GROWING FORESTS IN A CITY

CASE STUDY

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SUMMARY

Forests do not have to be big to deliver big value. Their value continues to grow as cities seek to address converging challenges of population growth, climate change, and biodiversity loss. They can offer refuge in heatwaves, sequester greenhouse gas emissions, limit flooding, filter air pollution, and provide wildlife corridors. Green space also offers many mental and physical health benefits. The City of Montreal has one of the most ambitious municipal tree planting plans in Canada, aiming to increase its tree cover to 25 per cent by 2025 and plant 500,000 trees by 2030. But it faces challenges in terms of finding space and financing. To accelerate progress on urban forests across Canada, governments of all levels can help expand private and public incentives to invest in and maintain tree cover.

This case study is part of a collaborative series between the Canadian Institute for Climate Choices and the Smart Prosperity Institute exploring the value of urban natural infrastructure within the context of climate change and other economic, environmental and societal objectives. Other case studies in the series cover green roofs and wetlands.

CANADIAN INSTITUTE FOR CLIMATE CHOICES

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WHAT ARE URBAN FORESTS?

Urban forests are trees and greenspace within and around cities, both small and large. They may be natural spaces or areas where trees are planted. They can range from a few trees to larger stands. They may be in urban parks, lining streets, surrounding commercial or institutional buildings, in and around parking lots, in residential backyards, along rivers or wetlands, in designated nature preserves, in shelter belts in agricultural areas, or surrounding the urban periphery.

Indigenous Peoples should be involved in decision-making processes around urban forests as they hold historical and cultural significance.

Largest urban Indigenous reserve incorporates green and blue infrastructure

Seven Treaty 1 First Nations in Manitoba challenged the Government of Canada's proposed sale of the former Winnipeg Kapyong Barracks in 2007, paving the way for the largest urban Indigenous reserve in Canada. The agreement between the Treaty 1 Development Corporation and Canada Lands provides an opportunity to showcase Indigenous-led urban development. The Master Plan released in March 2021 states that trees, vegetation, and waterbodies are vital elements in nature and in sustainable community building. The community will use native species for urban trees and vegetation as a means to share knowledge about the cultural value of local plants, contribute to carbon sequestration, and create critical habitat for pollinators and other fauna (T1DC, Canada Lands, 2021).

Photo credit: GRAME

WHAT ARE THE BENEFITS OF URBAN FORESTS?

Urban forests can help cities adapt to a changing climate, cooling air temperatures and reducing flood risk by absorbing excess rainfall. They also absorb CO_2 emissions and filter air pollutants. At the same time, they support birds and wildlife, offer recreational areas, and increase property values. The table below highlights some of the many benefits of urban forests. .

Table 1: Benefits of Urban Forests

Benefit	Why it Matters
Reduce GHGs	Between 1990 and 2018, urban trees removed an average of 2.4 Mt of GHGs per year according to the National Inventory Report[1]. Urban forests also contribute to GHG emission reductions by reducing air conditioning needs in nearby buildings.
Cool the air	Large trees reduce ambient air temperatures with their shade and through evapotranspiration, cooling the air by as much as 1-5 degrees Celsius.
Limit flooding	Climate change will increase the frequency and intensity of storms and rainfall in some regions. Permeable, natural surfaces allow water to seep into the ground and reduce total amount and slow rate of runoff, reducing the risk that wastewater and stormwater systems overflow. Root systems from trees and shrubs make it easier for water to infiltrate the soil and soak up large quantities of water.
Support biodiversity	Connected urban forests can provide corridors for plants and animals to move. This is increasingly important as a changing climate leads to shifts in habitat as urban areas expand.
Clean air	Extreme heat associated with climate change is projected to increase concentration of ground level ozone, and more frequent and intense wildfires will make particulate matter pollution worse in some areas. Trees can help filter airborne particulate matter and absorb ground level ozone and other pollutants.
Food / medicine	Green spaces can increase food security and build healthier communities. If urban forests are combined with community gardens, they can provide the opportunity to source healthy food and support lower income families. Indigenous-led green spaces can also provide space to share knowledge and traditions.
General health	Urban forests provide opportunities to practice both physical and relaxing activities. The mere presence of greenery is shown to improve mental health, with some doctors now prescribing nature alongside other treatments.

Source: ECCC, (2020a); EPA (2019); NCC (2019); GreenBlue Urban (2017); Kardan et al. (2015); McDonald (2016); Bratman et al., (2015)

[1] Urban areas are defined by population centers with a population greater than 30 000 individuals. This subset captures all major Canadian cities and represents 67 per cent of the total urban area in 2012 (ECCC, 2020a)

CAN WE PLACE A DOLLAR VALUE ON TREES?

When the social benefits of urban forests are translated into dollars and cents, they usually outweigh the costs of planting and managing them.

Tools exist to monetize the value of trees and urban forests. I-Tree, developed by the USDA forest service, is the most widely used and provides monetary estimates for a suite of benefits. Table 2 illustrates a selection of estimates developed for Canadian cities using the i-Tree tool.

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Table 2: Estimated benefits of urban forests

Per capita value of urban forest benefits for select Canadian cities

Benefits / City	Toronto	Halifax	Guelph	Mississauga	New Market
Total population	6,197,000	413,000	134,842	801,877	84,224
Number of trees	2	18	22	3	4
Annual air pollutants removal	2.60$	0.58$	15.21$	5.99$	3.82$
Annual carbon sequestration	0.38-0.75	2.47-4.94	2.39-4.79	0.46-0.92	0.92-1.85
Stored carbon	8.88-17.75	46.07-92.13	73.01-146.02	12.66-25.32	20.98-41.97
Replacement value	1,129.58$	3,842.62$	5,955.12$	1,745.90$	4,321.81$
Sources:	City of Toronto, 2013	Foster & Duinker, 2017	City of Guelph, 2019	TRCA, 2011	LSRCA, 2016

Return on investments from urban forests

Location	ROI value	Source
Average of 5 US cities	1:1.37 to 1:3.09	McPherson and Simpson, 2005
York Region	01:23.6	Infrastructure Canada, 2019

Note: The values in the table were generated using the i-Tree tool available at www.itreetool.com. Details on methodology are available on the website. Air pollution values include CO, NO_2, O_3, PM10 (Toronto, Mississauga), PM 2.5 (Halifax, New Market), and SO_2. Carbon sequestration and storage values are estimated at a range of 50$ and 100$ per tonne. These values likely underestimate the benefits of reducing or sequestering one tonne of CO_2 (Samson and Rivers, 2020). ROI values from McPherson and Simpson include energy savings, air quality benefits (O_3, NO_2, SO_2, PM10), stormwater runoff reduction, carbon capture (15$/tonne), and aesthetic values based on property sales. York region ROI values refer to 23.60$ in long-term savings on recovery and replacement cost from extreme temperatures and flooding for every 1$ invested.

While the cost-benefit ratios noted above are promising, they assume that trees are planted on existing public or private land. Urban forests that involve the purchase of property within cities will be more costly. Some programs may also discount the carbon sequestration benefits associated with trees to reflect “non-permanence” risks associated with tree damage or death.

CITY OF MONTREAL URBAN FOREST ACTION PLAN

Montreal's *Plan de développement durable de la collectivité montréalaise* 2010-2015 originally set urban tree canopy targets that aim to increase tree coverage from 20 per cent to 25 per cent by 2025. The 2012 *Plan d'action forêt urbaine* (PAFU) followed shortly after paving the way with per municipality targets and a 10 year budget. In its recent climate plan, Montreal further committed to plant 500,000 trees by 2030. This is one of the most ambitious goals in the country, considering the timeline and population, as well as industry and commercial density.

Table 3 compares urban forest indicators across select Canadian cities for the latest year information is available. A study by Ziter et Al. (2019), for example, finds that tree cover needs to approach 40 per cent in order to achieve significant cooling benefits.

Table 3: Urban forest comparative from select Canadian cities

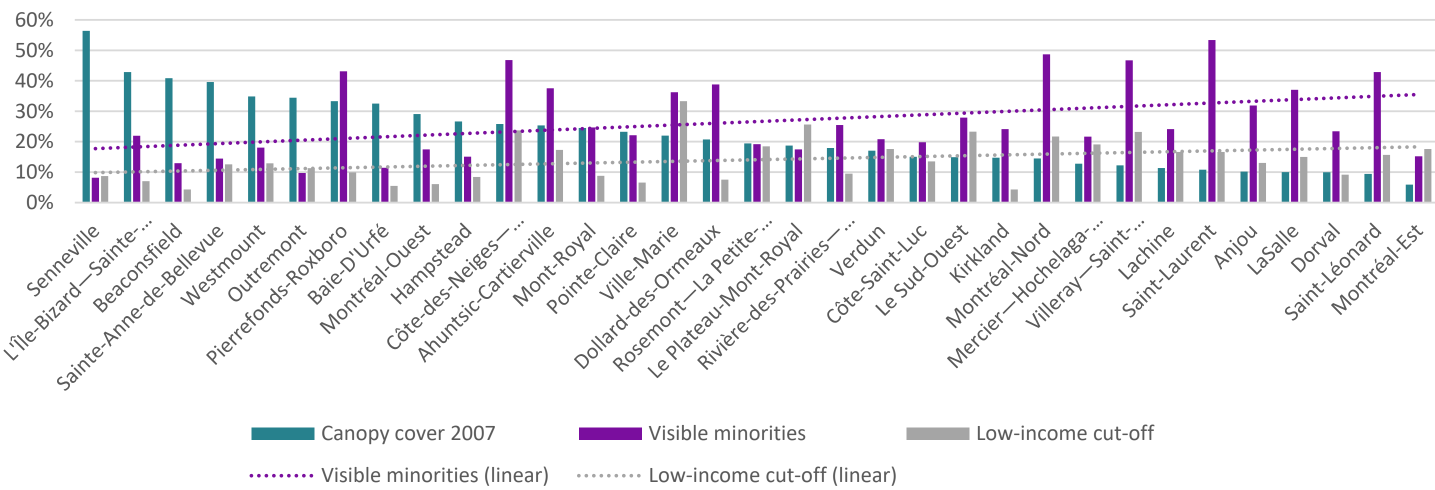
City	Population density (per Km2)	Canopy cover	Set goal
Vancouver	5,492.6	23%	30% by 2050
Toronto	4,334.4	28-31%	40% by 2050
Montreal island	4114,0	23%	25% by 2025
Winnipeg	1,518.8	20%	25% unspecified
Guelph	1,511.1	23%	40% by 2031
Oakville	1,395.6	28%	40% by 2057
Ottawa	334.8	25%	30%, unspecified

The City of Montreal committed to plant 500,000 trees by 2030. sources: Chan, 2020; City of Toronto, 2020; Statistics Canada, 2019; CMM, 2019; City of Ottawa, 2017

Obtaining benefits is about more than the quantity of trees, however. Quality also matters. The location of trees, the type of trees, planting conditions, and work done to maintain and protect the health of trees will determine the magnitude of benefits realized as benefits increase along with tree growth.

In terms of location, it is important to balance tree cover across communities within the city. In most cities, canopy cover is lower in areas with lower levels of education, income, and property value (Steenberg et al., 2018). In Montreal, tree cover is higher in historically wealthier areas. The south west and eastern parts of the city were traditionally home to industry and factory workers. Today, they have higher proportions of visible minorities (Figure 1). The 2018 heatwave showed that those communities are more vulnerable to illness and death. The people who died were generally low-income, elderly, and living alone (Lamothe, 2019). Increased tree cover in these areas would help cool the air and provide a refuge during heatwaves, generating the highest social return of all — potentially saving lives.

Figure 1: Montreal's visible minority and low income communities have less trees



Note: The figure above compares the percentage of canopy tree cover, visible minorities, and people who fall below the low-income cut-off for each Montreal neighbourhood. It shows a correlation between low levels of tree cover, visible minority population, and income. The City uses Statistics Canada's low-income cut-off which assumes that economic families spend more than 20 percentage points of their income on food, shelter, and clothing (City of Montreal, 2012; City of Montreal, 2016)

It may be more expensive and challenging to plant trees in areas that have a high concentration of industry and transport infrastructure, given that surfaces are often covered with pavement and asphalt. Greater investment is usually justified in these areas, however, with higher societal benefits.

The type and diversity of trees planted also matters. Native tree species appropriate to the local climate, light, soil, moisture conditions, and sufficient space availability for root and canopy growth will usually be more resilient (Tree Canada, 2020). Planting a diversity of trees also helps to avoid widespread devastation

from disease and insects. The Emerald Ash Borer, for example, has slowed Montreal's efforts to increase its tree canopy. The insect put 20 per cent of Montreal's urban forest at risk, potentially setting back tree cover by 2 to 3 points of percentage over 15 years (City of Montreal, 2015) (Figure 2).

In addition to the loss of valuable trees, fighting insects and disease is costly.. Efforts to limit damage from the Emerald ash borer cost the City $33.2M between 2013 and 2019 (Grignon-Francke, 2019; Bérubé, 2019; BVGMTL, 2016). An additional $1M was provided to support private ash tree owners. Forest fires, insect infestations, and poor planning practices are among the leading causes of urban tree loss in Canada. Losing trees is expensive and hinders the expansion of the canopy. Strong regulations, strategic planning, and a diverse urban forest can go a long way to keep trees standing.

Figure 2: Emerald ash borer sets back Montreal's canopy goals

Trees cut down between 1999 and 2020

Source: (Montreal, 2021)

Note: The increase in tree removals between 2011 and 2019 is largely due to the Emerald ash borer. The figure only includes the trees cut down in 13 boroughs of the city of Montreal.

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Credits: GRAME

To gain the full benefits of trees, cities need to provide sufficient funding for effective operations, maintenance, and protection. If a tree dies, the benefit of the initial investment is lost. In 2014, the city of Montreal estimated the cost of planting 75,000 trees on public land at $94M over 14 years (around $1200 per tree) (BVGMTL, 2016).

To reach private landowners, the City and SOVERDI, a local greening NGO, created the Alliance Forêt Urbaine, a coalition of NGOs dedicated to increase Montreal's canopy cover on private land. In addition to investments for public trees, the city of Montreal provided more than $4.2M to SOVERDI and the alliance through grant programs from 2015 to 2019 (SOVERDI, 2016; SOVERDI, 2017; SOVERDI, 2018; SOVERDI, 2019). This partnership allowed for more focused outreach, increasing community and corporate participation. Together, these NGOs planted close to 55 000 trees on Montreal's boroughs and cities' private owned land since 2015.

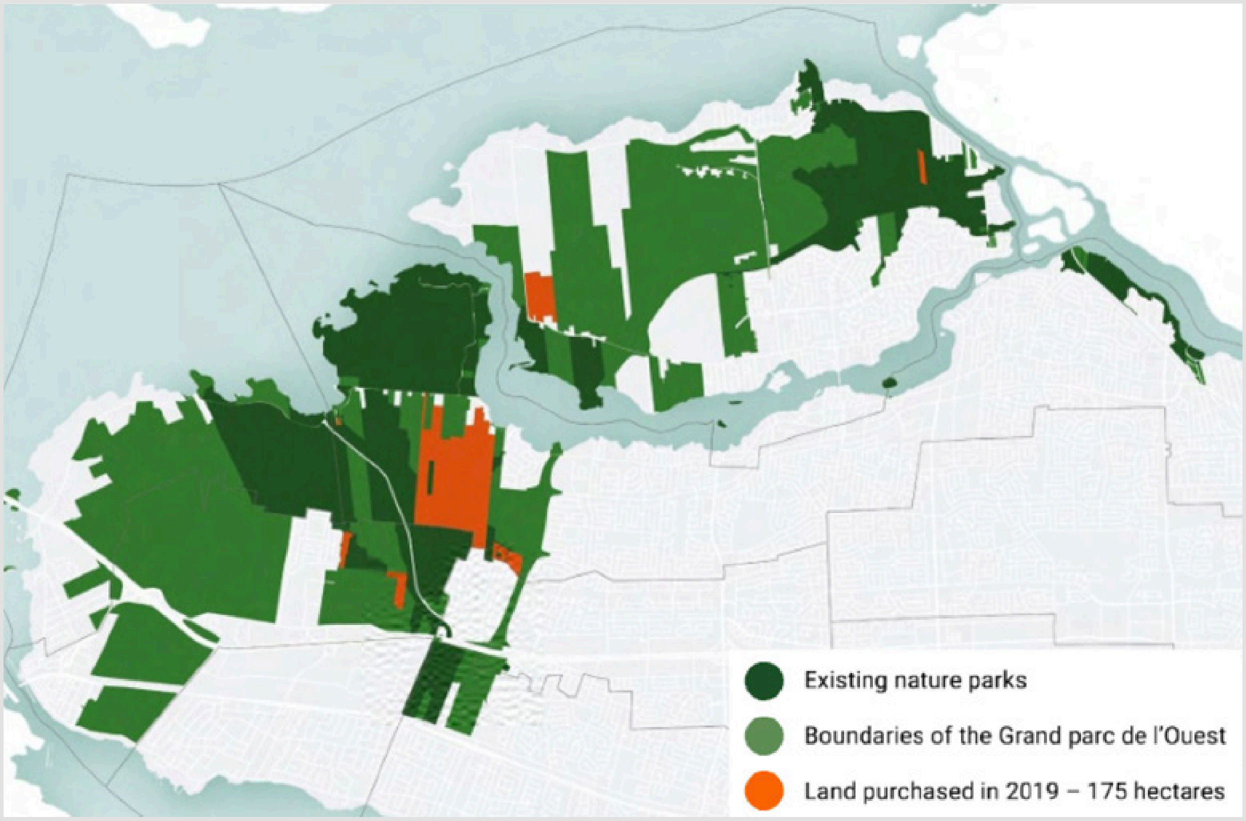
With the funds provided by the City, the NGOs were able to leverage more than $3.7M in private investments from project proponents through targeted planting campaigns for institutional, commercial, and industrial landowners as well as residents. Partnerships with important stakeholders like Tree Canada, CN, Port de Montréal, and Hydro-Québec also contributed to these investments (GRAME, 2017; GRAME, 2018; SOVERDI, 2018; SOVERDI, 2019). After the initial years of the action plan, the City lowered annual tree planting objectives in grant agreements with SOVERDI and increased per tree budgets to ensure the necessary care for each tree planted. SOVERDI and GRAME, a member of the alliance, were able to create similar financing agreements with other cities on the island, securing close to 350,000$ to leverage more private dollars (GRAME, 2019; SOVERDI, 2019).

Financing tree planting projects can be challenging due to restrictions on municipal accounting. Under the Generally Accepted Accounting Principles (GAAP), trees are considered operating expenses as opposed to capital investments. This prevents cities from financing (or amortising) the upfront cost of planting trees. The Permanent Commission on Water, Environment, Sustainable Development and Parks recommended that the urban forest instead be recognized as a green infrastructure capital investment, a recommendation that the executive committee implemented (City of Montreal, 2014). The City also faces uneven funding and capacity challenges within its boroughs. Some struggle with scarce human and financial resources to maintain the existing canopy.

Cost-effective planting strategies also require steady sources of new trees. Montreal has had its own tree nursery since 1948. It is the biggest in Canada, with around 80,000 trees at different stages of development. It provides Montreal boroughs with about a third of trees planted annually. It has around 140 different species and is seeking to increase diversity (City of Montreal, 2020). Nonetheless, the City has faced challenges in sourcing trees.

Grand parc de l'Ouest, Canada's largest municipal natural park

Montreal's Grand parc de l'Ouest, covering 3000 hectares, is projected to become Canada's largest municipal natural park. The area includes forest, agricultural and wetland, supporting biodiversity, protecting natural infrastructure that limits flooding, and providing a range of recreational opportunities. To establish the park, the city acquired land covering 175 hectares, with the help of $50M from the federal disaster mitigation and adaptation fund (DMAF) (Dupras, 2020; Infrastructure Canada, 2020; Réalisons Mtl, 2020).



Could carbon markets finance urban forests?

Offset markets – where businesses or individuals offset their greenhouse gas emissions by purchasing credits generated from emission removal or reduction efforts – offer a potential source of finance to expand urban tree cover. Urban trees could yield greater overall societal benefits than trees in outlying areas as they provide multiple benefits to larger populations.

There are two types of offset markets: compliance and voluntary. Compliance markets are linked to a greenhouse gas regulation or market mechanism. Purchasers in these markets are regulated companies. Voluntary markets are open to all purchasers, including businesses, governments, and individuals.

Canada currently has provincial compliance markets in Quebec/California and Alberta. The federal government is also working on a national offset framework to support the output-based carbon pricing system that applies to large emitters (ECCC, 2019; ECCC, 2020b).

California developed an urban forestry protocol for its offset system. It allows municipalities and private landowners to register their land to receive saleable credits for carbon sequestrated and stored by trees on their lots. However, no projects have been registered to date. The long-term commitments required for permanent sequestration, expensive tree management, and reporting costs have deterred interest.

This is not surprising at carbon prices in the range of 16$ to 17$ per tonne (McPherson, 2008; CARB, 2019). As carbon prices rise, there could be increased uptake.

An urban forestry protocol developed by a Seattle-based non-profit for the voluntary market has shown promising results. The City Forest Credit protocol reduced commitment periods and reporting requirements. It also recognized additional ecosystem benefits from urban forests such as air purification, water management, and energy savings.

Buyers were willing to pay a premium for credits that provide additional benefits such as increased resilience to a changing climate and biodiversity (Monahan et al., 2020). Cities, counties, and companies are recognising the value of urban forest credits and have developed or financed a multitude of projects since the inception of the protocols in 2015 where credits range from 29$/t to 40$/t CAD (City Forest Credits, 2020a).

Given increased action will be taken to meet Canada's 2030 GHG reduction target (such as the proposed increase in the carbon price to $170/tonne), interest in urban forest offsets could grow. Cities or other levels of government could consider incentives or regulations that balance the inherent non-permanence risks of CO_2 sequestration with other benefits. Regulatory certainty could increase confidence to supply chains and help nurseries plan several years ahead to meet any growth in demand for urban trees.

LEADING INTERNATIONAL URBAN TREE POLICIES

Population density and property prices do not have to be a barrier to expanding tree cover

Singapore has one of the highest population densities in the world, with an estimated 8000 people per square kilometre (OWD, 2020). It also has some of the highest property prices. It is therefore surprising that it ranks among the top cities worldwide for the proportion of public green space, with an estimate of 47 per cent (WCCF, 2020). Singapore set out to become a "garden city" in 1967. In 1975, it implemented a Parks and Trees Act that required government and private companies to reserve space for trees and vegetation in their new projects and buildings (Alonso, 2020). As its population grew from around 2 million to almost 6 million, finding space for trees became challenging. In 2008, the government made green buildings mandatory, requiring builders to replace any vegetation lost in construction with the equivalent area on and around the building. Vegetation now grows on the top, outside, and inside of buildings. Education and awareness have helped to facilitate the incorporation of significant green space. Each year there is a tree planting day, which aims to continue the expansion of tree cover across the city (Ang, 2020).

Tree planting can provide opportunities for marginalized youth

The small city of Des Moines, Iowa partnered with a local non-profit called Trees forever and Microsoft to plant 600 to 1,000 trees per year over the next 30 years financed by the City at 200 000$ per year. The project generates environmental benefits valued at $56,000 per year, but also creates social and economic benefits by employing and building skills in 20 to 40 youth each year, with a focus on youth from diverse backgrounds. The trees are planted along streets and in parks in historically underserved areas where tree canopy has been lacking (City Forest Credits, 2020b).

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WHAT IS HINDERING THE EXPANSION OF URBAN FORESTS?

Missing benefits: If only one or two of the societal benefits of trees are considered, governments may believe that projects are too costly. Tools such as i-Tree have made it easier to measure benefits comprehensively.

Cost and financing: Trees require an upfront cost, as well as ongoing maintenance. Trees are often not recognized as infrastructure in accounting systems, creating challenges in obtaining appropriate financing.

Lack of space: In many cities, it is challenging to find easy and low-cost places to plant trees. Costs can be higher for projects that require removing pavement or purchasing land.

Growing recognition of the need to include Indigenous Peoples in urban planning

Urban development occurs on land connected to Indigenous peoples through treaties, self-government agreements, and/or inherent rights. Municipal planners are increasingly adopting more collaborative approaches with local Indigenous communities and organizations, but additional work and capacity building is needed to develop truly inclusive processes (CIP, 2019).

Human Resources capacity: Smaller municipalities often struggle with a lack of capacity and knowledge when looking to increase their urban tree stock and practice sustainable maintenance. This can increase the vulnerability of urban forests and long-term resilience. For example, road salt can negatively affect street trees. Choosing the right tree type, selecting the right location, minimizing salt use, and cleaning salt away in the spring can help reduce damage (TAC, 2013).

A lack of incentives for private investment: Some of the most cost-effective opportunities for tree planting could be on private land, and there is likely to be growing interest from private investors in offset projects as carbon prices rise and more companies commit to net-zero emission goals. Without proper incentives and frameworks in place, opportunities could be missed.

Quality supply of trees: With the number of trees of various species required to increase biodiversity, limit climate change impacts, and ensure neighborhood resilience, municipalities often run into limited tree stocks and varieties when placing orders with nurseries.

Data collection: The first step to begin sound natural asset management is to know what you are working with and set a benchmark. Unfortunately, many municipalities do not have a clear view of the extent of their canopy and the trees that are within it. Aerial and satellite photography cannot provide the same detail as ground level measurements. Understanding the type of tree, size, height, and location can allow for more precise and detailed evaluations of tree biomass and ecosystem services like carbon storage, water retention, and air pollution abatement.

WHAT CAN GOVERNMENTS DO?

Design investment programs and offset frameworks to capture more benefits – Governments at all levels are moving forward with investments in tree planting and GHG offset frameworks. These initiatives should include urban trees and consider a range of environmental and social benefits that balance the risks associated with non-permanent CO_2 sequestration. If programs are narrowly targeted, focusing only on the least cost options to attain CO_2 sequestration, there could be significant missed opportunities.

For example, new funds such as the federal Growing Canada's Forests program could facilitate demineralization (removing pavement) of urban surfaces such as parking lots. Such an approach would reduce the number of cars entering a city – by reducing parking spaces – while also providing additional space for tree planting. Such funds should also include strong biodiversity and tree monitoring requirements.

Finance capital and operating costs – Municipalities require sufficient resources to keep trees alive in the face of disease and a changing climate. Smaller municipalities may require proportionally more resources to build capacity. Costs should consider the full lifecycle of trees and need to be factored in from the outset. These should include the cost of demineralization of surfaces as space will becomes increasingly scarce.

Require developers and property owners to invest in trees – Commercial and residential developers are often required to put in place a minimum number of parking spaces. Urban planning regulations could require a minimum amount of trees per meter of street frontage and green space coverage as a percentage of the total property area. Property owners such as governments, schoolboards, and real estate investment trusts also often rely on contractors for property maintenance. Procurement contracts should require sustainable maintenance practices and hold service providers accountable for tree health.

The role of local NGOs in engaging and supporting private land owners in greening their property is crucial to increase urban forests. Governments can financially support NGOs to increase their capacity to leverage private investment.

Implement stringent regulations to protect existing trees and provide incentives for private landowners to plant and care for new trees – Trees on private property in urban areas can provide private benefits, such as increases in property values, as well as public benefits like clean air. Valuable mature trees should be protected through stringent tree cutting regulations. Governments can also provide property owners with information and incentives to plant and care for native tree species.

Support strong supply chains: Nurseries will be facing unprecedented demand for trees, and governments could face challenges in finding the trees they need to meet their targets. Seedlings can take 1-4 years before they are ready for planting (FPAC, 2020). Governments can play a role in ensuring that supply is in place to meet demand, helping existing and prospective nurseries overcome barriers to growth.

Invest in research and data collection: With more information, data, and analytical tools, local governments and other organizations can improve their plans to expand tree canopies. In particular, understanding how societal and biodiversity benefits differ by tree type and location could inform more effective strategies. It will be important to harmonize data collection methodologies amongst boroughs and municipalities to facilitate analysis and ensure efficiency.

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