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Public resilience and private returns

Identifying the potential of private capital to fund climate adaptation infrastructure

Prepared by: The Canada Infrastructure Bank (CIB)

ABOUT THE CANADA INFRASTRUCTURE BANK (CIB)

Who we are

We are an impact investor developing the next generation of infrastructure Canadians need. Partnering with businesses, institutional investors, Indigenous communities and government, we help bring private investment to projects delivering outcomes like sustainable economic growth, connected communities and energy security and competitiveness.

What we do

The CIB is a proven catalyst for infrastructure that supports Canada's priorities, from economic benefits in the form of increased GDP, improved supply chains, modernized plants and buildings to reliable clean energy, Indigenous participation, and job creation.

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Executive summary

Protecting Canadian communities from climate change's effects will require investing billions of dollars into assets that improve resilience to hazards. These include investments to improve an asset's ability to withstand changing climate and weather conditions (such as burying powerlines and installing sensor networks), and solutions that directly mitigate/manage the effects of climate change on communities (such as building floodwalls and increasing the size of crisis response units). Many of these investments offer clear societal returns in the form of avoided costs and damages. Despite these clear benefits, studies often identify investment in resilience infrastructure is not occurring at the pace or levels needed to avoid significant adverse impacts from climate change. Given growing needs, current funding models and competing public sector priorities, this underinvestment may persist.

One frequently discussed path to bolstering investment would be to increase private sector investment into resilience assets. As an investor with a mandate to both invest alongside the private sector and embed climate resilience into infrastructure development, the Canada Infrastructure Bank (CIB) is a frequent participant in these discussions. This discussion paper identifies the potential for financing tools to drive private sector funding into resilience assets, which has been shaped by over four years of market engagement and advisory work. While resilience infrastructure projects have risk and revenue profiles that limit the usefulness of many innovative or alternative financing models, this paper discusses three paths forward today that offer potential to overcome identified challenges.

What challenges need to be overcome to attract private investment into resilience assets?

Discussions around innovative financing solutions for resilience are often framed around attracting private sector funding into projects that deliver public value but lack viable private market revenues, meaning they are otherwise reliant on public sector funding (sources include property tax revenues, transfers from other levels of government, etc.). Examples of these types of projects include flood walls and sea walls. To attract investors, these projects must offer competitive risk-adjusted returns, manageable risks, and a favourable return relative to alternative investment opportunities. Challengingly, resilience assets often struggle on all three measures due to several barriers (summarized in Table 1). In some cases, these barriers may limit the value private investment offers a project, raising costs relative to public financing.

Table 1: Identified barriers to attracting private investment into resilience infrastructure.

Identified barriers	How do they impact projects?	Examples in practice
BARRIER 01 **Many resilience projects do not generate their own revenues and lack a path to monetizing benefits without government involvement.**	Capturing the broader cost savings offered by resilience assets is difficult for a private actor, as they are often diffuse and indirect. Individual parties often do not benefit enough to merit investing independently. Estimating the value of avoided damages is also highly uncertain and difficult to verify, making revenues hard to predict and rely on. Avoided losses do not necessarily translate into increased cash flow that can support repayment of financing.	Identifying the monetary value of direct/indirect savings from wildfire fuel management, then capturing them amongst a widespread group of households, businesses, government programs and insurers is risky and challenging for individual investors.
BARRIER 02 **Private sector involvement is less effective in infrastructure projects where risks cannot be clearly defined or allocated, a challenge that faces a large share of resilience assets.**	Private partners can reduce costs on projects when they are responsible for specific, well-defined risks and are rewarded (through higher returns) for managing them effectively. In many resilience projects, future climate risks (i.e. hazard intensity, pace of warming, etc.) are highly uncertain, making it difficult to define what "success" looks like or when a private actor should be held accountable for outcomes. If private actors are made accountable for fully avoiding an outcome like a flood, then the risk becomes too great to attract private financing (or purchase insurance) without government support. When risks cannot be clearly defined and assigned, private partners offer less benefit to projects through disciplined decision-making, making it more likely their involvement serves to increase project costs without adding value.	Designing a flood wall requires making decisions around factors like the severity of hazard it should protect against, where it should be located and total project costs. Asking a private actor to manage trade-offs between each would require them taking on risks that cannot be clearly defined or controlled. This limits their potential to lower project costs or achieve protection outcomes more cost-effectively. Additionally, this highly uncertain risk would almost certainly be recognized and avoided by investors and insurers.

Table 1: Identified barriers to attracting private investment into resilience infrastructure - Cont.

Identified barriers	How do they impact projects?	Examples in practice
BARRIER 03 **Many smaller resilience assets (<$50M) have high upfront capital costs, long asset lives, and lower risk-adjusted returns. Yet investors can deploy their capital into competing opportunities with shorter payback periods, higher returns and less perceived risk, meaning investing in many resilience projects can be accompanied by opportunity costs.**	Outside of large urban centers, many individual resilience projects are smaller, making them less likely to attract investors as stand-alone projects. Project development/construction and payback can be lengthy, but returns are often less competitive than other investments (and face risks detailed in barriers #1 and #2). Aggregating projects would help, but resilience assets are hard to bundle because each project has different risks, timelines, transaction costs and approval requirements. Aggregating projects with similar attributes in other sectors is typically done by governments or quasi-public entities (i.e. rate-regulated utilities or municipal service corporations/MSCs), not private investors.	A municipality's resilience strategy may involve numerous $5M-$20M capital projects with long payback periods (10+ years). At this ticket size/payback period, investors will evaluate opportunities against energy, digital and other projects, many of which could offer higher risk-adjusted returns. While attractiveness would be improved if projects were bundled by a utility or MSC, investors will often avoid bundling projects themselves, as this would make them responsible for coordination and project-level risks.

In addition to barriers identified above, it bears repeating that the use of financing tools is not a substitute for funding. Financing will still need to be repaid by funding, either through government support or revenues raised from households, firms or private market sales. Given the scale of the challenge, grants programs from federal, provincial and territorial governments will not be sufficient.

Which paths forward can help overcome these barriers?

This combined suite of challenges makes it difficult for many financing tools, conventional or innovative, to attract private capital into resilience projects. However, this paper believes that there are currently three paths forward to fund and finance resilience, each applying to a different set of infrastructure projects.

Which paths forward can help overcome these barriers?

PATH 01

Advance revenue-generating projects that have resilience benefits/co-benefits or generate funds for resilience spending:

Projects that generate revenues through activities that are not explicitly tied to resilience outcomes (ex. electricity tariffs, real estate, biomass sales, etc.) may also have benefits/co-benefits for resilience or can generate funds for investments that reduce future damages, costs and disruptions. In some cases, projects may benefit one party enough to offer a viable business case for a single investor. In others, business models may be adopted by governments to create supplementary revenue streams that reduce the net cost of interventions. Path #1 would overcome identified barriers, as:

- **Barrier #1:** Project funding would come from sources that did not require aggregating.
- **Barrier #2:** Projects would be viable without need to formally transfer design/performance risk.
- **Barrier #3:** Opportunity cost mitigated through returns from multiple value-streams.

PATH 02

Leverage quasi-public delivery models (utility and MSC models) to advance and finance resilience investments:

Utilities and MSCs are best suited for delivering goods/services that have high upfront costs, low marginal costs, are inefficient to duplicate and only generate benefits through networked infrastructure systems. This description applies to many resilience assets (ex. sea walls and flood walls, fire breaks etc.). In many cases, these assets already fall within the scope of coverage of existing utilities or municipal service corporations. Others, such as interventions designed to reduce risk of forest fires or extreme urban heat at community scale, currently fall outside the scope of coverage of existing utilities. In these cases, a stand-alone "resilience utility" (hazard-specific or addressing a wide array of hazards) could be created to manage these challenges. This would be most beneficial to mitigate hazards like coastal erosion, extreme urban heat and wildfires.[1] These quasi-public entities could also attract private debt and equity capital. Path #2 would overcome identified barriers, as:

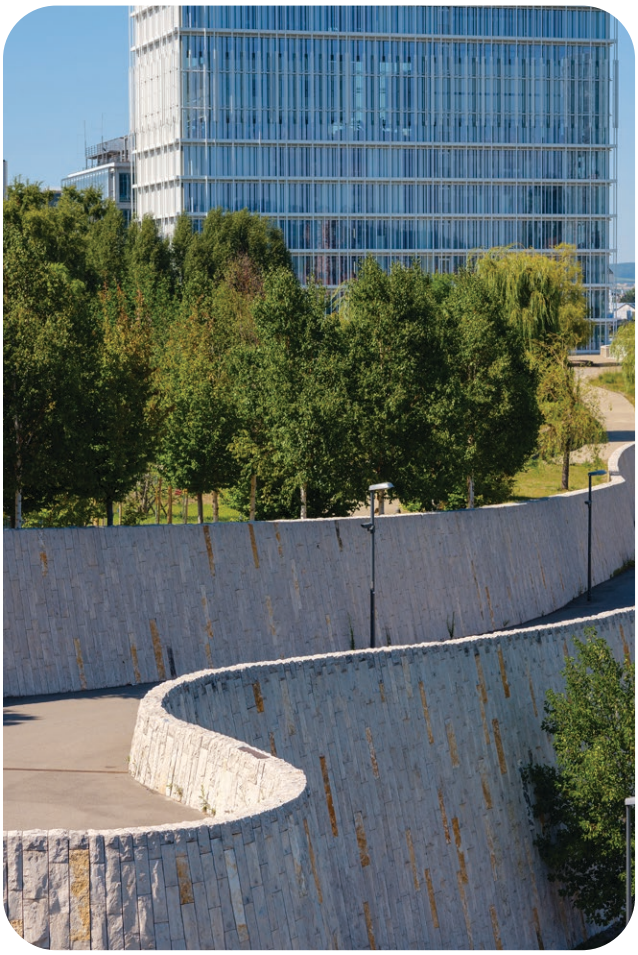
- **Barrier #1:** Utilities/MSCs can directly charge beneficiaries, reducing revenue risk.
- **Barrier #2:** A regulatory/oversight process could set design and performance standards, reducing risk borne by the private sector.
- **Barrier #3:** Quasi-public entities have narrow mandates and can serve as project aggregators.

1 A rate-regulated utility model may not be well-served to address building or property level responses to heat and water scarcity. Wildfires represent a potential fit, but the efficacy of the model would depend on its scope and design.

PATH 03

Publicly fund and finance projects that cannot be advanced under Path #1 or #2:

For the assets that cannot be advanced under Path #1 or #2, public funding (raised from property tax revenues or other sources) and financing remain a viable path to supporting many individual assets. If governments opt to fund and finance projects directly, identified barriers largely do not apply. They can do so through a range of public financing tools including municipal resilience bonds, which allow governments to seek financing at public borrowing costs, leverage the municipality's creditworthiness and repay investors through general revenues. Public funding also offers an additional benefit to governments by reducing future spending on disaster clean-up, as well as maintenance and repair expenditures for publicly owned infrastructure. Beyond these three paths, others may also arise in future that can overcome barriers identified in this report.



How can the CIB help?

The CIB's mandate limits its participation to projects that generate revenues and attract private capital. Projects advanced under Paths #1 and #2 above could meet these criteria. Additionally, if municipal and provincial governments identify that Path #3 will represent most of their resilience spending, the CIB can support private investment into other revenue-generating infrastructure projects to reduce the balance sheet impact of increasing spending into resilience. Parties interested in any of these measures are welcome to connect with the CIB to discuss.

EXPLORING THE ROLE FOR PRIVATE CAPITAL

Can private investment help address the growing investment gap for resilience?

Canadian communities are increasingly exposed to climate-related risks, with impacts expected to intensify over the coming decades.[2] Research consistently indicates that mitigating the most severe effects of climate change will require investing billions of dollars annually in proactive resilience.[3] The societal case for improving resilience is strong, as each dollar directed can generate significant social, environmental and economic returns. However, studies also indicate that the scale and pace of current investment is not aligned with growing needs.[4] Given the rapid increase in spending needs expected in the coming decades, as well as competing public sector priorities, this underinvestment may persist in the coming years.

There has been growing discussion about the role that private capital could play in plugging this resilience investment gap, particularly for assets that offer public benefits but lack private-market revenue streams.[5] As an investor with a mandate to both invest alongside the private sector and embed climate resilience into infrastructure development,[6] the Canada Infrastructure Bank (CIB) is a frequent participant in these discussions. The CIB already considers physical climate impacts and resilience across all its investments and has actively explored further investment into resilience assets. This discussion paper represents a synthesis of insights and market perspectives gathered over more than four years of research, market engagement, advisory work, and investment activity around the subject. The paper considers the key barriers and risks associated with investing in resilience assets today, while also highlighting several paths forward that could overcome identified challenges.

2 Lulham, N., Warren, F.J., Walsh, K.A. & Szwarc, J. 2023.

3 FCM & IBC, 2021; CCI, 2026.

4 CCI, 2023; McNally, J & Sarraf, N. 2024.

5 In the context of resilience, an archetypal example of these types of projects is a flood wall or sea wall, but this description spans a wide range of interventions.

6 CIB, 2023.

What categories of infrastructure assets support resilience?

In this report, the term "resilience infrastructure"[7] refers to physical assets and systems that are planned, built, managed and maintained to support two objectives:

1. Improve an asset's capacity to withstand the effects of a changing climate.
2. Mitigate and/or help manage the adverse impacts of climate[8] change on economic activity and communities.[9]

This definition is intentionally neutral with respect to asset types and individual hazards, reflecting the diversity of solutions that governments, asset owners and communities are likely to deploy as they adapt to future climate risks. This discussion paper focuses on assets that are traditionally owned by public or quasi-public entities, given that privately owned assets face different incentives and constraints related to cost recovery and risk management. Examples of infrastructure projects that advance these objectives are detailed in Table 2.

7 A potential alternative term with a similar definition might be "resilience-improving/enhancing infrastructure".

8 FCM, 2023.

9 ICSI, 2025. These definitions broadly align with the Climate Bonds Initiative Resilience Taxonomy (CBI, 2023).

Table 2: Typology of resilience infrastructure projects for investors[10]

	Investments that prevent/harden infrastructure systems to climate change	Investments that improve monitoring and detection capacity	Investments that bolster emergency management and response functions
Retrofits and Upgrades	» Burying existing transmission and distribution lines. » Redesigning and redeveloping spillways for existing dams and drainage canals. » Elevate substations and electrical infrastructure components. » Repaving roads with heat-tolerant materials.	» Installing flood and contamination sensors in existing stormwater and water treatment systems. » Installation of advanced temperature sensors on rail networks to monitor heat conditions.	» Upgrading back-up power and communications systems. » Retrofitting community centers and libraries to serve as cooling or warming centers. » Building new evacuation shelters and emergency coordination centers. » Enhance hospital capacity with mobile triage units. » Upgrading aging airborne firefighting aircraft and hangers.
New Assets and/or Construction	» Build redundancy in power grids by "twinning" transmission corridors with new lines. » Building seawalls/flood walls around coasts/rivers. » Relocating roads and broadband networks.	» Satellite, surveillance plane or drone networks to spot and track wildfires. » Upgrading radar and weather buoys for storm tracking in coastal regions.	

Source: Canada Infrastructure Bank, with additional project examples drawn from reports listed in footnotes. [11]

10 Some investments serve multiple resilience functions and may contribute simultaneously to objectives of infrastructure hardening, risk monitoring, and emergency response.

11 Co-operators & ICLEI Canada, 2024; CICC, 2021.

12 CCI, 2023.

How are returns generated through investments in resilience?

The returns on investment for improving resilience, or explicitly building assets to offer protection against hazards, largely accrue as avoided damages. For asset owners, avoided damages are captured as savings on future maintenance, replacement or repairs. For firms, reducing future repairs and replacement expenses also helps mitigate the risk of foregone revenue from unplanned outages and repairs. Savings may accrue to a narrow group of beneficiaries, such as homeowners avoiding flood damage in a specific neighbourhood, or be widely distributed across a region, as in the case of population-wide reductions in heat-related morbidity from city-scale interventions.

Avoided damage can represent a significant source of benefits. Canadian studies suggest pro-active adaptation can offer a combined social, environment and economic return of 13x-15x on an initial investment over certain time horizons.[12] Positive societal returns often remain present even if conservatively discounted across a range of warming scenarios, and typically compound over time if an asset is successful at preventing escalating levels of damages.[13] In some cases, evaluating a project based on its forecasted savings offers positive benefits relative to costs over a 10-20 year timeframe, implying a social return on investment can be realized relatively rapidly.[14]

Most returns from public or quasi-public assets are indirect benefits that accrue widely across broad groups. Depending on the asset, these benefits may be largely non-excludable (i.e. it is difficult or impossible to prevent individuals from consuming once provided) and non-rivalrous (i.e. can be consumed by multiple individuals without diminishing the quantity available for others), such as those provided by a flood wall or sea wall. This offers a clear case for public investment into resilience but can pose challenges for private investors evaluating the attractiveness of various opportunities. This is not the case for all assets, as sufficient direct and indirect benefits may accrue to a single asset/property owner to offer a viable business case. If the asset under consideration is revenue-generating through sales of goods or services that are not tied to resilience outcomes (i.e. real estate, revenues from electricity sales, rail freight rates and fares etc.), then the funding source for a resilience expenditure can be revenues from sales of these goods or services.[15] However, other assets in Table 2 offer benefits that are widely dispersed and do not have a clear pathway for generating revenues in private markets, meaning they may struggle to attract financing even if estimates show positive cost-to-benefit ratios. Given their significant societal benefits, there may be potential for attractive returns if savings from avoided damage could be monetized, a key step needed to attract investors.

13 Upcoming research from the Canadian Climate Institute and ICLEI Canada. In many cases, analysis indicates annual benefits grow as warming accelerates later in the century. This implies the business case for resilience will increase as hazard severity grows, potentially improving project economics.

14 CCI, 2026; Upcoming research from the Canadian Climate Institute and ICLEI Canada.

15 Importantly, this may still lead to under-investment from a societal perspective if regulated cost recovery frameworks reduce the amount of capital that can be invested, or if anticipation of receiving future disaster clean-up funding from governments reduces proactive spending to harden assets.

Funding, financing and risk allocation

Before discussing the role of private investment in resilience markets, it is important to define key concepts and terms. For private investors to consider owning or operating infrastructure assets, a project needs to offer attractive risk-adjusted returns. Estimating returns requires identifying a project's cash flow and how it will be financed, among other steps.[16] These two steps are distinct. Cash flows represent a project's funding source, or its sources of revenue used to pay a project's costs across its lifecycle. Funding is what ultimately pays for the project. Financing mechanisms are the tools, instruments and structures used to raise upfront capital and manage the risks associated with being repaid for this initial investment over time. Financing tools allow projects to manage the allocation of risks and costs of capital, but do not determine who pays – only how and when investors will ultimately be repaid by a project's funders. A typology of funding sources and financing tools available for infrastructure projects are summarized in Table 3.

Table 3: Comparing sources of funding vs. financing for resilience infrastructure projects

Sources of money/capital provided for a project/purpose (i.e. funding sources)	Tools/mechanisms used to obtain upfront money/capital and manage risks associated with project and being repaid (i.e. financing tools)
» Federal, provincial or municipal government revenues, raised directly or transferred from another level of government (i.e., property and income tax revenues, grants, etc.) » Charges applied directly to users or beneficiaries of a given project (i.e. user fees, future property tax revenues, utility rates, etc.). » Own-firm revenues generated from private market through sales of other goods/services (i.e., addition of hydroelectric generation to a dam, rail freight fares, etc.)	» Government borrowing repaid by general government revenues (i.e. municipal bonds, resilience bonds, etc.). » Private debt or equity investments repaid by governments over time through a dedicated revenue stream (i.e. availability-based public private partnerships, etc.) » Debt or equity repaid from revenues generated directly by the project (i.e. project finance structures that do not include availability payments).

Source: Canada Infrastructure Bank

16 Institute for Government, 2017.

Public infrastructure can be financed through a range of mechanisms but is typically funded through government revenues and/or charges to users or beneficiaries.[17] The optimal financing approach will vary depending on whether private sector participation can accelerate delivery, improve cost efficiency, transfer or mitigate specific risks and/or reduce near-term public fiscal pressures.

Importantly, Table 3 does not outline how risks are allocated. Risk allocation is used to determine (alongside other factors) the appropriate financing mechanism(s) and delivery and ownership model for a particular project (i.e., advancing via public balance sheet, public-private partnerships, remaining privately-owned long-term but supported via tools like blended finance, etc.). In practice, risk allocation decisions are commonly guided by the principle that risks should be borne by the party best able to manage or mitigate them. Where infrastructure is privately financed, non-governmental lenders and/or project proponents carry financing costs and project risks on their balance sheets, even in cases where the ultimate funding sources include public revenues or government payments.

17 Projects that generate revenues through charges to users and beneficiaries may be eligible for CIB financing, provided they also meet ticket size requirements and include private investment.

Which barriers limit the use of conventional and/or innovative financing tools for resilience assets?

Employing private financing solutions for projects that do not naturally generate their own revenues is challenging for several reasons. First, financing tools are not a substitute for funding. Employing any private financing tool, innovative or not, will still require funding from governments or revenues on private markets, as investors will need to be repaid. Second, in cases where governments own the asset, private financing tools are most beneficial if private investors bear risks and/or make trade-offs around project design that reduce overall costs. Yet for resilience assets, transferring risks around performance and design creates significant challenges that can make projects more expensive at best, or potentially even uninsurable and unfinanceable at worst. Third, many smaller resilience assets have ticket sizes, capital costs, payback periods and risk-adjusted returns (particularly when accounting for the first two barriers) that may be unattractive relative to competing opportunities. This means resilience investments may not be well-positioned to attract capital in competitive investment environments. Table 4 summarizes these challenges, which are explored in greater detail below.

Table 4: Funding, financing and risk allocation barriers to attracting private investment into resilience infrastructure projects

Funding barriers	Risk allocation barriers	Financing barriers
#1: Many resilience projects do not generate their own revenues and lack a path to monetizing benefits without government involvement.	#2: Private sector involvement is less effective in infrastructure projects where risks cannot be clearly defined or allocated, a challenge that faces a large share of resilience assets.	#3: Many smaller resilience assets (<$50M) have high upfront capital costs, long asset lives, and lower risk-adjusted returns. Yet investors can deploy their capital into competing opportunities with shorter payback periods, higher returns and/or less perceived risk, meaning investing in many resilience projects can be accompanied by opportunity costs.

BARRIER #1

Resilience assets face barriers to raising revenues needed to fund...

Many resilience projects do not generate their own revenues and do not have a clear path to monetizing benefits without government involvement.

Limited funding is a central challenge for many resilience assets. Without funding, projects will not have sufficient revenue to repay financiers, creating a barrier regardless of whether financing is provided by the private or public sector. Resilience projects can use any of the funding sources detailed previously in Table 3. However, projects that do not generate revenues in private markets and whose benefits are largely limited to avoiding damage must rely on alternative funding sources. Grant and contribution funding are unlikely to be enough to support investment for all communities and asset classes at levels needed to avoid the worst effects of a changing climate.[18] Unless funding under these programs is significantly expanded beyond current levels, additional revenues will need to come from users, beneficiaries or developers.

Given that the economic value of resilience assets is derived from avoided damage, collecting revenues from users and developers requires aggregating savings realized by each party. This aggregation is required because most benefits are indirect, widespread and diffuse, meaning individual actors rarely benefit enough to justify bearing the full cost of construction, operation and maintenance.[19] In some cases, the parties that benefit from resilience investments are also not the same parties that would bear the costs of damages if no investment is made, weakening incentives for any single actor to fund the project.[20] The act of monetizing and collecting societal benefits typically falls on the public sector through mechanisms such as taxes, levies or user charges, particularly where the incidence of benefits is unclear or difficult to

18 CCI, 2023; McNally, J & Sarraf, N. 2024. While grants and contributions will likely play a role in advancing some resilience projects, it is beyond the scope of this report to note which level of government should allocate what levels of funding, or how much should be set aside to support projects.

19 A broad distribution of benefits is not standard for all projects, as earlier discussed.

20 Upcoming work from the Canadian Climate Institute and ICLEI Canada discusses this challenge in greater detail. One example is that municipal governments may be responsible for funding the construction and maintenance of resilience assets, and federal and provincial governments may contribute funding for disaster clean-up.

BARRIER #1 | CONT

attribute to a specific asset or intervention, as is common for climate-related risk reduction. Investors have emphasized the importance of public-sector participation to capture avoided damages around resilience projects, with emphasis on projects that offer non-excludable benefits to a dispersed group of individuals, households, firms and/or public asset owners.

Investors also emphasize the importance of public sector participation to reduce revenue risk associated with valuing and monetizing savings. The first key risk is that many benefits take the form of potential avoided future losses rather than new, observable revenues or savings. These benefits depend on counterfactual assumptions about what would have occurred in the absence of investment. This means the scale and growth of future cash flows are based on difficult-to-validate assumptions around rates of future warming and hazard incidence. This creates uncertainty around future revenue streams, as the value of future avoided damage (and therefore cash flows) may ultimately not align with assumptions. Moreover, avoided losses do not generally translate into additional cash flows for households or other beneficiaries, as reducing projected expenditures is not equivalent to generating new income. One example of this occurring in practice is that insurance premiums or asset repair costs may remain stable or continue to rise despite investments into resilience, even if the cost increase is smaller than it otherwise would have been. This remains possible due to expected increases in hazard intensity and damage over time.[21] Scenarios such as these raise concerns about the ability of beneficiaries to provide a stable and predictable revenue base, increasing revenue risk for investors.

Overall, in the absence of public sector engagement to value, monetize and collect these benefits, the presence of funding gaps and revenue uncertainty significantly constrain the potential to use private financing tools.

21 Other factors, such as the pass-through of higher reinsurance costs, may also contribute to rate increases.

BARRIER #2

...Cannot allocate risk to private investors in a manner that improves performance or cost-effectiveness...

Private sector involvement is less effective in resilience projects where risks cannot be clearly defined or allocated, a challenge that faces a large share of resilience assets.

Selecting the right financing and delivery model for a given infrastructure project is based on a host of factors, including questions around optimal risk allocation between project partners. Private partners can reduce costs on projects when they are responsible for specific, well-defined risks and are rewarded (through higher returns) for managing them effectively. The value offered by private partners is typically highest on complex or high-risk projects. In addition, financing and delivery models may include payments based on performance, with the intent of creating an incentive to manage design and performance risk.

For resilience projects, many of the decisions surrounding project design and performance involve optimizing the trade-off between the size/cost of a resilience asset and the degree of protection it should provide. An example of this in practice is contracting a private partner to determine the optimal trade-off between the cost of construction, operations and maintenance of a floodwall, and the design specifications (i.e. height, length, location etc.) required for the wall to prevent flooding. To ensure a private party has an incentive to effectively balance this trade-off, their returns would need to be linked to both construction costs and the full long-term costs of damage to the assets (i.e. homes, businesses etc.) that this floodwall is meant to protect.

Challengingly, such a financing structure would not be financeable because of the magnitude of potential damage, and the inability to price or insure these damages over the long run. Warming trajectories and hazard intensity are highly uncertain, and no party (public or private) can express with a high degree of certainty whether a given design specification could fully prevent all harm over any given period (meaning they cannot fully manage this risk). This includes insurance and reinsurance markets, whose terms for products that protect against climate risk (property and casualty insurance, catastrophe bonds etc.) are annually repriced or are limited

to five years or less. This reflects either significant uncertainty or the view that markets would not be willing to pay premiums associated with the full risk of climate-related damage over decades. Given that this liability can be neither priced nor insured, asking a private party to bear it would likely render a project unfinanceable, as investors would identify the risk and avoid it. Mitigating this risk would require governments to retain responsibility around design and performance, which raises questions about whether private financing and delivery tools would deliver desired outcomes. It is unlikely that this risk could be effectively jointly managed by governments and the private sector, as governments would still need to define acceptable levels of protection in the face of climate risk that is near impossible to fully and accurately define and price.

BARRIER #3

… and face competition from other investment opportunities.

Many smaller resilience assets (<$50M) have high upfront capital costs, long asset lives, and lower risk-adjusted returns. Investors can deploy their capital into competing opportunities with shorter pay-back periods, higher returns and less perceived risk, meaning invest-ing in smaller resilience projects with lower returns can be accom-panied by opportunity costs.

Many resilience projects share attributes with other infrastructure assets, including high upfront development and construction costs, long asset lives, lengthy payback periods (10-15+ years), long asset lives and low correlation to broader financial markets. However, many of these individual projects - particularly those advanced by smaller municipalities – also have relatively small ticket sizes for infra-structure (<$50M-$100M) and are subject to the risks and challenges detailed in barriers #1 and #2. As a result, these projects often fall into a financing gap between traditional infrastructure investment and commercial or corporate investment. Many infrastructure investors focus on larger assets that justify transaction costs, while commercial investors often prioritize opportunities with lower capital intensity, shorter payback periods, and clearer revenue models. Within infrastructure, investors may instead allocate capital to sectors such as energy, digital infrastructure, telecommunications, or transportation, where revenues are more readily monetized and projects can be developed at greater scale.

Resilience projects must also compete for capital against opportunities outside the infrastructure sector, including public equities, private equity, and private credit. These alter-natives may offer advantages such as greater liquidity, stronger security positions within the capital structure, greater diversification, or less risky pathways to generating investor returns. As a result of this competition, investors may perceive a quantifiable opportunity cost when allocating capital to smaller resilience projects, particularly if risk-adjusted returns are uncer-tain or fall below desired thresholds. Unless project characteristics change through stronger revenue mechanisms, improved risk-adjusted returns, reduced development risk, or other forms of public support, competition for capital is likely to remain a significant constraint on

BARRIER #3 | CONT

private investment in resilience assets. In other infrastructure asset classes, projects with similar attributes are often advanced through a mix of public sector capital funding and quasi-public delivery models like municipal service corporations and rate-regulated utilities.

For resilience investments, the current need to rely on public funding is compounded by the fact that interventions often consist of multiple, small, geographically distributed assets that serve to collectively mitigate climate-related risk.[22] As a result, individual project sizes are unlikely to increase over time, with increased spending instead dedicated to advancing a larger number of overall projects. While project aggregation by private actors[23] is sometimes proposed as a means of attracting private capital,[24] this approach is unlikely to be viable for resilience projects. Aggregation by private actors is uncommon in asset classes where projects differ significantly from one another, have high transaction costs to advance, and require a high degree of involvement from public bodies (whose capacity to engage is often limited). These attributes characterize most smaller municipal resilience infrastructure assets and/or interventions. Aggregation by a private party is therefore unlikely to offer a viable path forward unless it takes the form of a quasi-public delivery model with majority private ownership (i.e. a majority privately-owned utility or municipal service corporation). Other barriers, such as a lack of investor familiarity with resilience projects,[25] may also serve as challenges, but are secondary to the barrier posed by competition.

22 CCI, 2023.

23 Project aggregation refers to bundling separate assets together for a single investment offering.

24 CDP, 2025.

25 UK CCC, 2023; CCI, 2023.

Impacts of barriers on investment into public and quasi-public resilience assets

The above section indicates that many projects, even where they demonstrate positive societal returns, face challenges related to funding, risk allocation and financing. The simplest and most direct approach to overcoming this combination of barriers is for governments to monetize revenues needed to payback investors, overcome collective action challenges, offer funding or support to fill financing gaps and set design standards. These steps would largely amount to greater public funding and financing and may help broadly unlock greater capital investment into resilience assets. However, they also highlight that private investment tools alone are unlikely to resolve the funding challenge faced by resilience assets, given both the scale and complexity of barriers faced and likely need for public involvement.

PATHS FORWARD

Identifying current paths forward to increase investment into resilience assets

While barriers do limit the utility and potential of many private financing tools, this report identifies three current paths forward that could help attract greater funding into municipal resilience. Each will offer benefits to different types of projects. As the nascent resilience market grows in time, additional paths forward may be identified through business model innovation or enabled through policy and regulatory changes. Any successful and/or scalable path will need to be capable of overcoming the challenges identified in this discussion paper.

PATH 01

Advance revenue-generating projects that have resilience benefits/co-benefits or generate funds for resilience spending

This has been previously discussed in this report, but funding for resilience projects can be generated through cash flows that are not explicitly focused on resilience (i.e. electricity tariffs, rail freight revenues, user fees, leases, etc.). In many cases, organizations can invest in projects that provide resilience as a co-benefit, or leverage revenues from existing business activities to fund investments that reduce future damage, operational disruptions, or revenue losses. This is particularly true if sufficient benefits are accrued by a single party (i.e. landowners, property owners or facility operators) to offer a viable payback based on savings. For example, a real estate developer may find that incorporating flood protection infrastructure into a project increases asset value and reduces insurance costs. If sufficient benefits are accrued to the developer or property owner, they may be able to justify the upfront investment without requiring a separate revenue stream tied to the resilience benefits. This overcomes the barriers around collective action and requirements to monetize resilience benefits.

Beyond allowing private actors to improve the resilience of their own operations, revenue-generating projects may also offer a path forward if funds can be used to fully or partially recover costs of public spending on resilience. In these cases, governments could participate in new business models and leverage revenue streams to reduce the public cost of spending on resilience. For example, a municipality undertaking selective clearing for wildfire fuel management could collect and sell timber and biomass to processing facilities or mills. A municipality could also invest in stormwater management infrastructure that treated and captured runoff for use in non-potable applications such as irrigation, industrial processes or landscape maintenance. Even if revenues in one or both cases did not fully cover project costs, the activity may still be valuable, as cash flows can reduce the net cost of undertaking an activity that would otherwise be fully publicly funded. In some cases, this offset may be enough to make prohibitively expensive resilience activities financially feasible.

In all cases detailed above, the funding source from the project is distinct from the resilience benefits generated by investing. This distinction can help overcome listed barriers and offers a clear path forward for a broad-range of resilience-related investments.

PATHS FORWARD

PATH 02

Leverage quasi-public delivery models (utility and MSC models) to advance and finance resilience investments

An additional path forward that could potentially overcome barriers identified in this report is to design, approve, build and recover costs for resilience assets under rate-regulated utility or municipal service corporations (MSCs) models. Utilities (and MSCs) are valuable for the provision of public goods and services that are most efficiently delivered through monopoly providers, meaning they meet the following criteria:

- Assets or networks are capital-intensive, long-lived and inefficient to duplicate, reducing the benefits (and raising the costs) of competition.
- To successfully perform, assets need to coordinate operations across a network within a defined geographic area.
- Assets or networks have low marginal costs for adding new users/beneficiaries.

Resilience infrastructure that aligns with these criteria is well-suited to be delivered by utilities or MSCs. In many cases, these assets already fall within the scope of coverage of existing utilities and municipal service corporations. Others, such as interventions designed to reduce risk of forest fires or extreme urban heat at community scale, currently fall outside the scope of coverage of existing bodies. In these cases, a stand-alone "resilience utility" (hazard-specific or addressing a wide array of hazards) could be created to manage these challenges. This rate-regulated utility model (referred to in this report as a "resilience utility"[26]) would be well suited to infrastructure built to mitigate hazards such as coastal erosion and sea-level rise, extreme heat in urban environments and wildfires.[27] Assets, systems and interventions required to mitigate these threats include stormwater management systems, flood walls and sea walls, community-level firebreaks, and the installation of flood and contamination sensors, all of which would align with criteria outlined above. Stormwater utilities have already begun investing in projects to mitigate property-level flood risk, offering a rare successful model for private investment into resilience.[28] However, interventions to mitigate water scarcity and extreme heat at a building-level may not be well suited to advance under utility or MSC frameworks. These may require public support through other means.

26 This concept could apply to a single "resilience utility" that invested in projects mitigating a range of hazard types, or one or more hazard-specific utilities. MSCs would likely need to be hazard/ intervention specific.

27 Wildfire risk may not be fully addressable through a utility or MSC model, depending on the design and scope. In some cases, models may need to be paired with more direct government supports.

28 Ewart, T, Coffee, J & Miller, S. 2023. Details such as tariff design, cost recovery mechanisms and the underlying regulatory framework would likely vary by utility structure or asset type. For example, stormwater utilities commonly set tariffs based on a property's impervious surface area, which would not translate directly into capturing benefits generated by other interventions (i.e. fire breaks, sea walls, etc.).

PATHS FORWARD

PATH 02 | CONT

Utility and MSC models are also well-suited to overcoming the barriers detailed in this paper. First, many resilience infrastructure projects offer non-excludable benefits, meaning capturing revenue streams requires a mechanism that compels users to pay to avoid free riding. Free-riding concerns can be overcome if a utility or MSC targets beneficiaries directly and charges rates/tariffs at rates that fully recover costs, which would significantly reduce risks around revenues and benefit valuation for investors. Second, performance specifications can be overcome under a utility or MSC framework. The creation of a regulator (or, in the case of an MSC, the presence of a municipal government) would socialize the process of determining appropriate standards for performance and design, reducing the outsourcing trade-offs faced by the public sector. For the public, it would also ensure discussions around costs, benefits and trade-offs occurred transparently and received democratic input. In the case of a utility, a regulatory framework may even lead to greater investment than would be advanced under current funding models alone. Third, a stand-alone utility or MSC could fund resilience projects without impacting other sources of public revenues and expenditures. This reduces the probability that investment in resilience will create fiscal pressures and pull public capital away from other priorities. Fourth, having a single utility or MSC allows one party to serve as the aggregator for projects.

Utility and MSC models would represent quasi-public owned infrastructure but have potential for greater private investment over the long term if they prove viable at scale. Given these models' potential to overcome identified barriers and manage several climate-related hazards, they merit further exploration as tools for attracting private investment into resilience.

PATHS FORWARD

PATH 03

Publicly fund and finance projects that cannot be advanced under Paths #1 or #2

In cases where the two paths above are not available, public funding and financing are often an effective mechanism for funding resilience infrastructure for several reasons. First, public funding and financing does not face many barriers identified in this report, as governments do not face the same barriers as private investors. Monetization and revenue risk, for example, are not obstacles for public financing because direct and indirect benefits represent significant public goods that justify government investment. In cases where monetization of benefits is still not possible, governments also have the power to impose taxes, levies and other charges. Other barriers, such as the risk of free ridership and opportunity cost relative to other investments, are not relevant for publicly financed projects.

The second reason public funding/financing is a rational response is that governments themselves accrue significant benefits from investing proactively, as they reduce their own long-term risks and costs. 70% of Canada's infrastructure is publicly owned[29], meaning investments in resilience infrastructure that reduce damages to existing assets can avoid future repair expenditures. Analysis from Housing, Infrastructure and Communities Canada's Economic Analysis and Modelling Division estimates that, depending on warming trajectories, climate hazards could reduce the serviceable life of certain public assets by up to one third, meaning repair expenditures will likely increase as warming (and hazard intensity) grow over time[30] Taking steps to reduce the scale of this increase will likely benefit public balance sheets. Resilience infrastructure investments can also reduce public spending in other areas. One example is avoided health care costs, which can represent significant sources of indirect savings for provincial governments.[31] Finally, public investments in resilience can offset future costs of disaster clean-up and recovery that are otherwise incurred through relief programs or increases in inter-governmental transfers. Analysis indicates Canadian governments already spend billions more than initially budgeted to recover from climate-related disasters.[32] Proactive investment could help mitigate the risk of overruns associated with future recovery.

Governments have a range of tools available to make these investments, including general obligation borrowing through municipal bonds and green/resilience bonds. These allow governments to seek financing at public borrowing costs, leverage the municipality's creditworthiness and repay investors through general revenues. Revenue collection tools, such as property-specific charges and dedicated property tax levies, can also link funding sources more closely to benefiting properties.

29 Statistics Canada, 2025.

30 Housing Infrastructure and Communities Canada. Economic Analysis and Modelling Division. Unpublished, 2025. This analysis focused on potential impacts of extreme heat and precipitation on roads assets in high emission scenarios (RCP 8.5) by 2100.

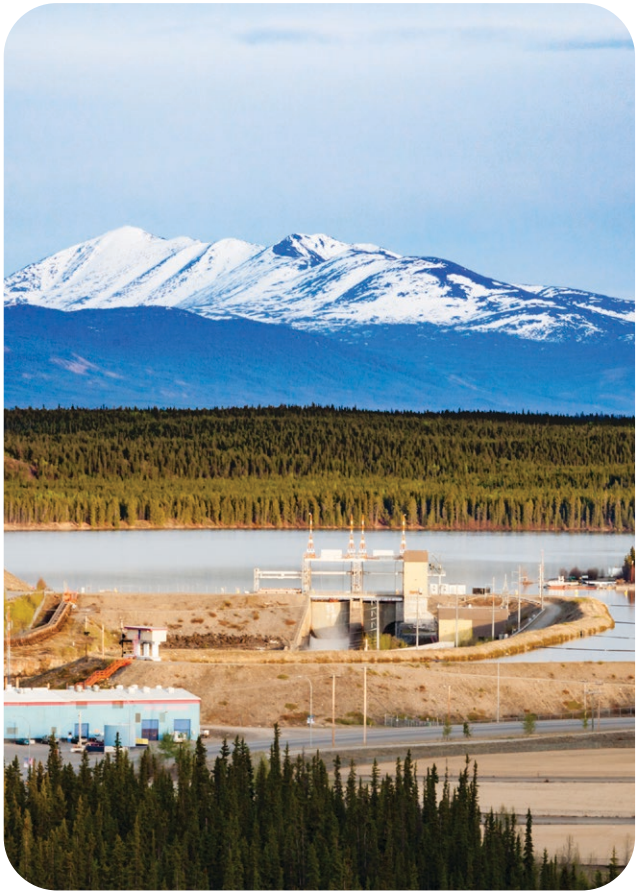
31 CCI, 2022.

32 McNally, J & Sarraf, N. 2024.

ROLE OF THE CIB

What role could the CIB play in these markets?

The CIB currently considers physical risk across its investment portfolio, evaluating whether each project is resilient across a range of future warming scenarios. Additionally, the CIB's mandate is to invest in revenue-generating assets alongside the private sector. This means the CIB can invest in resilience infrastructure projects that generate revenues, even if through other value streams. However, the CIB's mandate rules out investment into resilience infrastructure that is 100% publicly funded, including projects funded through proceeds from municipal resilience bond issuances. If a larger number of projects are advanced under Path #1, Path #2 or alternative paths that offer private investment potential, the CIB would have greater opportunities to invest. Parties interested in discussing these paths are welcome to connect with the CIB to further discuss.



The CIB is largely unable to support projects advanced under Path #3. However, municipalities expecting to spend more on resilience (and disaster clean-up and recovery) can collaborate to attract investment into other revenue-generating infrastructure projects that meet the CIB's eligibility criteria (ex. water and wastewater infrastructure, electricity distribution, etc.). This can reduce the balance sheet impacts associated with increasing spending into resilience, which may otherwise lead to difficult decisions and trade-offs as fiscal capacity becomes limited.

Conclusion

Protecting Canadian communities from climate change's effects will require investing billions of dollars into assets that improve resilience to hazards. This discussion paper explores the potential for innovative private financing tools to help address the growing investment gap and concludes that several barriers exist that limit their uptake. However, several paths forward do exist for increasing funding, and two of them would enable larger amounts of private capital to be dedicated to resilience priorities. These models would need to be deployed and adopted at scale for the current reality – where governments are the primary funders and financiers of resilience – to change going forward. Ultimately, additional paths forward capable of overcoming identified barriers may emerge as the market for resilience assets continues to develop. The CIB looks forward to continuing to engage in these markets and embed resilience into infrastructure decision-making in the decades to come.

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