Jessica Winton 300502232

How Montreal Boroughs Can Implement an Semi-Intensive Green Roof Bylaw to Combat Climate Change

The Issue

Climate change is threatening the social wellbeing of neighbourhoods through an increase in temperature. Many cities are already built up, with little vacant land remaining for development to implement initiatives that would combat climate change. Issues such as Urban Heat Island, which is when dark and hard surfaces like asphalt and concrete absorb more heat, continue to grow with the acceleration of climate change. Cities need to look at their building and land use practices for opportunities to fight climate change, which is where green roofs can play a massive role.

Montreal is a city with medium density in many areas, as the ‘plex’ style building dominates over half of the city’s housing stock (CMHC, 2002). This type of building typically has a flat roof and is no more than 4 stories, providing an ideal adaptation for green roofs. More than half of these buildings were built before 1970 (CMHC, 2002) meaning they are energy inefficient compared to modern standards while also contributing to urban heat island effect despite the mandate* for white roofs (City of Montreal, 2019). Neighbourhoods such as Villeray-Saint-Michele-Parc-ex [VSP] suffer from temperature increases that come along with climate change compared to wealthier neighbourhoods like Westmount that have a denser tree canopy (Li et al., 2025).

Other metrics such as urban biodiversity loss and stormwater management can easily be targeted with semi-intensive green roofs. Cities in Canada like Montreal have limited tax options to finance greening projects themselves however they are in control of their bylaws that dictate building codes. The current cost of construction does not account for their negative environmental traits. The long-term benefits of green roofs offset their higher initial cost compared to asphalt roofs and address multiple aspects of climate change beyond the current single-issue solution of white roofs and urban heat island.

*The mandate for adding white roofs is only applied when performing major roof renovations and limited to certain boroughs of Montreal (City of Montreal, 2019)

Objective

The benefits of greater building energy efficiency, improving urban biodiversity and broader neighbourhood cooling are all achievable in modifying the abundance of flat roofs in Montreal with semi-intensive green roofs through a bylaw change. A white roof mandate has been implemented for major renovations or construction in several boroughs, however the lack of its application

As climate change accelerates, cities will be adversely impacted through urban heat island effect. Many urban planning efforts are focused on the streets of cities rather than looking to better utilize what is easily available to us: changing how Montreal plans roofs. A simple policy change for mandating semi-intensive green roofs may be enough to significantly improve the climate resilience of Montreal.

Green roofs

Green roofs are nature based solutions that aim to increase building energy efficiency, reduce building construction and operating costs, reduce urban heat island effect through their added insulation, act as stormwater management systems, and improve local biodiversity through their role as green spaces (City of Westmount, 2016), if done at scale, they can also improve the air quality of a city by absorbing emissions. Green roofs use grasses, moss, and plants of varying sizes to achieve these effects (Green Roof Technology, 2026a). Certain types of green roofs can be retrofitted to existing buildings and should be considered in the design process of construction when bylaws permit them. Cities are able to change their local building regulations to permit or even require green roofs, typically as an aspect of their climate change mitigation plans.

Green roofs are best suited for flat roofs and there are several types of green roofs that can be employed. However, with the characteristics of Montreal in mind, the minimum requirement should not exceed a semi-intensive green roof. Semi-Intensive green roofs provide the strongest cost to benefit ratio (Green Roof Technology, 2026b), with protection against stormwater, greater impacts on improving local biodiversity, and provide greater energy savings through more substantial cooling (Green Roof Technology, 2026b). The energy savings and other additional benefits from green roofs offset their higher installation cost compared to white roofs while addressing more than just urban heat island effect.

Alternatives

To combat urban heat island effect, white roofs have been mandated in some boroughs (City of Montreal, 2019) with marginal success for new buildings or during major renovations as a way to intervene without a large financial burden for the owner. Despite this, many boroughs do not enforce a similar bylaw and suffer the climate consequences as a result. Using white roofs as the new minimum standard to apply retroactively, eliminating the option of asphalt or concrete roofs, we are left with the existing scale of green roofs. White roofs apply a white surface to roofs to improve the reflectivity of the building and absorb less heat than asphalt or concrete roofs. Given the winters of Montreal, white roofs occur on nearly all roofs when snow is present, however white roofs do little to address anything aside from minor gains of urban heat island.

Green Roofs include:

1. **Extensive green roofs**
    a. Extensive green roofs are the lowest tier of green roof types. They consist of shallow grasses, mosses, and herbs including flowers. These types of green roofs alleviate urban heat island effect with the potential to support solar roofs but they do not target biodiversity or storm water management. Given Montreal's intense winters and increasingly frequent storm events, they may not be as sufficient in shielding the integrity of buildings. Extensive green roofs have been used in many cultures across the globe for centuries, as they are a robust and low maintenance solution for insulation.
2. **Semi-Intensive Green roofs**
    a. Semi-Intensive green roofs are the 2nd tier of green roofs. They consist of grasses, perennials and shrubs. They are able to support small ecosystems for local biodiversity, provide strong stormwater management capability and alleviate urban heat island effect to a greater degree. They are the most cost effective type of green roof, as the increase of added weight and additional depth required is minor compared to the baseline extensive green roofs. The increased scale of semi-intensive green roofs also provide greater impacts on building efficiency which can offset their slightly higher maintenance cost.
3. **Intensive Green roofs**
    a. Intensive green roofs are the highest tier of green roofs. They can support trees or urban gardens, providing substantial benefits for reducing urban heat islands, improving biodiversity and stormwater management. They are often more expensive than the other options and are typically reserved for large buildings as Intensive Green roofs can act as large gardens or even parks which come with higher costs to implement and maintain. Difficult to replicate at scale, Intensive Green roofs are too complex for a large-scale bylaw change.

4. **Blue-Green roofs**
    a. Blue-Green Roofs are a type of Intensive Green Roof that focus on stormwater management and water collection. They are often much more expensive and

deployed in water scarce regions or buildings aiming for maximum sustainability rating standards. They are not relevant for Montreal's climate.

5. **Solar Roofs**
    a. Solar roofs consist of roofs with solar panels atop them. They are often employed in combination with large extensive green roofs. These would not be as economically viable in an urban setting, given the presence of abundant Hydro-electricity in Quebec and do not affect urban heat islands.

Evidence

Toronto is a city with the most similar climate to Montreal and a similar political structure. The City of Toronto had mandated 'extensive green roofs' for buildings with spaces larger than 200 square metres (Shafique et Al., 2018) with resounding success. A study by (Berardi, 2016) found that a green roof reduced the energy consumption of the main university campus building by 3% through less demand for heating. This finding proves that green roofs have benefits even during the winter months.

A study using a life cycle assessment comparing all forms of green roof types to conventional roofs in Quebec found that semi-intensive green roofs have a positive environmental impact in 14 years without accounting for other benefits aside from the carbon emissions of installation (Pique et Al., 2023). Even when factoring in the pollution of plastic based productions used for green roofs, the benefits are offset within 13-32 years depending on the type of green roof (Bianchini & Hewage, 2012).

A highly cited review of green roofs found that green roofs have significant environmental benefits. There have been some challenges with previous building techniques of green roofs such as leaks "However, initial high construction costs, high maintenance costs and roof leakage problems are the main challenges associated with the application of green roofs. These challenges can be overcome with the design of new cost effective green roof design that can work more effectively and efficiently in any area" (pg 1, Shafique et Al., 2018). However more recent estimates put the full installation costs of a green roof between $10-$24 USD/sq foot (Lambert, 2025) which rivals conventional roofs (Carlson, 2025)

Despite Quebec having 99% renewable energy (CER, 2026), demand is growing year over year (Hydro Quebec, 2020) meaning we need to improve our efficiency. We can reduce the energy demand from buildings using semi-intensive green roofs to act as insulation while reducing urban heat island effect (Berardi, 2016).

There is also a major social environmental cost as a result of not having enough green spaces in cities. In 2021 British Columbia experienced a heat dome, where hot air was trapped in the region causing it to only get hotter and hotter where as a result, 619 people died(Science Canada, 2022). Science Canada found that an increase of 5% in tree coverage lowers the risk of heat related death by 10% (Science Canada, 2022). When factoring in the environmental cost

of asphalt roofs over their life cycle (Bianchini & Hewage, 2012), green roofs only prove more valuable.

Montreal's density is achieved with denser mid-rise buildings (CMHC, 2002). Heritage building laws typically protect the aspects of buildings that are visible from street level (City of Westmount, 2016), this does not typically include flat roofs; meaning semi-intensive green roofs may be exempt from heritage building laws provided they follow building regulations.

Recommendation and Implementation

With the evidence in mind, it is our recommendation that by 2032 all tiers pass a bylaw to mandate white roofs on all flat roof buildings retroactively. By 2032 mandate semi-intensive green roofs with new construction, by 2036 for major renovations, and 2040 for minor renovations. The policy should be reanalyzed every 3 years to evaluate progress or implement changes to make it more effective.

The increased cost of initial construction can be offset with the municipal disbursement of federal funding pools such as the Green Municipal Fund (FCM, 2026) or provincial funding pools such as Quebec's Fonds d'électrification et de changements climatiques (Gouvernement du Québec, 2026) that can grant funding to Montreal for this purpose. Municipalities in Montreal such as Westmount already have local funding pools available to citizens for green initiatives (City of Westmount, 2026) and thus can be implemented without overbearing administrative burden beyond a new step of the building approval process. A large-scale program can be improved by building off of Toronto's EcoRoof Incentive Program (City of Toronto, 2026) for the policy framework, adapted to Montreal's urban characteristics.

The bylaw can also be updated over time to improve the goals or requirements of green roofs to be more effective as the information of the program is collected. Once sufficient industry expertise and capacity is created locally during the implementation phase of new construction, industry presence should be able to handle the green roof demand of major and subsequently minor renovations. An extensive network of green roofs the industry expertise will also bring down costs of construction and maintenance beyond what current practices exist, when factoring in the social environmental cost, which further solidifies this policy's long term climate benefits for Montreal.

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