SOCIAL CONNECTEDNESS
FELLOWSHIP PROGRAM

The Urban Heat Island Effect in Montréal

Effective Policy through an Interdisciplinary Perspective

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EXECUTIVE SUMMARY

The urban heat island effect is a phenomenon where some urban areas are significantly higher in temperature than surrounding rural areas. It is caused by urbanization, which leads to lower albedo (i.e. reflectivity) of surfaces, higher thermal mass of city structures (i.e. stores more heat), heat trapped by airflow changes, air pollution, urban canyons, human-generated waste heat, and a decrease in green spaces.

This effect reduces air and water quality, and places financial stress on individuals and businesses. During heat waves, there is a rise in heat-related illnesses which could lead to premature death. In addition, extreme heat damages public infrastructure and the natural environment. Extreme heat amplifies the negative effects already in play at normal temperatures, even more so for those living in urban heat islands.

Not all people are equally vulnerable to the impacts of extreme heat and the urban heat island effect. The lower income population, the older population, children, immigrants, refugees, asylum seekers, those suffering from chronic illnesses, those suffering from homelessness and those who are socially isolated are the most susceptible to negative impacts. In Montréal, the east end of the island, which is lower income and less green than the west end, suffers more from the urban heat island effect.

At a policy level, Montréal has an action plan called Sustainable Montréal 2016-2020, additional climate adaptation measures at the municipal and borough levels of government, ambitious greening initiatives, and plans to enhance public transport.

These policies, however, are siloed into one department or discipline. They should take into account the importance of social connectedness and community resilience more, and the lack of significant community participation in policy development. The greening efforts do not take social equity into account, and there are not enough urban planning measures that sufficiently mitigate climate change and the urban heat island effect.

It is recommended that borough and municipal governments incentivize consultation attendance and hold councilor office hours to increase community participation and engage new demographics. The borough and municipal governments should also work together with community organizations to retrofit existing community centres in a way that increases community resilience. When it comes to greening efforts, green spaces should be created in lower income neighbourhoods with measures against gentrification. Linear parks should also be created to combat green inequity. New construction should incorporate climate sensitive design and materials, passive cooling, and measures for white roofs and roads to increase albedo. The city should also incentivize the use of public and active transport by making them safer to use. Policies should be more accessible and more transparent to increase effectiveness by garnering community buy-in. Additionally, policies should be created in an interdisciplinary manner through increased communication between disciplines and between stakeholders.

INTRODUCTION

The worsening state of our environment is looming large in our collective consciousness. We have scientific experts giving us an ever-narrowing window of time to reverse the warming of the earth. Although the more extreme effects of the climate crisis may seem to be decades away, the hard truth is that we are seeing the devastating consequences now, especially in cities. More than half of the world's population is now living in urban areas, placing an enormous amount of pressure on how we should design and run our cities in order to deal with mounting environmental problems.[1]

The urban heat island effect is already wreaking havoc on city residents. It is a phenomenon where some urban areas are significantly higher in temperature than surrounding rural areas.[2] This phenomenon has many negative consequences, which not all residents of cities experience equally. This report aims to target the exact factors that contribute to urban heat islands, address what makes specific populations vulnerable, and recommend ways to improve on the policies that Montréal already has in place to tackle these factors.

Not all people are equally vulnerable to the impacts of the urban heat island effect. One major factor that makes one more vulnerable is social isolation. Social isolation occurs when an individual lacks meaningful connections to other individuals, to place, purpose, and power.[3]

> If you look at something like social identity, it turns out that people can feel like they belong to their local community, they can also feel like they belong to their city of province or country.

1 Hsu, A., N. Alexandre, J. Brandt, T. Chakraborty, S. Comess, A. Feierman, T. Huang, S. Janaskie, D. Manya, M. Moroney, N. Moyo, R. Rauber, G. Sherriff, R. Thomas, J. Tong, Y. Xie, A. Weinfurter, Z. Yeo (in alpha order). The Urban Environment and Social Inclusion Index. New Haven, CT: Yale University. Available: datadrivenyale.edu/urban.

2 U.S. Environmental Protection Agency. 2008. Reducing urban heat islands: Compendium of strategies. Draft. https://www.epa.gov/heat-islands/heat-island-compendium.

3 n.d. "About Us." Social Connectedness. Accessed August 17, 2019. https://www.socialconnectedness.org/about-us/.

> Now, those are very different things. And you might think that we have some kind of a limited amount of loneliness that we can feel, it turns out not… So the people who are happiest are the ones who feel they belong to every single layer and… [belong] to other groups… in parallel.. and it seems like those bonds just add up in their benefit to us.
>
> -- Dr. Christopher Barrington-Leigh (McGill University; Institute for Health and Social Policy; School of Environment, Department of Economics)[4]

Tackling a problem like the urban heat island effect requires action by stakeholders in diverse sectors because the factors that contribute to it are rooted in the fabric of our cities and societies. These stakeholders include the government (municipal, provincial and federal), health organizations, urban planners, researchers, community organizations, corporations, and individual residents.

In order to look at the issue from all sides, evidence was drawn from academic papers, current policies, interviews with stakeholders, census data analysis, and roundtable discussions with local community members.

URBAN HEAT ISLANDS

What exactly is the urban heat island effect?

The urban heat island effect is a result of urbanization.[5] Replacing rural, vegetated areas with built-up structures creates areas in a city that are significantly hotter than surrounding areas.[6] The physical properties of the buildings and streets, such as the low reflectivity (i.e. low albedo) of surfaces and a higher capacity to store heat (i.e. higher thermal capacity), contribute

4 Interview with Dr. Christopher Barrington-Leigh (McGill University; Institute for Health and Social Policy; School of Environment, Department of Economics). June 21st, 2019.

5 Hsu et al.

6 Ibid.

to the higher absorption and slower release of heat compared to surrounding areas.[7] Urban smog and changes in airflow due to the complexity of urban structures further traps heat from the sun and from anthropogenic activities.[8]

In short, the major urbanization factors that contribute to the urban heat island effect are the low albedo and higher thermal mass of city structures, airflow changes and heat trapped by air pollution and urban geometry, waste heat generated by human activity, and the decrease in vegetated areas which reduces evaporative cooling.[9] These factors can interact and compound each other and also vary by city.

Consequences of the urban heat island effect

The urban heat island effect has several ramifications. During extreme heat events, there is a proliferation of cyanobacteria blooms in water sources and an increase in the number and severity of smog episodes.[10] This leads to reduced air and water quality, causing negative health impacts.[11] Residents that live in areas with a stronger urban heat island effect are more vulnerable to these impacts during heat waves. In addition, the air pollution that contributes to areas with a stronger urban heat island effect traps heat, creating a vicious cycle of worsening pollution and heat.[12] The higher level of heat also creates an increased power demand for

7 Gutiérrez, Estatio, Jorge E. González, Alberto Martilli, Robert Bornstein, and Mark Arend. "Simulations of a heat-wave event in New York City using a multilayer urban parameterization." Journal of Applied Meteorology and Climatology 54, no. 2 (2015): 283-301.

8 Ibid.

9 Ibid.

10 Service de l'environnement. 2017. CLIMATE CHANGE ADAPTATION PLAN FOR THE Montréal URBAN AGGLOMERATION 2015-2020. Supervised by Roger Lachance.

11 Ibid.

12 U.S. Environmental Protection Agency.

cooling and generates heat stress, which leads to work absenteeism and productivity loss.[13] These consequences place financial stress on those living in urban heat islands.[14]

The detrimental consequences of the urban heat island effect are the most apparent during heatwaves. Residents in urban heat islands are disproportionately affected by the harmful consequences of heat waves, as extreme heat compounds the existing elevated temperature.[15] Therefore, these residents are more prone to suffer from heat-related illnesses and complications which could lead to premature death.[16] More than 400 deaths were attributed to heatwaves over the last 30 years in Montréal.[17] Heatwaves also cause damage to public infrastructure and to the natural environment, which would be more severe in areas affected by the urban heat island effect.[18]

Cities across the globe, including Montréal, have been and will be experiencing more frequent and severe heat waves as the number of days of extreme heat increases.[19] This means that the urban heat island effect and its harmful results will be amplified over time.

13 Hsu et al.

14 Service de l'environnment.

15 Centre intégré universitaire de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal. 2019. CHALEUR ACCABLANTE ET EXTRÊME 2019: Plan Régional De Prévention Et De Protection Et Guide à L'intention Des Établissements De Santé. Gouvernement du Québec. https://ciusss-centresudmtl.gouv.qc.ca/sites/ciussscsmtl/files/media/document/2019_PlanChaleurAccablanteExtreme.pdf.

16 Service de l'environnement.

17 Chan, Chee F, Julia Lebedeva, Otero José, and Gregory Richardson. 2007. "URBAN HEAT ISLANDS: A CLIMATE CHANGE ADAPTATION STRATEGY FOR Montréal." McGill School of Urban Planning. McGill University. https://www.mcgill.ca/urbanplanning/files/urbanplanning/CCAPUHIFinalReport-2007.pdf.

18 Service de l'environnment

19 Intergovernmental Panel on Climate Change. Global Warming of 1.5 ºC. October 2018. Accessed June 12, 2019. https://www.ipcc.ch/sr15/.

Vulnerable Populations

In Montréal, the western end of the island is less prone to the urban heat island effect because it has a lower population density and high tree cover.[20] In contrast, the central portion of the island, which has a high population density, and the eastern portion of the island, which has much less tree cover, are especially vulnerable to the urban heat island effect.[21] Furthermore, in Montréal the burden of the urban heat island effect falls inequitably on the lower income population.[22] Three of the city's neighbourhoods who score the lowest on urban heat island effect performance on the Urban Environment and Social Inclusion Index are Rosemont-La-Petite-Patrie, Le-Plateau-Mont-Royal, and Saint-Leonard, all of which are central or eastern Montréal and relatively lower income.[23] The Urban Environment and Social Inclusion Index, developed by Data-Driven Envirolab, measures urban heat island effect performance using the 15-year (2003-2017) mean difference in daytime and nighttime surface temperatures between urban land cover and non-urban land cover within the city in degrees Celsius (°C).[24] Additionally, there is a modest positive correlation between the proportion of immigrants in a borough's population and the magnitude of the urban heat island effect, suggesting that immigrants are also disproportionately affected.[25]

According to the Montréal Heat Response Plan 2019, some of the people who are most at risk during heat waves are older people, those with chronic illnesses, those living in urban

20 Chan et al.
21 Ibid.
22 Hsu et al.
23 Ibid.
24 Ibid.
25 See The Urban Heat Island Effect in Montréal on https://datadrivenlab.org/urban/.

heat islands, and those who are socially isolated.[26] As expected, risk is amplified for people who belong to more than one of these populations simultaneously.[27] Residents who live alone are especially vulnerable since they may not have anyone to rely on for immediate help when symptoms of heat-related illnesses surface.

POLICIES IN MONTRÉAL

Policy Overview

Montréal has an extensive set of policies aimed to adapt the city to the current effects of the urban heat island effect and heat waves, and to mitigate climate change in the long term. The following section lays out select policies at the municipal and borough level of government in order to pinpoint specific areas that need improvement.

At the municipal level, Montréal has a sustainable development plan called Sustainable Montréal 2016-2020 that is targeted towards partner organizations and the municipal administration.[28] It aims to mitigate urban heat and climate change by reducing greenhouse gas emissions and dependence on fossil fuels, adding vegetation and increasing biodiversity, and ensuring access to sustainable neighbourhoods.[29]

In terms of climate adaptation, Montréal has the Montréal Heat Response Plan 2019 (MHRP), a regional prevention and protection plan to be implemented by the health and social services network of Montréal in the event of extreme heat.[30] The five main objectives of this

26 Centre intégré universitaire de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal.

27 Ibid.

28 Bureau du développement durable, Natacha Beauchesne, Monique Côté, Isabelle Gauthier, Catherine Philibert, Melina Planchenault. 2016. Sustainable Montréal 2016-2020. Sustainable Montréal 2016-2020. http://ville.Montréal.qc.ca/pls/portal/docs/page/d_durable_en/media/documents/plan_de_dd_en_lr.pdf.

29 Ibid.

30 Centre intégré universitaire de santé et de services sociaux du Centre-Sud-de-l'Île-de-Montréal.

plan are to restrict public health impacts, mitigate morbidity and mortality, ensure accessibility to services, prevent and minimize psychosocial impacts, and prevent/limit social disruption.[31]

In addition to these policies, Mayor Valérie Plante has plans in the works for Canada's largest urban park, the *Grande parc de l'Ouest*, which will include organic vegetable farms, bike trails and a river shuttle, in a huge push to green the city.[32] She has also proposed adding a new 'pink line' to the metro system which would help reduce greenhouse gas emissions by expanding public transportation offerings.[33]

At the borough level of government, city councilors are providing services and putting measures in place to adapt to the urban heat island effect. In the borough of Outremont, borough councilor Valérie Patreau is focusing on better safety conditions for active and public transport in order to decrease car usage.[34] Outremont, like other boroughs in Montréal, provides *'îlots de fraîcheur*' like air-conditioned community centres, libraries, and swimming pools with extended hours where people can cool off.[35] Outremont's council also holds consultations where residents, including the older population, and neighbourhood representatives can voice their concerns.[36]

Another example of borough-level policy are the by-laws passed by Rosemont-La Petite-Patrie in 2011 to reduce urban heat islands. The by-laws mandate that new or replaced roofs

31 Ibid.

32 Sucar, Daniel. 2019. "Plante Announces Plan to Build Montréal's Largest Urban Park." Montréal Gazette, June 16, 2019. https://Montréalgazette.com/news/local-news/plante-announces-plan-to-build-Montréals-largest-urban-park.

33 "Montréal Presses Forward with Pink Line despite Province's Ambivalence | CBC News." CBCnews. CBC/Radio Canada, October 22, 2018. https://www.cbc.ca/news/canada/Montréal/Montréal-presses-forward-with-pink-line-despite-province-s-ambivalence-1.4872847.

34 Interview with Valérie Patreau (Outremont borough councilor, Chair of the Standing Committee on Water, Environment, Sustainable Development and Great Parks). July 10th, 2019.

35 Ibid.

36 Ibid.

must be green (vegetative), white or highly reflective.[37] In addition, new parking lots of ten spaces or more must be at least 15 percent landscaped with plants, bushes and trees.[38] After the by-laws' passing, homeowners have reported decreased temperatures inside their homes combined with reduction in domestic energy use.[39]

Policy Gaps

Gaps in the policies were identified independently based on secondary research and interviews with experts, and then collaboratively through the Urban Heat in Montréal workshop run in August 2019. The existing policies mentioned above are generally silo-ed into different departments, ignoring the crucial benefits that result from collaboration. Additionally, with policies like Sustainable Montréal 2016-2020, there is no transparent progress tracker that ensures the city is reaching its goals.

The aforementioned borough climate adaptation policies would benefit from addressing social connectedness and community resilience more. Community resilience is a community's ability to withstand and recover from adverse situations.[40] Addressing climate change requires building community strength because tight connections underpin community resilience and enable residents to coordinate community action.[41] Building a tight-knit

37 Canada. Natural Resources Canada. Measures to Reduce the Urban Heat Island Effect in Rosemont–La Petite-Patrie. July 2014. Accessed June 10, 2019. https://www.nrcan.gc.ca/sites/files/earthsciences/pdf/mun/pdf/13-0616-Rosemont-Case-Study_e.pdf.

38 Ibid.

39 Institute for Catastrophic Loss Reduction, Sophie Guilbault, and Paul Kovacs. n.d. Cities Adapt to Extreme Heat. Edited by Peter Berry and Gregory R.A. Richardson. Cities Adapt to Extreme Heat. Institute for Catastrophic Loss Reduction. Accessed July 22, 2019. https://www.iclr.org/wp-content/uploads/PDFS/cities-adapt-to-extreme-heat.pdf.

40 Isc. "What Is Community Resilience, and Why Does It Matter?" Institute for Sustainable Communities, February 20, 2019. https://sustain.org/what-is-community-resilience-and-why-does-it-matter/.

41 Hayes, K., Berry, P., & Ebi, K. L. (2019). Factors Influencing the Mental Health Consequences of Climate Change in Canada. International journal of environmental research and public health, 16(9), 1583.

community is especially important for the most vulnerable populations. We should be more inclusive of the older population and those suffering from mental illnesses, chronic ailments and homelessness. Additionally, there is not enough community input in the policies being made; consultations are available to residents but there is low attendance and a lack of diversity in the people who attend.

The greening efforts that are taking place in Montréal should do more to account for the inequities that exist in the city. The low-income population and visible minorities have disproportionately less access to green spaces than the more affluent population, which is concerning since they are more in need of the benefits provided by green spaces.[42] As mentioned before, the *Grande parc de l'Ouest* is to be located on the west end of the island, which has a higher average income and more green space than the east end.[43]

There is also a limit to the benefits of expanding green spaces to mitigate the urban heat island effect. Trees take up large swathes of area and their roots impact building foundations. Therefore we need more urban planning regulations that balance green space expansion with reducing urban sprawl. There are also not enough regulations for new buildings. New buildings are often built to rely on air-conditioning instead of using passive cooling or considering air flow. With respect to Plante's vision to expand the metro system in order to increase the use of public transport instead of cars, there has not been much development.

42 Apparicio, P., Séguin, A. M., Landry, S., & Gagnon, M. (2012). Spatial distribution of vegetation in Montréal: an uneven distribution or environmental inequity?. Landscape and urban planning, 107(3), 214-224.

43 Hsu et al.

RECOMMENDATIONS

The recommendations below draw heavily from the Urban Heat in Montréal workshop (03 August 2019), an event organized by myself along with another Fellow, to explore the linkage between the urban heat island effect and health. The event gathered participants from the fields of public health, research, municipal and federal policy, as well as the general public to brainstorm solutions to address the urban heat island effect in Montreal.

Community participation and resilience

Borough councils and community organizations should work to increase participation and engage new demographics in consultations by being more proactive in their promotion and outreach to residents. For example, a council or community organization may set up a tent at neighbourhood events, advertise information about consultations in several streams of media, or incentivize attendance to consultations with low cost benefits. City councilors should also strive to be more accessible to their constituency through weekly 'office hours' that occur outside of regular work hours in order to address resident concerns beyond formal consultations. The municipal government could also consider creating an easy-to-use app that can field questions and concerns from residents.

Borough councils and community organizations should focus on increasing community resilience. Boroughs should retrofit existing community centres in order to make them multi-use, intergenerational and accessible. Urban planners and sociologists should be involved in community centre design to maximize their efficiency and to make them eco-friendly. A variety of community events could be held by community organizations like weekly neighbourhood potlucks. A sharing economy could be established by creating toy libraries, shared tool sheds,

etc. This would not only decrease the environmentally detrimental impact of consumerism, but also foster community bonds. Intergenerational programs should be created such as a buddy system where a young adult is paired with an older adult.

Urban planning and the environment

Montréal requires better urban planning that takes green spaces into account in order to combat the urban heat island effect and climate change. The existing initiatives to expand green spaces must protect against gentrification-- for instance, by freezing rent prices for current residents. Creating linear parks, parks that cross through many neighbourhoods and may follow a waterway, would help balance the inequities in green spaces in Montréal since they would not be confined within a single neighbourhood.[44]

> When you [create] a park that is linear, so you follow, for instance, a river and you green all of the side of the river,... you will cross many neighbourhoods, and then you will lessen the effect of green gentrification because all kinds of population will have access to this long park instead of one big spot like Mont-Royal in Montréal.
>
> -- Mélanie Beaudoin (INSPQ)[45]

Additionally, funding should be allocated for creating more equitable green spaces in underserved areas in lieu of, or in addition to, building an enormous park in the west end of the island.

The municipal and borough governments should ensure that all new construction projects use climate sensitive design and materials.[46] Adopting the aforementioned Rosemont

44 Interview with Mélanie Beaudoin (Scientific Advisor, Territory, impact assessment and climate adaptation at the National Institute of Public Health of Quebec). August 7th, 2019.

45 Ibid.

46 Interview with Federal Government Employee. July 15th, 2019.

by-laws in vulnerable, low-income boroughs would help reduce the urban heat island effect economically as white roofs are one of the most cost-effective methods to combat the issue.[47]

Developers should be required to incorporate passive cooling and good airflow in new developments and construction, and in their designs and models. In the same vein, all new city designs should be required to consider the valley cooling effect which allows currents from lakes and oceans to cool the city.[48] Developers should also be required to build up instead of out, balancing green space expansion, in order to avoid urban sprawl. The design of cities will have environmental, health and social implications for years to come, thus interdisciplinary collaboration is key. For example, the municipal government could require having public health officials and other stakeholders in urban design committees.

In order to decrease the use of cars, which create the waste heat and air pollution that contribute to the urban heat island effect, Montréal should incentivize the use of public and active transport more. Councilor Valérie Patreau stated that active and public transit must be made safer to make sure people do not only use cars. The city must address the greater risk of accidents in lower-income urban areas for users of public and active transport. To further incentivize public transport, there should be programs for particularly vulnerable populations, such as free transit for the older population.

47 Ibid.

48 Ibid

Efficiency through accessibility and interdisciplinary collaboration

> People who [are]... pro-social... [are]... used to the idea that we can solve our problems... by coming together collectively… There is an expectation, understanding, experience that we can actually make ourselves better off by coming together, thinking better about problems collaboratively and implementing collective solutions.
>
> -- Dr. Christopher Barrington-Leigh[49]

Increasing public knowledge of existing sustainability policies can increase the impact and efficacy of them. Community organizations can inform local community leaders of relevant policies in order to increase the communities' understanding of the initiatives and services that are available. Policies should also be translated into different languages by the municipal government in order to inform and empower populations who do not speak English or French (e.g. immigrants, refugees, asylum seekers) to take action. Information should also be incorporated into signboards and events around the city to increase awareness.

More frequent, publicized evaluations of these policies will also greatly increase their efficacy. The municipal and borough councils should have periodic checks and a target tracker of policies like Sustainable Montréal 2016-2020. The progress of these policies should be kept transparent and open to the general public on the city website to keep the government accountable in meeting its goals and addressing subpar performance where needed. The policy evaluations could be outsourced to community organizations for cost-effectiveness, to reduce bias, and in order to increase collaboration between stakeholders.

> There has to be kind of this official recognition by cities… that this is a social issue. We [should] be talking about [climate change] and phrasing it and legally enshrining [as] a social, human rights issue. It's not about just plants and trees, it's about people.
>
> -- Alienor Rougeot (Climate Strike Canada, Fridays for Future)[50]

49 Interview with Dr. Christopher Barrington-Leigh. June 21st, 2019.
50 Interview with Alienor Rougeot (Climate Strikes Canada, Friday for the Future). June 18th, 2019.

Certain outcomes of and causes of vulnerability, such as isolation, to the urban heat island effect are social in nature. The urban heat island effect and climate change as a whole need to be addressed through a social lens in order to tackle these societal matters. For example, community organizations should run campaigns expressing the right to have cool communities, especially during heat waves.

Addressing climate change from a health perspective also increases its sense of importance and urgency. In order to bring stakeholders together, the municipal government and community organizations should work together to have a three tier collaboration where each government hospital or healthcare centre is tied with a climate organization and a human rights organization. Furthermore, climate policy should include a health impact assessment in the process. Moving forward, there should be more collaboration between researchers, community organizations and the government to create joint recommendations.

Interdisciplinary communication during the planning process of policies will help to address the root causes of environmental, social and health issues rather than reacting individually to the fallout. Lastly, there are economic benefits as well; collaborating is less expensive as stakeholders can plan correctly in a wider, preventive lens as opposed to a crisis, responsive lens.

Impact

A first step in taking these recommendations forward is to start conversations on this topic in our own spheres of influence. The more dialogue we have with one another, the more opportunities we create to collaborate and advance change. There should be more networking and knowledge sharing between the stakeholders implicated in this topic. At our community

engagement workshop, which focused on the intersection of climate and health in relation to the urban heat island effect in Montréal, many active stakeholders engaged in intersectional conversations and exchanged contact information for future collaboration.

Community organizations, research organizations, and governmental bodies in Montréal can continue this collaboration by holding recurring interdisciplinary assemblies. The Samuel Centre for Social Connectedness specifically can run more editions of our community engagement workshop in different cities. Each edition should take into account what has been learned from previous versions to foster more compelling and innovative discussions.

This kind of interdisciplinary conversation should be established as the norm so that future policies are as effective as possible in the Montréal community and in any other community, which is impacted by the urban heat island effect. As such, the recommendations from this report can be applied to other cities after assessing the distinct causes and severity of the urban heat island effect within them. This way, the most appropriate and effective recommendations can be implemented in each city.

Conclusion

Overall, Montréal has constructive policies in place to work towards a more sustainable city. The next crucial step is to evaluate the issue of climate change from overlapping disciplines in order to optimize on existing solutions and build stronger ones for the future. Policies should be preventive instead of reactive and should have a focus on community resilience. Future research should look into concrete methods that ensure interdisciplinary collaboration, including engaging the private sector in a more effective manner. Finally, there should be more investigation into how to extend this analysis on the urban heat island effect to other cities.

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