URBAN TREE PLANTING REPORT

Trees planted in urban areas can provide many benefits[1] that generally improve the lives of city dwellers. We focus here on direct and indirect climate moderation. Urban tree planting will not significantly affect the overall global CO2 sequestration effort, as compared to what can be achieved by careful management of Canada's forests and harvested wood products.[2]

Canada's Two Billion Tree project (2BT) aims to plant 2 billion trees over ten years added to approximately 600 million planted annually in commercial forestry. Here we advocate that a proportion of the 2BT budget be targeted at urban tree planting. Planting within cities and towns would include trees on private residential and commercial or industrial properties, in public parks, along roadways and in designated or reclaimed blocks where buildings have been demolished. These "urban forests" should be considered part of planned housing developments.[3]

TEMPERATURE REGULATION AND URBAN HEAT ISLANDS

Inner city areas typically contain a high proportion of impermeable surfaces such as concrete and asphalt, which are often dark in colour. Hence, they absorb a large proportion of incoming solar radiation, thereby raising local temperatures. Such areas form *heat islands*, which are warmer than surrounding suburban areas where the proportion of dark impermeable surfaces is generally smaller. Tree planting in urban areas contributes to increased release of absorbed solar radiation as latent heat (i.e., evaporation of water vapour from leaves and moist soil surfaces). This reduces the heat island effect.

Large trees also shade the ground from solar radiation, which makes the outdoor environment more comfortable for humans on hot sunny days. Increased evaporation and shading can both contribute to reduced electricity demand for air conditioning and refrigeration.[4] By lowering ambient temperatures in summer, tree cover can mitigate the impact of heatwaves and reduce human mortality from heat stress-related illness. In winter, properly placed trees may help to reduce heat loss from poorly insulated buildings exposed to strong winds. In a study by New

[1] Some of the other benefits include: Air quality improvement (mitigation of air pollution and reduction of respiratory diseases); mental health improvements (through access to natural spaces); encouragement of physical activity and outdoor recreation (walking, jogging and cycling). There are many benefits of tree planting, including their aesthetic contributions, air "cleaning" (pollution filtering), fruit and nuts production, which are not denied, but here we focus on those attributes that make cities more "liveable" to encourage healthy living that reduces fossil-fueled automobile and electricity use.

[2] Crowther, Bastien and others have published studies on planting 1 trillion trees. The authors of the original Trillion tree proposal however withdrew the original claim that "tree restoration is the most effective solution to climate change to date." (Bastien, 2020, online.) Others have argued that a naturalized process of tree regeneration may be more effective. This is an ongoing debate and will not be engaged here.

[3] Drever et al. in their paper "Natural Climate Solutions" they list expanding the urban canopy cover as a modest option for addressing CO2 emissions mitigation, particularly when compared to the far greater impact of preserving bogs and avoiding conversion of grasslands. https://www.science.org/doi/10.1126/sciadv.abd6034

[4] See for example: Akbari and Taha, The Impact of Trees and White Surfaces on Residential Heating and Cooling Energy Use in Four Canadian Cities, Energy Vol. 17. No 2. Pp. 141-149. 1992.

York City-based Natural Areas Conservancy,[5] small urban forests were found to produce greater cooling benefits than landscaped parks and street trees, depending on the region and tree type.

The cooling effect is experienced greatest within the woods themselves, and proximate to individual tree stands and not equally throughout the urban area. As Stewart and Mills point out[6], trees will "shade and cool the ground in their vicinity". Generally, an urban park's value is in producing microclimates where people can stroll and (for instance) be cooled during heat spells. Where entire city blocks are transformed into woods, they may provide greater heat mitigation effects.

An effective urban tree planting effort will require an Urban Heat Island Study to assess the many aspects of heat mitigation and required adaptation measures. This would involve a comprehensive evaluation of ideal building height, (botanical) roof greening, and "include planting of individual trees; replacement of hard or dark surfaces with pervious or light-coloured materials; and integration of passive heating and cooling systems into building designs"[7] within which a tree planting strategy would play a part.

The net impacts of HVAC and wall or roof insulation initiatives (and incentives) for new and aging buildings is likely to be far greater than that derived from trees planted around those buildings. However, Hashem Akbari, of Concordia University, estimates replacing ten square metres of dark roofing with white roofing alone can offset one tonne of CO2 emissions per year. And by "decreasing [heat] absorption of roofs by 25 per cent and pavement by 15 per cent", a city's temperature can be cut by 2 to 3 degrees Celsius.[8]

However, strategic[9] planting of trees – for shading and sheltering -- to cool low-rise buildings (and single-family housing) in summer or to reduce heat loss in winter, will still enhance other building energy-efficiency improvements.

TRADE-OFFS

The cost of tree planting within cities will be far higher per tree than for mass planting as part of the (timber) harvest cycle. Trees will have longer lifespans if planted where they can be watered regularly and protected from damage. (Survival rates for trees planted in forested regions are typically around 80%.)[10]

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[5] https://naturalareasnyc.org/media/pages/in-print/951f086032-1690225094/nac-cooling-cities.pdf "Natural Areas Conservancy (NAC) is a non-profit organization that works in partnership with the New York City Department of Parks and Recreation (NYC Parks), improving New York City's 10,000 acres of forest, marshes and wetlands".

[6] Stewart, I.D., and G. Mills. 2021. *The Urban Heat Island -- A Guidebook*. Elsevier, Amsterdam, NL.

[7] Stewart and Mills, page 92

[8] By comparison it is estimated that up to 100 trees might be needed to capture 1 tonne CO_2 on average per year, depending on tree species, location, and weather conditions. https://www.concordia.ca/cunews/main/stories/2015/02/25/a-groundbreaking-way-to-cool-down-cities.html
https://8billiontrees.com/carbon-offsets-credits/how-many-trees-to-offset-1-ton-of-co2/
https://www.climateneutralgroup.com/en/news/what-exactly-is-1-tonne-of-co2-v2
https://onetreeplanted.org/blogs/stories/how-much-co2-does-tree-absorb

[9] Trees need to be planted in locations that would reliably block prevailing winds in winter. This is not necessarily the same location that would maximally contribute shade-cooling from the summer sun.

[10] https://treecanada.ca/wp-content/uploads/2021/05/2017-PlantingSiteInfo-En.pdf

A major problem is that roots of large trees planted too close to buildings can damage foundations and sewer lines that are not adequately protected. Aging trees will need to be removed before they die and decay. Additionally, the dangers from trees falling during storms and other extreme events must be factored into an urban tree planting program.

PLANTING OPTIONS

There are a variety of tree planting strategies for urban areas. The Mayawaki forest is a planting system developed by a Japanese botanist, using indigenous trees grown in combination with native plants, and can be used to establish small city plots. Trees are grown close together in layers, three to five woody stems per square meter, and taking account of their final canopy height so that competition for light is minimized.

Cities such as Stockholm, Sweden,[11] have developed an urban tree planting method based on use of layers of large stones, crushed rock, and structural soil to create planting beds with high porosity, to allow for unimpeded gas exchange and water infiltration. Water is collected from roofs, sidewalks, and streets, which has the additional benefit of counteracting flooding. Biochar has been used to enhance soil quality to particularly good effect.

TREE SELECTION

It is essential to choose tree species/varieties appropriate for the urban environment to minimize long-term maintenance and replacement costs. Drought-resistant, long-lived, and adaptable species are most suitable for urban planting, but exact choices will be influenced by the local climate, soils and water availability.

RECOMMENDATIONS

Environment and Climate Change Canada, in partnership with all interested municipalities and provincial funding bodies, should continue to support the 2 Billion (additional) Trees Project. Funding should support Urban Heat Island studies, instructional programs, and distribution of millions of trees towards programs for urban forestry. Funding should also support increased private sector production of seedlings and saplings (including establishment of nurseries and greenhouses where needed). Encouraging volunteer citizen involvement wherever feasible will bring cost benefits in the long term, as well as sustainable political and participatory buy-in at the community level, all of which may spur policy development and implementation.

[11] https://www.tdag.org.uk/uploads/4/2/8/0/4280686/22.06.15_the_stockholm_system_bjorn_embren.pdf