



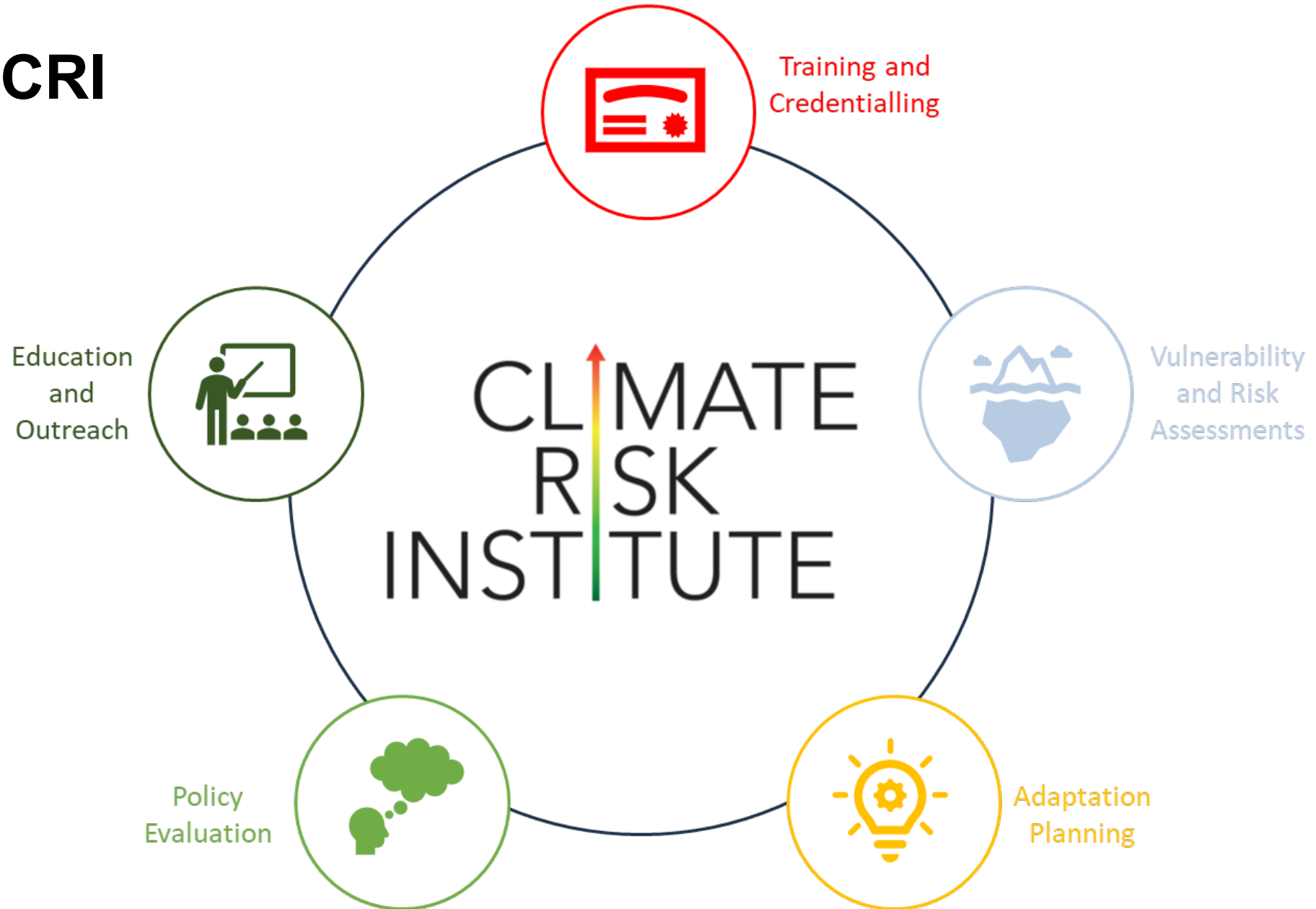
Durham Regional workshop

April 2024

Al Douglas, Paul Cobb, Alex Ho



About CRI





Part I - Climate Adaptation 101

Reflection Questions

- What are your highest priorities in the short-term for your constituents, communities and the region?
- What are your priorities for longer term social, economic, environmental well-being of the community?
- Will the impacts of **changing climate** threaten your ability to achieve those objectives or to make progress on those priorities? How?

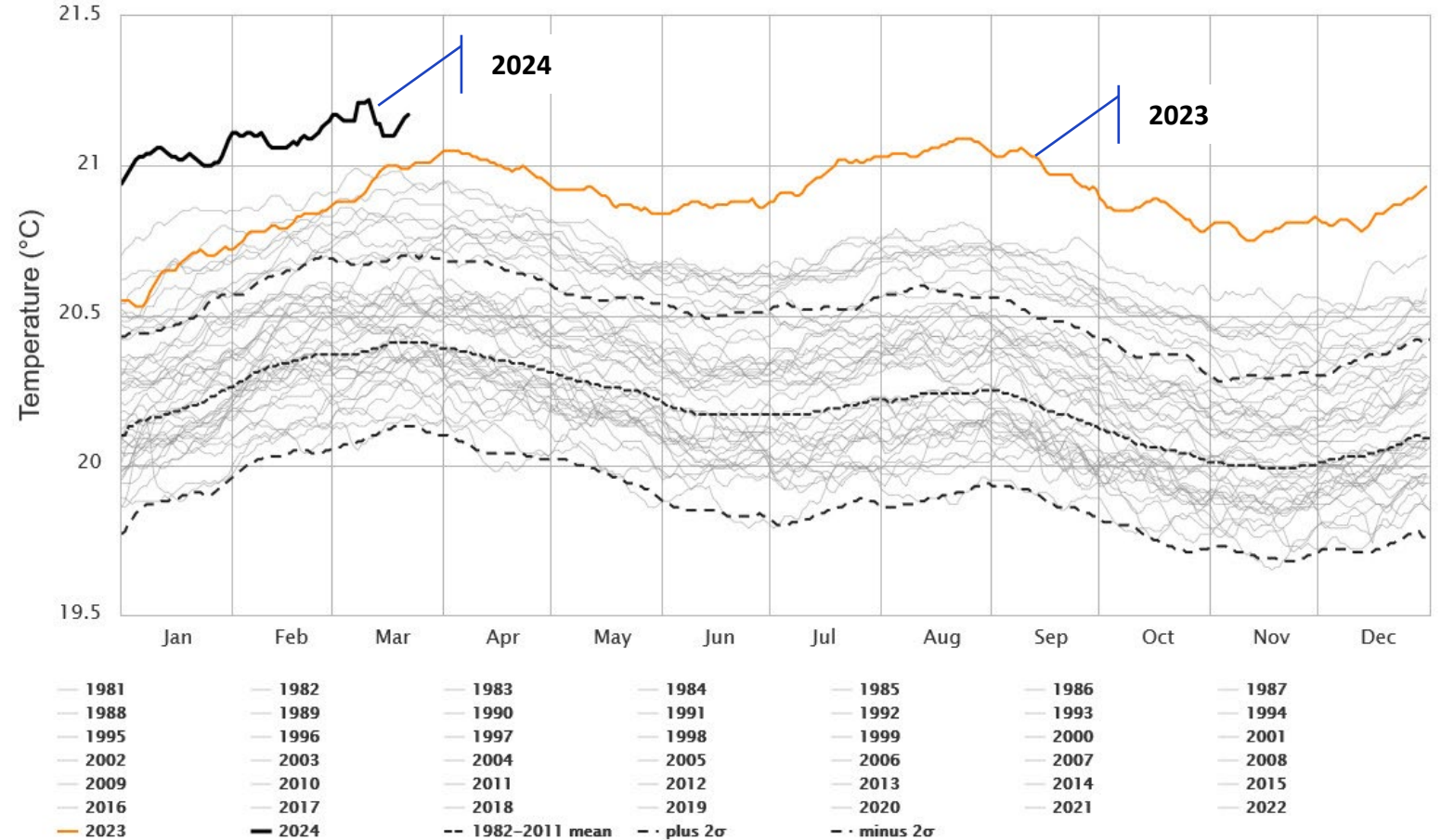


Climate Shift

- **Every single day** for the past 12+ months as broken previous record for global temperature.
- This winter of 2023-2024 was **5°C** warmer than historical average across Canada.
- Analysis shows majority extreme weather events made more likely, more severe by climate change.
- Increases in temperature **correspond** to increases climate impacts.

Daily Sea Surface Temperature, World (60°S–60°N, 0–360°E)

Dataset: NOAA OISST V2.1 | Image Credit: ClimateReanalyzer.org, Climate Change Institute, University of Maine



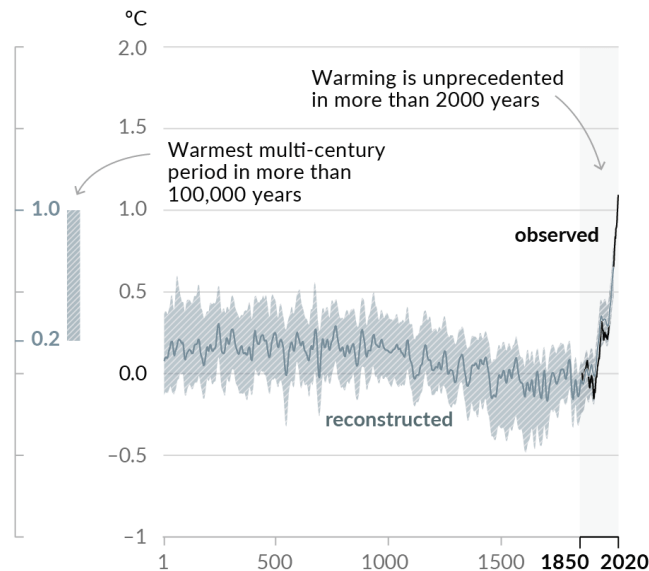
Driving Climate Change

- Warming trends have been **observed** (measured).
- These observed changes have no precedent.
- Observed and projected changes can only be explained by human activity.

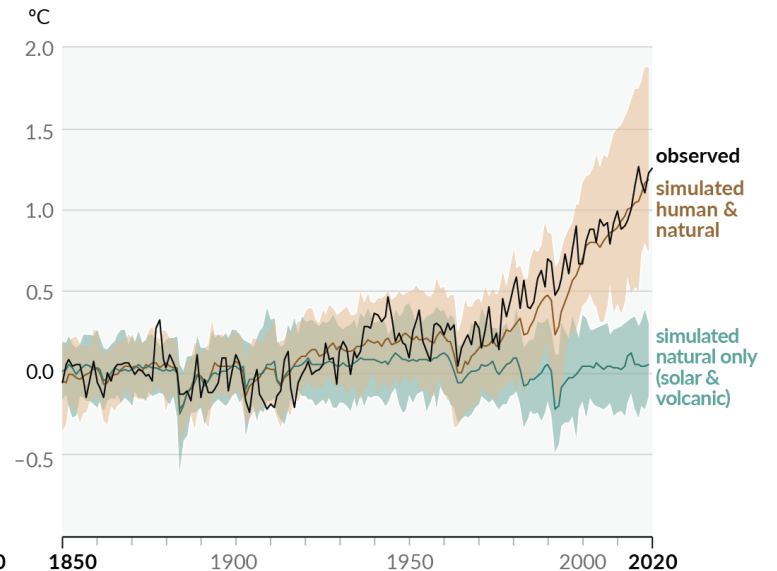
Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850–1900

(a) Change in global surface temperature (decadal average) as **reconstructed** (1–2000) and **observed** (1850–2020)



(b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850–2020)



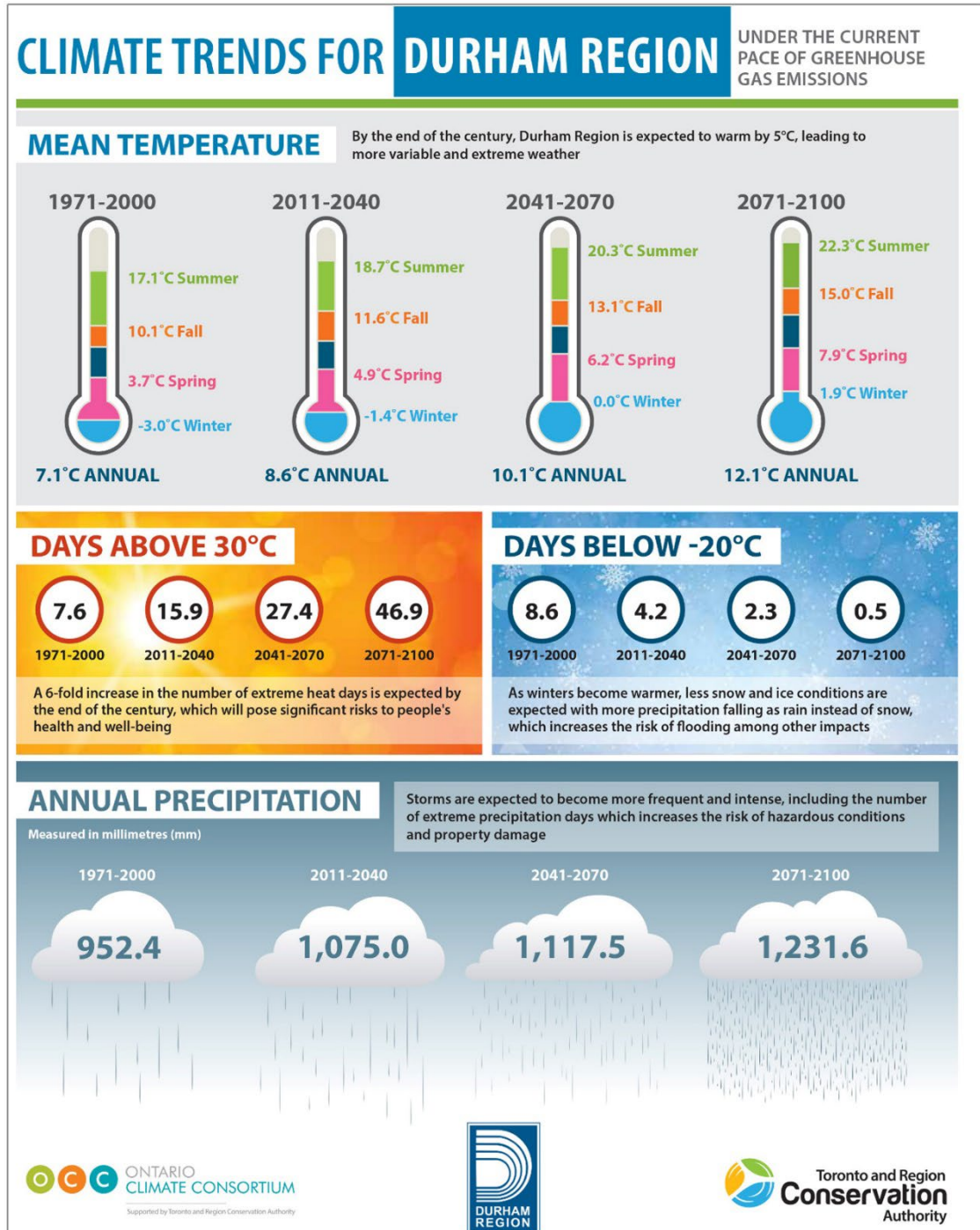
Canada's Changing Climate Key Findings



- Canada has already **warmed** and will continue to warm.
- Warming in Canada is about double the global rate
- The effects of widespread warming are evident, are projected to intensify.
- Total **precipitation** is projected to increase on average, with decrease in snowfall and increase in rain. Summer rainfalls may decrease in some areas.
- The seasonal availability of **freshwater** is changing, with an increased risk of water supply shortages in summer.
- Weather extremes are expected to intensify in the future.
- The oceans are warming, becoming more acidic, and are deoxygenating.
- The rate and magnitude of climate change under high versus low emission scenarios project **two very different futures** for Canada.

Climate in the Durham Region: Trends and Projections

- **6-fold** increase in days above 30C by later century.
- Fewer cold days.
- Precipitation:
 - Total annual precipitation increases
 - Less snow and more rain in winter
 - Storms more frequent, more intense
 - Number of extreme precipitation events increase.



Climate Events: Canadian Context

Flooding in Southern Alberta, 2013
[Thompson, J. \(2013\) via Canadian Geographic](#)



How climate change fits into Calgary's record flood

JUN 23, 2013 | 595 WORDS | 3 MINUTES

BY JIMMY THOMSON



Extreme heat cooked mussels, clams and other shellfish alive on beaches in Western Canada

By David Williams, CNN
 4 minute read · Updated 3:07 PM EDT, Mon July 12, 2021



"It was a catastrophe over there," he said. "There's a really extensive mussel bed that coats the shore and most of those animals had died."

Unprecedented heat

Mussels attach themselves to rocks and other surfaces and are used to

[...]

generally can't survive temperatures over 200 degrees for very long.

found that the heat wave "would have been virtually impossible without the influence of human-caused climate change."

It was also incredibly dangerous.

Lytton, British Columbia, broke Canada's all-time record on June 30 when the temperature topped 121 degrees. The town was all but destroyed in a deadly wildfire.

There were 719 deaths reported to the province's coroners between June 25 and July 1 - three times as many as would normally occur during that time period, according to a statement from Lisa Lapointe, British Columbia's chief coroner. Hundreds of people died in the US and many had to be hospitalized because of the heat.

WORLD & NATION

Canadian wildfire smoke spreads hazardous haze through northeastern U.S.

[Peltz, J. & Gillies, R. \(2023\), via LA Times.](#)



PEI

Fiona reshaped P.E.I.'s coastlines, stoking fears for the Island's future

Federal minister says these atmospheric events are directly linked to climate change



[Goodsell, D. \(2023\), via CBC](#)
[The Coastie Initiative, 2023 \(via CBC\);](#)
[Hennessey, S. \(2023\) \(via CBC\)](#)

Extreme heatwaves in British Columbia, Summer 2021
[\(Williams, D. \(2021\), via CNN\)](#)

Images: Jacobson, J. / Associated Press (2023);
[Canadian Forces/CPL Marc-Andre Leclerc/Canadian Forces via Reuters](#) via ABC News

Climate Events – Durham Region Impacts

NEWS

'High levels of air pollution': Durham air to be affected by wildfire smoke

Durham Region is going to be affected for the next several days by smoke from the wildfires in northern Ontario and Quebec

AJAX News Advertiser. By Ajax News Advertiser
 Tuesday, June 27, 2023 | 1 min to read

DurhamRegion.com, 2023



NEWS

Environment Canada puts Ajax and Pickering as well as Oshawa and Whitby under special weather statement Jan. 25-26 warning of 'hazard' for residents

Drivers and pedestrians being put on alert

By **Louie Rosella** Durhamregioncom
 Thursday, January 25, 2024 | 1 min to read

The air quality in Durham Region will be affected for the next several days by smoke from the wildfires in northern Ontario and Quebec.

Air Quality Ontario (AQO) issued a statement, noting, "High levels of smoke are expected to develop tonight (Tuesday, June 27) due to smoke from forest fires."

"Smoke plumes from forest fires over northeastern Ontario and Quebec are expected to move into the area overnight tonight, resulting in deteriorated air quality in some areas Friday," the agency added.

The agency noted that the smoke will cover an area from Kingston to Niagara area.

"Air quality and visibility due to wildfire smoke can fluctuate over the course of the day and can vary considerably from hour to hour," it said.

The AQO said the wildfire smoke can be harmful to everyone's health, especially for people with lung disease, older adults, and pregnant women. People should take action to reduce their exposure to the smoke.

"People with lung disease (such as asthma) or heart disease, older adults, pregnant people, and people who work outdoors are at higher risk of health effects caused by wildfire smoke. Speak with your health care provider about developing a management plan for wildfire smoke events, maintaining necessary medications at home, and always carrying these medications during wildfire season," the agency noted.

Anyone engaged in activity should stop or reduce what they are doing if breathing becomes uncomfortable, the AQO added.

TORONTO | News

Heat wave moving through southern Ontario

A heat warning is now in effect for Toronto and parts of the Greater Toronto Area, as the air quality in the region deteriorates.

At around 2 p.m., **Environment Canada said a two-day heat wave will start Thursday**, with daytime temperatures expected to be near 30 C today through Friday.

The heat warning impacts southern parts of the province – including Hamilton, Vaughan, Pickering, Halton and Peel regions – and most of northeastern Ontario.

On Wednesday morning, at around 10:15 a.m., **Environment Canada issued a special air quality statement, saying the air quality could pose a moderate risk** to people in the area with the **potential of increasing to high risk** later in the day. Just before 10 p.m., the air quality statement ended.

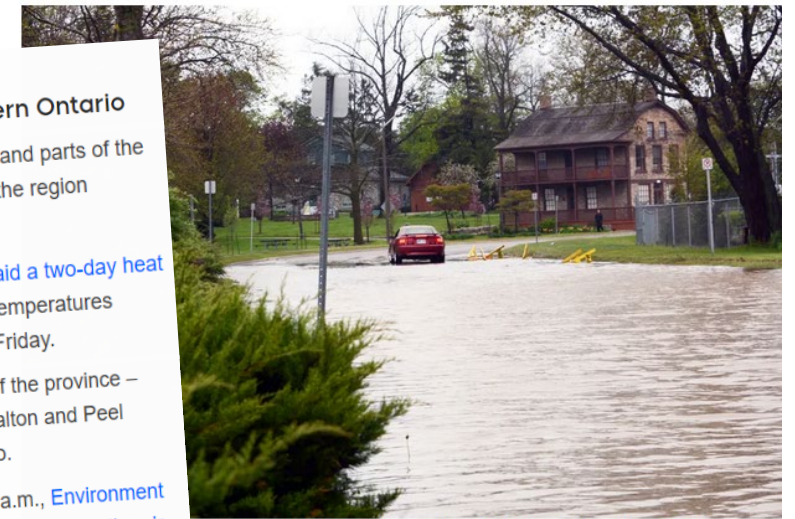
The federal agency says the "hot and humid weather conditions" can lead to elevated levels of air pollution.

The statement is in effect for Toronto, Mississauga, Brampton, Vaughan, Richmond Hill, Markham, Halton Hills, Milton, Burlington, Oakville, Pickering, Oshawa, Newmarket, Georgina, southern Durham Region and northern York Region.

Flooding continues across Durham

CLOCA warns to avoid bluff areas as erosion continues

Posted on May 31, 2017 by oshawaexpress in NEWS

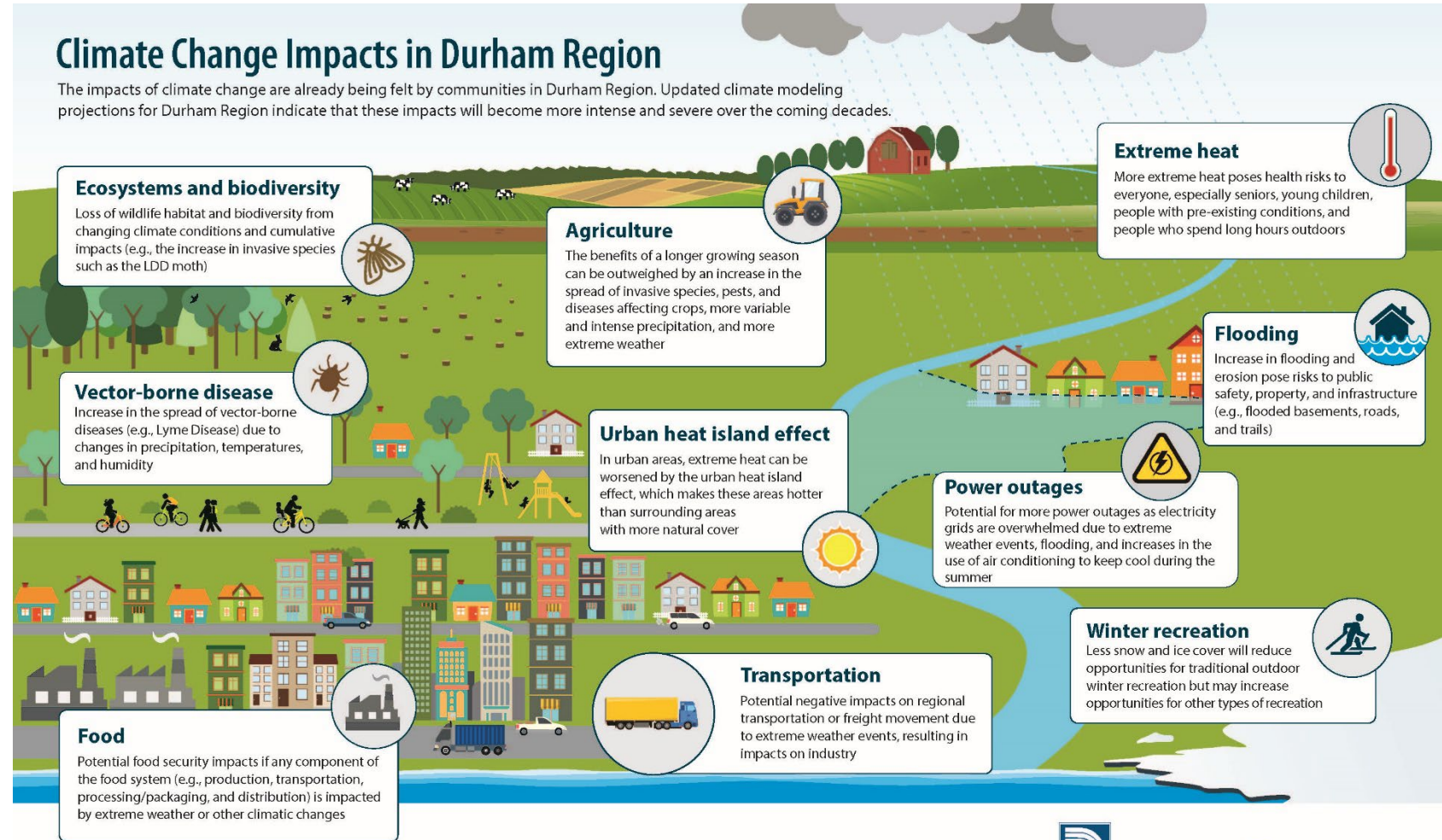


Beaches South at Lakeview Park were closed, including the beach parking lot as water levels rose. The high water levels are causing flooding and erosion across Durham Region, putting at risk to cause safety concerns along the lake's bluffs. (Photos by Joel)

Oshawa Express

Climate Impacts in Durham Region

- **Documented** impacts throughout the Durham region have been observed and reported and summarized.
- **Including:** Agriculture, Heat, Food Security, Recreation, Flooding, Biodiversity.



Increasing Flood Risk

Floods are the costliest type of natural disaster in Canada. Severity and frequency have both increased due to:

- More long-duration heavy precipitation events
- More short-duration intense storms
- Shifting spring snowmelt regimes
- Increasing rain-on-snow events
- Sea level rise
- Changes in coastal dynamics e.g. storm surge, extreme high-water-level events, waves, high tide

Predominant and secondary flooding hazards in Canada



Source: Marsh, 2023

Acute vs Chronic Climate Impacts

Acute climate events / hazards

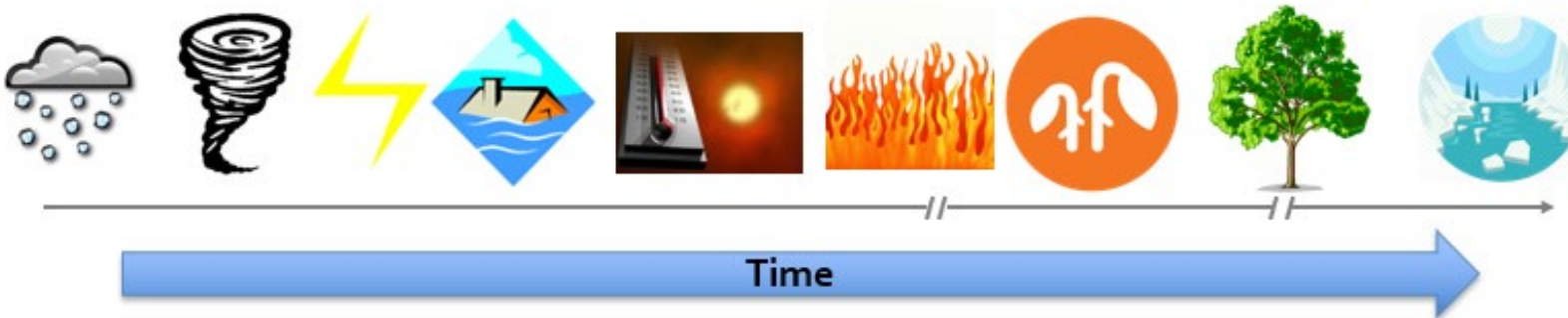


Changing in frequency/intensity due to climate change

Chronic climate stresses

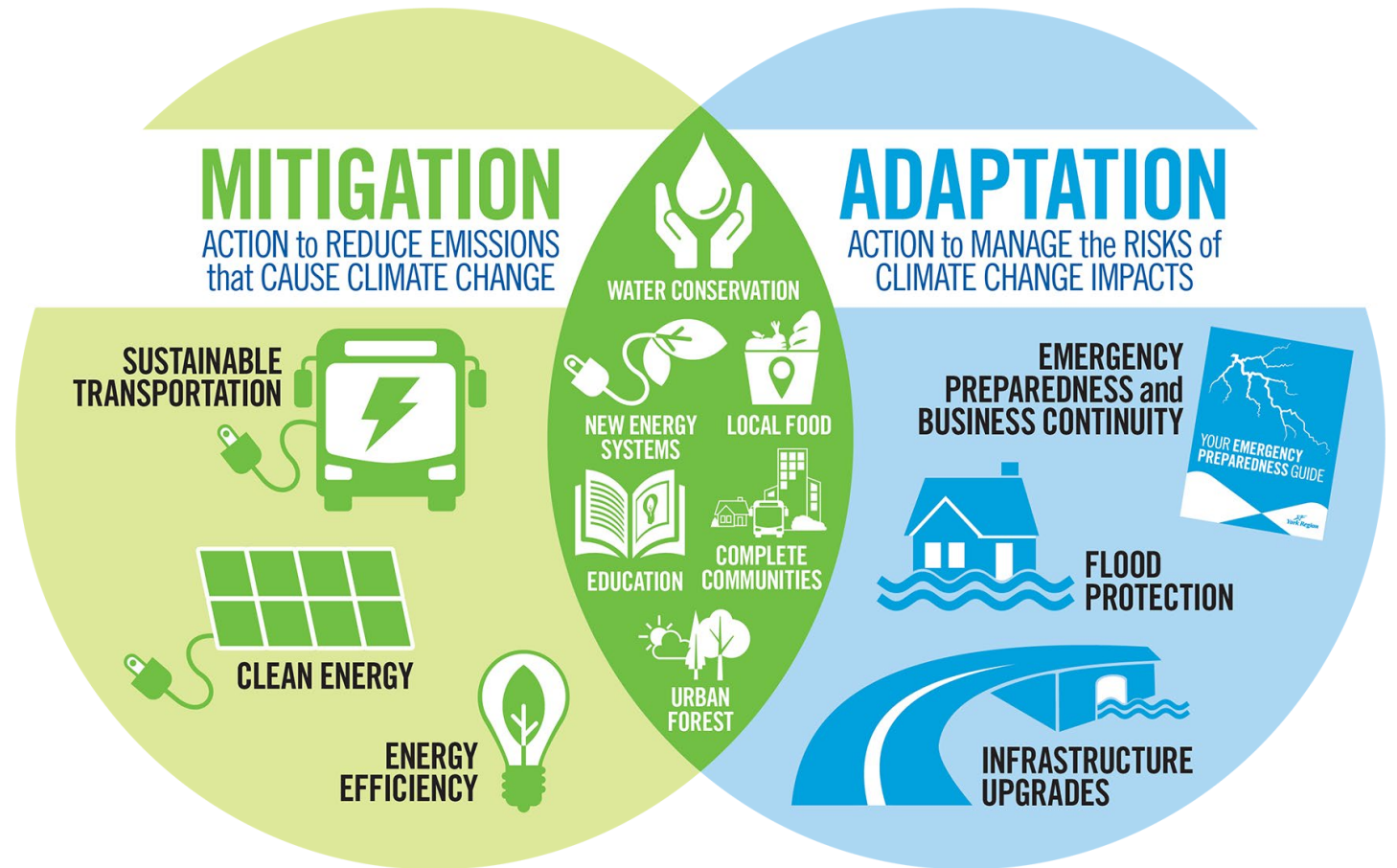


Driven solely by climate change



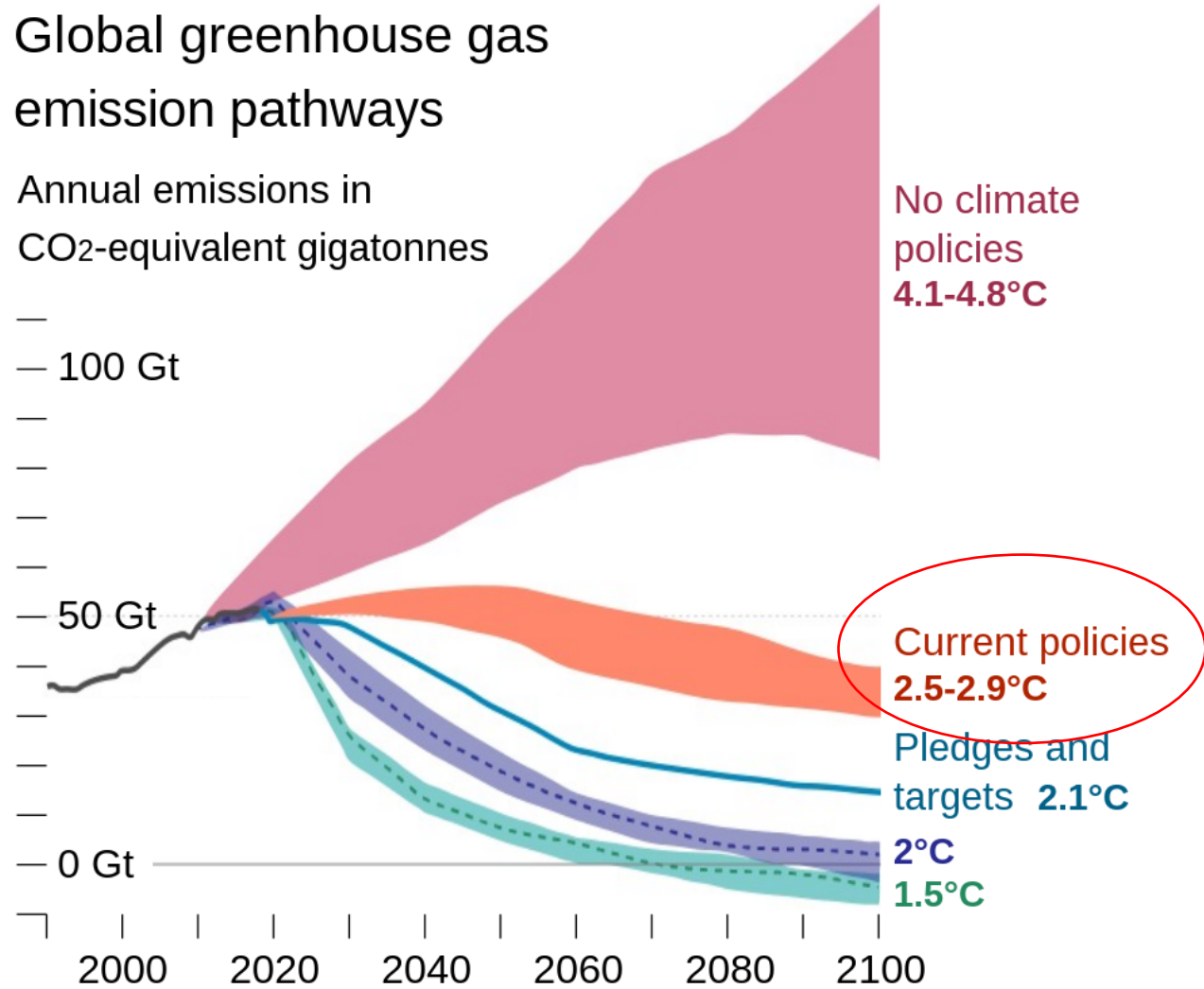
Responses to climate crisis

“Adaptation measures reduce risks from climate impacts but efforts will be **overwhelmed** by increasingly extreme weather events unless combined with **aggressive mitigation efforts** to curb global warming.” - IPCC



Source: York Region (2022)

Where Are We? Where Are We Going?



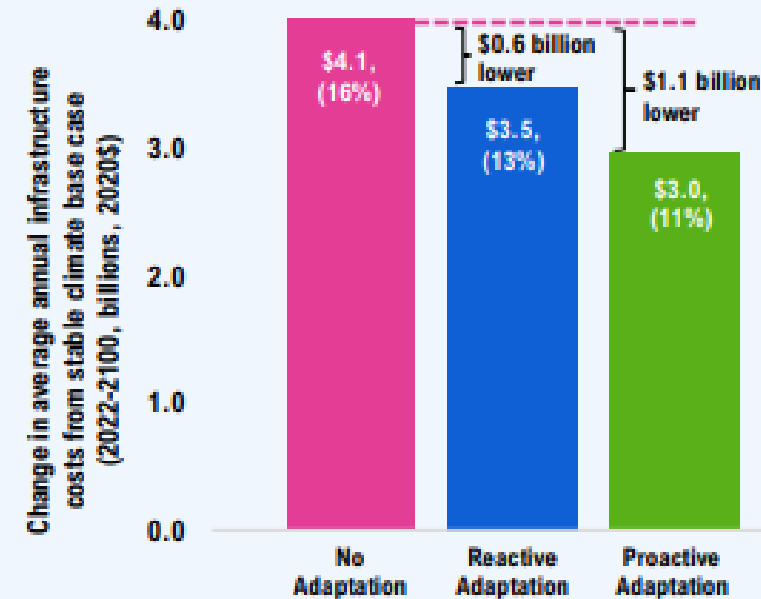
- Global temperatures have already increased by 1.3°C.
- With **current policies** global temperatures will increase by 2.7°C by end of century.
- → Some **progress** compared to where we were 10-15 years ago
- However, we are experiencing significant impacts already – at “only” 1.3°C warming.
- Climate hazards and risks are **amplified** with each tenth of a degree warming.
- Adaptation is recognizing and preparing for these impacts.

Financial Benefits of Adaptation

- Climate change will increase public infrastructure costs – risk assessment and adaptation can provide financial value to municipal and regional governments.
- **Proactive adaptation efforts** – reduces risk of infrastructure damage and service disruption at the lowest cost.
- Municipalities will incur **4x greater** climate costs to infrastructure than the province will.

Figure 1-2

Adaptation can lower infrastructure costs



Note: Values represent the median projection of the medium emissions scenario. Uncertainty bands are omitted from this figure for clarity of presentation (see [Accounting for uncertainty](#)).
Source: FAO.



Source:
Financial
Accountability
Office of
Ontario (FAO),
2023

2023

More Evidence of Cost-Benefit?

Investing \$1 in prevention results in avoided costs of...

\$4

from investments in improved resilience

Source: [Global Commission on Adaptation](#)

\$5

from governments' climate resilience investments

Source: [The Economist](#)

\$6

from hazard mitigation investments

Source: [US National Institute of Building Sciences](#)

\$6

from disaster mitigation investments

Source: [Federation of Canadian Municipalities](#)

\$13-15

from economy-wide direct and indirect benefits

Source: [Damage Control; Canadian Climate Institute](#)

\$40

related to the (prevented!) 1997 Winnipeg flood alone

Source: [Government of Manitoba](#)

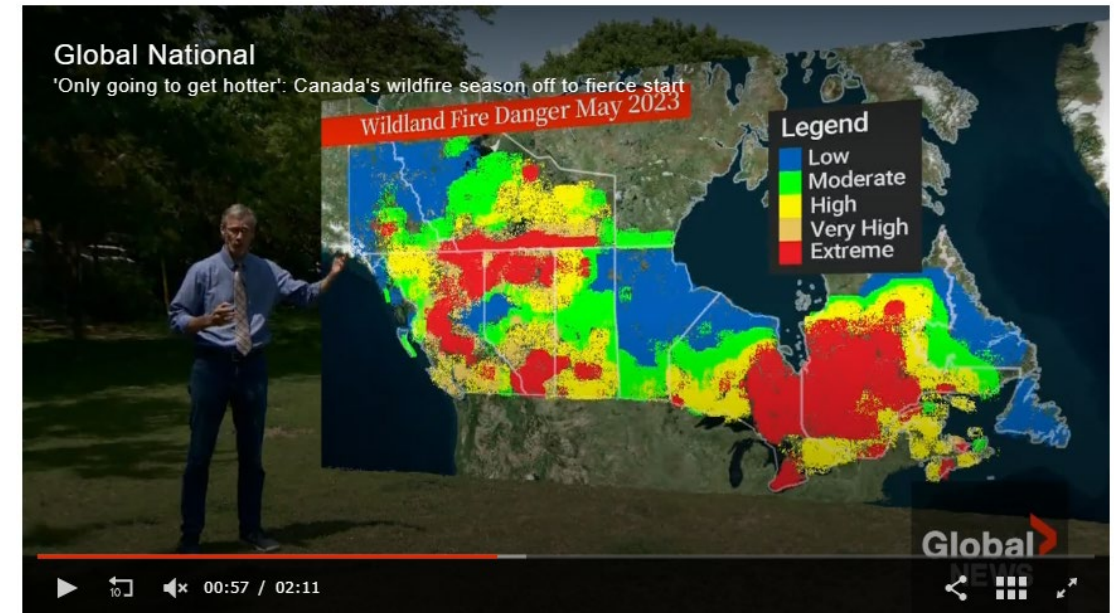
Climate Change and Cost Of Living

- "Climate-related **damages increase the average household's cost of living by \$700 each year** - in the form of higher grocery bills due to supply-chain disruptions, to rising home insurance premiums and tax hikes to pay for disaster recovery and infrastructure repairs."
- Climate damage to production and disruption to supply chain "very significant" impact on **food prices** already; "heatflation" could add another 3% per year to currently over next decade.
- Home **insurance costs** rising as insurance companies respond to increase in catastrophic events.
- Overall, climate damages slowing economic growth and costing jobs.

Insurance costs rising as 'catastrophic events' become the norm

By Rosa Saba • The Canadian Press

Posted June 2, 2023 11:45 am · Updated June 2, 2023 2:18 pm · 4 min read



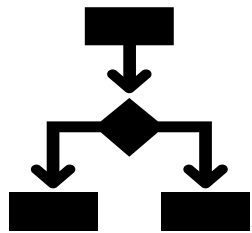
WATCH ABOVE: 'Only going to get hotter': Canada's wildfire season off to fierce start – May 31, 2023

What Can 'Adapting' Look Like?

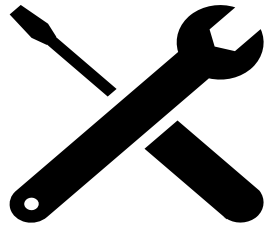
- Climate change has impacts and interdependencies between systems, including infrastructure systems.
- Variety of adaptation types
- Adaptation solutions can be diverse and overlapping



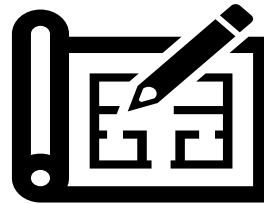
Policy



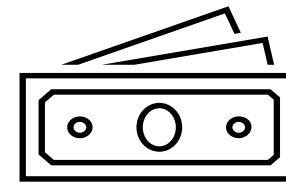
Procedures



**Physical
Interventions**



Planning



**Financial
Mechanisms**

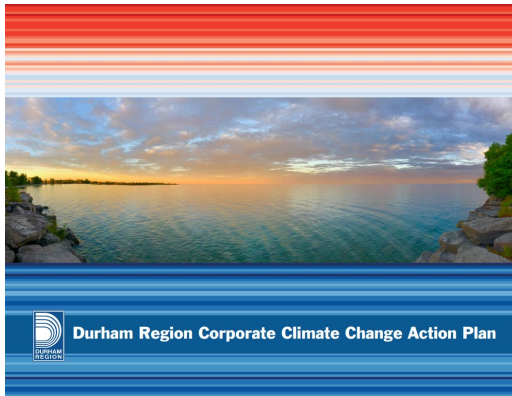


**Additional
Monitoring**

Adaptation and Resilience Initiatives in Durham Region



Flood Ready
Durham



Durham Region
Corporate Climate
Change Action Plan

If this information is required in an accessible format, please contact 1-800-372-1102 ext. 3803



The Regional Municipality of Durham
Report

To: Finance and Administration Committee
From: Chief Administrative Officer
Report: #2020-A-14
Date: June 3, 2020

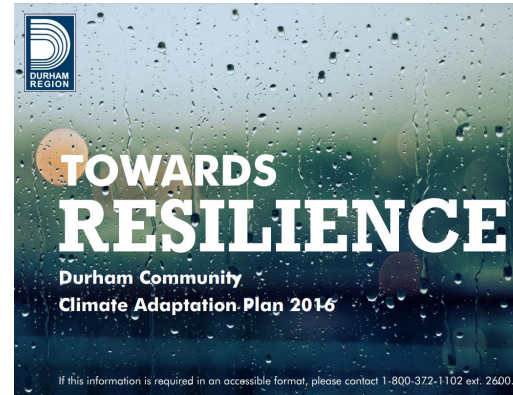
Subject:
Climate Mitigation and Environmental Initiatives Reserve Fund Investment Plan

Recommendations:

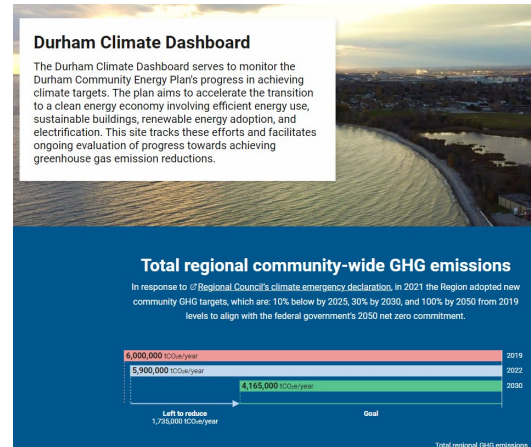
- A) That Regional Council approve general allocations in the total amount of \$5.0 million from the Climate Mitigation and Environmental Initiatives Reserve Fund to the priority project categories outlined as follows:
 - i) High-performance new buildings (Regional portfolio) - \$1.5 million
 - ii) Deep energy retrofits of existing buildings (Regional portfolio) - \$2.5 million
 - iii) Deep energy retrofits of existing buildings (Community-wide) - \$350,000
 - iv) Region-wide nature-based climate solutions - \$500,000
 - v) Adaptation vulnerability and risk assessments - \$150,000
- B) That Chief Administrative Officer and Commissioner of Finance be authorized to determine specific project funding allocations within the recommended allocation of \$5.0 million using the outcome-based principles described in this report.

Project	Estimated Investment (\$M)
High performance new buildings (Regional Portfolio) – incremental additional investment to meet net zero energy performance in new corporate facilities	\$1,500,000
Deep energy retrofits of existing corporate facilities (Regional Portfolio) – rooftop solar, energy audits, social housing retrofits	\$2,500,000
Deep energy retrofits of existing community buildings (Community-wide) – launch of Durham Home Energy Savings Program	\$350,000
Region-wide nature-based climate solutions program – enhance tree planting and stewardship programs in partnership with Conservation Authorities and non-profit partners (e.g. Forests Ontario, Highway of Heroes Tree Campaign)	\$500,000
Adaptation studies – urban flood risk vulnerability assessment and public health climate vulnerability assessment	\$150,000
Total Projects Budget	\$5,000,000

Climate Mitigation and
Environmental Initiatives Reserve
Fund Investment Plan
(\$500,000 for adaptation and
vulnerability assessments)



Community
Adaptation Plan 2016



Durham Climate
Dashboard

AJAX WATERFRONT EROSION MITIGATION PROJECT

HOME » CONSERVATION » EROSION RISK MANAGEMENT » ACTIVE PROJECTS » AJAX WATERFRONT EROSION MITIGATION PROJECT

SHARE:

Toronto and Region Conservation Authority (TRCA), in partnership with the Town of Ajax, is undertaking a flood and erosion control project along the Ajax Waterfront.



Aerial view of the Ajax Waterfront. Source: TRCA, 2021

TCRA – Ajax
Waterfront
Erosion Control



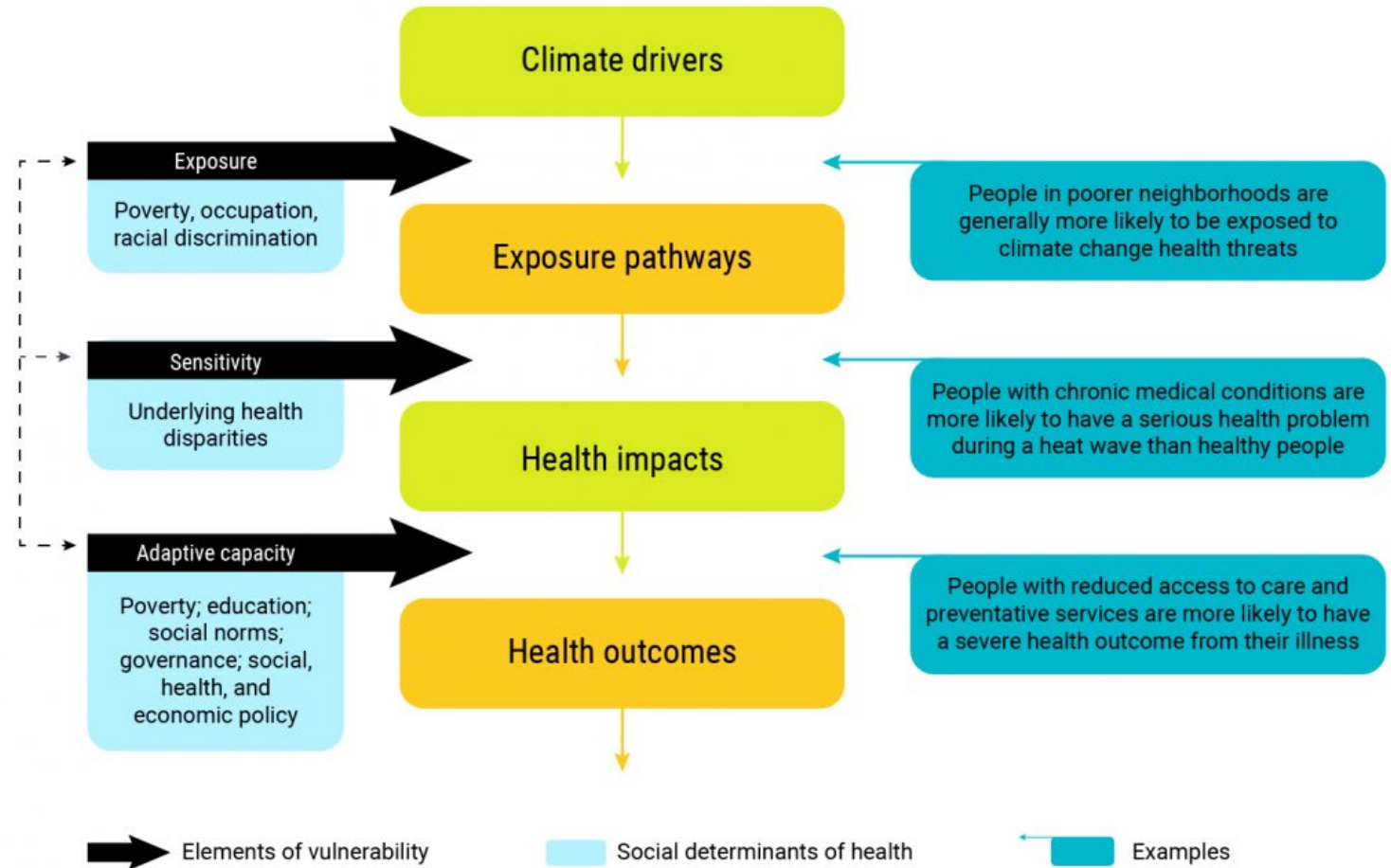
Durham Climate
Roundtable

Durham Climate Roundtable is a leadership body of public and private-sector representatives working together to strengthen climate action in a collective effort to decarbonize to net zero by 2050.

Durham Climate
Roundtable

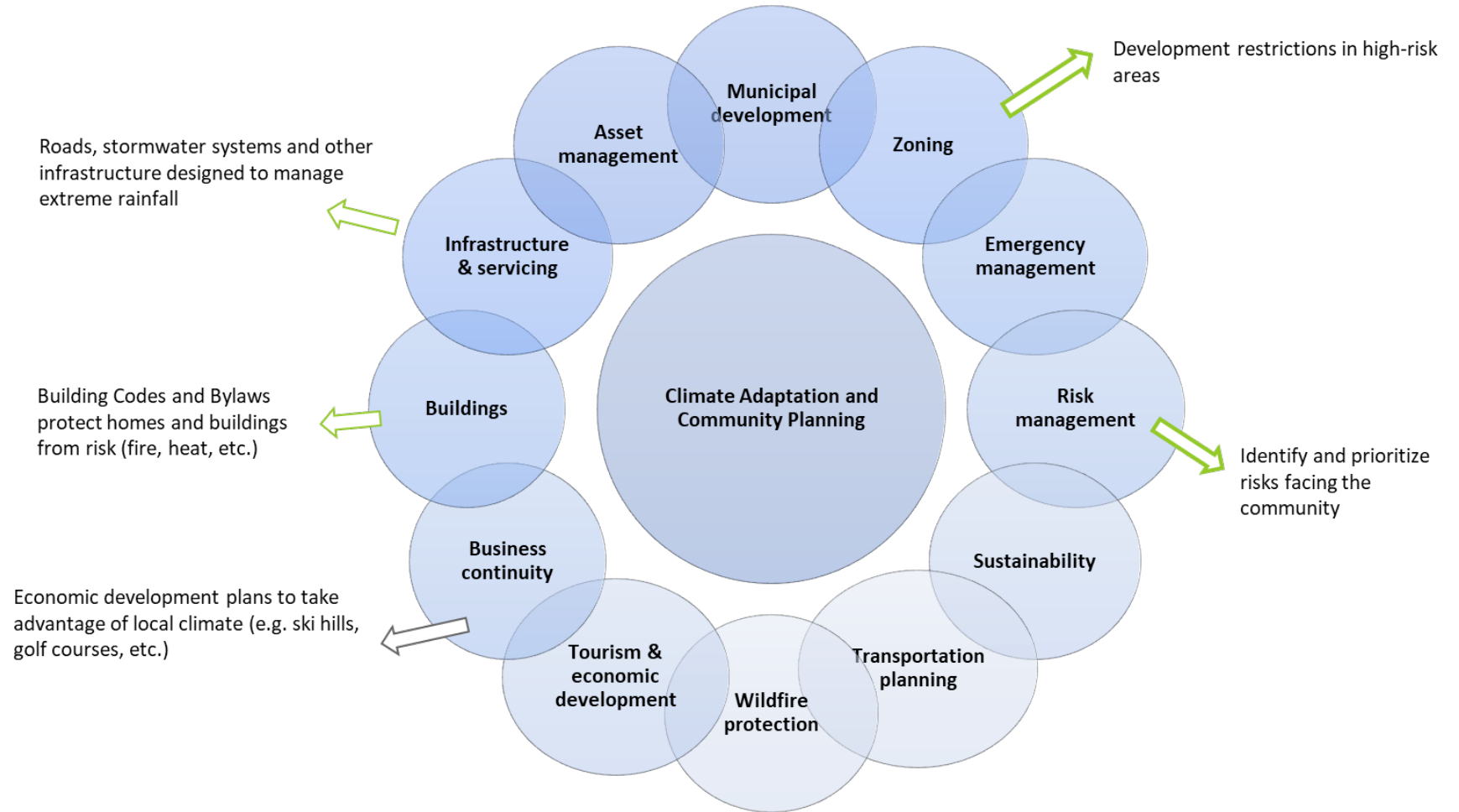
Adaptation Addresses Equity

- Addressing environmental, social and economic factors essential for increasing resilience – for all types of impacts and climate hazards.
- Apply equity lens to risk assessment and adaptation design.
- **Example (figure):** Health, equity and justice interact with climate, influencing health outcomes within a community.



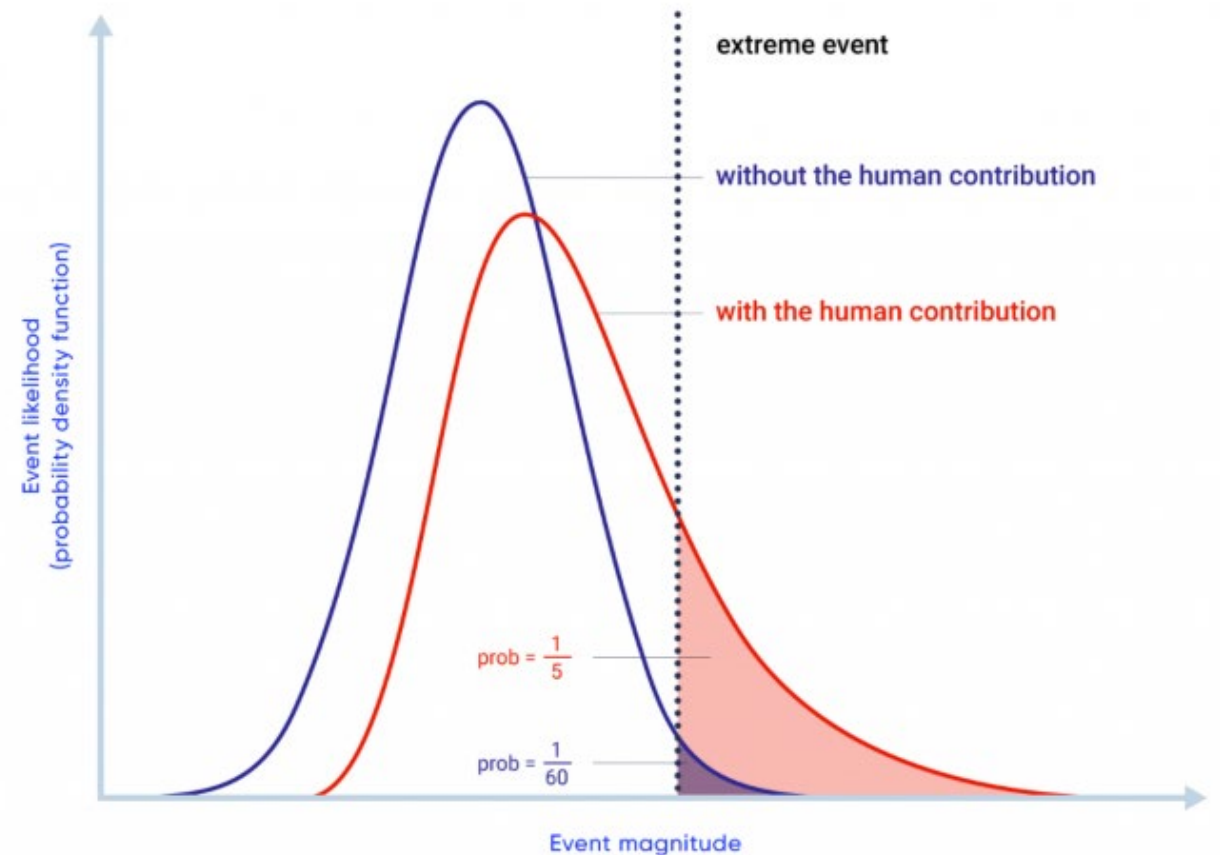
How Climate Intersects With Local Issues

- Adaptation to climate change can be coordinated through municipal or regional adaptation or climate plans.
- *However,* need to engage across all departments for buy-in and implementation.



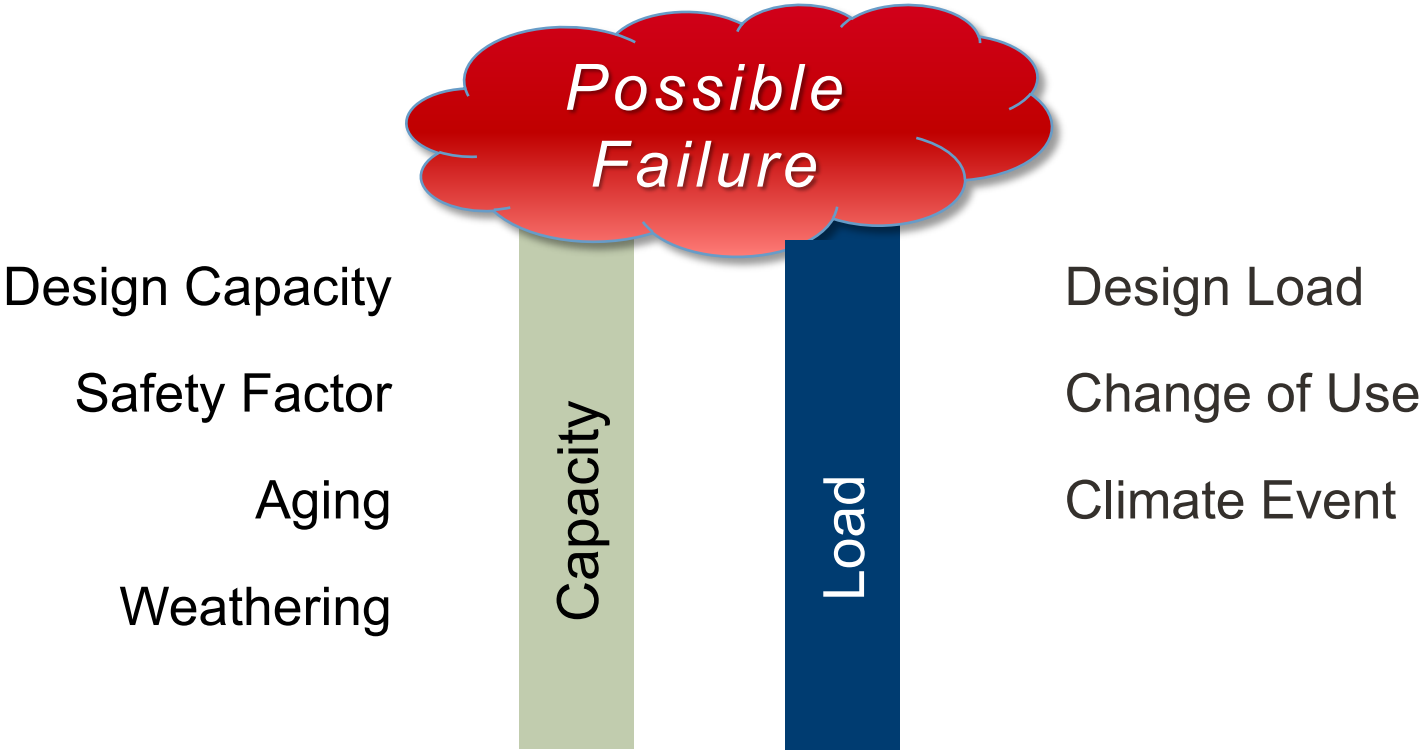
Changing Mean → Changing Extremes

- Frequency and intensity of extreme weather events has been increasing and this trend is expected to continue.
- A lot of research focuses on anthropogenic influences on the probability of particular weather events, as well as their strength and intensity.

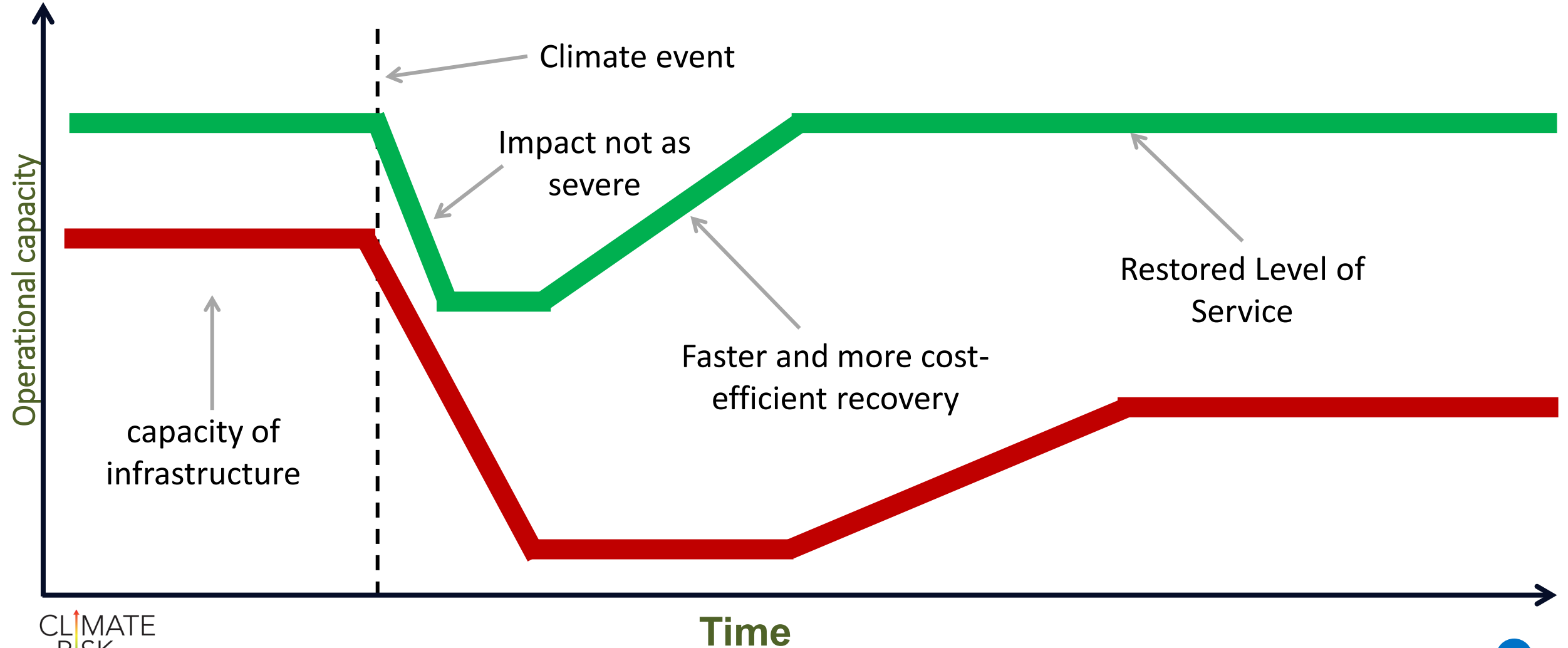


Source: Canada's Changing Climate Report, 2019

Small Changes → Catastrophic Failure



Unprepared vs Resilient Infrastructure Systems



Infrastructure Interdependencies

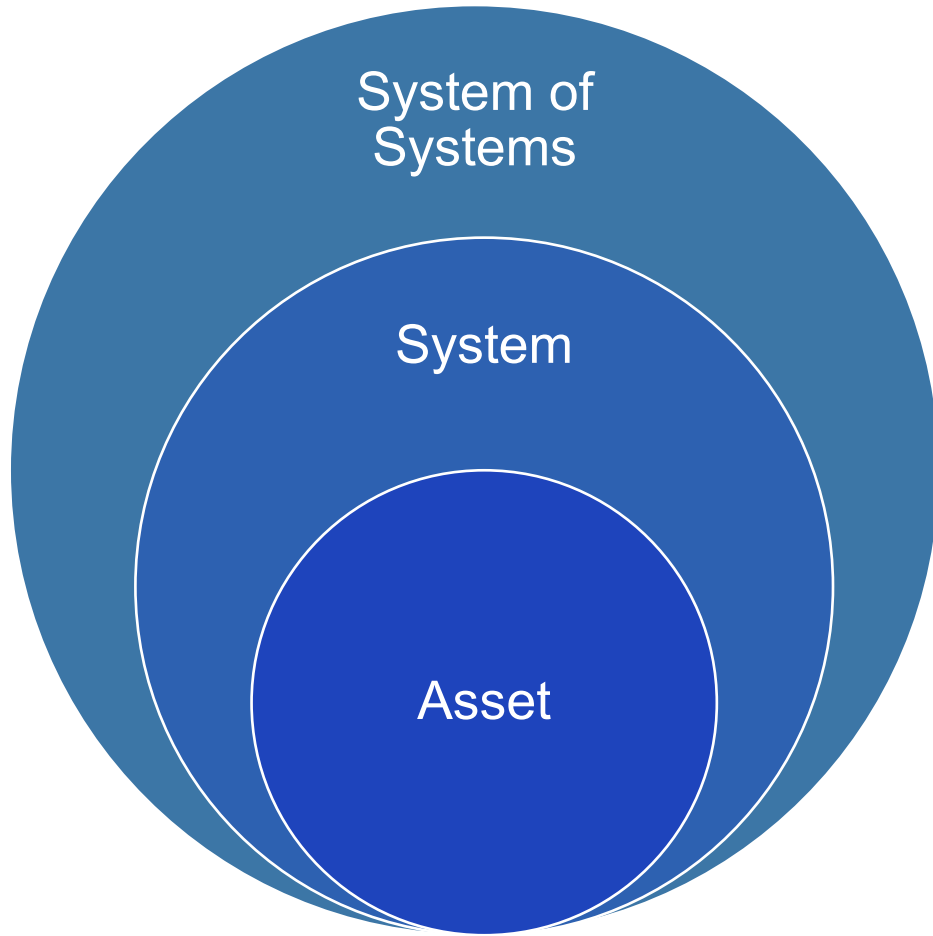
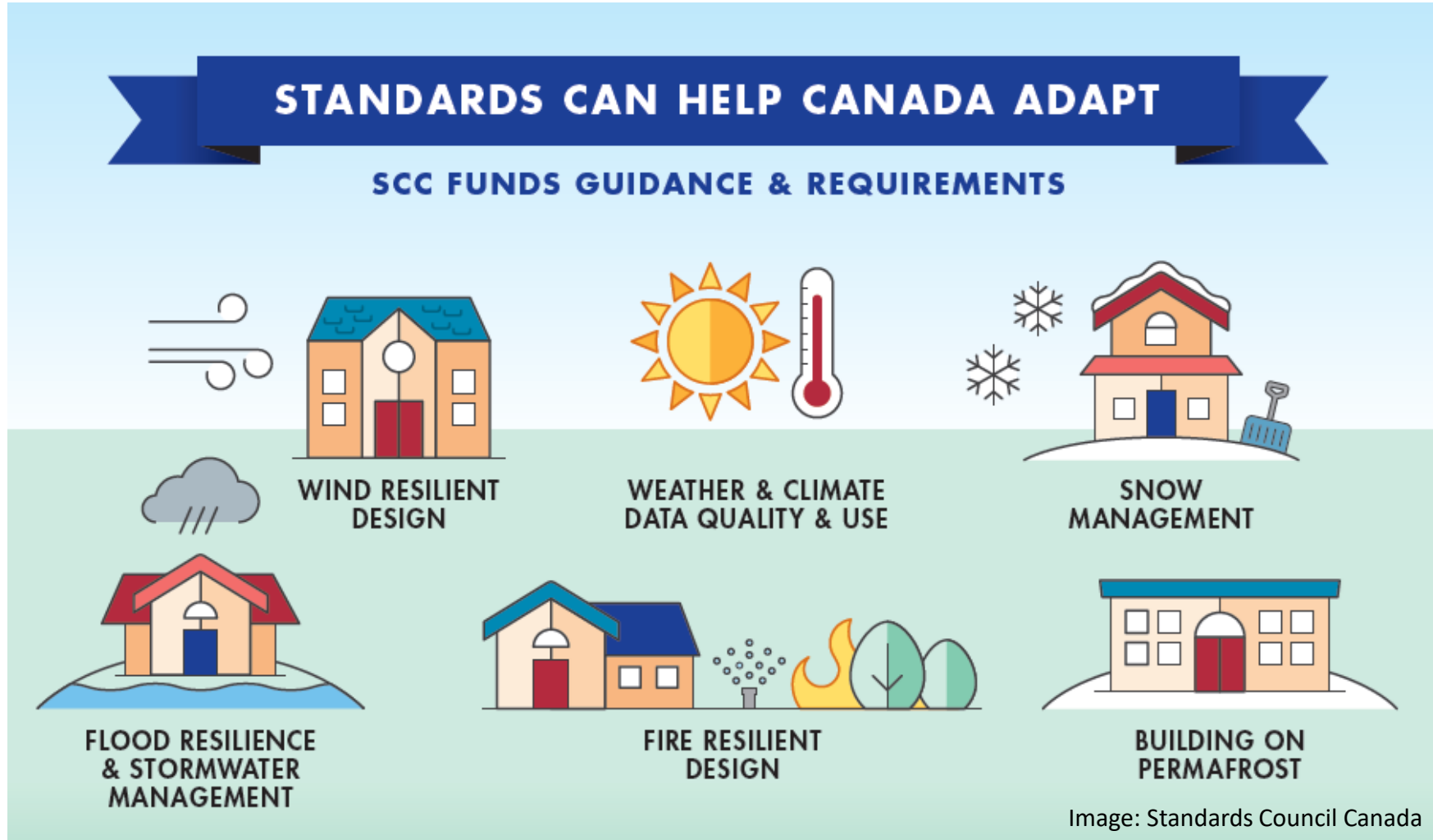


Photo source: CBC.ca (Ottawa)

Codes and Standards



Infrastructure

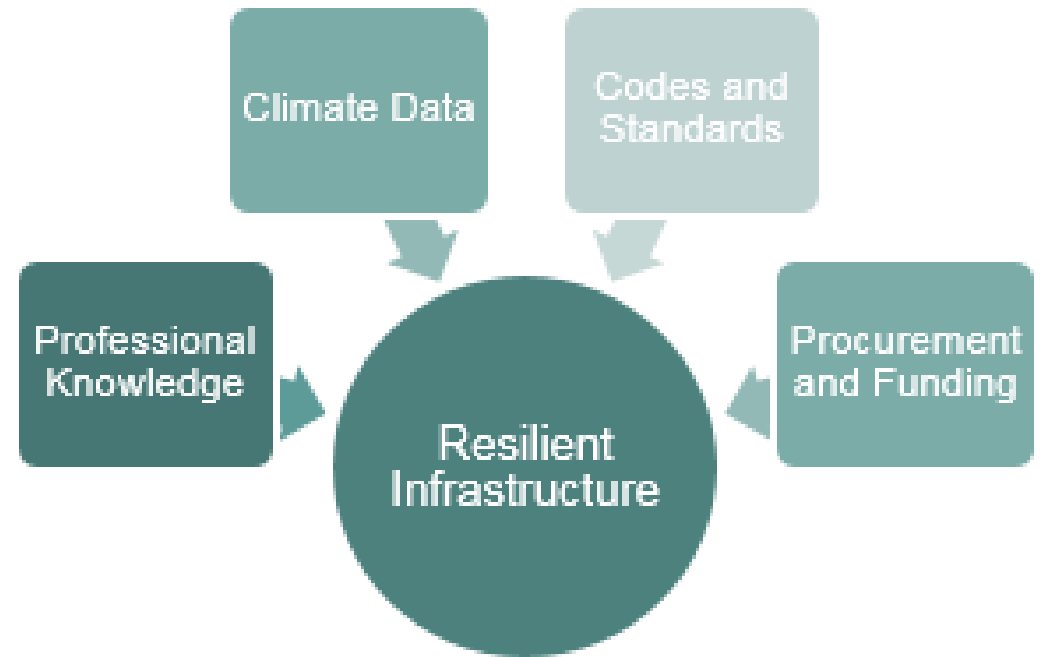
Infrastructure built today should....

- ✓ Withstand current climate impacts.
- ✓ Withstand the increased frequency, severity of current impacts and those expected in 20, 50 or more years.
- ✓ Support goal of net-zero emissions by 2050.

Federal policy direction supports resilient infrastructure by:

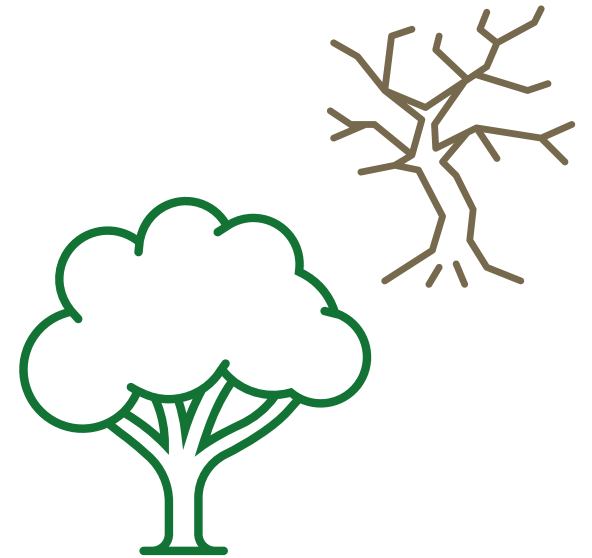
- Developing knowledge and capacity,
- Establishing requirements,
- Providing climate data,
- Providing resources (\$\$) to build resilient infrastructure.

Four components to advance resilient infrastructure



Agriculture and Food Security

- Food commodities across all regions experience increased risk, influenced by climate, production values, and exposed losses.
- Production and yields of important crops can be affected by:
 - Extreme heat → reduced growth
 - Late frost → kill crops
 - Drought → slower growth of orchard trees
- Local production connected to systems and food security
 - Supply chain disruptions → impacts on food prices
 - Critical infrastructure disruption → supply and food shortages
- Adaptation opportunities:
 - Communication of climate data and risk to producers
 - Support planting or transition to heat-tolerant, resilient varieties
 - Improve water management



Energy – Generation and Distribution

- Important impacts and risk in electrical sector, including **generation** and **nuclear** power:
 - Localized flooding, coastal erosion from extreme weather events.
 - Equipment damage and accelerated degradation (e.g. shorter lifespans) from climate change and extreme weather.
 - Decreased efficiency, including cooling capacity, as water temperatures rise.
- Impacts in **transmission** and **distribution**:
 - Failures, loss of efficiency, accelerated degradation of equipment due to range of extreme weather.
- Changes in seasonal demand affect planning and system design (e.g. increase peak demand for cooling).
- Reliability of energy services impacts on **people**, communities, local economies, and essential services (health care, emergency response, communications).



Asset Management

- The purpose of asset management is to ensure sustainable delivery of these services, by managing service, cost, and risk.
- Assets are managed to **deliver services** that support community wellbeing and economy.
- As **climate risks increase**, consider connection between asset and service



Health and Health System Impacts



- Wide variety of health impacts including increase in certain disease vectors, including tick-borne diseases.
- Health sector institutions, services and system vulnerable to climate disruption.
- Physical and mental health risks can come from displacement, damage to homes and loss of financial savings.
- Climate driven events such as extreme heat, air quality can lead to increases in food borne diseases, blue-green algae, beach closures.

Sources: 1. CMA. <https://www.cma.ca/news/its-time-own-our-climate-impact-lancet-report-finds-canadas-health-care-sector-contributing>. 2. Canadian Institute for Climate Choices. The Health Costs of Climate Change.

Better Health Outcomes Through Adaptation

- Health equity gap is increasing.
- Vulnerability to climate change linked to equity.
- Supporting health requires a broad range of adaptation initiatives across multiple domains.

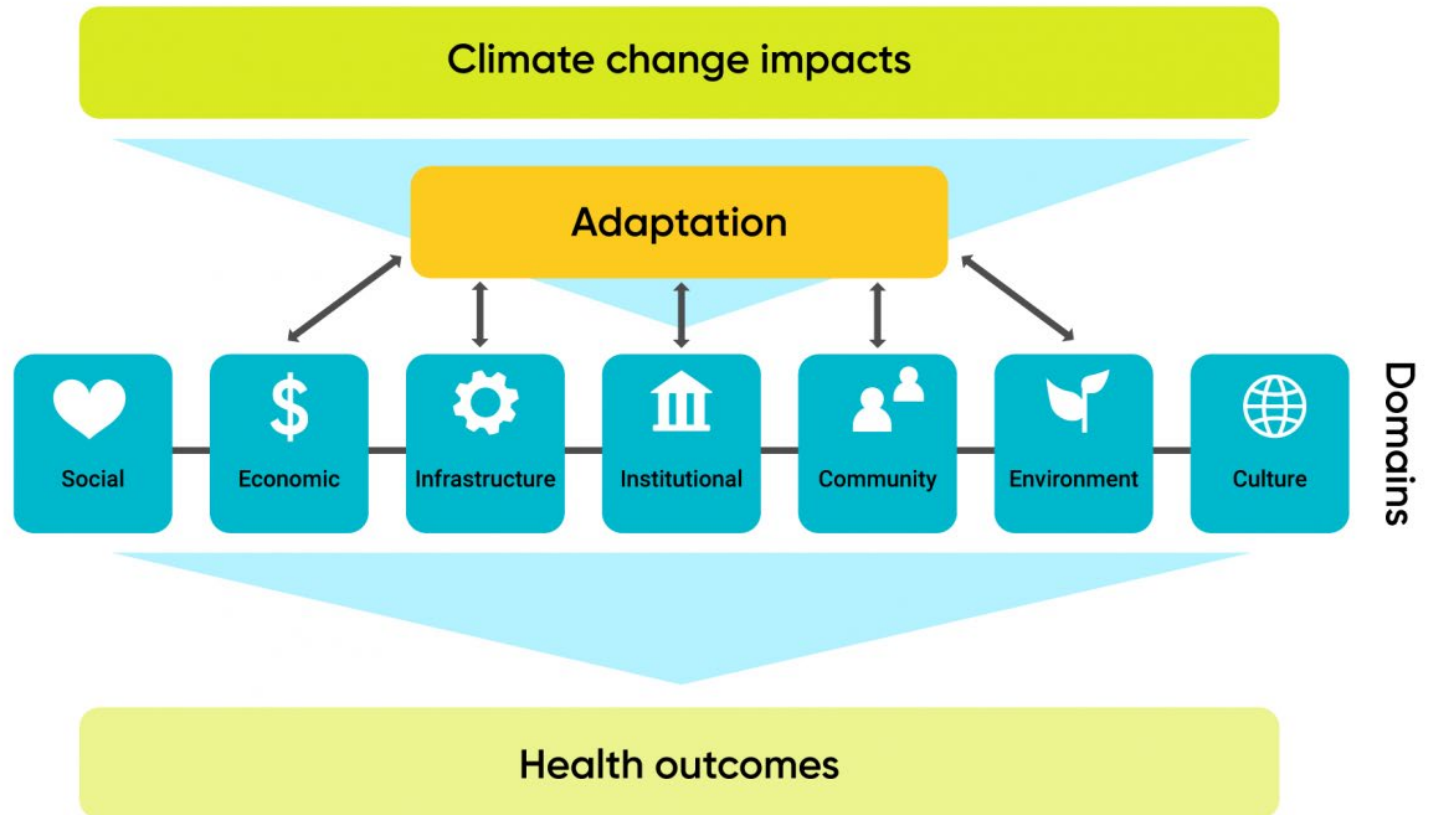


Figure 9.4: Domain-driven theoretical framework to evaluate adaptation based on justice concerns. Boeckmann & Zeeb, 2016. In *Health of Canadians in a Changing Climate*

Greenspaces and Natural Assets

- Natural assets and greenspaces play vital role in managing range of climate risks.
- Natural assets that are lost or not maintained, lead to loss of important services and reliance on expensive infrastructure.
 - E.g. routing a creek through a culvert requires ongoing maintenance and eventual renewal of the culvert.
- Protecting and restoring natural assets throughout region reduces climate risks, provides financial, environmental and social value.

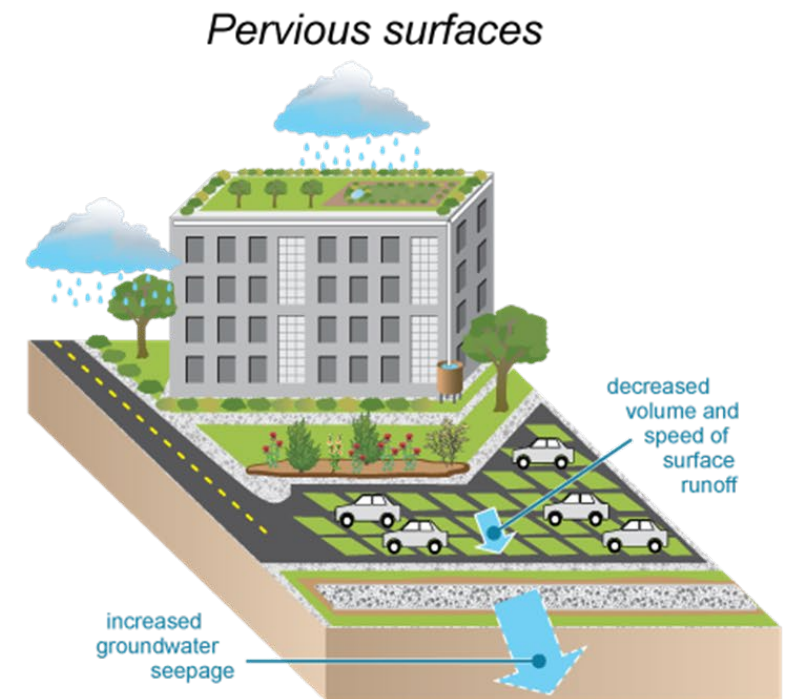


Planning and Housing

- Canadians want **new housing** that is **resilient** to the impacts of climate change.
- Planning and housing policy tools can be mobilized to support resilience.
- Co-benefits possible through smart design and planning.
- Natural and built environments **act together** to provide services for community, including hazard management.



Impervious 'hard' surfaces (roofs, roads, large areas of pavement, and asphalt parking lots) increase the volume and speed of stormwater runoff. This swift surge of water erodes streambeds, reduces groundwater infiltration, and delivers many pollutants and sediment to downstream waters.



Pervious 'soft' surfaces (green roofs, rain gardens, grass paver parking lots, and infiltration trenches) decrease volume and speed of stormwater runoff. The slowed water seeps into the ground, recharges the water table, and filters out many pollutants and sediment before they arrive in downstream waters.

Reflection - Revisiting

- What are your highest priorities in the short-term for your constituents, communities and the region?
- What are your priorities for longer term social, economic, environmental goals for the community?
- **REVISIT** – New reflections on how the impacts of **changing climate** threaten your ability to achieve those objectives or to make progress on those priorities?

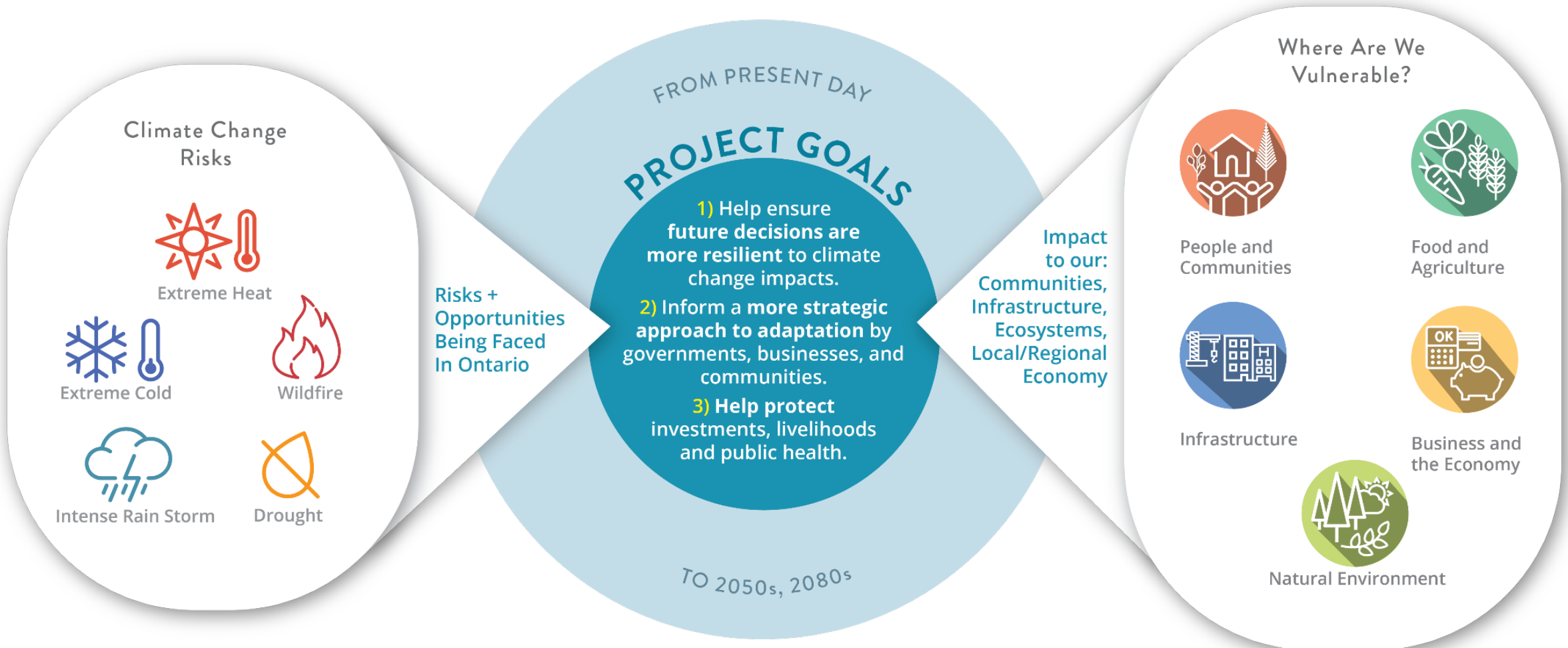




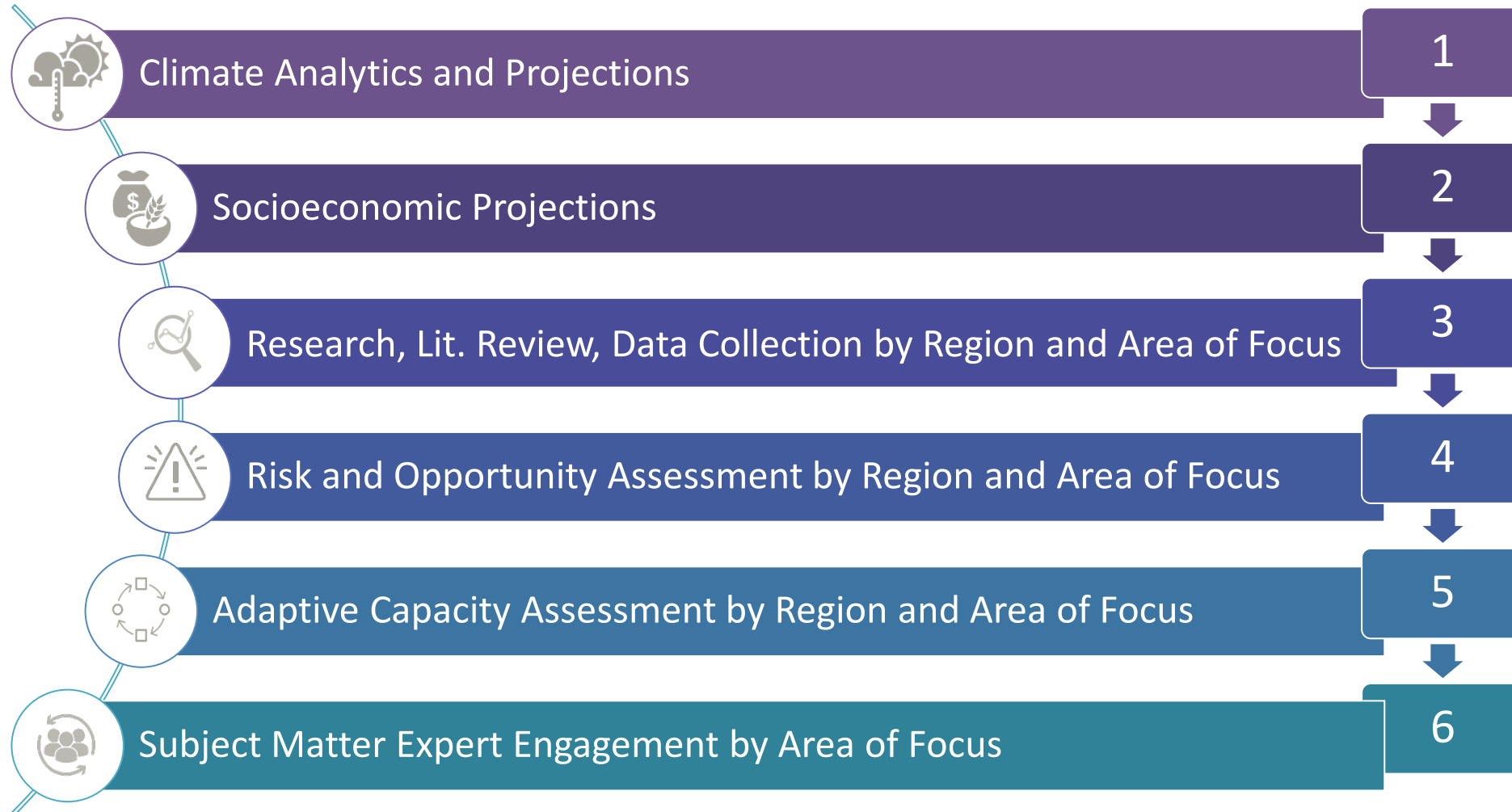
Part II - Provincial Climate Change Impact Assessment

Project Overview

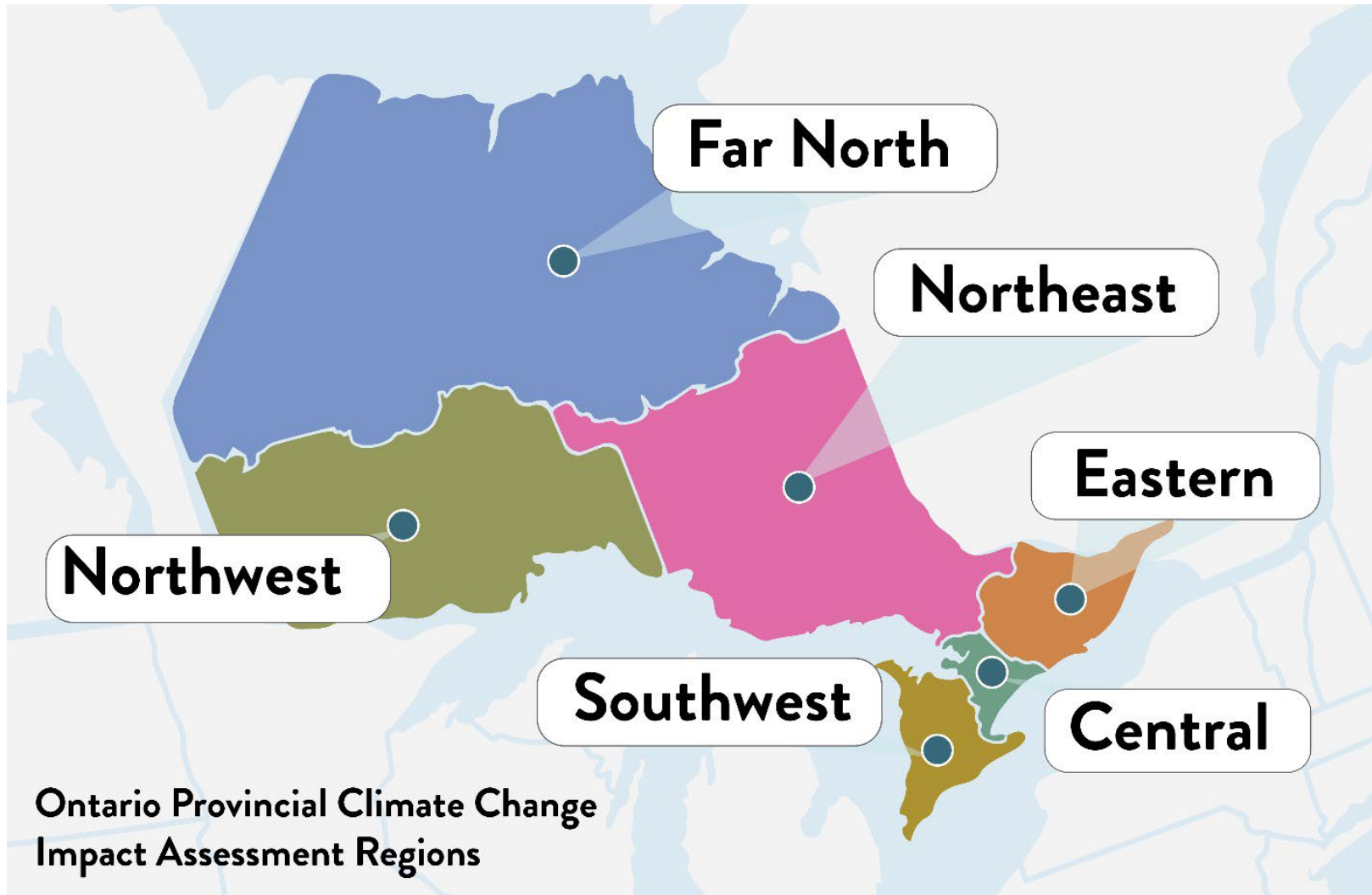
- ✓ Multi-sector climate impact assessment
- ✓ 5 Areas of Focus; 6 Regions



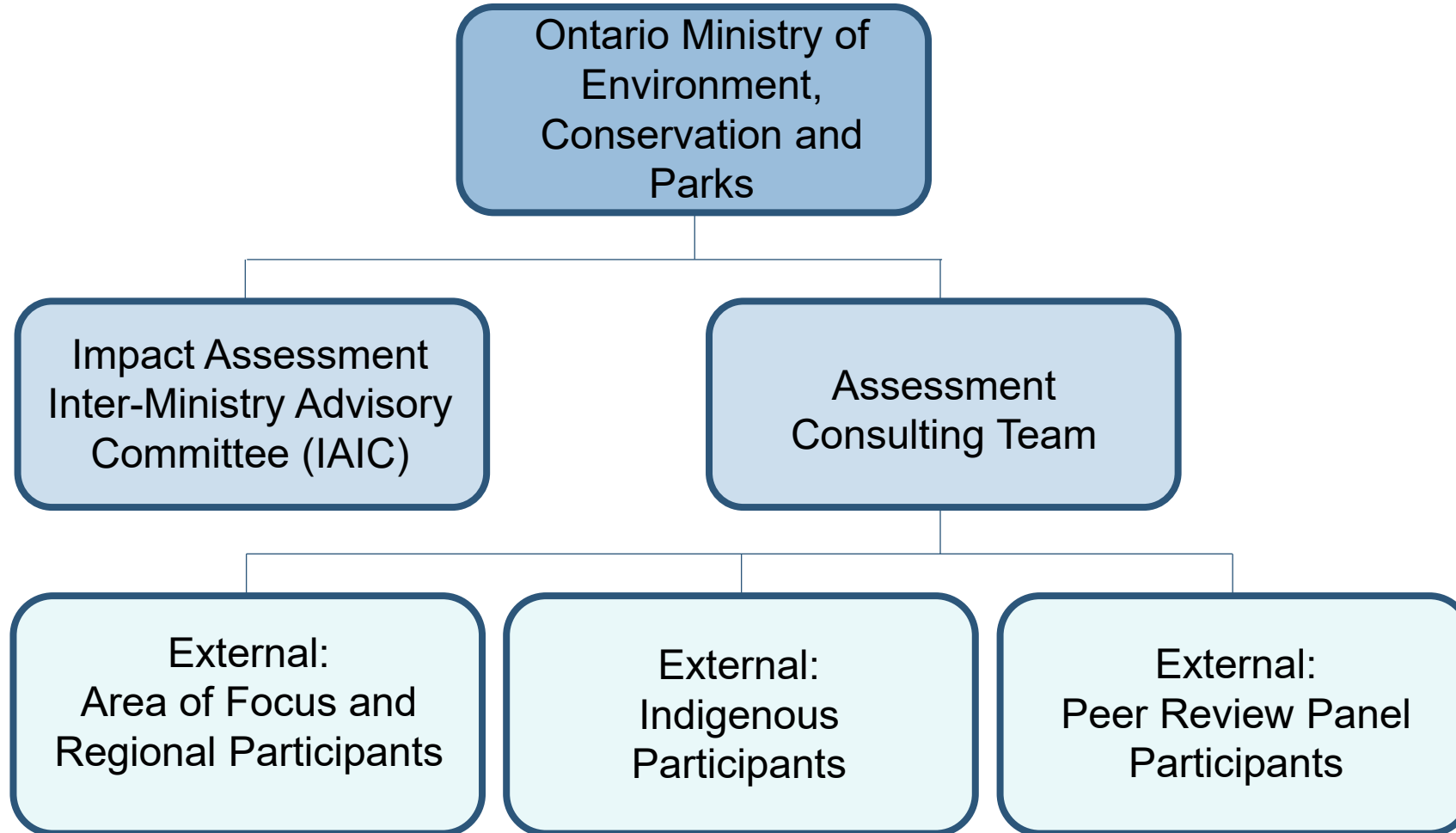
Key Project Elements



Geographic Regions

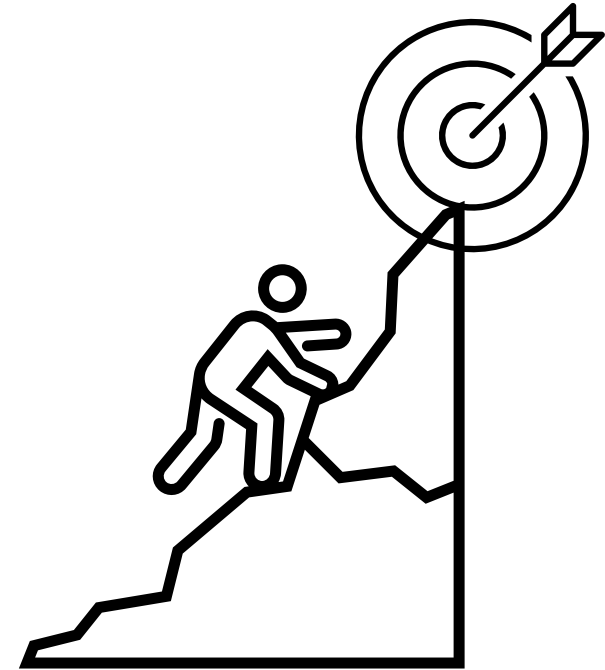


Project Participants



Project Objectives

- Improve our understanding to **inform future decisions** that build more resilience to climate impacts
- Provide a **methodology that is scalable** and can be replicated to support local assessments and future assessments
- Provide a **baseline** from which future provincial assessments could be built upon
- Inform **strategic approaches** to adaptation by governments, businesses and communities
- Support **decision-making that protects** investments, livelihoods and public health



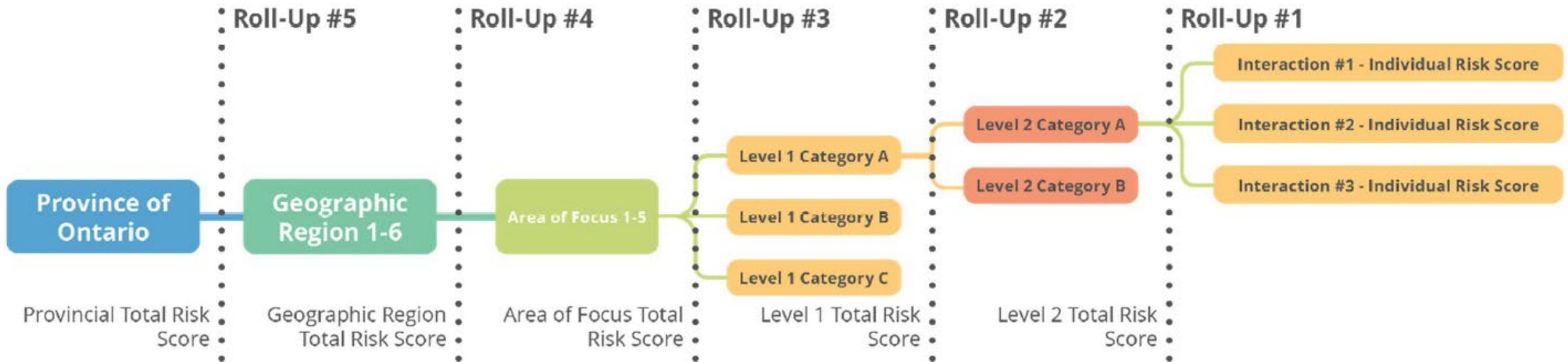
Information Inputs



Applied qualitative and quantitative data to characterize risks and opportunities

Risk Roll-Up Approach

Roll Up the Total Risk Scores from Right to Left

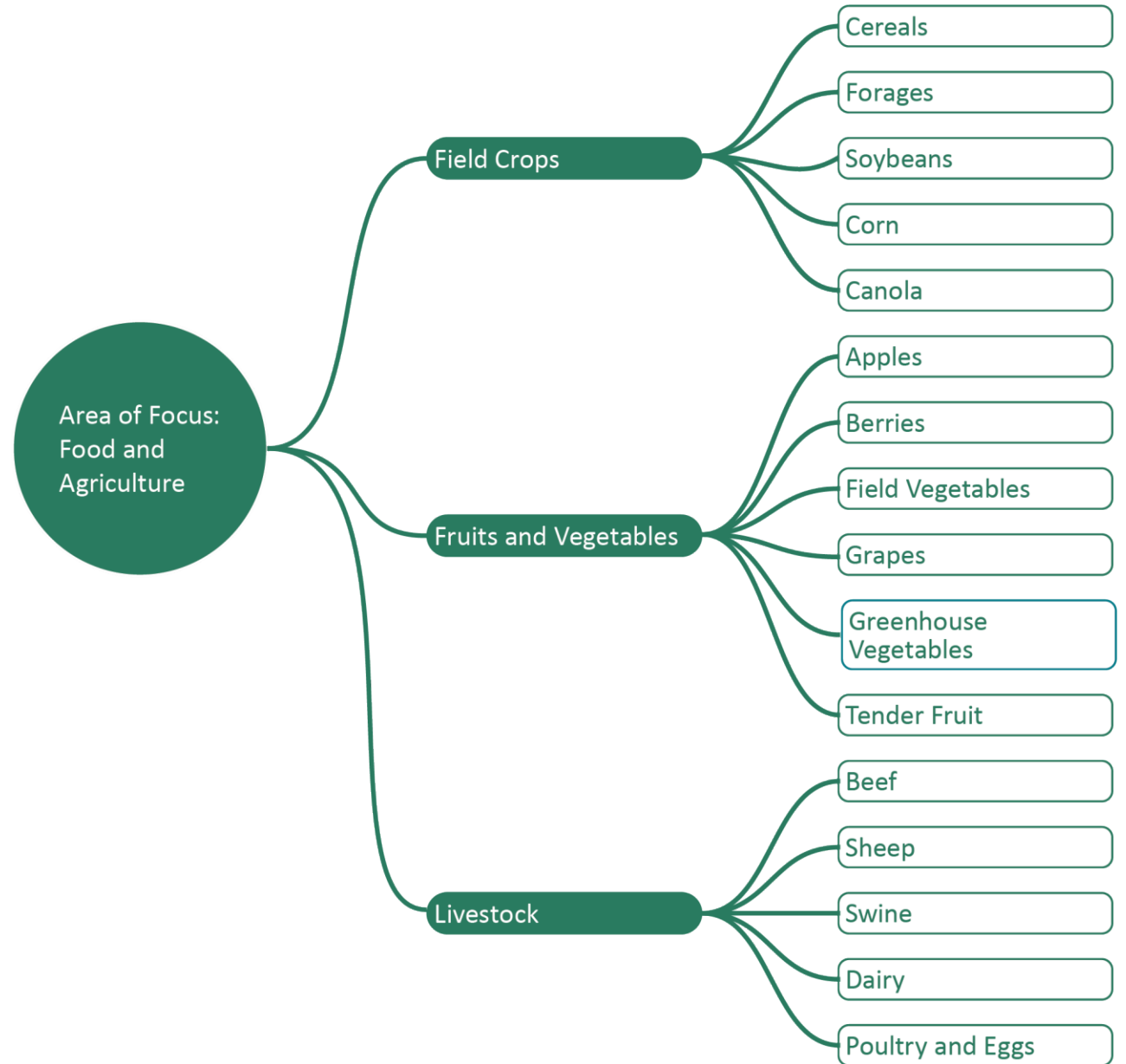


Area of Focus Delineation



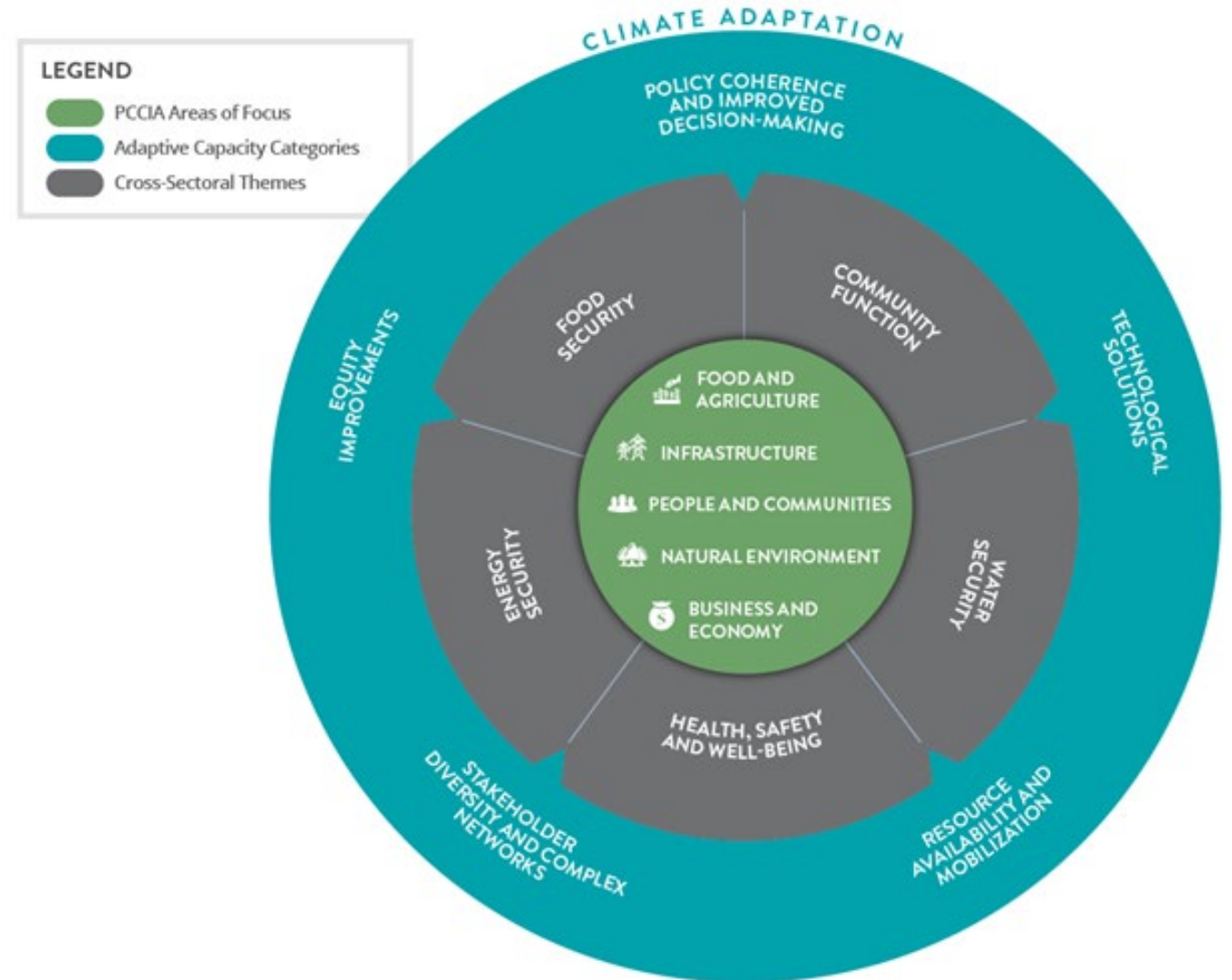
Food And Agriculture

- Each *Area of Focus* broken down in multiple levels or categories analysis.
- E.g., within Food and Agriculture:
 - Livestock
 - Field Crops
 - Fruits and Vegetables



Cross-Sectoral Themes

- Climate impacts occur in a complex, dynamic environment!
- Analysis considered cross-sectoral interactions
- Framework was used to illustrate how impacts cascade across a theme, and the opportunities for adaptation interventions across sectors.



Example 1: Analysis and Results Food and Agriculture

Changing climate conditions could present opportunities for agriculture in Ontario, but **such benefits may be offset or overwhelmed by negative impacts**, resulting in declining productivity, crop failure, and livestock fatalities. **Several commodities are expected to face ‘very high’ climate risks by the end of the century.**

In addition to direct impacts to crop and livestock productivity, Ontario’s agricultural sector is **vulnerable to indirect impacts** caused by climate interactions with pests and diseases, soil and water conditions, and infrastructure that is critical for agricultural production. With **proactive adaptation** by the agri-food industry, Ontario producers may experience more stability, lower economic losses from climate-related impacts and stronger competitive advantage.



Food and Agriculture Risk Levels



Level 1
Category

Now

2050s

2080s



Field Crops



High Risk



High Risk



Very High Risk



Fruits and
Vegetables



High Risk



High Risk



Very High Risk



Livestock



Medium Risk



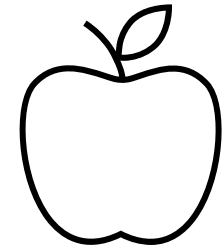
High Risk



High Risk

Apples and climate risk results

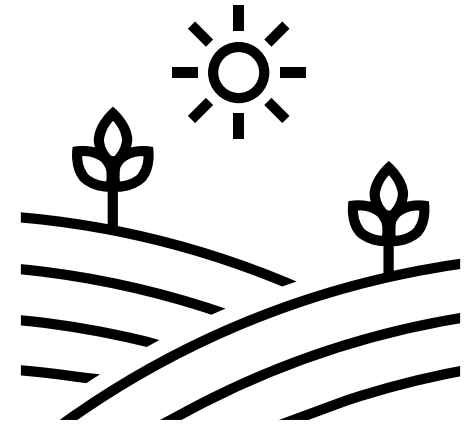
- **High** (current) and **very high** (by 2050s) risk for apple crops across Ontario, including central region.
- Sources of climate risk:
 - Late frosts can result in significant kill.
 - Drought conditions slow root and tree growth lowering yields
 - Temperatures above 32°C cause heat stress (stunting growth)
- Indirect impacts can affect producers, including risks to key pollinator species.
- Worker safety and productivity important consideration, including exposure to extreme heat events.
- Adaptation:
 - Adaptation needs to be priority as capacity to adapt lower
 - Ensure worker safety through programs and policies
 - Diversify and plant new varietal that have greater resilience
 - Address indirect risks. E.g., cultivate diverse wild bee species



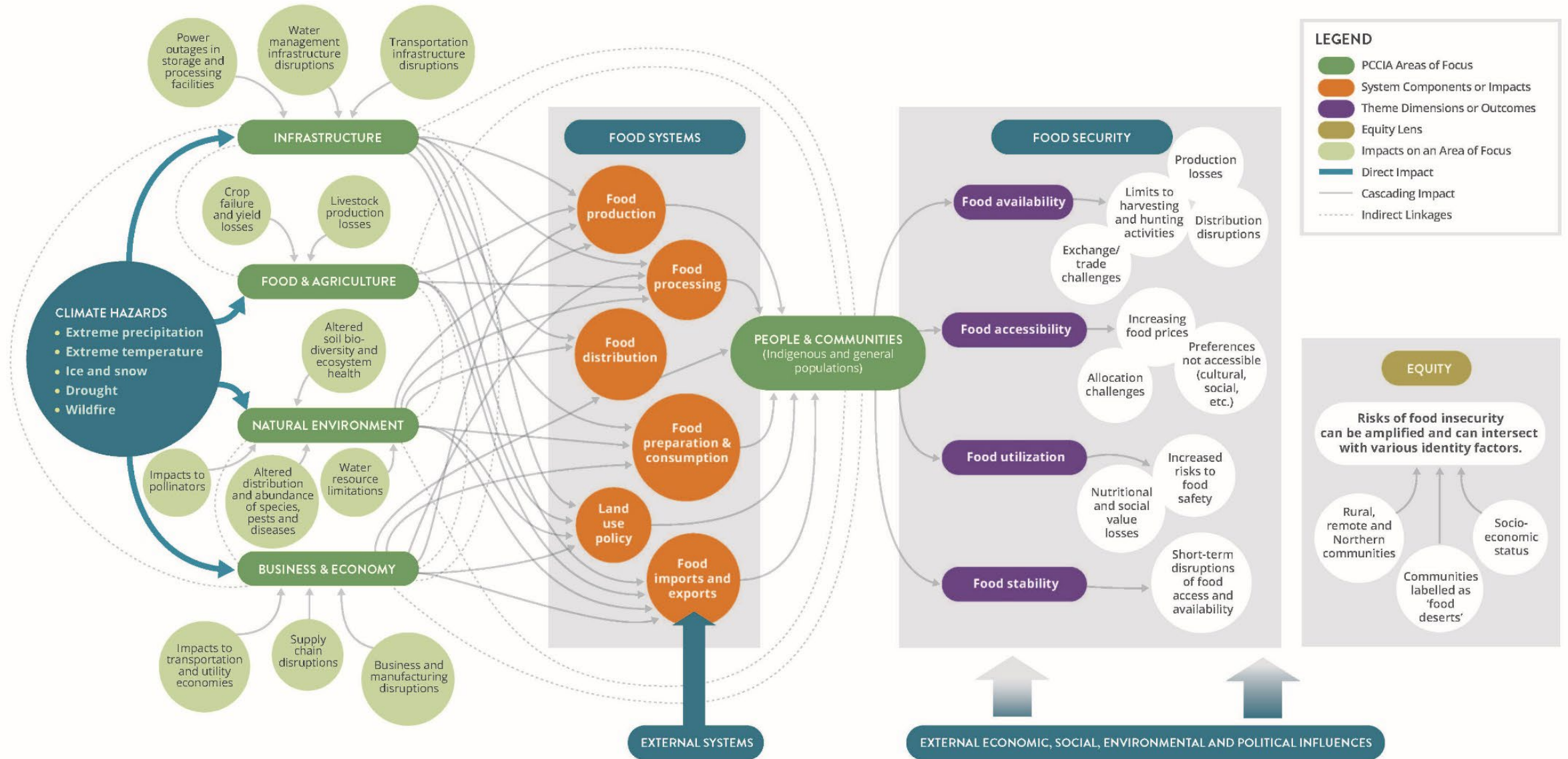
Food Security

With elements of productivity, processing, transportation, distribution and large retail, the agri-food system in Ontario is complex and has many points of interaction with weather and climate. **System-wide resilience with a focus on areas that are known to be vulnerable to climate change and regions that are more food insecure, will improve system resilience.**

Climate-related impacts on food security vary across Ontario and stand to contribute to existing vulnerability and inequities. A variety of social, cultural, and economic determinants can be used to identify pre-existing vulnerability to food insecurity in Ontario. Low-income households and neighbourhoods, remote regions, and Indigenous Communities have been identified as being at a disproportionate risk of food insecurity in Ontario.



Food Security Connections



Food Security – Climate Impacts

Food Production

- Crop failure and yield losses; livestock production losses and feed shortages.
- Soil health degradation causes lower yields and declining productivity.
- Limitations to water access impact irrigation.
- Increased in pests and disease, and declining pollinator species.
- Changes in species distribution and abundance impact food security for subsistence hunters and harvesters.

Food Processing

- Risk of prolonged power outages in food storage and processing facilities, results in wide- reaching consequences.
- Disruptions to water management infrastructure and limitations to water access.
- Disruptions and delays to the transportation of food inputs to processors and manufacturers.

Food Distribution

- Impacts to utility and transportation infrastructure result in implications for food distribution to markets, retailers, and consumers.
- Supply chain disruptions causes shortages of food products and influence food affordability.
- Disruption to public transportation and infrastructure can impact food accessibility for retailers and consumers.

Food Preparation and Consumption

- Increased occurrence and persistence of bacteria, viruses, parasites, and their vectors increase risks from food-borne illnesses.
- Climate-related impacts could result in declining nutritional content of some agricultural crops.
- Reduced access to a range and diversity of foods options in Ontario throughout the year from declining imports.

Adaptation Best Practices Report

- Comprehensive report on sector and cross-sector best practices.
- Designed for decision-makers and policy-makers.
- Range of adaptation and resilience measures included.
- Considers existing ‘Adaptive Capacity’
- Cautions against mal-adaptive measures!
- Included:
 - actions for each sector (e.g., Agriculture and Food)
 - actions that are cross-sectoral



Directions - Findings of the PCCIA

Direct Impacts

Ontario has a relatively **high capacity to adapt**, but this capacity has not yet been mobilized widely nor sufficiently to build resilience, **but** ability to adapt is not uniformly distributed across Ontario.

Selected areas to prioritize adaptation:

- Indigenous Communities
- Vulnerable and unhoused populations
- Stormwater infrastructure
- Field crop, fruit and vegetable commodities

Indirect impacts

Climate change occurs within complex, dynamic systems, and impacts can ‘cascade’. To build resilience requires addressing connections.

Selected resilience actions:

- Coordinate adaptation to enhance climate resilience between interconnected sectors
- Increase collaboration to support resilient, safe supply of water
- Act to address existing health inequities and vulnerability
- Develop approaches that consider climate in policy and decision-making.

Principles and Pitfalls for Climate Change Adaptation

Principles for Building Resilience

- ✓ Ensure resilient foundations through rapid and inclusive development.
- ✓ Facilitate the adaptation of businesses and people.
- ✓ Adapt land use patterns and protect critical public assets and services.
- ✓ Increase people's capacity to cope with and recover from shocks.
- ✓ Anticipate and manage macroeconomic and fiscal risks.
- ✓ Ensure effective implementation through prioritization and continuous monitoring.

Mal-adaptive

- ⊖ Focusing on technological fixes versus holistic approaches;
- ⊖ Difficulty of distinguishing the difference between adaptation and development;
- ⊖ Difficult in quantifying unquantifiable metrics and thus using inaccurate indicators to measure success; and
- ⊖ Competing challenges that lead to adaptation not being prioritized.

Tangible Cross-Cutting Actions For Resilience

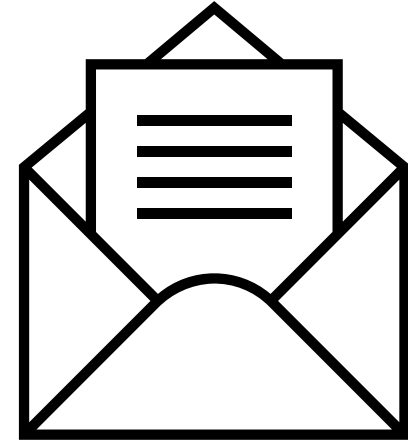
Adaptation Category	Examples of Adaptation Measures
Projects or Programs	<ul style="list-style-type: none"> • Facilitate access to relevant climate and hydrological data • Review and implement flood risk strategies in high-risk areas • Adopt Nature Based Solutions • Develop a suite of decision-support tools for climate change adaptation
Research and Development	<ul style="list-style-type: none"> • Integrate monitoring and evaluation of adaptation planning • Leverage larger city-based resiliency networks in Canada and internationally
Investment and Incentives	<ul style="list-style-type: none"> • Develop programs and enhance policies that support • Promote Nature-Based Solutions and increase protection of green spaces and green infrastructure
Policy and Regulation	<ul style="list-style-type: none"> • Apply a climate lens to government decision-making • Embed climate risk in land use planning and policy • Apply an equity lens to all climate change adaptation planning • Apply an Indigenous lens to all climate change adaptation planning

Tangible Actions Within Sector

Adaptation Category	Examples of Adaptation Measures (Food and Agriculture Sector)
Projects or Programs	<ul style="list-style-type: none"> • Strengthen monitoring and surveillance programs for pest and disease management. • Expand decision support tools for on-farm water, soil and nutrient management. • Enable demand-driven knowledge transformation and transfer through collaboration between researchers and farmers.
Research and Development	<ul style="list-style-type: none"> • Support and advance research on agricultural expansion opportunities. • Undertake research and development in new, climate-resilient varieties or species. • Fund a knowledge transfer and sharing program for practical adaptation and best management practice sharing with Indigenous knowledge at its core.
Investment and Incentives	<ul style="list-style-type: none"> • Advance research on agricultural expansion opportunities under a changing climate. • Support technological research and advancements on precision agriculture, advanced drainage and irrigation systems.
Policy and Regulation	<ul style="list-style-type: none"> • Apply a climate lens to government decision-making, integrate Indigenous perspectives. • Invest and strengthen coordination and integration of water management

Provincial Report - Take-Away Messages

- **The climate has changed.** Between 1948 and 2016, average temperatures have risen 1.3°C and total precipitation has increased by 9.7% in Ontario.
- **Ontario has already experienced significant climate impacts** from flooding, wildfires, heat waves, ice storms and many other events.
- **The climate will continue to change.** In fact, we are locked into climate impacts over the next half century, with impacts expected to become more frequent and more extreme.
- **There is an urgent need to act, to prepare and to invest.** The impacts associated with a changing climate have become more apparent in daily life, increasing risks to social, economic, cultural and ecological systems.



Activity – Explore the Reports

- Thinking about your highest-priority issues... what information would you expect to see in the provincial report?
- How do you think the report data can support local issues and planning?
- What question would you like to ask about the report?



Adaptation best practices - exploration

- Adaptation best practices report describes actions in four distinct themes, for each Area of Focus.
- Types of actions:
 - Projects or programs
 - Research and development
 - Investment and incentives
 - Policy and regulation
- **ACTIVITY:**
 1. Open the [Best Practices Report!](#)
 - Thank you to Seniors for Climate Action Now for posting it.
 2. Find Section 7.0 “People and Communities” then find the table “Examples of Adaptation Measures”.
 3. **Questions:**
 1. Which measures would help your constituents?
 2. Which of the actions listed in table 7-3 do you think the region or the lower-tier municipalities could implement?

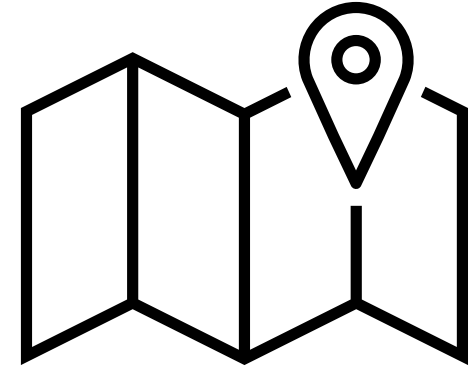


Table 7-3. Areas for People and Communities Climate Adaptation

Adaptation Category	Examples of Adaptation Measures
Projects or Programs	<ul style="list-style-type: none"> • Provide funding and programming support for development of heat event response planning for municipalities. • Promote Indigenous-led adaptation projects and programs. • Provide consistently available and up-to-date emergency planning guidance to communities. • Encourage the use of innovative technology to increase capacity to respond to climate-related health crises (e.g. emergency response planning scenarios)
Research and Development	<ul style="list-style-type: none"> • Advance research to fill remaining knowledge gaps on climate changes impacts to people and communities in Ontario
Investment and Incentives	<ul style="list-style-type: none"> • Invest in early warning systems for climate hazard events. • Invest in the establishment and enhancement of extreme heat impact reduction strategies. • Adapt food resource management in the face of climate change and provide funding for resurfacing of Traditional Ecological Knowledge
Policy and Regulation	<ul style="list-style-type: none"> • Develop policies and tools to support respectful and meaningful incorporation of Indigenous knowledge systems into adaptation planning and decision-making. • Reframe adaptation policies to be culturally appropriate for Indigenous communities. • Include a wide breadth of rights holders and stakeholders in public policy development and decision-making

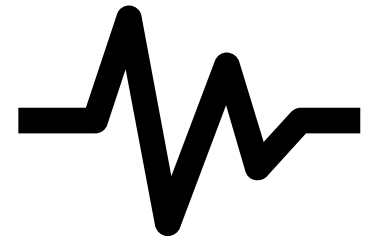
Table 7-3. Areas for People and Communities Climate Adaptation. Recreated from the Adaptation Best Practices online PDF report.

Thank you to Seniors for Climate Action Now for posting the [Adaptation Best Practices Report](#).

Example 2: Health, Safety And Well-being

Existing human **health inequities across Ontario will be worsened** by climate change. Health-related adaptation requires involvement from both inside and outside of the health sector, as well as coordination across levels of government and Indigenous Organizations and Communities.

Prioritizing adaptation **actions to address existing health inequities and vulnerability will minimize negative climate-related outcomes** for the health, safety, and well-being of Ontarians.



Health, Safety And Well-being

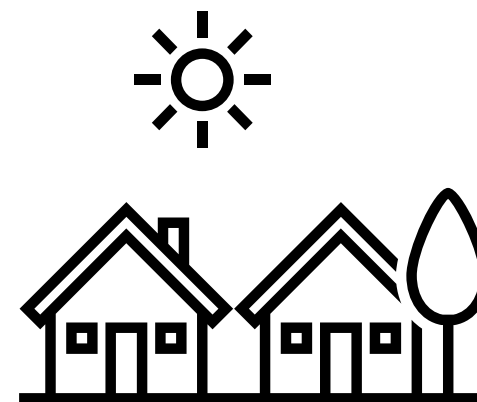
Infectious Diseases	Water and Food Safety	Mental Health and Well-being	Declining Air Quality	Public Safety and Emergency Response	Extreme Temperature Exposure
<ul style="list-style-type: none">• Increased prevalence of infectious diseases, due to an expansion of their vectors and more favourable conditions for transmission (e.g. West Nile and Lyme Disease).• Increased prevalence of pathogens and disease outbreaks in wildfire (e.g. deer and moose), cascading to human health and safety risks.	<ul style="list-style-type: none">• Impacts on water quality and quantity can increase risk of water-borne diseases.• Increased occurrence and persistence of bacteria, viruses, parasites, and pathogens across the food system, increasing risk of food-borne illnesses.• Harmful algal blooms can have significant human health impacts associated with exposure through drinking water systems and recreational water use.	<ul style="list-style-type: none">• Impacts on culture and heritage, language, and knowledge transmission.• Climate-related disasters can often lead to mental health outcomes.• Degradation of cultural identity and community cohesion.• Climate grief can affect mental health and well-being, resulting in emotional and behavioural responses, such as worry, grief, anxiety, anger, hopelessness, and fear.	<ul style="list-style-type: none">• Extreme heat events can increase smog and ground-level ozone.• Wildfire smoke can cause the exacerbation of asthma and respiratory conditions.• Drought conditions can contribute to increased dust.	<ul style="list-style-type: none">• Increased likelihood of accident, injuries and mortalities during extreme weather and flooding events.• Power outages and damage to critical infrastructure, result in a disruption of critical and emergency services.	<ul style="list-style-type: none">• Increased risk of heat-related illness and mortality.• Increased hospitalization rates during extreme heat events, resulting in capacity constraints.• Health impacts associated with extreme heat are exacerbated by the urban heat island effect.

Example 3: Community Function

Climate change impacts community function both directly, through different climate and weather events (e.g. extreme precipitation or wildfire), and indirectly, through a range of environmental, infrastructure, and economic pathways.

Community-level adaptation planning and response should seek to address social inequities and similarly, investments to address social inequity will lead to greater climate resilience.

Use of approaches that consider future climate change considerations will provide opportunities for making policy decisions to improve infrastructure redundancy, emergency response management, foster social support and inclusion, economic stability, and ecological stewardship.



Community Function

Social Support and Inclusion

- Property damage and communications system failures result in lack of access to support and daily needs.
- Localized and widespread power outages leading to service disruptions.
- Altered distribution and abundance of species of importance for Indigenous Communities impacts food security and culture.

Economic Stability

- Asset and infrastructure loss and damage, decrease in asset serviceable lifespan, supply chain disruptions.
- Changes in consumer demand for seasonal goods and services, health and safety impacts on staff.
- Changes in availability of key industrial inputs and costs, leading to production delays.

Access and Infrastructure Redundancy

- Compromised access to services.
- Damage to roads, property and infrastructure, power outages and shutdowns of facilities providing essential goods and services.
- Blocked access for emergency vehicles caused by flooding.
- Disruption of supply chains for medicines, food etc.

Emergency Response Management

- Power outages, damages to critical infrastructure disrupt critical services (e.g. healthcare etc.).
- Extreme weather affects response actions including evacuation, search and rescue, emergency services, and recovery of critical infrastructure.
- Weather-related impacts on infrastructure and natural environment amplify risks to personal safety and security.

Ecological Stewardship

- Degradation of air and water quality, new pathogens, pests and diseases, changes in ecosystem health and services.
- Compromised environmental sustainability, poor physical and mental health outcomes, limited access to nature and decreased quality of life.
- Critical infrastructure failure could have significant cascading impacts on surrounding ecosystems and communities.

Land Use Planning and Development

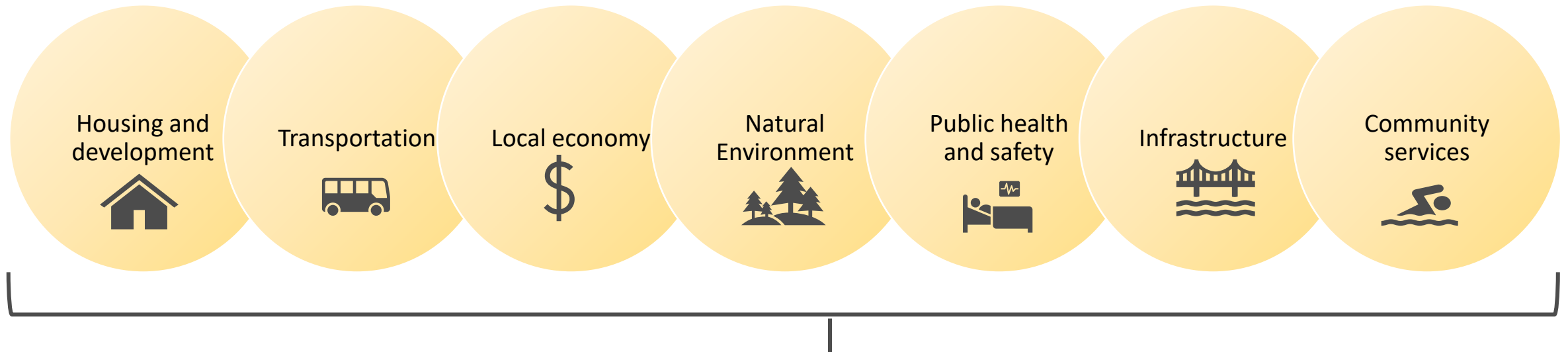
- Impacts on critical infrastructure, agricultural lands and production, ecosystem health and services, recreation, fishing, cultural heritage resources and assets.
- Coupled with socio-economic changes (e.g. population growth) these impacts result in the need to adjust land use planning and development approaches



Part III - Strategic Direction for Future Climate Resilience work

Resilience as a through-line

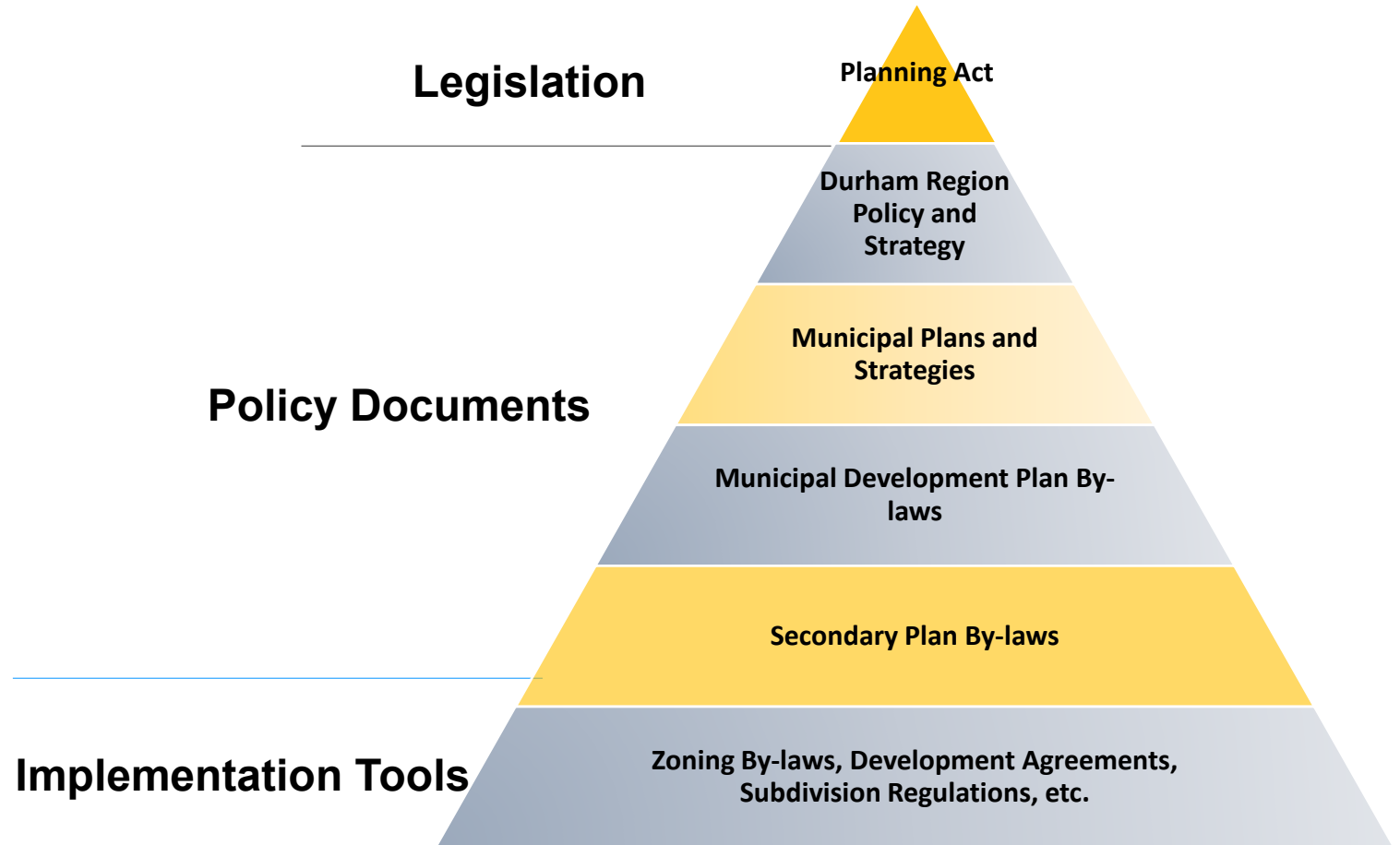
Elected officials and municipal staff have a direct influence on many areas of community development and function:



**Potential climate impacts
across range of services
and assets**

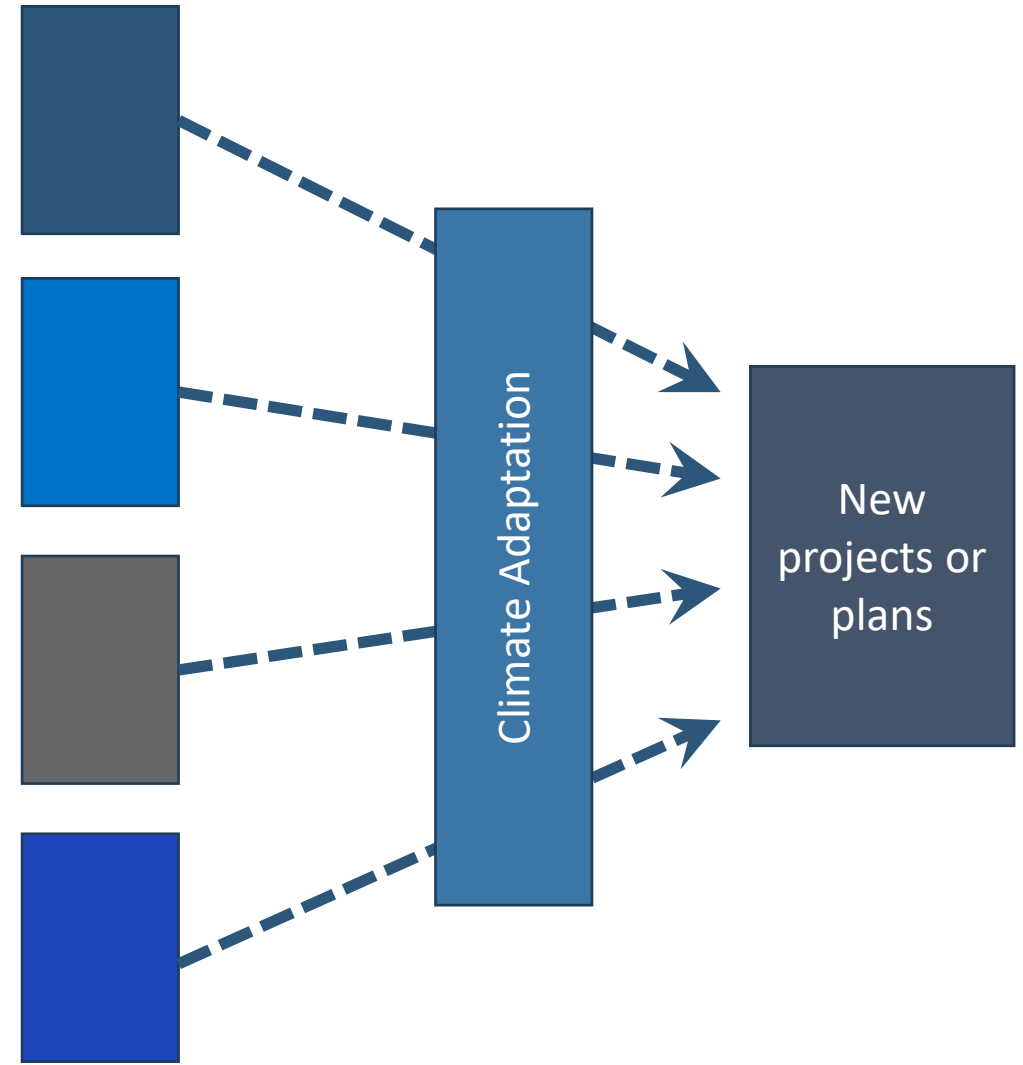
Policies and Policy Tools Interact

- Policy and decision-making across variety of policy areas are connected to climate resilience outcomes.
- Policies and implementation tools work at multiple scales.
- Regional and Municipal Policies can be connected and coordinated.
- Implementation tools – zoning, incentives, regulations, development charges – can be used to put in place resilience measures.



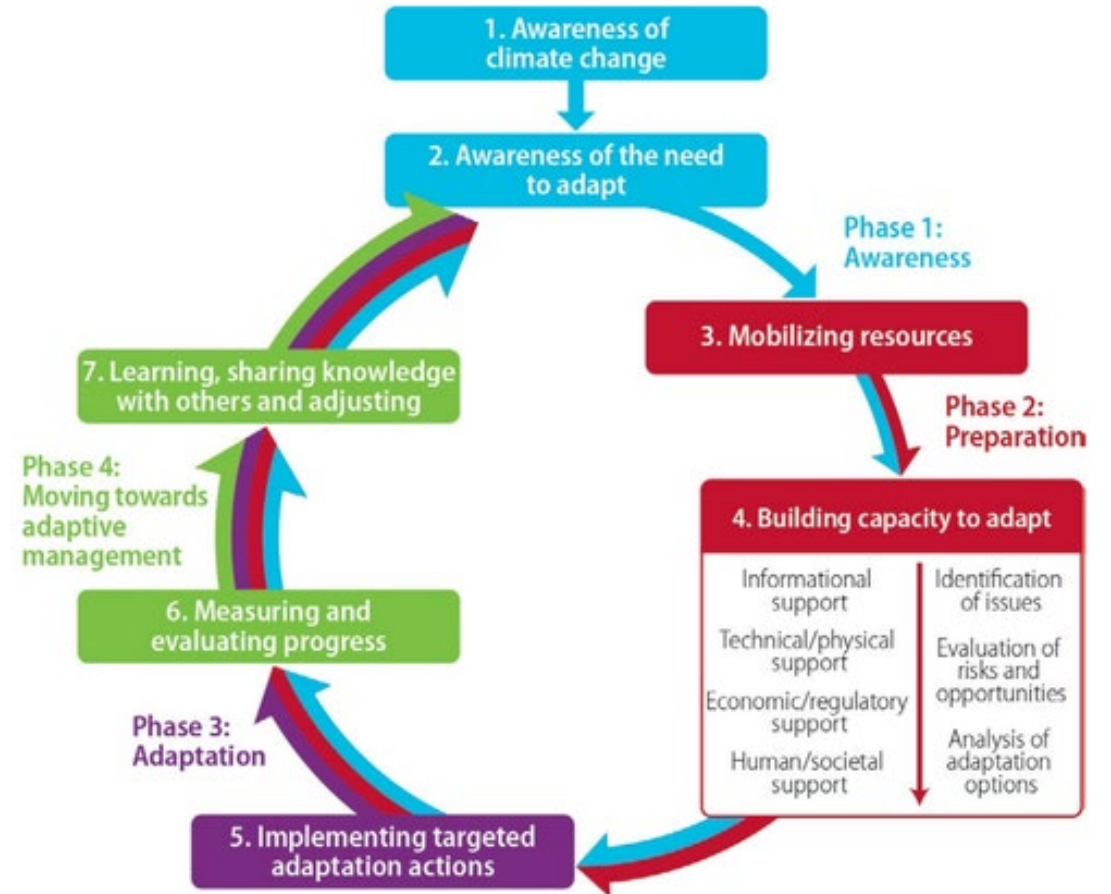
Mainstreaming

- Sometimes referred to as ‘climate policy integration’
- Integrating related government policies into several sectors OR
- Creating an institutional/organizational structure that automatically accounts for climate change adaptation needs



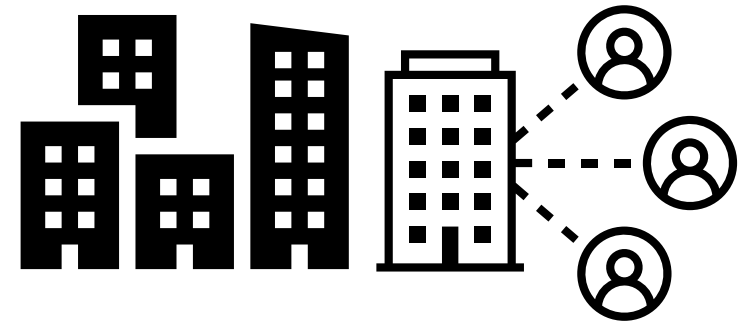
Adaptation is a Process

- Building resilience must be an ongoing process and priority.
- Process of:
 - Mobilizing resources
 - Assessing
 - Implementing
 - Monitoring
- Throughout:
 - Communication!
 - Learning!
 - Adding new knowledge and information (including new climate data)



National Direction On Resilience

- Requirement for risk assessment to access infrastructure funding (Climate Lens).
- Increased **support** from federal level for climate resilience, including:
 - Infrastructure resilience
 - Risk assessment
 - Climate data
- Expectation that professional and infrastructure sectors with **upskill** with essential climate competencies.
- **Key programs and policies:** Infrastructure Canada; Environment and Climate Change Canada; Federation of Canadian Municipalities; Natural Resources Canada; National Research Council; Standards Council of Canada.



Provincial Directions On Resilience

- **Planning Act** – identifies mitigating GHG emissions and **adaptation** to a changing climate as matters of provincial interest and directs Official Plan to include “policies that identify goals, objectives and actions to mitigate GHG emissions and to provide for adaptation to changing climate, including through increasing resiliency” Section 16(4)
- **Provincial Policy Statement** - Minimizes negative impacts from, and prepares for the impacts of a changing climate through policies related to: Healthy, livable and safe communities; long-term economic prosperity; density and mix of land uses; risks associated with natural hazards; infrastructure and public facilities; and, land use and development patterns.
- **Regional Growth Plans** - including the Growth Plan for the Greater Golden Horseshoe – looks to integrate climate change considerations into managing growth that is adaptive to the impacts of a changing climate

Example - City of Windsor

Windsor's stated objectives

1. Integrate Climate Change Thinking and Response
2. Protect Public Health and Safety
3. Reduce Risk to Buildings and Property
4. Strengthen Infrastructure Resilience
5. Protect Biodiversity and Enhance Ecosystem Functions
6. Reduce Community Service Disruptions
7. Build Community Resilience

City of Windsor
DEGREES OF CHANGE

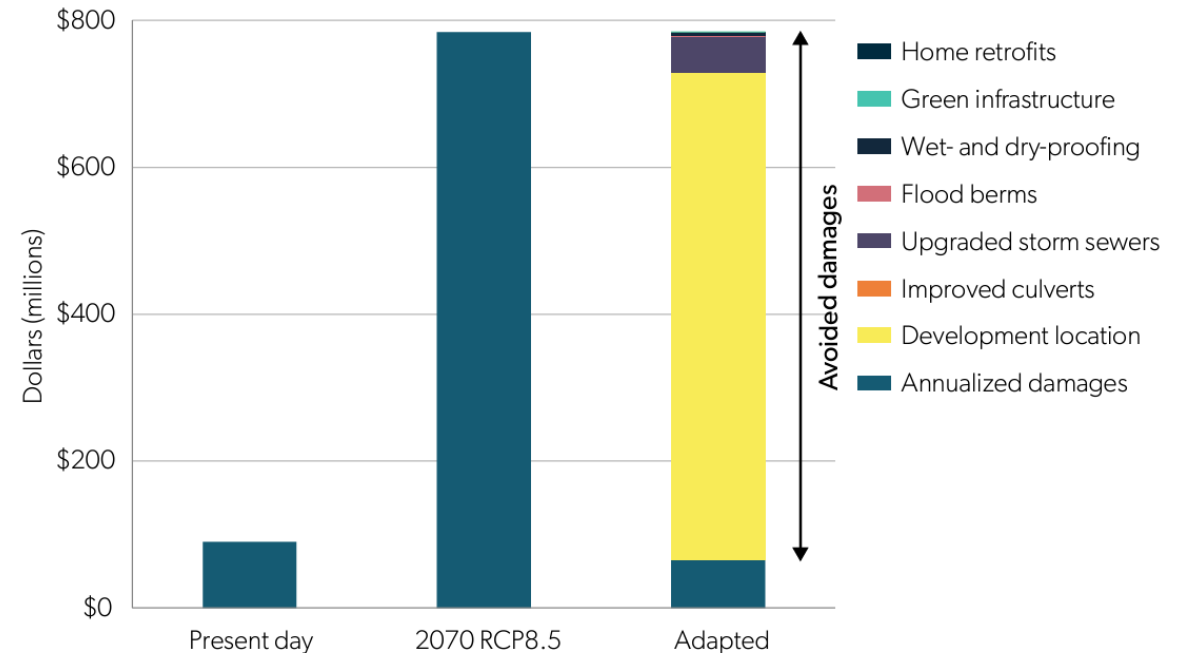
Climate Change Adaptation Plan

What has Windsor done to increase chances of success?

- ✓ Clear, detailed set of actions for each objective, with details on policy tools for implementation.
- ✓ **Governance structure and accountability clearly outlined.**
- ✓ Ensure the action plan has resources for implementation.
- ✓ Detailed monitoring including indicators are in place.

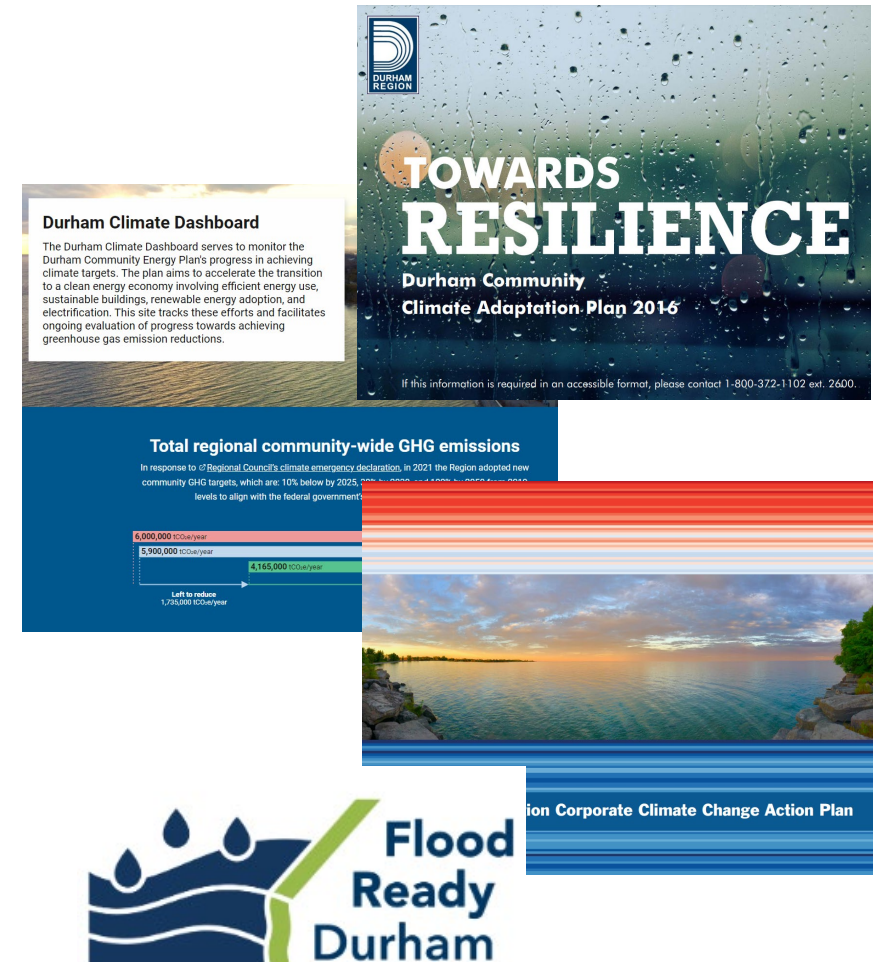
Example - Whitby Resilience analysis and plans

- Findings: 7-fold increase in financial cost of climate damages by late century
- Successful implementation of range of adaptation measures averts losses.
- Principles
 - Prevent loss before it happens
 - Robust and ready infrastructure
 - Protect people
- Implement!
 - Integrate across decision-making and planning.
 - Adapt infrastructure
 - Protect and restore natural spaces
 - Promote human well-being



Durham Region Resilience Planning

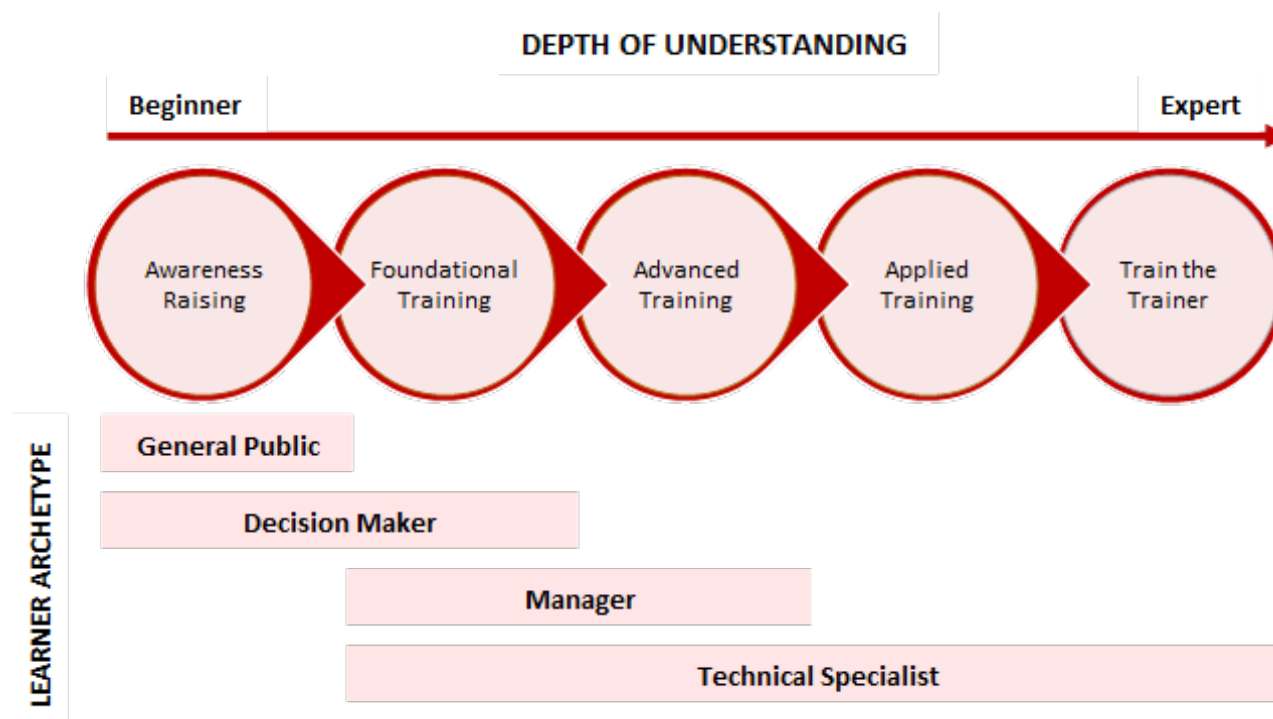
- Durham's regional climate change adaptation work has established knowledge and capacity in the region.
- Comprehensive adaptation plan and sectoral reports (food security, agriculture, managing urban heat, flood preparedness) each document:
 - Climate Impacts and Risks
 - Cross-cutting themes
 - Opportunities to build resilience
- Opportunities to accelerate action:
 - Build on institutional and adaptive capacity
 - Increase coordination across departments, between tiers
 - Continuing 'mainstreaming'
 - **Add resources to match scale of challenge**



Directions – Knowledge and Skills

Developing skills and capacity

- ✓ Addressing climate change requires whole-of-government approach
- ✓ Range of competencies needed throughout public (and private) sector.
- ✓ Level of awareness or training needed varies – from general awareness to technical specialists..



Directions – Implement Solutions!

Built Environment

- Consider mitigation and adaptation in all regional, local planning and policy
- Compact, walkable to reduce transportation emissions and infrastructure
- Have robust strategies for climate in new plans and developments
- Reduce life-cycle impact and enhanced built and natural system interactions through design
- Facilitate energy conservation and renewable energy

Natural Environment

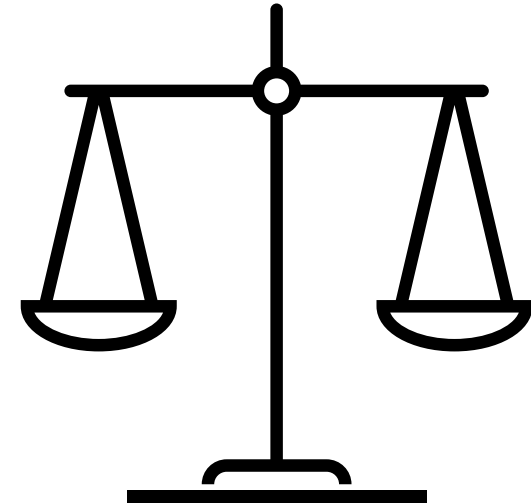
- Adapt infrastructure to changing climate
- Protect and restore water resources
- Protect and restore natural areas and biodiversity – they are vital in adaptation
- Support sustainable food systems

Social Environment

- Engage to garner support for commitment to reduce climate impacts
- Address health equity and social vulnerability
- Minimize climate impacts on mental health and social health through actions and response
- Integrate local Indigenous knowledge and planning traditions into planning processes, respecting the rights of Indigenous peoples.

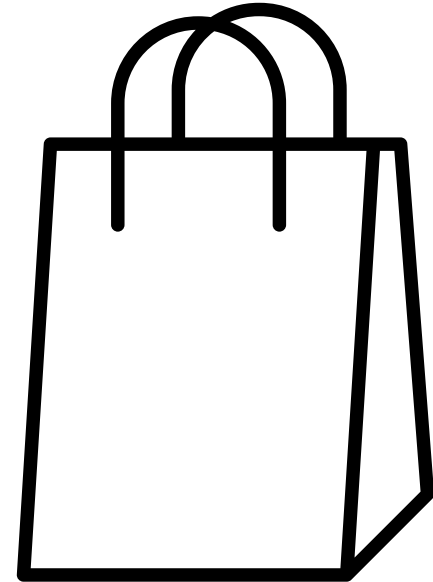
Legislation and Legal Obligations

- National and provincial level legislation carries climate-related obligations for local and regional governments.
- Liability for climate events ongoing issue for municipal governments.
 - Distinguish between **policy** and **operational** decisions.
- Codes and standards continue to evolve, can be leveraged by municipalities / region.
- For public sector staff – professionals may have distinct professional duties and expectations, and associated liability.
 - E.g., Engineers on staff should reference professional regulators to review expectations related to climate change.



Take Away Messages

- Climate change impacts nearly everything you do in a region.
- Climate damages are having impact on cost of living **now**; adaptation can limit negative effects later.
- Climate- and risk-informed decision making **now** can avoid **big costs** later.
- Adaptation to climate change should be integrated throughout existing local strategies, policies, plans and bylaws.
- Region and municipalities have many existing policy tools to manage climate change impacts and risks. Coordinate and collaborate with partners and across levels of government.
- Municipalities and regions – including in Durham are taking action – **existing resources and precedents exist**. Don't reinvent solution! – just tailor it to local needs.
- Address the adaptation gap! Need to scale up action!



Reflection – Revisiting question

- What are your highest priorities in the short-term for your constituents, communities and the region?
- What are your priorities for longer term social, economic, environmental goals for the community?
- Will the impacts of **changing climate** threaten your ability to achieve those objectives or to make progress on those priorities? How?
- How can **building resilience** / proactive **adaptation** help you achieve those objectives?
- What role can you play in support resilience?





Thank you

April 2024
Al Douglas
President, Climate Risk Institute

