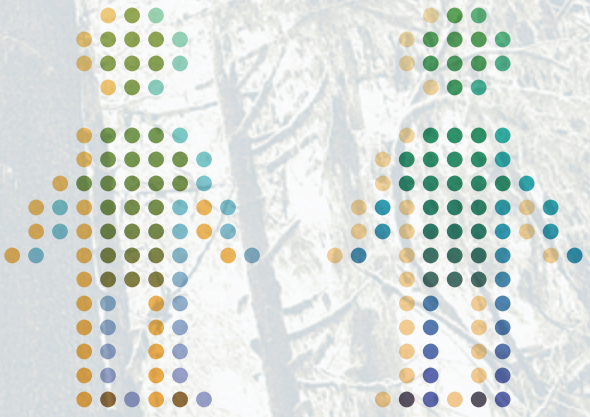
Chiefs-in-Assembly at the Annual General Assembly of the Assembly of First Nations pass a **resolution** declaring a climate emergency while recognizing the need for a just transition to address income inequality within First Nations.

Continued on p. 19

2. Put people first

A net-zero transition must be just and fair. No one can be left behind or shoulder the burden because of where they live, work, or their identity. These efforts must simultaneously promote fairness, inclusion, and wellbeing for all. To ensure these outcomes are achieved, net-zero pathways should be shaped by open dialogue with workers, families, and communities. Government programs and policies must respond to their needs. Equity and inclusion should be hard-wired in pathways. This is particularly true to address the needs of groups that are disproportionately impacted by the physical and economic risks of climate change and energy transition, and/or by workforce and supply chain disruptions due to energy system changes. A just transition will lead to more equitable outcomes on gender, racial justice and reconciliation with Indigenous peoples. It is vital that we work together with different groups and do not ignore power imbalances, instead finding new ways to lift the voices of those who are traditionally overlooked in climate discussions and decisions.

The most likely pathways support a just and fair transition.



3. Motivate and empower Canadians

A net-zero future will require structural changes and shifts to social, economic, and behavioural norms. But a net-zero society brings real, tangible benefits in addition to avoiding the worst climate change consequences. A net-zero society has cleaner air, more livable communities, more sustainable agriculture and natural systems. Healthcare costs are dramatically reduced. A net zero society could be a fairer, more just world. To help real, timely progress to a net-zero society, significantly more effort must be invested in ways to motivate and encourage Canadians to switch to low-emissions lifestyles and businesses. Traditional types of supportive policies and programs, and new approaches that draw on the expertise of social scientists and others experts in motivation and behaviour change are both critical. Solutions need to take into account privilege and accessibility, including within the broader context of rising income inequality, and result in real outcomes that improve the lives of Canadians. It will take all Canadians contributing their individual talents and skills towards more sustainable, fair, and secure futures of their communities. In particular, young people must continue to be heard and be empowered to shape a vision for a future that can fulfill their aspirations and dreams.

The most likely pathways enable Canadians to envision and strive towards a future that is desirable in itself, for reasons beyond GHG emissions reductions and removals.

4. Collaborate every step of the way

Modelling is very important to pathway development, but models do not make investments or purchases— people do. Pathways must be multidisciplinary, taking into account the contributions of workers, economists, investors, engineers, entrepreneurs, social scientists, and Indigenous knowledge holders, among others. They must be grounded in the reality facing everyday, hardworking Canadians. Pathways must be built on an understanding of the real issues and barriers facing Canadians and create space for respectful dialogue and opportunities for inclusive and shared decision-making models.

The most likely pathways are grounded in real-world experience and built collaboratively.

5. Recognize and respect regional differences and circumstances

There will be pathways that are common for all of Canada at the national-level, but there will also be different pathways for different regions and economic sectors. In many parts of the country, jobs, communities, and the economy are closely connected to GHG-intensive activities. Canada's net-zero transition will take place in a context with tensions and trade-offs, as well as benefits. As the **Supreme Court of Canada** recently affirmed, climate change is a matter of national concern that requires cooperative action from all orders of Canadian governments. Equitable effort-sharing across provinces, territories, and communities is necessary to get to net-zero. Diverse regional perspectives and experiences, especially from rural, remote and northern communities, need to inform the development of pathways. The experiences of Indigenous peoples in the northern and southern parts of Canada are very different. Communities on the coast face different opportunities than those inland.

The most likely pathways will take into account that there is no one-size-fits-all approach for Canada and prioritize place-based solutions.

FIVE DESIGN PRINCIPLES FOR PATHWAYS TO NET-ZERO

1. Act early, and urgently

The most likely net-zero pathways prioritize early and deep reductions

While the best time to act on a net-zero target was decades ago, the next best time to act is today. Canadians in all regions, especially in the Arctic, are already experiencing the drastic impacts of current levels of warming. The science is clear that allowing higher emissions in the near-term followed by steeper cuts in the longer-term will cause more global warming and associated impacts than steep cuts now. Doing little now to reduce emissions, and a lot later, will not work. There is no time to delay if we are to avoid some of the worst consequences of climate change. We have a 29 year window—or approximately 1,500 weeks—in which to make the fundamental choices and investments to achieve net-zero. Every day and every decision counts. Complex projects to generate and distribute electricity will span across decades. Transportation systems will need time to convert and recalibrate their many moving pieces—like the personal vehicles most Canadians own, public transit, and freight. We must move now and keep innovating to effect necessary, system-level changes.

The most likely pathways are the ones that start now, use a carbon budget as a basic tool, and increase ambition to keep the 2050 goal within reach.

Carbon Budgets

Carbon budgets are one way of defining pathways to net-zero. Carbon budgets specify the cumulative amount of GHG emissions permitted over a period of time to limit a specific temperature increase. Carbon budgets differ from targets in the sense that not only do emissions have to fall to a certain level by a particular year, the overall amount of emissions allowed leading up to that deadline is also limited.

In its 2018 Special Report, the IPCC found that the remaining global carbon budget to limit warming to 1.5°C is 420 $GtCO_2$ to 580 $GtCO_2$ (while noting there are many uncertainties with this estimate). As of 2020, the Global Carbon Budget report found that there is only 8% of the global carbon budget left and that at current emission rates, this will be exhausted within 10 years.

Carbon budgets can also be set at the national level, usually for 5-year intervals, as in the United Kingdom and France. In many jurisdictions, carbon budgets have proved essential to making clear the parameters within which near-term social and economic decisions must be made so that they lead to outcomes that are consistent with longer-term climate commitments. Carbon budgets present several challenges, however, including definitional issues, what datasets to use, the impacts of other GHGs on climate, and whether and how to account for earth-system feedbacks such as thawing permafrost.

Both carbon budgets and GHG emissions targets are reference tools that can help plan for emissions reductions needed to avoid climate change.

2. Be bold and proactive

The most likely net-zero pathways are strategic and ambitious

Pathways need a beginning, intermediate steps, and a defined end. Incremental changes to existing systems will not to lead to results in 2050 that both meet the needs of Canadians and are net-zero. We need to define the desired future systems now to allow sufficient time to invest and build the systems and infrastructures—physical, social, and institutional—of tomorrow. Building pathways between the current state, and defined future states is a recipe for success. The scale and pace of transformation required is unprecedented. This will require decisive government leadership and clear signals to support investment by the private sector. This means that the public and private sectors need to be prepared to take appropriate risks and back potential "game changers" now—both in terms of new technologies and infrastructure – to lead at home and around the world in a global multi-trillion dollar climate economy.

The most likely pathways detail the steps required to attain a defined future state, and have a clear description of the type and magnitude of changes required to get there.

The International Energy Agency's Net-Zero by 2050 Pathway

The International Energy Agency (IEA) recently released a special report, Net-Zero by 2050: a Roadmap for the Global Energy Sector, which was prepared at the request of the UK President of the COP 26. This is the first net-zero pathway that the IEA has produced. This detailed report sets out more than 400 sectoral and technology milestones. It provides a detailed analysis of implications for fossil fuel supply, the supply of low-emissions fuels (such as hydrogen, ammonia, biofuels, synthetic fuels and biomethane) and the electricity, transport, industry and buildings sectors. It estimates the costs of achieving a net-zero goal and the likely impacts on employment and the economy.

The analysis underscores the urgency of scaling up action to keep a net-zero future within reach, and sets out the specific, intermediate steps that would be required along this pathway.

3. Acknowledge there is more certainty than uncertainty

The most likely net-zero pathways prioritize available, at scale solutions

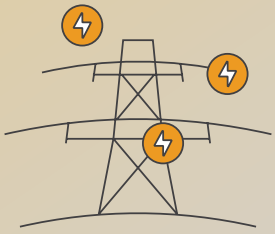
Getting to net-zero emissions by 2050 will be very difficult but is absolutely possible. Despite significant differences across sectors, regions, and households, there are real, definite actions that build on existing strengths and propel us forward. Elements that are common across domestic and international pathways have emerged and allow for decisive, immediate action. For example, there is confidence that demand for and supply of non- or low-GHG emitting power will increase. Electrification and energy efficiency are fundamental across all scenarios. Electric vehicles and charging stations will be the new normal. The importance

of integrated power grids and distribution systems will only grow. Notably, these measures will see real reductions in GHG emissions based on existing technology. Next steps in these areas, and others like them, should be about how to implement and scale.

The most likely pathways move decisively to implement what we already know will work to reduce or remove emissions.

Core Elements Across Pathways

Early investments will be more cost-effective over the long-run



Electrification and energy efficiency are foundational

More innovation is needed to get all the way to net-zero

Emissions reductions must be paired with socioeconomic benefits

4. Don't get caught in the "net"

The most likely net-zero pathways prioritize emissions reductions and use removal and offsets when necessary

The commitment to "net-zero" instead of "zero" emissions is important, reflecting scientific-based advice and practical constraints. We must get as close to zero emissions as we can by reducing or eliminating GHGs across all sectors. Despite best efforts to reduce all emissions, some sources of GHGs will be difficult to eliminate completely by 2050 - that's where the "net" comes in. Offsets or removals (carbon capture, utilization and storage; direct air capture technologies; nature-based removals) can be used to get to net-zero emissions for these hard-to-eliminate sources. An appropriate role for removals and offsets should be defined and focus on balancing out emissions from sources where we do not yet have the solutions to eliminate emissions, like some agricultural activities or heavy industries like cement production. However, the "net" in "net-zero" cannot become an excuse to allow continued emitting, growth of emissions, or slow action.

The most likely pathways do not allow for increases in GHG emissions.

5. Beware of dead-ends

The most likely net-zero pathways avoid locking-in systems and technologies that will become emissions liabilities before 2050

Not all pathways designed to achieve emissions reductions by 2030 will get us all the way to 2050. Some efforts to reduce emissions in the relatively short-term may entrench systems and technologies that will eventually have to be replaced to get to a net-zero society. This is something that businesses making decisions on what technology to invest in or adopt will have to grapple with. As more and more companies, municipalities, and other groups start planning now, they need to keep 2050 in mind. The required structural changes to get to net-zero is a generational project that needs to start now to avoid unintended wasted effort, time and investment. While there may be interim actions that serve as bridges on the path to net-zero, some projects or activities may obscure or misdirect us from the ultimate goal or lead to inaction.

The most likely pathways do not require retooling shorter-term solutions at greater expense and lost time.

Working towards Inclusion, Fairness and Justice in Climate Action (continued)

Continued from p. 14

2019

Blue Green Canada, founded by an alliance between Canadian labour unions, environmental and civil society organizations, calls on Canada to legislate a Just Transition Act to address climate change while giving workers access to the training, support, and new opportunities needed to prosper now, and in the future.

2019

Prime Minister **mandates** the Minister of Natural Resources to advance, in partnership with others, legislation to support the future and livelihood of workers and their communities in the transition to a low-carbon global economy.

2020

The Movement for a Just Recovery brings together over 600 organizations from across Canada and advocates that governments base their response to and recovery from COVID-19 on its *"Six Principles for a Just Recovery."*

2021

Unifor, the largest private sector union in Canada, supports Canada's latest emissions targets and even more ambitious ones, as long as there is a plan for a just transition that will not leave workers behind.

Where to From Here?

The first three months of our mandate have been incredibly instructive. This report is a starting point. Our mandate as the NZAB is to provide advice to the Minister of Environment and Climate Change. This advice will include actions that are within federal jurisdiction, but may also include actions that could be implemented by others, such as individuals, communities, businesses, and other orders of government.

We know that achieving net-zero will be a collective effort involving all levels of government, Indigenous peoples, all businesses, communities, and individuals. We have much to do, hear, learn, and share.

Year 1 Timeline/Cycle

2021

FEBRUARY
Net-Zero Advisory Board Launch

SPRING
Foundational Briefings on Pathways

JUNE
Release of Net-Zero Pathways Summary

SUMMER/FALL
Planned launch of research and engagement activities

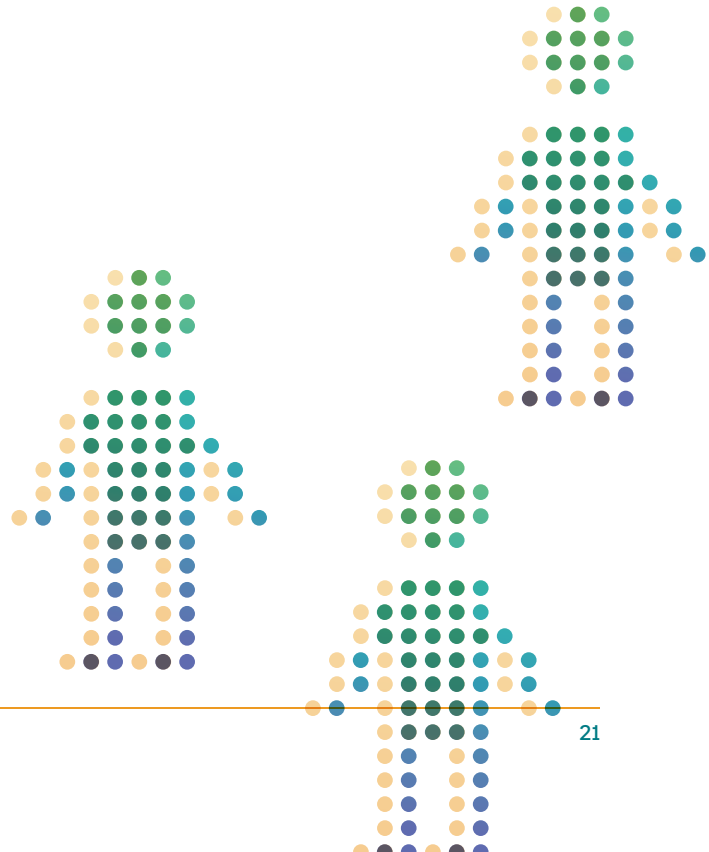
2022

WINTER/SPRING
First Annual Report

In the next phase of our work, we intend to delve deeper into the complex considerations that must inform specific policy advice. There are pressing questions about the practical actions that governments must prioritize to build an inclusive net-zero economy, and how to ensure the scale and pace of investment flows will match the required ambition. For example, we will review the recommendations of existing green recovery studies to draw out, verify, and nuance the elements of a green recovery from the diverse lenses of achieving net-zero. The behavioural and social shifts that will be critical to accelerating towards net-zero must also be supported and reinforced by ambitious, structural change. All of Canada—alongside the global community—must constructively struggle with the consequential choices we must make to get to net-zero. We look forward to contributing to this broader conversation and offering our advice.

Our next step will be to establish key priorities (or "lines of inquiry") for our work this year. These lines of inquiry will be set at regular intervals. In the next year, we will produce our first annual report, which will synthesize analyses, summarize what we heard from engagement, and provide advice to the Minister on the most likely net-zero pathways, with a focus on our lines of inquiry.

This report marks the beginning of our 29-year project.



Annex 1
METHODOLOGY AND BRIEFINGS

In spring 2021, we held a series of 14 briefing sessions with Canadian and international net-zero experts. The purpose of these briefings was to gather information about existing domestic and international net-zero pathways, to inform the summary the NZAB was mandated in its Terms of Reference to provide within three months of its establishment.

We requested briefings from organizations and individuals based on a specific set of criteria during this initial phase. Our approach was to prioritize briefings on recently published and forthcoming net-zero pathways – that is, analysis that examined the potential for deep emissions reductions across the full economy, supported by economic modelling, comprehensive literature reviews, or significant consultation with a cross-section of experts. The NZAB identified experts through an initial scan of publicly available net-zero literature, as well as suggestions by members and a call for input issued by co-chairs through social media.

Establishing connections with advisory bodies established in other countries that have conducted this type of in-depth net-zero analysis was also a priority for the NZAB, to open an ongoing dialogue on sharing best practices across jurisdictions.

The NZAB asked experts to focus their briefings on a common set of questions, including:

- high-level results;
- summary of approach, including key assumptions and methodology;
- self-assessment of strengths and weaknesses of the analysis; and,
- lessons learned and areas for further research/ refinement.

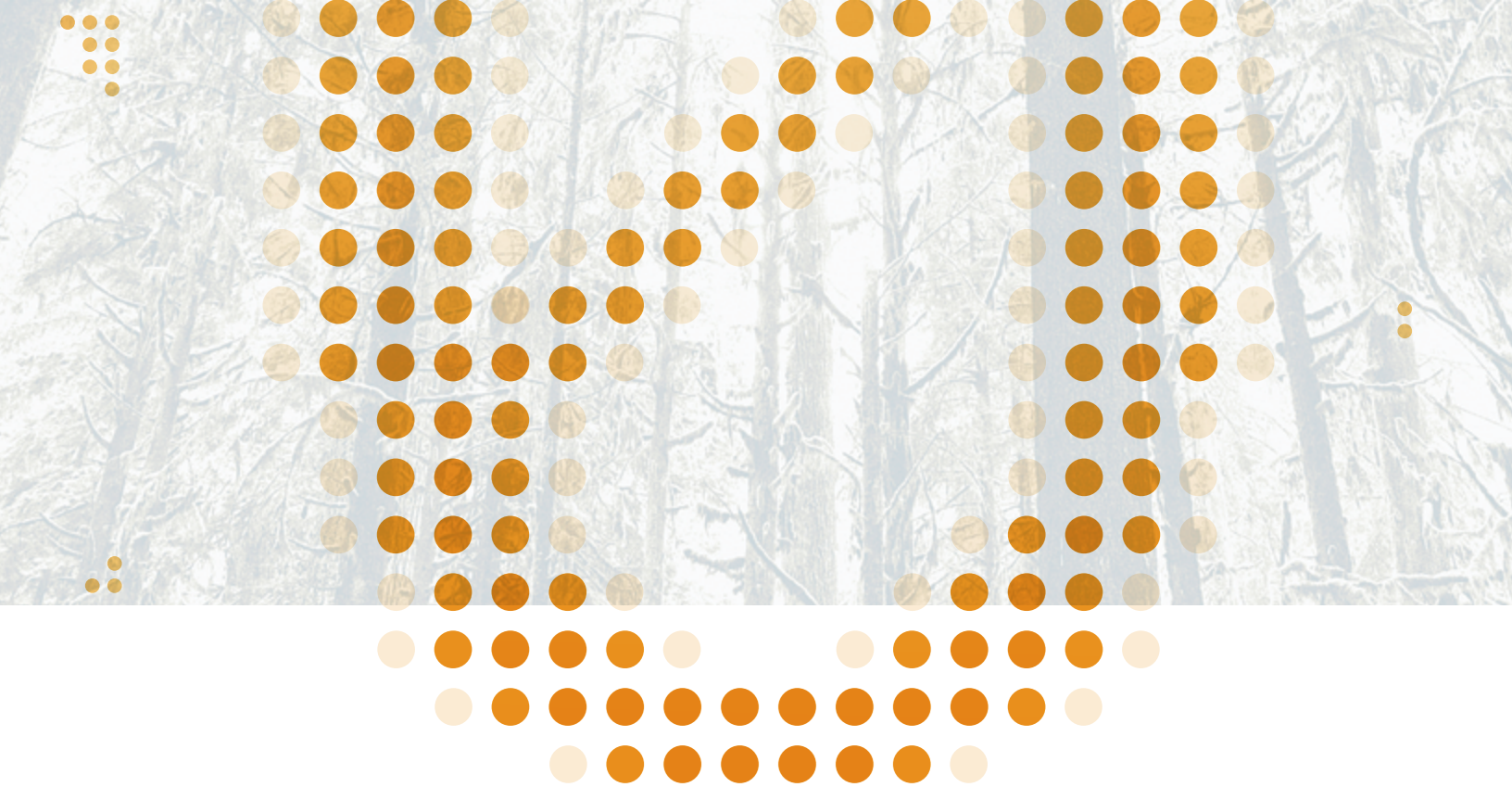
We recognize that there are a number of shortcomings to this initial focus on modelled pathways to net-zero. Many core elements of the values and principles the NZAB has proposed—for instance, fairness and inclusion, and advancing reconciliation with Indigenous peoples—are not well-captured in economic models. This was a point of discussion among members, and featured in some of these early briefings. There is much more work to be done, and we look forward to engaging with a diversity of individuals and organizations over the months and years to come.

Similarly, the NZAB has not yet connected with the numerous groups that have formulated specific policy recommendations in support of net-zero objectives. As we launch into our work to develop substantive policy recommendations, this input will be most welcome.

We are grateful to all of the organizations and individuals listed below that generously shared their time and knowledge with the NZAB during this initial briefing phase.

- Canada Energy Regulator
- Canadian Institute for Climate Choices
- Canadian Centre For Policy Alternatives
- David Suzuki Foundation and University of Victoria
- Haut conseil pour le climat (France)
- Indigenous Clean Energy
- International Energy Agency
- International Institute for Sustainable Development
- McKinsey & Company
- National Academies Of Sciences Engineering And Medicine
- Dr. James Meadowcroft, Carleton University, Transition Accelerator
- Dr. Jesse Jenkins, Princeton University
- UK Climate Change Committee
- Trottier Energy Institute

We also appreciated the opportunity to meet with the Minister of Environment and Climate Change to discuss our mandate and initial deliverables, and to receive briefings from federal officials.



Annex 2

NET-ZERO READING LIST

The reading list that follows sets out some of the reports that informed the NZAB's early net-zero considerations at the beginning of its mandate. It is intended as a starting point, and is in no way comprehensive or complete. It is encouraging how quickly the state of knowledge on net-zero pathways is evolving.

The list of resources in this annex has the same important gaps that were described in Annex 1. It focuses primarily on domestic and international pathways, as well as resources that helped to shape the NZAB's understanding of current net-zero momentum and how to conceptualize net-zero targets. It does not include sector-level or thematic analysis, or resources related to the economic, environmental, social and technological considerations that the NZAB must consider in formulating its advice.

Going forward, we intend to establish a process to collect and review additional net-zero resources and recommendations. This will be important to putting into practice our mandate to act as a platform to integrate recommendations stemming from multiple net-zero policy initiatives.

The following reports were the primary Canadian resources that the NZAB considered to be broad net-zero or deep decarbonisation pathways, as described in Annex 1.

- **Canada's Net-Zero Future: Finding our Way in the Global Transition** (Canadian Institute for Climate Choices, 2021)
- **Pathways to Net-Zero: A Decision Support Tool** (Transition Accelerator, 2021)
- **10 Ways to Win the Global Race to Net-Zero** (International Institute for Sustainable Development, 2021)
- **Canada's Energy Future 2020: Energy Supply and Demand Projections to 2050** (Canadian Energy Regulator, 2020)
- **Zeroing in on Emissions: Canada's Clean Power Pathways** (David Suzuki Foundation, 2019)
- **Canadian Energy Outlook 2018 – Horizon 2050** (Trottier Energy Institute, 2018)
- **Re-Energizing Canada: Pathways to a Low Carbon Future** (Sustainable Dialogues Canada, 2016)
- **Canada's Challenge & Opportunity: Transformations for major reductions in GHG emissions** (Trottier Energy Institute, 2016)
- **Canada's Mid-Century Long-Term Low-Greenhouse Gas Development Strategy** (ECCC, 2016)
- **Pathways to Deep Decarbonization in Canada** (Sustainable Development Solutions Network (SDSN) and Institute for Sustainable Development and International Relations (IDDRI), 2015)

The NZAB also examined other recent Canadian net-zero reports, which contain recommendations on policies or frameworks. Some references to recent reports are included below.

- **Clean Growth 3.0: Achieving Canadian Prosperity in a Net Zero World** (Business Council of Canada, 2021)
- **Engineering Net-Zero** (SNC-Lavalin, 2021)
- **How to Get Net-Zero Right** (Pembina Institute, 2021)
- **Creating Clean Prosperity** (Clean Prosperity, 2020)
- **Building Pathways to a Sustainable Future** (Transition Accelerator, 2019)

At the international level, the NZAB benefitted from the in-depth analysis of net-zero pathways included in the following reports:

Net-Zero by 2050: A Roadmap for the Global Energy Sector
(International Energy Agency, 2021)

Sectoral Pathways to Net-Zero Emissions (Institute for Sustainable Futures, 2021)

Accelerating Decarbonization of the U.S. Energy System
(National Academies of Sciences, Engineering, Medicine, 2021)

Net Zero Europe: Decarbonization pathways and socioeconomic implications
(McKinsey & Company, 2020)

Net-Zero America: Potential Pathways, Infrastructure and Impacts
(Princeton University – Larsen et al, 2020)

Making Mission Possible: Delivering a Net-Zero Economy
(Energy Transition Commission, 2020)

The NZAB also did a preliminary review of some of the **long-term low greenhouse gas emission development strategies** that other jurisdictions submitted to the United Nations Framework Convention on Climate Change (UNFCCC) between 2016 and 2021.

The various reports of other international climate change advisory bodies equally informed the NZAB's early deliberations. Some key resources include:

He Pou a Rangi – the Climate Change Commission (New Zealand)

Net Zero – The UK's contribution to stopping global warming

Rapport Annuel Neutralité Carbone (France)

Finally, to understand the scale of the challenge, status of current efforts to achieve net-zero, and considerations that should inform net-zero targets, the NZAB consulted an initial list of available resources that include the reports below.

NDC Synthesis Report (UNFCCC Secretariat, 2021)

Climate Math: What a 1.5 Degree Pathway Would Take (McKinsey & Company, 2020)

Taking Stock: A global Assessment of Net Zero Targets (Energy & Climate Intelligence Unit, 2021)

Critical Junctions on the Journey to 1.5°C: The Decisive Decade (Climate Strategies, 2021)

Net-Zero Emissions Targets are Vague: Three Ways to Fix (Rogelj et al, Nature, 2021)

State of Climate Action: Assessing Progress toward 2030 and 2050 (World Resources Institute, 2020)

Accelerating Net Zero: Exploring Cities, Regions, and Companies' Pledges to Decarbonise (New Climate Institute, 2020)

The Net-Zero Challenge: Fast-Forward to Decisive Climate Action (World Economic Forum, 2020)

Navigating the Nuances of Net-Zero Targets (Data-Driven EnviroLab & New Climate Institute, 2020)

The Net-Zero Challenge: Global Climate Action at a Crossroads (Part 1) (World Economic Forum, 2019)

Uncertainty, Scenario Analysis, and Long-Term Strategies: State of Play and a Way Forward (World Resources Institute, 2019)

Special Report: Global Warming of 1.5°C (IPCC, 2018)


Net-Zero
Advisory Body

Net-Zero
Advisory Body