





**WHO'S DOING WHAT?
And is it enough to get us there?**



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Senior
Director,
Building
Science, CHBA



**Local Energy
Efficiency
Partnership
(LEEP) - Natural
Resources
Canada**



Ericha Moores
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Technical
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Housing

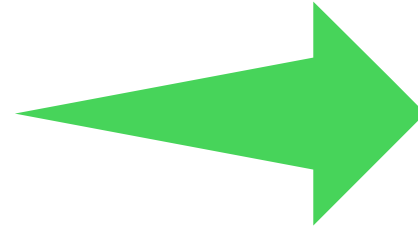
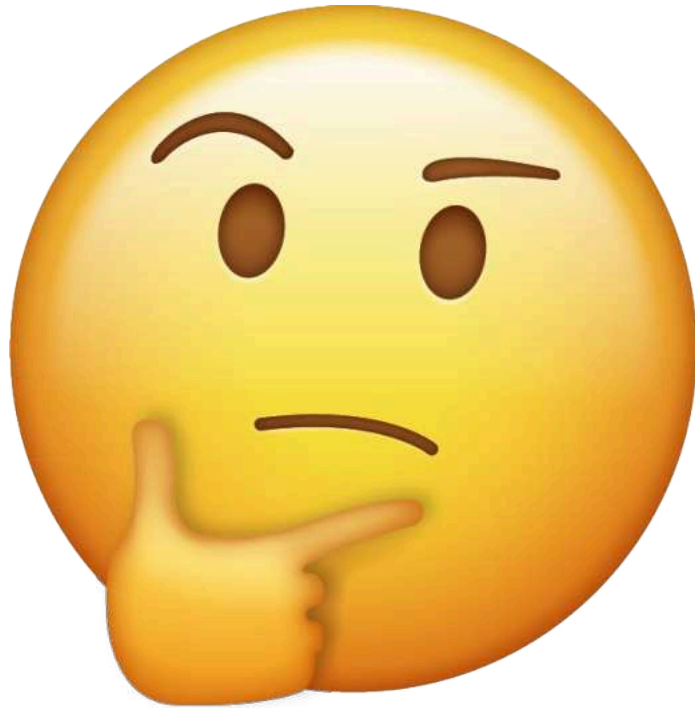


**Frank Lohmann,
Senior Director, Building Science,
CHBA**



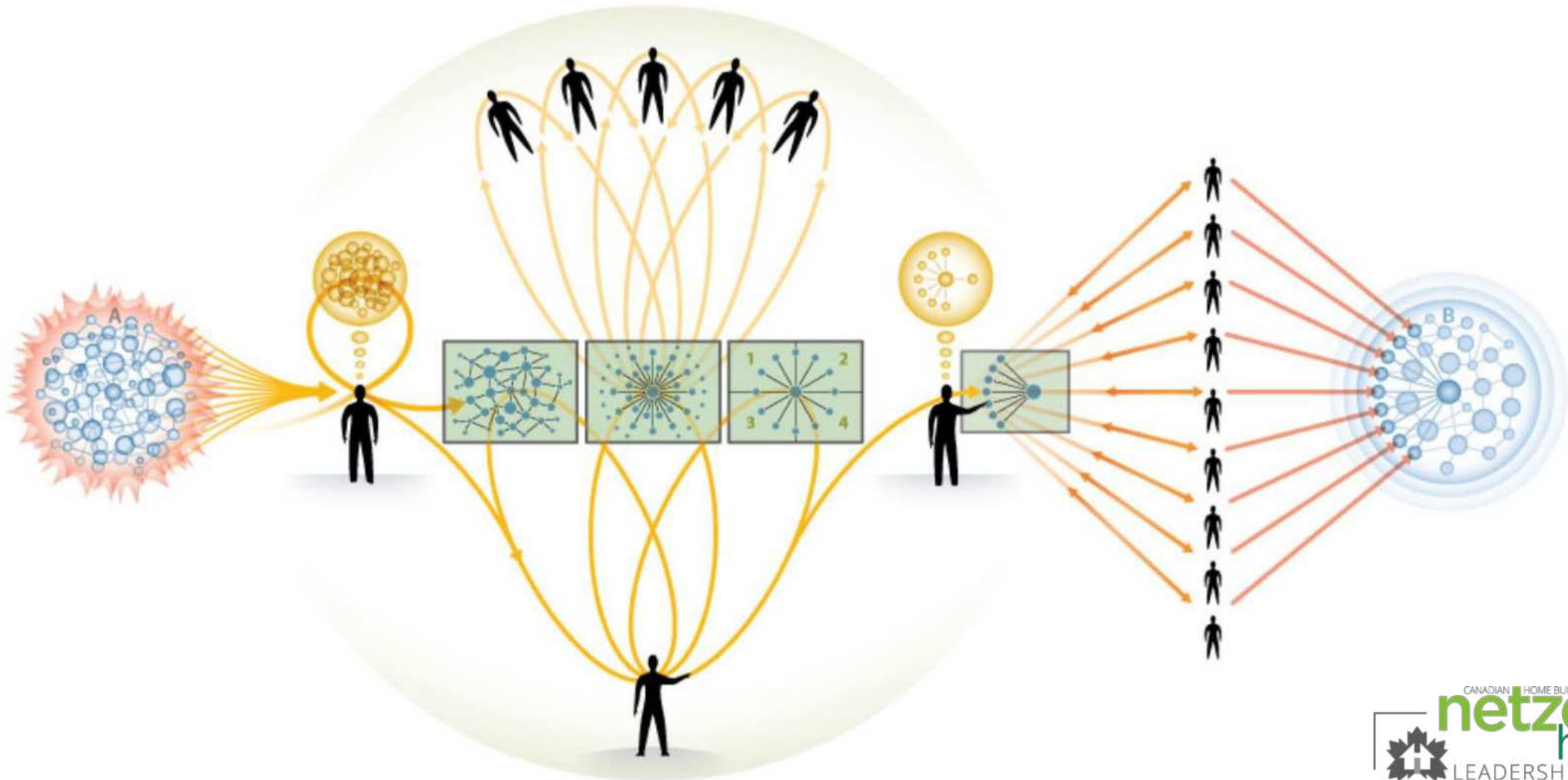
2 Sessions

Integrating Resilience and Adaptation



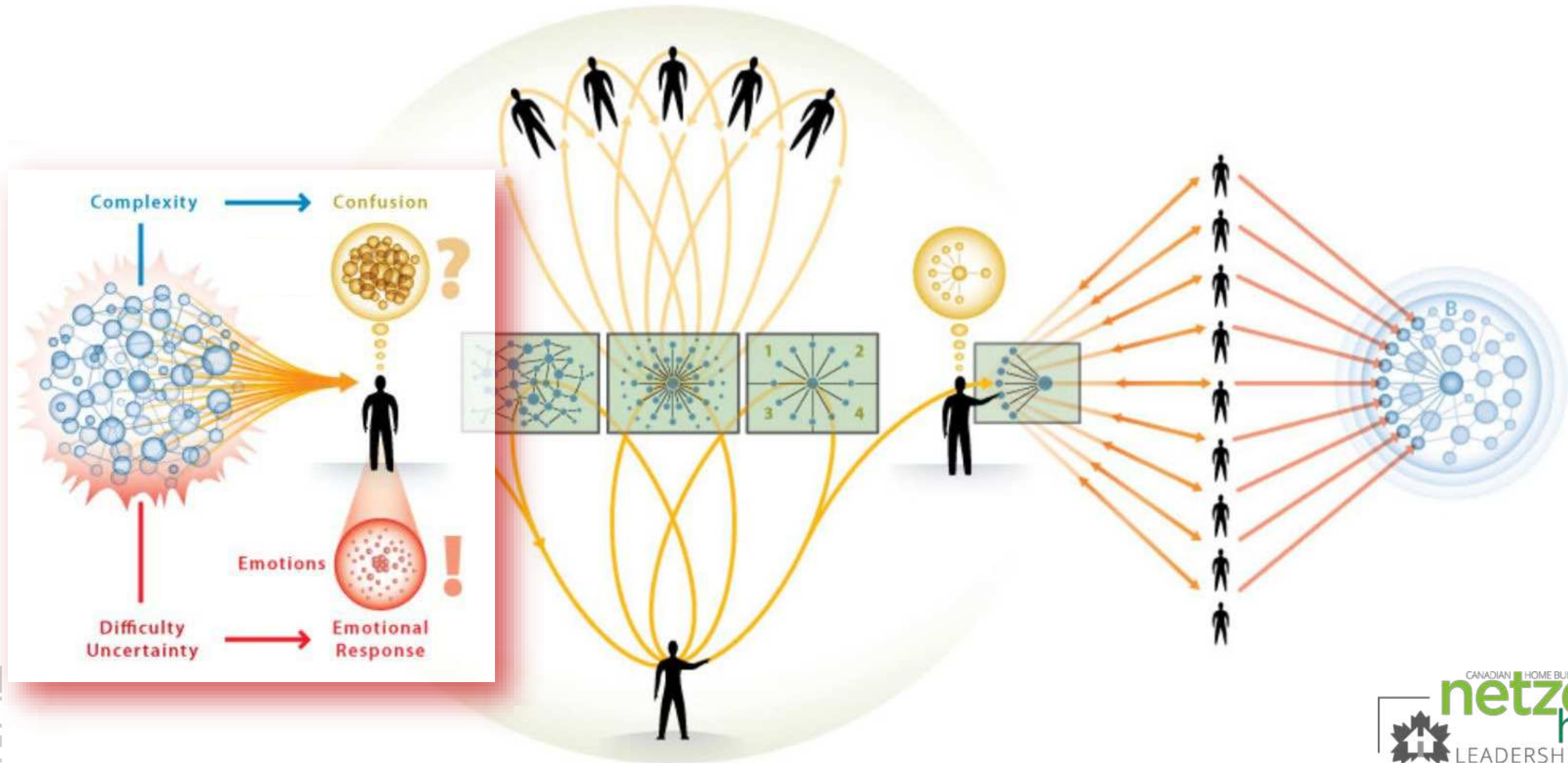
2 Sessions

Integrating Resilience and Adaptation



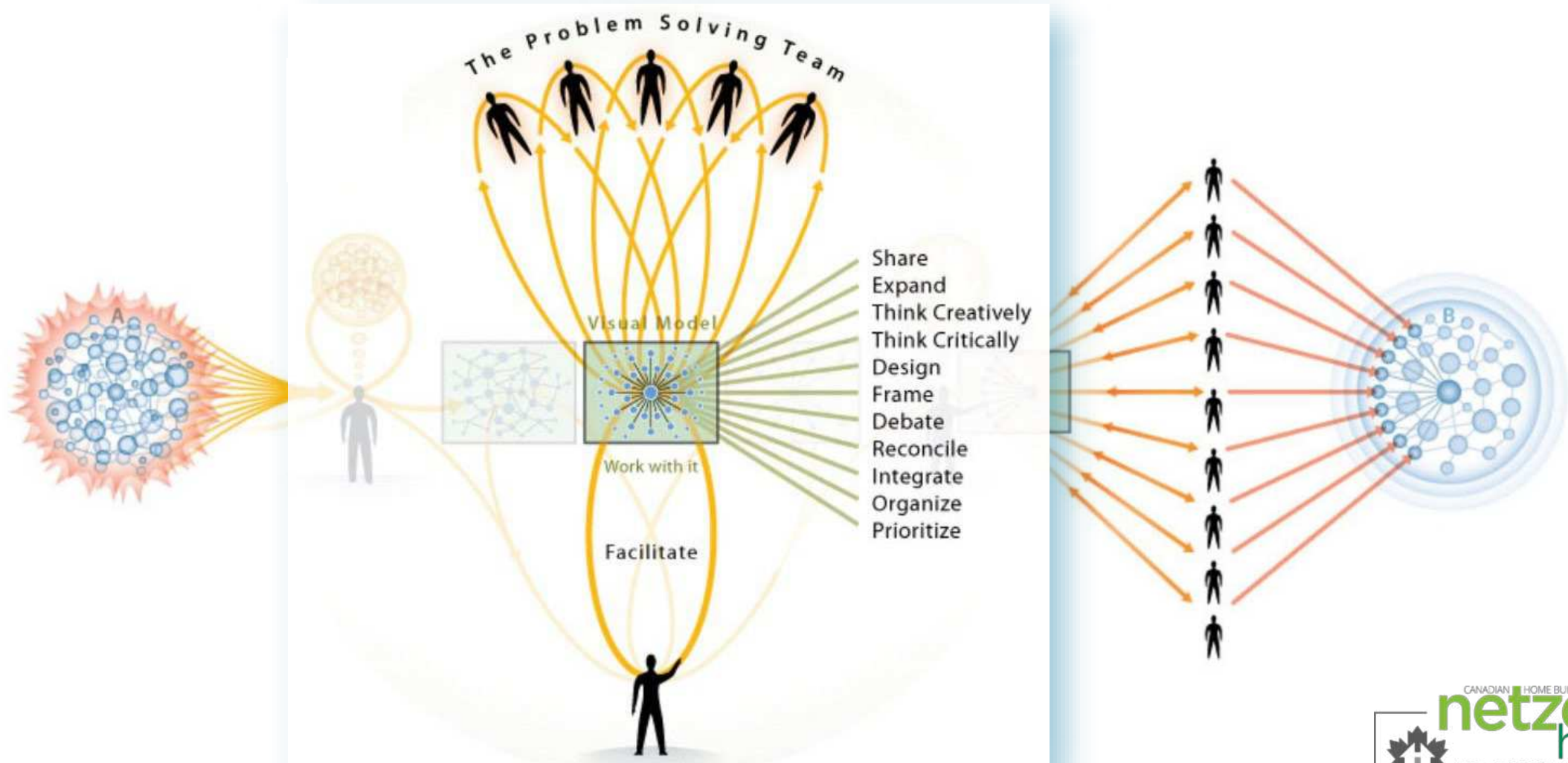
2 Sessions

Integrating Resilience and Adaptation



Session 3

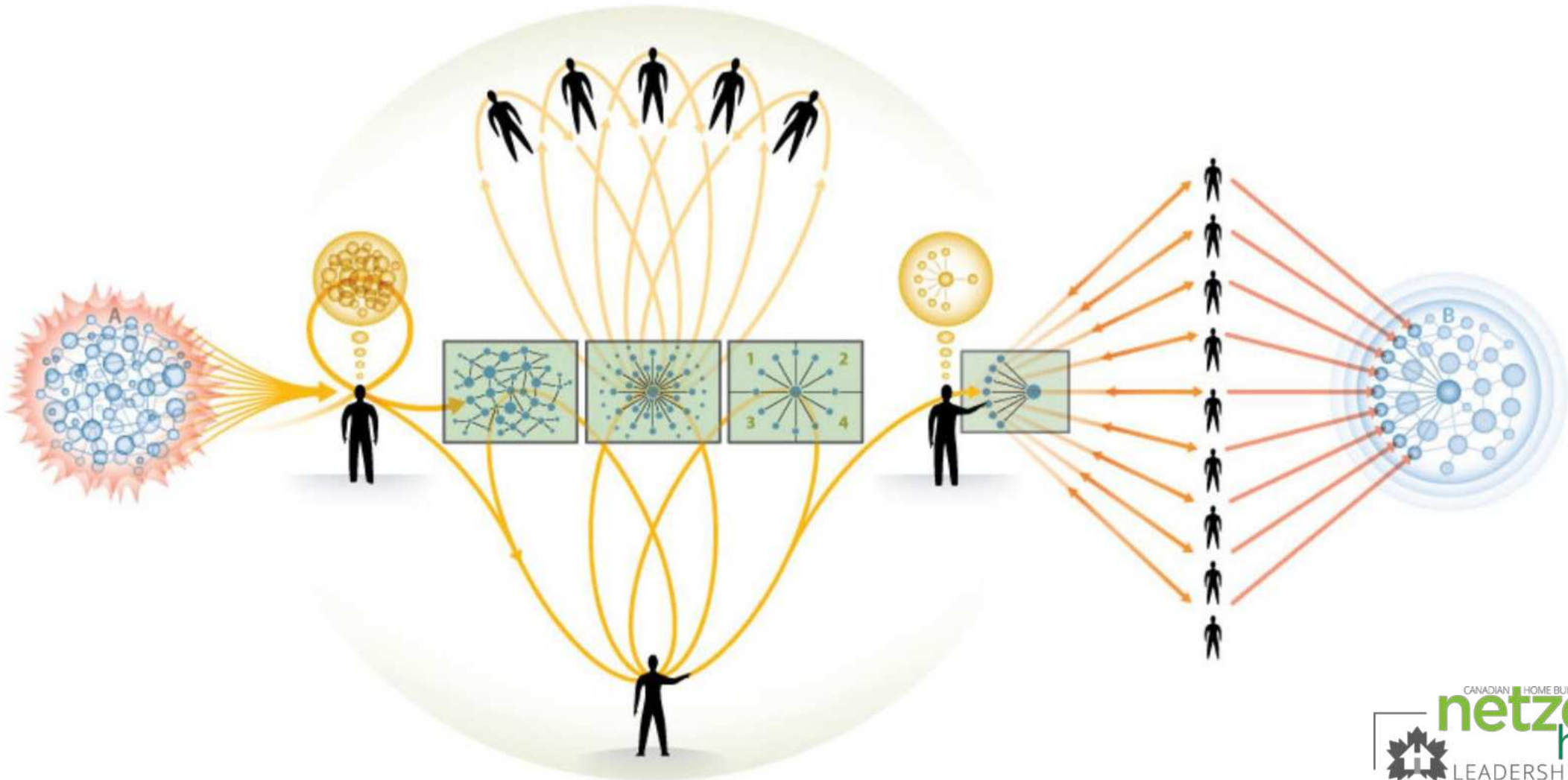
Integrating Resilience and Adaptation

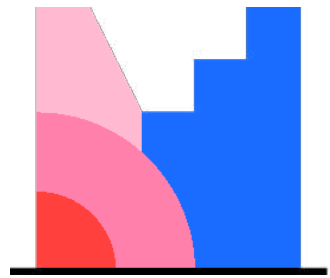


Session 3 – Who is doing what?

Session 3

Integrating Resilience and Adaptation





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Poll # 23 21 62 5



**Stephanie Coleman, Sustainable
and Resilient Housing Industry
Lead, LEEP, NRCan**

CANADIAN HOME BUILDERS' ASSOCIATION
netzero
home
LEADERSHIP SUMMIT



LEEP Sustainable Resilient Housing Tool

Stefanie Coleman: Stefanie.coleman@nrca-rncan.gc.ca

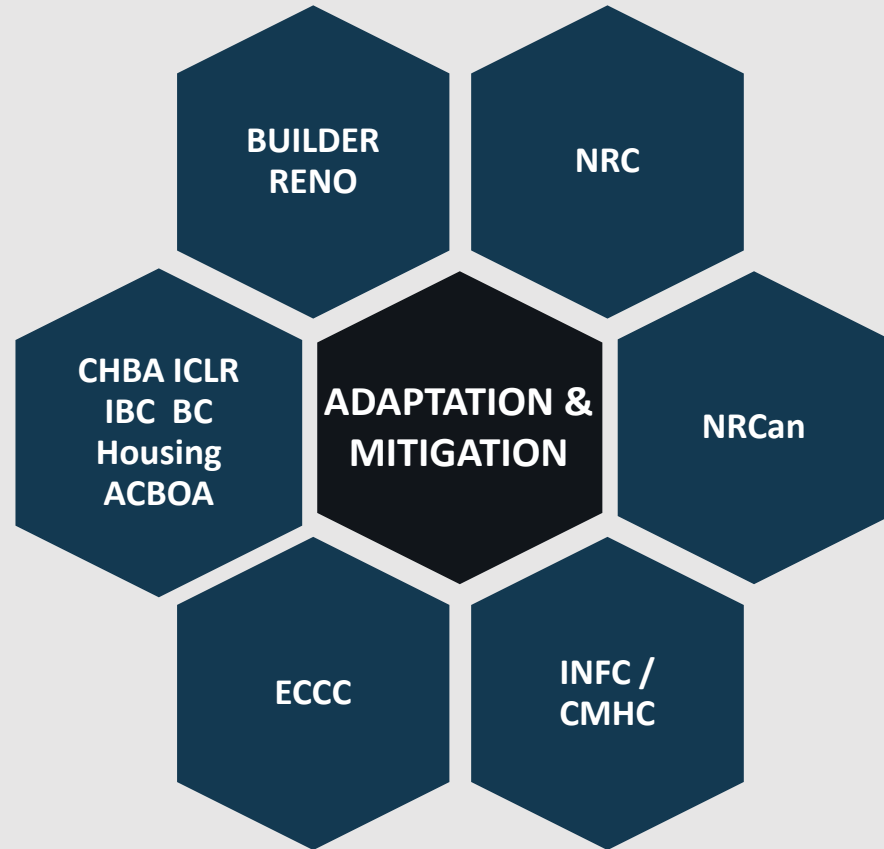


Natural Resources
Canada

Ressources naturelles
Canada

Canada

LEEP SUSTAINABLE RESILIENT HOUSING TOOL STEERING COMMITTEE



ECCC (Environment & Climate Change Canada)

NRC (National Research Council)

INFC (Infrastructure Canada)

CMHC (Canada Mortgage and Housing Corp)

NRCan (Natural Resources Canada)

4 Largest Residential Home Builders

CHBA (Canadian Homebuilders' Association)

ICLR (Institute for Catastrophic Loss Reduction)

BC Housing

New: ACBOA (Alliance of Canadian Building Officials' Association)

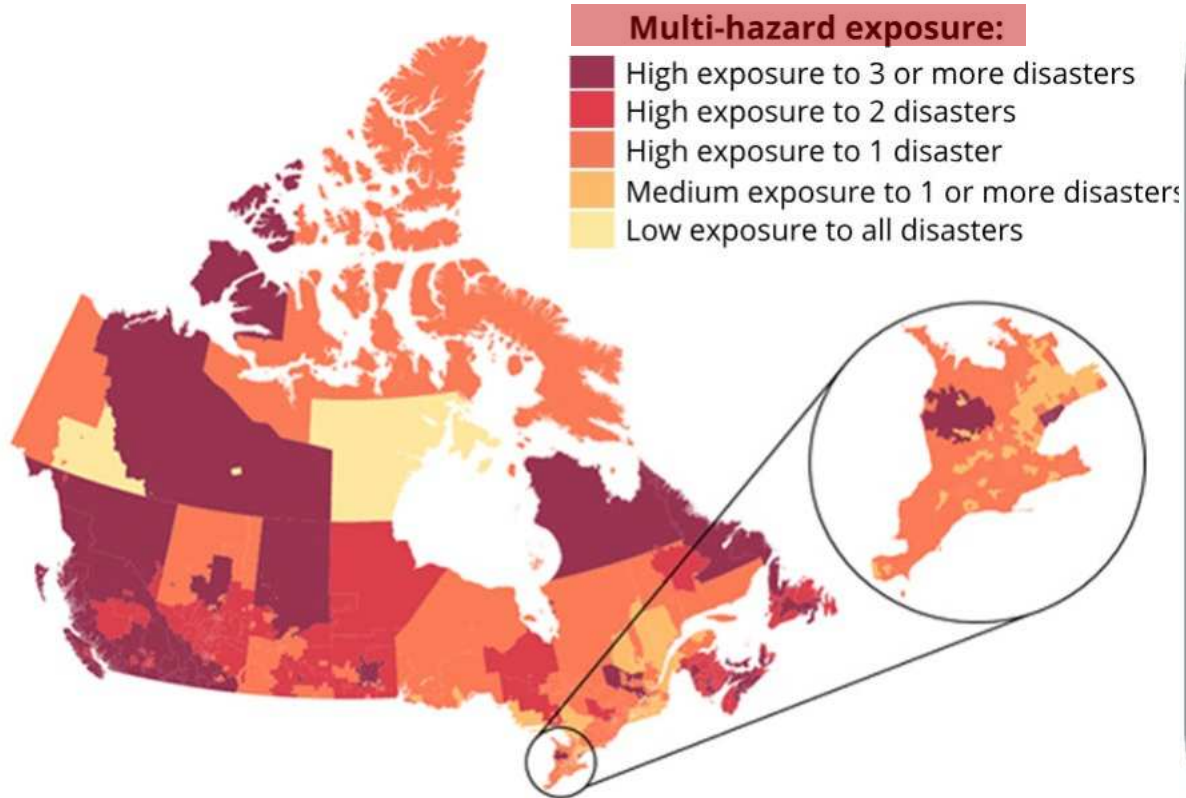
New: IBC (Insurance Bureau of Canada)

New: Others to be announced

ESCALATING CLIMATE-RELATED CATASTROPHIC EVENTS

Chart 2: Exposure to different types of natural disasters varies by region across Canada

Multi-hazard exposure index, by forward sortation area

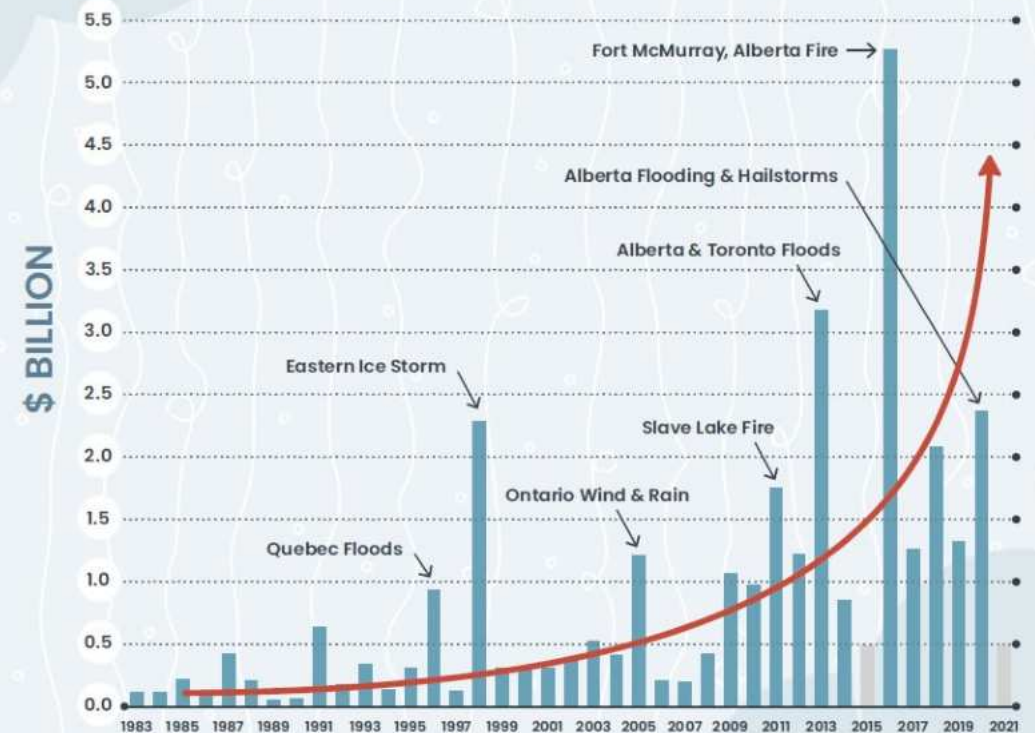


Data available as: [CSV](#), [JSON](#) and [XML](#)

Sources: Canadian Disaster Database and Bank of Canada calculations

(Bank of Canada, 2021)

Insured Catastrophic Losses in Canada



(Crew, n.d.)

CLIMATE-RELATED DISASTERS: TRIPLE THREATS



(Aalders, 2023)

Flooding – Nova Scotia



(Theoret, 2022)

Hurricane Fiona – Nova Scotia

CLIMATE-RELATED DISASTERS UNDERMINE NET ZERO GAINS

HOW MANY TONNES OF CARBON WERE SAVED?



(Phillips, 2023)

Tornado - Barrie



(Hayward, 2016)

Wildfire – Fort McMurray

- First of its kind
- **Builder/renovator-centric**
- Guided approach to **navigate complex information**
- Explores **buildability** and **affordability**
- **Enables builders** to provide feedback that informs future policy

About LEEP's Sustainable Resilient Housing Tool



LEEP SUSTAINABLE RESILIENT HOUSING TOOL / WORKSHOP

Module 1

**Hazard Exposure
and Climate
Projections**

Module 2

Risk Identification

Module 3

**Land Use Planning
& Considerations**

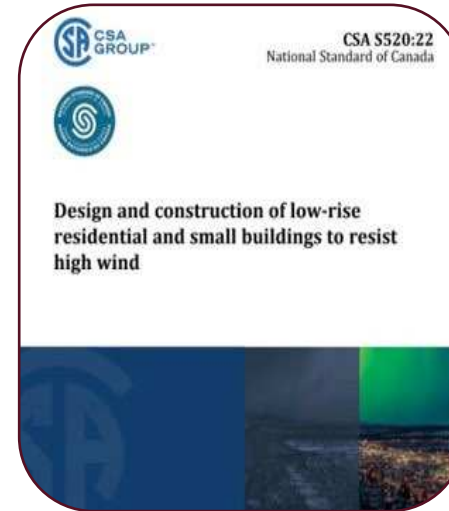
Module 4

**Adaptation
Measures**

Module 5

**Implementation
Plans & Pilots**

Guided interactive workshops with roundtable discussions



Learnings from workshops shared with others for consideration



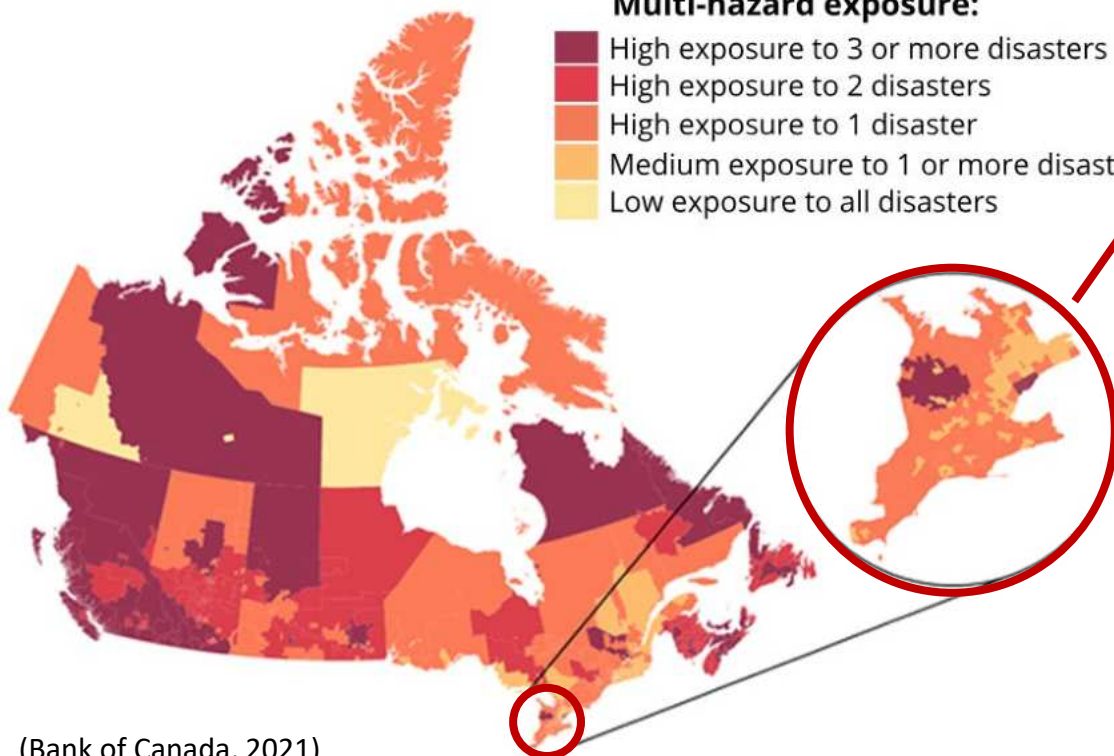
MODULE 1 – IDENTIFY HAZARDS IN YOUR REGION

Chart 2: Exposure to different types of natural disasters varies by region across Canada

Multi-hazard exposure index, by forward sortation area

Multi-hazard exposure:

- High exposure to 3 or more disasters
- High exposure to 2 disasters
- High exposure to 1 disaster
- Medium exposure to 1 or more disasters
- Low exposure to all disasters



(Bank of Canada, 2021)

Data available as: [CSV](#), [JSON](#) and [XML](#)

Sources: Canadian Disaster Database and Bank of Canada calculations

Warming Temperatures & Extreme Heat	Heavy Rainfall & Urban Stormwater Flooding	Heavy Snow, Increased Ice & Freeze-Thaw
Water Shortage & Drought	Interface Wildfire	Wildfire Smoke & Air Quality Impacts
Coastal Flooding (sea level rise, saltwater spray/intrusion, erosion)	River Flooding (debris flow, ice jamming, erosion)	Lake Flooding (erosion)
High Winds & Storms (high winds, conductive storms, hail)	Extreme Storms (tornado, hurricane, post-tropical storms)	Thawing Permafrost
	Slope Instability & Landslide	...and more?

MODULE 2 – IDENTIFY RISKS TO HOMES

**Warming
Temperatures &
Extreme Heat**

**Interface Wildfire
& Smoke**

**Heavy Rainfall &
Urban Stormwater
Flooding**

**High Winds &
Storms**
(high winds, conductive
storms, hail)

Extreme Storms
(tornado, hurricane,
post-tropical storms)





MODULE 3 – CLIMATE-CHANGE IMPACTS ON LAND USE, PLANNING & DEVELOPMENT CONSIDERATIONS

- Warming Temperatures & Extreme Heat
- Interface Wildfire & Smoke
- Heavy Rainfall & Urban Stormwater Flooding
- High Winds & Storms (high winds, conductive storms, hail)
- Extreme Storms (tornado, hurricane, post-tropical storms)

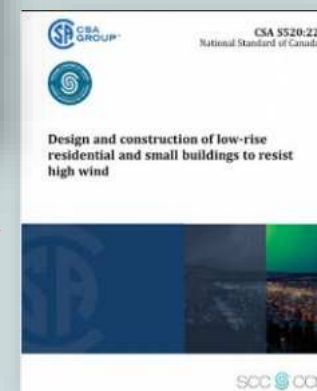
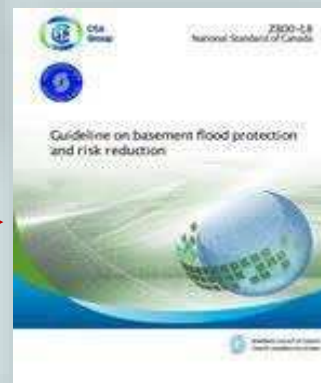
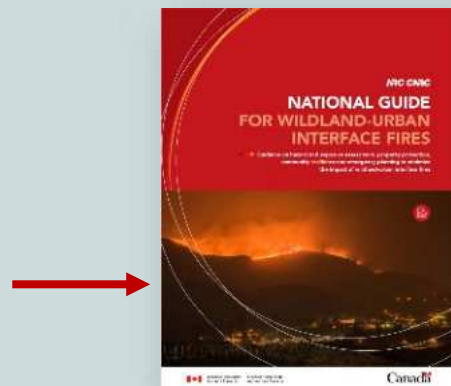
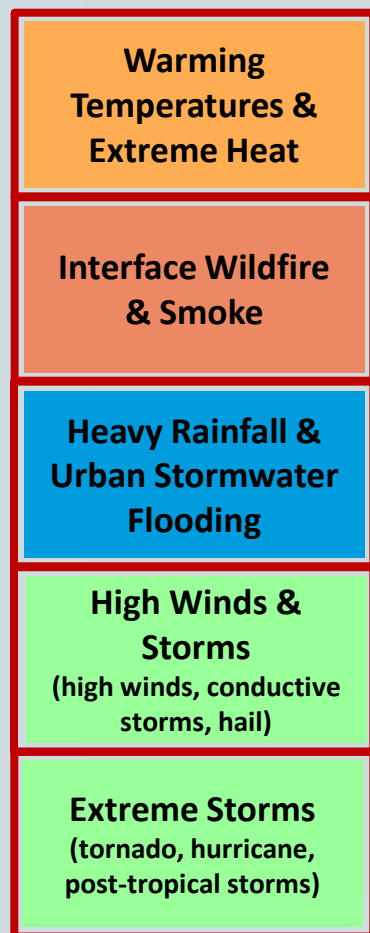


On the lot/site

In the neighbourhood/subdivision



MODULE 4 – CLIMATE-RELATED HAZARD-SPECIFIC STANDARDS & GUIDELINES



Considerations:

- Buildability
- Affordability
- Co-Benefits/Maladaptation
- Trade-offs
- Implementation Plans

Wildfire Resistant Housing

British Columbia – April-June 2024

Lucas Coletta, Senior Engineer – LEEP Team

Email: lucas.coletta@nrcan-rncan.gc.ca



Natural Resources
Canada

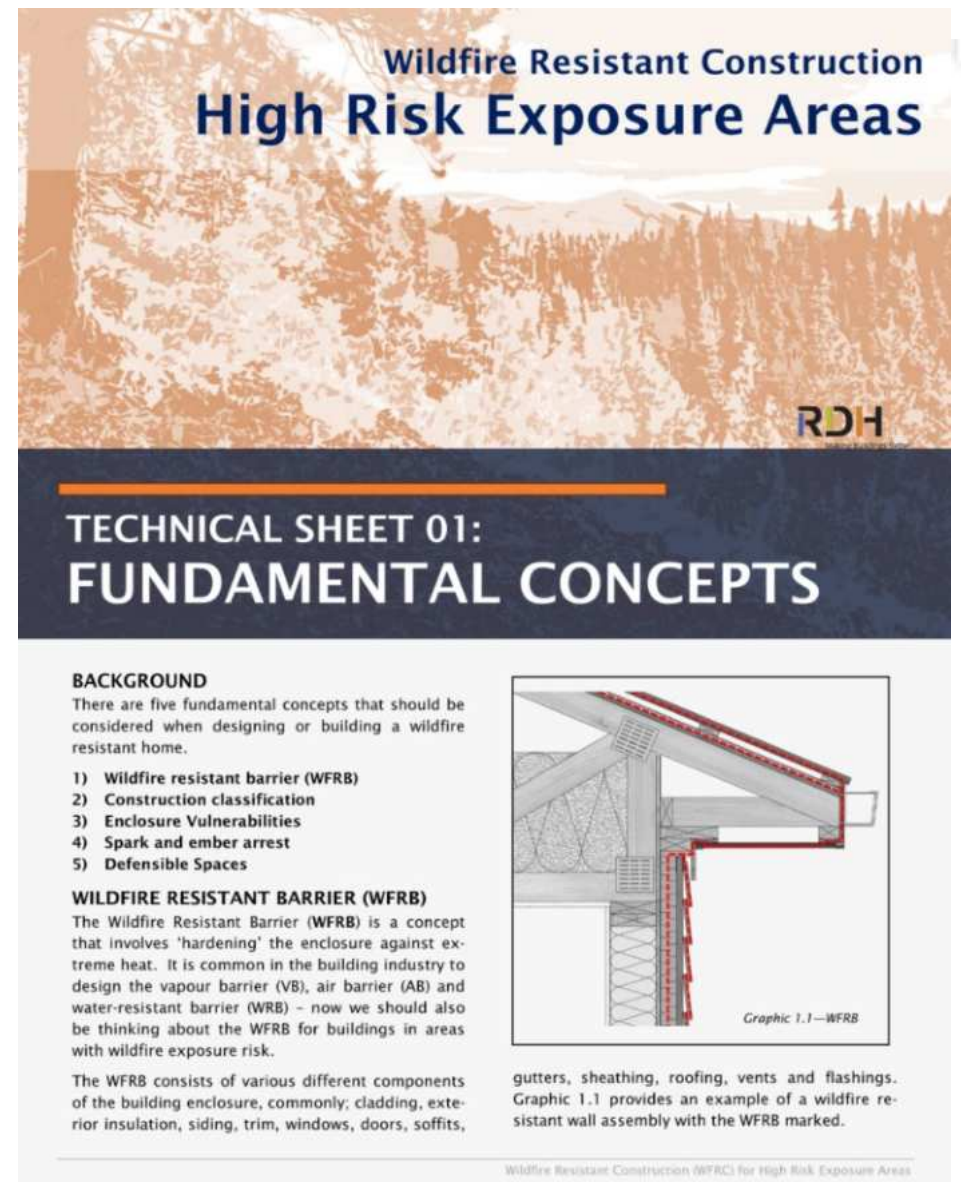
Ressources naturelles
Canada

Canada

NRCan Resource Guides

First of its
kind.

U.S. is using
this Info.

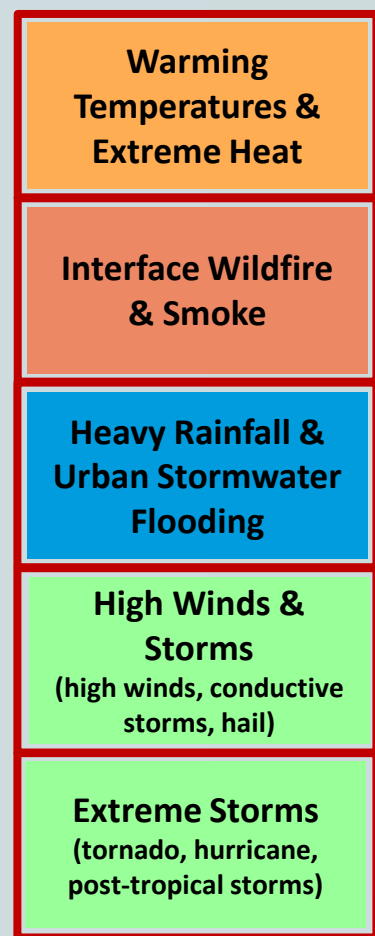


Natural Resources
Canada

Ressources naturelles
Canada

Canada

MODULE 5 – BRINGING IT ALL TOGETHER



Adaptation



Mitigation



Considerations:

- **Buildability**
- **Affordability**
- **Co-Benefits/Maladaptation**
- **Trade-offs**
- **Implementation Plans**



Workshop Pilot stage wrap-up – June 2024
Ready for roll out – Fall 2024
Proposed locations: London, Durham, Ottawa



Canada

CLIMATE
RESILIENCE
ACTIONS



Health
Canada

Santé
Canada

EFFORTS TO DEVELOP MAXIMUM INDOOR TEMPERATURE GUIDANCE

- Supporting physiological research on the **health impacts of exposure to extreme indoor temperatures** and **safe indoor temperature limits**.
- Developing **evidence-based guidance** to protect exposure to unsafe indoor temperatures
- Collaborating with NRC on indoor heat considerations
- International collaboration (World Health Organization and Global Heat Health Information Network) to identify **evidence-based best practices** in protecting health from extreme indoor heat.



INTEGRATED FLOOD RISK MANAGEMENT (IFRM)

Integrated flood risk management (IFRM) is a systems-based framework that promotes sustainable, long-term flood resilience by combining social, economic, financial, environmental, and institutional solutions.

IFRM requires coordination and complementarity across its elements, working toward common risk management objectives.

Public Safety Canada is advancing some components of IFRM, which were funded under Budget 2023 and the National Adaptation Strategy to:

- 1 Implement a **modernized DFAA*** program, which would incentivize mitigation efforts
- 2 Stand-up a low-cost **Flood Insurance Program** aimed at protecting high-risk households
- 3 Identify **Flood Risk Areas** to inform federal spending
- 4 Create a publicly accessible **online flood risk awareness portal** for Canadians
- 5 Conduct data-based **flood risk modelling** and complete **flood hazard maps** of higher risk area

*Disaster Financial Assistance Arrangements



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

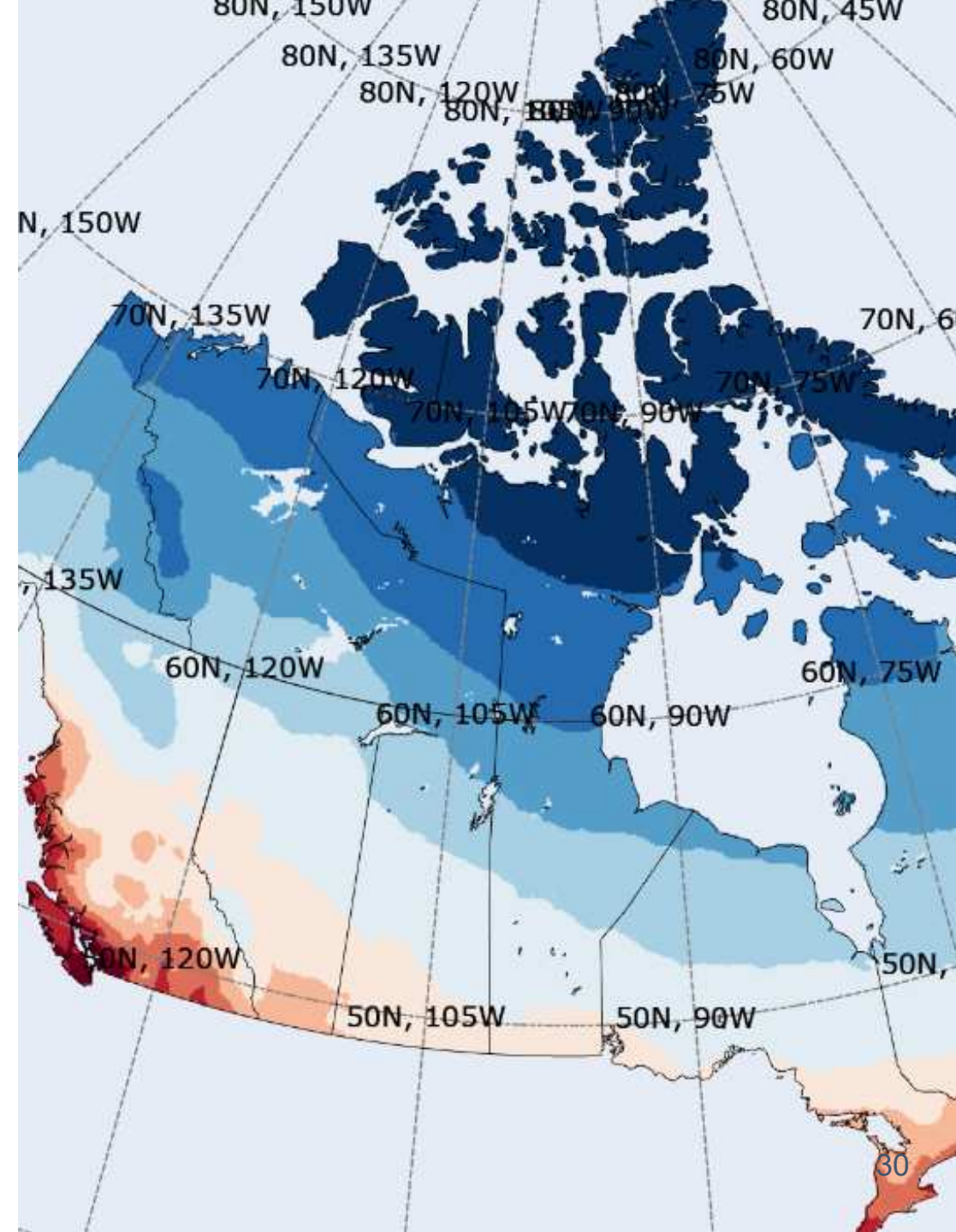
CANADIAN CLIMATE DATA

COMING SOON! Future Building Design Value Summaries:
Future climate-adjusted design values for over 660 locations in Canada

ClimateData.ca Learning Zone - Designing Future-Ready Buildings: Educational resource covering the importance of incorporating future climate data into building design.

ClimateData.ca Building Sector Module: Guidance for the Canadian building sector in using climate data, highlighting the impacts of climate variability and change on buildings.

Building Climate Zones Maps: Maps guide energy-efficient building design, ensuring Climate Zones are accurately defined to meet future heating and weather demands.





Natural Resources
Canada

Ressources naturelles
Canada

Canadian Forest Services

WILDFIRE PROGRAMS

NEW! Canadian Wildland Fire Prevention and Mitigation Strategy

Wildfire Resilient Futures Initiative (2023):

Resilient Communities through FireSmart program: increase the use of the FireSmart Canada program

Build and Mobilize Foundational Wildland Fire Knowledge program: grants/contributions targeting risk reduction measures.

Coming Soon! Centre of Excellence for Wildland Fire Innovation and Resilience: Resource to advance wildland fire knowledge and technology mobilization.

WILDFIRE AND HUMAN BEHAVIOUR

Program of Applied Research on Climate Action (PARCA)

partnership between PCO-IIU, NRCan, and ECCC:

Research on Canadians' knowledge and behaviours related to wildfire risk and identifying ways to increase adoption of mitigation measures (e.g., FireSmart™).



Key Take Aways

Stefanie Coleman

Stefanie.coleman@nrcan-rncan.gc.ca

- Climate impacts are **escalating** and threatening homes, people, the economy and can undermine our energy and carbon reduction efforts,
- There is a lot of research being done,
- But, there are a lot of things we don't know, like the **affordability** and **buildability** of MITIGATION & ADAPTATION MEASURES,
- Consider **contributing to our collective learning** by participating in the LEEP Sustainable Resilient Housing Workshop / Tool project and share your perspectives that can inform future policy.

Canada



**Ericha Moores,
Senior Policy Analyst,
Infrastructure Canada**



Infrastructure
Canada

A Vision for Resilience: Policy Direction and Solutions

Ericha Moores
Infrastructure Canada



Canada 

COMMUNITIES ACROSS CANADA ARE ALREADY EXPERIENCING IMPACTS OF CLIMATE CHANGE

The cost of damage to infrastructure has grown steadily higher - combined losses per Canadian weather-related disaster have increased by 1250% since the 1970s.



*Top: thawing permafrost, Hershel YT 2021; Flash floods, McKay Section, NS, 2023.
Bottom: Wildfires, Lytton, BC, 2021; Hurricane Fiona, Port Aux Basques, NFL, 2022.*

RESILIENCE IS A DRIVER FOR COLLABORATION BASED ON MUTUAL UNDERSTANDING OF URGENT NEED TO ADAPT



- Community-scale resilience projects are essential, but they are not sufficient – home-builders are an integral part of how we will achieve whole-of-society resilience.
 - Urban parks address extreme heat, but builders choose materials that keep home interiors safe and comfortable.
 - Stormwater management infrastructure, but builders choose the upfront cost of a backflow valve to prevent basement flooding.
- Resilience investments are also smart use of funds: proactive adaptation yields major benefits and can **return \$13-\$15 in benefits for every dollar spent** (CCI).

CANADA'S FIRST NATIONAL ADAPTATION STRATEGY SETS DIRECTION FOR DECADES TO COME

Overarching vision for resilience in Canada

All of us living in Canada, our communities, and the natural environment are resilient in the face of a changing climate. Our collective adaptation actions enhance our well-being and safety, promote justice, equity, and reconciliation with Indigenous Peoples, and secure a thriving natural environment and economy for future generations.

Underpinned by **guiding principles** for fair, inclusive, and equitable adaptation



Respect jurisdictions and uphold Indigenous rights



Advance equity and environmental justice



Take proactive, risk-based measures to reduce climate impacts before they occur



Maximize benefits and avoid maladaptation

Transformational **goals, objectives, and targets** under five key systems



FUTURE INVESTMENTS CAN ADVANCE THE GOALS & OBJECTIVES OF THE NATIONAL ADAPTATION STRATEGY

Transformational Goal

By 2050, all infrastructure systems are climate-resilient and undergo continuous adaptation to adjust to future impacts to deliver reliable services to all.

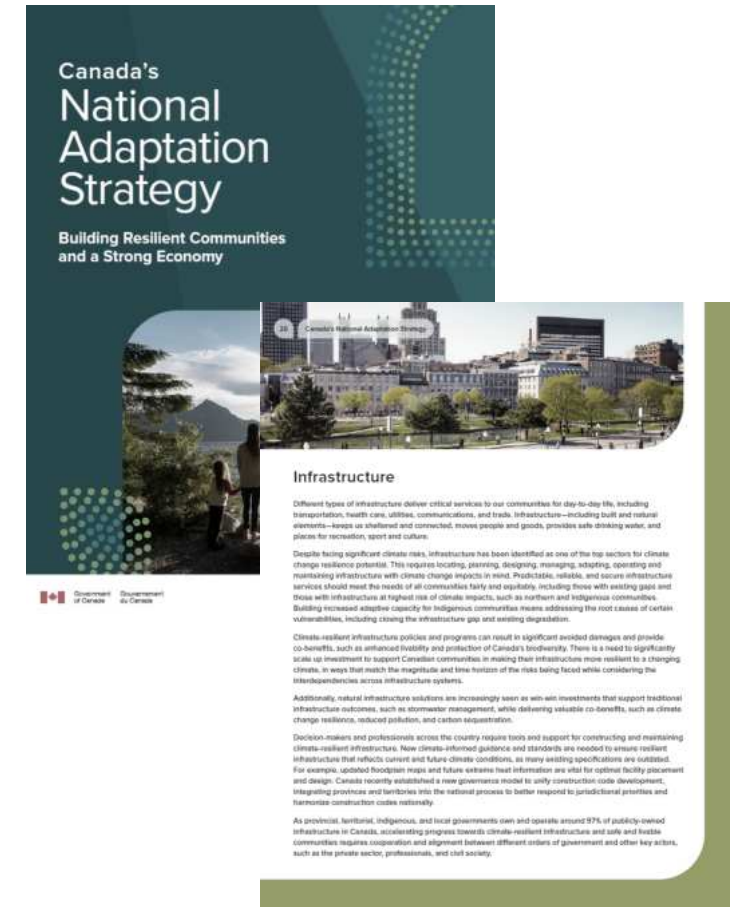
National Target

By 2030, 80% of public and municipal organizations have factored climate change adaptation into their decision-making processes.

New Priorities

To move towards **systems-based approaches** that consider assets within and across infrastructure systems, highlighting interdependencies and infrastructure services; and

To **prioritize benefits for marginalized communities** at highest risk of climate change impacts.





Target: By 2027, 70% of the members of relevant professional associations... have the capacity to apply climate change adaptation tools and information and communicate the business case for adaptation measures...

**BUILDERS IN THE VISION FOR
RESILIENCE**

EVERY INFRASTRUCTURE ASSET – INCLUDING HOUSING – CAN INCREASE RESILIENCE OF COMMUNITIES



Keep new buildings out of high-risk areas and prioritize locally-specific knowledge on current and future hazards.

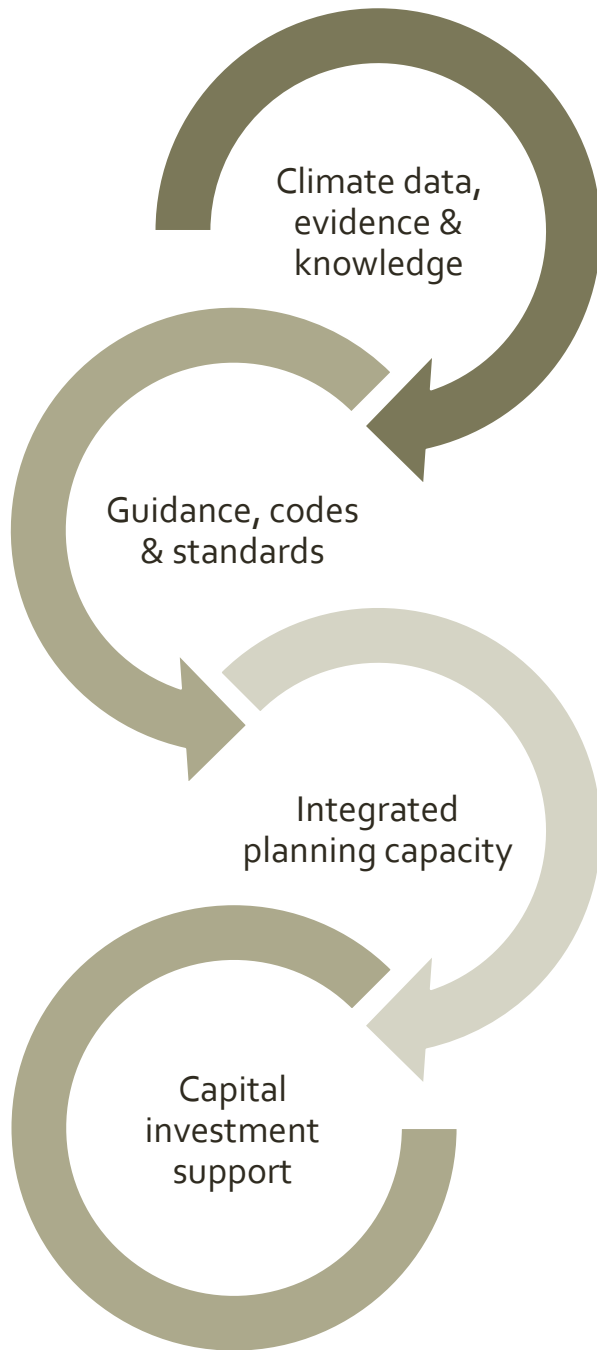


Build or adapt buildings that will be safe, healthy, and affordable under changing conditions.

If you think it's expensive to build it right, try building it twice.

*The Honourable Sean Fraser
Minister of Housing, Infrastructure and Communities*

A VALUE CHAIN APPROACH TO BUILDING RESILIENCE



Infrastructure Canada supports resilient infrastructure and communities by taking a 'value chain approach,' that moves knowledge to action through a strategic sequence of investments.

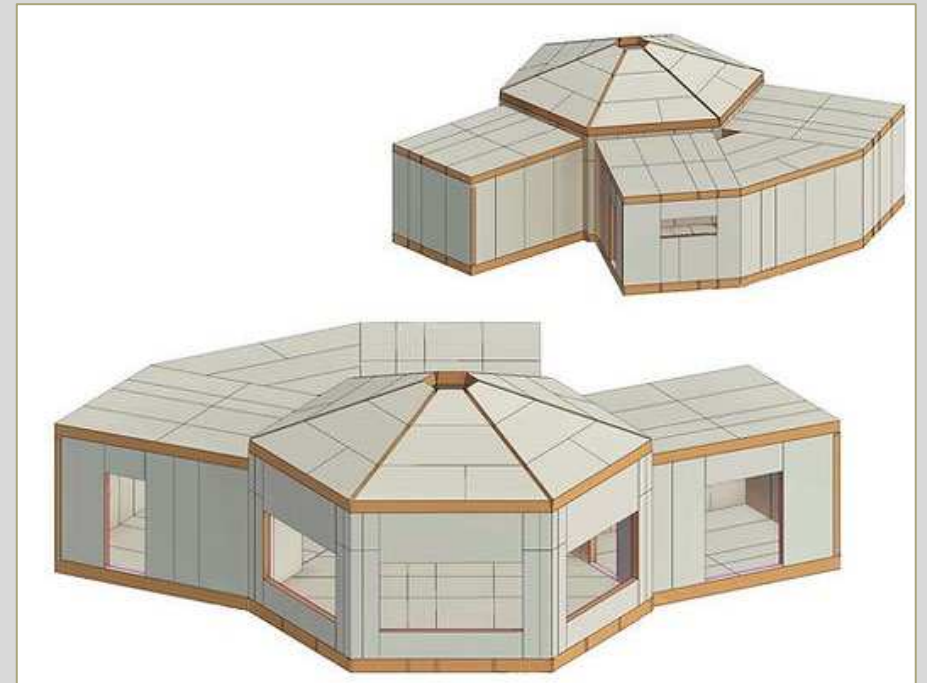
- **Resilience value chain:** A model that demonstrates key areas of work, and the relationship between them, to accelerate implementation of solutions.
- **Informed investor approach:** Encouraging infrastructure investors to make informed decisions.

RESEARCH AND DATA TO SUPPORT BUILDERS

- Research and Knowledge Initiative (RKI) is a national, merit-based contribution funding program (\$10 million) **to support data and research** on issues related to public infrastructure and communities.
- There were 7 resilience-focused projects funded, including projects that have provided flood maps and other hazard data to help builders understand local hazards.

PROJECT SPOTLIGHT

Nunamiutuqaq (Building from the Land) is an RKI-funded project designed to build a robust knowledge base around effective, culturally-informed designs and materials.



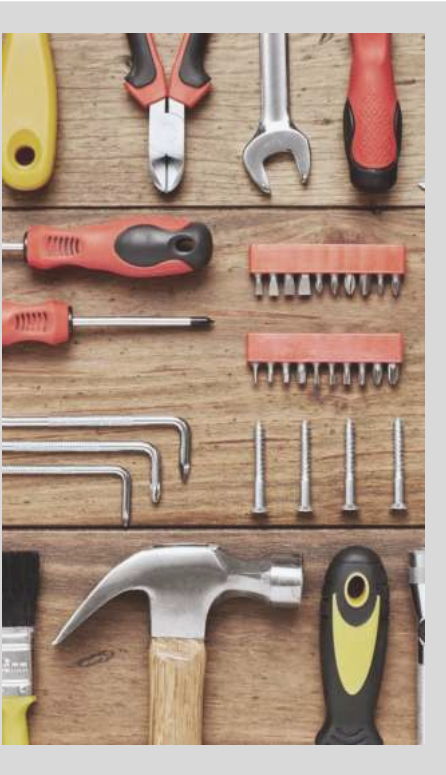
Source: Pitquhirnikkut Ilihautiniq

CLIMATE-INFORMED CODES, STANDARDS AND GUIDANCE TO SUPPORT COMMUNITY PROTECTION

- Since 2016, over \$160 million invested to **integrate climate resilience** into national guidelines, standards and codes, and **create future-climate design values**.
- Priority areas: nature-based solutions, flooding, extreme heat, resilient dams, Wildland-Urban Interface design, transit, Northern region and integrated risk management.
- There is guidance available right now :
 - 65 climate informed codes, standards, guidance, and decision-support tools
 - future-climate design data in 680 locations across Canada.

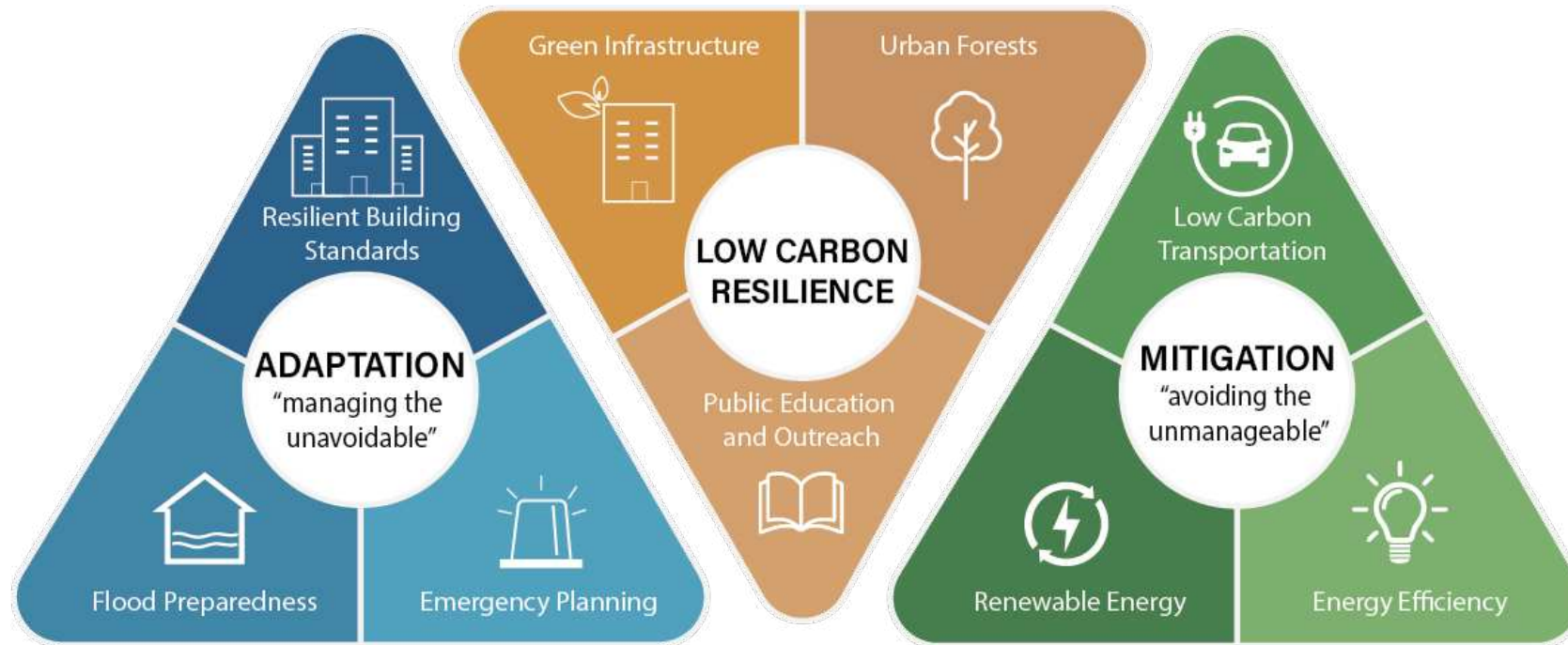


INTEGRATED PLANNING SUPPORTS AND SERVICES ARE FORTHCOMING



- The climate toolkit initiative is a five-year program (2023-28) **to support smart climate action for low-carbon and resilient infrastructure investments.**
- Support communities and practitioners to meet climate resilience and mitigation requirements across new infrastructure funding programs and enhance climate-informed guidance, standards, and codes.
- Enable practitioners, owners and investors with capacity through proven climate tools and supports to develop funding ready projects.
- Serve as a centre of expertise.

TOOLKITS TO SUPPORT LOCAL COMMUNITIES ACHIEVE LOW-CARBON, CLIMATE RESILIENT INFRASTRUCTURE



National Adaptation Strategy: Starting in 2024, resilience to climate change impacts factored into all new federal infrastructure funding programs.

2050 Net Zero Emissions: Reduce emissions by 40%-45% against 2005 levels by 2030. Achieve net zero emissions by 2050.

TOOLKITS WILL INVOLVE THREE CORE COMPONENTS

A new continuum of federal climate & infrastructure supports for local communities across Canada



New web-based open access tools & resources



Direct support for inquiries on tools & requirements



Advise municipalities on climate options for projects

HOW TO GET INVOLVED

Climate Toolkits and Solutions

Provide feedback, suggest useful tools and resources, receive updates:



Or email us at:

Climate-Infra-Climat@infc.gc.ca

Infrastructure & Buildings Working Group

Read the latest
IBWG Adaptation
State of Play Report
here:



If you would like to join the group,
attend showcases, and exchange
leading practices,
contact Chad Nelson at:
chad.nelson@infc.gc.ca



THANKYOU!

Resilience is a collective challenge, and INFC is committed to supporting the work of keeping our communities safe, healthy, and thriving.

If you have any questions or comments about the initiatives discussed here, please reach out to me at:

ericha.moores@infc.gc.ca





**Janette Meyrick,
Evaluation Officer,
CCMC, NRCan**



NRC-CMRC

Climate Resilient Built Environment Initiative



Janette Meyrick BBSoc, BSS

Evaluation Office; co-Lead - Climate Resilient Product Assessment Pilot
Canadian Construction Materials Centre (CCMC)
National Research Council (NRC)

CHBA NZ Summit
June 2024

WHO IS DOING WHAT?

Is it enough to get us there?

- How is government helping industry prepare?
- What work is being done to ensure that resilient homes are also affordable?
- And how are departments/agencies working together?



NRC's Climate Resilience Initiatives

Climate Resilient Buildings and Core Public Infrastructure (CRBCPI)

2016 – 2021

Infrastructure Canada; \$42.5M;

Climate Resilient Built Environment (CRBE)

2021 – 2026

Infrastructure Canada; \$35M;

2023 – 2028

Government of Canada Adaptation Action Plan; \$30.2M

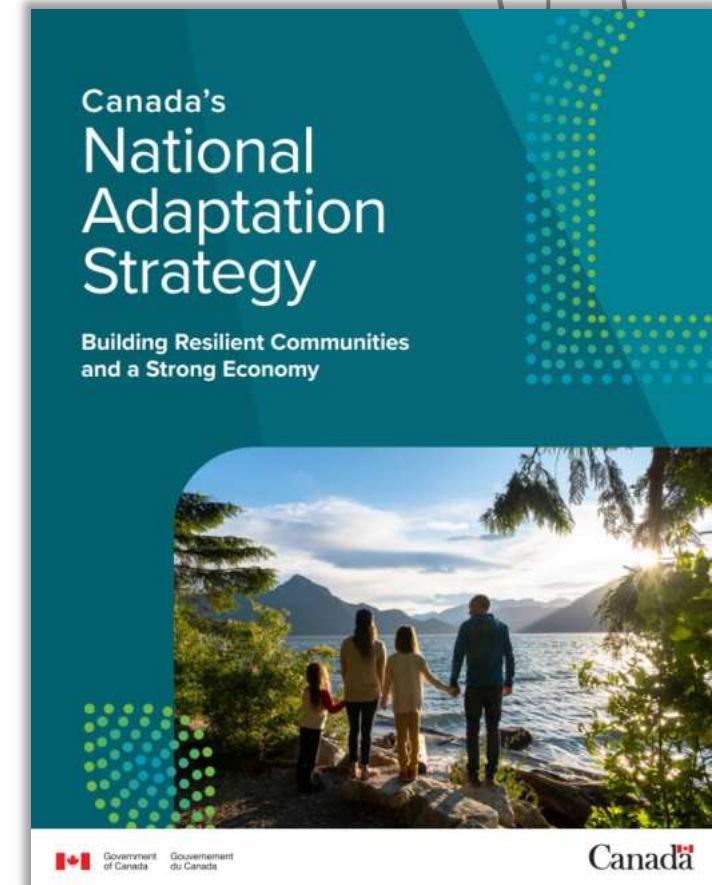


National Adaptation Strategy & Government of Canada's Adaptation Action Plan



National Adaptation Strategy Infrastructure target:

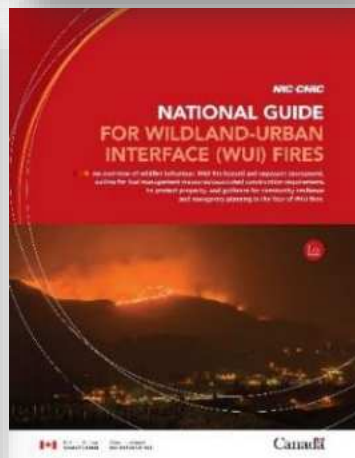
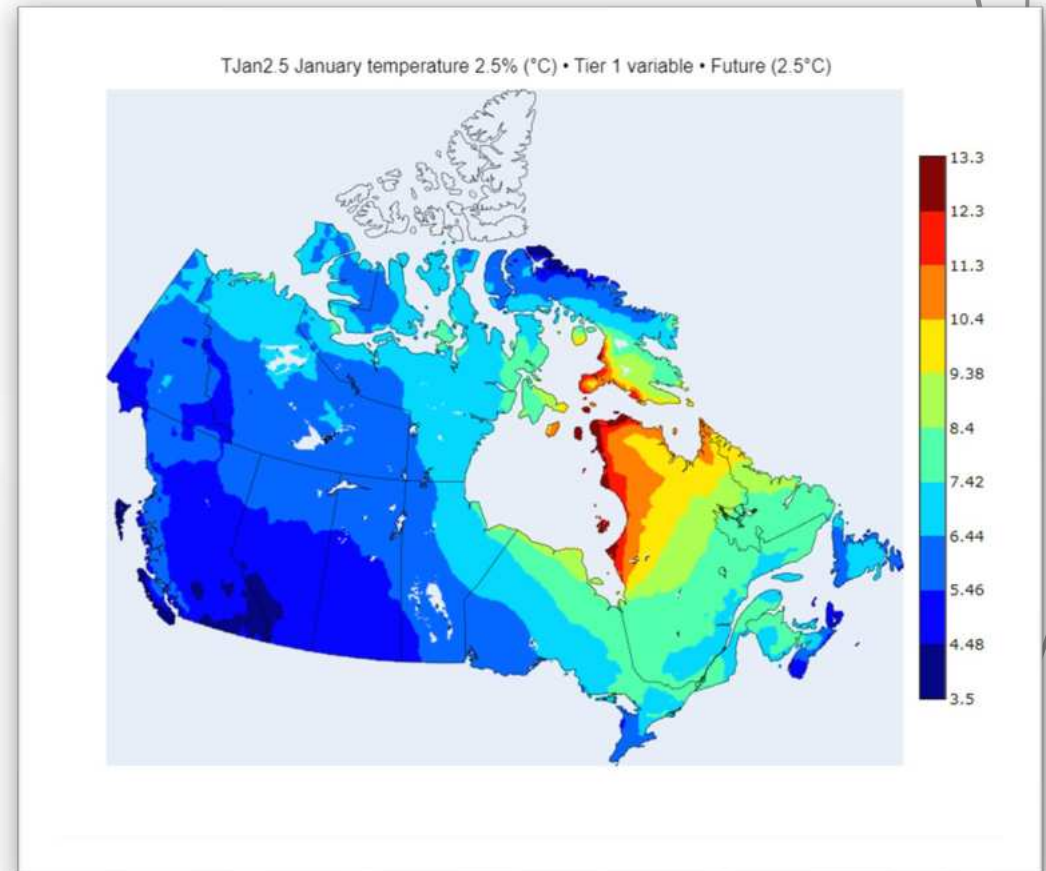
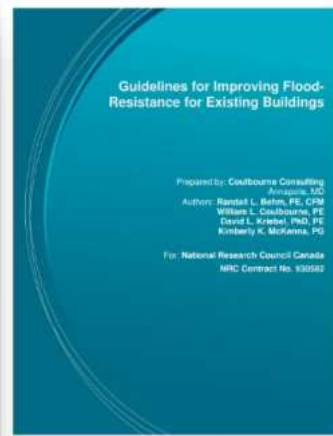
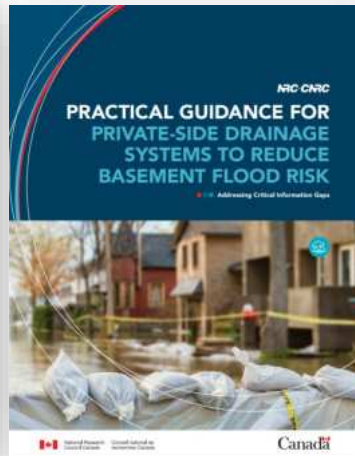
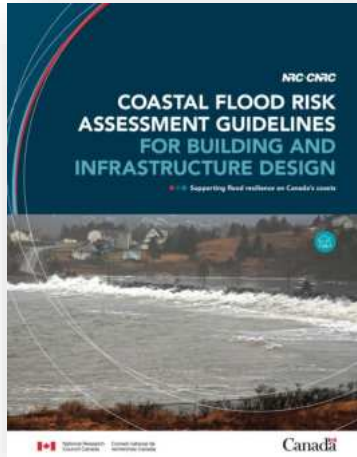
2030: Robust guidance, codes, and standards addressing top climate change risks for key public infrastructure systems are available to all infrastructure decision-makers.



NRC Climate Resilient Research Areas



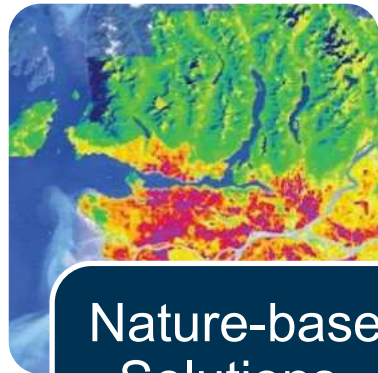
A suite of guides, data, and standards available to inform resilient construction in Canada



Ongoing Projects under Climate Resilient Built Environment (CRBE) Initiative



Nature-based
Solutions -
Flooding



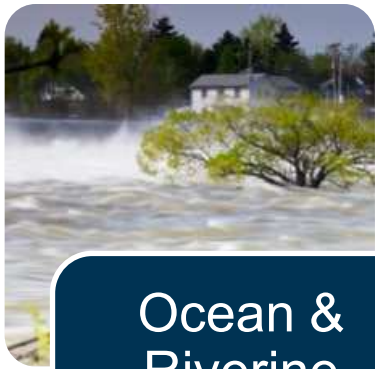
Nature-based
Solutions –
Urban Heat



Guidance for
Indigenous
and Northern
Communities



Core Public
Infrastructure
Management



Ocean &
Riverine
Flooding



Extreme
winds and
tornadoes



Tools:
Climate RCI



Tools:
Hygrothermal
database

Newly Launched Activities and Focus Areas Under the National Adaptation Strategy funding



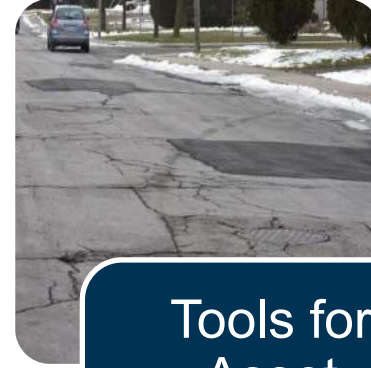
Climate resilient product evaluations



Resilient Residential Retrofit



Informing Resilient Building Codes



Tools for Asset Management



River Ice and Flooding



Flood Barriers



Accelerating Nature-Based Solutions



Addressing Remaining Climate Data Gaps



Enabling Resilience in the National Model Codes



In Summary

NRC Climate Resilient Initiatives

- Ongoing efforts over the last eight years
- Over 70 active projects
- Collaboration with other government agencies, national, and international experts
- New and updated guides, codes, tools, and standards
- Informing Codes and policy discussions



NRC-CNRC

Thank you



Janette Meyrick BBSc, BSS

Evaluation Office; co-Lead, Climate Resilient Product Assessment Pilot
Canadian Construction Materials Centre (CCMC)

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National Research
Council Canada

Conseil national de
recherches Canada

Canada



**Wilma Leung, Senior Manager,
Technical Research & Education,
BC Housing**





Net Zero Leadership Summit 2024

Session 3 - WHO'S DOING WHAT? And is it enough to get us there?

June 11, 2024

Wilma Leung
Senior Manager, Technical Research & Education
BCHousing Research Centre



Development,
management and
administration of affordable
housing;

Licensing of residential builders,
administration of owner builder
authorizations, and research and
education.



BC Housing Ready-to-Use Resources

Climate Resilience Guidelines for BC Health Facility Planning & Design

October 2020 – Draft V1.0

BC Energy Step Code Design Guide

A publication of the BC Energy Step Code Council and the Building and Safety Standards Branch

January 2018

CLIMATE CHANGE RESILIENCE FOR BUILDINGS

Number 19

BUILDER INSIGHT



Modelling the Future Climate in Passively Cooled Buildings

Overview

The Province of British Columbia will experience significant changes in climate over the next several decades. Temperature increases of between 1.3 and 2.7°C are projected by 2050, and the province is already experiencing more extreme weather, including frequent and severe heat waves and wildfire events as a result. The impacts of these events pose serious risks to British Columbia's buildings, along with the safety, well-being, and financial investments of their owners and occupants. As building design can play a key role in enhancing our resilience to these current and projected impacts, designers must increasingly consider how to adapt buildings for a warmer world.

This Builder Insight provides an overview of how designers can improve building resilience by considering the risk of overheating as described by the BC Energy Step Code for applicable projects. It includes a methodology for analyzing and reporting the potential for passively cooled buildings to overheat under future climate scenarios.

This document is intended for readers with an understanding of energy modelling who are new to this type of analysis, with the goal of establishing a procedure that can be consistently used across the building industry.



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BC Energy Step Code Design Guide Supplement S3 on Overheating and Air Quality

June 2019



SUPPLEMENT S3
Version 1.0



BRITISH COLUMBIA



BC HOUSING RESEARCH CENTRE



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**MOBILIZING
BUILDING ADAPTATION
AND RESILIENCE**

BC Housing Ready-to-Use Resources

Illustrated Guide

Insulated Wood-Frame Vaulted and Flat Roofs

for Residential Construction in British Columbia



A Comparative Feasibility Study for Encapsulated Mass Timber Construction

BC Energy Step Code Compliant 7 to 12 Storey Buildings



Number 23

MAINTENANCE MATTERS



Electrical Planning for Multi-Unit Residential Buildings

In British Columbia, strata corporations are regularly receiving requests from owners to approve upgrades, such as air conditioning, heat pumps, in-suite laundry and electric vehicle (EV) charging. New amendments to the Strata Property Act and Regulations are making it easier for people to request EV charging stations where they live. Additional, upcoming regulations will prioritize the use of high efficiency electrical equipment in an effort to phase out the use of fossil fuels in buildings.

Each of these upgrades will add electrical loads to the building. Since



Understanding electrical load and capacity to maintain safe, efficient, and reliable electrical systems in



BC Housing Ready-to-Use Resources




Moving towards improved earthquake performance and resilience for new buildings
An eight-part series by John Shestakoff, Aucauco
Session 1: Understanding code designs

BC HOUSING

Moving towards improved earthquake performance and...

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Business Case Study
Consider measures to protect, facilitate clean up, and "Build Back Better"

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MBAR: Flood Resilience

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Business Case Study
Consider measures to protect, facilitate clean up, and "Build Back Better"

10:43

Flood resilience for new and existing buildings: Introduction Part 1 of 4

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Understanding Risk: Flood types

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LEEP Video 1
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4:18

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BC Housing

3



3:30

LEEP Video 3
BC Housing • 411 views • 2 years ago

4



The world's first LEEP building is now open for business. Located in Whistler, BC.

LEEP Video - Whistler
BC Housing • 221 views • 2 years ago



Building my home to the BC Energy Step Code requirements

What The BC Energy Step Code Means for Your Home

BC Housing
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1



3:18

What The BC Energy Step Code means for Your Home - Invermere - Full Length CC

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2



1:01

What The BC Energy Step Code means for Your Home - Invermere - Short - CC

BC Housing • 57 views • 5 months ago

3



3:23

What the BC Energy Step Code Means for Your Home - Williams Lake - Full Length

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0:40

What the BC Energy Step Code Means for Your Home - Williams Lake - Short

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MOBILIZING BUILDING ADAPTATION AND RESILIENCE

BC Housing Ready-to-Use Resources

HEAT WAVES



Risks to Buildings, Occupant Safety & Environment

- Overheating beyond typical comfort conditions
- Electrical system overload due to increased energy usage associated with ventilation and air conditioning systems
- Potential utility service interruption due to increased energy usage
- Decreased lighting and communications connectivity
- Risk of heat exhaustion or loss of life due to overheating, dehydration or hyperthermia
- Decreased outdoor and indoor air quality due to smog and associated risk to human health

Heat waves are prolonged periods of abnormally hot weather that are often paired with high humidity in maritime climates such as the Pacific Northwest. What is considered a heat wave depends on the degree to which temperature exceeds the normal temperature range for the area and season. Heat waves can be particularly intense in urban environments, as the number of heat-absorbing structures and buildings can act to increase overall temperature in what is known as the urban island effect. Heat waves are projected to increase in frequency and intensity as a result of climate change, and are projected to have adverse impacts on human health and well-being as risks of overheating increase. Building designers and operators should consider a range of strategies to reduce impacts to health and comfort of building occupants.

Site Strategies

Strategy	Cost	Impact	Alignment
Identify and incorporate opportunities for cross ventilation during floorplan development to increase air flow without dependence on mechanical systems	\$	***	⊕
Reduce parking areas and/or add shading or vegetation to reduce the heat island effect	\$	**	⊕

Design Strategies

Strategy	Cost	Impact	Alignment
Use high-efficiency lighting, equipment and appliances to reduce internal heat gains	\$	*	⊕
Place equipment and furniture with air circulation and temperature control in mind	\$	**	⊕

Design Strategies

Strategy	Cost	Impact	Alignment
Conduct simulations to explore the thermal performance of individual suites and the building as a whole, focusing on window to wall ratio, window to floor area ratio, window thermal performance and solar heat gain coefficient, wall thermal performance, airtightness, shading, natural ventilation, stack effect and solar orientation	\$	***	⊕
Use the latest climate data for the modelling of thermal performance of the building and individual units	\$	*	⊕
Increase thermal mass performance of horizontal and vertical surfaces through the inclusion of exposed concrete floor slabs, exposed brick walls, natural stone tile, avoid carpeting and suspended ceilings	\$\$\$	***	⊕
Take advantage of thermal masses to allow for night-purging of heat from passive gains	\$	***	⊕
Identify facades with highest potential for solar heat gains and optimize glazing accordingly (e.g. reduce ratio of glazing)	\$	***	⊕
Design horizontal and vertical external shading and external operable screens to reduce incoming solar heat gains along south, east, and west façades	\$\$\$	***	⊕
Use high performance insulation and glazing, including higher solar heat gain coefficient fenestration, and low-e coatings to reduce the rate of heat transfer through building structures, and reduce heating and cooling loads	\$	***	⊕
Include operable windows throughout floorplan layout and common corridors to assist cross ventilation and night-purging of internal heat	\$	**	⊕
Incorporate operable windows in common corridors wherever security concerns do not pose a risk	\$	**	⊕
Locate amenity spaces in a north-facing area with operable windows (and high ceilings) to act as a cooling refuge area. Design for additional cooling capacity, connect to back-up power, and finish floors with exposed concrete or natural tile	\$	***	⊕
Place deciduous vegetation along south, east and west façades to reduce solar heat gains	\$	**	⊕
Install outdoor water fixtures connected to a gravity-fed source in a location easily accessible to building occupants	\$	**	⊕
Use high albedo or "cool" roofing materials or vegetated roof systems to reduce internal heat gains	\$	**	⊕
Use light-coloured building materials to reduce envelope surface temperatures	\$	*	⊕
Include passive and mixed-mode ventilation strategies to cool internal spaces without dependence on active cooling systems	\$\$\$	***	⊕
Investigate opportunities to use solar energy technologies to power cooling systems or chillers	\$\$\$	**	⊕

Operations Strategies

Strategy	Cost	Impact	Alignment
Ensure a minimum of 72 hours of fuel storage (natural gas) for power to refuge area and key services, including building pumps, fans, emergency lighting, and security systems	\$\$	***	⊕
Establish operations and maintenance procedures and building management systems (BMS) to determine the level of cooling required in extreme heat events	\$	**	⊕
Ensure common areas' operable windows are opened at night to allow for circulation	\$	*	⊕
Educate occupants on practices to keep cool, including closing windows after noon and opening them at night	\$	**	⊕
Ensure building operators and occupants understand how to use thermal mass to mitigate temperature swings and optimize comfort	\$	**	⊕
Develop training programs to help staff to be able to identify symptoms of heat stress and associated health complications	\$	**	⊕



- Community Benefits**
- Consider the following strategies to help improve the resilience of the community overall:
- Provide a resilient potable water supply in site design to allow for universally accessible drinking water
 - Design amenity rooms to act as cooling centres/refuge areas for at-risk community members (e.g. seniors) and a central location for emergency support and services
 - Ensure refuge areas are designed to foster social connection, mental health, and overall cultural safety
 - Increase tree canopies to help lower local temperatures and provide shading for community members
 - Increase public information in building common areas to educate on the common symptoms of health impacts from extreme heat
 - Incorporate greywater recycling and rainwater cisterns for irrigation and plant drought tolerant species to conserve water during heat waves

- Potential Design Conflicts**
- Take care and ensure resilient strategies do not exacerbate vulnerability and other risks:
- Passive ventilation strategies that help cool buildings with fresh outdoor air can conflict with strategies used to reduce the impact of poor air quality advisories. Ensure buildings have back-up cooling and ventilation systems that allow for mechanical ventilation when necessary
 - Increasing the thermal performance of vertical and horizontal surfaces through the use of concrete floor slabs may pose a risk to seismic resilience overall. Ensure concrete structures are appropriately designed to withstand seismic events.
 - Ensure any vegetation used to shade building interiors are planted with fire risk in mind.

Additional Resources

- City of Vancouver: Extreme Heat Cool Buildings, A Review of Alternatives to Traditional Air Conditioning
- Government of British Columbia: Current Air Quality Data Map – Air Quality Health Index
- Bureau de normalisation du Québec: Reducing the Urban Heat Island Effect



SEVERE STORMS



Risks to Buildings, Occupant Safety & Environment

- Loss of structural integrity due to increased moisture and compromised drainage
- Greater strain on building material fixtures, claddings and fasteners
- Potential utility service interruption due to increased energy usage
- Impact damage (mostly roofs, gutters, windows) and subsequent rain/moisture penetration
- Decreased indoor air quality and associated risk to human health due to increased humidity, condensation, mould

AIR QUALITY



Risks to Buildings, Occupant Safety & Environment

- Decreased outdoor and indoor air quality due to allergens (e.g. pollen)
- Risk of building-related and non-specific building-related illness
- Electrical system overload due to increased energy usage associated with ventilation and air conditioning systems
- Potential utility service interruption due to increased energy usage

CHRONIC STRESSORS



Climate change driven chronic stressors include freeze-thaw cycles, wind-driven rain, wetting and drying, frost penetration, wind-driven abrasive materials, atmospheric chemical deposition on materials, and broad spectrum solar radiation and ultraviolet (UV) radiation.

FIRES AT THE URBAN INTERFACE



Risks to Buildings, Occupant Safety & Environment

- Damage to, or destruction of buildings
- Utility service interruption
- Potential loss of property and personal assets
- Decreased outdoor and indoor air quality and associated risk to human health
- Risk of human injury or loss of life through exposure to fire, smoke, and/or decreased air quality

POWER OUTAGES & EMERGENCIES



Risks to Buildings, Occupant Safety & Environment

- Reduced functionality of building heating & cooling systems compromises indoor thermal comfort
- Access to potable water and sanitary services cannot be guaranteed
- Decreased lighting and communications connectivity
- Decreased indoor air quality and associated risk to human health due to lack of ventilation, increased humidity, condensation, and mould
- Medical equipment may be inoperable, and medication requiring refrigeration may be threatened
- Vulnerable populations without extensive support networks may become temporarily homeless
- Carbon monoxide poisoning

FLOOD EVENTS

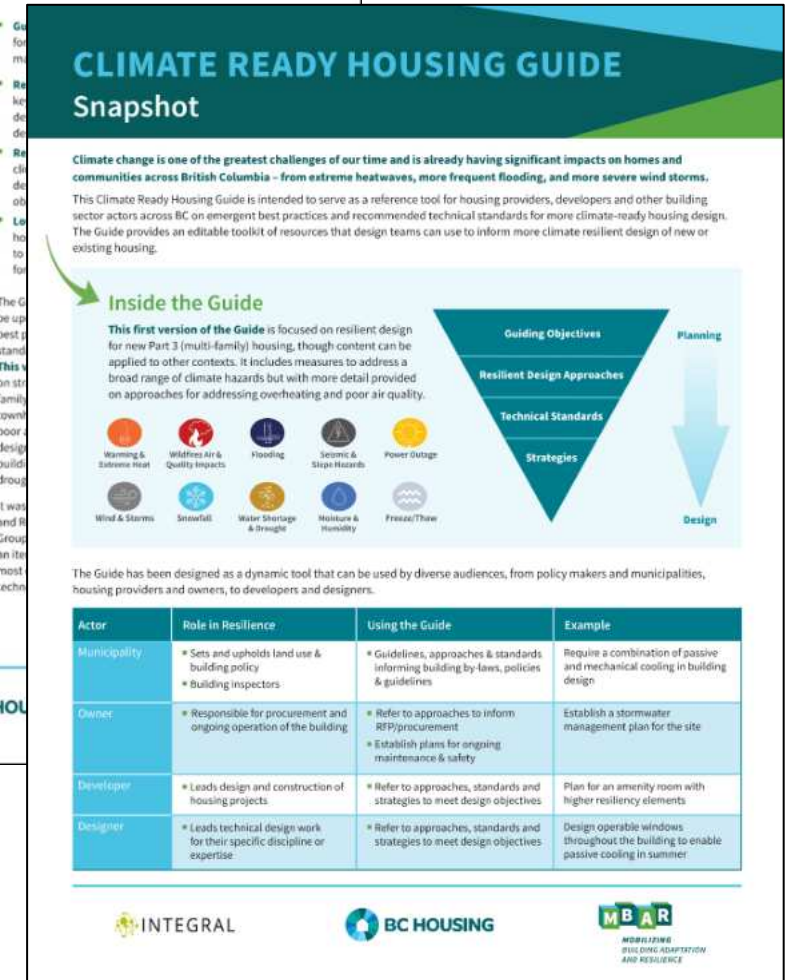


Risks to Buildings, Occupant Safety & Environment

- Damage to, or destruction of buildings caused by coastal or inland flooding
- Weakened foundations and structural integrity from flooding and increase runoff
- Utility service interruption, including sewage systems
- Loss of property and personal assets due to water damage or contamination from sewage, soil and mud
- Increased coastal salt spray and salinization of soils

BC Housing Climate Ready Housing Guide

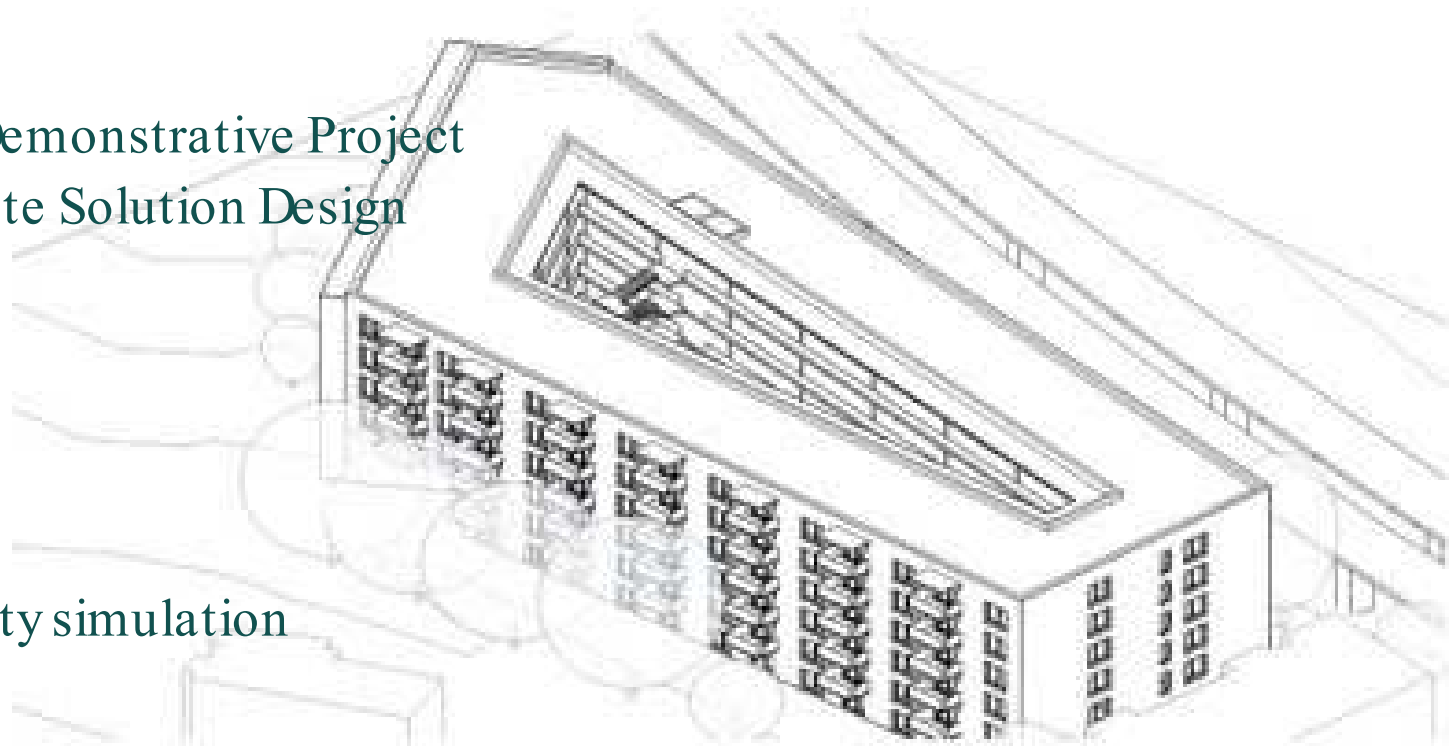
- **Reference tool** for designing more climate-resilient housing (focus on new-build)
- Sets **objectives, technical standards and resilience strategies** for resilient housing design
- Diverse applications:
 - Guideline for local governments
 - Framework for pilot projects
 - Reference for developers



Vienna House Project

<https://viennahouse.ca/about-the-project/research/>

- Vienna House
 - In City of Vancouver
 - Innovative Affordable Housing Demonstrative Project
 - Used IBAMA Framework in Climate Solution Design Workshops
 - UBC documenting all research
 - Noise abatement
 - Summer cross ventilation
 - Exterior shading
 - Social resilience: FLUID Sociability simulation
- Vancouver House
 - In City of Vienna, Austria
 - Similar knowledge sharing



Financial Sector Actors in the Housing Sector and Climate Change

Mapping of financial sector actors in collaboration with UVic

- To develop a stronger understanding of how climate change risks are filtering through existing financial systems into the housing sector in B.C.

Research aims to identify:

- Where market failures exist or may exist (including information gaps/asymmetric information) related to climate change risks
- How these identified market failures will or could impact the residential construction sector and homeowners/homebuyers in B.C.
- What can be done to address the identified market failures most likely to harm residential construction and homeowners/home buyers

R2B Discussion Report & Local Government Toolkit

Data and information: Understand, Identify, Disclose and Communicate Risk

8 Recommendations



Awareness and capacity: Expand Labour, Industry, Owner and Government Capacity on Resilience

6 Recommendations



Policy development: Build Market Demand for Resilient Building

11 Recommendations



Financial mechanisms: Improve Investment and Financing Opportunities

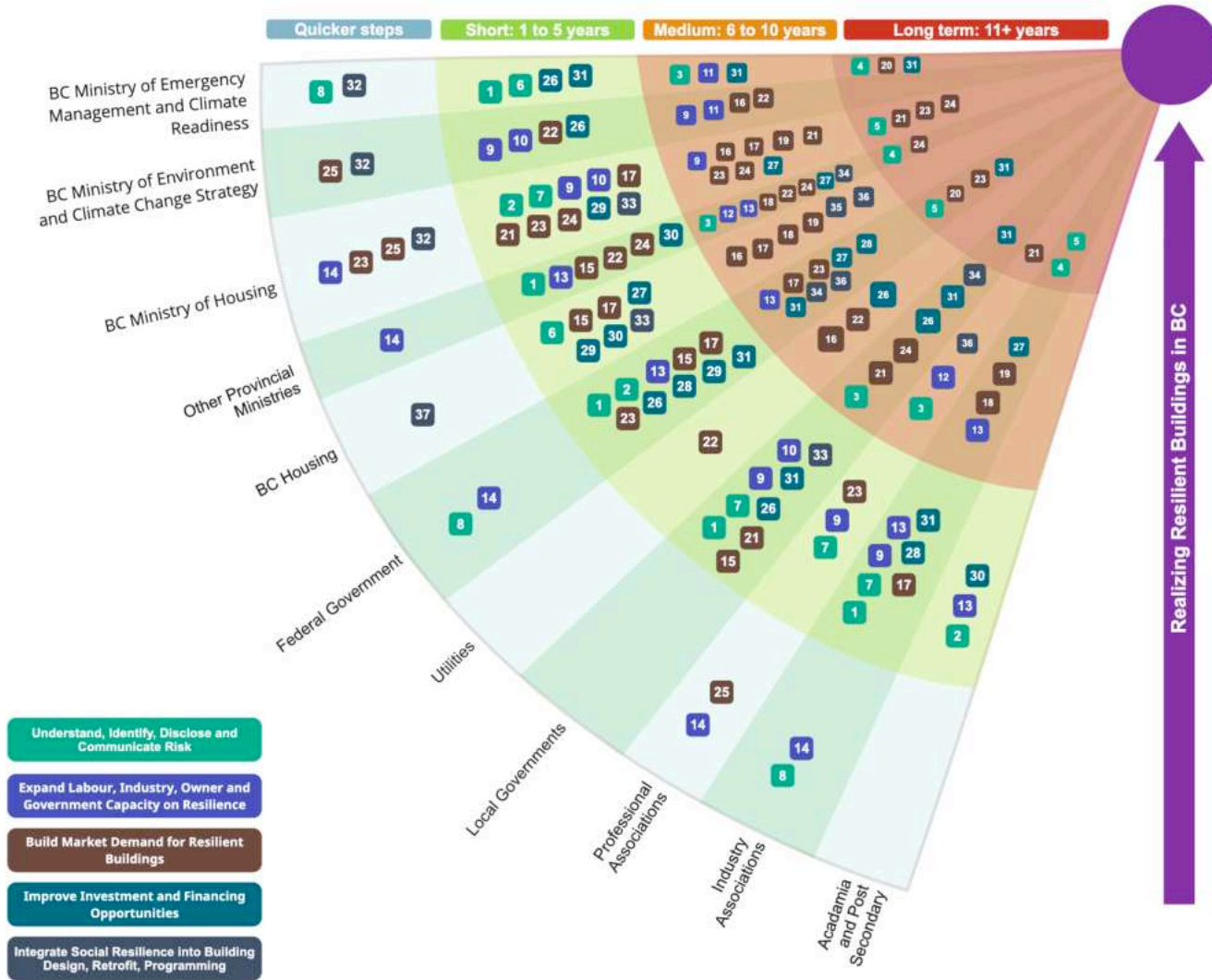
7 Recommendations



Social capacity: Integrate Social Resilience into Building Design, Retrofit, Programming

5 Recommendations

R2B Discussion Report & Local Government Toolkit



- the importance of collaboration and of each actor playing their role
- commitment (or at least thoughts) about what each organization can / will contribute to advance the issue
- examples to support overcoming barriers
 - ✓ through leadership in public sector procurement e.g. at BC Housing
 - ✓ use of contracting that supports integrated design and delivery
 - ✓ supporting / undertaking research on retrofit programs
 - ✓ assessing innovative materials and technologies

Overview: Primary Barriers

Technical training and capacity

- Limited innovation in design
- Little data/ understanding of site hazard exposures
- Insufficient training on appropriate resilience measures
- Little data on effectiveness of resilience measures
- Product availability
- Electrical grid capacity constraints
- Labour supply limitations
- Productivity Limitations

Political and Regulatory

- Barriers to retrofits and those imposed by leases and stratas
- Complex systems, processes cross jurisdictions
- Building Code slow to change
- Resilience insufficiently integrated into development regulations
- Resilient design conflicts with local policies
- Lack of strategic, policy or legislative direction
- Training and capacity for local government

Economic and Financial

- Few incentives to incorporate resilience approaches
- Low consumer demand
- Increased burden on operations
- Insurance sector grappling with increased costs and incentivizing resilience
- Banks and investors lack tools to evaluate climate-related risks
- Post-event financial assistance
- Funding resilience measures through development may impact affordability

Social and Informational

- Range of reporting frameworks on the resilience of buildings
- Lack of understanding building system operation and maintenance
- Poor awareness of and preparation for local hazards
- Social connectivity ignored in building design and operation, may conflict with security

Climate Risk Assessment Framework (CRAF) - for BC Housing projects only

- Excel based Climate Risk Profiling/ Assessment tool
- Uses existing data to estimate risks for BCH building projects
- Purpose:
 - Safety and health of residents, staff and guests
 - Integrity of the building and site
 - Functionality of residential programs
- Design objectives:
 - Useable for locations in BC
 - Simple and quick to learn and use
 - Able to provide assessment early in a project life

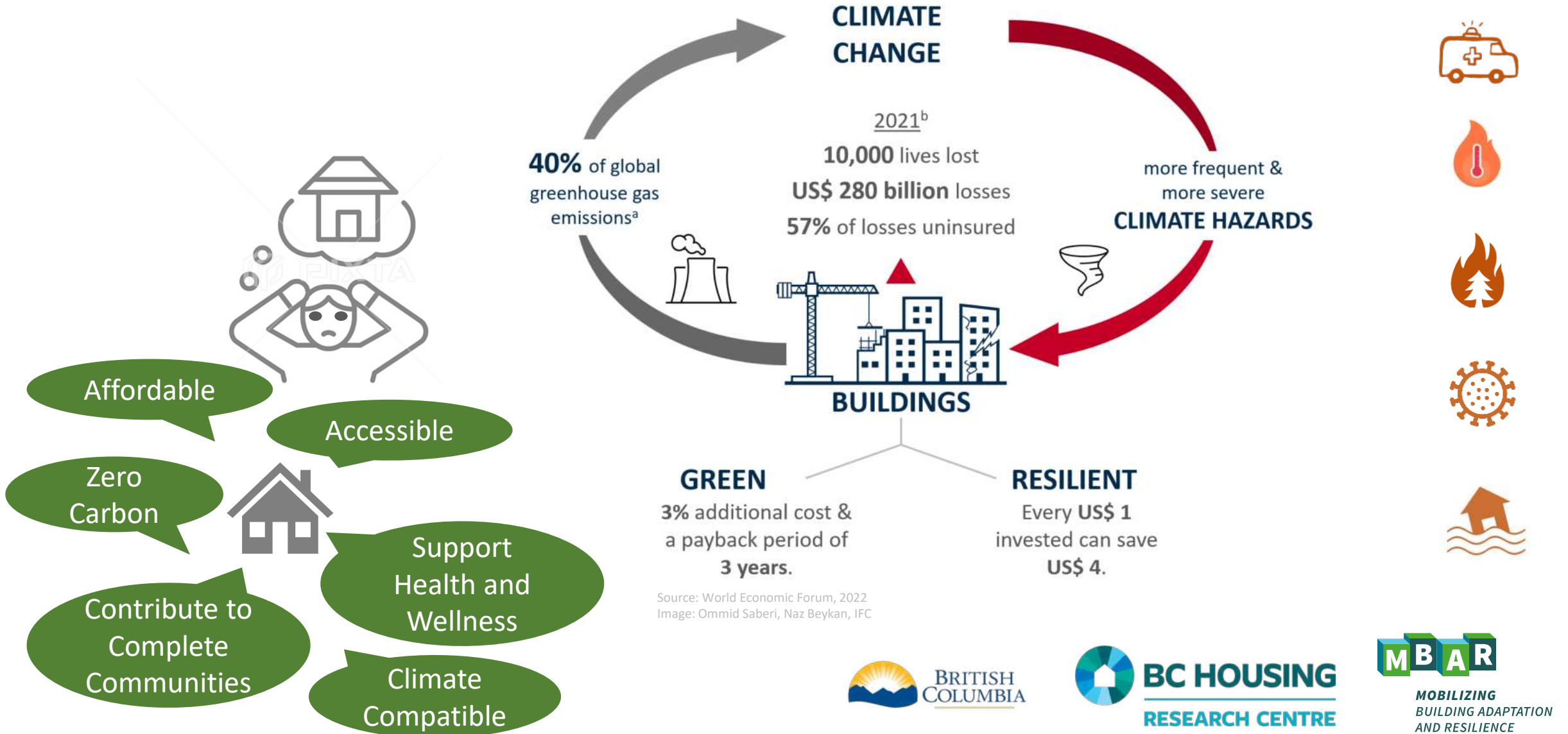
Risk Scores and Levels without Risk Mitigation Measures

Climate Risk Category	Risk Score (/25)			Risk Rating		
	Baseline	2050s	2080s	Baseline	2050s	2080s
Flooding & Rainfall	10.7	14.2	14.2	Medium	High	High
Extreme Heat Events	7.6	12.3	16.1	Medium	High	High
Wildfire Risk	25.0	25.0	25.0	Extreme	Extreme	Extreme
Emergency Power	8.3	7.9	7.9	Medium	Medium	Medium
General Air Quality	6.9	9.2	9.2	Medium	Medium	Medium
Wildfire Smoke	13.5	13.5	13.5	High	High	High

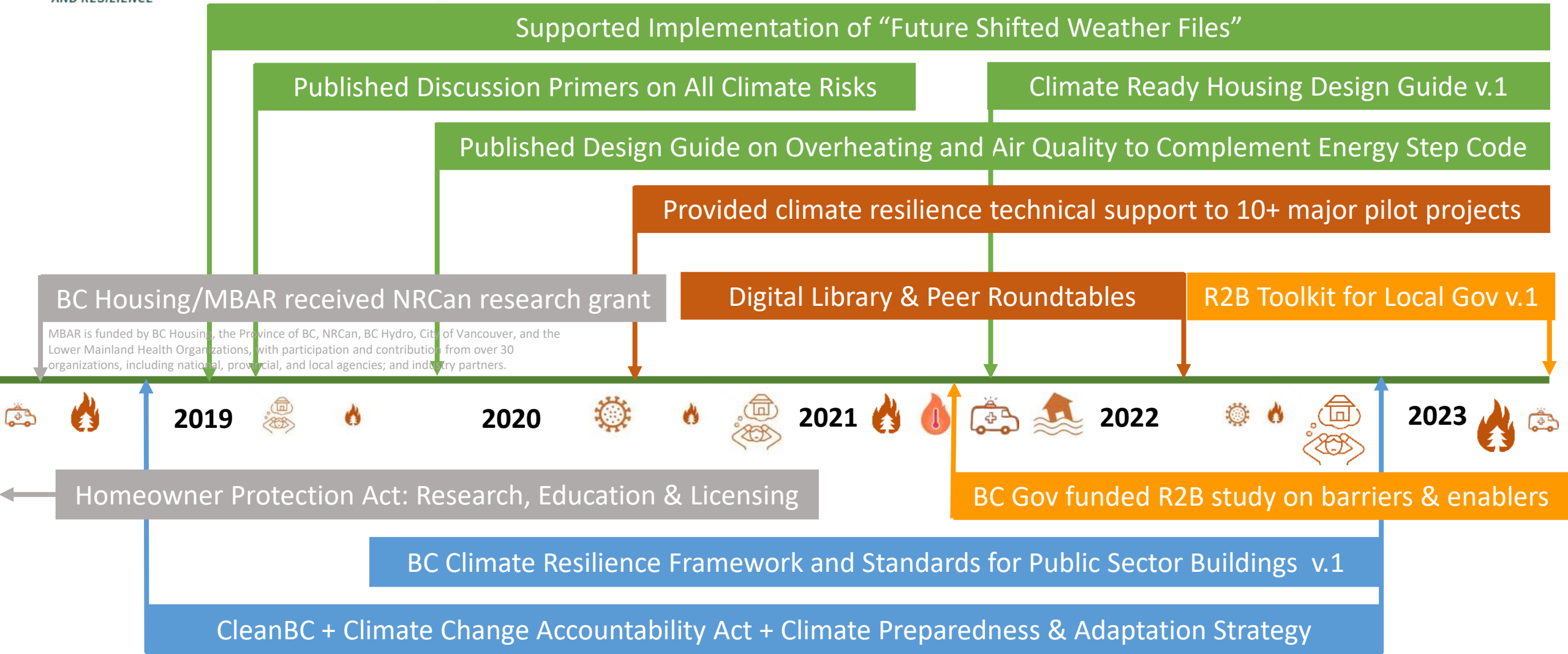
Risk Scores and Levels with Risk Mitigation Measures

Climate Risk Category	Risk Score (/25)			Risk Rating		
	Baseline	2050s	2080s	Baseline	2050s	2080s
Flooding & Rainfall	10.7	14.2	14.2	Medium	High	High
Extreme Heat Events	7.2	11.7	15.3	Medium	Medium	High
Wildfire Risk	23.9	23.9	23.9	Extreme	Extreme	Extreme
Emergency Power	7.5	7.2	7.2	Medium	Medium	Medium
General Air Quality	5.8	7.8	7.8	Low	Medium	Medium
Wildfire Smoke	11.1	11.1	11.1	Medium	Medium	Medium

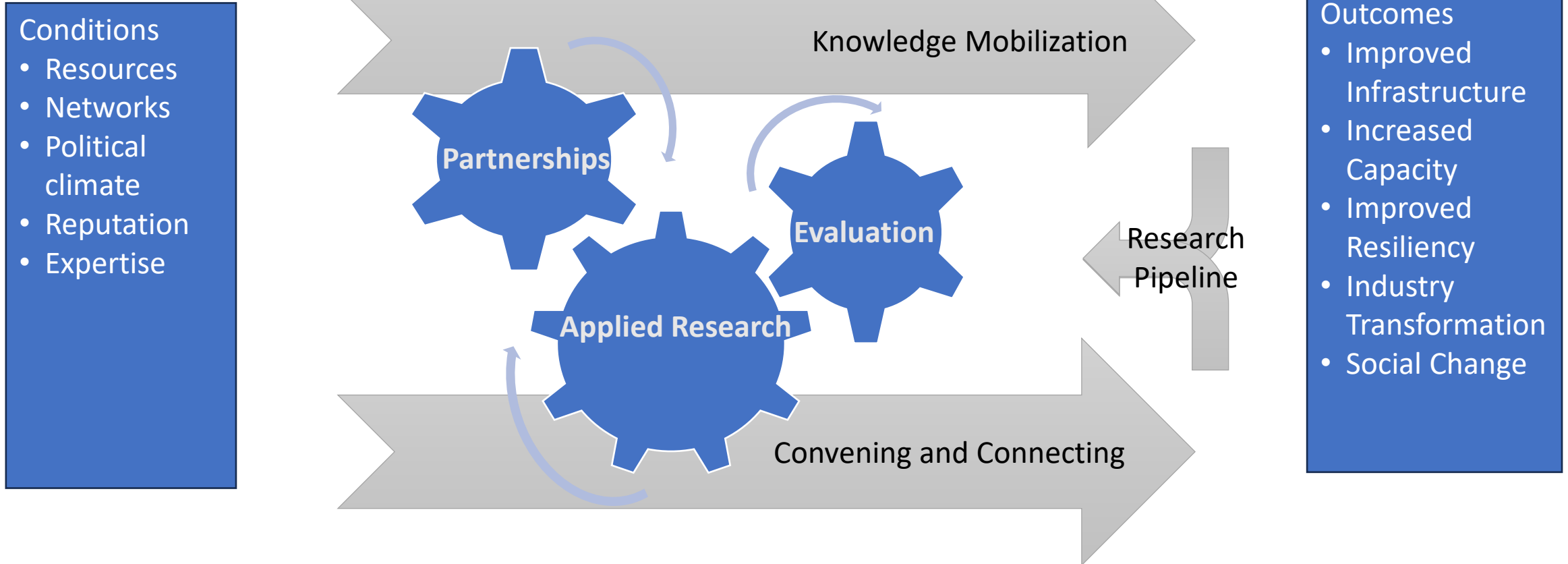
Realizing Resilient Buildings? Learning to Multisolve



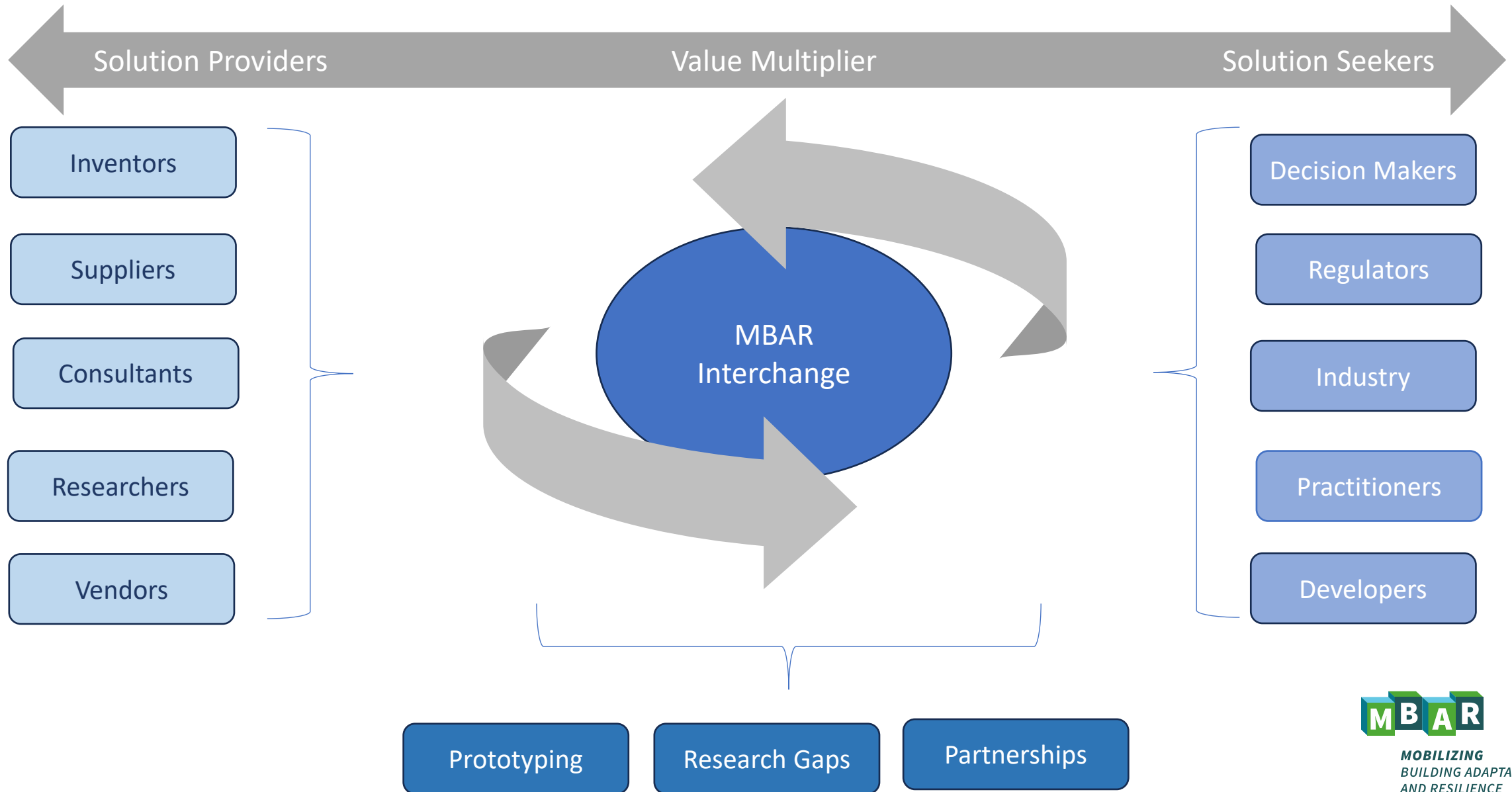
More Resilient Homes Quicker in B.C.



MBAR's Reimagined Model to Facilitate Multisolving



... And Fostering Innovation



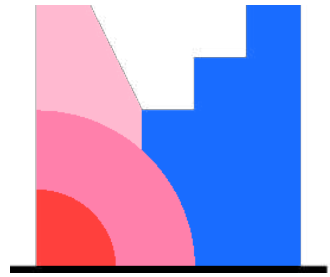
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Questions?





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Networking Break

in the Demo Hub. (Whistler Ballroom)

Be back by 3:00 pm.

