CIRCULAR
MONTRÉAL

BASELINE ASSESSMENT

November 2022

CIRCLE ECONOMY

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1 EXECUTIVE SUMMARY

Montréal is pioneering cities' transition to a circular economy. Circularity is increasingly becoming a part of the city's reality. So far, successful efforts have been made to decouple waste generation from recent demographic and economic growth—a trend set to continue, as new state-of-the-art waste processing infrastructure is already under development. Besides achieving significant material savings and recovery—diverting thousands of tonnes of waste from landfill each year—and preventing the emission of thousands of tonnes of carbon dioxide equivalents (CO2e), Montréal's transition to a circular city has already borne positive socioeconomic effects: the creation of jobs and new revenue streams from businesses working to further the circular transition, for example.

The sectors with a major role to play in accelerating Montréal's transition to a circular economy. To build on existing initiatives and accelerate the transition to a circular economy, Montréal and Circle Economy have explored four areas of particular interest to the city: **the Food system, Built environment, Textiles and Mobility**. In particular, Food and the Built Environment were already objects of Circle Economy's Québec's regional Circularity Gap Report in 2021, as the two sectors are often very resource intensive and, as such, are not only major contributors to the province's emissions, but also large contributors to the regional economy. This report analyses how materials flow across these four key sectors and derives potential scenarios for change. Identifying appropriate and context-specific opportunities for Montréal will allow the city to foster and enable circular opportunities at the municipal level.

Uncovering the circularity baseline of Montréal. Before suggesting avenues for change, it's important to first provide a baseline: a snapshot of the current state of circularity in the city. We performed four material flow analyses (MFAs) to analyse how materials and resources flow across four sectors, using the findings to inform a stakeholder workshop and formulate key challenges and opportunities for each focus sector.

Key take-aways:

- **Food system**: Montréal is a cluster of Québec's food processing industries, and as such, substantial volumes of food waste are generated in the city, especially early in the value chain. Although high recycling rates are achieved in processing industries, the largest share of food loss and waste is still downcycled into lower-value products such as animal feed.
- **Built environment:** High demand for materials to build new developments and upgrade existing stock has driven vast resource consumption in this sector. Most resources are locally sourced within the province of Québec, especially timber and metals: this is a step in the right direction for a circular built environment. Future efforts centre on decreasing total consumption, increasing the secondary material use rate and extending the lifetime of stocks.
- **Textiles:** This sector is often overlooked in terms of its resource intensity and waste generation. Montréal is a hub for textile manufacturing—and currently, most textile waste is either downcycled or exported: secondary textiles and products largely cannot be reused locally. Here, efforts should focus on tackling low capacity in terms of infrastructure and workforce for collecting, sorting and cycling textiles.
- **Mobility**: Personal vehicles remain the predominant form of transport for Montréal residents, despite recent growth in bicycle use during the covid-19 pandemic and a well-connected public transport network. This implies considerable material and energy consumption, as well as associated emissions. While fleet electrification is a key future step for achieving more sustainable mobility, the city must strive to further reduce its material footprint by adopting and promoting shared mobility options.

Circular scenarios to drive the transition in Montréal. Following the MFAand the stakeholder discussion, scenarios were developed based on potential circular actions. These were further defined in a collaborative, multi-stakeholder process coordinated by Ville de Montréal, in collaboration with various departments and experts. Together with stakeholders, we identified eight areas for effective and impactful action.

Actions for a Circular Montréal:

- To achieve a circular **Food system**, the Ville de Montréal may set up **living labs** and hubs to stimulate innovation, and give support to identify and enable industrial symbiosis solutions for its food system. Identifying opportunities for improved food waste measurement, collection and management from industrial, commercial and institutional establishments will also be a key action going forward.
- In working towards a circular **Built environment**, the Ville de Montréal may leverage **public procurement** to initiate change at a systemic level, supporting circular business models such as product-as-a-service, sharing platforms and circular supply chains. It will also be crucial to incentivise the high-value reuse and recycling of construction and demolition waste through better physical and digital infrastructure to match the supply of secondary materials with the demand for new construction works, among other instruments.
- To tackle the impact of **Textiles** within Montréal, systems-level change will be required—no single company can achieve circularity alone. Creating an ecosystem in which circular businesses can thrive will be crucial, by offering training and financial support, or raising awareness, for example. Creating this ecosystem will also enable improved collection, sorting and recycling capacity for textile waste to facilitate product, material and resource recovery and recirculation for extended time periods.
- To create a more circular **Mobility** system, the city may support **shared mobility** initiatives to provide joint access to vehicles, allowing people to get from A to B in a much more resource-efficient manner. Focus may also centre on optimising low-carbon freight and logistics systems to achieve the city's upcoming targets for zero-emissions vehicles.

The way forward: Recommendations for a Circular Montréal

Montréal is a vibrant city where great potential lies for a circular economy transition. The report highlights eight circular actions that will guide the City's four main sectors in the right direction. However, the following additional considerations should be kept in mind:

- **Political endorsement and collaboration** - From coordinating relations across value chains and stakeholders to steering and guiding the transition, public authorities from all departments must collaborate and will play a key role in the development of a roadmap and implementation of actions.
- **Clear governance** - Through multiple instruments and mechanisms and across different levels of governance, Ville de Montréal will simultaneously enable, facilitate and promote the circular transition across the different actions suggested.
- **Coordination amongst stakeholders** - Besides the local administration, citizens, businesses and other organisations must also engage in working groups for the design and implementation of the circular economy roadmap.
- **Improving data availability** - Data quality and reliability have been a challenge throughout the project, which is why an improved access to primary research and databases is needed across all sectors to improve the monitoring of Montréal's circularity in the future.
- **Leaving no one behind** - All the effects of the circular transitions on workers and the labour market composition should be investigated before implementation to avoid and mitigate negative impacts on Montréal's workforce.

2 INTRODUCTION

The circular economy is a global opportunity for local economies across the world. Given their sheer size, financial clout, abundance of natural resources and large environmental impact, North American countries such as Canada are well-positioned to drive the transition to a more circular and regenerative economy. Yet, the circular transition in Canada is in its infancy, both in terms of policy development and economic reality. While the world's circularity sits at 8.6%, the first regional Circularity Gap Report on the Canadian province of Québec found that the province is lagging behind—cycling just 3.5% of the materials it consumes[1]. The circular economy transition will bring numerous benefits, and as Québec begins its journey, the involvement of key cities like Montréal will be crucial.

In order to get involved in a meaningful way, however, cities need to go back to the basics, and first form a solid understanding of their current situation. They may ask: what is the current state of the circular economy in the city? Which sectors use the most resources? What are the main challenges for creating a flourishing circular economy? And ultimately, which potential scenarios could drive the most change and develop a circular economy in those sectors? To answer these questions, Circle Economy has worked with the Ville de Montréal (City of Montréal) to inform the development of a Circular Economy Roadmap for the city.

Circularity is slowly becoming a reality within the city of Montréal—and the trajectory for the future will centre on harvesting the fruits of actions already implemented in recent years. Since 2010, waste management measures have erased the impact of demographic and economic growth. Between 2010 and 2018, waste generation fell by almost 8%—a source reduction of 69 kilograms per capita—and the rate of recovered materials increased from 35% to 47%, stable also in 2019. New plans for state-of-the-art infrastructures will allow Montréal to increase its waste processing capacity to approximately 225,000 tonnes[2]. Moreover, the circular economy is already yielding positive socioeconomic effects, in particular through the creation of local jobs. The projects supported by Synergie Montréal—covering over 1,300 businesses working in the field of circular economy—generated CA$441,611 in revenue in 2020 alone, as well as savings in procurement costs and residual materials management fees, while also eliminating 2,800 tonnes of carbon dioxide equivalents (CO2e) and diverting 2,000 tonnes of waste from landfill each year[3].

Given the increasingly clear benefits of the circular economy for the city, the circular economy is considered in Montréal's Vision 2030 plan, in its Climate Plan, and in the 2020 and 2021 post covid-19 economic recovery plans through funding support for companies transitioning towards circular business models. These also support collaborations to implement the circular economy in the social economy, as a source of innovation, and in the bio-food industry. The Ville de Montréal is already a partner of RECYC-QUÉBEC, the reference organisation for everything related to the responsible management of residual materials in Québec, and Fondaction, a labour fund that established the first circular economy investment fund in Canada.[4]

Additionally, as part of C40 Cities, Montréal has signed the Advancing Towards Zero Waste and Good Food Cities declarations, and has developed a Zero Waste Plan 2020–2025, aiming at 1) a diversion rate of 70% by 2025 (85% in 2030) and 2) a 10% reduction in the generation of waste over the timespan set by the plan (20% by 2030).[5]

Montréal boasts clear objectives, a number of local initiatives and potential funding opportunities: it is time to build on this momentum and accelerate the circular transition in the city for a positive and long-lasting environmental, social and economic impact.

2 INTRODUCTION

About this project

To build on existing initiatives and further accelerate the transition to a circular economy, the Ville de Montréal and Circle Economy have further investigated four key sectors of interest for the City: the **Food system, Built environment, Textiles** and **Mobility**. The first two, among others, have also been identified as sectors of interest for accelerating the transition to a circular economy in Québec, following the regional Circularity Gap Report in 2021[6]. A baseline assessment of the circularity of these four sectors has been undertaken on the basis of the Circle City Scan, a process developed by Circle Economy to help cities identify contextually appropriate opportunities to foster a circular economy.

To meet this objective, the baseline assessment was structured around a:

- **Material flow analysis**. The project started by analysing the current state of the circular economy in the city, by analysing material flows across four key sectors through material flow analyses (MFAs) and visually mapping them in easy to understand diagrams. The results of the analysis informed a stakeholder workshop, in which different stakeholders validated the results, and reviewed and added to the main challenges and opportunities identified for each focus sector.
- **Scenario analysis**. Based on the stakeholder discussion, potential circular actions were further defined in a collaborative, multi-stakeholder process coordinated by the Ville de Montréal, in collaboration with various departments and experts. The scenario analysis investigates the potential impacts of these circular actions, and explores their feasibility in the context of Montréal.

3 MATERIAL FLOW ANALYSIS

Approach and methodology

A sectoral material flow analysis (MFA) provides a holistic view of the material throughput of a sector, depicting visually how resources are consumed, processed and disposed of. For each key focus sector, the MFAs investigate:

- **Material inputs:** What types and quantities of materials and products are consumed in the city of Montréal?
- **Stock use:** How do these products and materials flow within the city?
- **Waste:** What types and quantities of wastes are generated in the city of Montréal?

MFAs are a useful tool to visualise and summarise complex information. However, MFAs only offer a static 'snapshot' of resource flows through a given sector or area of the economy. Moreover, the accuracy with which a MFA can depict local realities is highly dependent on the quality, format, age and availability of the data. While the MFAs in this report were prepared using the best data available, they should not be viewed as complete and comprehensive representations of the resource metabolism of each sector. The data used to prepare the MFAs in this analysis was collected from a wide variety of sources, both from governmental and non-governmental sources, using different estimation methods. In some cases, national or provincial data have been adapted and scaled to represent the city, while in other cases, older data was used, therefore not necessarily reflecting the most recent developments. When trying to harmonise different sources and methods, the 'mass balance' principle does not apply, meaning that some flows could not be fully represented due to data limitations and gaps. Moreover, the MFAs provide system-level overviews and are not intended to present detailed information on specific business processes or operations.

All data points shown in the MFA diagrams have been rounded to the nearest ten (Food system) or hundred (Built environment) to indicate that they are the results of estimations by the researchers following the methodology and data sources. Data provided directly by Circle Economy or the Ville de Montréal is shown as an integer. Further research to address the data gaps identified through this project will be required in order to make informed regulatory or policy changes aimed at enhancing circularity in Montréal.

System boundaries

The scope of the MFAs focuses on the Agglomeration of Montréal, a territory of 500 square kilometres, made up of 16 related cities, including Montréal and its 19 boroughs. We use 'Montréal' when referring to the city and the 'Ville de Montréal' or 'the City' when referring to the city government.

MFAs include flows representing direct inputs and outputs (waste) into certain sectors. It is important to note that, while waste may be generated within the municipal boundaries of Montréal, many recycling and landfilling activities are located outside of the city itself. These treatment processes are included in the MFA to provide a more complete picture of waste management activities.

Where possible, movements across the municipal border are documented, including imports of goods, but also the export of waste products and the sale of recycled materials to secondary international markets. It is important to note that not all processes and possible material 'leakages' are modelled within the system, such as illegal dumping and scavenging. The omission of such processes and sources of material 'leakage' is the result of very scarce or absent data, often due to the nature of these activities.

Finally, the analysis also does not capture the effects of the covid-19 pandemic. The majority of the data and information used in the MFA analysis refers to 2019 as the baseline year. Analysis and interpretation are restricted to pre-pandemic conditions. The MFA assessed the status of circularity in Montréal based on actions and interventions possible in pre-pandemic times, rather than possibilities within the current disrupted system. In cases where 2019 data was not available, the most recent sources available were used instead.

Sectors

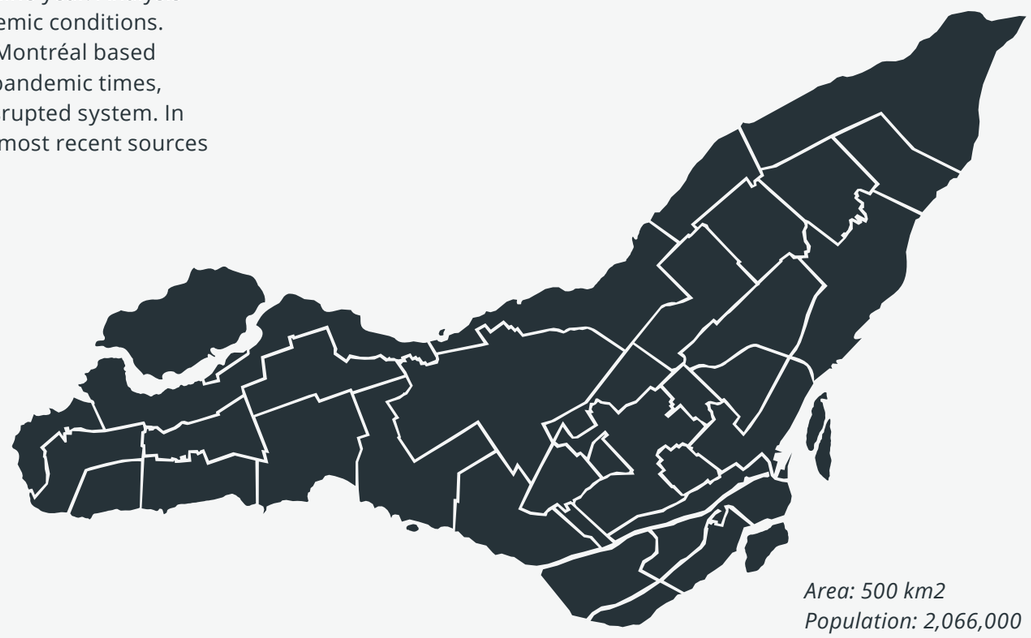
In this document, we present MFAs for three sectors, and a comprehensive assessment for a fourth sector, defined as follows:

Food system refers to the complex web of activities involving the production, processing, manufacturing, transport, retail and services that make food available for consumption.

Built environment, or built world, refers to the human-made environment that constitutes a city, including homes, buildings, streets, infrastructure, open spaces and more.[7] It includes the construction of new buildings as well as the demolition and renovation of built structures. Activities undertaken by private households are not included as data is not easily available.

Textiles refers to the textile value chain, primarily concerned with the design, production and distribution of yarn, cloth and clothing, and textile waste management.

Mobility refers to the consumption of materials, and the use and waste management phases of vehicles used for the transport of people and goods within the city. This includes both private and public forms of transport.



Area: 500 km2
Population: 2,066,000

Material flows

The material flow categories that are used in this report are general in nature. Materials are examined in a given sector according to their specific relevance, and thus not all material flow categories are present across all sector analyses. The specific material flow categories that are used in this report include:

Biomass [tonnes]: The amount of vegetable and animal products originating from agriculture and forestry (i.e. wood), as well as prepared meals and food products.

Minerals and Chemicals [tonnes]: The amount of solid materials that are present in nature, and products such as clay and bricks. This category also includes chemical compositions and oil-based products such as plastics and rubber.

Metals [tonnes]: The amount of raw and processed metals and products, varying from iron ores to paper clips.

Other materials [tonnes]: The aggregated total in this flow includes textiles, multi-layered materials, products made up of multiple materials, and other mixed materials.

Emissions [tonnes CO2e]: The combined total of all greenhouse gas (GHG) emissions produced by a sector, converted into tonnes of carbon dioxide equivalents (CO2e).[8]

Energy [terajoule]: The amount of energy consumed by a specific economic activity during its operations.

Management of **solid waste** is expressed according to two categories: diversion and disposal.

Diversion: Waste processing methods like recycling, composting, anaerobic digestion and others (i.e. reuse, repair, upcycling, etcetera) aimed at preventing waste from reaching landfills.

Disposal: Disposal of resources within an engineered landfill site, or through incineration. There is only one landfill site located in the vicinity of Montréal, which currently receives 39% of the materials intended for disposal. However, this is expected to close within the next ten years, while the current capacity is at risk. During the summer of 2022, the site closed its doors to certain customers for more than a month in order to avoid exceeding the annual tonnage capacity authorised by Québec. This further underscores the importance of preserving existing landfill capacity by diverting resources from disposal. Although no waste managed by the City is currently incinerated, this treatment method is still used by private sector enterprises.[9]

FOOD SYSTEM

Photo credit: Still Good

4 FOOD SYSTEM

Food is an essential need for humans everywhere, and meeting the individual food needs of city dwellers requires the successful functioning and cooperation of a number of large systems. Today, the world's food systems are responsible for more than one-third of global anthropogenic greenhouse gas (GHG) emissions and over two-thirds of human-induced pressures on biodiversity.[10] The interconnected nature of food systems makes this sector particularly suited to a circular economy approach, not only because circular principles are highly applicable to food systems, but also because food systems readily lend themselves to a framework focusing on communities and relationships.[11]

Circular food systems prioritise regenerative production, favour reuse and sharing practices, optimise resource inputs, reduce pollution and ensure resource recovery for future uses. In the process of going circular, food systems can leverage cross-sectoral synergies and close resource loops. Cities have a huge influence over food systems, both within and beyond their physical boundaries. Indeed, city dwellers often consume food produced far beyond the city's borders. As hotspots of food consumption, cities have an important role to play in creating more circular food systems that help to reduce the global footprint of their citizens' food consumption and extend this positive impact beyond their borders.

Although Montréal is highly urbanised and relatively little land is dedicated to agriculture (around 4%), the area's food industry is of high importance for the city and for the region. Montréal is, indeed, the primary food processing centre of the province and a major logistics hub due to its location and port infrastructure. For example, food processing and manufacturing activities in Montréal account for 39% of the total value of its food industry and 13% of its food industry workforce. There are about 726 food processing and manufacturing operations in Montréal with an economic value of CA$9.4 million.[12]

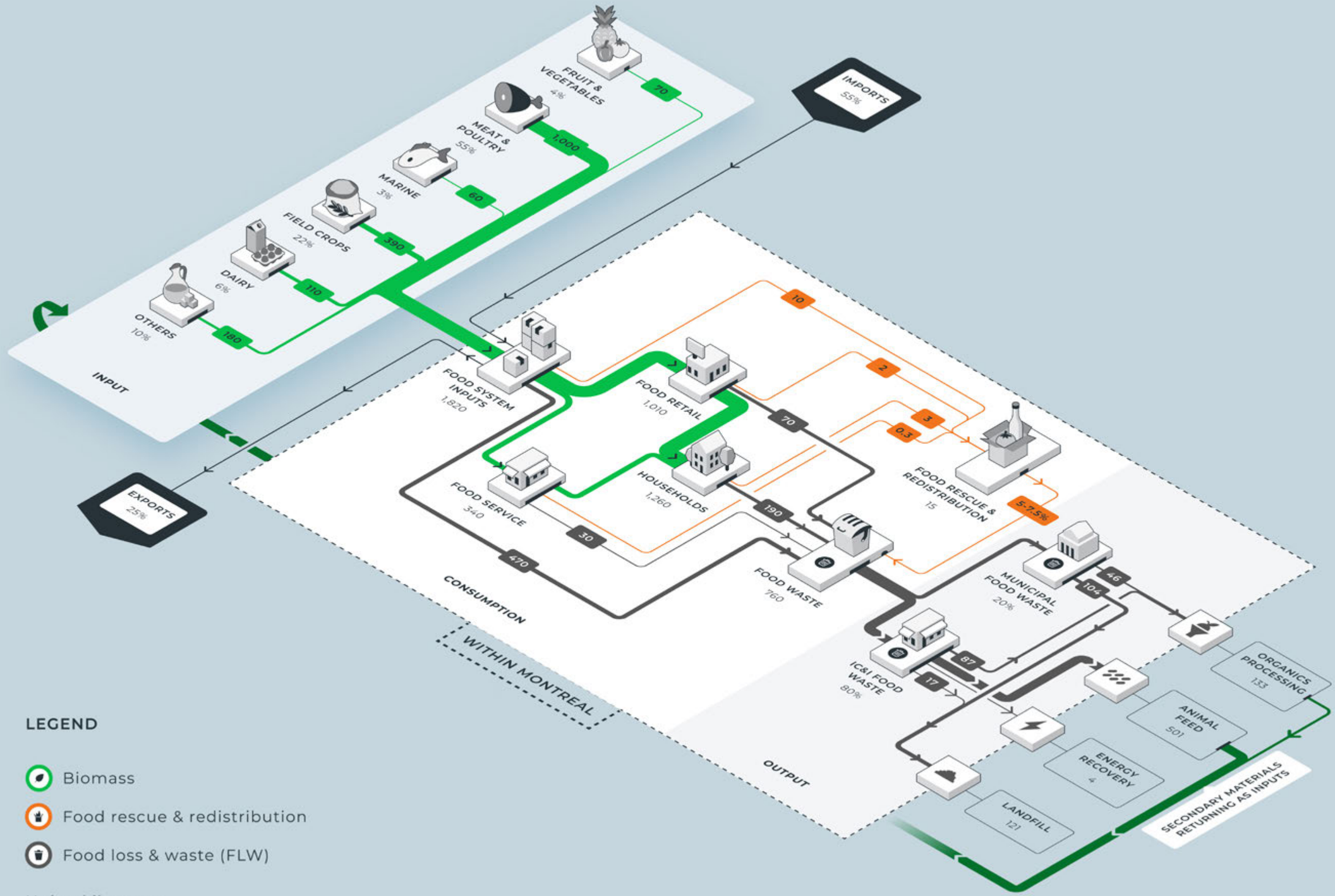
The industry has already seen many players taking part in the sustainability transition. On the public sector side, the Ville de Montréal kick-started its journey towards a circular food system by setting the ambitious target of cutting food waste by 50% by 2025[13]. To do so, the city aims to build a new organic processing infrastructure and expand food waste collection, progressively banning food waste landfilling from industrial, commercial and institutional (IC&I) sources[14], and banning the sale and use of the most toxic pesticides, including glyphosate—the first ban of its kind in Canada[15]. Additionally, the municipality has already sought public opinion on recommendations for food waste, and has developed an urban agriculture strategy spanning from 2021 to 2026, which aims to increase the area of cultivated land within the city by 33%.[16]

According to various sources, food waste in Montréal represents approximately CA$3.4 billion in losses (CA$3,500 per household), of which approximately CA$1.1 billion could be avoided. But reducing food waste is not only necessary to minimize the economic cost of food—it is also essential to reduce the negative environmental impacts that harm local ecosystems and Montréal's citizens.

SYSTEM BOUNDARY

- All steps of the food value chain are considered, from production to processing to consumption. It is important to note that while not all steps of the value chain occur solely within the agglomeration's boundaries, they are considered here to provide a more complete picture of the city's food system.
- Food waste is defined as both food loss and food waste (FLW) from production, to processing and manufacturing, to consumption. **'Food Waste'** consists of food that is discarded during distribution, retail, and food service, and subsequently in the home. **'Food Loss'** is the discarding of food that occurs from post-harvest up to, but not including, food service and retail.
- Two forms of FLW occur along the food chain: 1) non-edible (unavoidable) FLW—(such as animal bones); and 2) edible (avoidable) FLW (such as apples that reach the store but are not sold due to bruising in transit).[19]
- As is the case with food data in many cities, major data gaps were encountered throughout the research. Much of the available data on food flows are available in monetary values, and not volumes, meaning that we had to make assumptions and take measures to harmonise different data sources. Moreover, data on food trade along each step of the value chain is lacking and only scattered information could be found—as indicated by the black boxes in the visual.

4 FOOD SYSTEM MFA



LEGEND

- Biomass
- Food rescue & redistribution
- Food loss & waste (FLW)

Unit = kilotonne

4.1. MATERIAL FLOW ANALYSIS

Food inputs into Montréal are largely dominated by livestock and animal products, representing over 60% of total inputs. More than half of the total products are imported from outside of Québec (other Canadian provinces or the rest of the world). However, Montréal is also a major centre for food processing and manufacturing within the province—in fact, 25% of food production (in value) is exported abroad. About 62% of waste occurs before food even reaches households through retail and food services—during production, processing, manufacturing and distribution. Although the food manufacturing and processing industry has shown high recycling rates (as high as 97%), the majority is downcycled into animal feed products. Overall, 39% of the estimated total FLW (716 kt) is considered edible and could be avoided. Significant improvements could therefore be achieved via rescue and redistribution, as well as increased waste collection, especially from IC&I establishments where high-value organics processing is more scalable than at the household level.

FOOD SYSTEM INPUTS

Total food inputs of the food system are estimated at around 1,820 kt, equivalent to 2.41 kilograms per capita per day. About 55% of all food inputs entering Montréal's food system are related to livestock and dairy farming. Québec is, indeed, Canada's largest pork and veal producer. The province also leads in fruits and nuts production (cocoa, for example), but most importantly maple syrup (of which Québec is the world's largest producer).

About 45% of Montréal's food comes from Québec, the rest is imported—22% from the rest of the world and 33% from the rest of Canada. Statistics Canada estimates that around 25% of production value is exported.[23] The main markets for Québecois products are the United States (69%), the European Union (8%), Japan (7%) and China (6%).[24]

Before food reaches Montréal—through production, processing, manufacturing and distribution—about 470 kt of waste occurs (equivalent to 227 kilograms per capita). This is about 62% of Montréal's total food waste generation. About 10% occurs at the farming stage, 45% during processing, 4% during manufacturing and 4% during distribution. According to food waste reports, the main causes of FLW before reaching the city are poor quality inputs, inaccurate forecasts, and other factors such as human error, equipment malfunction/damage or changes in customer orders. Reports also reveal that around 80% of food manufacturers in Montréal are actively seeking to reduce FLW, although less than 15% of them are currently estimating quantities of FLW. FLW occurring before entering the city is typically directed towards organic waste processing plants, converted into animal feed and/or sent to landfill.

FOOD THROUGHPUT

Food retail

Food retail is an important segment of the food industry, accounting for 15% of the industry's GDP and 21% of its workforce, with a commercial value of CA$7.1 billion and over 3,254 establishments registered in the city.[28]

As such, food retail is also responsible for considerable volumes of food waste (nearly 10% of the total in the city, 22% of edible food waste for the entire province)[29], all of which is considered edible. The main reported causes of food waste in retail include inaccurate forecasts and poor quality inputs, but also date codes (for example, 'best before' dates). Around 80% of food retailers are actively seeking to reduce food waste and over 90% of them already measure (either directly or via estimations) the volumes of food waste generated. Most of the waste generated by this sector is managed either through rescue and redistribution, organic waste processing plants (compost) and/or sent to landfill.[30]

Food service (Hotels, restaurants and institutions)

The food service sector comprises businesses, institutions and companies responsible for preparing meals outside the home (i.e. hotels, restaurants and institutions). Food service is the largest contributor (32%) to the food industry's GDP and employs over half of the city's food sector workforce (54%). The commercial value of this sector is CA$4.5 billion, with a total of over 7,308 establishments.[31]

FLW at this stage is usually lower than in the production and retail stages, representing about 4% of the total waste generated in Montréal's food system, of which 50% is from edible food or 'plate waste' (i.e. served food that is discarded) while the rest is inedible parts that become waste during food preparation (peels, seeds, bones etcetera). In food services, the top three causes of edible FLW are plate and preparation waste, inaccurate forecasts and human error. Around 70% of hotels, restaurants and other institutions are actively seeking to reduce edible FLW, and over 90% of them are estimating the volume of FLW. The most common destination for FLW in food service establishments remains a landfill. Some of it is also sent to organics processing, and some food service establishments avoid or reduce FLW through rescue and redistribution options.

Households

The total volume of food available for final human consumption is estimated to be around 1,260 kt (equivalent to 610 kilograms per capita). Vegetables and fruits represent 45% of this food flow, followed by beverages (16%), dairy and eggs (14%), meat and fish (10%), and grains and cereals (10%). In Québec, final food consumption represents an average of 12% of the total household's expenditure. Most of this food demand is from retail (around 75%), while less is from food service (around 25%). Most household expenditure is spent on meat and dairy, although there is an increasing trend towards foods like fresh produce and grains. Households are responsible for the largest share (25%) of food waste generation.

Food rescue and redistribution

Food rescue and redistribution[37] is estimated based on the amount recovered by Moisson Montréal in 2018, the largest food bank in Canada, and upscaled based on national data on food rescue and redistribution.[38] This is likely an underestimation of the total quantities of food given to charitable organisations by companies in these sectors across Montréal, since many of them donate to other organisations. Data is indeed a challenge, as it is estimated that 50% of actors within the rescue and redistribution value chain are keeping track of FLW volumes, so the current estimate gives only a first glimpse into the current potential of food rescue and redistribution in Montréal.[39]

Overall, about 15 kt (equivalent to 7.3 kilograms per capita) of unsold edible food and beverages are currently rescued.[40] However, around 5 to 7.5% of rescued food never reaches the consumer due to poor quality inputs, date codes and human factors and ends up in landfill or composted. Retailers, manufacturers and, to a lesser extent households, play the largest role in rescuing and redistributing surplus food. In general, rescued food is from industrial surplus or products not meeting commercial standards (i.e. packaging defects, etcetera), or because food that is still meeting safety standards (i.e. meat frozen the day before to preserve it) cannot be sold because the 'best before' date has passed.

Food waste

Total FLW generation across the supply chain is estimated at about 761 kt (equivalent to 368 kilograms per capita). Overall, 39% of food wasted is still edible. Fruit and vegetables, followed by field crops (for example, bread, baked goods and pasta), represent the largest proportion of this: 45% and 25%, respectively.

The Province of Québec as a whole, along with jurisdictions like the Ville de Montréal, has a history of being at the vanguard of environmental initiatives, and is committed to reducing FLW and its associated environmental emissions.[41] A few circular practices are already underway. By the end of 2025, the goal is that 72% of households served by municipal services will be provided with a bin for separate food collection or for organic waste. Already, the quantities of organic matter collected have more than doubled between 2010 and 2018.[42]

However, despite the many efforts in separating collection, much of the food still ends up in mixed waste bins. Almost 69% of the food waste handled by municipal services is sent to landfill, while only 31% is directed to compost or biogas plants,[43] thanks to the newly implemented separate food and organic waste bin scheme. Municipal treatment of organic and food waste is carried out across several infrastructure types: a municipal organic matter composting centre, three private organic matter composting centres and six landfills. Two additional organic matter treatment centres are currently being designed (Montréal-Est and Saint-Laurent) to gradually replace the current private composting centres by 2023. The operation of the planned organic matter treatment centres will allow a reduction in GHG emissions of approximately 20,000 tonnes CO2e per year between 2022 and 2025.[44]

Still, the Ville de Montréal only manages about 20% of the estimated total FLW, and the city mainly serves waste generators such as households and small businesses. The private sector handles the remaining 80% of FLW generated throughout the food supply chain. Private waste haulers within the area direct food waste to animal feed and other biological treatment of organics. Thanks to important circular practices, like turning food unfit for human consumption into animal feed, the food processing industry reached a 97% diversion rate in 2013.[45] Although using food waste as animal feed is considered downcycling (especially if the FLW is considered edible), efforts by actors at this stage of the supply chain are noteworthy.[46] Little FLW generated in Montréal is still incinerated for energy recovery, mainly by private waste haulers active in the region.[47]

Photo credit: Still Good

4.2. CHALLENGES AND OPPORTUNITIES

1. Food waste from industries: towards a resilient and resource-efficient local food system based on industrial symbiosis

As highlighted by the analysis, the food industry produces large volumes of wastes, during the production, processing, and manufacturing of food. Industrial waste flows not only contribute to GHG emissions and pollution if improperly disposed of, but also constitute a significant loss of valuable biomass, nutrients and resources that other industries could benefit from.

The food industry has already shown a high potential for self-managing industrial food waste flows, of which significant associated non-edible parts are directed to animal feed production. More could be done to spur high-quality reuse of edible food waste in other industries, applying principles of industrial symbiosis to recover food waste, transforming it into alternative products fit for human consumption.

2. Localising food production and consumption: promote healthy, sustainable and local food choices as well as urban agriculture

The material flow analysis (MFA) has highlighted that about 55% of food inputs (in mass flows) stem from dairy and meat products. These food categories are also associated with the highest carbon footprint[48]. If there is no further climate action within the food sector, it has been estimated that the emissions impacts from farming, food production, processing, transportation and waste will increase by 38% by 2050.[49]

Canadians have already started embracing a more sustainable diet.[50] The greater availability of milk substitutes, like oat milk—as Canada is its second largest global producer—has eroded milk's market share.[51] For reasons of health, environment, animal welfare, price or the proliferation and marketing of plant-based products, the number of Canadians questioning the role of meat in their diets has never been higher.[52] Next steps in food policy development should focus on sustainable dietary choices to build on this momentum. For this reason, it will be crucial for the Ville de Montréal and its stakeholders to promote buying local and support the supply of healthy and sustainable foods.

BOX ONE: Opportunities for urban and peri-urban farming[53]

Although it was not possible to estimate how much is produced within Montréal from urban agriculture, this practice is well established within the city. Within the city itself, there are 28 farms, many practising urban agriculture and other activities such as beekeeping. The commercial urban agriculture installation of the world's first commercial rooftop greenhouse (Lufa Farms), launched in 2011, has placed Montréal at the forefront of commercial urban agriculture on a global scale.[54] Commercial urban agriculture has been experiencing unparalleled enthusiasm and marked growth in Québec in recent years, with a continuously increasing number of companies working in this sector.[55] The number of these enterprises has grown by an average of 30% per year since the early 2000s, with 40 urban agriculture companies in the city as of 2020, rendering Montréal a pioneer in this field.[56]

Moreover, based on a recent survey conducted for the Ville de Montréal, 44% of Montréalers practise some form of urban agriculture.[57] Montréal's citizens mainly cultivate food in their backyards (51%), but also on their balconies (30%), in community gardens (8%), and on roofs and other parts of buildings (5%). Despite the many challenges, the farming community in Montréal is already advanced in terms of a circular and sharing economy. Around 42% of urban farmers are able to produce enough food to share crops, while 23% of them already practice composting. Pesticides are used very little. On the contrary, rainwater harvesting is often used to irrigate crops (practised by 19–25% of people).

Beyond the city itself, only 21% of its agricultural zone is under cultivation. The territory of Montréal, mainly the west of the island, offers interesting potential in terms of peri-urban production. For instance, in the agricultural Parc du Bois-de-la-Roche, in the nearby village of Senneville, 48% of the remaining area is a natural environment. In the nature park of Cap-Saint-Jacques, the city also owns an ecological farm, which runs as a social economy enterprise.[58]

Urban farming not only helps increase circularity within the urban food system, but also helps improve relationships and communities. However, only about one in two people knows that the Ville de Montréal encourages and supports urban agriculture on the island and many still do not practise this due to lack of time (24%), lack of private space (37%) or a space where cultivating is possible (17%), lack of interest (25%), or lack of knowledge (26%). There are opportunities for the Ville de Montréal to build on this momentum and expand its reach to support urban farming.

3. Improve municipal collection of food waste

The Ville de Montréal began offering food waste collection services to all Montréal residential buildings with eight or fewer units in 2019, and is planning to expand the collection to larger buildings by the end of 2025, as part of the city's plan for managing residual waste. While the city currently offers collection from assimilable IC&I (i.e. 720 litres of organic matter per week), the frequency of collection and the admissible quantity do not meet the needs of all IC&I establishments. Therefore, many food processors, grocery stores and large food retailers in Montréal do not use the municipal collection services and rely largely on private collection services. Privately negotiated contracts do not require the use of municipal transfer stations or municipal landfill, or adherence to the City's waste related bylaws. Moreover, private waste management companies are not required to disclose their facilities or data to the City. For these reasons, even though public data is of good quality, data on privately handled waste is limited and inconsistent across reports.

Increasing the number of players and initiatives that offer collection and diversion solutions, or improving the waste service offer (for example, through the installation of dehydrators in companies to space out collections, sharing platforms and collection of certain materials) is a great opportunity to scale up the diversion of food waste from landfills. Moreover, as food waste is measured at different scales and stages of the value chain, expanding municipal waste collection to IC&I establishments or enforcing regulations and disclosure requirements could provide primary data on the quantity and quality of food waste produced by these types of generators.

BUILT ENVIRONMENT

Although the urban built environment represents a relatively small fraction of total land use on Earth, its impacts are far-reaching—from biodiversity loss, resource depletion and waste generation to greenhouse gas (GHG) emissions and environmental pollution. This sector is highly resource-intensive, and unlike many other sectors, the incoming material flows accumulate within the city in vast magnitudes over time in the form of buildings and infrastructure. Still, the built environment plays a crucial role in meeting basic needs for shelter, safety, mobility and a sense of community across cities.

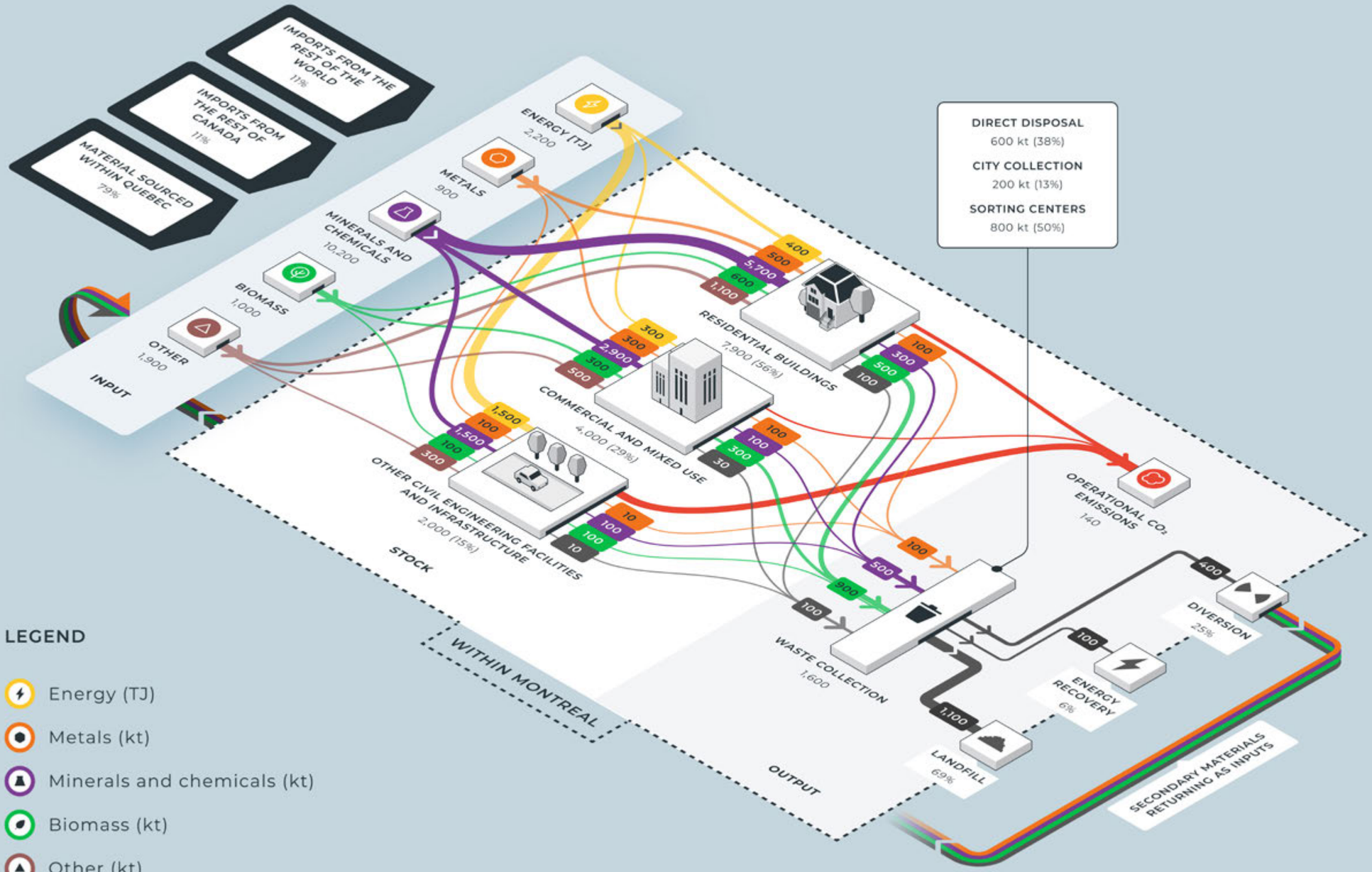
For these reasons, among others, the built environment is a focus sector for the Ville de Montréal. The City has recently revised its 2009 sustainable building policy for municipal buildings, with the release of a new policy for the Real Estate Management and Planning Service to improve the environmental performance of new developments in November 2021. Moreover, the City's Climate Plan 2020 identifies construction developments as a main opportunity to increase resilience to climate change and improve Montréal residents' quality of life. For this, a new roadmap for zero-emission buildings was announced in May 2022.[59] Finally, the Ville de Montréal has identified the urban built environment as a key lever to improve waste management practices, while increasing the recovery of construction, renovation and demolition (CRD) residues is one of the main objectives to reach the targeted diversion rate of 70% by 2030.

Incorporating circular strategies within this sector could serve to complement existing efforts. In an ideal circular city, the processes of designing, building, maintaining, refurbishing and replacing buildings and infrastructure would ensure that materials and components are maintained and used at their highest value for as long as possible. For example, circular buildings would be designed for disassembly, so that components can be salvaged and repurposed in other buildings at the end of their useful lives. Additionally, all materials used would be non-toxic and components would be easily repairable to ensure the longest possible lifespan. In some cases, it may be possible to use materials that are carbon negative, reducing the life cycle carbon footprint. Given that buildings and infrastructure often use a great deal of energy and water, it is important that they have optimal resource efficiency, embrace passive design principles and use renewable energy sources where possible.

SYSTEM BOUNDARY

- Although many materials used by the construction sector are mined outside of the city, the material flow analysis (MFA) considers the origins of these materials, deriving this data from the same database that fed into the Circularity Gap Report Québec (2021) and was downscaled based on labour data, with the exception of energy use.[60] [61]
- The MFA considers how materials are used across new residential, non-residential and infrastructure developments, using land use by building type to estimate the volume of construction inputs flowing into each building type. However, this is a rough estimate that does not take the material intensity of each building type into account. Commercial buildings, for instance, use more steel and glass on average than residential buildings, but this is not accounted for in the MFA.
- Due to data limitations, emissions accounted for in the present MFA only include operating emissions (i.e. energy and fuel use, transport, running offices, plants, etcetera) from the construction sector. It does not represent the emissions from waste treatment or disposal, and the life cycle/embodied emissions of construction materials

5 BUILT ENVIRONMENT MFA



LEGEND

- Energy (TJ)
- Metals (kt)
- Minerals and chemicals (kt)
- Biomass (kt)
- Other (kt)
- Emissions (tCO_2)

5.1. MATERIAL FLOW ANALYSIS

The built environment is a resource- and energy-intensive sector. A large volume of materials is needed to build new developments and upgrade existing building stock (mainly minerals, metals and biomass). Although most materials—such as wood and metals—come from Québec, the rest come from other parts of Canada or from the rest of the world. As a highly important regional centre, Montréal has a key role to play in driving up demand for sustainably and locally sourced materials and decreasing total material consumption, by upgrading existing stock and increasing the use of secondary recycled or reused materials.

BUILT ENVIRONMENT INPUTS

The built environment is one of the most resource-intensive sectors of the global economy. It consumes vast amounts of materials, like cement, sand, gravel and stone—most of which have extremely high embodied energy—as well as energy and water. In Québec, the construction and maintenance of houses and infrastructure is the greatest source of demand for these materials. It accounts for 88 million tonnes (34%) of the province's material footprint.[62]

The MFA for this sector offers a static 'snapshot' of how many resources are added to the existing stock in a given year (2019). The sector consumes 14,000 kt of materials. About **79%** of these materials are sourced from Québec, 11% from the rest of Canada, and 11% from the rest of the world. The main materials sourced locally are minerals, metals and biomass (i.e. wood). Indeed, one-fifth of Canada's mining output comes from Québec, mainly related to minerals and metals,[63] whereas about 2% of the province's GDP stems from Forestry.[64]

Montréal is home to almost one-fifth of the provincial population, and the hub of the province's engineering activity given the city's major public transportation infrastructure projects underway. Each year, Montréal and its boroughs carry out more than 500 construction projects (mainly roads and other infrastructure), representing 25% of all the work done in Montréal.[65] These projects serve to repair, optimise and modernise infrastructure to improve services to residents and their quality of life. In a word, they're essential. In addition, over 16,000 permits[66] to build or modify residential, industrial, commercial and institutional (IC&I) buildings are issued by the Ville de Montréal each year for work on its territory, excluding reconstituted cities. For these reasons, the way the City sources the materials used in its built environment has a clear impact that extends well beyond the city's border—meaning that the City has an important role, along with other stakeholders in the built environment sector, in reducing the local, regional and global ecological impacts stemming from its construction activities.

BUILDING USE

In Montréal, the housing stock is largely dominated by residential buildings. Medium- and high-density residential construction are taking up more and more space in the urban area, while the proportion of single-family homes available on the Montréal market has fallen sharply since the early 2000s (from 50% to around 7% in 2021)[67]. This was also fuelled by the strong demographic growth experienced in downtown Montréal—stronger than any other major urban centres like Vancouver and Toronto. Indeed, since 2011, 41% of new housing has been built in transit-oriented development (TOD) areas, which maximise the amount of residential and non-residential space within walking distance of public transport and are surrounded by a high-density mixed-use area, with lower-density areas spreading out from their centre.

Unfortunately, due to a lack of data, it was not possible to differentiate the impact of different residential, non-residential and infrastructure developments on material consumption. Material intensity is only available for residential and non-residential developments, but not for infrastructure. However, regarding energy intensity, it is possible to differentiate between building types due to data from Statistics Canada.

Infrastructure developments are the most energy-intensive building type (69% of consumed energy), followed by residential buildings (18%) and non-residential buildings (13%).[68]

The use phase of buildings represents the largest resource flows for energy and water.[69] For this reason, key actions such as upgrading the existing building stock and improving the resource efficiency of new buildings are key to advancing circularity in the built environment. These types of actions could also have a positive impact on decreasing vacancy rates (as existing buildings can be refurbished, repurposed or renovated) and on emissions from buildings use (see BOX THREE).

BOX TWO. Vacant spaces are a well of untapped potential

In a circular economy, vacant spaces in cities are idle assets that could be put to better use, improving overall resource management in the urban built environment. In Montréal, vacancy rates constitute a key challenge in the city both for residential and commercial buildings, but for different reasons. In 2019, Montréal recorded its lowest residential vacancy rates in recent history, resting at just 1.5%. This meant there were few apartments available for those looking for a new home, starting a new housing crisis. While the effects of the pandemic (i.e. a decrease in immigration, tourism and the overall number of students) temporarily ameliorated the issue, rental prices did not decrease—and are in fact expected to rise again once students and workers return.[70] The opposite is happening with regards to the office vacancy rate, nationally at its highest level since 1994[71] (10.6% in Montréal).[72] Western and eastern suburbs suffer from the highest commercial vacancy rate in the city, and hit 22% and 20%, respectively in 2018.[73]
By renovating and repurposing existing office buildings, Montréal could both decrease the sector's material footprint by cutting demand for new buildings, and also turn empty office buildings into apartments to ameliorate the housing crisis.

BOX THREE. Emissions from buildings

Around 28% of emissions generated in Montréal stem from the use of buildings, primarily due to heating and cooling using fossil fuel energy. Emissions from commercial and institutional buildings constitute 16% of Montréal's total emissions, and residential buildings account for 12% (2015). GHG emissions per square metre from the use of commercial buildings are about 2.6 times higher than those from residential buildings (29 kilograms and 11 kilograms of carbon dioxide equivalents (CO2e) per square metre respectively).[74] Given that the ownership of commercial and institutional buildings is more concentrated than residential buildings, interventions to reduce operating emissions in these types of buildings are likely to yield impact more swiftly.

The construction sector's operations are estimated at around 140 kt of GHG emissions: those are related to the construction of residential and non-residential buildings, and other civil engineering projects.[75] However, emissions embodied in materials are not accounted for in the MFA due to data gaps. Steel, cement and glass are the major elements used in many modern constructions, which have high embodied energy profiles. Indeed, approximately 50% of a building's life cycle energy use comes from energy embodied in materials.[76]

Therefore, emissions are significantly underreported here as they exclude the embodied life cycle/embodied emissions of input materials, from waste treatment and disposal. However, this issue is on the radar of city stakeholders. The Zero Carbon Building project, powered by the Canadian Green Building Council, is currently investigating zero carbon design opportunities based on the embodied carbon of different materials.[77]

WASTE

As much as 30% of all building materials delivered to a typical construction site can end up as waste. Construction and demolition waste (CDW) contains a wide variety of materials, such as concrete, bricks, wood, glass, metals and plastic. It includes all the waste produced by the construction and demolition of buildings and infrastructure, as well as road planning and maintenance. The Ville de Montréal handles about 10% of this waste. The treatment of this type of waste is carried out across several infrastructures under contract with the City: one sorting centre, eight CRD treatment sites and six landfills.[79]

Estimating the total quantity of construction and demolition waste is challenging. Many data sources report discrepant values. For the purpose of this analysis, estimates from RECYC-QUÉBEC were used. Total CDW is estimated at 1,600 kt.

CRD waste generated in Montréal is almost fully treated within the province (approximately 95%),[80] either locally landfilled (69%) or recovered through reuse, recycling (25%) or energy recovery (6%). Energy recovery is still used as a treatment method by private companies, mainly for biomass waste flows, such as wood.

5.2. CHALLENGES AND OPPORTUNITIES

1. Prioritise the use of secondary and bio-based materials over virgin materials

There are various reasons why the use of secondary and bio-based materials is not the norm in the built environment value chain. First, the potential for reuse is dependent on the type of material and the way that it has been sorted. If different materials are mixed, this might lead to a potential decrease in the quality of the resulting secondary material. The virgin raw materials used in construction are also typically cheap, abundant and easy to source and use relative to secondary and bio-based materials. On top of this, architects and engineers are typically trained to use virgin materials, and clients are seldom aware of the alternatives when commissioning new projects. Using regenerative and bio-based materials, such as building with more sustainable forms of concrete or with timber, means experimenting with new products, which comes with a higher risk that can lead to a lack of funding by investors and financial backers. These are all structural disincentives that jeopardise the shift from a linear to circular economy.

Although the costly and complex nature of using secondary materials acts as a disincentive, the rising prices of virgin materials in Canada[81] and technological innovations could soon change this. Using the existing building stock as an urban mine can provide the materials needed for new construction works locally, cutting time and transportation costs, while decreasing demand to mine virgin raw materials. Increasing infrastructure capacity to handle materials at their end-of-life will be crucial in ensuring the uptake of secondary materials. This could mean designing buildings for easy disassembly, and training workers to deconstruct rather than demolish. In addition to using secondary materials, the use of regenerative and bio-based materials such as hemp, timber or seaweed can successfully cut demand for virgin materials, replace carbon-intensive materials such as concrete and steel, and even create climate-positive buildings. These lightweight materials also increase the efficiency of transport and construction, substantially cutting carbon and nitrogen emissions. New alternatives—although not yet mainstream—are increasingly welcomed by the sector.

CarbiCrete, a Montréal company located in the Lachine borough, has designed cement-free concrete, for example, and is carrying out its pilot project in the Drummondville region. The company is supported by the Circular Economy Fund (FEC) and Fondaction, which are committed to making these alternatives the norm.[82]

2. Upgrade and repurpose the current building stock

As Montréal is already a largely built-up city, the measures taken to improve the urban built environment will inevitably need to extend to the already existing stock of over 475,000 buildings. However, barriers to stretching the lifetime of what is already built persist. Building on greenfield (undeveloped) land is typically cheaper than refurbishing existing buildings or redeveloping existing areas. In fact, often the costs of demolition and redevelopment of industrial estates and office parks are not part of the financing of new developments, so when the time comes to replace buildings, the community or the new investor are required to pay for them.

Circular procurement could be an effective instrument to change this and create market demand for energy efficiency-related circular renovations (and retrofitting) and adaptive reuse to transform already standing buildings. The City has already taken significant steps to leverage this opportunity and make funding available. The City's Plan approvisionnement responsable 2022–2025 (Responsible Procurement Plan 2022–2025) already includes some sustainability criteria. Energy efficiency commitments are being developed for 1,750 buildings owned by the City, and for an area of around 167,225 square metres that the City rents for various activities. A new Roadmap towards zero-emission buildings was announced in May 2022 to make the whole building stock net-zero carbon by 2030.[83] Measures include replacing the use of fossil fuels with renewable energy; improving energy efficiency regulations and encouraging the construction of sustainable buildings; phasing out oil-fired heating systems throughout the city; and developing a funding programme for building owners to support green renovations. The Sustainable Industrial Buildings programme is also part of this, which offers a subsidy corresponding to the increase in the general property tax following construction, expansion, renovation or demolition-reconstruction work that meets certain conditions of sustainable development.[84] All of these initiatives represent a great opportunity to steer the sector towards improved energy efficiency and resource consumption (i.e. use of materials, water and energy) and consequently cut the built environment's greenhouse gas (GHG) emissions.

3. Upscale high-value recycling and reuse of buildings and their components

Recycling activities typically focus on downcycling to lower order uses (e.g. converting used bricks into aggregates), which means that value is lost. There are many challenges that limit the upscaling of high-value recycling of building materials. First, the long lifespan of building structures makes it difficult to ensure that they will be suitably repurposed or decommissioned at the end of their use. No clear method to assess the 'environmental performance' of a building or a material over multiple life cycles has been developed, obstructing the development of a clear certification and quality assurance process for the performance of secondary materials. Secondly, CDW typically contains a wide variety of materials and components, many of which are complex composites of multiple materials. When it is not separated at source, CDW can also contain small amounts of hazardous materials such as solvents and asbestos, which pose risks to the environment and impede recycling. Lastly, reusing components and materials from construction and demolition activities requires that they are salvaged, separated, processed, transported and stored in locations that make them easily available for reuse. In urban areas where land is highly valued, it can be difficult to find suitable land for these space-intensive, noisy and dusty activities. Land availability also poses challenges in terms of having enough space for building sites. In addition to the above mentioned challenges, high-value recycling and reuse are mainly restricted by the absence of a common shared database containing comprehensive information on the building stock and the non-availability of shared digital infrastructure to instigate the market.

In Montréal, the majority of materials handled by ecocentres consists of CRD residues (58%).[85] However, due to the changing market for recyclables, sorting centres have a difficult time making their activities minimally profitable, which places a burden on companies that serve the environment.[86] Finding ways to reuse and recycle these materials locally, and at their highest possible value, could ease some of this burden. For this reason, along with the Ville de Montréal, we have further investigated the potential for emissions, material and cost savings in Circular action four. A few initiatives have already been identified by the City to upscale high-value recycling and the reuse of buildings and their components, to meet both climate and waste objectives. On one hand, the City wants to analyse existing or find new innovative management methods for high-value recycling and reuse of residual materials (CRD and recyclable materials). It aims to incentivise this by including a clause requiring the recovery of CRD waste when issuing permits, with the collaboration of borough officials, and in the technical clauses of the City's calls for tenders for work.[87] On the other hand, part of the Zero Waste Strategy 2020–2025 is to roll out several road yard waste depots and deliver residential CRD waste and bulky items to private sorting centres to ensure that there is adequate infrastructure to handle this waste at its end-of-life.

TEXTILES

Half of Canada's manufacturing jobs in the fashion industry are located in Québec, most of which are concentrated in Montréal, making the city the 3rd largest clothing manufacturing hub in North America after New York and Los Angeles.[88] The city's textile industry has a vibrant history and generates significant revenue and employment.[89] About 57% of Québec's jobs in clothing and accessories manufacturing and 52% of jobs in textile manufacturing are concentrated in Montréal.[90] There are 4,558 establishments active in the city's textile sector, most of which concentrate on wholesale and retail (64%), followed by clothes and textile manufacturing (22%) and rental and repair (14%).[91] Small and medium-sized enterprises (SMEs) are the protagonists of this sector, especially in regards to circular activities such as rental and repair, while over 75% of textile manufacturing establishments have 4 or less employees.

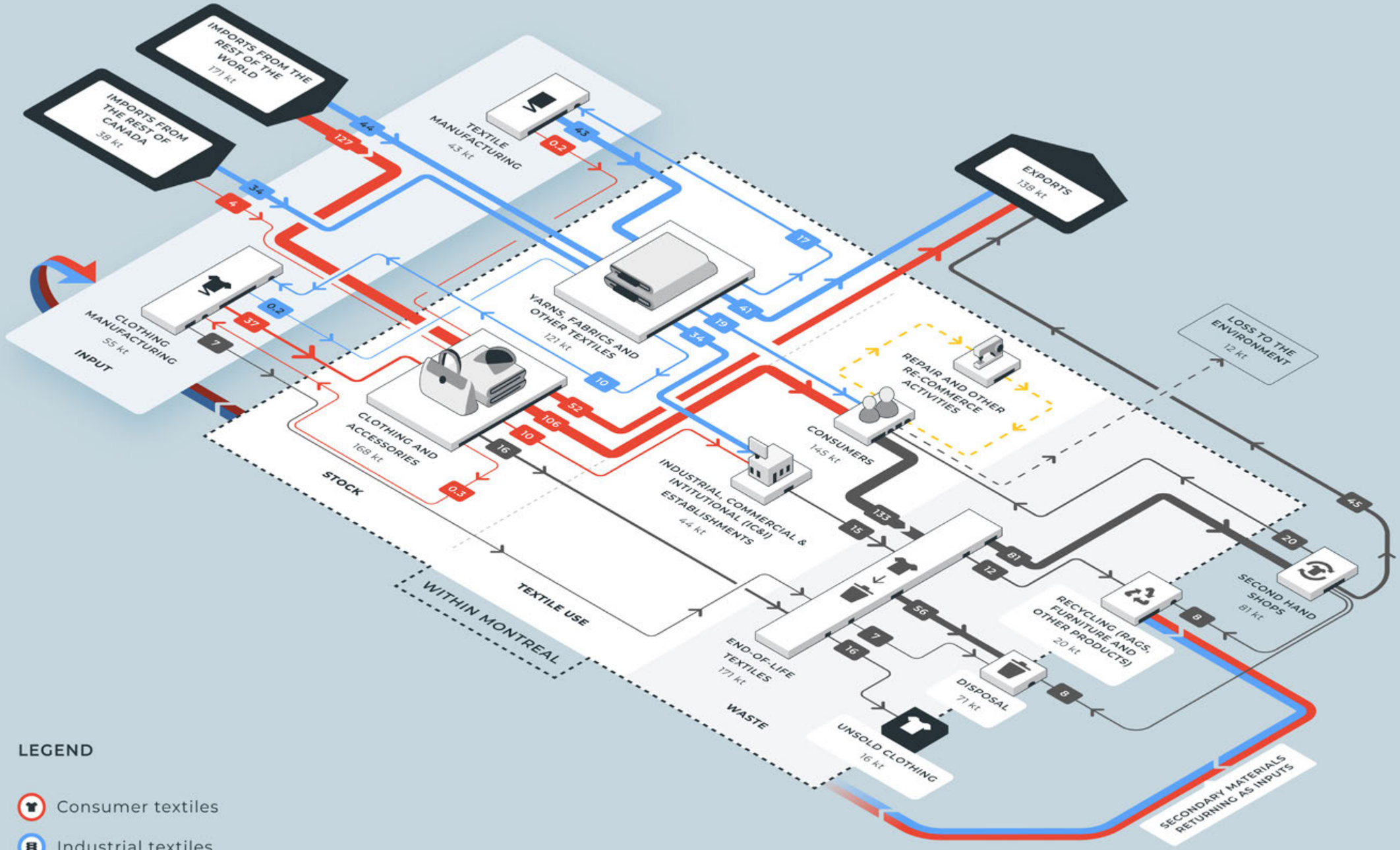
Québec's textile sector has an essentially linear value chain, whether it's for clothing, furnishings, uniforms or textiles for bedding. Recycling is limited and most businesses still operate within the conventional 'take-make-waste' system, although many regional actors within the sector are starting to explore how the circular economy could be applied. With this goal in mind, MUTREC, an open innovation consortium was formed in the spring of 2018, resulting in the publication of its report in November 2020. The consortium explored circular actions for the textile sector through research and analysis as well as recommendations to scale circularity for textile use in Québec. This analysis served as the main source of data used in the present study.

In Montréal, however, the circular economy has not yet been discussed in the context of the textile sector. The Metropolitan Community of Montréal (CMM)'s seven-year plan on residual materials management does not set objectives for the management of textile materials, although it does aim to 'promote and supervise the recovery of textiles'. This is also due to the fact that Québec's Residual Materials Management Policy and its 2019–2024 Action Plan do not set clear objectives for this sector, making it difficult to localise action at the city level.[92] However, given this sector's importance within the province, the Ville de Montréal wants to investigate it further. It aims to identify the key levers for the transition to a circular system and sets out ambitions and actions to design out negative impacts and fundamentally transform the way textiles are designed, sold, used, collected and recovered.

SYSTEM BOUNDARY

- Data on textile material flows at the city level is lacking. The main source of data was a regional assessment of the textile sector by MUTREC, which was downscaled to the Montréal level based on labour data provided by the Ville de Montréal.[93]
- To dive deeper into the local context, the analysis has been complemented by other municipal-level data and reviews of local studies.
- The analysis distinguishes between two different types of textiles: fibres, yarns, fabrics and other trims, mainly used by Industrial, Commercial and Institutional (IC&I) establishments, and finished goods such as clothing and accessories.

6 TEXTILES MFA



LEGEND

- Consumer textiles
- Industrial textiles
- Textile waste

Unit = kilotonne

6.1. MATERIAL FLOW ANALYSIS

The textile sector is often overlooked in cities, mainly due to the fact that textile waste is not one of the main household waste streams in terms of volume. However, in important textile manufacturing hubs such as Montréal, the textile sector could be a substantial means to scale circularity. In fact, the sector is currently downcycling most of the waste it generates, exporting what cannot be reused locally abroad, and largely mismanaging unsold stock. Montréal can leverage its thriving textile sector to address these challenges, and improve the reuse and recycling of textiles both at the household and sectoral levels. However, first capacity issues should be addressed. Textile waste is currently not separately collected and recycling capacity is limited both in terms of infrastructure and skilled workers.

TEXTILE INPUTS

Local production of the fibres used to manufacture textiles is nonexistent in Québec on an industrial scale: most fibres are imported from other countries for manufacturing in Québec. The same is true for finished products, such as clothing and other accessories. Almost 70% of textile fibres and finished products used by the industry are imported, 18% from within national borders and 82% from the rest of the world (mostly from China and Bangladesh).[94] Industry players partially or totally outsourced their production in order to refocus on creation, product development, logistics and distribution.

China has become the world's primary textile manufacturer, meaning that many jobs in the Québecois sector have been lost. Yet, Québec was able to remain the main provincial player within the Canadian fashion market, and despite market shares falling by roughly 75%, the province also remains Canada’s main exporter.[95] As Montréal is a major textile manufacturing hub in the province, exports follow a similar trend. Several manufacturers today are wholesaler-distributors, a subsector that has continued to grow while others are experiencing a business downturn.[96] Some textiles are exported before use by consumers of IC&I, but exports are mainly fuelled by second-hand clothing exported to Africa after use.

In terms of composition, most textiles in the country are cellulose-based fibres (47%), followed by synthetic fibres (42%) and protein-based fibres (11%).[97]

TEXTILE USE

Consumers and IC&I

Nearly 68% of clothing and other textiles belong to the retail industry that fuels consumers' habits, while 32% of textiles are used by the IC&I sectors, either in the composition of their products (such as furniture or materials), as uniforms (such as for workers, police, the army, etcetera) or other textiles like hospital and hotel bedding.[98]

Unsold clothing

16 kt of clothing are not sold, representing 9% of total end-of-life textiles and 5% of all textiles flowing in and out of Montréal in a year. These clothes are either disposed of or shipped outside of the country—but detailed data on these flows are lacking.[99]

Second-hand clothing

In contrast to national trends, in Montréal the percentage of the population taking part in the second-hand economy is about 76%, one of the lowest when compared to other Canadian cities and the national average of 82%.[100] Still, in Montréal, second-hand stores handle quite a large share of post-consumer textiles, around 47% (or 81 kt).[101] Many local community organisations, indeed, made recovered textile material their primary resource.[102] In 2019, due to 176 collection points across the city, over 34 tonnes of post-consumer textiles were collected by the seven largest organisations, and many more are active within the city. Some of these companies own their own second-hand retail stores and directly resell to consumers—for example, Renaissance, a Québec-based non-profit organisation that facilitates the social and professional integration of job seekers whilst promoting environmental action; or Village des Valeurs, an organisation that buys donated clothing and household items from non-profits to help them fund their community programmes, and resells them to consumers.

About 80% of the textiles collected by private and municipal organisations are deemed rewearable: 25% is resold on domestic markets, while 55% is exported and resold internationally, primarily in African countries. The remaining 20% of the total volume is deemed non-rewearable, and is either landfilled or downcycled for industrial purposes. These items are mostly winter clothing and accessories that are not accepted by international destinations, given the difference in climatic conditions. Generally, it is unclear whether or not this is a good practice. On one hand, this type of trade may help create employment in the receiving countries (for instance in transporting, cleaning, repairing, restyling, resale etcetera) and provide low-cost, and ideally high-quality, clothing for people living in poverty. On the other hand, however, this type of export could be viewed as a linear model with a different endpoint, which simply puts social and environmental pressure on Africa, instead of on global North countries. It is reported that a large percentage of what is exported cannot be resold in the receiving countries and is landfilled, burnt, or dumped in informal settlements and in the sea. Furthermore, this clothing waste often compounds local social issues, such as increased risk of Malaria, dispossession from land, and health complications that arise for the head porters, who transport bales of used textiles, or for communities living in close proximity to informal landfills.[103]

Consumer-to-consumer activities.

About 47% of second-hand textile/clothing consumption in Montréal is via resale, 29% via donation, 15% via rental and 8% via peer-to-peer swapping activities.[104] Although second-hand and thrift stores retain the largest share of these purchases, consumer-to-consumer activities are growing, fuelled by a surge in digital marketplaces.[105] Canadians have long traded clothing at garage sales, on Kijiji (an online classified advertisement platform), in social media trading groups, or more recently on Facebook Marketplace or the Bon shopping clothing resale platform. Today, the supply is growing to meet a growing demand. In May 2021, Vinted—a popular European online platform for the resale of second-hand clothing between individuals—launched in Canada. According to its estimates, the market could even reach double the size of that of fast fashion by 2030. The boom in the second-hand market is mainly driven by young Generation Z and millennial consumers, eager to save money while making more conscious choices.[106] Building on this momentum will be crucial in achieving the targets set by the City's Zero Waste Plan and contributing to climate targets.

Finally, it is important to acknowledge that a few rental and repair activities exist within the city. About 14% of the 3,901 establishments active in the city's textile sector focus on the rental and repair of consumer goods, footwear, furniture and other personal and household goods.[107] Although empirical data on the number of establishments providing this type of services exists, estimating the quantity of textiles recovered through rental and repair is virtually impossible to discern. However, these activities are a core element of the circular economy: they prevent textiles from becoming waste and keep them in the economy for as long as possible at their highest value. For this reason, they are qualitatively visualised in the material flow analysis (MFA).

WASTE

Waste collection and management of post-industrial and post-consumer textiles

More clothes are thrown away than are reused through second-hand activities. In Montréal, 183 kt of post-consumer textile waste is generated each year, 12 of which are lost in the environment. Of the remaining 171 kt collected, about 90% comes directly from consumers: they are therefore a clear hotspot for potential impact. Of this waste, only 65 kt are deemed rewearable and are resold domestically or exported. What is deemed non-rewearable, due to poor quality, unsuitability for resale, or the market saturation that the sector is now facing, becomes waste. About 71 kt of textiles are disposed of each year (either in landfills or through energy recovery), while only 20 kt are recycled, mainly into lower-grade applications such as rags and furniture filling.[108]

Most post-consumer textile waste is collected through donation points throughout the city. Ecocentres are also available for post-consumer textile collection, but so far less than 1% of waste collected in these facilities is textile waste, equivalent to 40 and 45 tonnes annually.[109] However, a system for the recovery of IC&I textiles does not exist yet. The Ville de Montréal, on the other hand, does not offer a separate collection for textile waste. Municipal waste management services collect textiles at the curbside together with mixed waste. From the curbside, it is estimated that a total of 19 kt of waste (or 9 kilograms per capita per year) is textiles (equivalent to 11% of total post-consumer textile waste).[110]

6.2. CHALLENGES AND OPPORTUNITIES

1. Promote sustainable fashion choices to buy less, buy better and use for longer

In less than ten years, the Terrebonne landfill serving waste flows coming from the Ville de Montréal will have reached its maximum capacity. If elected officials at provincial level decide to create a new landfill, it will take more than ten years of planning to come to fruition. As textiles still end up clogging landfills in the region, it will be crucial as the city transitions to a circular economy to decrease the amount of textile waste generated by industries and citizens.

Consumers will be critical in this transition for a multitude of reasons—and they can become suppliers within a circular system. Information raising and education (for municipal and government officials, citizens, community organisations and retailers) can promote second-hand purchases, clothing swaps and rental and repair activities throughout the city.[111]

2. Upscale textile waste collection from consumers and IC&I establishments and ensure the quality of the textiles collected

In recent years, municipalities and boroughs have increasingly adopted by-laws to contain the proliferation of clothing donation points by for-profit companies, which have installed donation points almost everywhere in a disorganised way (public areas, vacant lots, unsafe places, etcetera) without deference to municipal regulations. However, the reduction in the number of collection points has led to a significant increase in textile disposal in the whole province (by 78.7%, according to the latest study by RECYC-QUÉBEC[112]), as there is a direct link between the proximity of a service and its use.[113] Additionally, the number of donation points from legitimate textile collectors has more than halved in the past six years.[114]

There are currently not enough collection points to capture the entire volume of post-consumer textiles discarded[115]—and so far, the collection of post-consumer clothing and accessories has advanced much more than the collection of IC&II textiles.[116] Separate collection infrastructure for both post-consumer and post-industrial textiles could significantly lower the negative environmental impact of textile waste management, as well as textile losses in the environment.[117] However, collecting more from generators will not solve the issue of lacking outlets. New markets for textile reuse and new recycling channels should be established.

BOX FOUR. Regulatory advancements for the upscaling of separate collection of textiles

A regulatory framework for the deployment of donation points will be proposed as part of the City's Zero Waste Plan 2020–2025.[118] By harmonising municipal by-laws governing donation points across municipalities and boroughs, it will be possible to promote the recovery of textiles by accredited collection, sorting and recycling organisations from the community. However, it will also be important to ensure the quality of the textiles collected. A large issue with textile collection is the pollution or contamination at the point of collection, either because of subpar donation points (where leakage happens) or subpar consumer behaviour (where consumers drop non-textile waste in donation points, therefore contaminating entire batches). It is therefore crucial to select adequate collectors to incentivise collection rates, ensure the quality of what is collected, and improve subsequent reuse and recycling rates. As advised previously, a permanent working committee could help bring different stakeholders together to solve these issues, while active partnerships with non-profit organisations could extend their service offers (donation points, occasional neighbourhood collections, etcetera) and regulate their quality.[119]

Finally, regulatory measures should also address the problem of unsold stock and data gaps (monitoring and evaluation) around the volumes of textiles collected, reused, recycled, landfilled and incinerated in order to improve collection performance and achieve the targeted diversion rate by 2030. A ban on the destruction and disposal of unsold goods and rejects of production from the textile industry and businesses is being analysed.[120] However, more can be done to gather the data and insights currently lacking, to better understand textiles flows within the city.

3. Advance technology for the regional recycling of textiles and the uptake of recycled and ecological fabrics

Recycling facilities for textiles have been declining in Québec for several years. A major recycler in the Montréal area, Leigh Textile, moved its activities to the US in 2011.[121] Despite the difficulties experienced by recycling outlets in recent years, a recent study by MUTREC showed that manufacturers in the province offer a wide variety of reprocessing activities, which can be applied to post-industrial or post-consumer textiles. Still, only a few recycling routes currently exist—some clothes are turned into rags and some cut scraps are downcycled to produce nonwovens and felts—mainly due to the lack of local expertise and equipment for defibrating, topping and felting post-industrial or post-consumer textiles.[122]

Increasing recycling and technological capacity in the city would not only be beneficial for the environment, but also for the municipality (through lower costs of recovery and operation of landfill sites) and for the community in general (through revenues for charities and other social organisations that can be repurposed for community support services). Moreover, technological advancements in the textile sector could open up opportunities to develop and export recycled fibres, fabrics and products, as well as to create more eco-sustainable fabrics, such as creating leather from mushrooms or garments from seaweed.

MOBILITY

Mobility plays a fundamental role within cities, connecting people, goods and services, ensuring we have food to eat, and enabling residents to commute to work and access key services such as health and social care. Montréal has already recognised the fundamental role of mobility in sustainable urban development. First, because the Greater Montréal area serves as a major freight hub, hosting Canada's second largest port and third largest airport, and accommodating two rail networks.[123] The mobility system is also the greatest source of emissions in Montréal, responsible for 39% of greenhouse gas (GHG) emissions, of which 77% stem from road transport.[124] The Ville de Montréal can influence how mobility operates in the city, but it cannot do it alone. The local bus and metro system is operated by Société de Transport de Montréal (STM) and consists of 1,869 buses across 222 bus routes and 64 metro stations. CDPQ Infra is in the process of developing an automated light metro network with 19 stations in the city. The Ville de Montréal has a more direct influence on its bicycle infrastructure, which now includes an impressive 889 kilometres of dedicated bike paths.[125] [126]

Recognising this influence, the Ville de Montréal has already made commendable efforts and set ambitious targets to create a more sustainable mobility system:[127]

- Reducing the number of cars on the road by increasing the density of development, particularly around metro stations.
- Shifting to less energy- and emissions-intensive modes of transport with the aim of transferring 25% of solo car trips to less energy-intensive modes (for example, public transit) as well as promoting electrification.
- Promoting the use and sharing of bicycles by further developing bike lanes and increasing the supply of shared bicycles, particularly electric bikes.
- Creating a zero-emission zone by 2030. A zero-emission zone is free of air and noise pollution caused by fossil-fuel vehicles and aims to reduce GHG emissions and other pollutants from the transportation sector.
- Increasing public and private charging infrastructure to facilitate the electrification of personal and commercial vehicles, with the aim of at least 30% electrification of person-trips.
- Electrifying the city's public buses by 2040.
- Reducing freight emissions with the target of achieving 25% zero-emission deliveries.

In addition to these targets, ambitious plans are resulting from other initiatives such as the *Ambition EST 2030,* a roadmap developed by Propulsion Québec that aims to advance the electric and smart transportation (EST) sector through a series of programmes, making it a global frontrunner.[128] [129]

Steering the mobility system towards greater circularity should mean going beyond decarbonisation, by, for example, aiming to close material loops, extend product life cycles and increase vehicle usage intensity through shared mobility options. However, until now, circularity within this sector has been overlooked. It was not possible to perform a conventional material flow analysis (MFA) to analyse the current status of the circular economy in this sector due to the lack of data and complexity of the mobility value chain. Instead, a comprehensive assessment of the mobility system's current state is provided, driven by the following three research questions:

1. **Input:** What quantity of materials do vehicles in Montréal consume annually?

2. **Stock use:** What are the material-, energy- and carbon emission intensities of various vehicles in Montréal?

3. **Waste:** How are end-of-life vehicle (ELV) components managed in Montréal?

SYSTEM BOUNDARY

- The assessment considers Montréal's mobility system, although some contextual elements are provided beyond this area, when appropriate. For example, the energy and emissions associated with the manufacturing of vehicles outside of the city is not included quantitatively, but rather is described for a more systemic understanding.
- The elements of the mobility system considered in this report are limited to passenger vehicles (shared and private), public transport (bus and metro) and bicycles (shared and private).
- Freight vehicles are considered in the opportunities section, however not in the baseline due to a lack of data. This baseline assessment focuses primarily on vehicles in the mobility system, as opposed to infrastructure. However, the mobility system is considered more in its entirety in the opportunities section.

7.1. CURRENT STATE ANALYSIS

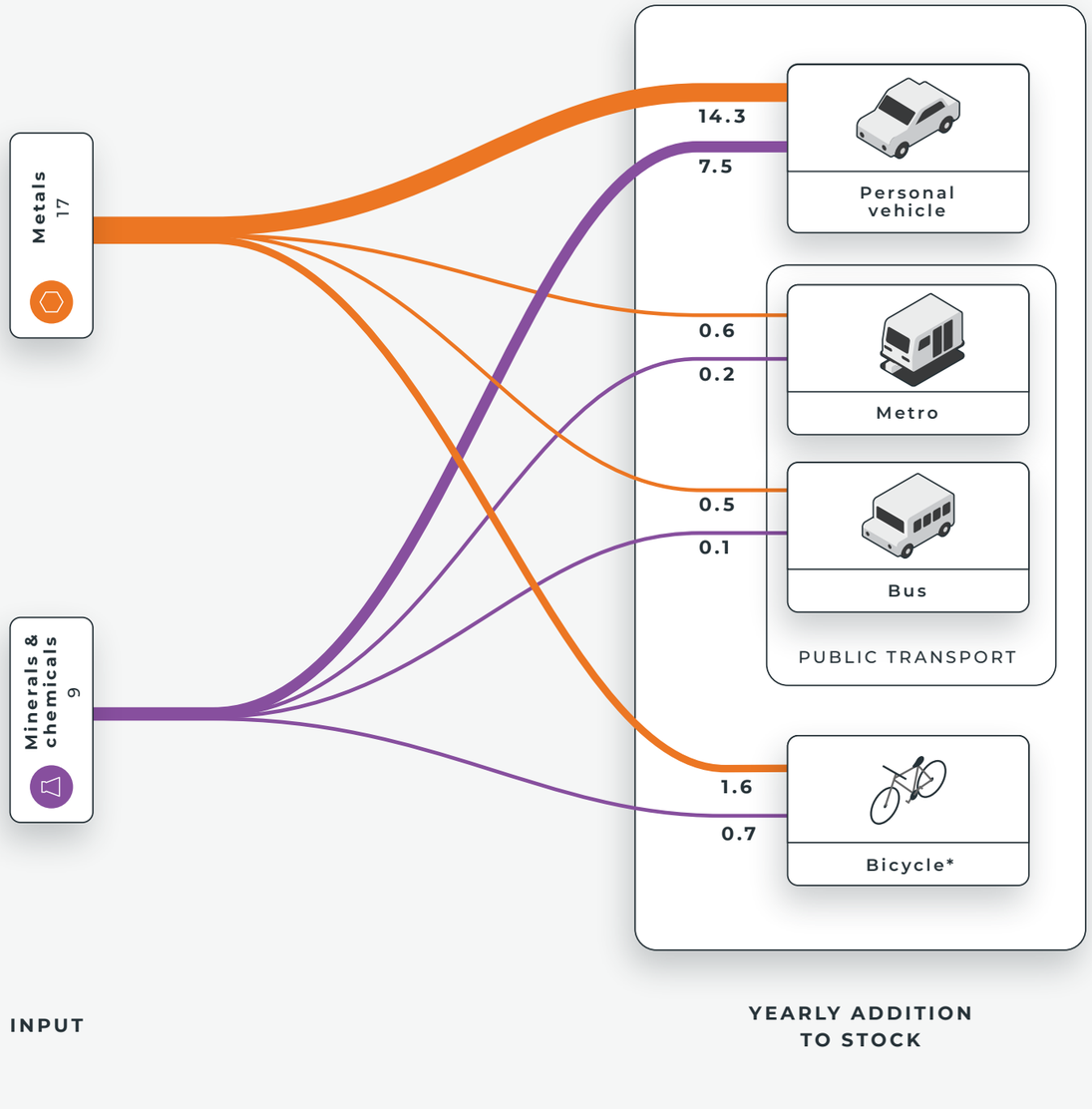
Montréal has an extensive, and highly used public transport system, while the use of bicycles has seen a massive spike during the covid-19 pandemic. However, our assessment shows that personal road vehicles still account for the vast majority of materials consumed by the mobility sector in the city (80% of total inputs within the scope). These vehicles are also the most intense in terms of energy and emissions. In a circular economy, the electrification of these vehicles alone is insufficient, despite the low-carbon electricity system in the province. Montréal must go further and dramatically reduce its material footprint by adopting and promoting shared mobility practices, for both passengers and goods. The management of ELVs and infrastructure is a well-established industry, yet data collection is fragmented and lacking on the whole. In order to close the loop of materials, complete data collection is necessary to identify and pursue all opportunities.

INPUTS

Vehicles in Montréal contain vast amounts of materials and require significant energy inputs to manufacture. Most vehicles in the city are imported into Canada from other countries, with a few exceptions: shared bicycles from Bixi, some heavier duty vehicles and buses (for example Class 6 and 8 trucks by Lion Electric and buses by Nova Bus), and some electric vehicle (EV) charging infrastructure—all of which are manufactured in Québec. Thus, the environmental impacts associated with the production of most vehicles occur almost entirely beyond Canada's borders. In 2019, 26 kt of materials were added to the material stock of vehicles in Montréal. The majority of this (85%) was in the form of personal vehicles,[130] 6% in the form of public transport and 9% in the form of bicycles. For all vehicle categories, metals account for the largest portion of material use (primarily steel) with the remainder represented by minerals and chemicals (primarily plastics). The breakdown of materials per vehicle type are displayed in Figure one.

In spite of bicycles' low weight (around 1% the weight of a car), they claim a significant portion of total material consumption for the sector (11%). In 2020, approximately 145,000 bicycles were purchased in Montréal, a 136% increase from the yearly average since 2000.[131] This increase is likely due to the covid-19 pandemic, which sparked people to seek alternative ways to commute and boost their outdoor leisure time

Figure one. *Annual additions to stock of personal vehicles, public transport and bicycles*



STOCK USE

Vehicle fleet

Montréal's vehicle fleet consists of approximately 900,000 household-owned personal vehicles,[132] 2 million bicycles,[133] 2,000 buses and 1,000 metro carriages.[134] This fleet has likely grown at a rate similar to Québec as whole, in which passenger vehicles increased by 66% between 1990 and 2019, whilst the population grew only 22%. Larger passenger vehicles (such as SUVs, pickup trucks and vans) increased by 319% in this period, in contrast to smaller passenger vehicles which decreased by 22%.[135] This shows a concerning trend towards purchasing more material-, and typically energy- and emissions-, intensive forms of transport.

Material-, energy- and emission-intensity of different vehicles

To analyse the material and energy use and carbon emissions associated with mobility, it is useful to analyse how much utility is derived from the various modes. This can be achieved by measuring material and energy use and emissions relative to passenger kilometres.[141] Passenger kilometres measure the distance travelled per individual passenger. Therefore, a vehicle with more passengers will have higher associated passenger kilometres. Normalising factors relative to passenger kilometres allows efficiency to be determined on an individual passenger basis.

Figure two displays a comparison of material-, energy- and carbon-intensities per passenger kilometre for personal vehicles, public transport and public bicycles. The higher the value, the more intensive a vehicle is for the particular parameter. It can be seen that personal vehicles exhibit the highest intensity across all three parameters, followed by public transport and public bicycles. The energy intensity of personal vehicles is double that of public transport, whereas the emission intensity is triple. This is likely due to the fact that the majority of the personal vehicles on the road are powered by fossil fuels whereas a large proportion of the public transport is powered by electricity.

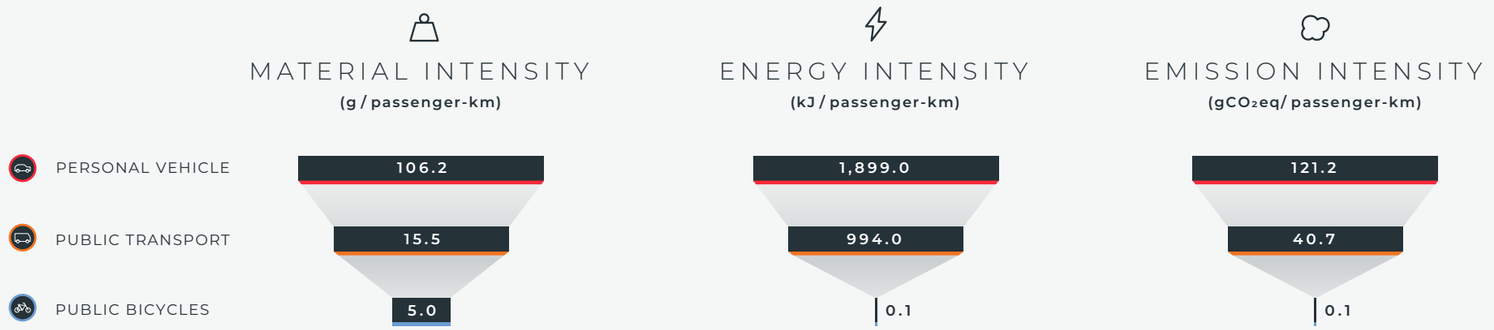


Figure two. *Material, energy and emission intensity nexus for personal vehicles, public transport and public bicycles in Montréal*[142]

BOX FIVE: Electric vehicles

EVs are expected to experience significant uptake by 2035, when the sale of light internal combustion engine vehicles will be banned both provincially and nationally. There are already 13,100 EVs registered in the city of Montréal, accounting for 1.6% of all light vehicle registrations. The share of sales of new light electric and plug-in hybrid vehicles in Québec represented approximately 6.8% of all sales in 2020.[136]

The city has laid out ambitious targets related to EVs, including: increasing the share of EVs to 47% of all registered vehicles by 2030, increasing the portion of shared EVs to 5%–10% of the total shared fleet and increasing the number of electric taxis to 250.[137] [138] Given that in 2018, 99.6% of Québec's electricity generation was generated by renewable sources, namely hydropower, the switch to EVs has the potential to significantly reduce direct carbon emissions in Montréal from vehicle use.[139] However, this does not take into account the emissions associated with the production and distribution of the vehicles, which remain significant.

EVs need to be considered in the context of the entire mobility system, in which other forms of transportation may be less material-, energy- and emission-intensive than EVs. Nevertheless, EVs will play an important role for residents, especially in situations where other forms of mobility are not suitable.

BOX SIX: Freight

The freight sector transports materials and products to maintain society, from ensuring that food arrives at supermarkets every day to enabling the construction of new buildings and infrastructure. It serves a fundamental role in a city by connecting value chains and other sectors. Despite this, little data is available that can provide an overall picture of the material and energy use and carbon emissions associated with the current freight system, as it is primarily operated by the private sector.

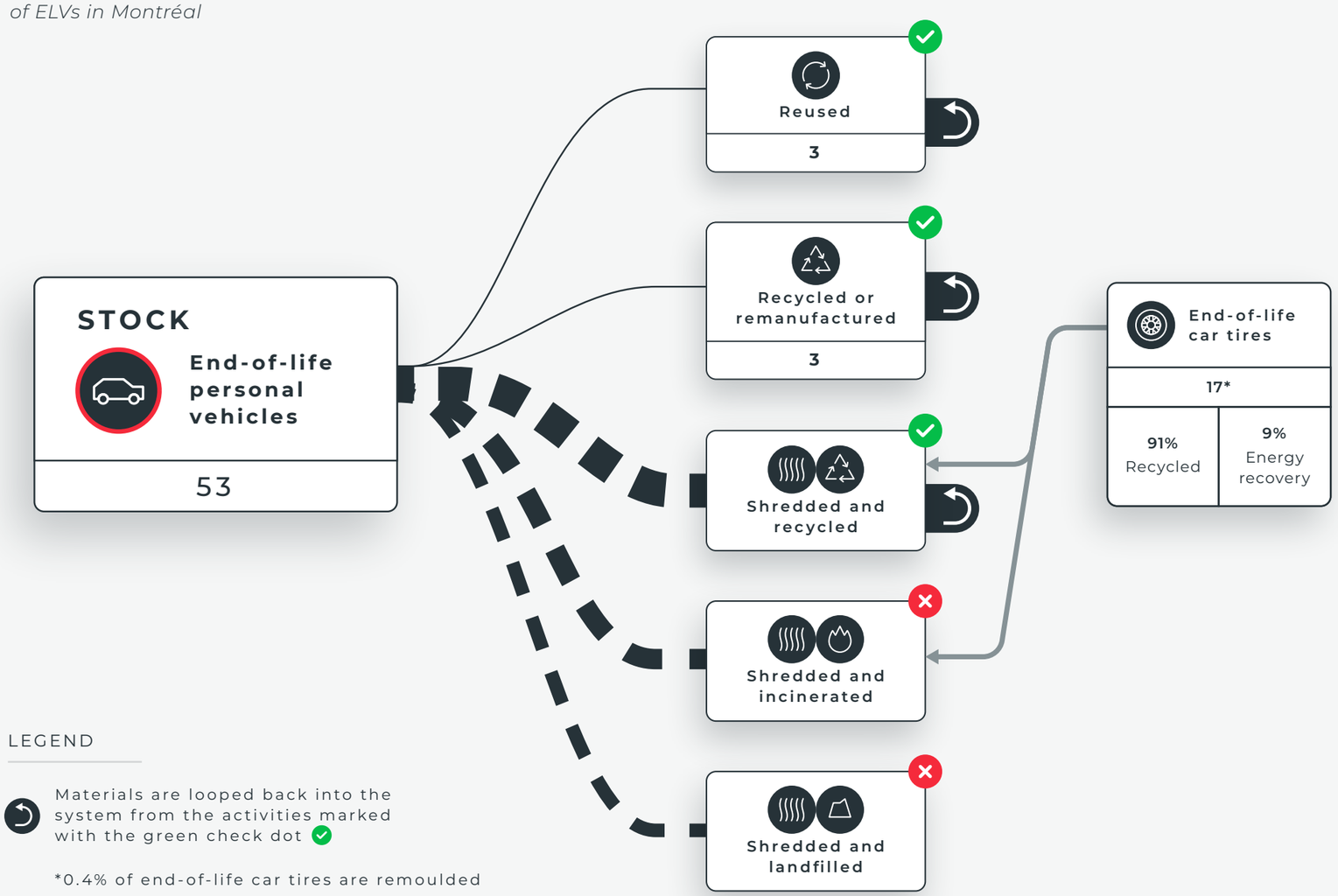
Freight accounts for 35% of final energy consumption in Québec, consisting of heavy trucks (16%), light trucks (8%), mid-sized trucks (7%), maritime (3%), rail (1%) and air (0.3%).[140] The freight sector could play a key role in enabling circularity through actions such as low-carbon forms of transport and optimised logistics.

WASTE

The processing of ELVs represents one of the largest recycling sectors in Canada with about 1.2 million ELVs recycled each year. The majority (94%) of ELVs are successfully recovered for recycling, making the waste diversion rate much higher than for other sectors.[143] However, significant challenges still exist in the management of ELVs due to the presence of substances of concern, increased use of plastics and non-standardised management practices. The wide range of materials used in the mobility sector has yielded a complex ecosystem of managing such materials. The significant progress already made in managing waste flows is largely due to the recyclability and profitability of some components, such as metals. However, the management of these flows is poorly mapped and monitored. This makes it difficult to see where interventions can be implemented to increase circularity.

Circular economy principles yield a hierarchy of waste management for ELV: first the reuse of components, followed by the recycling of components, recycling of materials, energy recovery and finally landfilling. Vehicles are generally first dismantled and separated into different components, such as body, tyres, batteries and fluids. These components are then either reused, recycled or remanufactured. After dismantling the valuable components, the remainder of the ELV is then processed in a shredder and separated by material type for recycling or incineration, or sent to landfill. Figure three. shows the material flow of the waste management of ELVs in Montréal, including a more detailed view for end-of-life tyres. It is assumed that 6% (53 kt) of the current stock of registered vehicles in Montréal is retired each year. Of this, 6% (3 kt) consists of reused components and another 6% (3 kt) of materials and components are recycled or remanufactured.[144] The remainder are shredded and subsequently the vast majority, in terms of weight, is recycled, with a small part destined for incineration or sent to landfill. In terms of materials, the majority of ferrous metals (namely steel) are successfully recycled, however, much of the plastic waste is typically incinerated or sent to landfill.

Figure three. *Material flow of the waste management of ELVs in Montréal*

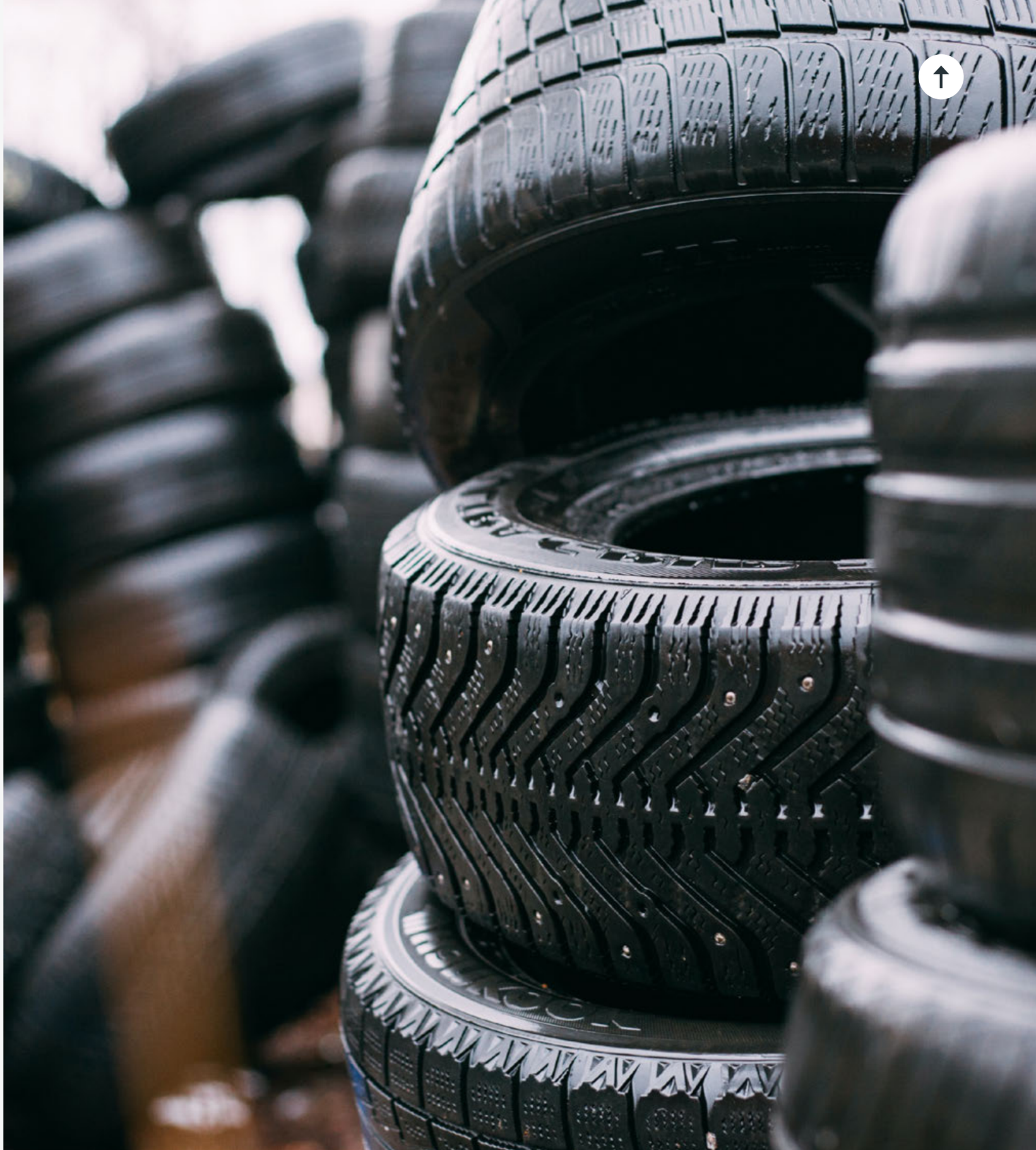


Tyres

Used tyres are managed through a Québec-wide scheme which directs them to be remoulded or recycled as a priority, and incinerated for energy recovery in some cases. In 2018, 22,341 tonnes of tyres were collected and processed in Montréal, of which 75% (16,689 tonnes) were car tyres. Tyre collection is estimated to account for 94% of all tyres destined for waste management. Of the total number of tyres collected, 90.6% are recycled into other products, 9% are incinerated for energy recovery and 0.4% are remoulded.[145]

Lithium-ion batteries

Most EVs are powered by lithium-ion batteries. With the sale of EVs increasing significantly in Montréal, the management of batteries will create great environmental and economic challenges. In Canada, standard warranty coverage is eight years, or in some cases the Original Equipment Manufacturers provide a mileage limit warranty. Current predictions show that batteries can last for ten to 20 years[146] before being deemed inadequate for such purposes, thus exceeding the typical warranty period. The management of batteries first involves removing the battery from the vehicle and sending the component to an appropriate storage facility to be further managed. Batteries are especially challenging due to the complexity and quantity of materials in the component, making material recovery and recycling difficult. Therefore, it is favourable to first try to reuse batteries for other purposes, such as for stationary storage in homes where performance standards are less critical than for EVs. When batteries are not suitable for other applications or reach the end of their secondary life, recycling must be the next option. A lithium-ion battery recycling demonstration plant, based on hydrometallurgy, has been inaugurated in the Montréal area, with claims to be able to recycle 95% of the battery materials.[147] Extended producer responsibility legislation in Québec is currently being amended to include lithium-ion batteries from EVs, obligating the recycling of the component. This will make Québec the first jurisdiction in North America to require the recycling of EV batteries.[148]



7.2. CHALLENGES AND OPPORTUNITIES

1. Increase shared, low-carbon mobility services

The majority of vehicles in the city spend most of their lifespan unused—and when used, they are often used inefficiently, such as for solo car trips. In addition, much of the city's vehicle fleet is powered by fossil fuels. Thus, the city's current mobility system is largely inefficient in terms of materials, produces harmful emissions and causes more traffic in the city.

Shared mobility services can be a key lever for reducing the city's material consumption. This involves services such as car pooling, shared cars and micro-mobility (such as bicycles and electric scooters) as well as freight services such as electric cargo bikes for last mile delivery. The City has acknowledged the great benefits of such initiatives and has set ambitious targets, such as: aiming to shift 25% of single occupant car journeys to less energy-intensive modes, such as shared mobility modes by 2030; increasing the electrification of the vehicle fleet for active and shared micro-mobility services to 25%–30% by 2023, serving 19 boroughs with active and shared micro-mobility services; increasing the electrification of car sharing vehicles to 5%–10% of the shared fleet; increasing the amount of electric taxis to 250.[149]

2. Increase electric vehicle battery reuse and recycling

The shift from internal combustion engine (ICE) vehicles to EVs is gaining significant traction in Montréal. Between 2016 and 2020, there was an almost tenfold increase in the number of registered EVs.[150] As previously noted, facilities for EV recycling are lacking or are not cost effective due to the complexity of recovering and recycling lithium-ion batteries.

Opportunities lie within facilitating the reuse of EV batteries, by establishing collection schemes and creating businesses around repurposing the batteries for other energy applications, such as home energy storage systems. In addition to this, opportunities lie at the point when batteries are no longer suitable for further reuse. At this point it is important that battery recycling capacity is sufficient and cost effective to keep up with the rapid shift from ICE vehicles to electric alternatives.

3. Improve data collection for waste management and the transport of goods

Data collection related to the mobility sector is lacking in several areas, namely related to the waste management of ELVs and infrastructure, and for the transport of goods within the city. Despite an established recycling industry for ELVs, the presence of coherent data down to a component level is largely lacking. Goods transportation faces a similar challenge, in that it is an established industry consisting of many private businesses with little data exchange to allow for a coherent picture of the sector as a whole. The lack of this data makes progress towards circularity difficult to monitor in these areas.

The presence of ELV and infrastructure data that shows how components and materials are managed can enable Montréal to capitalise on areas of opportunity. It can help established businesses pivot their services, and new businesses provide in-demand services. Data related to goods transportation, such as vehicle capacity potential, its planned carrying load and its route, can be the key to optimising the use of vehicles in a circular mobility system.

8 SCENARIO DEVELOPMENT

Before choosing a course of action to transform the challenges identified so far into circular opportunities, it is useful to understand their potential. This section aims to do this by defining potential future actions and analysing them through a qualitative scenario analysis. The material flow analysis (MFA) provided an easy-to-understand visualisation of the current state of material flows within the city. In this chapter, we aim to take a broader perspective, analysing what needs to happen in order to increase the circularity of future material flows across our four focus sectors.

Each action has been defined based on a stakeholder workshop held in March 2022, where we presented the results of the analysis and collaboratively identified the main challenges and opportunities for each focus sector, and validated key results. The workshop outcomes were then further defined by the Ville de Montréal, which transformed challenges and opportunities discussed during the workshop into two clear actions for each of the focus sectors (Food system, Built environment, Textiles and Mobility), in collaboration with various city departments and external experts.

Each of the following aspects are described for each circular action:

Vision and description: A description of the action, and illustration of how it contributes to circularity within the relevant focus sector.

Role of the city: A description of the concrete instruments the Ville de Montréal could take to implement the action at hand, and which role it must play within the broader stakeholder group to achieve implementation.

Stakeholders: To shape the directions into implementable actions, a collaboration between various stakeholders in the city is required. This section describes the groups of stakeholders that are missing links in bridging theory into practice, for successful development and implementation.

Socioeconomic potential: A description of the socioeconomic benefits that could be expected from each action.

Impact reduction potential: A description of the ecological and social benefits that each action could generate.

Technical feasibility: An exploration of the feasibility of each action within Montréal, based on available resources and existing tools.

Existing initiatives: A selection of successful case studies in Montréal and beyond, that showcase how the selected actions have been implemented on the ground.

It is important to note that the evaluation of economic, environmental potential and feasibility aims to give an overview of possible success factors and barriers to be taken into account by the Ville de Montréal. It is not to be seen as an exhaustive list or a quantitative assessment.

SUMMARY OF CIRCULAR ACTIONS

ACTION			SOCIOECONOMIC POTENTIAL	IMPACT REDUCTION POTENTIAL	TECHNICAL FEASIBILITY
Food System	**One**	Create living labs and hubs to stimulate innovation and support industrial symbiosis solutions for the food system	**High**	**Medium**	**Low**
	Two	Improve food waste measurement and collection from industrial, commercial and institutional establishments	**Medium**	**High**	**High**
Built Environment	**Three**	Leverage circular public procurement for buildings	**High**	**High**	**Low**
	Four	Incentivise high-value reuse and recycling of construction and demolition waste	**Medium**	**High**	**Medium**
Textile	**Five**	Create a circular business ecosystem for circular fashion	**High**	**Medium**	**Medium**
	Six	Increase collection, sorting and recycling capacity for textile waste	**Medium**	**High**	**Low**
Mobility	**Seven**	Support shared mobility initiatives	**Medium**	**High**	**High**
	Eight	Optimise efficient and low-carbon freight and logistics systems	**High**	**High**	**Low**

CIRCULAR ACTION ONE: CREATE LIVING LABS AND HUBS TO STIMULATE INNOVATION AND OFFER SUPPORT TO FIND INDUSTRIAL SYMBIOSIS SOLUTIONS FOR THE FOOD SYSTEM

Vision and description

In a circular city, businesses, local authorities and citizens work together to address social, economic and environmental challenges by developing practical and scalable solutions. 'Living labs' are user-centred, open innovation ecosystems based on a systematic user co-creation approach that integrates research and innovation processes in real life communities and settings.[151] By bringing together private, public, academic and civil actors in one room,[152] living labs can be the perfect setting to explore circular economy solutions, such as industrial symbiosis—which redirects waste from one company as resource inputs for another—and to reduce food loss and waste (FLW). Many private initiatives to tackle or revalorise food waste are already in place across Montréal, however, they typically operate in silos. Given the many actors already involved, a living lab is a great opportunity for different actors along the food value chain to talk to each other to co-create solutions, complementing each others' existing efforts, even beyond industrial symbiosis. If such a lab were to exist in Montréal, circular food system solutions could help prevent food waste and help the city work towards SDG 12.3, which requires countries to cut per capita food waste in half by 2030.[153]

Role of the City

The Ville de Montréal can play a key role in shaping living labs for different enterprises to collaborate with each other and the broader public.[154] It can **promote** collaboration and exchange by taking up a leadership role and initiating the project, by providing direct initial financial support and calling upon other participants. As an **enabler** of living labs, the Ville de Montréal could facilitate the exchange between stakeholders by making spaces available within the city to host living labs and thus enable research, innovation and experimentation in a real environment. As a **partner**, the City could also collaborate horizontally, awarding shared leadership to other stakeholders, and acting as another 'participant' during living lab sessions.

Stakeholders

- **Food industry representatives**, especially food processing companies and local food service providers (for example, food producers, processing businesses, distributors, hotels, restaurants, institutional food services and independent food retailers).
- **Food and organic waste collection companies**, to develop efficient measurement and separation of organic waste from other streams and prepare waste or discarded food for potential symbiotic applications.
- **Circular economy and industrial symbiosis experts (academia and industrial associations)** to provide the technical knowledge and help other stakeholders identify synergies and opportunities as well as limitations and challenges.
- **Start-ups, entrepreneurs and volunteer organisations**, to drive innovation and creative thinking and for the design of food waste solutions and business opportunities.
- **Municipality representatives**, to take up the role of facilitators and allocate temporary or permanent spaces for experimentation in the context of living labs, as well as to coordinate events, raise local awareness and give supporting oversight and monitoring.
- **Community groups or representatives of civil society**, to stimulate co-creation and programming within living labs from a consumer perspective.

Socioeconomic potential

- **Value creation:** Living labs foster innovation and co-creation, and as such can be catalysts for successful economic value creation through new business opportunities (typically small and medium-sized enterprises (SMEs) and artisan-based ventures),[155] that also responds to the needs of an entire sector (food system) but also final customers: tackling FLW with solutions that capture economic value from wasted or discarded food resources. To give an order of magnitude, an extensive review of companies providing food waste solutions revealed that 50% of ventures boasted at least a 14-fold or greater return on investment, which demonstrates the profitability of such initiatives.[156]
- **Market testing environment:** Not only do urban living labs allow innovative ventures to be created, they also represent an ideal testing environment: companies are able to test their offer directly with target customers, therefore allowing them to assess market feasibility of such projects and rapidly implement improvements.[157]
- **Socioeconomic resilience and social capital improvement:** Urban living labs, by nature, promote the development of a more localised socioeconomic environment, which in this case would result in positive impacts on local employment in the food and drink sector. Beyond employment, living labs may also contribute to social capital by promoting social cooperation and cohesion through the inclusion of users in public-private-people partnerships, and the production of knowledge and greater environmental consciousness (in this case on food sustainability).[158]

Impact reduction potential

It is difficult to quantify the potential impact reduction directly attributable to living labs, given the varying nature of each living lab. Each project or initiative coming out of living labs could look quite different and generate a wide range of potential benefits. For instance, in Montréal, the following industrial symbiosis initiatives have already demonstrated quantifiable impacts and are actually all finalists for Canada's Food Waste and Reduction Challenge:[159]

- Blanc de Gris: This mushroom farm produces high-end mushrooms from brewery spent grains (beer production), recycling two tonnes of spent grain per week and producing over 300 kilograms of mushrooms marketed locally in short circuits.
- TriCycle: This edible insect farm uses about 80 tonnes of organic/food waste per year to feed its insects.
- Still Good: This company upcycles brewers' spent grains into tasty creations in collaboration with local businesses. To date, it has recovered over 90 tonnes of pulp, transformed over 363 tonnes of spent grains and saved over 45 tonnes of fruits and vegetables. In 2021, through Fondaction, the first circular economy investment fund in Canada, it received an investment of CA$500,000 plus technical support from the Ville de Montréal through Synergie Montréal, in addition to a grant from RECYC-QUÉBEC.
- LOOP Synergies: This new rescue programme facilitates the recovery of food rejected by various industry players. So far, annual savings have been around 295 tonnes of fresh produce, 235 tonnes of carbon dioxide equivalents (CO2e), and 17.7 million litres of water.

Technical feasibility

- **Global momentum:** There are already many successful examples of living labs,[160] some of which have focussed on food waste solutions.[161] [162]
- **Municipal support:** So far, the Ville de Montréal has already demonstrated its enthusiasm for this emerging concept by directly supporting initiatives such as La Transformerie and Centrale Agricole, which are already working towards a living lab format, with public and private actors cooperating to develop circular urban food systems. The Ville de Montréal also supports Récolte in its multi-stakeholder project SALIM (Local and Integrated Food System of Montréal), which aims to strengthen the supply network of community food organisations in the city with fresh and healthy local products.
- **Inclusive financing models:** Living labs rely on funding and co-investments from participants, although in many cases significant up-front investments from public institutions are required to launch the projects.[163] However, empirical evidence suggests that over time, successful self-organised living labs rely on more de-centralised financing models, often arising from bottom-up initiatives such as crowdfunding, cooperatives and public-private-people partnerships (for example, Barcelona, Tallinn, Riga and Turku)[164]. These more inclusive models—in which all stakeholders play an active role in co-creation—are also beneficial for public engagement and commitment as financial stakes are spread wider across all stakeholders.
- **Agreed organisational structure:** Living labs for food sustainability include the following categories of stakeholders: private, academic, public institutions and end users, all of which should have a shared and agreed upon understanding of their roles and that of other actors within the lab. This will help ensure an effective, goal-oriented and long-term co-creation environment to identify and implement solutions for food sustainability. For this, the adoption of a living lab organisation canvas (similar to the business model canvas, it is a tool that allows stakeholders to understand how t he living lab is organised, its scope, the expected outcome and impacts and a framework for learning and evaluation) can be beneficial.[165]

Existing initiatives

- RECYC-QUÉBEC: This organisation announced funding of CA$3.3 million towards new projects supporting industrial symbiosis and other circular initiatives for food waste, such as the Symbiose Agroalimentaire Monteregie project. Montréal could leverage these incentives to support the living lab.
- Synergie Montréal: This organisation could be a key facilitator of the living lab. Since launching in 2016, Synergie Montréal has supported around 1,350 companies, creating 125 symbiotic relationships that have diverted over 3,000 tonnes of waste from landfill. It has also saved roughly 5,000 tonnes of CO2e[166] and generated over CA$8 million in total from revenue and cost savings.[167]
- Montréal in Common: This initiative aims to build a testing ground for ideas to improve Montréal residents' quality of life, and has already provided support to two food projects:
    - Valorisons MTL, which sheds light on industrial symbiosis opportunities such as heat recovery from industrial processes to feed urban greenhouses, as well as recovering sludge and digestates for soil enhancement and fertilisation purposes.
    - MutuAli, a digital platform where food professionals across Québec can share professional equipment and infrastructure as an alternative to ownership.
- Ivey Circular Economy Program: This initiative has already identified, examined and facilitated food waste repurposing exchanges between businesses through research. Thanks to the programme, many industrial symbiosis initiatives are emerging and being mapped throughout the city and province.[168] This tool could be integrated as a key feature of living labs.

CIRCULAR ACTION TWO: IMPROVE THE COLLECTION AND MEASUREMENT OF FOOD SURPLUS AND WASTE FROM INDUSTRIAL, COMMERCIAL AND INSTITUTIONAL ESTABLISHMENTS

Vision and description

Well-designed and effective separation and collection logistics are key components for circular food waste management in cities, as they represent enablers to 1) prevent edible food waste through rescue and redistribution (i.e. reuse), but also to 2) recover valuable resources.[169] In Montréal, food waste management is particularly challenging for industrial, commercial & institutional (IC&I) establishments, also due to the lack of an efficient waste storage and collection infrastructure.[170] Improving food waste collection, both of edible and non-edible food, from these types of establishments could allow the city to achieve its targeted 85% diversion rate of waste from landfill by 2030. Moreover, expanding the collection of waste to these types of establishments could help form a more complete and accurate assessment of FLW across all IC&I sectors, documenting and measuring waste volumes and their varying composition.

Role of the City

By expanding waste services to more IC&I establishments, the City could increase the diversion of food waste from IC&I sources, and at the same time gather primary data on volumes and composition of waste streams per type of waste generator (i.e. restaurants, hotels, etcetera). Gathering this type of data would allow these companies to directly compare their performance to others, and therefore incentivise greater efforts for waste reduction—both through rescue and recovery. Then, the City could also further support the automation of measurement by collection trucks. Currently, bins already have chips that should allow for accurate measurements, but such technology does not seem to have been fully adopted by IC&I establishments. Finally, the City could incentivise others, such as private waste management companies, to offer separate collection services for organic waste—for instance, by banning the flow of food waste to landfills; by mandating separate collection of waste to certain IC&I establishments, such as offices or restaurants; or by promoting new systems, like dehydrators in commercial settings, where food waste can be separated from other waste.[171] Finally, when food waste collection is in the hands of private waste haulers, another incentive could take the form of introducing new waste data disclosure requirements to IC&I establishments specific to food waste, to be monitored through audits. For this, however, the municipality should be responsible for establishing a standardised measurement methodology based on the National Zero Waste Council, and directly support companies below a certain turnover in conducting their food waste audits.

Stakeholders

- **IC&I establishment representatives** play a key role in implementing improved and more adequate measurement methods, conducting food waste audits, but also establishing partnerships with food rescue organisations.
- **Food industry organisations and entrepreneurs** are important for introducing innovative solutions and business models to reduce, recover and valorise food waste.
- **Waste collectors** can scale up the separation of organic waste from mixed waste streams.
- **Municipality representatives** can support waste collectors further by mandating preferred collection and treatment techniques for IC&I establishments, and introducing disclosure requirements to ensure food waste is rigorously measured.

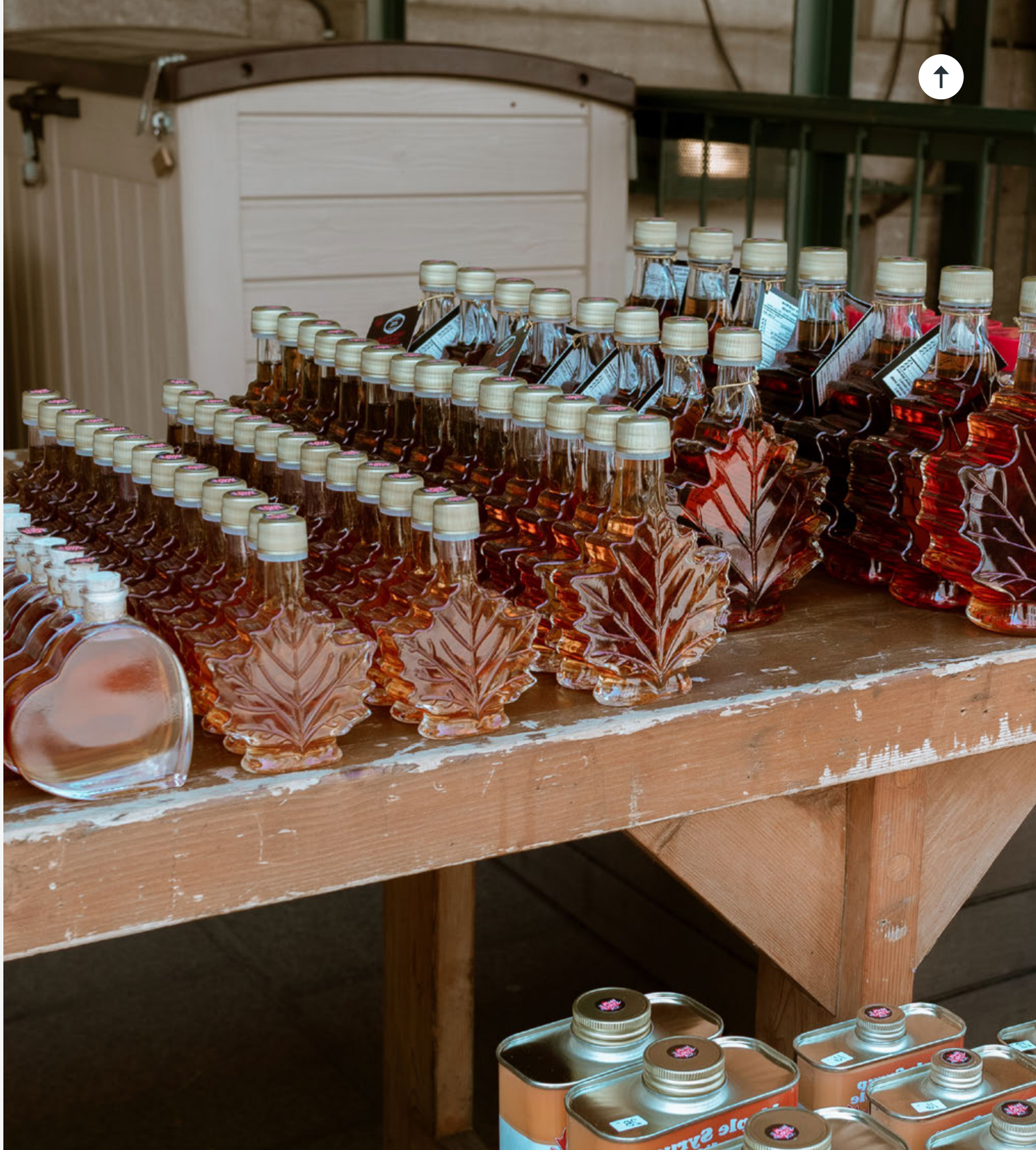
Socioeconomic potential

- **Revenue from secondary materials:** Food waste in Montréal is estimated to represent a loss of CA$3.4 billion, of which CA$1.1 billion is estimated to be from food that was still edible.[172] Improved collection and measurement of food waste is the first step to allowing innovators to capture the economic value of food that is still fit for consumption before it is discarded (that can be reprocessed into higher-value goods such as oils or chutneys, for example), and turn wasted resources into revenue through the sale of good quality compost or other recycled products (such as animal feed).
- **Efficiency:** There is a clear opportunity to leverage collection efficiencies or standardised services already refined by municipalities like Montréal for the residential sector, to minimise driving distances between pick-up points and delivery to food recovery and organic processing markets in a cost-effective manner. Vertuo Mutual is already working towards this (see Existing initiatives on page xx).[173]
- **Costs and incentives:** Low landfill disposal costs and high recycling costs still constitute a major barrier to upscaling food waste diversion from IC&I establishments, as the costs associated with doing so may prove prohibitive to businesses. Additionally, investments in infrastructure will be necessary to accommodate for increases in diverted material from the IC&I sector.[174]

8 SCENARIO DEVELOPMENT FOR FOOD

Impact reduction potential

- **Environmental impact reduction:** Only what gets measured gets managed. Therefore, more advanced knowledge and measurement of food waste can help reduce food waste from big generators and reduce the land, carbon, energy and water footprint of food that is wasted across the whole food supply chain. For instance, the LOOP mission estimates that their food savings has saved 5,400 tonnes of CO2e and 446 million litres of water since beginning its operations in 2016.[175]
- **Impact on other waste streams:** By collecting food waste from IC&I establishments, opportunities can arise to increase diversion across different waste streams: unsold food for recycling and reprocessing (for example, LOOP); surplus edible foods for donation; packaged foods that require de-packaging for organics and package recycling.
- **Redistribution:** When surplus edible food is collected for donation, charity organisations and food banks can intervene and close the loop on valuable resources, not only minimising losses to landfill, but also helping people in need.[176] For instance, the food redistribution initiative La Tablée des Chefs has been active for several years, redistributing over 1.2 million servings of food annually in Montréal and beyond.
- **Effective policies:** Boosting measurement and data on food waste, including insights on the volumes of collected reusable organic material, and the economic and energy costs associated with waste treatment would enable the City to shape policies incentivising IC&I establishments to opt for collection and treatment options with the lowest environmental impact.[177] For instance, if data collected reveals that most food waste sems from the discarding of edible food products, policies such as an increasing food waste collection tax for IC&I establishments could be implemented.



Technical feasibility

- **Costs:** Substantially increasing the diversion rate of waste (including food waste) from IC&I entails significant infrastructural and operational costs.[178] Therefore, a successful increase in the collection of food waste for resource recovery would strongly benefit from legislation banning landfilling, which without policy intervention would often be a cheaper alternative.
- **Willingness to collaborate:** Workshops and roundtable discussions over the course of this project have revealed a genuine willingness to collaborate among stakeholders from IC&I establishments and public institutions. However, this willingness to improve both the collection and measurement of food waste from IC&I must now be translated into tangible actions and initiatives that actively involve IC&I stakeholders, for instance, through the creation of a partnership or association for food waste collection and treatment among the main IC&I establishments. This will help build economies of scale and reduce costs.[179]
- **Enabling infrastructure:** The Ville de Montréal is already considering improving and expanding organic waste collection services to new users, as well as progressively banning food waste from IC&I sources (mainly businesses and grocery stores).[180] To this end, investment and deployment of new organic processing infrastructure is also being considered.

Existing initiatives

Food rescue and redistribution from IC&I establishments:

- LOOP-Mission: This Montréal-based circular company is fighting food waste by rescuing surplus or rejected products from IC&I establishments.
- Supermarket Recovery Program: This programme, implemented by Moisson Montréal, enables the redistribution of products that are still fit for consumption from supermarkets to beneficiary organisations such as food banks. Moisson Montréal is now also partnering with Too Good To Go to scale its impact.[181]

Food waste collection:

- WM's CORe programme: This business and commercial waste management company offers efficient and customised food waste collection systems to businesses, with multiple options for food waste revalorisation (such as energy production, anaerobic digestion and composting).
- Vertuo mutual fund: This mutual fund helps high-food-waste-generating companies in Québec by connecting them to smart organic waste collection and food redistribution services.[182] It supports the development of mutual insurance projects for IC&I establishments that aren't served by the City, but that also don't generate enough waste to obtain attractive rates from private collectors.[183]

Food waste measurement:

- York's food waste audit: York, Ontario conducted a food waste audit and waste-reduction pilots with restaurants and supermarkets to address the lack of information on FLW.
- Ontario's impact assessment: A recent study for Ontario examined the challenges and opportunities for increasing diversion in the IC&I sector using a cost model.
- CEC's practical guide: This Montréal-based guide on measuring FLW at various food value chain stages includes specific guidance for IC&I establishments.
- RECYC-QUÉBEC/Ville de Montréal: As a follow-up to the national report *The Avoidable Crisis of Food Waste*,[184] Montréal, commissioned VCMI to establish a robust detailed estimate of FLW volumes and types from a whole value chain perspective—from production or catch to final destination. (such as composting).

CIRCULAR ACTION THREE: LEVERAGE CIRCULAR PUBLIC PROCUREMENT FOR BUILDINGS

Vision and description

Circular public procurement is a powerful tool for the City to initiate changes at a systemic level within the built environment sector. This approach deals with 'the purchase of works, goods or services that seek to contribute to the closed energy and material loops within supply chains, whilst minimising, and in the best case avoiding, negative environmental impacts and waste creation across the whole life cycle'.[185] Considering that Montréal recognises the built environment sector to be a major consumer of materials and resources, significant changes can be brought about by the City applying circular economy principles and criteria while purchasing goods and services. These principles emphasise the need to shift from technical specifications being set by the procurers alone, to a process where ideally the specifications are decided through exchanges between suppliers and procurers. This approach facilitates the efficient communication of needs, providing adequate information about the goods and services and more importantly, coordinating circular activities across relevant sectors and regional economic systems. [186] [187]

Role of the City

When it comes to infrastructural planning, the Ville de Montréal plays a dual role: on the one hand, it is one of the largest property managers (controlling around 1,200 buildings) while on the other, it is responsible for urban planning and land use management in the city (issuing over 16,000 permits and conducting over 500 infrastructure development projects per year).[188] Given the importance of the City in the sector, circular public procurement for buildings and roads could be a way to encourage the upgrading and reallocation of the current building stock and implement selective demolition for existing buildings, with subsequent collection, sorting, and transformation into secondary materials. Procurement tenders may include multiple criteria to measure the circularity of projects, mandatory requirements for life cycle assessment calculations and environment product declarations in order to promote competitiveness among contractors and suppliers. They may also follow a social urban mining approach to actively provide jobs for unemployed/underemployed persons. Finally, through public procurement the City can play a role in standardising the use of digital tools such as material passports for tracking and tracing materials throughout the life-cycle of projects. For instance, the City could mandate the use of material passports for every new project within the city, set up a common trading platform for the sale and purchase of secondary materials or encourage suppliers to include Radio-frequency identification (RFID) tags for tracking and tracing.

Note: Although the City holds great power when it comes to creating and remodelling the urban built environment, for a transition at a systemic level, the purview may not be restricted to public projects alone. There must also be focus on the involvement of private contractors, suppliers, academic institutions, research and development centres, etcetera.

Stakeholders

- **Municipal circular tender teams** could be responsible for the creation of clear circular ambitions and criteria. They focus on the execution of the tender and final procurement.
- **Designer and project planners** focus on designing the project based on the ambitions and criteria set by the tendering team. They plan the execution, schedule, budget, funding and cost targets of the project.
- **Construction contractors** bid for tenders and deliver the desired circular results. They validate the tender specifications in market consultations, and provide feedback when the tender is executed.
- **Material suppliers** provide construction materials in accordance with the project plan tendered by the contractor. They can also serve as material experts.
- **Extended Government:** Beyond the City administration, other public sector authorities that may possess the capacity to issue contracts within the city limits (for example, the Ministry of Transport).
- **Real Estate players** can play a role in altering procurement processes through the adoption of circular business models. They can also promote circular projects to gain a competitive edge to attract tenants.

Socioeconomic potential

- **Innovation:** Adopting circular procurement practices can act as a huge accelerator for innovation. For example, the Innovation Barn in Charlotte, North Carolina brings together businesses and zero-waste initiatives to collaborate and implement projects.[189]
- **Vacancy rate:** Through procurement, the City can make spaces available for meanwhile-use to decrease vacancy rates across the city. From 2017 to 2019, The Young Project turned a former 929 square metre warehouse owned by the City (empty but heated for five years, and slated for demolition) into a social housing space for over 20 social economy organisations, community associations and artists from 2017 to 2019. The project not only reduced the vacancy and maintenance costs, but also generated employment by supporting these organisations.[190]
- **Competitive advantage:** Beyond the territorial limits of the city, the Ville de Montréal could play a leadership role in harmonising the legislation (for example creating the same requirements for specifications concerning construction, renovation and demolition (CRD)), which could have a greater impact for various private and public players. The role/entity to implement such legislation could be created and accelerated in collaboration with an external sponsored actor, providing a competitive advantage to the City.
- **Cost savings:** The City of Hamburg required the use recycled asphalt during the refurbishment of a road, which cut costs by 30% compared to conventional road resurfacing.[191] However, local circumstances and economic implications are influenced and determined by factors such as labour costs, disposal fees and secondary materials pricing.

8 SCENARIO DEVELOPMENT FOR BUILT ENVIRONMENT

Impact reduction potential

- **Sustainable procurement:** Through procurement, the city can plan an urban environment that is built in harmony with nature. For instance, a sustainable procurement strategy was used for the Montréal Soccer Stadium to limit its impact on the environment. The project repurposed a former quarry, recalling the geological nature of the ground, and fully integrating natural elements of the site and preserving its trees. During construction, the project was able to reduce energy consumption by 54%. By prioritising locally-sourced wood (60%) and materials with recycled content (7%), transport-related and embodied emissions were cut, while 82% of construction waste was recovered.[192]
- **Material and emission savings:** One of the pilot projects implemented by REBus for the reconstruction of the Dutch Almere A6 motorway demonstrated that, if extrapolated at national level, a project of this kind could generate savings of 45,000 tonnes of CO2e and 2.7 million tonnes of materials.[193]

Technical feasibility

- **Responsible procurement policy:** The City has already taken a significant step in the direction of circular public procurement by integrating circularity criteria in its *Plan approvisionnement responsable 2022–2025 (Responsible Procurement Plan 2022–2025)*. The built environment has been recognised as a priority area with special emphasis on construction waste reduction and promotion of sustainable and reusable building materials. The policy is already looking into setting up a 'marketplace' platform for the management of goods by different business units.
- **Professional training:** It is evident in the case of Montréal that organisations and businesses are becoming increasingly aware of the circular economy approach. However, it is essential that this awareness is transformed into collective action and an overall change in organisational culture. The City may promote educational initiatives by supporting volunteering organisations that provide dedicated training for professionals, for example through collaboration with research universities and vocational training centres.

Existing initiatives

- Country-wide collaboration and knowledge sharing: The Circular Cities and Regions Initiative brings together Canadian communities, including Montréal, to discuss the latest advances in circularity and how best to put these into action through municipal initiatives. Construction is one of the main themes among participating cities: the initiative boasts circular procurement projects, deconstruction initiatives, integration of recycled materials and partnerships including social economy enterprises.
- Promoting supplier innovation in Rotterdam: The City of Rotterdam buys materials directly from industrial suppliers for publicly-owned infrastructure projects. Since 2015, instead of asking for specific materials or methods, the City has encouraged innovation by asking suppliers to demonstrate the environmental cost as a performance indicator. Suppliers are then pushed to invest in innovation or engage in dialogue with larger buyers such as the city government.
- Circle House project, Denmark: The Circle House project consists of 60 social housing units in the Lisbjerg Bakke district of Aarhus, and was initiated with the objective of reusing 90% of the building materials at a high value. This project was supported by the Danish government and is a scalable demonstration project for bringing new circular knowledge into the industry. This project boasted around 60 stakeholders and more than 30 enterprises across various construction sector value chains.

CIRCULAR ACTION FOUR: INCENTIVISE HIGH-VALUE REUSE AND RECYCLING OF CONSTRUCTION AND DEMOLITION WASTE

Vision and description

Currently, buildings require brute force to be dismantled, making material separation on-site difficult and preventing reuse elsewhere. To ensure high-value reuse and recycling of construction and demolition waste (CDW), demolition practices need to advance—complemented by a boost in urban mining. Secondly, infrastructure (both physical and digital) needs to develop so that demand can be matched to the supply of available secondary materials. This will help ensure that materials are actually reused at end-of-use. Material passports can facilitate the uptake of urban mining by highlighting which materials buildings are made of, and where these materials can be found, while selective demolition, which removes hazardous materials through pre-demolition audits and dismantles building parts, allows the recovery of pure materials for reuse.[194] The design phase of buildings will also be crucial, with strategies such as deconstruction, disassembly and modularity coming to the fore to facilitate reuse at end-of-life. Planning for disassembly must begin in the early stages of a project—and should include key elements from disassembly diagrams to inventories of possible materials for reuse.[195] Incentivisation (financial and otherwise) to promote efforts and to provide a level-playing field for industrial players will be essential for bringing about this transformation.

Role of the City

As the Ville de Montréal is not directly responsible for the management of all landfill sites that receive CDW, as it is mostly private, imposing a ban on landfilling may not be a viable solution at this stage. However, the city can adopt other incentivisation measures such as making the deposit of CRD waste free for small entrepreneurs, provided that the materials are sorted—thus prohibiting the deposition of mixed CRD waste. In addition, the City can invest and support in the development of infrastructure, both physical and digital, that can connect the two ends of the high-value reuse and recycling chain—the suppliers who are responsible for providing the reusable materials and the demand side responsible for incorporating these materials into new construction projects. This could take the form of CDW recycling facilities, facilities for the reconditioning of deconstructed building elements, and material and component marketplaces to collect and recover disassembled pre-used building components and material. Finally, the City could invest in and facilitate research to map the building stock, aiding the identification of recovery opportunities and disseminating knowledge around adequate demolition and deconstruction practices.

Stakeholders

- **Demolition contractors** are responsible for the recovery of high-value CRD waste. In some cases, contractors also assume the role of suppliers of these materials.
- **Manufacturers/Suppliers** provide the construction materials in accordance with the project plan, tendered by the contractor. These stakeholders should be a key focus while undertaking the spatial planning of material marketplaces.
- **Property owners, investors, and company owners** can play a part in solving some of the challenges revolving around high-value reuse and the unreliability of supply. Risks involved in such projects are inevitable. It is essential that the property owners or investors also have a vested interest in such projects and the capacity to absorb such risks.
- **Construction companies and developers** bid for the tenders and deliver the desired circular results.
- **Architects, builders, and engineers** design the project based on the ambitions and criteria set by the tendering team. The plan the execution, schedule, budget, funding and cost targets of the project.

Socioeconomic potential

- **Jobs:** Changing the way we build our cities will inevitably change the job market. Demand could increase for new jobs locally, as deconstructing buildings and recovering materials are generally more labour-intensive processes. However, a decline in employment could be seen in mining and other industries in the region.
- **Cost savings:** Economic analyses have also shown that selective demolition has similar average costs to conventional demolition.[196] Projects supported by Synergie Montréal resulted in the generation of CA$441,611 in income and savings related to sourcing and waste management fees in the year 2020, along with the creation of local jobs.[197]

Impact potential

- **Materials and emissions savings:** The Darwin bridges in Montréal incorporated about 70,000 wine bottles in the concrete used during construction. This resource made the concrete stronger and durable and saved about 40,000 kilograms of cement, preventing the emission of 40 tonnes of CO_2[198]. Another fine example is that of the deconstruction of the former Hippodrome de Montréal, during which the city also achieved impressive materials and emissions savings, such as 82% reduction in landfill of construction waste, 13% reductions in GHG emissions and a 28% increase in material recovery. (Group Ageco)
- **More functional spaces:** The metamorphosis of Frédérick-Back Park in Montréal is an example of bold landscaping for a sustainable ecosystem.[199] The area was converted from an old limestone quarry, then used as a landfill for residual materials, and now is one of the largest green spaces in Montréal.
- **Use of secondary materials:** A vast quantity of materials were also recycled during the development phase of Frédérick-Back Park (200,000 tonnes of excavation soil, 40,000 tonnes of sand, 10,000 tonnes of gravel). About 24,000 tonnes of leaves were composted on-site, and 10,000 tonnes of wood chips recovered from the City's pruning operations, were used for the design of benches (made from felled ash trees) and the creation of new paths and trails (made from flaking residue from the cliffs).
- **Waste avoidance:** A nursing home in the Netherlands has shown that selective demolition, if successful, can lead to lower waste generation during the demolition process.[200] In Montréal, the deconstruction of the disused Hippodrome has further proven this. The project achieved a reduction in landfilled CDR of 82%.[201]

8 SCENARIO DEVELOPMENT FOR BUILT ENVIRONMENT

Technical feasibility

- **Governmental support:** With the identification of the urban built environment as a major focus area within the Zero Waste Strategy, the city is already aware of the necessity to invest in the recovery of CRD residual waste.[202] Moreover, the new Policy for the ecological transition and sustainable development of municipal buildings (SGPI 2021) has already included some measures targeting circularity.
- **Dynamism of the sector:** High-value reuse and recycling of CRD waste will require a systemic transformation. While transformation at such a scale is not easy, a very dynamic sector in Montréal can be leveraged in this direction. Various professional orders are also increasingly aware of circular practices within this sector.[203] An expert committee (comprising representatives of industry, sectoral associations and civil society) has been announced by the Government of Québec to promote the adoption of best practices for managing CRD waste.[204] Similarly, a Centre for Intersectoral Studies and Research in Economics Circular (CERIEC) for the construction sector (lab construction) has operated since 2021.[205]
- **Digitalisation:** Integrating smart technologies such as the Internet of Things within the City's physical infrastructure is essential for efficiently tracking products' life cycles. Ongoing research at McGill University explores how data-driven approaches can be used for the development of simple frameworks that map the Built Environment value chain, highlight relationships, and allow for communication across its stakeholders towards low-carbon and cost-effective decision-making.[206]
- **Disincentives:** Landfilling waste is still the most cost-effective option and virgin materials are still preferred over secondary ones. It is essential that the city government extends support to the stakeholders in the private sector as well by providing economic incentives and favourable business environments.

Existing initiatives

- Brique-Recyc: Although masonry bricks have the potential for reuse, several challenges such as the use of adhesive mortar and the damage to bricks while cleaning restricted its reuse. Brique-Recyc, the brainchild of Montréal-based contractor Maçonnerie Gratton, has developed a machine that can clean the mortar from brick up to 99% in a matter of a few seconds. Concrete actions have been initiated through a collaboration between Brique-Recyc and Architecture Without Borders Québec (ASQF) (Architecture Sans Frontières Québec).[207] A digital platform dedicated to the reuse of bricks during projects in Montréal will be developed, connecting those wishing to dispose of bricks, with those needing blocks for their projects.
- Governmental Incentives: The ‘Materials Without Borders' project initiated by (ASQF) has received financial support from the Government of Québec in addition to the financial incentives from the Ville de Montréal. This project is dedicated to the development of infrastructure for material recovery and resale business.
- Éco-Réno: Éco-Réno is a social economy business with a store in Montréal, specialising in the recovery and resale of new and used materials and old architectural components. It offers services for collecting donations and transporting materials, as well as advice for carrying out deconstruction or material reuse projects.
- Ecocenters: Currently, the ecocentres in Montréal do not sell materials for reuse, however the LaSalle and St-Laurent ecocentres store certain deconstruction materials brought by citizens and transfer these materials to organisations that handle the sale for reuse.

CIRCULAR ACTION FIVE: CREATE A CIRCULAR BUSINESS ECOSYSTEM FOR CIRCULAR FASHION

Vision and description

The textile sector is a complex system—with activities ranging from design and production to global distribution. This means that no company can achieve circularity alone. Circular business ecosystems can help achieve the systems-level change required, by building a new kind of value creation mind-set. These ecosystems can together create products, solutions and services based on the principles of a circular economy, and apply circular business models in their way of operating and doing business.[208] Activities in a circular business ecosystem range can cover 1) eco-design, training and innovation 2) repair and maintenance, 3) reuse of a product (rental and other services), 4) reuse of a material (for example, for stuffing or insulation) and 5) recycling-related activities and business models for post-consumer textiles along the whole value chain. Montréal can leverage its position as the third leading city in North America for clothing manufacturing[209] to create this ecosystem and become a nexus of new circular designers, manufacturers, retailers, craftsmen, creators and entrepreneurs.

Role of the City

The City can support the development of a circular business ecosystem for the fashion and textiles sector for the entire value chain, starting from eco-design to end-of-life. It can do this by directly supporting the development of tools, training, directories, and research and innovation for eco-design and/or repair activities; creating exchange platforms for post-industrial fabrics; or, more in practice, by offering transitional places to support eco-designers—for instance, by providing short-term use of temporarily empty buildings to sustainable clothing stores or repair services (i.e. ‘meanwhile-use'). Direct economic incentives can then support repair and reuse businesses like thrift stores or other shops. This could take the form of a Repair Fund[210] to tackle the cost of repair, or a ‘voucher’ system in which consumers can earn credit as they purchase used clothes to create other products. To scale up citizens' participation, the City can also carry out awareness and communications campaigns to 'revamp the used' and make such schemes more appealing. Finally, the City can lead by example, acquiring uniforms and other textiles directed to municipally-owned services that meet eco-design, durability and recyclability requirements.

Stakeholders

- **Designers and manufacturers** can create items for circularity, using recycled, recyclable and renewable inputs and technology that maximises resource efficiency.
- **Consumers** can create the demand needed to fuel closed-loop circular business ecosystems. People need to move away from current unsustainable buy, wear and throw-away consumption habits.
- **Digital innovators** can design solutions such as augmented reality (AR) and virtual reality (VR) tha can allow consumers to ‘wear’ or try out products virtually and ease second-hand purchases.

And many more...[211]

Socioeconomic potential

- **Market growth:** The resale of garments is expected to grow 11 times faster than the broader retail clothing sector by 2050.[212]
- **Branding:** A circular business ecosystem for the textile sector can help position Montréal as the centre of sustainable fashion in North America, building on its strong existing position within the industry, and fostering business innovation, local talent and entrepreneurship—for a future 'Made in Montréal' branding.
- **Lack of data:** Although research is advancing in the sector, data on textiles material flows, innovation potential and quantifiable impacts of a circular business ecosystem at city level is lacking.

Impact reduction potential

- **Resource efficiency:** Purchasing second-hand clothing is found to save almost 34 kilowatt hours of energy and 293 litres of water, compared to equivalent new clothing.[213] By not buying new, pollution from textile production, which utilises non-renewable natural resources and a high amount of chemicals, can be displaced.
- **Emission reduction:** The carbon footprint of second-hand clothing is found to be 82% lower than for the equivalent new clothing.[214] By doubling the average number of times a garment is worn, greenhouse gas (GHG) emissions from textiles can be lowered by 44%.[215]
- **Global impact:** By reusing clothing locally, it is possible to reduce the excessive amount of second-hand clothing shipped to African countries, which shifts the waste problem away from the city and creates a challenge for local textile production.[216]

8 SCENARIO DEVELOPMENT FOR TEXTILES

Technical feasibility

- **Stakeholder engagement:** The textile ecosystem in Montréal is already showing dynamism and increasing interest in circularity. The open-innovation collective MUTREC already sees many city stakeholders involved.[217] More and more groups and events are mobilising the sector, such as the Fibershed, Mmode Cluster and Concertation Montréal (CMTL) events.
- **Expand capacity:** Collection, sorting and recycling capacity are yet to be improved to fuel the needs and potential of a circular business ecosystem. This is further considered in the next section.
- **Clear vision and value proposition:** For the success of a circular business ecosystem, it is important to develop a clear, shared systems-level vision, including many different actors along the whole value chain, and ensure the new value proposition for customers is well-articulated.[218]

Existing initiatives

- Digital innovators: Innovative companies like Tengiva and Vestech Pro are bringing digitalisation into the fashion world to increase resource efficiency. Tengiva created a digital exchange platform to allow a circular economy for textiles in the city. Vestech Pro, with support from the Ville de Montréal, launched a digital fashion-clothing course to push for the uptake of digital technology in the sector.
- Communities of Practice: In 2021, a 'Community of practice' was formed for SMEs to join forces and transform practices in the strategic textile and clothing sector towards models of eco-responsibility and circularity applicable to all sizes of business. The project was led by Concertation Montréal (CMTL), in collaboration with the Metropolitan Fashion Cluster (Mmode) and the Network of Women in the Environment (Réseau des femmes en environnement).
- Relooping Fashion Initiative: This pilot model for a closed-loop textiles ecosystem is based on the principles of circular economy. The project produced business opportunities and shared value for all parties along the value chain, working on themes such as service, production, design and business.
- British Fashion Council: The Circular Fashion Ecosystem Project is the first stepping stone working towards designing an holistic city-level Circular Fashion Ecosystems across cities in the UK.

CIRCULAR ACTION SIX: INCREASE COLLECTION, SORTING AND RECYCLING CAPACITY FOR TEXTILE WASTE

Vision and description

Similarly to food waste, well-designed and effective separation and collection logistics are key to accelerating the circular economy in the textile sector.[219] In a circular economy, both post-consumer and post-industrial textile waste is collected, separated and fed to new industries for high-value recycling. Montréal is known as Canada's fashion capital, but despite the growth experienced by the sector, recycling in the sector is still in its infancy and most textile waste currently has no other destination than downcycling, landfill or incineration. A new system to collect, sort and recycle textiles is needed, alongside with the expertise needed to run it. Although textile waste is not a significant part of IC&I or residential waste streams, it is estimated that about 22% of textiles in the waste stream are available for recycling, meaning that tackling this issue is necessary for the ambitious objective of generating no textile waste by 2025.[220]

Role of the city

The City can contribute to diverting post-consumer textile waste by harmonising the regulations governing their collection (see the text BOX FOUR), as well as funding the collection, sorting and packaging of end-of-life textiles through eco-contributions.[221] Then, for post-industrial textiles, the City can consult with industry representatives to develop eco-design directives, to design products for a second life and find synergies across industries so that textiles waste can have another life at its highest possible value. Especially in regards to collection, a system for the recovery of IC&I textiles must be created, and best practices should be established. For this, the City could support promising projects that will serve the whole value chain. It could be important to establish a network of 'buyers' that could modify textiles and unsold inventories for the purpose of redistribution, although this comes at a significant cost. Finally, the city could support projects aimed at developing recycling technologies (such as automated sorting) and at research on cutting-edge, sustainable materials.

Stakeholders

- **Designers and manufacturers** can drive the demand for recycled fibres and will have a key role in redesigning clothes and other textiles in a way that optimises recycling: for example, clothes without labels or made of only one material. They can also create new cutting-edge garments from recycled fabrics.
- **Industry consortiums** will have to bring people together, explore synergies and assess the potential of different business models for brands and manufacturers to successfully integrate secondary textiles.
- **Logistics providers**, particularly for reverse logistics, have a central role in transporting textile waste from collection to facilities that can recover materials and efficiently put them back into use.
- **Waste collectors and reprocessors** can scale textile waste collection, so that textiles can be reused or recycled.
- **Academia** can continue researching, developing, designing and implementing new technologies to improve both mechanical and chemical recycling.

Socioeconomic potential

- **Harvest revenues and lower costs:** In Europe, the missed economic potential of textile waste is estimated at CA$100 billion each year, compounded by the high costs of landfill disposal.[222] With proper sorting and collection of textile waste, there could be enough material to feed multiple textile recycling facilities in Canada in an economically viable way, while lowering operating costs for municipal landfill sites.[223]
- **Jobs:** Recycling textiles could create local jobs: research has found that for every 10,000 tonnes of resources that are recycled instead of being incinerated, 36 additional jobs are created.[224]
- **Technologies:** Many technologies already under development in Canada could find valuable applications in Montréal.[225] [226] Using such technologies at an industrial scale remains a challenge, although capacity is quickly expanding (see text BOX SEVEN on page 50).[227] So far, fibresorting technology is only available in Germany and Sweden.

Impact reduction potential

- **Reduce landfill space requirements:** Textiles in Canada account for 7% of all plastic in Canadian landfills.[228] By recycling these materials instead, valuable space could be saved. Atelier b, a local company, plans to divert more than one tonne of textile materials from landfills through its end-of-life clothing collection programme and the transformation of production scraps.[229]
- **Prevent pollution:** Natural fibres, when disposed of in landfills, can take hundreds of years to decompose and release harmful GHG emissions into the atmosphere. Synthetic materials take much longer to decompose and release toxic substances into groundwater and the surrounding soil. By recycling textiles instead of landfilling, this type of pollution is avoided.
- **Material footprint:** The process of recycling natural textiles includes the sorting of materials by type and colour, which reduces the need for re-dying the fabric, thus saving energy, water and avoiding pollution, while also reducing the need for virgin fibres.[230]

Technical feasibility

- **Regulatory barriers:** Several regulations have already paved the way for increased recycling in the region. In December 2021, Québec abolished a law requiring labelling for stuffed and upholstered products[231] and any stuffing or lining materials (i.e. for filling of a pillow, or a part of a mattress or any upholstered products, or even the lining of a winter coat) to be only filled or made with new materials. Another bill was repealed to allow the use of post-consumer recycled fibres for building insulation.[232] However, a few regulatory barriers persist to ensure that textiles are collected and fed into recycling (see BOX FOUR on page 28).
- **Contamination:** Most textile waste is difficult to recycle because it includes a blend of fibres that are hard to separate. Moreover, even a 100% cotton t-shirt contains recycling disruptors such as labels, which are usually made of different materials. The way clothes and other textiles are designed and produced needs to change to facilitate recycling.[233]
- **Local expertise:** The local expertise needed to upscale textile waste collection, sorting and recycling is lacking. The City should encourage the arrival of new workers with experience in fibre-sorting at all skill levels: textile sorting is usually labour intensive, slow and requires a skilled workforce.[234]

Existing initiatives

- Atelier b: This small textile manufacturer optimises the use of textiles scraps with specialised software and manufactures small accessories, baby clothes and home items in Montréal from natural fibres with a completely zero waste process.[235]
- Atelier retailles: This local initiative upcycles fabric scraps from the local fashion industry into fine papers.[236]
- Rose Buddha: This certified B Corp makes sustainable athleisure wear and accessories, using recycled materials and natural and organic fibres. Every product is designed in Canada and ethically made. See the BOX SEVEN on page 50 for more examples.

BOX SEVEN. Recycling and reinventing fibres is challenging but capacity is expanding throughout the province and the country.

The Ville de Montréal has identified textile recycling as a clear opportunity for the future. For this, funding and partnerships between municipalities and waste collectors and other stakeholders will be crucial for better management.[237] The City is taking first steps in this direction by supporting the non-profit organisation Renaissance with a total investment value of over CA$500,000.[238] Part of this funding will be devoted to a textile recycling pilot project that will see the setup of the first defibration for clothing in the province. Since the closure of Leigh Fibers in 2010 and the Textile Centre Techniques Chaudière-Appalaches (CTTC-A) in 2016, there are only two companies in Québec that have operational machines that can cut, defibrate and card fabrics—however, these are reserved for post-industrial textiles. The project is also in partnership with Vestechpro and will put forward concrete actions that can be taken on a daily basis in order to recover, reuse, repair, recondition and ultimately recycle textile fibre.[239]

Other closed-loop recycling processes already exist in Canada. The company General Recycled, based in Vancouver, British Columbia,, is already recycling polyamide fibres and has built a second facility in Val-des-Sources, Québec. While the company's primary focus is on aramid fibres—a specific type of polyamide fibre extensively used in fire-resistant garments—it is also exploring recycling nylon and polyester fibres. Québec-based Duvaltex, North America's largest contract textile manufacturer, is known for its Eco-Intelligent Recycled Polyester Fibre and is trying to optimise processes to use post-consumer materials and transfer them to 100% post–consumer biodegradable polyester fabrics. It has a product line made from ocean waste and has a closed-loop production and recycling programme for textile trims in collaboration with its fibre suppliers.

However, to understand and further investigate the feasibility of different recycling technologies, more reliable data on how much textile waste IC&I establishments produce is needed, since textiles are currently often classified as ‘other’, and are not tracked as a stand-alone waste category. A natural next step for the City, although it would require significant resources, would be to conduct a thorough manual sorting of the non-wearable textile fraction, so as to collect detailed data on the exact nature of post-consumer textile waste in the region, and understand the potential opportunities for downcycling or high-value recycling. The potential to recycle textiles is dependent on a multitude of factors—from fabric composition, to fibre composition, to levels of contamination (printing, hardware) on the garment, and of course the exact feedstock specifications of available recycling technologies.

CIRCULAR ACTION SEVEN: SUPPORT SHARED MOBILITY INITIATIVES

Vision and description

In cities, vehicles spend most of their lifespan unused. Producing new vehicles typically requires significant quantities of materials, yet they provide little utility. To this end, the City aims to shift 25% of single-occupant car journeys to less energy-intensive modes, such as shared mobility options, by 2030.[240] Shared mobility provides joint access to vehicles to allow people to move around the city, making much more efficient use of resources. In addition, many forms of shared mobility can help solve other common problems such as traffic through the use of shared micro-mobility vehicles (such as. bicycles and e-scooters) or through increased occupancy initiatives such as car-pooling and car-sharing.

Role of the City

The City can continue to support the development and uptake of shared mobility initiatives by: promoting initiatives and creating awareness of their benefits; collecting data and conducting research on the best use and form of shared vehicles, as well as the business models best suited to the local context; developing and extending existing infrastructure such as e-bike charging stations and bicycle lanes; providing financial support through, for example, incubator and investment programmes for new initiatives and scaling up existing initiatives; and ensuring a positive regulation environment by, for example, issuing new types of parking permits for shared vehicles and implementing parking restrictions for e-mobility to prevent instances of nuisance from damaging public perception. In 2024, Montréal will roll out its Land Use and Mobility Plan 2050, which will propose innovative tools to redesign the city and shape mobility around the green transition.[241] Integrating circular economy actions, such as shared mobility initiatives and optimised logistics (see Action eight), into this plan could be a way to revise ways of transporting people and goods for the better.

Stakeholders

- **Businesses** can provide a shared mobility initiative through maintaining a vehicle fleet, such as electric bicycles, that are accessible to the public.
- **Infrastructure providers** can set up charging stations for shared electric mobility (bicycles, scooters and electric cars) as well as construct suitable infrastructure, such as bicycle lanes.
- **Industry clusters**—regional concentrations of related industries—have a role to play in supporting the transition to shared mobility options, such as the electric vehicle (EV) industry cluster (Propulsion Québec), the logistics and transport cluster (Cargo M), travel management centres, etcetera.
- **Academia** can collect data from shared mobility initiatives to assess their impacts, compare different business models and provide recommendations for further development.

Socioeconomic potential

- **Lower cost travel:** Shared mobility services reduce expenditure on car insurance, taxes, parking permits and reparation costs. Thus, these services are estimated to provide Montréalers with significant savings compared to private car ownership, which on average costs between CA$7,000 to CA$10,000 per year.[242]
- **Stimulate start-ups and innovative business models:** New forms of shared mobility provide an opportunity for new companies to enter the mobility market with novel technologies and business models. This can help stimulate local businesses as well as shape how people move around the city.

Impact reduction potential

- **Reduced material footprint:** New vehicles in Montréal added 26 kt of materials to the material stock in 2019, with an associated footprint likely much higher. Increased sharing has great potential to reduce this figure by significantly cutting the vehicle fleet size within the city, particularly in terms of cars. With regards to e-scooters the benefits are less clear. E-scooters have a limited lifespan, carry only one person, and recharging them often adds to the environmental burden due to increased battery use. There is a place for e-scooters among circular sharing mobility, but they must become longer-lasting and made of materials easy to recycle (i.e. aluminium, not composite plastic) to justify their manufacturing.
- **Reduced GHG emissions and air pollution:**[243] In addition to the material footprint, reducing the vehicle fleet size in the city will also reduce the GHG emissions and local air pollution. This will also be serviced through the use of EVs and micro-mobility vehicles, which benefit from a local electricity supply based primarily on renewable sources.[244] A study in Palermo, Italy demonstrated a reduction in GHG emissions of 38% through car sharing alone.[245] In Lisbon, car sharing was found to result in 35% to 65% reduction.[246]
- **Reduced traffic and congestion:** Increasing the occupancy of mobility options in the city means that fewer vehicles perform the same utility, subsequently reducing traffic and journey times. On top of this, the demand for parking spaces may decrease, opening up possibilities to repurpose the space for other uses, such as green spaces. A Montréal-based study found that one shared car led to ten fewer private cars on the road, with the potential for further reductions with increased passenger kilometres of the shared car.[247]

8 SCENARIO DEVELOPMENT FOR MOBILITY

Technical feasibility

- **Public perception:** Private car ownership is deeply ingrained in North American culture—so many people may be initially unwilling to adopt such a behaviour change. In addition, shared micro-mobility has gained a bad reputation in some cities due to bad practices, such as parking in obstructive locations and vandalisation. The City can create information and awareness campaigns to help encourage the uptake of sharing options and good etiquette, as well as financial incentives to participate in mobility sharing schemes, or deterrents to private car ownership.
- **Lack of infrastructure:** Shared mobility often requires access to existing infrastructure such as parking spaces, and these may—in many cases—be reserved for privately owned vehicles. Other infrastructure may also be hindering uptake, such as the lack of electric charging infrastructure for electric mobility, cycle lanes to ensure users can travel safely and digital platforms that integrate different forms of mobility by sharing information with one another.
- **Location dependency:** Different types and models of shared mobility will be more suitable for different parts of the city. For instance, some forms of shared mobility work better in densely populated parts of the city where users have sufficient options to carpool to work or to find a shared bicycle or car.
- **Limited supply:** A lack of available shared options is a common problem in Montréal. The supply of vehicles has not kept up with the growth in users and lack of competition is worsening the issue.[248]

Existing initiatives

- Communauto: The largest car sharing network in Canada. The company operates both a station-based service, where the car must be returned to the original location, and a point-to-point service, where the car can be returned elsewhere in the city. In addition, the communauto fleet in Montréal includes hybrid and full EVs.
- BIXI: A public bicycle sharing system based in Montréal. BIXI is a subscription-based service where bicycles are left at designated docking stations when not in use. The service includes both conventional and electric bicycles.
- Netlift: A Montréal-based mobile application, online platform and support team that provides carpooling, taxi and shuttle services. In addition, the platform enables users to reserve low-cost parking spaces. Other ride sharing initiatives include Eva coop and Turo.
- Solon Collectif: A non-profit organisation, supported by the city and the federal government[249], that implements environmental projects in selected neighbourhoods. Such projects include car, bicycle and bicycle trailer sharing schemes, bicycle repair events, and a volunteering network to transport eldery residents by bicycle.
- ATRM integrated mobility service project: The regional authority for metropolitan transportation (ARTM) and its partners are undertaking an ambitious integrated mobility service ('MaaS') project that will reinvent the way citizens travel. By setting up a one-stop shop, the objective is to simplify access to sustainable mobility services offered on the territory in order to increase the use of public transit. Ultimately, the project will contribute to reducing the use of private vehicles, contributing to GHG reduction objectives.

CIRCULAR ACTION EIGHT: OPTIMISE EFFICIENT AND LOW-CARBON FREIGHT AND LOGISTICS SYSTEMS

Vision and description

As a consequence of lacking data, the freight sector was not considered in the baseline analysis. However, this is an important sector that forms a complex web of activities in the city. The City has two important targets linked to this action: (i) to deliver half a million parcels each year from local urban logistics spaces using electric modes of transportation by 2023[250] and (ii) for 25% of all deliveries to be made with zero-emission vehicles by 2030.[251] In 2021, the first target was revealed to be just past half-way to its goal.[252] If the City takes concrete action to optimise and decarbonise freight and logistics systems, they can take large steps towards meeting this target. Freight services allow goods to enter, leave and move around cities, but their vehicles also consume a disproportionate amount of road space and generate significant pollution compared to the distance travelled. In a circular city, freight services would be optimised to use resources to their full potential, through practices such as logistics pooling, where multiple companies share the same transport service to deliver goods within or to the city. Operating freight services in this way creates a more liveable, cleaner and safer environment.

Role of the City

The City should orient and provide a clear vision regarding its plans for the optimisation of freight and logistics systems in Montréal. For this, it can support optimised and low-carbon freight and logistics services by considering all the components of this system and how they interact with one another. A good starting point is to create an urban logistics plan in collaboration with local stakeholders. Such a plan can be grounded in several core activities. These may include: encouraging logistics data sharing within a harmonised data sharing framework to accurately guide the logistic solutions; public procurement of zero-emission public freight vehicles (such as waste collection, maintenance and repair, and deliveries to public offices); encouraging new logistics concepts and zero-emission freight vehicles through incentives (such as subsidies) and disincentives (such as low emission zones and freight capacity requirements); and increasing consumer knowledge and awareness to make use of new logistics solutions.[253] More direct interventions and stricter regulations can also make a significant impact. For example, a data disclosure requirement as an extension of delivery vehicle permits or licences could be mandated to carriers regarding vehicle information (type of delivery or collection function, emissions, fuel consumption efficiency, type of fuel or energy source, or distance coverage performance, for example).

Stakeholders[254]

- **Logistics service providers, retailers, and courier companies** can engage in urban logistics plans, test zero-emission vehicle fleets and new logistics concepts, and share data with the city.
- **Electricity companies** can ensure sufficient electric charging infrastructure.
- **IT companies** can develop solutions and tools to optimise urban space utilisation.

Socioeconomic potential

- **Cost savings:** Colibri, a project in Montréal, achieved a reduction in operation costs of 30% to 40% through a combination of logistics micro-hubs and cargo bikes for last mile delivery.[255] The replacement of trucks with cargo bikes for last mile delivery achieved cost savings of €0.76 million (CA$1 million) per year in Paris.[256]
- **Investment:** Freight logistics initiatives vary in terms of investment costs. Initiatives considered to have higher investment costs include creating low emission zones and adopting low-emission vehicles, whereas initiatives considered to have lower investment costs include introducing time access restrictions on freight, freight vehicle size and weight restrictions, and establishing a freight specialist in key stakeholder agencies within the city.[257]

Impact reduction potential

- **Resource efficiency:** Optimised freight and logistics services share freight resources (such as vehicles, buildings and digital services) amongst multiple stakeholders. This can reduce the burden on the City's infrastructure and vehicles by doing more with less.
- **Emission reduction:** Reducing the infrastructure and vehicles required for freight services can subsequently reduce its energy consumption and CO2 emissions. The decarbonisation of such vehicles (for example, through the use of cargo bicycles and electric freight vehicles) can provide even deeper emission reductions. The Colibri project in Montréal is estimated to have avoided 150 tonnes of CO2 emissions in 2021 through the use of electric cargo bikes for last mile delivery.[258] Similarly, a project in Seattle achieved a 30% to 50% reduction in CO2 emissions through its network of micro-hubs and cargo bikes, compared to operating conventional freight services.[259]
- **Air pollution:** Optimised freight logistics also reduces local pollutants. The London Borough Consolidation Centre has reduced the number of deliveries entering the city, utilising a maximum capacity of vehicles that do enter. In addition to a CO2 reduction of 41%, the project resulted in a 51% reduction of nitrogen oxide emissions and 61% reduction in particulate emissions, both of which are severely detrimental to human health.[260]
- **Traffic reduction:** In addition to emission reduction, the Colibri project in Montréal is estimated to have reduced 30,000 hours of truck presence in 2021 in the centre of the city.[261]

8 SCENARIO DEVELOPMENT FOR MOBILITY

Technical feasibility

- **Successful initiatives:** Montréal has already successfully shown the potential of shared logistics vehicles with cargo bicycles performing last mile delivery. It has set an example for other cities around the world, and can continue to learn from new initiatives in other cities.
- **Enabling elements:** A number of practical barriers still exist that hinder the wider adoption of such initiatives by stakeholders. For example, ensuring strict enforcement and harmonisation of zero-emission areas requires good organisation and the ability to amend the appropriate regulation.

Initiatives

- Colibri project involves a combination of shared logistic vehicles and cargo bicycles to deliver goods to their final destination.
- Envoi Montréal is a shipment management platform that promotes the use of carbon-free options for the first mile of delivery in Montréal.
- Logistics hub in Paris is creating logistics micro-hubs to consolidate goods before the last mile delivery.
- Amsterdam's low emission zones encourage zero-emission freight vehicles and regulate emitting vehicles to create a cleaner, safer environment.

Photo by Christian Brault for Dumoulin Bicyclettes

9 THE WAY FORWARD: RECOMMENDATIONS FOR A CIRCULAR MONTRÉAL

9 THE WAY FORWARD: RECOMMENDATIONS FOR A CIRCULAR MONTRÉAL

Montréal is a vibrant and innovative city that is off to an excellent start on its transition to a circular economy—yet the road ahead remains long. Considering the current status of the circular economy in the city—and the associated challenges and opportunities—we have defined key recommendations that the City could consider in its next steps towards circularity. These recommendations are meant to guide and inform the Ville de Montréal in the development of the City's *Circular Economy Roadmap*, which will define more detailed actions. The Roadmap should not just formalise what is already taking place in the city, but should also open up new perspectives and drive ambitious new developments. The eight Circular actions in this document have made a first attempt at guiding the City in the right direction. A few additional considerations should be kept in mind:

- **Political endorsement and collaboration**. Local governments are key actors in steering and guiding the transition while creating momentum across other stakeholders. To this end, the circular economy agenda should be endorsed as a priority at the highest political level. A crucial part of the transition will also involve changing relations across value chains and identifying synergies across sectors. This will require the support of various departments across political levels. Those departments should participate in the development of the Circular Economy Roadmap, and subsequently have a clear mandate and budget to guide and support the implementation of the identified actions.
- **Clear governance**. For each of the proposed actions highlighted in this report, the role of the City could change. There are multiple key governance dimensions, levers and tools that allow and enable city governments to *promote, facilitate or enable* the circular economy.[262] In the development of the *Roadmap*, the means by which the city may implement the actions proposed should be elaborated upon further (see the Urban Policy Framework for more information on this): for instance, will the City be a promoter of the selected action through awareness campaigns? Will it be an enabler through direct financing? Or will it be a facilitator, connecting stakeholders through matchmaking platforms?

BOX EIGHT. The missing link in the circular transition: key stakeholders for each sector

- **Food system:** Many independent circular food initiatives are already taking place across the city. Now Montréal needs an entity that will take on the role of the **facilitator** to harmonise existing initiatives (for example through living labs), identify synergies between them and facilitate collaboration and partnership creation. A key role for the facilitator will also be to drive the efforts to improve data measurement and transparency regarding food waste flows throughout the City. This facilitator role could take the form of a new entity or programme, a strategy that was adopted in the UK with the National Industrial Symbiosis Programme (NISP) and exported to more than 20 countries. Instead, Montreal could leverage the efforts of an existing initiative, such as Synérgie Montréal, that already holds remarkable experience in guiding local efforts towards a circular economy.
- **Built environment:** With the traction created through the development of supportive policies and initiatives by the City of Montreal, the built environment sector is now in need of **first-movers**. Financial institutions willing to invest in new circular business models, construction companies promoting new design strategies (e.g. Design for Deconstruction, Modular design, prefabrication, passive housing, Design for flexibility and adaptability) and manufacturers producing sustainable and circular products (e.g. reusable secondary materials, bio-based construction products). In addition, the City can focus on developing a public-private ecosystem for developing the digital infrastructure (eg. material passports, digital marketplaces) and physical infrastructure (e.g. recycling units, trading facilities) within the city for promoting the retrieval and reuse of secondary materials. It is essential that the first-movers experiment and demonstrate that such initiatives are economically viable in the long-term and environmentally beneficial for the city and its citizens.
- **Textiles:** Similarly, the textile sector in Montréal is lagging behind in the circular transition, primarily due to the lack of infrastructure for the collection and recycling of textile materials and products. **New businesses and business models** are needed to fulfil these services by, for example, offering collection and sorting services for textile waste and delivering these to businesses that create new products from the materials. Montréal needs to ensure that such businesses and business models can operate profitably in the market, and provide financial support where necessary. The City can also act as a facilitator in terms of connecting these businesses, centrally collecting and monitoring the data, and identifying specific bottlenecks in the system where investment in infrastructure and technologies are needed.
- **Mobility:** While circular mobility options are well-known to the public, private vehicles still dominate the streets of Montréal. Public behaviour is likely to be one of the main factors explaining the slow shift towards more shared mobility alternatives, which is why the city needs to raise awareness of the benefits that such options will have on the City's mobility, **helping incentivise residents** to progressively move away from private cars whilst ensuring that the alternative forms of transport are sufficient, affordable and well-connected. However, this factor is less applicable to logistics services. In this case, **business innovations** are required to decarbonise logistics services, whilst reducing congestion on the roads through the use of smaller vehicles and optimised delivery schedules based on real-time traffic reports. To realise these changes to passenger and freight transport, the City must continue to move away from car-centric urban planning in which cars take up the majority of city space and cause most congestion issues. This can free up space for more circular forms of transport, such as public transport, walking and cycling. Montréal also requires **new businesses and business models** that can circulate vehicle waste through disassembly, sorting and reverse logistic processes to be recovered for use in remanufacturing, refurbishing and reusing facilities, rather than primarily recycling the materials for lower value purposes in other sectors. Vehicle components, particularly those of higher value, for example batteries can be sold as a service to extend the lifetime of the vehicle and ensure a closed loop on the materials. This can be implemented through a manufacturer guarantee for such components. As a whole, new businesses can greatly benefit by working together with vehicle manufacturers to steer the design and business model of vehicles to facilitate these circular practices.

9 THE WAY FORWARD: RECOMMENDATIONS FOR A CIRCULAR MONTRÉAL

- **Coordination amongst stakeholders**. Implementing the circular economy in the city will require more than the involvement of local administration offices: citizens, businesses and other institutions will be needed too. The local government should work towards a widely agreed-upon Circular Economy Roadmap, and then raise awareness and knowledge amongst Montréal's inhabitants and businesses so that they can participate in and promote the transition. This could be done through advisory or working groups, as well as public consultation rounds. In the text box on page 56, we have summarised the main missing links and stakeholders needed to fully implement the suggested circular action within the four focus sectors.
- **Improving data availability.** Often only what gets measured gets managed. This is especially true if we look at how the range and variety of indicators to measure circularity has grown in the past years, with different frameworks, terminologies and methodologies being applied. This research is the first attempt to measure circularity in Montréal. However, the report brings together different studies and datasets received from many different stakeholders. Data quality and reliability, as well as harmonisation, have been a challenge throughout the project. Moving forward, **primary research and data collection** should be a priority.
    - For textiles, for example, conducting manual sorting of the non-wearable fraction could help the city collect detailed data on the exact nature of post-consumer textile waste in the area, and understand potential opportunities for downcycling or high-value recycling.
    - For food, as mentioned above, waste audits from IC&I sources could help form a better understanding of the nature of this waste and develop diversion strategies tailored to those waste streams.
- **Monitoring mechanisms.** To make meaningful progress when implementing a *Circular Economy Roadmap*, businesses and policymakers need to put measuring and tracking systems in place. For this reason, this report provides a measurement framework (see Annex) that could be used as a starting point, available to both measure the current status of the circular economy in the city and the impact of each action being implemented to accelerate the transition.
    - The first steps in this direction are already underway, as in 2021 the Government of Québec announced a call for proposals for the creation of a pan-Québec circular economy research network. Through conversations with various stakeholders over the course of the project, it is clear that a similar initiative would work in Montréal, as there is already a good network of experts and businesses involved in the circular economy.
    - A distinction should be made between the city's climate and circular economy goals, to show which indicators are common to both strategies and which are only relevant for one of the two. This is important to avoid double monitoring of the same indicators and to show how both agendas can work together and independently.
- **Leaving no one behind.** Implementing the actions proposed in this report will inevitably impact the workforce. Demand will increase for new and existing roles in labour-intensive industries, such as services, resource management and repair. At the same time, the transition will see declining employment in material-intensive extractive industries, such as mining and the manufacturing of products from raw materials. This suggests that job losses resulting from a transition towards a circular economy have the potential to be replaced with jobs created in other sectors. In order to maximise the employment opportunities offered by the circular economy and ensure that the transition positively impacts work and workers, the effects of different actions on workers and labour market composition should be investigated, before they are implemented.

Montréal is at a pivotal stage in truly making its transition from a linear to a circular economy. It stands out from other cities by already hosting a range of ambitious initiatives and policies and it has all the assets to become a leader in circularity in North America and beyond.

We hope that this document will serve as a springboard to spark new businesses, connect key stakeholders and support the development of new policies.

10 MEASUREMENT FRAMEWORK

In driving the circular transition, a systematic, data-driven approach is crucial for setting ambitious targets and tracking progress towards these. Correspondingly, recent years have shown an increasing interest in the field of circular economy indicators and metrics. Both research[267] and practice[268] show consensus on the need for and role of metrics and indicators in providing a framework for measuring progress towards the implementation of the circular economy. As Montréal has already taken many actions to accelerate the transition, how can the progress and impact be measured?

As shown in this report, material flow analyses (MFAs) are a useful method to analyse sectors in detail and pinpoint key challenges across a city's metabolism. However, conducting a city-wide sectoral MFA is very time consuming and the results and conclusions that can be drawn from it are only as good as the data available for calculating material flows. Furthermore, the MFA method relies on the material balance principle, which does not apply if data from different sources are combined and harmonised.

For these reasons, we propose here a selection of 5 indicators for each sector that could be easily measured on a yearly basis. The selection of these indicators has followed the Circular City Action Framework, developed by Circle Economy in collaboration with ICLEI, Metabolic and the Ellen MacArthur Foundation.[269] This framework aims at taking a holistic perspective, laying out what circular economy approaches can be taken across the whole value chain of different sectors. It relies on the following key actions: Rethink, Regenerate, Reduce, Reuse, Recover. Despite some slight differences, we see that this framework is also well aligned with RECYC-QUÉBEC's circular economy framework developed in collaboration with L'institut EDDEC.[270] The following sections will then highlight one suitable indicator to measure the status or progress of each R-strategy applied to the four sectors analysed for Montréal. Some of the suggested indicators have been calculated as part of the MFA in this report, others are already calculated by the city and some not yet calculated and so a suggestion has been made to measure them in the future.

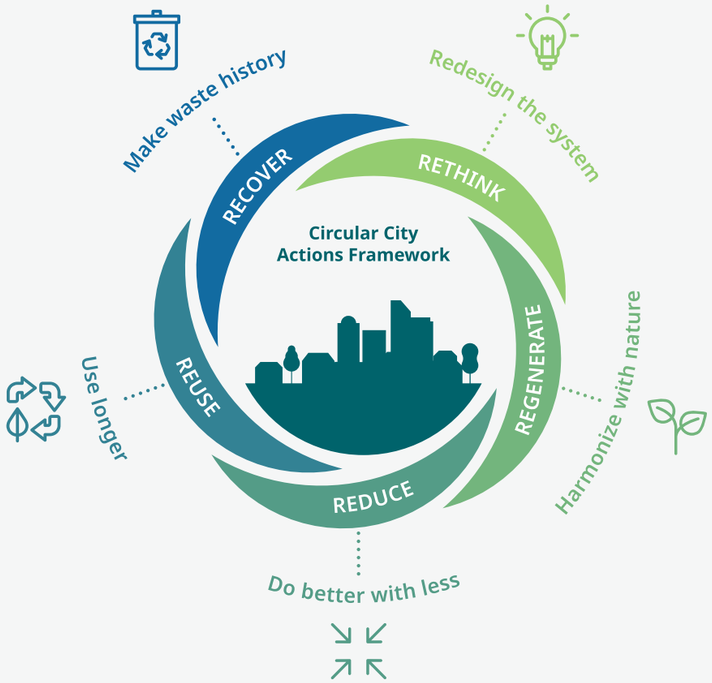


Figure four. *The Circular City Actions Framework*

FOOD SYSTEMS

Montréal's commission on "Water, Environment, Sustainable development and Great Parks" held a public consultation about food waste in 2021, in which it recommended defining key indicators related to the objectives of the city's plan to reduce food waste, that would enable progress to be monitored for the implemented actions. The consultation also recommended a plan for frequent data collection to measure and track commercial practices regarding food waste especially in IC&I establishments.

In the table below, key indicators that could be used for measuring the circularity of Montréal's food systems are suggested.

INDICATOR (UNIT OF MEASURE)	DOES THE CITY MEASURE IT? IF YES, INCLUDE SOURCE/LINK	DOES THE MFA MEASURE IT?	CALCULATED INDICATOR
Number of circular food initiatives in the city (#)	**No**	**No**	**Not currently measured. Could be measured through an industry survey**
Urban Agriculture (measured in number of urban agriculture enterprises, and total area of cultivated land within the city)	**Yes**	**No**	• **55 companies** • **120 ha cultivated**
Total food waste generation (tonnes). • Edible food lost or wasted • Associated inedible parts (peelings, bones, etc.)	**Yes**	**Yes**	• **761 kt** • **368 kilograms per capita**
Food redistribution (% or tonnes)	**Yes (Source)**	**Yes**	**15 kt per year**
Food waste diverted from landfill (% and tonnes)	**Yes**	**Yes**	**84%**

Table x. *Food systems*

BUILT ENVIRONMENT

Ville de Montréal will soon adopt the *New Policy for the Ecological Transition and Sustainable Development of Municipal Budget*. While this policy will certainly account for criteria on energy sobriety and GHG emissions reduction, it could be interesting to incorporate criteria related to the circularity of the built environment as well. These criteria could be complemented with a shortlist of circularity indicators that the City could adopt to monitor the sector's performance and number of circular building initiatives and tools that are taking place in Montréal.

INDICATOR (UNIT OF MEASURE)	DOES THE CITY MEASURE IT? IF YES, INCLUDE SOURCE/LINK	DOES THE MFA MEASURE IT?	CALCULATED INDICATOR
Number of circular built environment initiatives in the city (#)	**Yes (Source)**	**No**	**Not currently measured. Could be measured through an industry survey**
Embodied emissions of building stock (tCO_2e)	**No**	**No**	**Not currently measured.**
New material passports (by mass or number of components being quantified digitally, e.g. BIM)	**No**	**No**	**Not currently measured. Could start measuring the proportion of renewable/recycled materials in new constructions**
Total C&D waste (tonnes)	**No**	**Yes**	**Estimated at 1,600 kt**
Adaptive Reuse of buildings/spaces (# projects, ha). Could start with measuring this for municipal buildings initially.	**No**	**Yes**	**Not currently measured. Could start with measuring this for municipal buildings initially.**
Recycling rate of CDW (%)	**No (Québec level)**	**Yes**	**Estimated at 25%**

Table x. *Built environment*

TEXTILES

In the table below, key indicators that could be used for measuring the circularity of Montréal's textile system are suggested.

INDICATOR (UNIT OF MEASURE)	DOES THE CITY MEASURE IT? IF YES, INCLUDE SOURCE/LINK	DOES THE MFA MEASURE IT?	CALCULATED INDICATOR
Circular textile initiatives in the city (# initiatives, #employees)	**No**	**No**	**Not currently measured. Could be calculated through a business survey, for example by Synergie Montreal.**
Local textile businesses with biodegradable products certification (#, %market share)	**No**	**No**	**Not currently measured. Could be calculated through a business survey.**
Total textile waste (tonnes)	**No**	**Yes**	**189 kt**
Repair and reuse activities (#, total market value or market share)	**YES, Estimated from Statistics Canada, not specifically for textiles sector.**	**No**	**11%**
Facilities for textile collection & recycling (# or capacity volumes)	**No**	**No**	**Not currently measured. Could be calculated through a business survey.**

Table x. *Textiles*

MOBILITY

In the table below, key indicators that could be used for measuring the circularity of Montréal's mobility system are suggested.

INDICATOR (UNIT OF MEASURE)	DOES THE CITY MEASURE IT? IF YES, INCLUDE SOURCE/LINK	DOES THE MFA MEASURE IT?	CALCULATED INDICATOR
Modal split (% journeys, passenger-km, goods vehicles-km, freight tonnes-km)	**YES, %passenger journeys is measured in ARTM Origin-Destination survey (2018)**	**No**	• **Car (56%)** • **Public transport (25%)** • **Non-motorised (18%)**
Share of electric vehicles (% of stock, % of newly registered vehicles)	**YES, Statistics Office Québec (2019)**	**No**	**0.61% of stock**
Addition to vehicle stock (kilotonnes/year)	**No**	**Yes**	**25.6 kt/year**
Share of single occupancy car journeys (%)	**No**	**No**	**Not currently measured. Could be included in the ARTM Origin-Destination survey.**
Circular end-of-life vehicle initiatives, e.g. dismantling, recycling, reusing (#)	**No**	**No**	**Not currently measured. Could be calculated through a business survey.**

Table x. *Mobility*

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