Ministry of Energy and Climate Solutions

Guide for Assessing the Co-Benefits of Community-Based Climate Actions

Report of Findings

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Prepared for

Ministry of Energy and Climate Solutions

Prepared by

WSP Canada Inc.
Vancouver (840 Howe St), BC, Canada
T +1 604 214 1525

Quality control	Name
Prepared by:	Aleksandra Lazarevic
Reviewed by:	Charles-Antoine Gosselin
Approved by:	Scott Cole & Darius Tokien-Spurr

Revisions

Rev	Details
V1	Draft Report (75%) Climate Action Co-Benefits
V2	Climate Action Co-Benefits Final Report
V3	Climate Action Co-Benefits Final Report – final comments addressed

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Glossary

Abbreviations

Abbreviation	Description
CCME	Canadian Council for Ministers of the Environment
CEEI	Community Energy and Emissions Inventory
ECCC	Environment and Climate Change Canada
DPA	Development Permit Area
GHG	Greenhouse Gas
GMF	Green Municipal Fund
ICE	Internal Combustion Engine
LGCAP	Local Government Climate Action Program (för British Columbia)
Ministry	Ministry of Energy and Climate Solutions
NCCEH	National Collaborating Centre for Environmental Health
NECB	National Energy Code of Canada for Buildings
PM	Particulate Matter
VSL	Value of a Statistical Life

Terms

Term	Explanation
Attribution	A process of determining how much of an observed impact (*see also "Indicator"*) can reasonably be linked to, or caused by, a specific climate action.
Climate Measures or Actions	The specific actions (measures) taken by an actor to achieve a policy outcome. For example, this may be a requirement to restrict an activity or provide a certain level of funding. For the purposes of this Guide, co-benefits focus narrowly on community-based climate measures, i.e., measures that could be reasonably implemented on a local government level.
Co-benefit	Based on Lowe and Davies 2025: Co-benefits of climate action are additional positive consequences that result from mitigation or adaptation measures. By applying a co-benefit lens into the screening, analysis, and communication of climate measures/actions policy makers can select and prioritize investments that are not only effective in reducing emissions or increasing resilience, but that also advance affordability, inclusivity, economic development, and overall community quality of life. Note that in practice there are often trade-offs, i.e., multiple co-benefits may have competing impacts, which means the decision

Term	Explanation
	maker must prioritize (implicitly or explicitly) which is most important to pursue in the policy.
Co-benefit (Economic)	Co-benefits associated with economic systems, services, and infrastructure, including consumption, investment, employment, productivity, affordability, and trade. (*See also "co-benefit"*)
Co-benefit (Ecosystem)	Co-benefits that influence ecological systems and environmental quality, including the provision of biodiversity and many common types of ecosystem services that depends on it (e.g., carbon sequestration, recreation, water quality/quantity, etc). (*See also "co-benefit"*)
Co-benefit (Energy)	Co-benefits related to the production, conversion, distribution, and use of energy, including aspects of access, availability, quality, acceptance, efficiency, and reliability. (*See also "co-benefit"*)
Co-benefit (Health)	Co-benefits affecting individual and population health, as well as health systems, health services, and health infrastructure. This includes outcomes and determinants of physical, mental, psychological, social-cultural, spiritual, and emotional health and wellbeing. (*See also "co-benefit"*)
Co-benefit (Socio-cultural)	Co-benefits relating to social and cultural systems, institutions, identity, heritage, ceremony, spirituality, worldview, and governance. (*See also "co-benefit"*)
Indicator	A quantified measure of the impact expected from a given climate action (e.g., tons of carbon emissions, number of cars removed from the road, etc.), which serves as the basis for later monetizing those impacts.
Trade-off	A situation where a climate action delivers a benefit in one area while worsening another, creating a tension between the two goals. The concept captures the idea that not all side-benefits of a climate measure/action are positive.

Introduction

Purpose

By integrating co-benefits into the screening, analysis, and communication of climate measures or actions ("climate actions"), this Guide supports communities and local governments in selecting and prioritizing investments that are not only effective in reducing emissions or increasing resilience, but that also advance affordability, inclusivity, economic development, and overall community quality of life. The Guide also provides a consistent basis for monitoring the co-benefits of climate actions already undertaken, helping to make their broader value more visible. Focusing on co-benefits underscores the strategic implications of climate investment by highlighting how a single action can advance multiple community priorities. Climate actions deliver measurable value across health, affordability, resilience, and economic opportunity, making them more compelling and relevant to decision-makers, staff, and the public. By quantifying and clearly communicating these benefits, communities and local governments are better positioned to demonstrate how climate investments support broader social wellbeing and long-term prosperity.

Context

Local governments are increasingly recognizing the need to address climate-related hazards, which are accelerating in frequency, severity, and cost. The resulting impact places significant pressure on local governments and Modern Treaty Nations which, in turn, suggests a need to respond.

Across B.C., communities are already experiencing the impacts of extreme heat, wildfire, flooding, drought, and storm events that the Local Government Climate Action Program (LGCAP) surveys identify as top concerns by its survey respondents. These risks are intensifying, affecting public health, community safety, infrastructure stability, and local economies. Local governments hold frontline responsibility for emergency preparedness, land use decisions, infrastructure systems, and social support, which means climate impacts quickly translate into operational, fiscal, and social strain. Without rapid and coordinated action, climate impacts are likely to continue, disproportionately affecting vulnerable populations, undermining community wellbeing, and increasing long term costs for all levels of government.

By taking a wider view of the social benefits associated with climate action, local governments are better able to help underscore the strategic implications of investment that advances multiple community priorities. Climate actions deliver measurable value across health, affordability, resilience, and economic opportunity making them more compelling and relevant to decisionmakers, staff, and the public. By quantifying and clearly communicating benefits, communities are better positioned to demonstrate how climate investments support broader social wellbeing and long-term prosperity.

Moreover, this approach aligns with the Ministry of Energy and Climate Solutions ("The Ministry") mandate to connect climate action to key policy priorities such as health, wellbeing, economic growth, and ecological resilience, ensuring that climate strategies resonate with diverse audiences and respond to on-the-ground needs.

A co-benefits lens also strengthens evidence-based planning by enabling the use of credible, quantifiable indicators such as the dollar value of health savings, avoided infrastructure damage, increased

productivity, and ecosystem service valuation to illustrate the full range of outcomes generated by climate actions. Identifying co-benefits associated with selected climate actions can increase public and political support, guide prioritization of impactful measures, and improve resource allocation by identifying actions that yield multiple returns for each dollar invested. In short, the valuation of co-benefits helps to demonstrate the economic efficiency of a climate policy. Failure to capture the full suite of impacts in the policy making process leads to a sub-optimal provision of positive externalities within our communities. As noted, a co-benefits lens can also support better communication around previously implemented actions.

This report, developed by WSP, builds off of the Pinna Sustainability's Climate Action Best Practice Guidebook which identifies and provides practical tools for implementing the most impactful climate actions local governments and Modern Treaty Nations can undertake. It is intended for local governments and Modern Treaty Nations.

Intended Audience

This report is designed to support government staff, who require practical, evidence-based guidance to integrate co-benefits into planning, program delivery, evaluation and communication; decisionmakers, who must evaluate climate actions in light of social, economic, and environmental priorities; and communities, including local governments and community organizations, who rely on accessible insights to inform local climate action. By tailoring the Guide to these groups, the report ensures that its content is relevant, actionable, and aligned with the Ministry's objective to equip both technical and nontechnical users with clear, defensible information on the suite of benefits associated with climate measures.

Expectations of users of this Guide

This Guide is intended for less technical staff who need a clear, accessible way to identify, measure, and communicate co-benefits of impactful climate actions. Users only require a basic understanding of climate action planning, as the Guide provides practical steps and indicators to support local governments and Modern Treaty Nations where data is available. Further, the reader can find theory and details in both Chapter 3 and also the Appendix.

Limitations

This development of this Guide, including the detailed methodology that supports it, has focused exclusively on identifying and measuring co-benefits and therefore has excluded consideration of potential co-harms. However, we identify, when appropriate, examples of trade-offs that may arise in identifying potential co-benefits, which could be used as the basis for identifying co-harms. The analyst applying this Guide is responsible for ensuring that any potential co-harms are considered to ensure a holistic assessment of climate measures. For details on how to identify both co-benefits and co harms for climate measures, see WSP Canada Inc. and Golder (2022).

We do not separate direct benefits of a climate measure (e.g., increased carbon sequestration) from indirect co-benefits but rather include them together in our overarching definition of a co-benefit (see Glossary). Further, the focus on co-benefits is narrow, encompassing community-based climate measures, i.e., actions that could be reasonable on a local government level rather than on a national or province level.

Finally, the Guide does not provide input on how to attribute a specific magnitude of impact from a given climate action but rather focuses on how to value impacts with multipliers, once the impact(s) are identified. This means the user is expected to motivate through e.g., with cause and effect studies in the literature,

the actual expected impact, which could be measured with the help of a defensible indicator (see Glossary).

A more detailed list of limitations associated with developing the detailed methodology is provided in Appendix A (see 3.5 Limitations).

Structure

The Guide is divided into 5 sections:

- Chapter 1 lists the step-by-step implementation guidance (“The Guide”) for assessing the co-benefits of community-based climate actions.
- Chapter 2 provides a case study that demonstrates how to implement the Guide.
- Chapter 3 provides policy-relevant findings that emerged while conducting research to develop this Guide. These offer an enhanced understanding of co-benefit assessment.
- Sources and references, which were used to build the Guide.
- Appendix A, the detailed methodology, which aims for a credible, transparent, and tailored approach.

1. Implementation Guide

The following checklist provides step-by-step implementation guidance for assessing the co-benefits of community-based climate actions. This set of steps ("The Guide") is complemented by a set of key research findings (Chapter 3) and supported by a detailed methodology (provided in Appendix A). The Guide suggests eight steps as follows:

1. Validate how the specific climate actions align with the standardized and curated list and co-benefit evidence provided.
2. Review local context and data (risk assessments, CEEI, LGCAP findings) to understand where each action is most relevant to tailor the co-benefit metrics and identify key inputs to be included.
3. Refer to WSP Canada Inc and Golder (2022) and the Pinna guidebook to map potential co-benefits areas.
4. Apply a qualitative framework to assess the evidence for co-benefits.
5. Apply available quantitative indicators to estimate outcomes (e.g., avoided costs, emissions reductions) and then value these outcomes in monetary terms where defensible.
6. Compare and prioritize actions by considering impact, feasibility, local alignment, and availability of credible metrics.
7. Integrate co-benefit insights into staff reports, capital planning, business cases, and funding applications.
8. Communicate using clear messaging that links climate action to tangible community benefits (health, safety, affordability/economic savings). Communication should include a description of key distributional effects expected from the climate action (i.e., those who benefit and those who pay the cost).

2. Case Study – Active Transportation

A representative case study has been selected to demonstrate application of the methodology described in Appendix A. The purpose of this case study is to demonstrate how the methodology outlined in the Guide can be applied in practice by illustrating the step-by-step assessment of co-benefits for a representative active transportation climate action.

Description and background

A fictive medium-size municipality (roughly 2,500 to 10,000 hectares) supports the adoption of bikes, e-bikes, and scooters by expanding active transportation infrastructure through the "Move. Commute. Connect" strategy, including bike lanes, multi-use pathways, end-of-trip facilities, and secure bike parking across communities. Secure, convenient bike parking is essential to integrating these modes with the broader transportation system and encouraging widespread uptake.

Bikes, e-bikes, and scooters require secure parking to support their integration with the broader mobility system and to encourage uptake.

This case study therefore assumes that a local government in BC leads in the implementation of this type of active transportation infrastructure through the provision of safe, convenient, and secure bike parking facilities and or development of an active transportation corridor. In practice, this might require a multimillion-dollar investment, including purchase, construction, and communication efforts. While the costs of such an investment will vary from location to location (depending on ambition level, local funding, political prioritization etc), the following demonstrates how the co-benefits of such an investment could be assessed and then compared to a hypothetical investment cost.

Step 1: Validate how climate actions link to impacts (co-benefits)

Table 1 provides, for each co-benefit area, whether there is sufficient evidence for assessing co-benefits associated with active transportation measures and an estimated confidence in the evidence. This confidence assessment is sourced from Lowe, J. and Betts-Davies, S. (2025). The last column in the table offers a narrative that could be used in describing and communicating potential co-benefits, which can also refer to the confidence levels associated with each. Note that evidence of co-benefits is simply the qualitative assessment of whether evidence in the literature exists to support the fact that a climate action will generate co-benefits. It doesn't necessarily mean evidence of *quantifiable* and/or *monetizable* co-benefits.

Table 1. Validating how climate Action for Active Transportation can be linked to co-benefits

Co-benefits Areas	Evidence of co-benefits?	Confidence in the evidence	Narrative Description
Health	Yes	Very high confidence	There is very high confidence in the evidence that active transport offers health benefits, which come from both the improved air quality and increases in physical activity. Lower rates of obesity, cardiovascular disease and better mental health are apparent. There are reductions in air pollution-related deaths, reductions in deaths due to physical inactivity and reduced exposure to harmful pollutants. Reductions in hospital admissions, chronic bronchitis, acute and chronic respiratory infections and work-loss days. Note

Co-benefits Areas	Evidence of co-benefits?	Confidence in the evidence	Narrative Description
			that physical activity benefits accrue regardless of what cycling displaces, whereas improved air quality will depend on the portion of internal combustion engine ('ICE') vs electric vehicles displaced.
Energy	Yes	Moderate confidence	There is moderate confidence in the evidence that active transportation yields large energy return per dollar, because it directly eliminates vehicle energy use rather than improving efficiency.
Ecosystem	Yes	Very high confidence	There is very high confidence in the evidence that active transportation improves air quality and decreases emissions. While the confidence is high, the actual value of these co benefits will depend on how many ICE vehicles are displaced.
Economic	Yes	Very high confidence	There is very high confidence in the evidence that active transport such as cycling leads to cost savings both for the cyclists themselves (costs of traveling a bike is less than a car), and a cost for society, decreasing the demand for car-related infrastructure.
Socio-cultural	Yes	High confidence	There is high confidence in the evidence that active travel infrastructure is associated with various Socio-cultural co-benefits, such as equal gender representation in cycling. (CBC, 2025)

Step 2: Review context and data to identify key inputs

To assess the co-benefits identified in the table above – and to compare these to the potential costs – requires data and information around the following:

- **Costs**: The required investment cost (including capital and operational costs).
- **Attribution**:
    - The number of adopters of more active transportation and how many vehicle miles they would have travelled annually (which affects the expected substitution effects on the shift from vehicle to bikes/e-scooters)
    - The number of cars expected to be displaced by bikes/e-scooters and the types of cars that are displaced (i.e., an assumption about how many personal ICE vehicles vs personal electric vehicles are replaced by bikes/e-scooters. This impacts, among other things, the air quality co-benefits)
    - The expected changes in health outcomes (including avoided mortality), ownership costs (for cars, bikes, e-scooters), and energy intensity (for cars, bikes, e-scooters)
- **Valuation**. Access to economic literature to help value in monetary terms these types of expected changes.

Steps 3, 4 and 5: Map co-benefits and apply framework, including monetary valuation where possible

The next step in the Guide is to analyse the collected data and to estimate monetary values for co-benefits where possible. This begins by assessing the costs associated with the expanding active transportation network and then considers the co-benefits associated with this investment.

1. **Assessing costs**:
    - **Capital expenditure (Capex) costs:** Based on total installation costs, we can assume that each new bike rack in B.C. costs roughly $15,000. With approximately 100 bike racks planned, this represents a total investment of about $1.5M, all occurring within the first year of the project.
    - **Operational expenditure (Opex) costs:** Each project requires annual maintenance and inspection, which represents approximately $2,000/year (snow removal, minor repair, security, etc.) per intervention. Annually, the costs total $0.2M/year.
    - **Useful service life:** Each bike rack should last approximately 10 years.
2. **Attribution:**
    - This involves identifying key indicators used for valuing benefits in additional units (per additional bike rack). In this example, we assume that this climate action will influence 1,000 new adopters across the community/municipality of active transportation, with an average of 1,000 km travelled every year (10 km/day x 100 days). This is the key indicator used to value co-benefits in the next step.
3. **Valuing co-benefits**:
    - **Health** co-benefits associated with active transportation
        1. The estimated health benefit of cycling in British Columbia is approximately $2.5/km, based on the mortality-related economic gains observed in Canadian cities (including Victoria and Kelowna) using the "WHO HEAT" methodology. Therefore, 1,000,000 km/year * $2.5/km = **$2.5M/year, based on the mortality-related economic gains**.
        2. Half (of the 1,000 bikers x 1,000 km) are substituting an internal combustion engine, therefore leading to a decrease of PM2.5 emissions from 500,000 km of travel. Over 500,000 km of travel by an average gasoline internal combustion vehicle, total PM2.5 emissions amount to only about 9–12 kg (≈0.01 t/year), based on typical U.S. light duty exhaust emission factors of roughly 0.025–0.037 g/mi.

            Using an estimated value of $650 per tonne of PM2.5 avoided, and assuming combustion vehicle tailpipe PM2.5 emission factors of approximately 0.025–0.037 g per mile, this results in the **relatively insignificant estimated health benefit of reduced pollution exposure of roughly $6.50 per vehicle off the road per year**.
    - **Energy** co-benefits associated with active transportation:
        1. Order-of-magnitude estimates suggest that per $1 million invested, active transportation can enable ~15–50 GWh of lifetime final-energy savings, primarily by displacing short, highly energy-intensive urban ICE vehicle trips with near-zero-energy walking, cycling, and micromobility. The range reflects assumptions about trip length, vehicle efficiency, and the type of fossil fuel displaced. These savings are largest in dense urban contexts where trips under 3 km are most common.

2. On this indicative basis, assuming $1.5M in capex investments, the program could enable approximately 22.5–75 GWh of energy savings over 10-year project lifetime, equivalent to an estimated $3.0–$11.25M or **$0.3M-$1.1M/year in avoided gasoline and diesel energy costs,** recognizing that results are highly context-dependent and reflect modeled displacement.

- **Economics** co-benefits associated with active transportation:

    1. Canada-wide operating costs vary by vehicle type, but the Canadian Automobile Association emphasizes that real ownership costs include depreciation, insurance, fuel, tires, and maintenance. Their calculator confirms that true cost per km generally aligns with the 50–70¢/km range once all components are included. A median value of $0.60/km for BC is considered.

    2. Instead of operating a car, the user will now have to operate a bike/e-scooter, which is considerably cheaper. An average cost of approximately $0.10/km is considered based on an average Canadian cycling purchase and maintenance costs (Dekker, 2016).

    3. The **net cost savings to commuters** can be estimated as $0.50/km ($0.60-$0.10), therefore $0.5/km * 500,000 km = **$0.25M/year**, because half (50%) of this distance traveled (1,000 bikers x 1,000 km) is assumed to replace an internal combustion engine, and because the provision of secure infrastructure generates a net increase in distance traveled by bike of 500,000 km per year.

- **Ecosystem** co-benefits associated with active transportation:

    1. Ecosystem-service benefits from active transportation investments are typically estimated using an impact-pathway approach consistent with the System of Environmental-Economic Accounting (SEEA-EA) applied in Canada. Reductions in automobile use are measured through avoided vehicle-kilometres travelled (VKT) and translated into ecosystem benefits via three channels: (i) air-quality regulation and reduced pollutant deposition, (ii) reduced ecological pressure on urban and peri-urban ecosystems due to lower traffic intensity, and (iii) marginal gains in habitat connectivity where green infrastructure is integrated along corridors. Monetization relies on Canadian benefit-transfer values for urban ecosystem services, drawing primarily on Statistics Canada ecosystem accounts and valuation studies for large Canadian metropolitan areas (Statistics Canada, 2025; Dupras et al., 2014; Macaskill & Lloyd-Smith, 2022).

    2. Canadian urban ecosystem accounting identifies air-quality regulation as one of the highest-value ecosystem services in dense cities, while supporting services reflect avoided degradation rather than new ecosystem creation (Statistics Canada, 2019; 2025). Empirical valuations for Canadian cities suggest conservative ranges of $1,000–$3,000/ha/year for air-quality regulation and **$300–$1,000/ha/year for urban habitat and connectivity**, commonly applied through benefit-transfer methodologies (Dupras et al., 2014; Aziz et al., 2023). For example, applying these parameters proportionally to observed or modelled VKT reductions—while excluding human-health valuation to avoid double counting—yields an order-of-magnitude potential ecosystem benefit of $1.5–$5.0M/year for active transportation programs in a medium-sized Canadian city of 5,000 hectares.

- **Socio-cultural** co-benefits associated with active transportation, such as the adoption of bikes, are recognized by the literature, but the metrics to support these lack a defensible evidence base.

Table 2. Summary of co-benefit valuation for Active Transportation

Co-benefits Areas	Confidence in the evidence	Valuation of co-benefits
Health	Very high confidence	Improved health benefit of cycling (reduced mortality) $2.5M/year. Also, a much less significant reduction in health costs from reduced exposure to PM2.5 air emissions of roughly $6.50 per vehicle off the road per year.
Energy	Moderate confidence	Reduced energy consumption costs equivalent to $0.3M–$1.1M/year.
Ecosystem	Very high confidence	Potential urban habitat and ecosystem connectivity benefits of $300–$1,000/ha/year.
Economic	Very high confidence	Net reduction in vehicle ownership costs in the order of $0.25M/year.
Socio-cultural	High confidence	Despite the (qualitative) findings in the literature that evidence supports existence of Socio-cultural co-benefits, data and metrics were unable to support quantification/monetization in this example.

Steps 6, 7 and 8: Prioritize Actions, Integrate Insights, and Communicate Results

The case study shows that enhancing the local government's facilities with safe, convenient, and secure bike-parking infrastructure generates clear net co-benefits for the society. From a narrow financial perspective, this climate action appears to result in a net loss over the first 10 years, given $1.5 million in upfront capital costs and $0.2 million in recurring annual operating costs. However, when the co-benefits of substituting internal-combustion-engine trips with bicycle travel are valued, the economic savings for adopters alone exceed the recurring public costs. Moreover, the long-term health benefits associated with increased active transportation amount to an estimated $25 million over 10 years (undiscounted, calculated as a simple total without discounting future benefits) – significantly outweigh the initial and ongoing investments, demonstrating that the project yields substantial net benefits for society. In other words, the net impacts could be interpreted as improving affordability, as the total cost of to the local government of providing social services has decreased. In this example, the $1M invested led to more than $13M, in co-benefits. This does not include the potential ecosystem co-benefits that could accrue over the same timeframe.

This case study demonstration excluded the valuation of *socio-cultural* co-benefits because of a lack of applicable metrics. The analysis also highlights trade-offs associated with assessing co-benefits, i.e., not all side effects are positive. In this particular case, it could be the case that the land required to build out bike paths/parking may have negative impacts across co-benefit areas such as *ecosystem* (afforestation can impact biodiversity/food production, while also causing emissions), *socio-cultural* (sensitive sites may be impacted), *economic* (resistance from car users), and/or *health* (potential increased risk of cycle injuries).

A distribution analysis (i.e., who benefits from the action and who bears the costs) of impacts should also be considered to better understand how the co-benefits may be experienced by different groups in society. For example, individuals who willingly adopt bike transportation over car transportation (often younger, healthier and higher income users) will gain health benefits, while those who pay for the policy may include tax-payers (in the first year) who don't bike and businesses that may lose car-dependent customers (e.g., disabled drivers) due to reduced space for car parks. This points to a further reason to conduct a distribution analysis, which is to explore possibilities for generating

more optimal climate action design – an action that reduces impacts on (or compensates) those who bear the cost, potentially also reducing resistance to policy implementation. This might take the form of revenue recycling from the cost savings associated with avoided future health care costs to pay for the increased investment costs and/or long-term loss of parking-dependent customers.

Finally, the local government should consider effective ways of communicating these co-benefits with citizens, so that they are not 'hidden' in a cost-benefit analysis. For example, this could be installing signs posted at bike storage facilities or along bike paths that share key insights from research on how these investments provide social returns, including health benefits, energy savings, and reduced vehicle ownership costs.

3. Key Research Findings

While conducting research to develop this Guide, a number of policy-relevant findings emerged. The purpose of this chapter is to summarize some of the key messages to support enhanced understanding of co-benefit assessment across a variety of climate actions.

The findings indicate that there is significant evidence supporting the assessment of community-based climate action and co-benefits and, in some cases, these co-benefits can be defensibly quantified and/or monetized in dollar terms.

Table 3 provides a wide definition of co-benefits (see first row) with five key, defensible co-benefit categories, identifying different types of climate interventions and their co-impacts. As noted in the Limitations section of this Guide, this analysis exclusively focuses on co-benefits and does not assess any potential co-harms/trade-offs associated with climate measures or actions.

Table 3. Definitions Utilized for Co-benefit Categories

Co-benefit Category	Operational Definition	Examples
Co-benefit: Based on Lowe and Davies 2025: Co-benefits of climate action are additional positive consequences that result from mitigation or adaptation measures. By applying a co-benefit lens into the screening, analysis, and communication of climate measures/actions policy makers can select and prioritize investments that are not only effective in reducing emissions or building resilience, but that also advance affordability, inclusivity, economic development, and overall community quality of life.		
Health	Co-benefits affecting individual and population health, as well as health systems, health services, and health infrastructure. This includes outcomes and determinants of physical, mental, psychological, social-cultural, spiritual, and emotional health and wellbeing. (*See also "co-benefit"*)	Avoided premature mortality; reduced disease-specific morbidity; increased life expectancy; improved thermal comfort; increased recreation and physical activity; improved water and food security; better air-quality-related health outcomes.
Energy	Co-benefits related to the production, conversion, distribution, and use of energy, including aspects of access, availability, quality, acceptance, efficiency, and reliability. (*See also "co-benefit"*)	Improved access to renewable energy; increased availability of renewable fuels; decreased or increased energy demand; improved energy efficiency.
Ecosystem	Co-benefits that influence ecological systems and environmental quality, including the provision of biodiversity and many common types of ecosystem services that depends on it (e.g., carbon sequestration, recreation, water quality/quantity, etc). (*See also "co-benefit"*)	Enhanced ecosystem services; increased biodiversity; increased carbon sequestration; improved water, air, or soil quality.
Economic	Co-benefits associated with economic systems, services, and infrastructure, including consumption, investment, employment, productivity, affordability, and trade. (*See also "co-benefit"*)	Economic gains; cost savings; reduced emissions-control costs; increased or reduced investment needs; minimized economic losses and damages; job creation; strengthened financial resilience for low-income populations; improved livelihood resilience; changes in government subsidies or tax revenues; opening or closure of industries.
Social-Cultural	Co-benefits relating to social and cultural systems, institutions, identity, heritage, ceremony, spirituality, worldview, and governance. (*See also "co-benefit"*)	Enhanced social capital; improved adaptive capacity; potential erosion of community cohesion; reconciliation, Indigenous-specific cultural co-benefits, increased or reduced conflict between social groups; improved social wellbeing.

Throughout the discovery phase of methodology development, it was essential to determine which actions had quantifiable measures that could be mapped to their associated impacts. This assessment informed the development of Table 4, which identifies for each relevant community-based climate action[1] the availability of **qualitative** evidence found within North America associated with each of the five co-benefit areas. An important conclusion is that there is sufficient evidence to have the ability to generate quantitative metrics for a number of climate actions (Note the summary in this table builds largely on Lowe, J. and Betts-Davies, S., 2025).

Table 4. List of Climate Actions and the Availability of Qualitative Evidence

Climate Actions	Health	Energy	Ecosystem	Economic	Socio-cultural
Governance, Planning, and Preparedness - Climate risk assessments	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Governance, Planning, and Preparedness - Extreme temperature response plans	Potential for co-benefits	Insufficient evidence	Insufficient evidence	Insufficient evidence	Potential for co-benefits
Governance, Planning, and Preparedness - Education and awareness	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence	Insufficient evidence
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Climate-Informed Land Use and Development - Hazard-informed land use planning	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Resilient Buildings and Infrastructure - Building retrofit programs	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Resilient Buildings and Infrastructure - Training for local building industry	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Insufficient evidence	Insufficient evidence

[1] The climate actions identified in the table are those in Pinna Sustainability's Guidebook and those identified in WSP's literature review (See Limitations in the Appendix).

Climate Actions	Health	Energy	Ecosystem	Economic	Socio-cultural
Resilient Buildings and Infrastructure - Landscape and property programs	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Insufficient evidence	Insufficient evidence
Transportation and Mobility - Green fleet transition	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits
Transportation and Mobility - Public transit infrastructure	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits
Transportation and Mobility - Active transportation	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits
Ecosystems and Natural Assets-Urban Forest strategies	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Insufficient evidence	Potential for co-benefits
Ecosystems and Natural Assets - Green infrastructure	Potential for co-benefits	Potential for co-benefits	Insufficient evidence	Insufficient evidence	Insufficient evidence
Ecosystems and Natural Assets - Natural asset management	Potential for co-benefits	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits
Economy, Energy, and Waste Management - Renewable energy programs	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits
Economy, Energy, and Waste Management - Organic waste diversion	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Insufficient evidence
Economy, Energy, and Waste Management - Circular economy initiatives	Insufficient evidence	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits	Potential for co-benefits

Table 5 on the following page is the Guide's central lookup table that links each impactful climate action to its definition, the associated type of co-benefit that can defensibly be attributed to it, and the specific indicators and quantifiable valuation multiplier connected to these (e.g., number of avoided premature deaths is an indicator that can be valued in monetary terms by applying a valuation multiplier). It is overlayed with the colour-coding from Table 4.

This is not an exhaustive list, rather a listing of priority climate actions for British Columbia Modern Treaty Nations and local governments to consider as they are associated with evidence-based co-benefits and opportunity for benefits and climate mitigation. The table indicates that:

- Some climate actions are associated with a wider suite of defensible co-benefits than others.
- Not all climate actions deliver the same range of co-benefits. Some actions tend to create benefits across many areas, such as health, affordability, energy savings, and resilience, while others mainly deliver benefits in just one or two areas. For example, actions like active transportation or compact community planning often generate multiple, reinforcing benefits, whereas more targeted actions may deliver important but narrower outcomes.
- While many co-benefits are defensible and can be attributed to a climate action, only a subset of these can defensibly be quantified in monetary terms (e.g., avoided hospitalizations and health-care costs can be valued, while improvements in quality of life, safety, or community cohesion generally cannot). There is generally very little or no defensible quantitative evidence for socio-cultural co-benefits.
- Trade-offs among co-benefit areas are inevitable; policy design and creative compensation mechanisms can help address many of these negative impacts and thus potentially reduce resistance to climate actions and measures.
- It is assumed that for every $1 million invested, the same number of benefits are consistently accrued.
- Valuation limitations: Multipliers provide a broad estimate of potential indirect benefits, not an exact measure. They assume that the policy causes the expected changes in behaviour or outcomes and if those changes don't occur, the benefits don't accrue either. Therefore, multipliers are best utilized as a high-level indication of possible impacts, rather than a guaranteed result.

Potential for co-benefits	Insufficient evidence

Table 5. Impactful Climate Actions and Associated Quantifiable Multipliers

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Governance, Planning, and Preparedness - Climate risk assessments	Assess climate-related hazards, vulnerabilities, and risks to inform adaptation and emergency planning.	Health	$1.5M–$4.0M in health co-benefits.	Underlying outcomes: ~0.15–0.4 premature deaths avoided + 10–25 heat-related hospitalizations avoided (per assessment cycle covering ~100k people). Valuation basis: Avoided mortality (Value of a Statistical Life (VSL) ≈ $9.6M) + avoided hospitalizations ($32k each).
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Build localized resilience through community-led emergency preparedness initiatives and mutual support networks.	Health	$0.4M–$1.2M in health co-benefits.	Underlying outcomes: 15–35 heat-related hospitalizations avoided + 150–300 Emergency Room (ER) visits avoided annually in engaged neighborhoods (~50–100k people). Valuation basis: Avoided hospitalizations ($32k) + avoided ED visits ($1.7k).
Governance, Planning, and Preparedness - Extreme temperature response plans	Prepare communities for extreme heat and cold through risk mapping, shelter planning, and coordinated response.	Health	$5M–$20M in health co-benefits.	Underlying outcomes: ~0.5–2.0 premature deaths avoided per major heat event (per ~100k population covered), plus reduced severe illness. Valuation basis: Dominated by avoided mortality (VSL ≈ $9.6M), with secondary morbidity reductions.
Governance, Planning, and Preparedness - Education and awareness	Support climate literacy, communications, and public engagement to build awareness and action.	Health	$0.35M–$0.7M in health co-benefits.	Underlying outcomes: ~150–300 ED visits avoided + 5–10 heat-related hospitalizations avoided per year through behaviour change (hydration, cooling, early care-seeking). Valuation basis: Avoided ED visits ($1.7k) + avoided hospitalizations ($32k). Mortality benefits excluded.
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Design compact, mixed-use, low-carbon communities that reduce emissions and increase resilience.	Health	0.8M–$2.5M in health co-benefits.	Underlying outcomes: reduced heat exposure (urban heat island mitigation), increased physical activity, improved air quality → fewer cardiovascular & respiratory events. Typical impacts: ~10–25 avoided hospitalizations + long-term chronic disease risk reduction in ~50–100k residents. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k); mortality excluded.
Climate-Informed Land Use and Development - Hazard-informed land use planning	Use updated hazard data and mapping to guide development decisions and reduce climate-related risks.	Health	$2M–$6M in health co-benefits.	Underlying outcomes: avoided exposure to floods, wildfires, extreme heat → fewer injuries, fatalities, and acute stress events. Typical impacts: ~0.2–0.6 premature deaths avoided over planning horizon + reduced emergency healthcare demand. Valuation basis: avoided mortality (VSL ≈ $9.6M) dominates; morbidity benefits secondary.
Resilient Buildings and Infrastructure - Building retrofit programs	Support homeowners with energy-efficiency upgrades and resilience improvements through retrofit pathways.	Health	$0.9M–$2.0M in health co-benefits.	Underlying outcomes: improved indoor thermal comfort, reduced heat/cold stress, improved indoor air quality → fewer respiratory and cardiovascular events. Typical impacts: ~20–40 hospitalizations avoided annually across ~300–600 homes retrofitted. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k); mortality excluded.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Resilient Buildings and Infrastructure - Training for local building industry	Provide training on zero-carbon, energy-efficient, and climate-resilient construction for local building professionals.	Health	$0.3M–$0.8M in health co-benefits.	Underlying outcomes: higher-quality buildings delivered over time → cumulative reductions in heat stress and poor indoor air quality. Typical impacts: downstream avoidance of ~10–25 hospitalizations over several years. Valuation basis: benefit transfer via avoided healthcare costs; impacts accrue gradually → conservative lower-bound estimate.
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Guide development through energy-efficient, water-conserving, and low-emissions design requirements.	Health	$1.5M–$4.0M in health co-benefits.	Underlying outcomes: systematic improvement in building performance → reduced heat illness, respiratory impacts, and flood-related injuries. Typical impacts: ~0.15–0.4 deaths avoided over permit lifetime + reduced hospitalizations across new developments. Valuation basis: avoided mortality (VSL) + avoided hospitalizations.
Resilient Buildings and Infrastructure - Landscape and property programs	Strengthen property-level resilience to wildfire, flooding, and extreme weather through programs and policies.	Health	$1.0M–$3.0M in health co-benefits.	Underlying outcomes: reduced wildfire smoke exposure, flood injuries, and evacuation-related health stress. Typical impacts: ~20–50 hospitalizations avoided + reduced acute respiratory episodes during smoke events. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k); mortality excluded unless in high-risk wildfire zones.
Transportation and Mobility - Green fleet transition	Transition municipal fleets to low- or zero-emission vehicles through phased electrification and planning.	Health	$0.6M–$1.5M in health co-benefits.	Underlying outcomes: reduced tailpipe $PM_{2.5}$ and NO_2 exposure → fewer respiratory and cardiovascular events. Typical impacts: ~10–30 avoided hospitalizations + ~200–400 avoided ED visits over vehicle lifetime in urban service areas. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k). Mortality excluded → conservative lower bound
Transportation and Mobility - Public transit infrastructure	Invest in transit infrastructure and safe access to support low-emission mobility and reduce congestion.	Health	$1.5M–$4.5M in health co-benefits.	Underlying outcomes: improved air quality, increased incidental physical activity, reduced traffic injuries → fewer chronic diseases and hospital admissions. Typical impacts: ~20–60 avoided hospitalizations + long-term reduction in premature mortality risk in ~50–100k users. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits; mortality effects partially excluded.
Transportation and Mobility - Active transportation	Expand safe, accessible walking and cycling networks to encourage active, low-carbon travel.	Health	$3.0M–$10.0M in health co-benefits.	Underlying outcomes: increased physical activity → reduced cardiovascular disease, diabetes, and premature mortality; improved mental health. Typical impacts: ~0.3–1.0 premature deaths avoided over infrastructure lifetime + large reductions in chronic disease incidence. Valuation basis: avoided mortality (VSL ≈ $9.6M) + avoided hospitalizations; aligns with Canadian active-transport health evidence.
Ecosystems and Natural Assets - Urban forest strategies	Protect, enhance, and expand the urban tree canopy to support cooling, biodiversity, and wellbeing.	Health	$2.0M–$6.0M in health co-benefits.	Underlying outcomes: reduced urban heat exposure, improved air quality ($PM_{2.5}$ and ozone removal), and enhanced mental well-being → fewer heat-related illnesses and respiratory events in urban neighbourhoods (~50–100k residents).Typical impacts: ~0.2–0.6 premature deaths avoided over canopy expansion period + 20–50 avoided hospitalizations during extreme heat episodes. Valuation basis: avoided mortality (VSL ≈ $9.6M) + avoided hospitalizations; mental-health benefits not monetized.
Ecosystems and Natural Assets - Green infrastructure	Implement nature-based systems for stormwater, cooling, flood mitigation, and biodiversity.	Health	$1.5M–$5.0M in health co-benefits.	Underlying outcomes: reduced flood injuries, heat stress mitigation, and improved local air quality through nature-based stormwater and cooling systems. Typical impacts: ~15–40 avoided hospitalizations + 200–500 avoided Emergency Department visits over project lifetime

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
				in serviced catchments. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k); mortality effects excluded except in high-risk flood areas.
Ecosystems and Natural Assets - Natural asset management	Manage, restore, and protect natural assets that provide ecological and infrastructure services.	Health	$1.0M–$4.0M in health co-benefits	Underlying outcomes: protection of wetlands, riparian zones, and coastal buffers reduces flood injuries, wildfire smoke exposure, and heat-related stress while supporting long-term community wellbeing. Typical impacts: ~0.1–0.4 premature deaths avoided over asset management horizon + reduced acute respiratory and stress-related hospitalizations. Valuation basis: avoided mortality (VSL ≈ $9.6M) + avoided hospitalizations; ecosystem-linked mental-health benefits excluded.
Economy, Energy, and Waste Management - Renewable energy programs	Adopt or support renewable energy systems such as solar, biomass, district energy, or biofuel technologies.	Health	$1.5M–$5.0M in health co-benefits.	Underlying outcomes: reduced combustion of fossil fuels → lower $PM_{2.5}$, NO_2, SO_2 exposure → fewer respiratory and cardiovascular events and premature deaths. Typical impacts: ~0.15–0.5 premature deaths avoided + 10–30 hospitalizations avoided over system lifetime (urban or grid-connected context). Valuation basis: avoided mortality (VSL ≈ $9.6M) + avoided hospitalizations ($32k); aligns with Health Canada air-pollution valuation frameworks.
Economy, Energy, and Waste Management - Organic waste diversion	Reduce methane emissions and landfill waste by supporting community-wide organics diversion.	Health	$0.4M–$1.2M in health co-benefits.	Underlying outcomes: reduced landfill gas, odours, leachate, and local air contaminants → fewer respiratory symptoms, infections, and stress-related health impacts in nearby communities. Typical impacts: ~10–25 hospitalizations avoided + reduced nuisance-related health complaints near landfill sites. Valuation basis: avoided hospitalizations ($32k) + avoided ED visits ($1.7k); mortality excluded.
Economy, Energy, and Waste Management - Circular economy initiatives	Promote reuse, recycling, and waste reduction through circular systems and material recovery.	Health	$0.5M–$2.0M in health co-benefits.	Underlying outcomes: reduced upstream extraction and processing → lower air and water pollution → reduced chronic respiratory and cardiovascular disease risks. Typical impacts: ~15–40 avoided hospitalizations over program lifetime + indirect reductions in pollution-related illness. Valuation basis: benefit transfer via avoided healthcare costs linked to reduced pollution exposure; mortality effects excluded → lower-bound estimate.
Governance, Planning, and Preparedness - Climate risk assessments	Assess climate-related hazards, vulnerabilities, and risks to inform adaptation and emergency planning.	Energy	$0.5M–$1.5M in energy co-benefits (planning-enabled, indirect).	Underlying impacts: identification of priority adaptation and efficiency opportunities avoids maladaptive investments and enables earlier deployment of energy-efficient measures across public assets. Typical impacts: enabling effect equivalent to ~3–8 GWh lifetime energy savings through better-targeted capital planning and avoided retrofit rework. Valuation basis: avoided energy expenditures ($0.15–$0.30/kWh) attributed to improved investment timing and design efficiency → conservative attribution.
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Build localized resilience through community-led emergency preparedness initiatives and mutual support networks.	Energy	$0.2M–$0.6M in energy co-benefits.	Underlying impacts: community preparedness reduces outage-related energy losses, improves use of passive cooling/warming strategies, and lowers emergency backup-energy demand during extreme events. Typical impacts: ~1–4 GWh avoided emergency energy use and reduced peak demand in engaged neighbourhoods over program lifetime. Valuation basis: avoided electricity and fuel use during emergency operations; broader behavioural efficiency benefits excluded.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Governance, Planning, and Preparedness - Extreme temperature response plans	Prepare communities for extreme heat and cold through risk mapping, shelter planning, and coordinated response.	Energy	$0.8M–$2.0M in energy co-benefits.	Underlying impacts: coordinated cooling/heating strategies, cooling-centre planning, and targeted load management reduce peak electricity demand and inefficient emergency energy use during extreme heat and cold events. Typical impacts: ~4–10 GWh avoided peak and emergency energy demand per major event across ~100k population coverage. Valuation basis: avoided high-cost peak electricity consumption and backup energy use; long-term efficiency spillovers excluded.
Governance, Planning, and Preparedness - Education and awareness	Support climate literacy, communications, and public engagement to build awareness and action.	Energy	$0.4M–$1.0M in energy co-benefits	Underlying impacts: improved climate and energy literacy leads to behavioural changes (thermostat settings, equipment use, cooling practices) that reduce household energy consumption. Typical impacts: ~2–6 GWh lifetime energy savings across participating households. Valuation basis: avoided residential electricity and heating energy use; no structural efficiency upgrades assumed → conservative lower bound.
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Design compact, mixed-use, low-carbon communities that reduce emissions and increase resilience.	Energy	$3.0M–$7.5M avoided energy expenditures).	Underlying impacts: reduced building energy demand, shorter travel distances, and shared infrastructure lower per-capita energy intensity in compact, mixed-use communities. Typical impacts: ~20–50 GWh lifetime energy savings. Valuation basis: Canadian evidence shows compact urban form delivers persistent building- and mobility-related energy savings; only building-side savings monetized.
Climate-Informed Land Use and Development - Hazard-informed land use planning	Use updated hazard data and mapping to guide development decisions and reduce climate-related risks.	Energy	$0.8M–$2.5M avoided energy expenditures	Underlying impacts: avoided development in high-risk areas reduces energy losses from flood damage, equipment replacement, and emergency energy use, while improving long-term infrastructure efficiency. ~5–15 GWh lifetime energy savings. Valuation basis: avoided restoration and emergency operation energy use; efficiency gains from better siting partially captured.
Resilient Buildings and Infrastructure - Building retrofit programs	Support homeowners with energy-efficiency upgrades and resilience improvements through retrofit pathways.	Energy	$1.2M–$2.5M avoided energy expenditures.	Underlying impacts: 25–50% reduction in space-heating and electricity demand in ~300–600 homes (deep vs. moderate retrofits). Typical impacts: 8–15 GWh lifetime energy savings. Valuation basis: Canadian retrofit programs consistently achieve ≥50% energy savings for deep retrofits and 25–35% for standard pathways; energy efficiency is the lowest-cost “energy resource
Resilient Buildings and Infrastructure - Training for local building industry	Provide training on zero-carbon, energy-efficient, and climate-resilient construction for local building professionals.	Energy	$0.6M–$1.5M avoided energy costs.	Underlying impacts: improved compliance with BC Energy Step Code / National Energy Code of Canada for Buildings (NECB) → 10–20% energy intensity reduction across hundreds of downstream buildings. Typical impacts: 4–10 GWh lifetime energy savings enabled (≈ . Valuation basis: benefit transfer from Canadian code-training and workforce-capacity studies showing persistent energy-performance gains across trained projects.
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Guide development through energy-efficient, water-conserving, and low-emissions design requirements.	Energy	$2.0M–$4.0M avoided energy expenditures.	Underlying impacts: mandatory siting, envelope, and system requirements → 20–40% lower energy demand in new developments over permit lifetime. Typical impacts: 12–25 GWh lifetime energy savings. Valuation basis: BC Development Permit Areas (DPAs) explicitly target energy conservation and GHG reduction and operate at scale across all permitted development.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Resilient Buildings and Infrastructure - Landscape and property programs	Strengthen property-level resilience to wildfire, flooding, and extreme weather through programs and policies.	Energy	$0.3M–$0.9M avoided energy costs.	Underlying impacts: shading, cool surfaces, wind buffering, and reduced outage-related losses → 5–15% reduction in cooling demand and avoided backup-energy use. Typical impacts: 2–6 GWh lifetime energy savings. Valuation basis: benefit transfer from Canadian wildfire-resilience and urban-greening evidence linking landscape measures to reduced cooling loads and energy disruptions.
Transportation and Mobility - Green fleet transition	Transition municipal fleets to low- or zero-emission vehicles through phased electrification and planning.	Energy	$0.9M–$1.8M avoided fuel & energy expenditures.	Underlying impacts: EVs are ~70% more energy-efficient than ICE vehicles; fuel switching reduces diesel/gasoline use across municipal service fleets (public works, waste, transit support). Typical usage: 6–12 GWh lifetime energy savings. Valuation basis: Canadian municipal fleet electrification programs consistently report large fuel-energy reductions and lower operating energy intensity.
Transportation and Mobility - Public transit infrastructure	Invest in transit infrastructure and safe access to support low-emission mobility and reduce congestion.	Energy	$1.5M–$4.5M avoided energy use.	Underlying impacts: modal shift from private vehicles to transit + higher passenger-km energy efficiency; marginal energy intensity of transit is substantially lower than private cars. Typical usage: 10–30 GWh lifetime net energy savings. Valuation basis: NRCan transportation energy data and Canadian research showing strong structural (mode-shift) energy effects.
Transportation and Mobility - Active transportation	Expand safe, accessible walking and cycling networks to encourage active, low-carbon travel.	Energy	$2.0M–$7.5M avoided energy use.	Underlying impacts: direct displacement of short car trips (which are highly energy-intensive per km) with near-zero-energy modes; strongest savings in urban contexts. Typical usage: 15–50 GWh lifetime energy savings. Valuation basis: Canadian evidence shows many trips < 3 km can shift to walking/cycling; active transport delivers the largest structural energy-reduction effect.
Ecosystems and Natural Assets - Urban forest strategies	Protect, enhance, and expand the urban tree canopy to support cooling, biodiversity, and wellbeing.	Energy	$1.0M–$3.0M avoided energy expenditures.	Underlying impacts: urban canopy expansion reduces building cooling demand through shading and evapotranspiration, and moderates peak electricity loads during heat events. Typical impacts: ~6–15 GWh lifetime electricity savings across shaded residential and commercial areas. Valuation basis: Canadian urban-forestry and heat-island studies consistently show measurable cooling-energy reductions; heating-penalty effects excluded → conservative.
Ecosystems and Natural Assets - Green infrastructure	Implement nature-based systems for stormwater, cooling, flood mitigation, and biodiversity.	Energy	$0.8M–$2.0M avoided energy expenditures.	Underlying impacts: green roofs, permeable surfaces, and wetland systems reduce cooling demand, protect energy equipment from flood damage, and avoid energy losses during storm events. Typical impacts: ~5–12 GWh lifetime energy savings and avoided backup-energy use. Valuation basis: benefit transfer from Canadian green-infrastructure and green-roof performance studies; indirect grid-resilience benefits excluded
Ecosystems and Natural Assets - Natural asset management	Manage, restore, and protect natural assets that provide ecological and infrastructure services.	Energy	$0.6M–$2.0M avoided energy expenditures.	Underlying impacts: intact forests, wetlands, and riparian buffers reduce temperature extremes, stabilize hydrology, and protect energy and water-energy infrastructure from disruption. Typical impacts: ~4–10 GWh lifetime avoided energy use and reduced emergency-energy demand. Valuation basis: avoided energy losses and avoided reliance on emergency or temporary energy systems; efficiency spillovers not monetized.
Economy, Energy, and Waste Management - Renewable energy programs	Adopt or support renewable energy systems such as solar,	Energy	$4.5M–$12.0M in avoided energy expenditures.	Underlying impacts: deployment of on-site or community-scale renewable energy systems (e.g., solar, biomass, district energy) directly displaces grid electricity or fossil fuel use. Typical implementations generate or displace roughly 30–80 GWh of energy over system lifetimes,

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
	biomass, district energy, or biofuel technologies.			providing long-term cost stability and reduced exposure to energy-price volatility. Valuation basis: observed performance and cost outcomes from Canadian municipal renewable-energy programs.
Economy, Energy, and Waste Management - Organic waste diversion	Reduce methane emissions and landfill waste by supporting community-wide organics diversion.	Energy	$0.9M–$2.5M in avoided energy costs.	Underlying impacts: reduced landfill disposal and methane emissions, combined with energy recovery through composting or anaerobic digestion where applicable, lower net system-wide energy demand. Typical organics-diversion systems deliver net lifetime energy benefits on the order of 6–15 GWh when accounting for processing and transportation energy. Valuation basis: Canadian studies of municipal organics diversion and waste-to-resource systems.
Economy, Energy, and Waste Management - Circular economy initiatives	Promote reuse, recycling, and waste reduction through circular systems and material recovery.	Energy	$1.5M–$4.5M in avoided energy expenditures.	Underlying impacts: reuse, recycling, repair, and material circularity reduce demand for energy-intensive virgin material production and upstream manufacturing. Across multiple material streams, circular economy initiatives typically avoid 10–30 GWh of embodied energy over program lifetimes by displacing primary production processes. Valuation basis: material-intensity and embodied-energy evidence from Canadian and international circular-economy research.
Governance, Planning, and Preparedness - Climate risk assessments	Assess climate-related hazards, vulnerabilities, and risks to inform adaptation and emergency planning.	Ecosystem	$0.5M–$2.0M in ecosystem-service value.	Underlying services: improved identification and siting of natural assets support long-term ecosystem protection by reducing degradation, fragmentation, and loss of regulating and supporting functions. These benefits arise through more informed land-use decisions, infrastructure alignment, and protection priorities. Valuation basis: avoided ecosystem service losses and enhanced outcomes attributed to improved planning quality.
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Build localized resilience through community-led emergency preparedness initiatives and mutual support networks.	Ecosystem	$0.3M–$1.0M in ecosystem-service value.	Underlying services: community-level preparedness reduces damage to parks, waterways, and green spaces during extreme events, lowers contamination loads, and supports faster ecological recovery. Benefits accrue primarily through reduced disturbance and improved stewardship during and after climate shocks. Valuation basis: ecosystem-impact reductions observed in disaster-preparedness and recovery studies.
Governance, Planning, and Preparedness - Extreme temperature response plans	Prepare communities for extreme heat and cold through risk mapping, shelter planning, and coordinated response.	Ecosystem	$0.4M–$1.5M in ecosystem-service value.	Underlying services: coordinated response to extreme heat and cold reduces thermal stress on urban vegetation, soils, and green infrastructure, improving survival and functional performance during extreme events. These measures help sustain regulating and supporting ecosystem services over time. Valuation basis: avoided loss of ecosystem services during extreme temperature events.
Governance, Planning, and Preparedness - Education and awareness	Support climate literacy, communications, and public engagement to build awareness and action.	Ecosystem	$0.2M–$0.6M in ecosystem-service value enabled.	Underlying services: improved stewardship and behaviour → reduced ecosystem degradation, increased uptake of urban greening, protection of green/blue spaces (regulating + cultural services). Typical impacts: avoided loss of urban tree canopy, enhanced recreational and cultural ecosystem services across ~50–100k residents. Valuation basis: benefit transfer from Canadian urban ecosystem accounting showing measurable cultural and regulating services tied to public engagement and stewardship; impacts are indirect.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Design compact, mixed-use, low-carbon communities that reduce emissions and increase resilience.	Ecosystem	$1.5M–$4.0M in ecosystem-service value.	Underlying services: urban heat regulation, stormwater retention, air-quality regulation, carbon storage, recreation (regulating + cultural). Typical impacts: preservation and integration of green infrastructure delivering long-term services across dense urban areas. Valuation basis: Canadian conservation-authority valuations and Statistics Canada ecosystem accounts consistently show high per-hectare value for urban green infrastructure embedded in compact development.
Climate-Informed Land Use and Development - Hazard-informed land use planning	Use updated hazard data and mapping to guide development decisions and reduce climate-related risks.	Ecosystem	$2.0M–$6.0M in ecosystem-service value.	Underlying services: flood attenuation, erosion control, water filtration, habitat provision, carbon storage (regulating + supporting). Typical impacts: avoided conversion of wetlands, floodplains, riparian zones; maintenance of high-value natural assets providing risk-reduction services. Valuation basis: Canadian evidence shows hazard-informed land-use planning protects ecosystems that deliver some of the highest regulating service values (flood control, water quality).
Resilient Buildings and Infrastructure - Building retrofit programs	Support homeowners with energy-efficiency upgrades and resilience improvements through retrofit pathways.	Ecosystem	$0.6M–$2.0M in ecosystem-service value.	Underlying services: reduced pressure on natural systems through lower energy demand, improved urban microclimates, and reduced air-pollution deposition affecting vegetation and soils (regulating + supporting).Typical impacts: cumulative reductions in ecosystem stress associated with energy production, improved resilience of urban green spaces through better thermal regulation at the building scale, and reduced need for emergency infrastructure that can disrupt natural assets. Valuation basis: benefit transfer from Canadian studies linking building energy efficiency and thermal comfort improvements to reduced environmental externalities and improved ecosystem conditions.
Resilient Buildings and Infrastructure - Training for local building industry	Provide training on zero-carbon, energy-efficient, and climate-resilient construction for local building professionals.	Ecosystem	$0.3M–$0.8M in ecosystem-service value enabled.	Underlying services: reduced land take and disturbance through better design; improved integration of green infrastructure (regulating + cultural services). Typical impacts: downstream protection of urban tree canopy, soils, and small green/blue features across hundreds of projects delivered by trained professionals. Valuation basis: benefit transfer from Canadian urban ecosystem accounting showing measurable regulating and cultural services associated with green-infrastructure uptake; impacts are indirect.
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Guide development through energy-efficient, water-conserving, and low-emissions design requirements.	Ecosystem	$1.8M–$5.0M in ecosystem-service value.	Underlying services: stormwater regulation, urban heat mitigation, air-quality regulation, carbon storage, habitat connectivity (regulating + supporting + cultural). Typical impacts: systematic preservation and enhancement of green/blue infrastructure embedded in all permitted development over the DPA lifetime. Valuation basis: Canadian conservation-authority valuations and Statistics Canada ecosystem accounts consistently show high per-hectare values for urban green infrastructure protected through land-use controls.
Resilient Buildings and Infrastructure - Landscape and property programs	Strengthen property-level resilience to wildfire, flooding, and extreme weather through programs and policies.	Ecosystem	$2.0M–$6.0M in ecosystem-service value.	Underlying services: flood attenuation, erosion control, water filtration, carbon sequestration, micro-climate regulation, habitat provision (regulating + supporting). Typical impacts: protection and restoration of riparian zones, wetlands, and vegetated buffers that deliver high-value regulating services and reduce reliance on grey infrastructure. Valuation basis:

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
				Canadian natural-asset and nature-based-solutions valuations show floodplain, wetland, and urban forest services among the highest ecosystem values per dollar invested.
Transportation and Mobility - Green fleet transition	Transition municipal fleets to low- or zero-emission vehicles through phased electrification and planning.	Ecosystem	$0.8M–$2.5M in ecosystem-service value	Underlying services: reduced air and soil contamination from fuel spills and tailpipe pollutants, lower noise disturbance, and indirect benefits to urban vegetation and sensitive habitats due to cleaner local environments (regulating + supporting). Typical impacts: gradual improvement in urban ecosystem quality and reduced cumulative stress on roadside vegetation and adjacent natural areas over fleet lifetime. Valuation basis: benefit transfer from Canadian studies linking reduced vehicular pollution to improved ecosystem health; biodiversity and noise-ecosystem interactions only partially captured.
Transportation and Mobility - Public transit infrastructure	Invest in transit infrastructure and safe access to support low-emission mobility and reduce congestion.	Ecosystem	$1.5M–$4.5M in ecosystem-service value.	Underlying services: avoided land consumption, reduced habitat fragmentation, lower air-pollution deposition, and reduced pressure on peri-urban ecosystems through mode shift from private vehicles (regulating + supporting). Typical impacts: long-term structural reduction in vehicle-kilometres travelled (VKT), yielding persistent benefits for urban and peri-urban ecosystems along major corridors. Valuation basis: ecosystem benefits inferred from avoided vehicle activity and land-use pressure; carbon benefits excluded here (accounted for elsewhere).
Transportation and Mobility - Active transportation	Expand safe, accessible walking and cycling networks to encourage active, low-carbon travel.	Ecosystem	$1.5M–$5.0M in ecosystem-service value.	Underlying services: reduced air and noise pollution, lower deposition of contaminants on soils and vegetation, and reduced pressure on urban and peri-urban ecosystems due to decreased vehicle traffic (regulating + supporting). Active transportation corridors also create opportunities for green infrastructure integration, enhancing habitat connectivity and urban biodiversity. Typical impacts: sustained reductions in vehicle-kilometres travelled lead to cumulative improvements in ecosystem conditions along transport corridors and in dense urban areas, with co-benefits for green spaces and waterways. Valuation basis: ecosystem benefits inferred from avoided vehicle activity, pollution exposure, and land-use pressure, drawing on Canadian urban transport and ecosystem-services literature.
Ecosystems and Natural Assets - Urban forest strategies	Protect, enhance, and expand the urban tree canopy to support cooling, biodiversity, and wellbeing.	Ecosystem	$3.0M–$8.0M in ecosystem-service value.	Underlying services: urban heat mitigation, air-quality regulation, stormwater interception, carbon storage & sequestration, habitat provision, recreation (regulating + supporting + cultural). Typical impacts: canopy expansion and improved forest conditions delivering long-lived services across dense urban areas. Valuation basis: Canadian urban-forest valuations consistently show very high per-hectare ecosystem service values; urban trees are among the most productive natural assets per dollar invested.
Ecosystems and Natural Assets - Green infrastructure	Implement nature-based systems for stormwater, cooling, flood mitigation, and biodiversity.	Ecosystem	$2.5M–$7.0M in ecosystem-service value.	Underlying services: flood attenuation, water filtration, temperature regulation, carbon storage, biodiversity support, recreation (regulating + supporting + cultural). Typical impacts: replacement or deferral of grey infrastructure while delivering multi-service benefits through wetlands, rain gardens, bioswales, and green roofs. Valuation basis: Canadian conservation-authority and Greenbelt-scale studies show wetlands and green infrastructure provide some of the highest ecosystem service values per hectare, particularly for flood and water regulation.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Ecosystems and Natural Assets - Natural asset management	Manage, restore, and protect natural assets that provide ecological and infrastructure services.	Ecosystem	$4.0M–$12.0M in ecosystem-service value.	Underlying services: flood regulation, water supply & filtration, carbon storage, erosion control, habitat connectivity, climate regulation (regulating + supporting). Typical impacts: sustained delivery of municipal services by forests, wetlands, riparian corridors, and soils treated as infrastructure assets. Valuation basis: Canadian natural-asset inventories and Green Municipal Fund (GMF) / Natural Asset Initiative (NAI) case studies show natural assets can deliver very high and durable service value relative to management cost
Economy, Energy, and Waste Management - Renewable energy programs	Adopt or support renewable energy systems such as solar, biomass, district energy, or biofuel technologies.	Ecosystem	$0.8M–$3.0M in ecosystem-service value.	Underlying services: reduced air pollution deposition, lower disturbance to ecosystems associated with fossil-fuel extraction and transport, and reduced pressure on land and water systems used for conventional energy production (regulating + supporting). Typical impacts: long-term reductions in cumulative ecosystem stress driven by lower upstream energy impacts and improved local environmental conditions where renewable systems replace conventional supply. Valuation basis: ecosystem benefits inferred from reduced fossil-fuel lifecycle impacts and avoided environmental externalities associated with energy generation, drawing on Canadian energy-environment evidence.
Economy, Energy, and Waste Management - Organic waste diversion	Reduce methane emissions and landfill waste by supporting community-wide organics diversion.	Ecosystem	$1.0M–$3.5M in ecosystem-service value.	Underlying services: improved soil health through compost application, reduced contamination of soils and waterways, and avoided ecosystem degradation associated with landfill expansion and leachate (supporting + regulating). Typical impacts: enhanced terrestrial and aquatic ecosystem function through nutrient cycling, reduced waste-related land impacts, and lower pollutant loads over program lifetimes. Valuation basis: benefit transfer from Canadian studies linking organic waste diversion and composting to soil quality, water protection, and reduced ecosystem degradation.
Economy, Energy, and Waste Management - Circular economy initiatives	Promote reuse, recycling, and waste reduction through circular systems and material recovery.	Ecosystem	$2.0M–$6.0M in ecosystem-service value.	Underlying services: reduced pressure on forests, soils, and aquatic systems through lower raw-material extraction, reduced waste generation, and decreased pollution across material supply chains (regulating + supporting).Typical impacts: cumulative preservation of ecosystem functions as demand for virgin materials declines and landfilling and disposal pressures are reduced. Valuation basis: ecosystem-service benefits inferred from avoided resource extraction, reduced waste burdens, and lower material-related environmental impacts, based on Canadian circular-economy and natural-capital evidence.
Governance, Planning, and Preparedness - Climate risk assessments	Assess climate-related hazards, vulnerabilities, and risks to inform adaptation and emergency planning.	Economic	$2.0M–$6.0M in avoided future losses and improved capital efficiency.	Underlying mechanisms: better siting and design of infrastructure; avoided maladaptation; reduced repair, insurance, and disaster-recovery costs. Evidence basis: Canadian Climate Institute shows climate damages are a growing drag on economic growth and that proactive adaptation can substantially reduce future costs; Canadian Council of Ministers of the Environment (CCME) guidance identifies risk assessments as foundational to cost-effective adaptation and capital allocation.
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Build localized resilience through community-led emergency preparedness initiatives and mutual support networks.	Economic	$1.0M–$3.0M in avoided response and recovery costs.	Underlying mechanisms: faster local response, reduced demand on emergency services, reduced property damage and business interruption, lower social-assistance and recovery expenditures. Evidence basis: Government of Canada and provincial guidance consistently emphasize that community-level preparedness reduces disaster impacts and recovery burdens; economic-preparedness frameworks link preparedness to reduced post-event disruption

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Governance, Planning, and Preparedness - Extreme temperature response plans	Prepare communities for extreme heat and cold through risk mapping, shelter planning, and coordinated response.	Economic	$3.0M–$10.0M in avoided economic losses.	Underlying mechanisms: avoided health-system surge costs, protected labour productivity, reduced emergency response and infrastructure stress during extreme events. Evidence basis: Canadian Climate Institute documents the very high economic costs of extreme heat events (including productivity and system disruption) and concludes that adaptation yields strong economic returns; National Collaborating Centre for Environmental Health (NCCEH) identifies preparedness gaps as cost drivers.
Governance, Planning, and Preparedness - Education and awareness	Support climate literacy, communications, and public engagement to build awareness and action.	Economic	$0.3M–$1.0M in economic value enabled.	Underlying mechanisms: improved risk-aware behavior, higher uptake of cost-effective adaptation measures, reduced misinformation-driven delay and maladaptation. Evidence basis: Federal climate-literacy investments frame education as an enabling condition for effective climate action; economic impacts are indirect and therefore conservatively valued.
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Design compact, mixed-use, low-carbon communities that reduce emissions and increase resilience.	Economic	$1.5M–$4.0M in lifecycle economic benefits.	Underlying mechanisms: lower per-capita infrastructure capital and O&M costs; reduced public-service delivery costs (roads, pipes, transit); reduced household transportation and energy expenditures; improved fiscal efficiency of growth. Evidence basis: Canadian urban-planning and infrastructure analyses consistently show compact development reduces infrastructure cost per unit and avoids long-term fiscal liabilities compared with low-density growth; these savings accrue to municipalities and households over asset lifetimes.
Climate-Informed Land Use and Development - Hazard-informed land use planning	Use updated hazard data and mapping to guide development decisions and reduce climate-related risks.	Economic	$4.0M–$12.0M in avoided future losses.	Underlying mechanisms: avoided disaster damage to housing and infrastructure; reduced insurance, recovery, and rebuilding costs; lower fiscal exposure for governments. Evidence basis: Canadian Climate Institute analysis shows that steering even a small share of new development away from high-risk flood and wildfire zones can avoid the majority of future losses, with potential national savings in the billions annually; federal land-use guidance identifies land-use planning as one of the most effective levers for reducing disaster costs.
Resilient Buildings and Infrastructure - Building retrofit programs	Support homeowners with energy-efficiency upgrades and resilience improvements through retrofit pathways.	Economic	$1.5M–$4.0M in net lifecycle economic benefits.	Underlying mechanisms: avoided repair and replacement costs from extreme heat, cold, and flooding; reduced operating and maintenance costs; protection of housing asset value. Evidence basis: Canadian analyses consistently show retrofits are more cost-effective than rebuilding and deliver long-term savings by reducing operating costs and exposure to climate damages; resilience benefits are additive to energy savings and therefore conservatively valued here.
Resilient Buildings and Infrastructure - Training for local building industry	Provide training on zero-carbon, energy-efficient, and climate-resilient construction for local building professionals.	Economic	$0.8M–$2.5M in economic value enabled.	Underlying mechanisms: reduced construction defects and retrofit failures; improved cost-effectiveness of upgrades; avoided rework and premature asset degradation. Evidence basis: Canadian retrofit and building-sector studies emphasize that skills and capacity gaps are a key driver of higher costs and underperformance; training improves capital efficiency but has indirect benefits, reflected in a conservative range.
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Guide development through energy-efficient, water-conserving, and low-emissions design requirements.	Economic	$1.5M–$4.0M in net lifecycle economic benefits.	Underlying mechanisms: reduced building energy and water operating costs; lower municipal capital and O&M costs for water, wastewater, and energy-related infrastructure; avoided future retrofit and compliance costs by embedding performance requirements at permitting stage; improved capital efficiency and predictability of development.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Resilient Buildings and Infrastructure - Landscape and property programs	Strengthen property-level resilience to wildfire, flooding, and extreme weather through programs and policies.	Economic	$3.0M–$9.0M in avoided damages and recovery costs.	Underlying mechanisms: reduced flood and wildfire damage to buildings; lower insurance claims and public disaster-assistance costs; protection of private property values. Evidence basis: Canadian flood and wildfire research consistently identifies property-level measures as highly cost-effective, with avoided losses far exceeding program costs when implemented before disasters occur.
Transportation and Mobility - Green fleet transition	Transition municipal fleets to low- or zero-emission vehicles through phased electrification and planning.	Economic	$1.0M–$3.0M in net lifecycle savings after higher upfront vehicle and charging costs.	Upfront cost consideration: EVs (especially medium- and heavy-duty) have higher acquisition and infrastructure costs, which are partially offset by grants/loans and financing programs. Net economic mechanisms: lower fuel and maintenance costs; reduced vehicle downtime; improved total cost of ownership over vehicle life. Evidence basis: Canadian municipal fleet programs require lifecycle TCO analysis because upfront costs are higher but operating costs are materially lower over time.
Transportation and Mobility - Public transit infrastructure	Invest in transit infrastructure and safe access to support low-emission mobility and reduce congestion.	Economic	$0.8M–$2.5M in net economic benefits after capital costs.	Upfront cost consideration: transit infrastructure has very high capital costs and long delivery timelines. Net economic mechanisms: reduced household vehicle operating costs; reduced congestion and collision costs; avoided road expansion and maintenance costs. Evidence basis: Canadian transit economic evaluations consistently show that, despite high capital costs, transit investments generate net economic benefits through congestion reduction and avoided household transport costs.
Transportation and Mobility - Active transportation	Expand safe, accessible walking and cycling networks to encourage active, low-carbon travel.	Economic	$2.0M–$6.0M in net economic benefits, even after upfront construction costs.	Upfront cost consideration: active transportation infrastructure requires capital investment but at much lower unit cost than roads or transit. Net economic mechanisms: avoided road congestion; reduced vehicle operating costs; deferred road and parking infrastructure investments. Evidence basis: Canadian active-transport strategies and funding programs identify active transportation as one of the highest-return transport investments due to low capital costs and broad congestion-reduction benefits.
Ecosystems and Natural Assets - Urban forest strategies	Protect, enhance, and expand the urban tree canopy to support cooling, biodiversity, and wellbeing.	Economic	$1.8M–$5.0M in economic value (net of planting and maintenance costs).	Underlying services: urban cooling and heat-stress reduction, stormwater interception, reduced building energy demand, air-quality regulation (avoided infrastructure and operating costs). Typical impacts: reduced municipal stormwater and road-maintenance costs; avoided building cooling expenditures; deferred grey-infrastructure upgrades through canopy-based regulation. Valuation basis: Canadian urban-forest valuation studies and GMF case evidence show that monetizable avoided energy and infrastructure costs from urban trees exceed establishment and lifecycle maintenance costs when managed at scale.
Ecosystems and Natural Assets - Green infrastructure	Implement nature-based systems for stormwater, cooling, flood mitigation, and biodiversity.	Economic	$2.5M–$7.0M in economic value (net of capital and O&M costs).	Underlying services: stormwater retention and filtration, flood-damage avoidance, urban cooling, reduced peak hydraulic loads on drainage systems. Typical impacts: avoided flood and basement-damage costs; reduced capital and operating expenditures on pipes, culverts, and treatment facilities; deferred expansion of grey stormwater infrastructure. Valuation basis: Canadian conservation-authority and municipal asset-management evidence consistently shows green infrastructure delivers lower lifecycle costs than grey alternatives while avoiding flood-related damages.

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Ecosystems and Natural Assets - Natural asset management	Manage, restore, and protect natural assets that provide ecological and infrastructure services.	Economic	$4.0M–$12.0M in economic value (net of inventory, planning, and stewardship costs).	Underlying services: flood regulation, water supply and filtration, erosion control, climate regulation, service substitution for engineered infrastructure. Typical impacts: sustained delivery of municipal services by forests, wetlands, riparian corridors, and soils treated as infrastructure assets; reduced capital renewal and operating costs for engineered systems. Valuation basis: Canadian natural-asset inventories, Natural Assets Initiative guidance, and GMF/NAI case studies show natural assets can deliver very high and durable service value relative to management cost when integrated into asset-management system
Economy, Energy, and Waste Management - Renewable energy programs	Adopt or support renewable energy systems such as solar, biomass, district energy, or biofuel technologies.	Economic	$1.2M–$3.5M in economic value (net of capital and integration costs).	Underlying services: avoided fossil-fuel expenditures, price-stability and risk reduction, local energy retention, reduced exposure to energy-market volatility. Typical impacts: reduced municipal and community energy operating costs; local economic retention of energy spending; improved resilience to energy price shocks and service disruptions. Valuation basis: Canadian community-energy and Green Municipal Fund (GMF) program evidence shows renewable energy systems deliver positive lifecycle economics despite high upfront capital costs through long-term operating savings and risk mitigation.
Economy, Energy, and Waste Management - Organic waste diversion	Reduce methane emissions and landfill waste by supporting community-wide organics diversion.	Economic	$1.5M–$4.0M in economic value (net of collection and processing costs)	Underlying services: avoided landfill expansion, reduced methane-management costs, production of compost or renewable natural gas, extended landfill lifespan. Typical impacts: reduced long-term landfill capital and closure liabilities; avoided methane-control expenditures; creation of marketable compost or biogas products. Valuation basis: Canadian municipal waste and Environment and Climate Change Canada (ECCC) analyses show organics diversion reduces costly methane management and landfill expansion while generating recoverable value streams that exceed system costs at scale.
Economy, Energy, and Waste Management - Circular economy initiatives	Promote reuse, recycling, and waste reduction through circular systems and material recovery.	Economic	$2.0M–$6.0M in net economic benefit	Underlying impacts: reduced material procurement costs, lower waste-management expenditures, and improved resource productivity across municipal and local economic systems. Circular initiatives also support local job creation in repair, reuse, recycling, and material recovery sectors. Valuation basis: avoided raw-material and disposal costs, combined with local value-added effects, based on Canadian circular-economy and waste-management evidence.
Governance, Planning, and Preparedness - Climate risk assessments	Assess climate-related hazards, vulnerabilities, and risks to inform adaptation and emergency planning.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Build localized resilience through community-led emergency preparedness initiatives and mutual support networks.	Socio-cultural	Insufficient Evidence	Insufficient Evidence

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Governance, Planning, and Preparedness - Extreme temperature response plans	Prepare communities for extreme heat and cold through risk mapping, shelter planning, and coordinated response.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Governance, Planning, and Preparedness - Education and awareness	Support climate literacy, communications, and public engagement to build awareness and action.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Design compact, mixed-use, low-carbon communities that reduce emissions and increase resilience.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Climate-Informed Land Use and Development - Hazard-informed land use planning	Use updated hazard data and mapping to guide development decisions and reduce climate-related risks.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Resilient Buildings and Infrastructure - Building retrofit programs	Support homeowners with energy-efficiency upgrades and resilience improvements through retrofit pathways.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Resilient Buildings and Infrastructure - Training for local building industry	Provide training on zero-carbon, energy-efficient, and climate-resilient construction for local building professionals.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Guide development through energy-efficient, water-conserving, and low-emissions design requirements.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Resilient Buildings and Infrastructure - Landscape and property programs	Strengthen property-level resilience to wildfire, flooding, and extreme weather through programs and policies.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Transportation and Mobility - Green fleet transition	Transition municipal fleets to low- or zero-emission vehicles through phased electrification and planning.	Socio-cultural	Insufficient Evidence	Insufficient Evidence

Climate Action	Definition and Context	Associated Co-benefit	Multiplier (*Per $1M Invested)	Explanation
Transportation and Mobility - Public transit infrastructure	Invest in transit infrastructure and safe access to support low-emission mobility and reduce congestion.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Transportation and Mobility - Active transportation	Expand safe, accessible walking and cycling networks to encourage active, low-carbon travel.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Ecosystems and Natural Assets - Urban forest strategies	Protect, enhance, and expand the urban tree canopy to support cooling, biodiversity, and wellbeing.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Ecosystems and Natural Assets - Green infrastructure	Implement nature-based systems for stormwater, cooling, flood mitigation, and biodiversity.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Ecosystems and Natural Assets - Natural asset management	Manage, restore, and protect natural assets that provide ecological and infrastructure services.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Economy, Energy, and Waste Management - Renewable energy programs	Adopt or support renewable energy systems such as solar, biomass, district energy, or biofuel technologies.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Economy, Energy, and Waste Management - Organic waste diversion	Reduce methane emissions and landfill waste by supporting community-wide organics diversion.	Socio-cultural	Insufficient Evidence	Insufficient Evidence
Economy, Energy, and Waste Management - Circular economy initiatives	Promote reuse, recycling, and waste reduction through circular systems and material recovery.	Socio-cultural	Insufficient Evidence	Insufficient Evidence

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Appendices

Appendix A. Methodology

The methodology for this Guide establishes a clear, evidence-based framework for identifying and evaluating the co-benefits of climate actions on the community level across British Columbia, drawing on robust data sources and established analytical practices. The methodology aims to offer a credible, transparent, and tailored approach.

4.1 Overview of Research Approach

To support the development of a practical and user-friendly guide for the Ministry and its stakeholders, a research approach was designed to identify and measure the co-benefits of local climate actions across British Columbia (Figure 1). This approach focused on priority actions such as building retrofits, green fleet transitions, and climate risk assessments, among others, and quantified their environmental, economic, and social co-benefits (e.g., health savings per kilometre, economic return per dollar invested) to ensure that the prioritized measures were evaluated through performance indicators. Prioritized measures within this research approach were selected based on the robustness and completeness of available data, geographical relevance of the data source within the context of British Columbia, and the overall credibility of the source. The resulting localized examples help BC-based communities evaluate priority climate initiatives, enabling evidence-based policy, planning, and investment decisions.

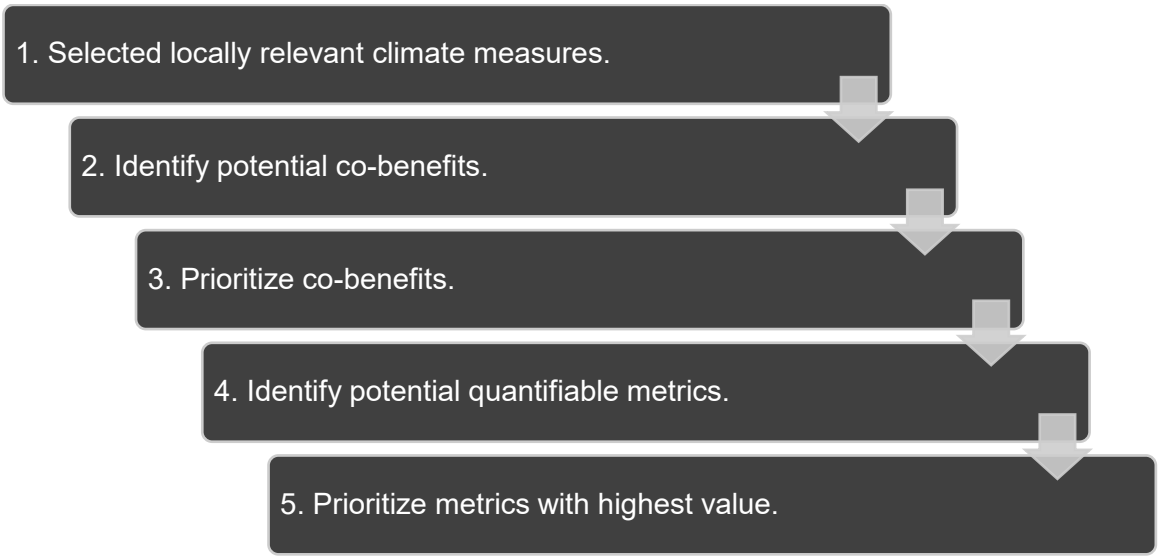

Figure 1. Research Approach for Identifying Climate Co-Benefits

4.2 Key Steps to Identifying Climate Co-Benefits

The following five steps summarize the structured approach WSP used to identify, assess, and prioritize locally relevant climate measures and their co-benefits for communities across British Columbia.

Step 1: Selected locally relevant climate actions/measures

WSP identified climate measures by starting with the standardized list in the Pinna Climate Action Best Practice Guidebook, as these actions are already tailored for local governments and Modern Treaty Nations in British Columbia. From this foundation, WSP selected measures that were both locally relevant and supported by credible evidence, ensuring alignment with BC-specific planning needs and the Ministry's mandate (refer to Section 3.4 below).

Step 2: Identified potential co-benefits

WSP reviewed each selected climate measure to identify the full range of potential co-benefits using the qualitative evidence summarized in the Pinna Climate Action Best Practice Guidebook and supporting literature. This step focused on determining which social, economic, environmental, health, energy, and socio-cultural impacts each action may generate, drawing primarily from established guidance for BC local governments and Modern Treaty Nations.

Step 3: Prioritized co-benefits

WSP prioritized co-benefits by assessing which qualitative impacts were most robust, credible, and broadly applicable across BC communities, focusing on those with the strongest supporting evidence and clearest relevance to local government and Modern Treaty Nation planning needs.

Step 4: Identified potential quantifiable metrics

WSP identified a comprehensive set of quantifiable metrics for each prioritized co-benefit by reviewing available social, economic, and environmental indicators and mapping these to the most defensible and applicable measurement approaches for BC.

Step 5: Prioritized metrics with highest value

WSP then prioritized the metrics that provide the greatest decision-making value—those that are locally relevant, supported by credible data, and most effective in illustrating meaningful co-benefit outcomes for communities.

4.3 Data Inputs

A comprehensive review of scientific literature, jurisdictional analyses, and high-quality studies informed the development of a robust repository of data to support assessment of climate measure co-benefits. The Guide is grounded in six primary data sources, including provincial studies, federal census data, institutional publications, and peer-reviewed scientific research.[2] It builds directly on the Climate Action Best Practice Guidebook, developed to support B.C. Local Governments and Modern Treaty Nations in advancing climate action through practical strategies, examples, and tools (Pinna Sustainability, 2025). It also incorporates and aligns with insights from the WSP Golder report, Methodology for Estimating the Co-benefits and Co-harms of Climate Policy (WSP Golder, 2022).

The data inputs used in this Guide reflect an up-to-date, credible framework to support the development of social, economic, and environmental metrics, complemented by qualitative sources such as BC Local Government Climate Action Program (LGCAP) community feedback, peer-reviewed literature, institutional reports, and policy analyses. These sources have been outlined in Table 5. No additional stakeholder interviews were conducted for this Guide.

Note that a complete repository of references will be completed to capture all metrics used in the development of the guide.

Table 6. Data Sources

	Data Source	Source Description
1	Climate Action Best Practice Guidebook (Pinna Sustainability, 2025)	Practical, evidence-based resource designed to help B.C. local governments and Modern Treaty Nations accelerate climate action by outlining strategies, examples, and tools for reducing emissions and building community resilience.
2	Methodology for Estimating the Co-benefits and Co-harms of Climate Policy (WSP Golder, 2022)	This report presents an initial scoping study and structured methodology designed by WSP for the BC Ministry of Environment and Climate Change Strategy to help decision-makers transparently identify, assess, and evaluate the indirect co-benefits and co-harms of climate policies using a process-focused, case-study-informed approach.
3	BC LGCAP Survey (Government of British Columbia, 2021-2024)	Dataset that compiles multi-year survey responses from B.C. local governments detailing their climate action capacity, GHG inventories, planning status, resilience initiatives, funding allocations, barriers, and priority indicators across mitigation, adaptation, transportation, buildings, community-wide emissions, and climate risk management.
4	Census of Population (Government of Canada, 2021)	The 2021 Census of Population is a nationwide enumeration conducted by Statistics Canada that recorded Canada's population and provides detailed demographic, social, and

[2] The starting point for the literature review was global, but where possible we narrowed down relevant results to those that woudl be most applicable to North America.

	Data Source	Source Description
		economic data used to understand and plan for communities across the country.
5	Community Energy and Emissions Inventory (CEEI) Buildings Data (Government of British Columbia, 2021)	The BC Community Energy and Emissions Inventory (CEEI) is the Province of British Columbia's standardized system that provides community-level estimates of energy consumption and greenhouse gas emissions across the buildings, on-road transportation, and municipal solid waste sectors to support local governments in tracking, planning, and reducing their emissions.
6	Climate Co-benefits Portal (University of Leeds, 2022)	Evidence-based, decision-support tool developed by the Priestley International Centre for Climate to help policymakers explore systematically synthesized scientific research on the co-benefits and trade-offs of climate actions across health, energy, ecosystems, economic, and socio-economic domains.

4.4 Selected Locally Relevant Climate Measures

WSP's literature review has expanded the climate action inventory beyond the Pinna framework, identifying more than 60 commonly referenced adaptation and mitigation actions and categorizing them across five co-benefit areas, health, energy, ecosystem, economic, and socio-cultural, while assessing each action's potential impacts, confidence levels, contextual considerations, and evidence robustness.

Notably, during the literature review of climate actions, additional climate actions outside of those identified within the Guidebook developed by Pinna Sustainability had been discovered. To ensure that quantified co-benefits were mapped to climate actions of similar nomenclature, these additional climate actions were mapped to the naming convention of those within the Pinna Sustainability guidebook to ensure cohesiveness within the language of the study, as shown within the following table.

Table 7. Aligning Climate Action Nomenclature

Pinna Climate Action List	Literature Climate Action List
Governance, Planning, and Preparedness - Climate risk assessments	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Governance, Planning, and Preparedness - Neighbourhood preparedness programs	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Governance, Planning, and Preparedness - Extreme temperature response plans	Disaster risk reduction / Early warning and response systems
Governance, Planning, and Preparedness - Education and awareness	Adaptive social protection - Adaptive finance and education
Climate-Informed Land Use and Development - Compact, energy-efficient community planning	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Climate-Informed Land Use and Development - Hazard-informed land use planning	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Resilient Buildings and Infrastructure - Building retrofit programs	Energy efficient infrastructure / buildings - Cooling measures / practices
Resilient Buildings and Infrastructure - Training for local building industry	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Resilient Buildings and Infrastructure - Development permit areas (DPAs)	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Resilient Buildings and Infrastructure - Landscape and property programs	Urban green infrastructure, land use, and planning - Urban land use and spatial planning
Transportation and Mobility - Green fleet transition	Active and electric transportation - Active transport and electric transport
Transportation and Mobility - Public transit infrastructure	Active and electric transportation - Active transport and electric transport
Transportation and Mobility - Active transportation	Active and electric transportation - Active transport and electric transport
Ecosystems and Natural Assets - Urban forest strategies	Urban green infrastructure, land use, and planning - Urban greening

Pinna Climate Action List	Literature Climate Action List
Ecosystems and Natural Assets - Green infrastructure	Urban green infrastructure, land use, and planning - Urban green buildings (roofs / walls)
Ecosystems and Natural Assets - Natural asset management	Water and land resource management
Economy, Energy, and Waste Management - Renewable energy programs	Energy supply / distribution - Growth in renewable energy systems / Decline in carbon intensity of global energy systems
Economy, Energy, and Waste Management - Organic waste diversion	Economy, Energy, and Waste Management - Organic waste diversion
Economy, Energy, and Waste Management - Circular economy initiatives	Economy, Energy, and Waste Management - Circular economy initiatives

Building on this foundation, WSP aligned Pinna's climate action terminology with broader literature classifications to ensure consistency in evaluating co-benefits and integrating Pinna-identified insights into the overall framework. To support the development of quantitative metrics, WSP is applying benefit-transfer methods, which draw on quantitative evidence from existing studies conducted in other regions. This approach allows previously established impact estimates to be adapted where local data are unavailable, while recognizing associated uncertainty. Priority is given to climate actions that are both high-impact and supported by strong quantitative evidence, with particular attention to actions relevant to local governments and Modern Treaty Nations.

Concurrently, the study had integrated demographic and emissions data, including LGCAP survey results, census data, and CEEI information, to contextualize and adapt co-benefit metrics for the lens of BC local governments and Modern Treaty Nations. In doing so, this aided in identifying the potential impacts that would hold the highest degree of potential impact from local climate actions to the broader population. It is important to note that quantifiable climate actions and co-benefits were not only focused on those categories that would hold the highest degree of greenhouse gas (GHG) reduction potential and climate resilience / adaptation within communities, but those that would also support affordability, smart and sustainable community planning, economic prosperity, and accessibility within British Columbia.

4.5 Limitations and Uncertainties

The following section outlines important considerations that qualify the findings of this Guide and clarify where data, methodological constraints, or contextual factors may influence the interpretation of results.

1. Data Availability and Quality

Quantifying co-benefits depends heavily on the availability and robustness of existing datasets. Many climate actions have qualitative evidence but lack reliable quantitative metrics or BC-specific coefficients, which limits the precision of estimates. Some inputs (e.g., health cost factors, infrastructure cost savings) rely on non-BC sources where local data were not available. Note that regional economic impacts were excluded from the analysis (e.g., jobs created, income to businesses, etc).

2. Geographic and Contextual Transferability

When BC-specific research was unavailable, the analysis used evidence from broader North American studies. Applying these results to BC introduces uncertainty because climate conditions, population exposure, urban form, and environmental baselines differ across jurisdictions. As a result, values adapted from other jurisdictions may only approximate local effects.

3. Modelling and Quantification Constraints

Several co-benefit pathways could be identified but not monetized due to incomplete data or insufficient valuation studies. For some actions, only partial quantification was possible; for others, quantifiable pathways existed but lacked economic conversion factors. Assumptions used in modelling (e.g., elasticity of mode shift, avoided incident rates, ecosystem service values) introduce additional uncertainty.

4. Temporal Variability and Evolving Conditions

Climate risk trends, technology adoption, economic conditions, and demographic factors evolve over time. Because co-benefit calculations do not apply a consistent time-value adjustment or scenario discounting framework, outcomes may shift as new conditions emerge. Short-term and long-term benefits may also be unevenly represented.

5. Scope of Climate Actions and Co-impacts Included

The climate actions assessed are limited to those in Pinna Sustainability's Guidebook and those identified in WSP's literature review. Climate actions for which there is "potential for co-benefits" (see Table 4), does not mean that all co-benefits for that action could be monetized, only that at least one quantifiable metric was available. Further, our focus is on co-benefits, rather than co-harms, which means users of this guide are to independently consider whether any adverse impacts (trade-offs) may also arise from a given climate action.

6. Limits of Monetary Valuation

The quantifiable metrics help inform communities about the approximate monetized scale of the less tangible or indirect impacts that climate actions can generate when implemented. While such rule-of-thumb estimates do not offer the scientific rigor of comprehensive empirical econometric studies or in-depth economic analyses, they represent a reasonable compromise. They support faster decision-making on climate action and can ultimately help enhance social welfare and economic prosperity.

7. Attribution of a Climate Action's Impact is Excluded

This report provides high-level guidance on assessing whether there is sufficient evidence to suggest that a climate action is likely to generate co-benefits. It does not provide guidance on attributing or quantifying the specific magnitude of those impacts. In practice, the user of this guide must explain why they chose a particular indicator, using evidence from existing studies. That indicator is then used to estimate the co-benefit using the valuation multipliers provided in this methodology. An example of the need to make this type of attribution is the following: air quality measures often lead to a reduction in particulate matter (PM), as does a climate measure, which suggests a need to attribute only the marginal reduction in PM from the climate measure before applying the methodology suggested in this Guide. This type of overlap in benefits is very hard to disentangle in practice, which means the analyst will have to make some kind of attribution assumption before claiming a co-benefit of a climate measure.

8. Absence of Stakeholder Interviews

Although the starting point for identifying relevant climate actions were those that were local in nature, the development of this Guide did not rely on any stakeholder interviews, which limits the incorporation of on-the-ground operational insights or community-specific perspectives. As a result, some findings may not fully reflect local implementation realities or community-identified priorities.

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