# BC | Climate Resilience Summit 2025

Vancouver, Robson Square March 3rd/4th

# Database: Multi-Hazard Resilient Retrofits

## ClimateResilientRetrofits.ca

Adapting homes for safety & comfort when facing floods, heatwaves, fires, extreme wind, & ice and snow – all at once

INNOVATION SHOWCASE BC Climate Resilience Summit – Vancouver, BC, March 3-4, 2025


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*(2023-25)* Sumana Mitra, Benedictus Haryanto, & Sheridan Hill
**Website Designer**: Felicia Watterodt
**Advisors:** Marzieh Riahinezhad & Alexander Hayes (National Research Council Canada)

# We thank the Musqueam, Squamish and Tsleil-Waututh peoples, on whose unceded territories we are gathering today

First Nations communities are disproportionately at risk with over **81% of reserves exposed to flooding alone** (Chakraborty et al., 2022).

**Deep inequalities exist within our communities, as many live in substandard housing.**

**We need climate resilient buildings for everyone.**

# Partners for Action (P4A)

A research initiative that seeks to **empower Canadians** to become **climate hazard resilient** by promoting **awareness and preparedness actions** that are **inclusive** and **evidence-based**


With founding support provided by:

co-operators

Farm Mutual Re
Collaborate. Empower. Succeed.

Contact: p4a.info@uwaterloo.ca

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# P4A's Resilient Retrofit Research Team (2023-25)

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**Devon Jones**

**Monika Mikhail**

**Benedictus Haryanto**

**Sumana Mitra**

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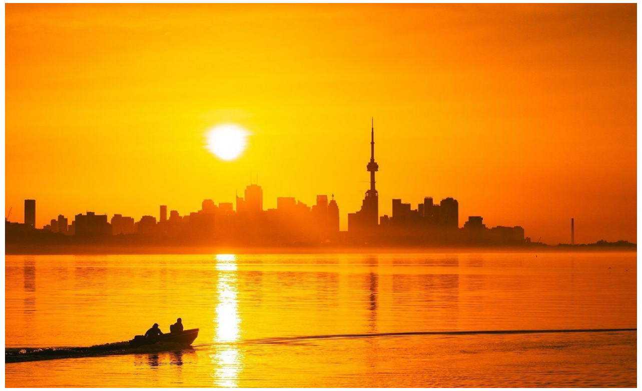
# 2024 Extreme Climate Events

Jasper, Alberta Wildfires (July)

Calgary, Alberta Hailstorm (Aug.)

Halifax, Nova Scotia Snowstorm (Feb.)



Toronto, Ontario Heatwaves (June)

BC Atmospheric River Floods (Oct.)

Ontario Tornados (Aug.)

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# What are the most prevalent climate hazards that buildings need to adapt to?

**Floods** | **Extreme Heat** | **Extreme Wind** | **Ice & Snow** | **Wildfire**

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# What are the most prevalent climate hazards that buildings need to adapt to?

**How do these hazards affect our existing buildings?**

**What will help reduce risk for buildings and their inhabitants against multiple hazards?**

**How do measures for one or more hazards relate to each other?**

# Retrofitting for Extreme Heat

## The Hazard

1. Increased internal building temperatures

2. Increased external building temperatures

## Impacts

Human Comfort & Health

## Adaptation Objective

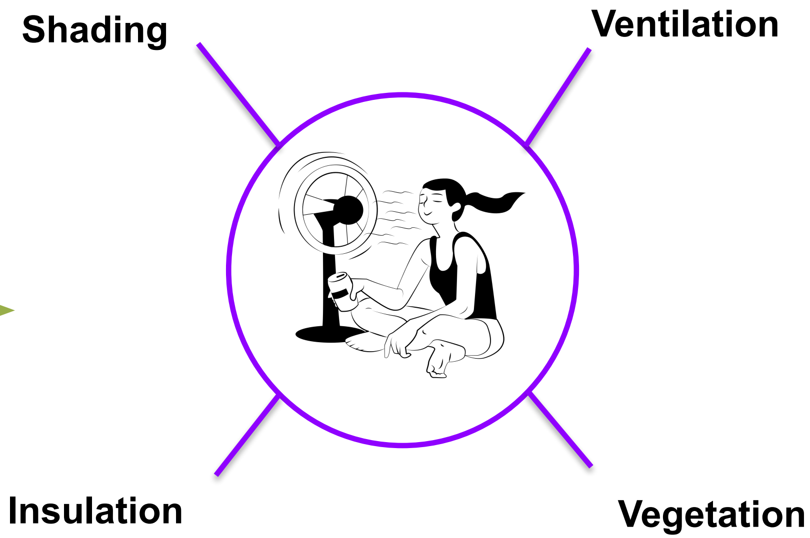
Reduce heat transfer

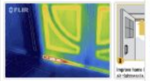
Reduce solar heat gain

Increase airtightness

Increase cooling

## Retrofit Options



| Retrofit/M… | I… | Building Area | Hazard(s) | Problem | Adaptation … | Images | Objective Description (com… | How retrofit addresses … | Consideratio… | Conflicting | Complement… | Coordinated | Cost (Material) | Time/Effort | Expertise Required | Invasiveness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Shading devices | EH1 | Envelope - Window…<br>Interior/Finishes | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Reduce solar he… |  | Solar heat gain is the thermal energy that comes from sunlight. Excessive solar heat gains can cause buildings, occupants, and … | Shading devices can reflect sunlight and reduce solar heat gain. Examples include interior or exterior blinds. | Loss of daylight | | EH8: Add insulation<br>EH17: Shaded courtya<br>F12: Shield systems | IS35: Install windov | $ | ◷ | 🔨 | ▨ |
| Increase natural ventilation | EH2 | Interior/Finishes | Extreme Heat | Increased building temperatures… | Increase cooling |  | Passive and active cooling measures can take away excessive thermal energy and reduce internal building temperatures | Large windows and doors can be opened to increase air flow can help cool indoor temperatures. | | EW20: Closed win<br>EW37: Reinforce s | EH19: Water heat sink<br>EH23: External plaster<br>IS31: Open kitchen, ba | | $ | ◷ | 🔨 | ▨ |
| Install temperature and humidity controls | EH3 | Mechanical, Electric… | Extreme Heat | Increased building temperatures… | Increase cooling |  | Passive and active cooling measures can take away excessive thermal energy and reduce internal building temperatures | Temperature and humidity controls allow occupants to stay informed and proactive about building conditions | Potential energy savings | | | EH4: Install fans<br>EH5: Add mechanic<br>F34: Install water m | $$ | ◷◷ | 🔨 | ▨ |
| Install fans | EH4 | Interior/Finishes | Extreme Heat | Increased building temperatures… | Increase cooling |  | Passive and active cooling measures can take away excessive thermal energy and reduce internal building temperatures | Fans will increase air circulation, airflow, and ventilation | Increases energy consumption | | EH9: Apply low-e coat | EH3: Install temper<br>EH5: Add mechanic | $ | ◷◷ | 🔨 | ▨ |
| Add mechanical cooling | EH5 | Mechanical, Electric… | Extreme Heat | Increased building temperatures… | Increase cooling |  | Passive and active cooling measures can take away excessive thermal energy and reduce internal building temperatures | Active cooling measures can take away excessive thermal energy and reduce internal building temperatures. … | Increases energy consumption | | IS18: Seal attic hatche<br>IS22: Apply caulk arou | EH3: Install temper<br>EH4: Install fans<br>EW32: Anchor equi | $$ | ◷◷ | 🔨 | ▨ |
| Rearrange living spaces | EH6 | Interior/Finishes | Extreme Heat | Increased building temperatures… | Reduce solar he… |  | Solar heat gain is the thermal energy that comes from sunlight. Excessive solar heat gains can cause buildings, occupants, and … | Beds, workspaces, and other furniture can be moved to cooler places to reduce heat exposure | Potential social benefit | F32: Moving living | | | $ | ◷◷ | 🔨 | ▨ |
| Seal air leaks | EH7 | Envelope - Walls | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Increase airtight… |  | Airtight buildings are more resilient against draughts and are easier to heat or cool | Cracks and air leaks can be sealed to increase airtightness and decrease exterior heat infiltration. This can include … | Potential energy savings | | IS2: Make all ceilings a<br>IS22: Apply caulk arou<br>IS23: When insulating | EW26: Flat roof - u | $$ | ◷◷ | 🔨🔨 | ▨▨ |
| Add insulation | EH8 | Envelope - Walls | Extreme Heat | Increased building temperatures… | Reduce heat tra… |  | Materials with low thermal conductivity transfer heat slowly from the exterior environment to the building and internal building… | Reduces heat transfer between the outdoor environment and building interior space. Higher R-value insulation assemblies… | Potential energy savings. | | IS1: Add insulation to<br>IS2: Make all ceilings a<br>IS40: Add insulation to | EH12: Install green<br>EH13: Paint walls w<br>EH14: Reflective Su | $$$ | ◷◷◷ | 🔨🔨 | ▨▨ |
| Apply low-e coating to windows | EH9 | Envelope - Window… | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Reduce solar he… |  | Solar heat gains is the thermal energy that comes from sunlight. Excessive solar heat gains can cause buildings, occupants, and … | Windows with low thermal transmittance reflect and reduce the amount of solar gain | Potential energy savings | | EH1: Shading devices | EW13: Reinforcing<br>IS35: Install windov | $$ | ◷◷ | 🔨🔨 | ▨▨ |
| Choose energy efficient lights and appliances | EH10 | Mechanical, Electric… | Extreme Heat | Increased building temperatures… | Reduce heat tra… |  | Materials with low thermal conductivity transfer heat slowly the exterior environment to the building and internal building … | Reduces the amount of 'waste heat' emitted from the appliances and lights | Potential energy savings | | EH3: Install temperatu | IS29: Replace old r | $ | ◷ | 🔨 | ▨ |
| Plant Vegetation | EH11 | Landscaping | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Heat absorption |  | Materials with high heat or thermal capacity can store large amounts of thermal energy. These materials help regulate temperatures … | Increases urban heating index and occupant well being. In high wind prone and wildfire areas, additional … | Potential social benefit, Flammable | EW15: Ensure lanc<br>WF3: Clear vegeta<br>WF11: Replace de | F20: Rain gardens<br>WF4: Fire resistant veg<br>WF21: Non-combustil | EH12: Install green<br>WF16: Clearing fue | $ | ◷ | 🔨 | ▨ |
| Install green roofs | EH12 | Envelope - Roof | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Reduce solar he… |  | Solar heat gain is the thermal energy that comes from sunlight. Excessive solar heat gains can cause buildings, occupants, and … | Green roofs provide shade, absorb heat, and reduce the heat island effects. | Aesthetic, Flammable | WF2: Fire-resistan | F20: Rain gardens<br>WF4: Fire resistant veg<br>WF21: Non-combustil | EW8: Roof Sheathir<br>EW9: Roof Sheathir<br>EW14: Roof coverir | $$$ | ◷◷◷ | 🔨🔨🔨 | ▨▨▨ |
| Paint walls with white or light colours | EH13 | Envelope - Walls | Extreme Heat | Increased building temperatures… | Reduce solar he… |  | Solar heat gain is the thermal energy that comes from sunlight. Excessive solar heat gains can cause buildings, occupants, and … | Light or white colours will reflect more heat, reducing solar gain. | Aesthetic | | EH14: Reflective Surfa | EH23: External plas | $$ | ◷◷◷ | 🔨 | ▨▨ |
| Reflective Surfaces | EH14 | Envelope - Roof | Extreme Heat | Increased building temperatures…<br>Increased building temperatures… | Reduce solar he… |  | Solar heat gain is the thermal energy that comes from sunlight. Excessive solar heat gains can … | Highly reflective material to reflect sunlight and reduce heat absorption | Potential energy savings | | EH14: Reflective Surfa | EH15: Ventilated fa<br>EW10: Roof coverir | $$$ | ◷◷◷ | 🔨🔨🔨 | ▨▨▨ |

Add…

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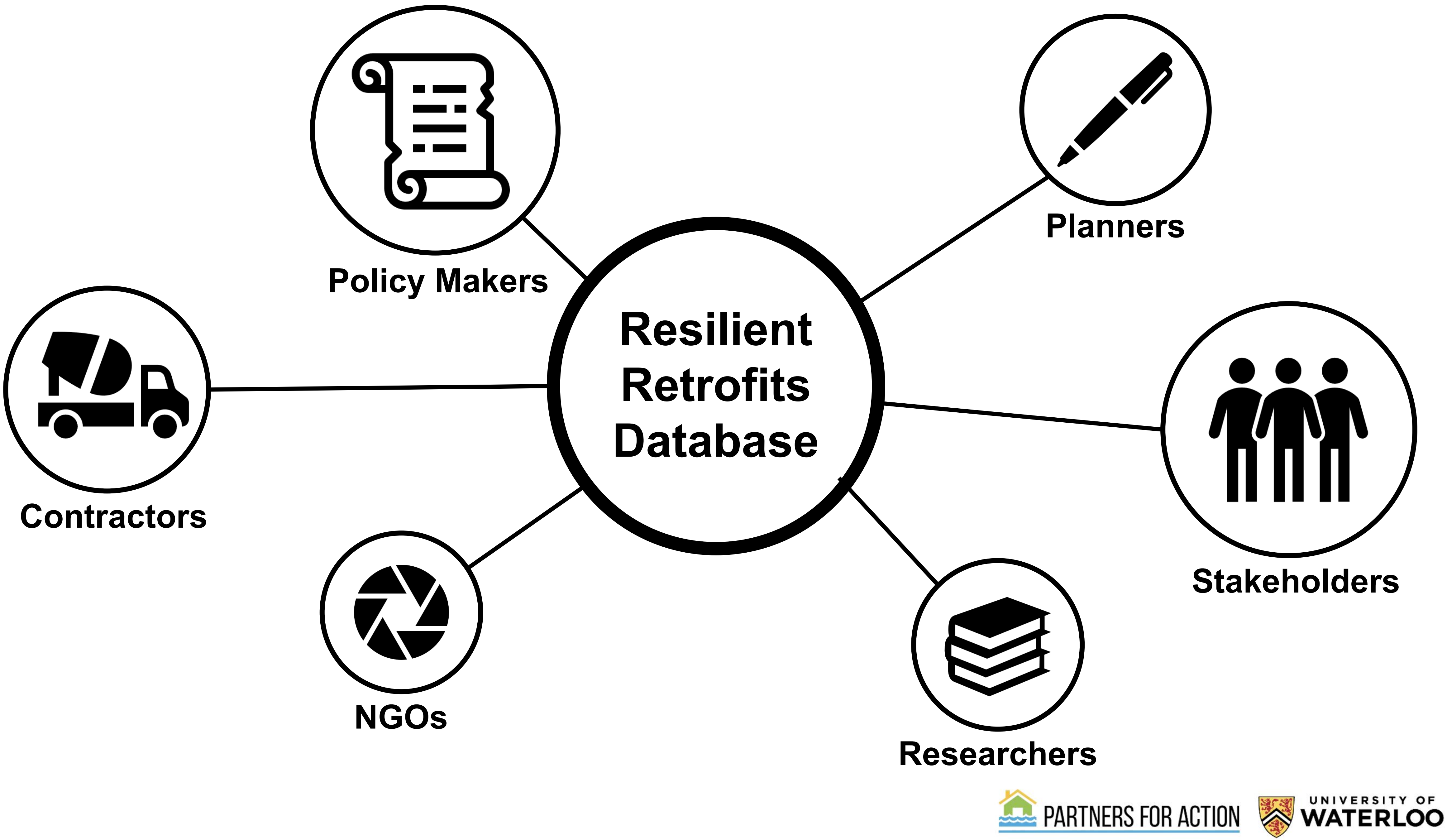
Resilient Retrofits Database
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# “Ratings” (General, Relative)

**Cost (Material)**

**Time / Effort**

**Expertise**


**Invasiveness**


**Energy Use / Emissions**

# “Ratings” (General, Relative)

Cost (Material)

Time / Effort

Expertise

Invasiveness

Energy Use / Emissions

**Cost (Material)**

| | |
|---|---|
| $$$ | > $5000 |
| $$ | $500-$5000 |
| $ | < $500 |

# “Ratings” (General, Relative)

Cost (Material)

Time / Effort

Expertise

Invasiveness

Energy Use / Emissions

## Time / Effort

considerable planning/ extended duration

some planning/ duration

minimal planning/ short duration

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# “Ratings” (General, Relative)

Cost (Material)

Time / Effort

Expertise

Invasiveness

Energy Use / Emissions

**Expertise**

🔨🔨🔨 specific expertise

🔨🔨 some expertise

🔨 no expertise

# “Ratings” (General, Relative)

Cost (Material)

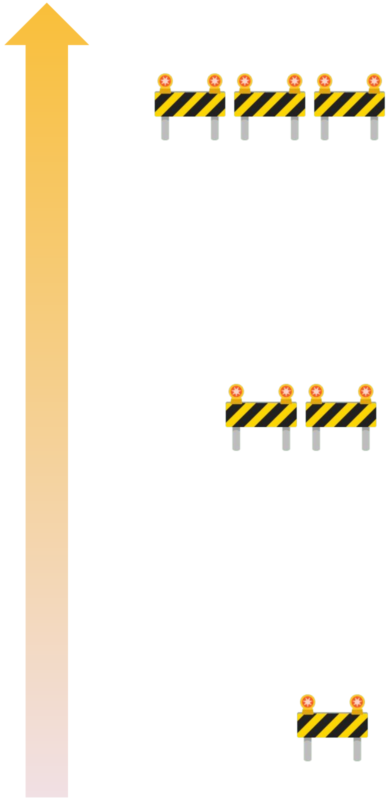
Time / Effort

Expertise

**Invasiveness**

Energy Use / Emissions


**Invasiveness**



major disruptions

extended disruptions

no / little disruptions

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# "Ratings" (General, Relative)

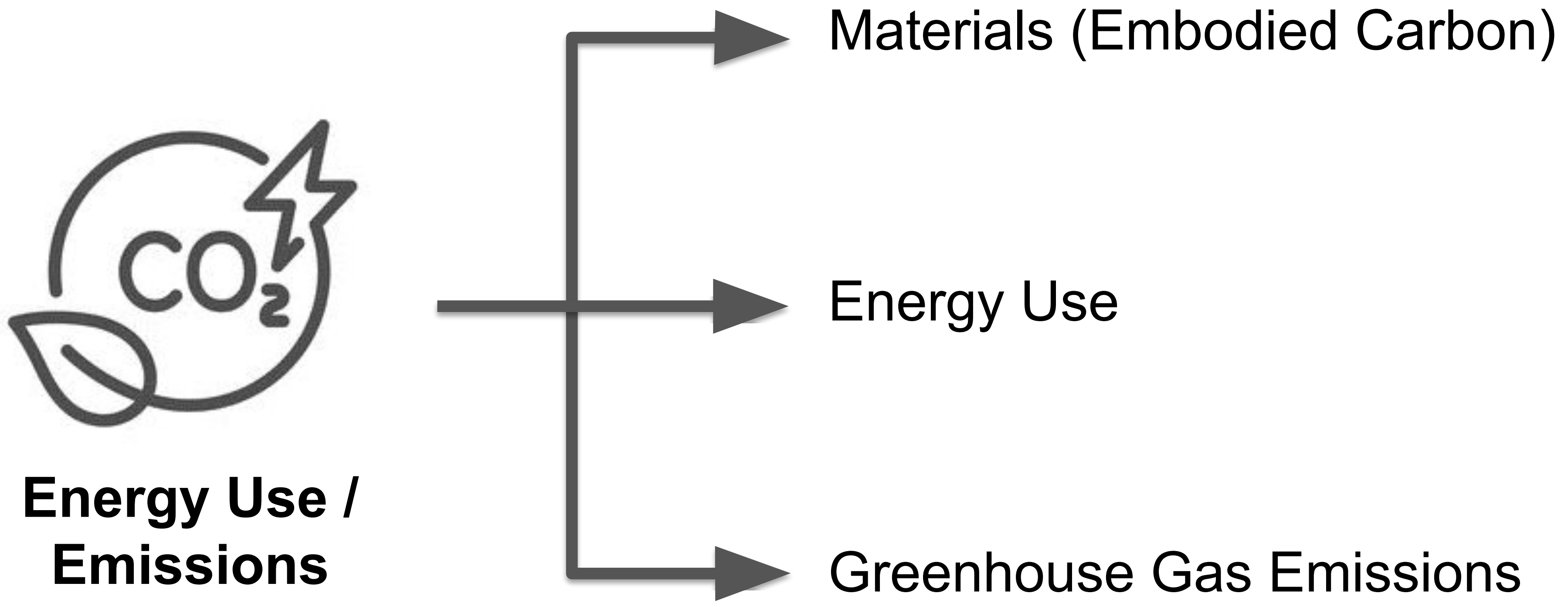
Cost (Material)

Time / Effort

Expertise

Invasiveness

**Energy Use / Emissions**

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# Retrofit Relationships: The "3 Cs"

## Conflicting

A measure that **works against or diminishes the benefits of another** measure

**Example:** Planting vegetation can help with extreme heat but also increase wildfire risk

## Coordinating

A measure **to consider alongside another for practicality and convenience**, saving cost and time while addressing one or more objectives / hazards

**Example:** If you are renovating and replacing old windows, you should consider adding a low-emissivity coating

## Complementary

A measure that **addresses multiple hazards or multiple adaptation objectives**

**Example:** Airtight sealant helps protect buildings against wildfires, extreme heat, and floods

# Example Retrofits: Extreme Heat

**Conflicting**

**Wildfires**
Clear Vegetation

**Coordinated**

**Extreme Wind**
Remove stones

**Complementary**

**Floods**
Rain Gardens

## Planting Vegetation

**Cost (Material)**
$ <500

**Time / Effort**
🕒 little planning

**Expertise**
🔨 no expertise

**Invasiveness**
🚧 no/few disruptions

**Energy Use / Emissions**

**Absorbs carbon**
**Potential energy savings**

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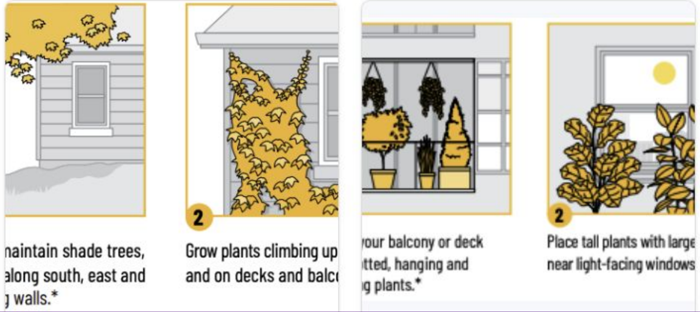
# Database Pop Up

Retrofit/Measure

## Plant Vegetation

| | |
|---|---|
| ID# | EH11 |
| Building Area | Landscaping |
| Hazard(s) | Extreme Heat |
| Problem | Increased building temperatures (internal)<br>Increased building temperatures (external) |
| Adaptation Objective (Concise) | Heat absorption |
| Images | Attach file |




| | |
|---|---|
| Objective Description (comprehensive) | Materials with high heat or thermal capacity can store large amounts of thermal energy. These materials help regulate temperatures fluctuatations by releasing or storing thermal heat throughout the day |
| How retrofit addresses the objective | Increases urban heating index and occupant well being. In high wind prone and wildfire areas, additional considerations should be taken for type and size of vegetation. |
| Considerations | Potential social benefit, Flammable |

Conflicting

**EW15: Ensure landscapes can resist strong winds**

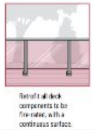
| Building Area | Hazard(s) | Problem |
|---|---|---|
| Landscaping | Extreme wind | Flying de... |

**WF3: Clear vegetation within 1.5m of house**

| Building Area | Hazard(s) | Problem |
|---|---|---|
| Landscaping | Wildfires | Fire encr... |

**WF11: Replace deck components with fire-rated/non...**

| Building Area | Hazard(s) | Problem |
|---|---|---|
| Landscaping | Wildfires | Fire encr... |



**WF23: Remove trellises**

| Building Area | Hazard(s) | Problem |
|---|---|---|
| Envelope - Walls, La | Wildfires | Fire encr... |

Add link

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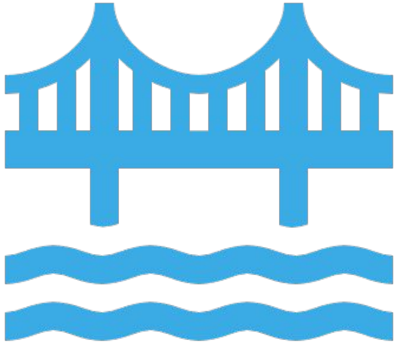
# How does our database help reduce risk for the most prevalent climate hazards in Canada today?



**Synthesizes information about retrofits for multiple hazards in one place**

**Organizes retrofits by key parameters (i.e., adaptation objective)**
to make it easy for users to know what to do and why

**Identifies how retrofits interact and relate to one another**
(the "3 Cs")

# Acknowledgements

This research was done in partnership with **Halifax Regional Municipality** in 2022-2023 as part of the*HalifACT Climate Action Plan*, and with **National Research Council Canada (NRC)** in 2024 for the *Climate Resilient Built Environment Initiative*, in support of delivering the Government of Canada’s Adaptation Action Plan, and towards achieving commitments under the National Adaptation Strategy.

HalifACT Acting on Climate Together | HALIFAX

National Research Council Canada | Conseil national de recherches Canada

**Special thanks: Alexander Hayes** as well as Louis Poirier, Cheryl Evans, Stef Coleman, & Sarah A. Stevenson

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# Check out ClimateResilientRetrofits.ca!

**Tell us what you think! p4a.info@uwaterloo.ca**

**Climate Resilient Retrofits**

*Adapting Canada's existing building stock to withstand a changing climate*

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HalifACT Acting on Climate Together | HALIFAX | National Research Council Canada | Conseil national de recherches Canada | UNIVERSITY OF WATERLOO

# References


- Chakraborty, L., Thistlethwaite, J., Minano, A. et al. Leveraging Hazard, Exposure, and Social Vulnerability Data to Assess Flood Risk to Indigenous Communities in Canada. Int J Disaster Risk Sci 12, 821–838 (2021). https://doi.org/10.1007/s13753-021-00383-1

- Partners for Action. (2024). Climate Resilient Retrofits Database-All Hazards. https://www.climateresilientretrofits.ca/all-hazards/


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BRITISH COLUMBIA Ministry of Environment and Climate Change Strategy

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