BUILDING A TOOLKIT TO

# Investigate Sustainable Solutions for Gasoline-Powered Leaf Blowers

IN A MUNICIPAL CONTEXT

A project report to alter autumn norms and look forward to resilience

# Project Team

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# Acknowledgements

## Land Acknowledgement

The landscape of primary discussion in this educational toolkit is located within the City of Toronto. "Toronto is in the 'Dish With One Spoon Territory'. The Dish With One Spoon is a treaty between the Anishinaabe, Mississaugas and Haudenosaunee that bound them to share the territory and protect the land. Subsequent Indigenous Nations and peoples, Europeans and all newcomers have been invited into this treaty in the spirit of peace, friendship and respect." We (Madison, Jessica and Celina) want to acknowledge the landscape of the Dish With One Spoon Territory and express our gratitude for the opportunity to conduct our discovery in this territory.

## Gracious Thanks To...

Professor Nina-Marie Lister for her support and guidance throughout the completion of the 'Planning for Sustainability' class. We appreciate this opportunity to complete such projects and could not have done so without her motivation. Thank you to our class for taking this journey with us!

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## Purpose

The purpose of this educational toolkit is to bring awareness to not only the City of Toronto Parks, Forestry & Recreation Division, but also the general public on the adverse impacts of using a two-stroke gas leaf blower has on the environment and broader society. It is our utmost hope this toolkit provides motive to stop the use of gasoline-powered leaf blowers (GLBs), as well as provoke the general public to hold municipal leaders accountable for banning year-round use of such a detrimental tool.

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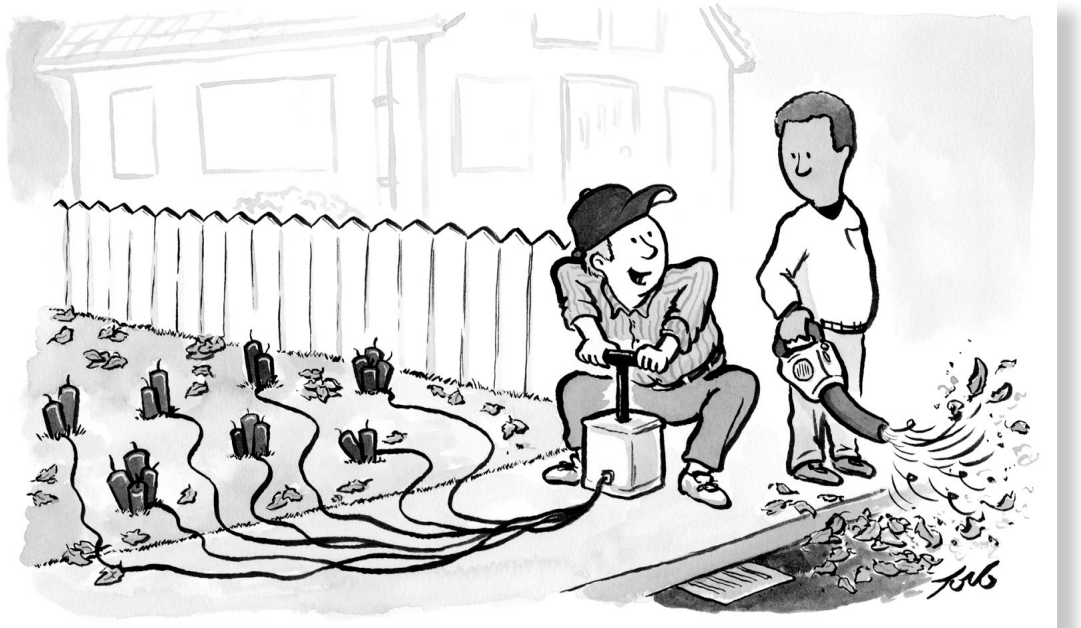


"Leaf blowers aren't loud or dirty enough, so I'm clearing my lawn with dynamite."

## Executive Summary

GLB's have a two-stroke motor and are a common garden tool used to collect fallen leaves, grassing clips, and other debris (Costa-Gomez, 2020). In society, not many are aware of the adverse effects GLBs have on human health and the environment. Specifically, in the City of Toronto GLBs are a concern as heavily reliance has begun to threaten air quality, ecosystem services, and human health (Watkins, 2019). The City of Toronto has done little to investigate this unsustainable practice and if trends prevail, GLBs have the potential to cause serious harm (City of Toronto, 2021a). The three lenses of sustainability, can be used to better understand the implications that GLB's have on society and provide tangible solutions at a local-level. Viable solutions may be created through a rigorous understanding of the critical infrastructures that GLBs affect, including nature, waste, and fuel, as well as an analysis of applicable UN SDGs. Finally, through investigating global case studies that outline diverse approaches to tackling reducing the impact of GLB's, recommendation for resiliency can be put forth for the City of Toronto.

Image Source https://yaleclimateconnections.org/2021/01/are-leaf-blowers-bad-for-us/

# Background

## What is a leaf blower?

GLBs are composed of a two-stroke motor that is used to collect fallen leaves (Costa-Gomez, 2020). Leaf blowers continue to be popular in contemporary society as they increase cleanup speed by 60%, compared to completing yard work by hand (Watkins, 2019). Mechanically, leaf blowers use a two-stroke engine to power a fan, and the fan pulls air into a chamber. Air is then pushed out of the machine at a high-speed through a controlled nozzle to move the leaves. Lawn machines typically use a two-stroke engine, where the oil and gas is mixed, spewing a number of gases including carbon monoxide, carbon dioxide, volatile organic compounds (VOC) and nitrogen oxides (Aziz, 2021).

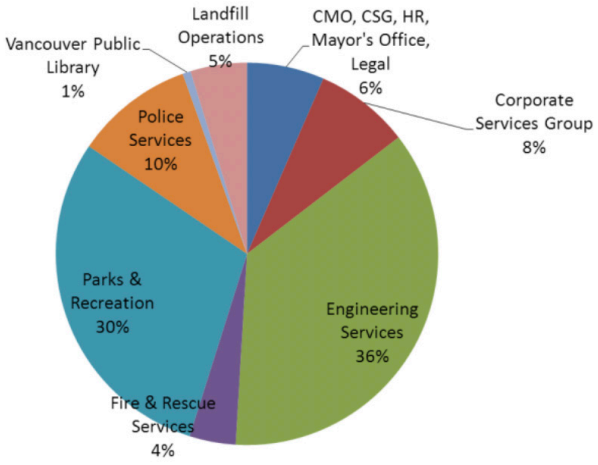



Figure 1: Corporate GHG Emissions by Department in City of Vancouver

## Who uses leaf blowers?

Leaf blowers are used by diverse demographics as most homeowners who live in places with temperate climate experience leaf fall. Particular demographics who may have greater exposure to leaf blowers include landscapers, parks workers, and property managers. Due to their widespread use, leaf blowers pose a number of issues including destroying viable ecosystems, contributing to ongoing air pollution, and unsustainable consumption of fuel.

Image Source Marquez, 2018

# Why are leaf blowers a problem?

## Environmental Effects

Incoming fuel enters the combustion chamber of the engine as the exhaust leaves, this timing overlap can result in up to 30% of the fuel/oil mix, created an unburned exhausted. The unburned exhaust tangibly looks like a large puff of grey smog being admitted from the oil-gas mixture (Watkins, 2019). Unsurprisingly, many of the chemicals that leaf blowers emit including, hydrocarbons, and carbon monoxide, can be extremely harmful to human health and largely contribute to air pollution.

In a study published in Nature Communications, the researchers concluded that a variety of carbon-based gases (which form smog) were on average 124 times higher from an idling two-stroke motor than that of a truck or car (Fallows, 2019).

Through the process of blowing the leaves up off the ground, the user is destroying crucial animal habitats and eliminating the potential for a natural fertilizer.

## Social Effects

The ubiquitous presence of leaf blowers concerns the health and well-being of society because of the exhaust emissions, resuspended dust, and high noise levels. It places populations at risk to respiratory illnesses, lung cancer, hearing loss, hypertension, and negatively impacts cognitive development in children (Costa-Gómez et al., 2020). Also, the travelling noise pollution makes day-to-day conversations indoors difficult and disconnects ourselves and other neighbours from outdoor nature.

In an urban environment, bystanders cannot maintain safe distances from leaf blowers. This creates tensions and conflict between citizens and the behaviours of leaf blower operators.

GLB operators are most affected because they cannot protect themselves from direct emissions or predict what particle matter and debris might be under the leaves (Costa-Gómez et al., 2020). While homeowners in suburban neighbourhoods occasionally use leaf blowers, those that are heavily exposed to leaf blowers include landscapers who have been shown to be of lower socioeconomic status, including migrant workers. Furthermore, research has illustrated racial and labour implications associated with leaf blowers and describes the segregation between migrant labour involved in landscaping and the suburban affluence (Boykoff, 2011).

## Economic Effects

Being one of the first mechanized garden tools, the leaf blower fortifies our understanding of how the development of technology can reorganize space and the social relations of a city (Boykoff, 2011). The leaf blower created what Latour (1999) calls "the slight surprise of action" which is a way of saying that we invent objects to make life easier and slowly we become overtaken by its actions.

In one year approximately between 5 and 6 million leaf blowers were sold across the US (Butterfield, 2011). Today landscaping services in Canada accumulate to 13.3 billion (IbisWorld, 2021) which is why many actors in these industries want us to continue to take care of lawns by using various mechanized tools.

Like cars, leaf blowers are slowly becoming electric being a better alternative than a gasoline leaf blower. However, these  are expensive, electric leaf blowers require frequent charging, charging outlets and sufficient electricity to charge the batteries which comes at an added cost for businesses (Walters, 2021).

Image Source Fallows, 2019

## Leaf Blowers in Toronto

Since April 25th, 2002, Torontonians have pushed to ban or restrict the use of leaf blowers because of the noise they generate (LOHTA, 2002). Today, almost 10 years later, gasoline-powered leaf blowers still pester Torontonians as they are widely used by the City of Toronto's Parks, Forestry & Recreation Division.

Currently in Toronto, the only measure in place to control power devices (including leaf blowers) is Noise Bylaw 2021-05-28. The by-law states: "A. No person shall emit or cause or permit the emission of sound from a power device from 7 p.m. until 7 a.m. the next day, except until 9 a.m. on Saturdays, Sundays and statutory holidays. B. Subsection A does not apply to a power device used to maintain a golf course or public park". Without a ban or severe restriction of GLBs, the City of Toronto continues to expose our neighbourhoods to numerous air pollutants, harm viable ecosystem health, and further contribute to unsustainable fuel reliance.

In September 2020, the City of Toronto council approved a motion to request the City Manager and Medical Officer of Health, to study the environmental and health impacts of two-stroke gasoline-powered leaf blowers and other garden equipment. Also, a feasibility study of a year-round ban or a ban from May to September was requested by Councillor Shelley Carroll and seconded by Councillor James Pasternak (City of Toronto, 2021a). However, due to the ongoing COVID-19 pandemic, the study has been delayed.

It should be noted that the City of Toronto has a mechanical leaf collection period and a $200 fine for leaving leaves on the sidewalk, ditches or roads (City of Toronto, 2021b). Also, the City of Toronto website clearly states residents should "rake their leaves" out of accumulated pathways and ditches, but most importantly recommends the best solution to manage your leaves is to compost them.

# A Call To Action for Sustainability

GLBs are heavily polluting and are contributing to the destruction of our ecosystem.

They threaten human health by polluting the air with dangerous carcinogens, disturb many pollinator species through mechanically lifting leaves, and lead to heavy reliance on waste management services through increased use of landscaping bags (Boykoff, 2011). To ground sustainability in a municipal context, GLBs should be banned year-round as they are threatening life on earth. This outcome will be made possible through altering the contemporary norm of over reliance on leaf blowers by simply leaving leaves on the ground, and holding landscaping tool manufacturers accountable for innovative solutions.

The following toolkit will delineate sustainable solutions through:

1) Outlining how GLB's impact the three lens of sustainability: social, environmental and economical;

2) Addressing how leaves impact the critical infrastructure of nature, waste and fuel;

3) Connecting to the United Nation Sustainable Development Goals;

4) Providing case study analyses on municipalities taking varying levels of sustainable action to ban GLB's;

5) Recommending a viable solution for the City of Toronto.

# SOCIAL IMPLICATIONS

## Changing Society's Norm

During the fall season most individuals gravitate towards using the fastest tool ('or the norm') to clean their yard waste, being a leaf blower (Beatley, 2013). This indicates concerning patterns of unsustainable practice that threaten not only the users health and well-being, but also those in the surrounding vicinity. While raking leaves provides a healthy dose of physical activity, most individuals gravitate towards relying on convenient technology to collect their leaves as it is significantly more time effective.

It should be noted that GLBs are not just used for leaves. Many private landscapers (and the general public) are using leaf blowers during spring-summer months to pick up grass clippings, thus harming our ecosystem year-round (City of Toronto, 2021a). GLBs are favoured by landscapers because they are cheap and easy to clear spaces of leaves, grass clippings and other debris without physically exerting oneself.

Noise ordinances do exist globally, but many citizens complain that they lack enforcement and are ineffective at regulating leaf blower usage (Marquez, 2018). GLBs were reported to increasingly become an element of concern during the COVID-19 pandemic when most people had to work from home and were annoyed by the nuisance that disrupted productivity (Cardoza, 2021). It should also be noted that the irritating sound disconnects people from one another and nature as it inherently pollutes the occupied space.

## Most at Risk

It is nearly impossible to avoid noise and lung-related injuries and illness from GLBs in an urban environment (Cardoza, 2021). Bystanders cannot maintain a safe distance from leaf blowers in dense environments and it creates conflicts between citizens, business owners, and the behaviours of leaf blower operators. In addition, as contemporary capitalist society continues to prevail and wealthier neighbourhoods are increasingly evident, many properties have a maintenance contract for lawn care, who is disproportionately affected by the adverse effects of leaf blowers.

While homeowners in suburban neighbourhoods occasionally use leaf blowers, those that are heavily exposed to leaf blowers are typically landscapers and park personales. GLB operators are most affected because they cannot protect themselves from direct emissions or predict what particle matter and debris might be under the leaves (Costa-Gómez et al., 2020). Operating for several hours each day several days a week in seasons of use, exacerbates blower operators exposure to high noise and air pollutants. They are at higher risk for hearing loss, lung-related illnesses and headaches from emission fumes (Marquez, 2018). Furthermore, many operators simply forget to put on eye, hearing, and face protection from particulate matter. Although more research is needed to investigate the role of personal protective equipment for leaf blower operates, one study recorded that 1 in 10 operators wear hearing protection (Boykoff, 2011). This statistic alone demonstrates that there is a dire need to either educate landscapers on the potential harms of operating a leaf blower unprotected or to ban gas leaf blowers as a whole.

## Socio-Environmental Injustices

It has been demonstrated that the majority of landscapers workers are of low socioeconomic status, including migrant workers (Boykoff, 2021). This places a disproportionately high health risk on low-income populations. There is a clear inequity at play in this instance as low-income populations are limited to entry-level labour jobs that have inherently more precarious work environments. In the case of GLB operators, most cannot afford to miss work because of health and safety concerns like long operation hours or lack of protective equipment. In addition, it is unlikely that leaf blower operators have health care benefits, further ingraining labour and health inequities.

A few researchers have illustrated racial and labour implications associated with leaf blowers and further describe the segregation between migrant labour involved in landscaping and suburban affluence (Boykoff, 2011). Leaf blowers can be used as a metaphor that amplifies how technology alters socio-spatial relations. Cameron (1999) has gone so far as to argue that the ban on leaf blowers may subjugate foreign workers, specifically people of Latino origin, from assimilation into suburban society (Cameron, 1999 in Boykoff, 2011). While this researcher specifically investigates the implications for Latino workers, the inferences made about social exclusion may be applied to diverse populations of labour workers. Furthermore, through removing a commonplace form of labour for low-income workers, such as landscaping, policymakers are interfering with the ability for low-income workers to make a living wage, or to build upon their work experience in hopes of finding more stable employment (Boykoff, 2011). Controversially, it is not a viable solution to maintain the current practices of leaf blowing based on the aforementioned health concerns. Therefore, this toolkit calls on policymakers to not remove this form of entry-level labour, but to create safer working conditions through the use of electric powered leaf blowers.

Image Source ttps://www.latimes.com/opinion/story/2021-11-23/leaf-blowers-gardening-sense-of-community

# ENVIRONMENTAL IMPLICATIONS

## Increased Air Pollution

Leaf blowers inherently affect air quality as they are made to propel participles of debris into the surrounding air, these particles are known as particulate matter (PM) (Watkins, 2019). The force of a typical GLB mirrors that of a concentrated hurricane, producing winds at a speed of 300 km/h. As mentioned, GLBs use a two-stroke engine, where oil and gas is mixed, spewing a concoction of chemicals including: hydrocarbons, carbon monoxide, benzene, butadiene, acetaldehydge, and formaldehyde. To put the quantity of these pollutants in perspective, in 2018, the most popular leaf blower produced an equivalent amount of smog-forming air pollutants in a single hour of operating that a 2017 Toyota Camry produced over 1700 km.

Overall, in most urban areas, it is estimated that lawn equipment accounts for 10-20% of overall emissions (Aziz, 2021). Figure 2 demonstrates the findings of Watkins (2019), which indicates a spike in PM during the use of a GLB (Watkins, 2019). Interestingly, the PM remains at a moderately high level for a few minutes after the leaf blower has been powered off. Watkins (2019) explains that it takes a few minutes for the particles to once again settle to the ground after being lifted into the air. Furthermore, the individual is still being exposed to lingering air pollutants even after the GLB is powered off.

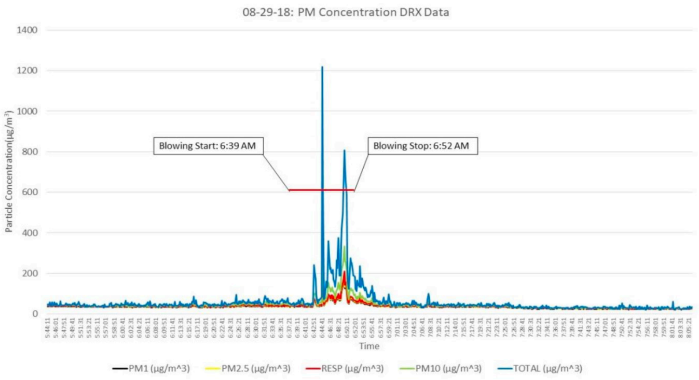



Figure 2: Particle Concentration from GBLs, taken during a 13 minute interval (Watkins, 2019).

Image Source Watkins, 2019

## Increased Air Pollution - Human Health Effects

Human exposure to atmospheric pollution is one of the major environmental problems affecting the longevity of the global population (Costa-Gomez et al., 2019). Health effects from GLBs vary but they are primarily a repercussion from exhaust emissions, resuspended dust, and noise levels. Specifically, long-term exposure to particulate matter (PM) has been demonstrated to increase the risk of lung cancer and atherosclerosis. Comparatively, short term exposure has been associated with respiratory diseases and heart rate variability. Notably, PM has also been classified as a carcinogen by the International Agency for Research on Cancer. Researchers Costa-Gomez et al. (2019), conclude that GLBs create a "dust effect" of high PM that is maintained for 2 minutes after leaf blowing has finished. Therefore, not only are operators at risk while they are using the GLB but the particulate matter remains in the air for minutes after, posing increased health risks.

Noise pollution is another concern of leaf blowers as the loudness can trigger strokes and heart attacks (Aziz, 2021). Specifically, the low-frequency rumble from leaf blowers can penetrate through homeowners windows and doors posing a risk to not only the user but surrounding residents (Pollock et al., 2018). A few researchers have documented how some GLB's produce more than 100 decibels of low-frequency sound at levels which have the ability to cause tinnitus and hearing loss with long exposure (McConnell & Banks, 2015). In addition, leaf blowers may have particular implications for vulnerable populations, including expediting hearing deficits in seniors and interfering with cognitive development in children.

## Disturbances to Non-Human Ecosystems

The Nature Conservatory of Canada has begun recommending that residents leave their leaves on the ground in the winter to support 'backyard biodiversity' (Haines, 2019). Collecting and bagging leaves are a fall tradition however, ecologists are beginning to articulate how leaving your leaves untouched can preserve many animal ecosystems as well as provide a natural and cost-effective mulch. Changing these engrained norms will take a lot of social conditioning as homeowners typically desire finely pruned laws. However, initiatives such as Xerces "#LEAVETHELEAVES", are making small steps to increase awareness about the destructive powers of using GLBs to move leaves (Wheeler, 2017). The following two sections will detail the effect GLBs have on non-human ecosystems including animals life and soil health.


Image Source Wheeler, 2017

## Supporting Ecosystem Resilience: Animals

Leaf litter provides a hospitable habit for native insects, pollinators, and other backyard invertebrates to hibernate in throughout the cold winter (Haines, 2019). Through mitigating the usage of GLBs, we are limiting our interference with the habitats of smaller critters and are supporting the cycle of life in the ecosystem as larger animals, such as birds and chipmunks, feed on the critters. In the absence of leaf cover these animals must migrate to other habitats to find shelter in the cold winter conditions, most do not survive the journey (Independent Tree, 2019). Furthermore, there needs to be a shift in societal understandings of winter ecosystems to uncover integral role that leaf cover provides for ecosystem services (Wheeler, 2017). In the winter months we don't see the critters that normally inhabit our gardens, further we don't think of them. However, numerous species rely on the diverse ecosystems in our back and front yards yearound- even if we cannot see them!

Leaf litter also creates a vital food source for invertebrates living in the micro-ecosystem (Lin, 2012). The critters feed on the litter and break it down into smaller pieces as a mechanism to obtain nutrients. Therefore, GLBs have the potential to not only destroy habitats but can also threaten a vital food source for the animals who reside under the leaves.

Butterflies and moths are an examples of species that we admire in our gardens during the summer months but that we don't realize we can and need to support in the winter months (Wheeler, 2017). Butterflies and moths rely on the habitat created from leaf cover to support their longevity in the winter months. A few specific examples include:

- Great spangled fritillary and wooly bear caterpillars tuck themselves into piles of leaves for protection in the cold weather.
- Red-banded hairstreaks lay their eggs on fallen oak leaves which become the first food for their offsprings when they are born.
- Luna moths actually use the leaves as a disguise, blending their cocoons into the dried leaves.
- Bumble bees also rely on leaf cover in the winter. Bumble bees burrow approximately two inches into the soil in the winter, the extra layer of leaves provides them with an added layer of protection in the elements.

It is important to note that the longevity of these small insects and invertebrate then affects the life cycles of larger animals including birds, turtles, and chipmunks that prey on the insects for food (Haines, 2019).

Image Source Top: Wheeler, 2017 Bottom: https://uwm.edu/field-station/wooly-bear-caterpillar-re-do/

## Supporting Ecosystem Resilience: Soil

Leaf litter provides a hospitable habit for native insects, pollinators, and other backyard While most homeowners believe that excess leaves covering the ground suffocates the soil beneath, in reality the leaves provide a natural and cost effective fertilizer (Haines, 2019). As the leaves remain on the ground they decompose and create a natural mulch made up of organic matter. The leaf layer directly provides nutrients to your lawn as it decomposes to create an organic fertilizer that enriches soil (Lizee, 2019). There is another layer of complexity to this phenomena as when the leaves break down they store some of the carbon in the soil, and absorb carbon dioxide from the atmosphere. Therefore, through leaving the leaves untouched on the ground you are supporting the transformation of your yard into a "carbon sink" (Lizee, 2019).

Gnankambary et al (2008) demonstrated that even poor quality leaf litter from indingeous trees has the potential to provide useful organic inputs that can increase soil fertility. The researchers conclude their study by expressing the importance of using leaf litter as a mulch in both rural and urban contexts as the cost of mulch has continued to exponentially increase.

## Increases of Bags and GHGs from Waste Collection Services

Typically, individuals dispose of the leaves that they collected with the GLB in a brown bag. That brown bag is collected every other week by the City of Toronto from March to December (City of Toronto, 2021). The yard waste is then turned into compost and some, but not all of it, is offered to the public for free at certain community events. However, there is little information about what the city does with the excess leaves.

Interestingly, while the city makes bold remarks about the success of their collection processes, such as diverting 90,000 tonnes of yard waste out of the landfill each year, they do not inform residents that taking the leaves off the ground is environmentally harmful (City of Toronto, 2021c).

There is also a substantial amount of GHG released from the collection process itself through waste collection services and the production and breakdown of brown bags. Garbage trucks in particular are one of the least efficient vehicles on the road as they are powered by diesel, burning over $50,000 worth of a fuel a year, and emitting about 20 times more carbon than the average home (Coren, 2016).

# ECONOMIC IMPLICATIONS

## Economic Theory Behind the Leaf Blower

The first leaf blower was a patented device designed for cleaning leaves and other light debris off of lawns and other surface such as gravel yards, concrete, and driveways. By the 1940's inventors had already applied patents for portable blowers leading to the full commercialization of the product in the 1950's (Boykoff, 2011). Landscaping has become more mechanized than ever before, influencing the intensity and pace of labour. Mechanization grants the ability for "time-space compression" (Harvey, 1996), which allows for less labour and the ability to get the job done more efficiently. In a capitalist society mechanization, such as the leaf blower, changes the way we think about the operation of garden upkeep. Whereas in the past we may have tolerated some unorderliness on our lawns, such as some spare leaves, the leaf blower has changed our perception that our lawns need to be manicured to perfection (Mey, 1996).

For Boykoff (2011), the leaf blower is a complex socio-spatial relation that amplifies ecological destruction. This coincides with the rise of neoliberal capitalism which is the same time the leaf blower became popular. The leaf blower is a metaphor that reveals the ideological repercussions of the political economy (Boykoff, 2011). Being one of the first mechanized garden tools, the leaf blower illustrates how the development of technology can reorganize space and the social relations of a city (Boykoff, 2011). The leaf blower created what Latour (1999) calls "the slight surprise of action" which means that we invent objects to make life easier and slowly we become overtaken by its actions. For example, pesticides allow crops to grow immensely but pollute groundwater and jeopardize biodiversity. Similarly, the leaf blower helps remove leaves in an efficient manner but at social and environmental costs.

## The Manicured Lawn as Capitalist Tool

Why do we feel the need to pick up our leaves? A long time ago, a manicure lawn became one of the most powerful symbols of global modern urban landscapes, producing a consumer product on the market (Ignatieve et al., 2015). Through various urban beautification campaigns, a few American suburbs in the 1950'a developed neat and weed-free lawns. These lawns were later promoted in various magazine as the successful lawn. At the same time, technology was taking off and various landscaping tools were being invented such as the lawn mower. The manicure lawn quickly became a fixture for Canadian and American suburbs and a symbol of the successful middle-class. The race for the perfect lawn began (PlanetNatural, 2021). Today landscaping services in Canada accumulate to 13.3 billion (IbisWorld, 2021). Therefore, individuals involved in these industries want us to continue manicuring our lawns and leaf blowing our leaves for capitalist gains.

Image Source https://www.greensideup.com/benefits-landscaping-industry/

## The Leaf Blower and Advertising

Over the span of a year, from 2010-2011, approximately between 5 and 6 million leaf blowers were sold across the US (Butterfield, 2011). Leaf blower corporations tend to disparage fall leaves by stating that they are only beautiful until they fall off the trees. This is one of the ways corporations have changed the socio-ecological landscape. These same companies encourage spending your weekends 'watching the game' instead of outside raking leaves (Bobvila, 2021). Others tend to promote raking leaves as a chore and that the leaf blower will make this chore quicker and easier (Standard, 2021). The question remains, why do we view leaves falling off the trees so unsightly in the first place? Is it because of the leaf blower advertisements that have ingrained these views into us? Is it time we put down the leaf blower and let our lawns grow by their own accord? Should we lay down the leaf blower and take up the rake? It will benefit our health, why can't leaf-raking be a fun outdoor activity again? Should we spend more time outside instead of watching the game? Let's take back autumn.

## Future of Leaf Blowers

Like cars, leaf blowers are slowly becoming electric as they are a more environmentally-friendly alternative than a GLB. However, banning GLBs too soon can have big impacts on many people that have large and small businesses in landscaping. Electric leaf blowers require frequent charging, charging outlets and sufficient electricity to charge the batteries which, comes at an added cost for businesses (Walters, 2021). Moreover, the batteries come at an extra labour cost, employees would have to carry 30 to 40 fully charged batteries to have enough power to use their equipment for a full day of work (Walters, 2021). These batteries also require a high voltage, therefore companies would have to completely retrofit their workshops to be able to handle the influx of power use. Electric leaf blowers also come at a high cost; a high-quality one can cost approximately $1000 (Walter, 2021). There are economic considerations to keep in mind when developing a new policy around GLBs. How much will it cost to replace them? This conundrum illustrates the complex interrelated factors of urban issues.

Electric Leaf Blower


Charger and Battery


Backpack Battery


Image Source Marquez, 2018

# CRITICAL INFRASTRUCTURES

# Sustainability Analysis on 3 Applicable Critical Infrastructures

## Nature

While infrastructure is often thought of as large buildings and infrastructure, it is all-encompassing of the natural system around us (Luedke, 2019).

GLBs have severe implication for the environment as they disturb and potentially destroy ecosystems through using high-speed winds to collect leaves (Costa-Gomez et al., 2019). The gusty winds affect nature by damaging insect habitats and further disturbing the lifecycle of the ecosystem, and eliminating the potential for a natural mulch that occurs when the leaves decay (Haines, 2019).

Through sustained use and reliance on leaf blowers, the natural system will continue to be threatened, and the resilience of ecosystems to recover from damage will increasingly dwindle.

## Waste

Waste management is a global concern and poses a serious threat to ecosystems and human health. Poor waste management, including minimal collection systems, ineffective disposal, and unsanitary landfills, have the potential to cause air pollution, water and soil contamination, as well as threaten the health of urban dwellers.

The typical individual who operates a GLB does so when the intent of collecting the leaves to then place them in a brown bag to be picked up by waste collectors. What the individual may not reflect on is the energy and infrastructure needed to collect that waste bag, and then what happens to the waste bag once it is picked up by municipal services (Coren, 2016).

As mentioned, the City of Toronto has continued to make bold claims about the positive environmental changes that their waste collection services has made (City of Toronto, 2020c). In reality, there is very little information given to the public about where and how the bags of leaves that are collected end up. The City has explained that the yard waste is composted and some is given to local communities to use in their gardens. However, there is a lot of ambiguity about this process and most Torontonians do not question where their leaves end up once they are off their yard.


## Fuel

**Leaf Blowers**

GLBs operate on a two-stroke motor that commonly creates a byproduct of unburned exhaust which, looks like smog (Watkins, 2019). Furthermore, GLBs do not efficiently use fuel, contributing to growing concern fuel overuse. GLBs play a vital role in contributing to global efforts for green cities through limiting fuel consumption at local context.

**Collection Services**

Typically when individuals use GLBs to collect leaves, they place them in a brown bag to be picked up by waste management services. Interestingly, garbage trucks release a substantial amount of greenhouse gases (GHG) from the collection process itself as they are diesel powered, and make very frequent stops (Coren, 2016).

Image Source https://qz.com/749622/the-economics-of-electric-garbage-trucks-are-awesome/

# SUSTAINABLE DEVELOPMENT GOALS

# Connection to Sustainable Development Goals (SDGs)

## SDG 3: Good Health and Well-Being


GLB's threaten the health of citizens as it contributes to growing air pollution concerns. Specifically, GLBs release numerous dangerous toxins, including hydrocarbons, that may provoke long term diseases including cardiovascular disease, cancer, and respiratory infections. It also important to note that the sound from GLBs has the potential to adversely affect hearing and cognitive complications. GLB's specifically affect target 3.9 that aims to reduce the number of deaths and illnesses from hazardous air pollutants.

## SDG 11: Sustainable Cities and Communities


Due to lack of enforcement and regulation of GLB's, they are overused by municipalities and residents to maintain green space. Thus, negatively impacting local air quality, and threatening ecosystem services. Target 11.6 and 11.7, explain that it is the responsibility of the municipality to adhere to local sustainable practices for the betterment of global society. As GLB's threaten the longevity of the environment the municipality is responsible for mitigation measures to support ecological resilience.

## SDG 13: Climate Action


Given the convenience of GLBs many people are not aware of the detrimental implications they have on reaching climate action targets. Integrating restrictions on GLBs can contribute to achieving target 13.2 that focuses on integrating climate change measures into national policies, strategies and planning. An important step in implementing restrictions on GLB's, is creating an education platform that can guide the public to make more sustainably-informed decisions and offer more environmentally-friendly alternatives to garden tools. Thus, contributing to ongoing global efforts in meeting target 13.3.

## SDG 15: Life on Land


As previously mentioned in this toolkit, GLBs degrade natural habitats and advance biodiversity loss. Specifically, the use of GLB's eliminates the potential for pollinator and other insects to use the leaf cover as a habitat to shelter themselves during the winter months (Wheeler, 2017). Although many municipalities have integrated ecosystem and biodiversity values into local planning and reduction strategies, they do not specifically address the adverse effects GLB's have on ecosystems, as outlined in targets 15.5 and 15.9.

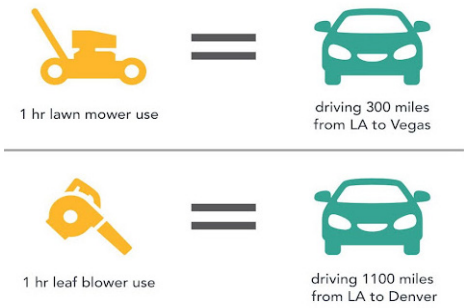
Image Sources United Nations, 2015

# CASE STUDIES

# Case Study 1

## State of California: Leaf blowers are going to be illegal by 2024

California has passed a ban (AB 1346) on highly polluting small engines, including leaf blowers, which goes into force in 2024 (Blanco, 2019). The law was motivated by the powerful California Air Resources Board (CARB) who explained that there are 3 million more small engines in California than cars. CARB grounded their argument in the need for increased regulation on small-engines that currently lack governance but produce a much larger proportion of pollution than passenger cars. When in force law AB 1346 requires the state to "adopt cost-effective technologically feasible regulations to prohibit engine exhaust and evaporative emissions" from small-engines. CARB has also convinced the state to invest $30 million towards incentives to encourage people to purchase zero-emissions machines. The overarching agenda for this policy is to reduce polluting smog from small engines by 80% by the year 2031 (Hegarty, 2021). It is important to note that the law would not apply to landscape workers that are further than 25 feet from a residential building. Some politicians have raised concerns about this portion of the policy as it sets a double standard for lawn works and individual homeowners.




# Case Study 2

## Sacramento, California: Leaf blowers are banned on bad air quality days

In 2020 The City of Sacramento approved a city ordinance to ban leaf blowers on bad air-quality days (Miller, 2020). The dominant narrative in the argument was that GLBs increase PM in the air and can exacerbate asthma and upper respiratory complications. The ordinance also included a noise restriction on GLBs, ordering that GLBs cannot be used near a residence before 10 a.m on sundays.

The ordinance will be in-effect when air quality index is more than 100, the City hypothesized that this will occur on approximately 30 days a year but possibly more if wildfires continue to occur more frequently (Sacramento City Express, 2021). Interestingly, if a resident is caught using a GLB, they will first be given an educational warning, then a penalty for $250, and if problems persist they will be fined $250,000 for each day that they continue to use the leaf blower.

Image Source https://www.caranddriver.com/news/a38004981/california-ban-gas-powered-lawn-equipment/

# Case Study 3

## City of Vancouver: The longevity of leaf blowers is being investigated

Leaf blowers are legal to operate in Vancouver but are illegal to operate in the west end of Vancouver (Marquez, 2018). However, in all parts of the city there are time limits on when the GLBs can be used due to noise concerns at night and in the early morning. Early in 2021 several councillors brought forth motions to ban two-stroke gasoline engines but they have yet to have received approval (Alexander, 2021). Many residents and business owners disagree with the ban as they believe it to be both premature and costly.

Much of the support that has been garnered in favour of banning gas equipment is from the Greenest City Scholars report which, aimed to support the City of Vancouver's goal of becoming the Greenest City in the world by 2020 (Marquez, 2018). One component of this goal is to reduce greenhouse gas emissions by 50% of 2007 levels, and to eliminate fossil fuel dependency. Currently, there have been numerous studies conducted to assess the feasibility of reducing carbon dependency in parks and recreation spaces by shifting from gas-powered to electric-powered equipment. The support for the switch to electric-motors continues to grow in the city as policy-makers raise awareness about the harmful environmental effects of two-stroke engines.

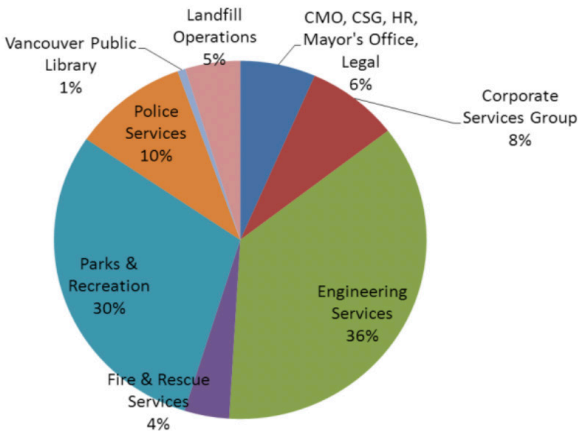



Figure 3: Percentage use of gas-powered equipment during the year in the City of Vancouver, Parks and Recreation Department (Marquez, 2018).

Image Source Marquez, 2018

# SUSTAINABLE SOLUTIONS

# Sustainable Solutions

## Social

To achieve socially sustainable practices, it is necessary that society alters their perceptions and usages on GLBs. It should be mandatory for all leaf blower operators to be considerate of their wind gusting boundary to ensure a respectful safe environment is maintained. GLB operators should also acknowledge that the polluting sound is ubiquitous, as well as damaging to both their hearing and bystanders. It should be mandatory for all leaf blower operators to undertake formal training that educates them on the criticality of health and safety, along with ways to protect themselves with proper personal protective equipment. In addition, formal training should include strategies that explain how to avoid conflicts between the general public, and should alert operators to mechanical failures of leaf blowers. Furthermore, society needs to adjust 'the norm' of perfectly manicured lawns to mitigate the overuse of GLBs, unveiling the potential that simply keeping leaves on the ground has.

## Environmental

As mentioned the three main environmental effects of GLBs include: increased air pollution, destruction of ecosystems, and increased reliance on waste collection services. To mitigate these environmental harms, GLBs should be banned and leaves should be left on the ground. Through banning GLB's, the air pollutants that are typically released will decrease, minimizing the negative implications for human health. Ecosystems will also improve through banning GLBs as the leaves will naturally fertilize green spaces, and animals habitats will flourish. Finally, banning GLBs will decrease the pollution from brown bags and abolish the need for waste collection services that are tedious, costly, and environmentally harmful.

## Economic

Our urban systems are very intertwined with the economy, therefore economic solutions can be costly. Banning GLBs will be a big cost on all the small landscaping business across Toronto. Electric leaf blowers can be expensive and costly to maintain. Therefore, an incentive or subsidy grant for landscape businesses could be awarded to motivate increased compliance.

# Phasing Out Leaf Blowers in Toronto

Step 1: Raise awareness about the detrimental effects of GLBs while maintaining in-force noise bans.

Step 2: Adjust in-force noise bans to apply to City of Toronto golf courses and public park operators.

Step 3: Encourage property owners to leave their leaves on their yard by arranging them into their flower beds and around trees.

Step 4: Implement subsidies and incentives for electric-powered leaf blower manufacturers and landscaping companies.

Step 5: Limit operating GLBs to those made after 2005 to reduce exhaust pollution.

Step 6: Create db(a) restriction on GLBs.

Step 7: Start a 'Golden Rake' award, that endows citizens who use a rake on their lawn instead of a mechanized tool.

Step 8: Motivate citizens through social media campaigns to 'take back autumn' by getting outside and enjoying the ecological process of season change.

Step 9: Ban GLBs, and if necessary, increasingly rely on electric-powered leaf blowers.

# References


Alexander, S. (2021). Rats, mice and higher strata fees: A critic's warning about proposed leaf-blower ban in Vancouver. Global News. Retrieved 2021,https://bc.ctvnews.ca/rats-mice-and-higher-strata-fees-a-critic-s-warning-about-proposed-leaf-blower-ban-in-vancouver-1.5455818

Aziz, S. (2021). 'Highly polluting': Why lawn care can be hazardous to health, environment. Global News. Retrieved 2021, from https://globalnews.ca/news/8328175/leaf-blower-lawn-care-pollution/

Beatley, T. (2013, January 13). Celebrating the Natural Soundscapes of Cities. The Nature of Cities. Retrieved 2021, from https://www.thenatureofcities.com/2013/01/13/celebrating-the-natural-soundscapes-of-cities/

Best leaf blowers: Cordless and corded options to make tidying your garden a breeze. (n.d.). Evening Standard. Retrieved 2021, from https://www.standard.co.uk/shopping/esbest/home-garden/gardening/best-leaf-blowers-b948819.html

Blanco, S. (2019). California Enacts Ban on Gas-Powered Lawn Mowers, Leaf Blowers. Car and Driver. Retrieved 2021, from https://www.caranddriver.com/news/a38004981/california-ban-gas-powered-lawn-equipment/

Boykoff, J. (2011). The Leaf Blower, Capitalism, and the Atomization of Everyday Life. Capitalism Nature Socialism, 22(3), 95–113. https://doi.org/10.1080/10455752.2011.593896

Butterfield, B. 2011. Personal interview via email. National Gardening Association Research Director. March 10.

Cardoza, M. (2021). Why Cities are Taking Action to Limit Loud and Polluting Lawn Care. Audubon. Retrieved 2021, from https://www.audubon.org/magazine/spring-2021/why-cities-are-taking-action-limit-loud-and

City of Toronto. (2021a). Member Motion 23.3 - City Council. Retrieved 2021, from https://www.toronto.ca/legdocs/mmis/2020/mm/bgrd/backgroundfile-152694.pdf

City of Toronto. (2021b). Noise By-Law. Toronto Municipal Code - Chapter 591, Noise. Retrieved 2021, from https://www.toronto.ca/legdocs/municode/1184_591.pdf

City of Toronto. (2021c). Mechanical leaf collection. City of Toronto. Retrieved November 27, 2021, from https://www.toronto.ca/services-payments/streets-parking-transportation/road-maintenance/mechanical-leaf-collection/

Coren, M. (2016). The economics of electric garbage trucks are awesome. QUARTZ. Retrieved 2021, from https://qz.com/749622/the-economics-of-electric-garbage-trucks-are-awesome/.

Costa-Gómez, I., Bañón, D., Moreno-Grau, S., Revuelta, R., Elvira-Rendueles, B., & Moreno, J. (2020). Using a low-cost monitor to assess the impact of leaf blowers on particle pollution during street cleaning. Air Quality, Atmosphere & Health, 13(1), 15–23. https://doi.org/10.1007/s11869-019-00768-8

(N.d.-a). Expert Advice from Bob Vila, the Most Trusted Name in Home Improvement, Home Remodeling, Home Repair, and DIY. Tried, True, Trustworthy Home Advice. https://www.bobvila.com/articles/best-gas-leaf-blower/

Fallows, J. (2019). Get Off My Lawn. The Atlantic. Retrieved 2021, from https://www.theatlantic.com/magazine/archive/2019/04/james-fallows-leaf-blower-ban/583210/.

Finance & Commerce. (2021). https://finance-commerce.com/email-alert-registration/

Fitz, D. (2021). Determination Particulate Emission Rates from Leaf Blowers. 14.

Gnankambary, Z., Bayala, J., Malmer, A., Nyberg, G., & Hien, V. (2008). Decomposition and nutrient release from mixed plant litters of contrasting quality in an agroforestry parkland in the south-sudanese zone of West Africa. Nutrient Cycling in Agroecosystems, 82(1), 1–13. https://doi.org/10.1007/s10705-008-9165-3

Haines, B. (2019). Leave the leaves on the ground: Nature Conservancy says to stop raking your lawn. Global News. Retrieved 2021, from https://globalnews.ca/news/6060276/dont-rake-your-leaves/.

Harvey, D. (1989). From Managerialism to Entrepreneurialism: The Transformation in Urban Governance in Late Capitalism. Geografiska Annaler: Series B, Human Geography: The Roots of Geographical Change: 1973 to the Present, 71(1), 3–17. https://doi.org/10.1080/04353684.1989.11879583

Hegarty, P. (2021). Hayward moves closer to banning residential gardeners from using leaf blowers. East Bay Times. Retrieved 2021, from https://www.eastbaytimes.com/2021/04/23/hayward-may-ban-gas-powered-leaf-blowers-at-least-in-some-places/.

Independent Tree. (2019). Don'T Send Fallen Leaves To The Landfill [What To Do Instead]. Independent Tree. Retrieved 2021, from https://www.independenttree.com/fallen-leaves/.

Landscape Ontario Horticultural Trades Association (LOHTA). (2002) Use of leaf blowers threatened by Toronto Council. Landscape Ontario. Retrieved 2021, from https://horttrades.com/use-of-leaf-blowers-threatened-by-toronto-council

Latour, B. 1999. Pandora's hope: Essays on the reality of science studies. Cambridge, MA: Harvard Univ. Press.

Letter: An auditory assault. (n.d.). Anchorage Daily News. https://www.adn.com/opinions/letters/2021/10/18/letter-an-auditory-assault/

Lin, K. (2012). Seasonal Science: What Lurks in the Leaf Litter? Scientific America. Retrieved 2021, from https://www.scientificamerican.com/article/bring-science-home-leaf-litter-biodiversity/#.

Lizee, T. (2019). Fall leaves on your lawn can improve soil, biodiversity and environment: experts. Global News. Retrieved 2021, from https://globalnews.ca/news/6031393/fall-leaves-on-your-lawn/.

Luedke, H. (2019). Nature as Resilient Infrastructure – An Overview of Nature-Based Solutions. Environmental and Energy Study Institute . Retrieved 2021, from https://www.eesi.org/papers/view/fact-sheet-nature-as-resilient-infrastructure-an-overview-of-nature-based-solutions.

Pollock, C., Sparks, G. & Banks, J.L. (2019). Lawn and Garden Equipment Sound: A Comparison of Gas and Battery Electric Equipment. Journal of Environmental and Toxicological Studies, 3(1). https://doi.org/10.16966/2576-6430.118

Marquez, G. (2018). Reducing Vancouver Board of Parks and Recreation Emission Footprint through Utilizing Electric Small Equipment. 44. Retrieved 2021, from https://sustain.ubc.ca/sites/default/files/2018-53%20Reducing%20Vancouver%20Parks%20Board%20emission%20footprint%20using%20electric%20small%20equipment%20_Marquez.pdf

McConnell, R., & Banks, J. L. (2015). National Emissions from Lawn and Garden Equipment. US Environmental Protection Agency. Retrieved 2021 from, https://www.epa.gov/sites/default/files/2015-09/documents/banks.pdf

Miller, N. (2020). Sacramento Bans Leaf Blowers On Bad Air-Quality Days. Capradio. Retrieved 2021, from https://www.capradio.org/articles/2020/11/11/sacramento-bans-leaf-blowers-on-bad-air-quality-days/?__cf_chl_jschl_tk__=63EUKlQKCo83_PashBKygmwrCB9.0dvKbi6gnlR.Imk-1637982297-0-gaNycGzNCqU.

(N.d.-b). NorthJersey.Com. Retrieved 2021, from https://www.northjersey.com/story/opinion/2021/05/25/summit-nj-gas-leaf-blower-ban-bad-businesses-residents/7417188002/

Sacramento City Express. (2020). Planning To Use A Leaf Blower In Sacramento? Best To Check The Aqi First. Sacramento City Express. Retrieved 2021, from https://sacramentocityexpress.com/2020/11/13/want-to-use-a-leaf-blower-in-sacramento-best-to-check-the-aqi-first/.

Schouten , L. (2015). Leave the leaves: How doing less yard work helps the environment. The Christian Science Monitor. Retrieved 2021, from https://www.csmonitor.com/Environment/2015/1105/Leave-the-leaves-How-doing-less-yard-work-helps-the-environment.

United Nations. (2015). The Sustainable Development Goals. Department of Economic and Social Affairs. Retrieved 2021, from https://sdgs.un.org/goals

Using Autumn's Bounty. (2021). Planet Natural Research Centre. https://www.planetnatural.com/leaf-mold/

Walter, Dan. (2021). California's gas lawn equipment ban hits the little guys.

Watkins, R. G. (2019). Particulate Matter (PM) and Ultrafine Particle (UFP) Measured on Pedestrian Walkways During and after the Nearby Use of Leaf Blowers (Order No. 22621758).

Wheeler, J. (2017). Leave the Leaves! Retrieved 2021, from https://xerces.org/blog/leave-the-leaves.