Using Green Investment Banks to Finance Low-Carbon Pathways

Robert Stewart
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Executive Summary

Canada, like other G7 countries, has set an ambitious greenhouse gas emissions reduction target for 2030, and a goal of net zero emissions by 2050. However, while other G7 countries’ emissions levels have declined over the last decade, Canada’s emissions have risen. Despite government policies and public financing to counter this trend, there remains a financing gap for low-carbon investments that support the 2030 target. Public financing is insufficient and private financing can be constrained by barriers such as policy uncertainties, undesirable financial risks, and high capital demand for project investments.

Green Investment Banks (GIBs) are designed to finance low-carbon economic development by mobilizing private financial capital towards low-carbon investments. This paper describes and analyses GIBs as institutional tools capable of addressing the low-carbon financing gap in Canada.

I identify the main characteristics of GIBs (governance structure, capitalization method, asset vehicles, and performance measurement) and show how GIBs are being used to catalyse low-carbon investments and build institutional capacity to support low-carbon economic development. GIBs focus on long-term financing instruments and innovative financing mechanisms to reduce the barriers between private capital and low-carbon investments. GIBs help scale up private investments and reduce dependence on limited and inconsistently available public financing. GIBs can also support institutional capacity-building by aiding low-carbon policy development and supporting environmental awareness and low-carbon transition education.

This paper looks at four well-established GIBs – Australia’s Clean Energy Finance Corporation (CEFC), the UK Green Investment Bank (UKGIB), the Connecticut Green Bank (CTGB), and the New York Green Bank (NYGB) – and describes some of their achievements. The paper then discusses the potential for municipal GIBs in Canada, and highlights The Atmospheric Fund (TAF) in Toronto and the Low-Carbon Cities Canada (LC3) Network, which will establish institutions similar to TAF in six other Canadian cities: Vancouver, Calgary, Edmonton, Ottawa, Montréal, and Halifax.

While TAF operates like a GIB, there is more focus on grantmaking than is typically observed in other notable GIBs. TAF operates as both a grant-making and an investing institution. TAF’s grants, however, are funded from investment returns on its endowment capital, protecting its capital from being eroded. In general, grants reduce capital recycling potential and limit capital growth. While capital growth may not be an intended part of TAF’s mandate, a more standard GIB approach would reduce grants in favour of commercial financing that can attract private investment.

GIBs have been increasing in the United States, but are absent in Canada. The emerging LC3 Network could implement the GIB model across Canadian cities to leverage the catalytic financing capabilities that GIBs bring to low-carbon investments. To support this outcome, the LC3 Network should focus on building coalitions with financial institutions to identify barriers between the sources and destinations of financial capital, and develop effective mechanisms to reduce these barriers and accelerate private financing for low-carbon investment projects in Canadian cities. Through the GIB model, cities can also further leverage institutional capacity-building for low-carbon economic development.
Using Green Investment Banks to Finance Low-Carbon Pathways

Introduction

Canada has set an ambitious target of reducing greenhouse gas (GHG) emissions by 40 to 45 percent by 2030, relative to 2005 levels. This target is aligned with similarly ambitious targets by other G7 countries. However, Table 1 shows that while other G7 countries have been able to reduce their emissions level, Canada's emissions have risen. To counter this trend and chart the path to 2030 targets, regulatory initiatives have been established to target major emission sources, the existing carbon pricing policy has been extended with an increasing carbon tax, and substantial public financing has been made available to support decarbonization activities.

<table>
<thead>
<tr>
<th>Country</th>
<th>Current emissions reduction target (minimum)</th>
<th>Actual emissions reduction (between base year and 2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>40%</td>
<td>-7% (increase)</td>
</tr>
<tr>
<td>France</td>
<td>55%</td>
<td>16%</td>
</tr>
<tr>
<td>Germany</td>
<td>55%</td>
<td>34%</td>
</tr>
<tr>
<td>Italy</td>
<td>55%</td>
<td>20%</td>
</tr>
<tr>
<td>Japan</td>
<td>46%</td>
<td>13%</td>
</tr>
<tr>
<td>UK</td>
<td>68%</td>
<td>41%</td>
</tr>
<tr>
<td>USA</td>
<td>50%</td>
<td>11%</td>
</tr>
</tbody>
</table>

* Base year is the reference year used to assign reduction targets. Target achievement year is 2030. For Canada and the United States, the base year is 2005; for France, Germany, Italy, and the United Kingdom, it is 1990; for Japan, it is 2013.


Regulatory initiatives have been established to target major emissions sources in Canada, particularly oil and gas activities and transportation. Figure 1 shows that emissions from these two sources have been increasing as emissions from other major sources have declined. Federal and provincial regulations have been established to curb emissions
from the oil and gas sector, while public financing support and policy initiatives have been proposed to increase the manufacturing and sales of zero-emissions vehicles.

The federal government has established a long-term commitment to carbon pricing by extending the carbon pricing schedule to 2030 and increasing the carbon tax by $15 a year, from $50 in 2022 to $170 in 2030, to provide policy certainty on emissions pricing.

The geographical scope of GHG emissions suggests that federal policy involvement is an important component. Carbon pricing is a key instrument in the federal government’s emissions policy. Although carbon pricing has a valuable role to play in helping reduce GHG emissions, the efficacy of carbon pricing is contested. Therefore, additional policies are needed to support innovation to drive low-carbon substitutes. The modes available for financing investments are especially important to support investments in low-carbon technology and infrastructure capable of displacing carbon-intensive economic activities.

One estimate puts the total capital investments required to achieve Canada’s 2030 emissions reduction goals at $201 billion over the period 2021 to 2030, with significantly more financing required to achieve net-zero emissions. But public financing will not be sufficient to meet investment needs. Therefore, private capital must be directed to low-carbon investments to scale up financing and, more important, bring about changes within financial markets to establish long-term sustainable financing arrangements for low-carbon economic development.

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**Figure 1: Primary sources of GHG emissions in Canada**

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<table>
<thead>
<tr>
<th>Year</th>
<th>Oil and gas</th>
<th>Transport</th>
<th>Electricity</th>
<th>Heavy industry</th>
<th>Buildings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>1994</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1998</td>
<td>150</td>
<td>200</td>
<td>250</td>
<td>150</td>
<td>150</td>
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<tr>
<td>2002</td>
<td>200</td>
<td>250</td>
<td>300</td>
<td>200</td>
<td>200</td>
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<tr>
<td>2006</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>250</td>
<td>250</td>
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<tr>
<td>2010</td>
<td>300</td>
<td>350</td>
<td>400</td>
<td>300</td>
<td>300</td>
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<tr>
<td>2014</td>
<td>350</td>
<td>400</td>
<td>450</td>
<td>350</td>
<td>350</td>
</tr>
<tr>
<td>2018</td>
<td>400</td>
<td>450</td>
<td>500</td>
<td>400</td>
<td>400</td>
</tr>
</tbody>
</table>
dependencies. Various lock-ins (technology lock-ins, policy lock-ins, market lock-ins) give existing carbon-intensive technologies an economic advantage because they are well established and provide economies of scale. Financial markets also tend to show a propensity for short-term investments, while low-carbon investments demand long-term financing.

These issues create friction for private financial flows into low-carbon projects. Policy tools have to be devised to address this friction. One such tool is a Green Investment Bank (GIB), a development financing entity designed to finance low-carbon economic development by mobilizing private financial capital. GIBs reduce financing barriers that constrain investments in low-carbon technologies. GIBs have been used effectively in several countries and subnational regions across the world, with some precedence in Canada, with The Atmospheric Fund (TAF), and the opportunity for further implementation through the Low-Carbon Cities Canada (LC3) Network, all operating at the municipal level.

In this paper, I define GIBs and what they do, and describe four notable GIBs and some of their most successful outcomes. I then discuss GIBs in the context of Canada with a focus on TAF and the LC3 Network, municipal entities designed to support low-carbon development in major Canadian cities. The paper concludes with a few recommendations.

**Green Investment Banks**

Green Investment Banks (GIBs) are development financing institutions designed to attract private financial capital towards low-carbon investments. GIBs vary in their operational structures, but tend to operate with a narrow focus on low-carbon investment, bringing in private capital by identifying financing gaps, reducing risks, and improving the financial environment for low-carbon investments. Despite the variations in operations, GIBs share some features that can be organized into four categories, listed in Table 2: governance structure, capitalization method, financing instruments, and performance metrics.

In general, the governance structure of GIBs supports government corporations with independent boards of directors, which operate at arm's length from political decision-making. As government corporations, GIBs are capitalized by public funds, but the source of these funds can vary. Some GIBs have been capitalized through government budget appropriations, others from government environmental or clean-energy funds, others from one-off sources of funding (for example, the Montgomery County Green Bank in Maryland was initially capitalized by funds received through a public settlement from the merger of two power providers; TAF was initially capitalized by funds from the sale of municipally owned assets in Toronto). Capitalization affects the size and scope of GIBs’ activities. Larger, recurring sources of capital support greater scale and wider market reach, which require a larger institution.

**Table 2: Characteristics of Green Investment Banks**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Typical arrangement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance structure</td>
<td>Typically established through government corporations by government legislation. Legislation outlines the institution’s mandates and operational functions. An appointed board of directors is responsible for corporate governance.</td>
</tr>
<tr>
<td>Capitalization method</td>
<td>Initial capitalization is typically in the form of government funds. These funds can be appropriated on a recurring basis or over a fixed term until the GIB becomes self-financing.</td>
</tr>
<tr>
<td>Financing instruments</td>
<td>Traditional debt and equity instruments are used, but financing terms support long-term investment periods.</td>
</tr>
<tr>
<td>Performance metrics</td>
<td>Amount of GHG reductions associated with investments. Amount of clean energy production associated with investments. Private capital leverage ratio: Amount of private capital attracted per $1 of GIB capital deployed.</td>
</tr>
</tbody>
</table>
GIBs aim to reduce financing barriers for low-carbon investments by using traditional financial instruments with strategic effect. The barriers include high upfront capital demand and unfavourable risk profiles. Debt and equity capital are common financing instruments, and the focus is always on long-term financing arrangements that attract private capital. (Debt capital refers to borrowed funds that are repaid over time with interest, and equity capital refers to financing acquired by selling ownership stakes in companies.) These financing arrangements support low-carbon investments and drive GHG emissions reduction, which is one of the main performance metrics used by GIBs. Most GIBs also report on their private capital leverage ratio – the amount of private capital attracted per $1 of GIB capital deployed.

**What do GIBs do?**

GIBs use public funds to leverage private capital for low-carbon investments. Additionally, through their streamlined focus on low-carbon activity, many GIBs develop valuable internal expertise that can be used in capacity-building to support policy design and enablement. In the United States, for example, the Connecticut Green Bank has long championed the goal of a national climate banking institution (a national GIB) that provides financial capital and environmental policy support for low-carbon economic development. While legislation for such an institution has not been passed, the Inflation Reduction Act, 2022, provided significant financial support (US$27 billion) for green financing. The Connecticut Green Bank has also supported Connecticut’s Public Utilities Regulatory Authority in administering clean energy programs, while advising on the development of such programs.

In the United Kingdom, the UK Green Investment Bank was able to provide technical and financial expertise to project developers in the waste-to-energy and bioenergy sectors to support project due diligence requirements needed to secure private investments.

GIBs can also complement carbon pricing policies by recycling capital into low-carbon projects and by building awareness for low-carbon development through public outreach and stakeholder engagement. GIBs also publish annual reports and business plans that outline their work and strategic direction, which further increases awareness of their low-carbon agendas.

Some GIBs demonstrate a strong market signalling effect, enhancing their ability to attract private capital. By developing a record for selecting bankable projects, GIBs increase the confidence of private investors (in much the same way that multilateral development banks provide a signalling effect in risky markets). Some GIBs have also developed expertise in low-carbon project financing, which can be leveraged to support private investors.

**Reducing financial risks across the low-carbon project stages**

GIBs rely on different financing instruments to mobilize private finance at different stages of the low-carbon project development lifecycle, to reduce the financial risks that create barriers to private investments at each stage. Figure 2 depicts the three stages of the project development lifecycle, along with the key risk faced and the typical external private financing sources at each stage. GIBs take on different roles at each of these project stages.

The research and development phase of the low-carbon project lifecycle is essential for the innovation of low-carbon technology that can displace carbon-intensive economic activity. However, this stage of the technology lifecycle carries high levels of financial risks that derive from the uncertainties associated with technology development. The costs of innovation can be high, and research and development is often spread across multiple economic actors (such as research institutions, research funding agencies, policymakers, and private funders) who may not benefit from the potential rewards of the innovation. This imbalance creates a strong public financing demand at the research and development stage.

Traditionally, national development banks and other public research and development funding agencies have been the major sources of financing at the research and development stage, although some GIBs have provided grants and early investment capital for research and development. In general, however, GIBs steer away from the research and development stage and focus on scaling up proven technologies that can attract private finance.

At the early commercialization phase, once technology is demonstrable, financial capital is needed for commercial
success. Early commercialization, however, demands business expertise to identify appropriate markets, organizational structures, and business models, among other criteria for commercial success. Venture capitalists are often the primary source of private financing at this stage, and their investments benefit from their business expertise. Since venture capitalists are usually limited by their capital availability, especially in countries with small equity markets, GIBs can provide capital at this crucial stage of the low-carbon project development cycle.

At the full commercialization stage, large sources of capital are needed to scale up projects for larger markets. At this stage, projects are typically generating positive cash flow and can attract larger investors such as banks and institutional investors. However, these investors tend to prefer low-risk exposures and may be governed by regulations that constrain their capital deployment.

Banks are among the largest and most important sources of external financing, but they face regulatory constraints, which require them to hold a percentage of all assets in capital reserves. The amount of required capital reserves increases as the risk of the asset increases. New banking regulations emerging from the 2008 global financial crisis increased the stringency of regulatory capital requirements and added liquidity requirements that have further constrained bank lending. In this context, GIBs can use their capital provisioning role to reduce investment risk, making the investments more attractive to banks.

Institutional investors represent another important source of financing for low-carbon infrastructure, because of the large amounts of investment capital typically available from these investors and the long-term nature of their investment horizons. Institutional investors, like banks, may be deterred from low-carbon investments due to undesirable risk-return profiles, face barriers related to deal sizes, and lack the internal expertise needed to evaluate projects. Given the last concern, institutional investors typically invest through intermediaries such as private equity funds, so attracting these investors requires establishing effective asset vehicles.

GIBs reduce risks for institutional investors as they do for banks, and can also aggregate small projects into larger investment vehicles suitable for institutional investors. Furthermore, GIBs offer expertise in low-carbon investment financing, which can be leveraged by institutional investors in pursuit of these investments.

Notable GIBs and their activities

Four examples from Australia, the United Kingdom, and the United States

GIBs and similar entities have been increasing across the globe since 2012. The activities of GIBs vary based on their national or regional context. In this section, I outline four GIBs: Australia’s Clean Energy Finance Corporation (CEFC), the UK Green Investment Bank (UKGIB), the Connecticut Green Bank (CTGB), and the New York Green Bank (NYGB). These GIBs are notable because of their tenure and capitalization size. Table 3 outlines the governance structure of these four GIBs, and Table 4 lists their capitalization sources.

GIBs typically rely on traditional debt and equity financing instruments to provide long-term financing for projects at the full commercialization phase. The CEFC has also established a venture capital fund (Clean
Using Green Investment Banks to Finance Low-Carbon Pathways

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Energy Innovation Fund) to support low-carbon innovation at the early market entry stage. The UKGIB has established an operating infrastructure fund specifically for offshore wind financing (UK Operating Offshore Wind Fund). This infrastructure fund finances assets at the operating phase (analogous to the full commercialization phase), at which projects are cash-flow positive. This fund attracted significant investments from institutional investors.

All four GIBs measure performance in terms of GHG emissions reduced or renewable energy generated as well as a private capital leverage ratio. Table 5 lists the total capital committed by each GIB compared with the value of assets financed through these investments, and the ratio between the two. Additionally, the CEFC and UKGIB have also established ROI (return on investment) targets as a financial performance measure.

Mobilizing private capital for strategic low-carbon investments

While financing instruments are similar across these four GIBs, the low-carbon areas of focus vary by national and regional context. Table 6 shows some of the key areas of focus for these GIBs.

CEFC is the largest GIB in the world by total capitalization, and as such has the widest agenda. Critical areas of focus have been in solar and wind power generation and supporting grid infrastructure expansion to improve power distribution. The CEFC also supports the green bond market in Australia by investing in green bonds. The CEFC also established the Clean Energy Innovation Fund, a major low-carbon venture capital fund in Australia.

The UKGIB has financed strategic areas of low-carbon development, notably the offshore wind sector, and waste and bioenergy sectors. As of fiscal year-end 2017, 80 percent of the UKGIB’s investments were in these two sectors (46 percent in offshore wind and 34 percent in waste and bioenergy). At fiscal year-end 2017, the UKGIB’s offshore wind portfolio had 67 percent of its investment in offshore wind assets under construction, where risks are at their highest, projects are not yet cash-flow positive, and equity capital support is needed. Another notable outcome of the UKGIB is the establishment of the UKGIB Offshore Wind Fund, which has attracted significant investments from institutional investors. The fund is wholly dedicated to financing offshore wind projects in operation. Today, the UK has the largest offshore wind installed capacity in the world.

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* The UKGIB was privatized in 2017 and rebranded the Green Investment Group.

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**Table 3: Governance structure: CEFC, UKGIB, CTGB, NYGB**

<table>
<thead>
<tr>
<th>GIB</th>
<th>Governance structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT Green Bank</td>
<td>(State) government corporation, enacted as the CT Clean Energy Finance and Investment Authority (CEFIA) via Public Act No. 11-80 in 2011 and rebranded as the CT Green Bank in 2014.</td>
</tr>
<tr>
<td>NY Green Bank</td>
<td>Division of an existing (state) government corporation (NYSERDA – NY State Energy Research and Development Authority). Division established in 2012.</td>
</tr>
</tbody>
</table>

* The members are Connecticut, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Vermont, and Virginia.

**Table 4: Capitalization sources: CEFC, UKGIB, CTGB, NYGB**

<table>
<thead>
<tr>
<th>GIB</th>
<th>Capitalization sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Energy Finance Corporation</td>
<td>AU$10 billion, appropriated through the Australian federal budget.</td>
</tr>
<tr>
<td>UK Green Investment Bank</td>
<td>₤3 billion, appropriated through the government budget.</td>
</tr>
<tr>
<td>CT Green Bank</td>
<td>Initially capitalized by an existing fund (Connecticut Clean Energy Fund – funded by state regulatory charges on electricity use); further funded by 23% of proceeds generated from the Regional Greenhouse Gas Initiative – the emissions trading scheme for the northeastern United States. Additional capital sourced by issuing green bonds.</td>
</tr>
<tr>
<td>NY Green Bank</td>
<td>Capitalized by funds from New York State Energy Research and Development Authority.</td>
</tr>
</tbody>
</table>

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Unlisted infrastructure funds are an attractive asset vehicle for institutional investors.41 These funds allow institutional investors to work closely with fund managers to develop investment strategies tailored to the specific needs and objectives of the investors. The UKGIB has used this vehicle (UKGIB Offshore Wind Fund) exceptionally well, starting with a fund size of £463 million in 2015 to a closing fund size of £1.12 billion in 2017.42 The success of the UKGIB Offshore Wind Fund can serve as an example for other GIBs aiming to attract institutional investors to low-carbon investments.

The remaining two GIBs (CTGB and NYGB), being state entities, operate with a more limited scope relative to the national-level GIBs in Australia and the United Kingdom. Nevertheless, Table 5 shows that both have attracted significant private capital. The NYGB focuses on commercial-level investments with large deal sizes (typically US$10 million to $50 million).43 The CTGB, with a smaller capital base, focuses on retail investments, particularly household and commercial building solar financing.

Despite its smaller capital base, the CTGB has achieved the largest private capital leverage ratio of the four GIBs. An important part of the success of CTGB has been its extensive use of special-purpose entities, which are independent legal entities created to house or finance revenue-generating assets. The CTGB uses special-purpose entities to aggregate smaller

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**Table 5: Total committed capital and investments mobilized as of 2022: CEFC, UKGIB, CTGB, NYGB**

<table>
<thead>
<tr>
<th>GIB</th>
<th>GIB capital committed</th>
<th>Total value of investments financed</th>
<th>Capital mobilization ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFC</td>
<td>AU$10.76 billion</td>
<td>AU$37.15 billion</td>
<td>1 : 3.5</td>
</tr>
<tr>
<td>UKGIB</td>
<td>£3.4 billion</td>
<td>£12 billion</td>
<td>1 : 3.5</td>
</tr>
<tr>
<td>CTGB</td>
<td>US$322 million</td>
<td>US$1.95 billion</td>
<td>1 : 6.5</td>
</tr>
<tr>
<td>NYGB</td>
<td>US$1.7 billion</td>
<td>US$4.5 billion</td>
<td>1 : 2.6</td>
</tr>
</tbody>
</table>

*UKGIB: as of 2017 (last fiscal year in which the organization was publicly owned).


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**Table 6: Key areas of focus: CEFC, UKGIB, CTGB, NYGB**

<table>
<thead>
<tr>
<th>GIB</th>
<th>Key areas addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEFC</td>
<td>• Renewable energy generation (solar and wind)&lt;br&gt;• Grid infrastructure financing&lt;br&gt;• Clean Energy Innovation Fund – venture capital fund for low-carbon technology development&lt;br&gt;• Building decarbonization&lt;br&gt;• Green bond and climate bond purchases</td>
</tr>
<tr>
<td>UKGIB</td>
<td>• Offshore wind&lt;br&gt;• Waste and bioenergy&lt;br&gt;• GIB Offshore Wind Fund – operating infrastructure fund that manages offshore wind investments</td>
</tr>
<tr>
<td>CTGB</td>
<td>• Solar financing (rooftop residential and commercial)&lt;br&gt;• Commercial-Property Assessed Clean Energy (C-PACE) financing&lt;br&gt;• Solar power purchase agreements (PPAs)&lt;br&gt;• Innovative solar financing (Solar Home Renewable Energy Credit – SHREC – backed bonds), Green Liberty Bonds (minimum investment US$1,000), and Green Liberty Notes (minimum investment US$100)</td>
</tr>
<tr>
<td>NYGB</td>
<td>• Solar-energy generation (distributed generation, residential generation)&lt;br&gt;• Solar with battery storage&lt;br&gt;• Building decarbonization</td>
</tr>
</tbody>
</table>
assets into larger investment vehicles to attract investors seeking larger investment sizes or to divest investments so that capital can be recycled and used to acquire additional assets.

Figure 3 shows a simplified arrangement used by the CTGB to finance solar installations.\textsuperscript{44} The CTGB finances contractors to make solar lease arrangements to customers, reducing capital barriers faced by contractors. The special-purpose entity owns the equipment, and the customers pay monthly leasing fees for the equipment. The CTGB provides higher-risk capital (equity and subordinated debt – debt that has lower priority for repayment relative to other debt) and allows private investors to take lower-risk positions through senior debt (debt that has the highest priority for repayment). The special-purpose entity aggregates multiple financing arrangements, and the payments provide investment returns to capital providers, including the CTGB.

Like the UKGIB, the use of asset vehicles has been instrumental to the CTGB’s ability to attract private capital. These results reflect the level of financial market activity in the United Kingdom and the United States, which provide strong support to private capital mobilization.

**GIBs as municipal instruments in Canada**

In supporting low-carbon economic development, GIBs can offer valuable institutional capabilities to municipalities. Effective GIB design, however, is determined by the expected role of these entities. Therefore, the design of municipal GIBs will be informed by the role that municipalities occupy in emissions reduction and low-carbon economic transition.

Effective emissions-reduction policy design requires intergovernmental coordination, given the cross-border impact of emissions and the scale of policy responses needed.\textsuperscript{45} Emissions sources vary across provinces, and require province-specific abatement responses. Cities are large local emissions sources, so municipalities are important participants in emissions reduction. While emissions sources may be local, however, their impact is national, and emissions reduction demands federal participation.

Given variations in emissions output and abatement responses across regions, a fiscal decentralization arrangement is appropriate for emissions policy design.\textsuperscript{46} Decentralization allows subnational governments to implement local responses to local issues, which may improve response speed and
efficacy. Municipal GIBs need to determine the scope of emission sources relevant to their jurisdictions and the policy responses available within the authority of the municipal GIB entity.

Municipal GIBs can be further defined through the general principles of decentralized governance. The subsidiarity principle suggests that responsibilities that cross multiple levels of government should be assigned to the most local level of accountability. At the same time, the principles of correspondence (that is, the geographic dimension of benefits or externalities should match that of the level of responsible governance) and affordability (subnational levels of governance must have sufficient resources to meet assigned responsibilities) suggest that funding and legislative support are required from higher levels of governance. Legislation is beyond the power of municipalities, so emissions policy implementation falls largely within provincial responsibilities.

Public financing to address subnational, cross-border externalities such as GHG emissions is best sourced by intergovernmental transfers to foster subnational, cross-border cooperation and preserve local financing for strictly local benefits. Municipalities may also face local budget constraints. These principles can be seen in Canada in the work of The Atmospheric Fund, a not-for-profit organization established by the City of Toronto, that operates much like a GIB and is capitalized by all three orders of government.

**The Atmospheric Fund (TAF) as a Green Investment Bank**

Although it is not called a GIB, The Atmospheric Fund (TAF) has a similar organizational structure and operating characteristics to a GIB. Table 7 compares TAF to the four main GIB characteristics. TAF is a not-for-profit organization established by the City of Toronto, capitalized by public funds, which finances low-carbon investments by attracting private capital as well as additional philanthropic grants.

Unlike most GIBs, TAF has a strong focus on providing grants. In fiscal year 2021, approved grants constituted 44 percent of revenues. Grants do not usually generate revenues for a GIB, and may increase the GIB’s reliance on public funding. TAF, however, eliminates this concern by funding grants from investment returns on its endowment capital (grant-making is also supported by philanthropic donations). Nevertheless, grants, in general, reduce the potential for capital recycling, and limit capital growth. While capital growth is not a part of TAF’s institutional mandate, a shift in this direction can increase opportunities to deploy larger amounts of available capital over time.

Some GIBs, at the early stages of operations, rely heavily on grant financing to support their low-carbon activities. However, the expectation is that over time they will reduce grants in favour of commercial loans or equity. For example, the CTGB, which started out largely on a grant-funding model, over time restructured its financing arrangements to focus on investments with positive returns. Figure 4 shows the proportion of grant funding by the CTGB over time. Note that even with grants, the CTGB has mobilized significant private investments by using those grants to support private project investments.

**TAF: Innovative financing and support for low-carbon development in the GTHA**

As a municipal-level development financial institution, TAF provides two vital services to the GTHA (Greater Toronto

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>TAF features</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Governance structure</strong></td>
<td>Not-for-profit corporation established by the City of Toronto in 1991 and legislated through the Toronto Atmospheric Fund Act, 1992 (amended by the Toronto Atmospheric Fund Act, 2005). Governed by independent board of directors.</td>
</tr>
</tbody>
</table>
| **Capitalization method**      | Capitalized by government endowments:  
• CA$23 million: City of Toronto (1992)  
• CA$17 million: Province of Ontario (2016)  
• CA$40 million: Government of Canada (2020) through the Federation of Canadian Municipalities |
| **Financing instruments**      | • Grants  
• Debt  
• Equity |
| **Performance metrics**        | • Tonnes of GHG emissions reduced  
• Financial capital mobilized (TAF financing and external financing) |
Using Green Investment Banks to Finance Low-Carbon Pathways

and Hamilton Area). First, TAF reduces capital expenditure demands for low-carbon investments. By acquiring capital endowments from the provincial and federal governments, TAF reduces the public capital needed from the city. Federal and provincial fiscal transfers are vital for municipal capital expenditures, given the limited sources of self-financing available to municipalities. However, fiscal transfers may be inconsistent and vulnerable to political changes. TAF provides a stable conduit to channel federal and provincial transfers directly to low-carbon projects. Once fully capitalized, the entity provides a stable and committed source of financial capital, which can be recycled through revenue-generating investments. In fact, TAF’s total government endowment was $80 million and had grown to approximately $100 million by fiscal year-end 2021.

Second, TAF supports the GTHA in its emissions-reduction policy by serving as a centralized institution for low-carbon capacity-building. Several notable activities in this area include:

- TAF’s carbon inventory for the GTHA, which measures and reports on carbon emissions;
- TAF’s policy development support on the Toronto Green Standard policy to guide sustainable design practices for buildings and development sites;
- TAF’s role as co-director of the City of Toronto’s long-term emissions reduction strategy (TransformTO), which developed the plans for achieving Toronto’s 2030 and 2050 emissions goals.

TAF’s primary areas of low-carbon development are decarbonization of buildings and vehicle electrification (particularly electric-vehicle charging infrastructure). Buildings and vehicles account for approximately 75 percent of emissions in the GTHA. The institution has provided extensive support for energy-efficiency retrofitting programs not only in Toronto but across Canada, by collaborating with businesses engaged in building retrofitting.

A further major achievement has been the development of a proprietary financing arrangement: ESPA (Energy Savings Performance Agreement), which makes retrofitting more affordable. Figure 5 outlines this arrangement, which allows building owners to finance energy efficiency retrofits or upgrades through the savings achieved from the upgrades.
TAF provides a turnkey solution: energy audits to determine energy upgrade needs, financing for equipment and installation, and contractors to perform the installation. The energy upgrades are expected to reduce energy consumption and its associated costs. By matching potential cost savings with appropriate financing terms, the financial cost of the upgrades, with interest, can be recovered from the cost savings.

Similar financing arrangements are growing in popularity among GIBs in other countries. Examples include Property Assessed Clean Energy (PACE) financing programs in the United States. These programs finance clean-energy and energy-efficiency upgrades through a property tax surcharge. Some GIBs in the United States, such as the CTGB, have become central financing entities for PACE programs.

On-bill financing arrangements are a variant of PACE programs, whereby repayment is made through a surcharge on the electricity bill. On-bill financing is used by the Hawaii Green Infrastructure Authority (often referred to as Hawaii’s Green Bank).

Both PACE and on-bill arrangements typically provide financing terms long enough that energy savings cost from the upgrade can, at least partially, cover the financing costs of the upgrade. In Europe, energy performance contracts provide similar financing arrangements, allowing cost savings from energy upgrades to support financing for the upgrades. The European Investment Bank has a coordinated financing program for energy performance contracts to support bank lending for this activity.

TAF has also helped establish a building retrofit entity (Efficiency Capital) that offers ESPAs. Efficiency Capital pays TAF a licensing fee to use the ESPA model, which is trademarked by TAF. The licensing arrangement allows Efficiency Capital to expand the ESPA model beyond the Toronto region, while allowing TAF to earn revenues from the model it developed.

The success of TAF has inspired the development of similar entities in other Canadian cities through the Low Carbon Cities Canada initiative, coordinated through the Green Municipal Fund (GMF).

The GMF was formed in 2005, funded by the federal government and managed by the Federation of Canadian Municipalities. The GMF helps build capacity in sustainable development in Canadian municipalities by offering grants and loans to support sustainability projects that advance policy and program development and implementation. Table 8 compares the GMF to the four characteristics used to define GIBs.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Green Municipal Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance structure</td>
<td>Managed by the Federation of Canadian Municipalities (FCM). Formed in 2005 through the merger of two existing FCM funds (established in 2000): the Green Municipal Investment Fund (GMIF) and the Green Municipal Enabling Fund (GMEF). GMF council comprises federal government representatives (1/3), elected municipal representatives (1/3) appointed by the FCM board of directors, and external representatives.</td>
</tr>
<tr>
<td>Financing instruments</td>
<td>Grants and loans</td>
</tr>
</tbody>
</table>
| Performance metrics     | • Number of projects funded  
                          | • Contribution to GDP  
                          | • Contribution to job creation  
                          | • Tonnes of GHG emissions reduced                                      |
The GMF has also supported building decarbonization activities through energy efficiency retrofits and sustainable housing development. Credit guarantees have been used to attract private financing to these investments. Credit guarantees provide protection for loans and support favourable lending terms (lower interest rates and longer repayment periods), to make loans more affordable for borrowers while reducing credit risk exposure for the lender.

**Low-Carbon Cities Canada Network**

The GMF has served as a coordinating agent for the Low-Carbon Cities Canada (LC3) Network. The LC3 Network was established to replicate the TAF model in other major Canadian cities. Table 9 lists the cities that make up the LC3 Network and their endowment size.

Like TAF, LC3 centres focus on supporting emissions reductions in cities. These centres are relatively new, and have limited operations thus far, focused on building decarbonization and transport electrification.

Where reducing emissions from buildings is concerned, energy-efficiency retrofit financing has demonstrated financial viability through TAF (and other retrofit financing entities in Canada). This product could be expanded to appeal to institutional-based investors using aggregator financing entities or unlisted funds.

- Aggregator financing entities group small investments into a single large asset vehicle that can attract large-scale investments such as those from institutional investors.
- Unlisted funds are used to raise investment capital to fund other projects or other funds and are a common investment vehicle for institutional investors.

### Through the LC3 Network, GIBs can be established throughout Canada at the municipal level.

<table>
<thead>
<tr>
<th>City</th>
<th>LC3 Centre</th>
<th>Endowment</th>
<th>Year established</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calgary &amp; Edmonton</td>
<td>Climate Innovation Fund (CIF)</td>
<td>$43.4 million</td>
<td>2019</td>
</tr>
<tr>
<td>GTHA</td>
<td>The Atmospheric Fund (TAF)</td>
<td>$40.0 million</td>
<td>1992</td>
</tr>
<tr>
<td>Halifax</td>
<td>Halifax Climate Investment, Innovation, and Impact (HC3) Fund</td>
<td>$17.7 million</td>
<td>2021</td>
</tr>
<tr>
<td>Montréal</td>
<td>Greater Montréal Climate Fund (GMCF)</td>
<td>$32.5 million</td>
<td>2020</td>
</tr>
<tr>
<td>Ottawa</td>
<td>Ottawa Climate Action Fund (OCAF)</td>
<td>$21.7 million</td>
<td>2021</td>
</tr>
<tr>
<td>Vancouver</td>
<td>Zero-Emissions Innovation Centre (ZEIC)</td>
<td>$21.7 million</td>
<td>2021</td>
</tr>
</tbody>
</table>

Through the LC3 Network, GIBs can be established throughout Canada at the municipal level. However, a case for provincial GIBs could also be made. In the United States, GIBs typically function at the state level. Australia, a federal country, has a national-level GIB. The province of Ontario did establish a provincial GIB, the Ontario Climate Change Solutions Deployment Corporation, in 2017, but disbanded the organization in 2019.

Nevertheless, there are precedents for establishing GIBs at multiple levels of government. The state of New York has its state-level GIB, NY Green Bank, as well as the New York City Energy Efficiency Corporation, a GIB-like entity that operates mainly within New York City (but with extended operations in the northeastern United States). Similarly, the State of Maryland has a state-level GIB, Maryland Clean Energy Center, as well as a county-level GIB, Montgomery County Green Bank, and a city-level GIB, the Climate Access Fund, in Baltimore.

For jurisdictionally nested GIBs, it is important to establish the operating context of each institution and form working coalitions to identify synergies and reduce the duplication of effort. The American Green Bank Consortium supports coalition-building and collaboration among American GIBs. I would argue that the LC3 Network has the potential to serve this role in Canada through the GMF platform.

**Concluding Remarks**

GIBs have become valuable institutional instruments in financing low-carbon projects, and The Atmospheric Fund (TAF) sets a precedent in Canada. The Low-Carbon Cities
Canada (LC3) Network could expand the GIB model across Canadian cities to catalyse low-carbon investments and build institutional capacity for low-carbon economic development. Through a GIB model, the organizations that make up the LC3 Network could support the transition to a low-carbon economy by serving as a committed and sustainable source of financing capable of attracting private capital, while providing policy support to cities.

The LC3 Network could also provide a platform on which to develop a Canadian GIB consortium to support knowledge transfer, identify best practices, and leverage the resources and experiences of each member to find opportunities for innovation and improvement. The consortium could also be used to build coalitions with policy makers and attract political and social support to promote low-carbon policies and advance low-carbon goals.

Coalition-building should involve financial institutions. At present, the capital endowments of the LC3 centres are small. However, with appropriate financing instruments, these capital sources can leverage larger amounts of private capital. Engaging with financial institutions allows for the identification of financing barriers so that the LC3 centres can better design financing arrangements to mobilize private capital to low-carbon investments.

An energy-efficiency retrofit financing fund or aggregator at the GMF level could group smaller projects into larger assets to attract institutional investors such as the Canadian Pension Plan Investment Board. This institutional investor (and others in Canada) has supported green infrastructure investments both locally and internationally, acquiring operating wind and solar projects in Canada and Europe. With the appropriate financing arrangement, similar financing can flow to building decarbonization, and further scale up low-carbon financing in cities.

Endnotes


2 Environment and Climate Change Canada, 2030 Emissions Reduction Plan.


5 Environment and Climate Change Canada, 2030 Emissions Reduction Plan.


Using Green Investment Banks to Finance Low-Carbon Pathways

12 Rosenbloom, Markard, Geels, and Fuenschilling, “Why carbon pricing is not sufficient to mitigate climate change.”
17 Polzin and Sanders, “How to finance the transition to low-carbon energy in Europe.”
22 Buchner et al., *Global Landscape of Climate Finance 2021*.
31 Campiglio, “Beyond carbon pricing.”
36 Röttgers, Tandon, and Kaminker, *OECD Progress Update on Approaches to Mobilising Institutional Investment*.
37 For the CEFC, the target ROI is 3 to 4 percent above the five-year Australian government bond rate (before operating costs); the target annual ROI is 3.5 percent (after operating costs).


51 Since TAF also raises funds through donations, the growth in capital is not fully attributable to capital recycling.


