



URBAN FORESTRY TOOLKIT

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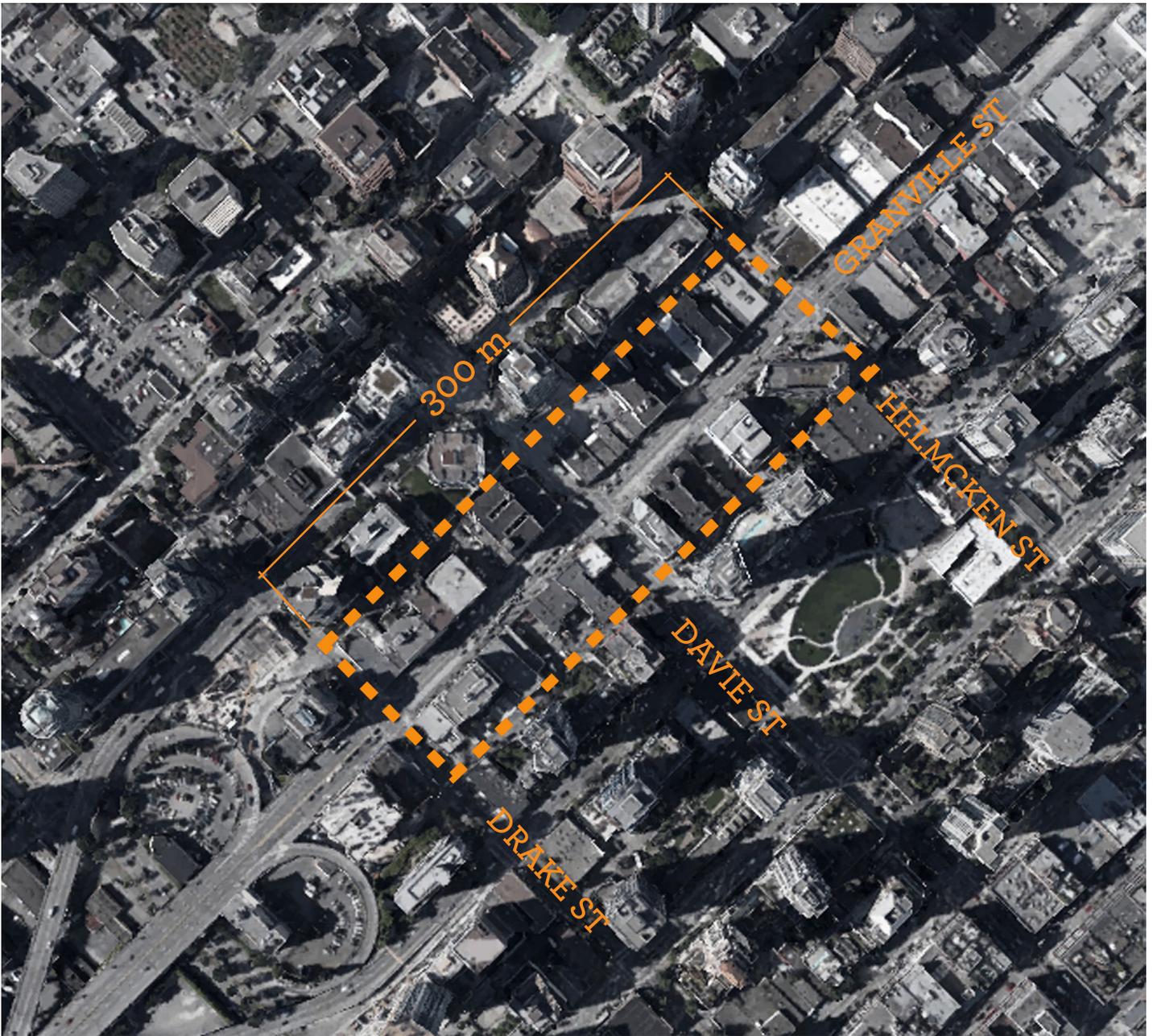


An urban forest is more than a collection of trees. It includes the understory, the plants growing along the street, and even the gardens on your balcony. A healthy urban forest is diverse. It has a variety of plant species, in a variety of ages, can support wildlife habitat, and positively affect the buildings and social atmosphere of the neighborhood. Maintaining and improving the urban forest coverage is important for the overall health of the city.

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CONTEXT: DOWNTOWN VANCOUVER

GRANVILLE - DRAKE TO HELMCKEN



For being one of the most livable cities, and priding itself on access to nature and public green space, Vancouver's downtown neighborhood has shockingly minimal green coverage. This report will focus on a section of Granville, two blocks from Drake Street to Helmcken Street. By conducting a hypothetical retrofitting scenario here, businesses, residents, and the City can take the information and pieces provided and apply it to any block or street within Vancouver's downtown.

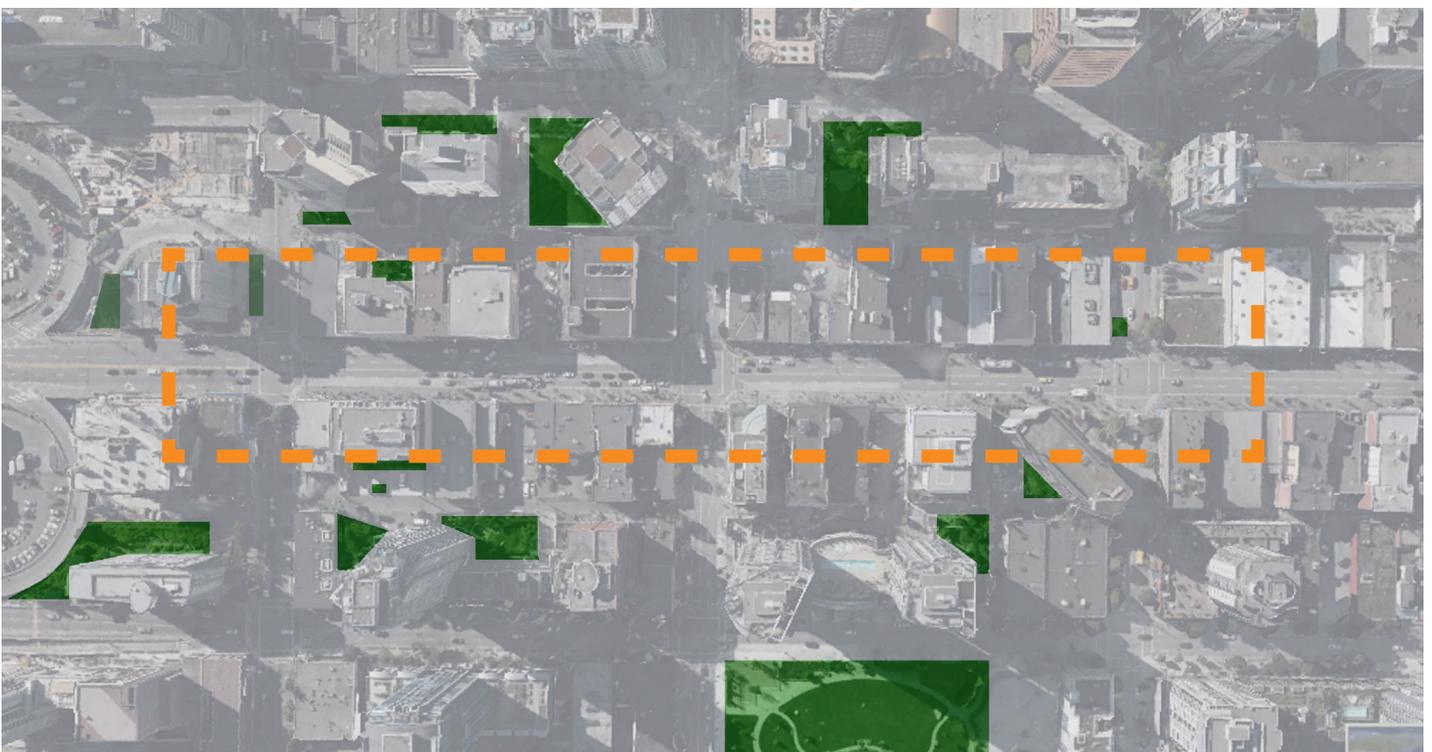
These two blocks specifically lack any apparent care to the urban forest. Street trees are dying and neglected, residential space has no planting, and sidewalk space is taken up by parked cars. Visitors arriving to the historic Granville Street, in one of the greenest cities in North America, will be completely underwhelmed by the aesthetic of the block.

How can we effectively change the look and function of an urban street?



TOPIC STATEMENT

The current canopy cover of Downtown Vancouver is only at 8.3% (the second lowest for any Vancouver neighborhood). 18% of the city's total area is covered by canopy, but this has been declining since 1995, which has been reducing the benefits of the urban forest.



■ Current Green Space ■ Current Built Space - - - Study Boundary

So what can be done to increase the urban forest canopy?

This toolkit will provide an inventory of the trees and greenspace in the designated site area, Granville Street between Drake and Helmcken, as well as a description of the environment of the space (including experiential and atmospheric conditions). By focusing on a single street, its streetscape and the adjacent affected buildings can be thoroughly explored.

How do we define the urban forest? Is it the canopy of trees? All green coverage? The individual plants? A combination of all of the elements listed above? An "urban forest" implies a collection of trees and their canopy, and though important, tree canopy alone often does not represent the actual green space coverage. Alternative options of green infrastructure can be incorporated to find a solution to contribute to the green coverage of Vancouver's urban areas. Any green space that is found within the study area can be used in the urban environment to increase the canopy, as well be a contribution to the community, businesses, and residents of the area. This toolkit will describe why it is essential to improve the current conditions, define what exactly is encompassed under the "urban forest", and then provide visions of what a typical Downtown Vancouver street could one day look like.

The goal is to create something that communities can use to visualize what the current urban forest coverage of their street is, and to create a document that can show how residents and the community can increase the urban forest and tree canopy. The project intends to allow residents and businesses to see the potential of what the street could be. Though this toolkit will focus the study to a single street as a case example, the results should be versatile enough to be able to be applied to any street or neighborhood within the city of Vancouver.

BACKGROUND

WHY DO YOU NEED THIS TOOLKIT?

Vancouver's 2020 Greenest City Action Plan Goals

Vancouver has ambitious goals in place for increasing the sustainability of the city via the development and implementation of the Greenest City Action Plan 2020 (GCAP). There are 10 distinct goals outlined five of which can directly correlated to this Urban Forestry Toolkit created for the downtown area.

The following break-down of the five important sections explains the goals, targets, and the influence of increasing green opportunities in Vancouver.

Goal 1: Creating a Green Economy

WHAT Developing and maintaining the vision of Vancouver as a global centre of sustainable operations must start with the people and the industries who live and work within it. This is recognised in the GCAP through the goal of creating and sustaining a 'green economy' where green jobs are encouraged and companies involved in greening their operations are increased. **Specifically there are two targets:**

a) – double the number of green jobs (from 2010 levels).

b) – double the number of companies actively involved in greening their operations (from 2011 levels).

HOW The potential for increasing green-space in the downtown area is huge. Any increase in this ability to create and maintain green-space will encourage jobs that are associated with it. The installation of green rooftops, green walls, green-space planning and maintenance etc. will require specialist help, therefore the demand for practitioners of this sort will increase and so will the number of jobs. Encouraging industry to actively green their operations may force them to consider changing the spaces they use (or may not utilise) into potential green areas. A key component of this will be the utilisation of previously unused rooftops where gardens or relaxing park-like areas can be installed.

Goal 3: Become a Leader in the Development of Green Infrastructure

WHAT Integrating green-space into the construction and design of new buildings will help to set Vancouver as a centre of green innovation and set the precedent for other cities to do something similar. Green buildings will be built with sustainable materials but will also need to factor their energy use, wastes, and insulation needs which green-space on rooftops or nearby green areas can aid in achieving. **There are two specific targets set by the GCAP:**

a) – by 2020 all new buildings to be carbon neutral in operation.

b) – reduce energy use and carbon emissions in existing buildings by 20% (from 2007 levels).

HOW The ability to retrofit green-spaces will be able to attribute to reductions in emissions of buildings by sequestering extra carbon. Rooftop gardens can provide insulation and the added greenery, as well as street trees, can provide shade in the summer providing natural cooling and reducing energy demand (air conditioning, and heating).

Goal 6: Ensure Residents Have Access to Green Spaces

WHAT Parks, tree-lined walkways, gardens and green-spaces are a global symbol of a friendly and healthy city environment. Access to these spaces is vital for developing a sustainable and liveable city where residents are proud of their community. **The two targets outlined in the GCAP are:**

- a) – residents live within a 5 minute walk of green-space**
- b) – 150,000 new trees planted by 2020**

HOW The current vegetation status of downtown does not enable the goal of close proximity to green-space outlined in the GCAP. With the introduction of rooftop gardens, people within downtown, especially within the buildings upon which the gardens are situated, will have access to green-spaces to have their lunch or to relax and relieve stress in. The introduction of trees into the landscape of downtown where they may have been previously left out will increase the ability of Vancouver to achieve the 150,000 new tree plantings by 2020.

Goal 9: Cleanest air of any Major City in the World

WHAT Air quality has an immense impact on our health and well-being, especially with regards to the health of young, elderly, or sick individuals. Trees actively filter toxic particulate pollutants often contained in the atmosphere of a major city due to the concentration of carbon emissions from traffic and lack of air filtering vegetation. **The main target of the is:**

- a) – beat the most stringent air quality guidelines set by Metro Vancouver, British Columbia, Canada, and the World Health Organisation (WHO).**

HOW Downtown is an area where traffic congestion is combined with vegetation scarcity. This means that the accumulation of harmful particulates is highly likely and the filtration of them out of the air may not be fast enough. The potential benefits from greening such an area would greatly improve the air quality for the individuals who work and live there creating a more liveable and likeable environment.

Goal 10: Global Leader in Urban Food Systems

WHAT The greater the distance from the food source to the end destination means the greater the carbon emissions. Developing a greener city means reducing the distance from source to plate as much as possible in order to reduce these emissions. By encouraging community garden projects, and gardens that utilise space in previously unproductive areas, it will increase the availability of locally grown food and reduce the demand for food that has been transported vast distances. **The main target is to:**

- a) – increase city-wide and neighbourhood food sources by 50% (from 2010 levels).**

HOW Such gardens where fruit and vegetables are grown can be integrated into the downtown environment especially with the availability of space on the rooftops of buildings. If these roofs were converted into productive gardens not only will the benefit be in the reduction of food miles but in the insulation capacity and increased carbon sequestration ability of such areas.

HOW WILL THESE STEPS HELP?

Major species in study field: European Beech (*Fagus sylvatica*).

There are 44 roadside trees in total in the Granville Street site. **Most of them are unhealthy and small**; the average height is lower than 3m and DBH (diameter at breast height) is smaller than 7cm

The height of maturing European Beech can grow up to 15 – 18m, and the spread size of this species can reach 10 – 14m. The growth rate of European Beech is about 0.3 – 0.6 m every year.

According to the table provided by EPA, **the annual carbon sequestration of these 44 trees is 226kg CO₂. ***

*** This is the amount of carbon the trees can take out of the atmosphere every year!**

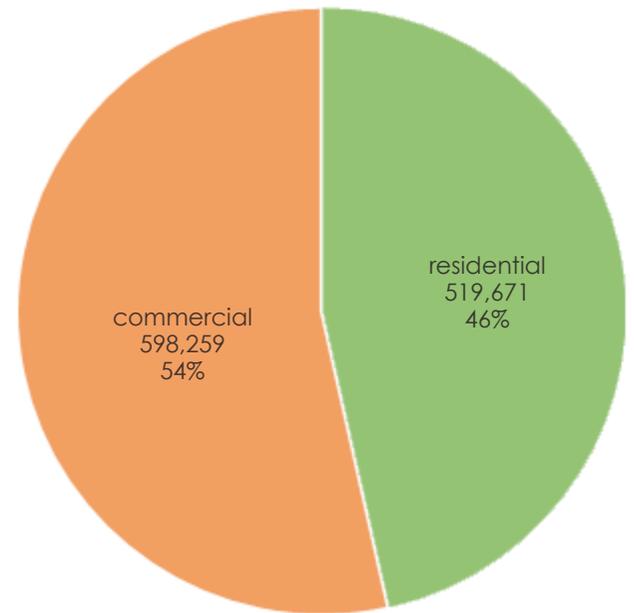
In 2007, the carbon emission of transportation and buildings in the City of Vancouver was 2,191,496 tons.

In 2010, the carbon emission of transportation and buildings in the City of Vancouver was 2,155,006 tons. (transportation: 48%).

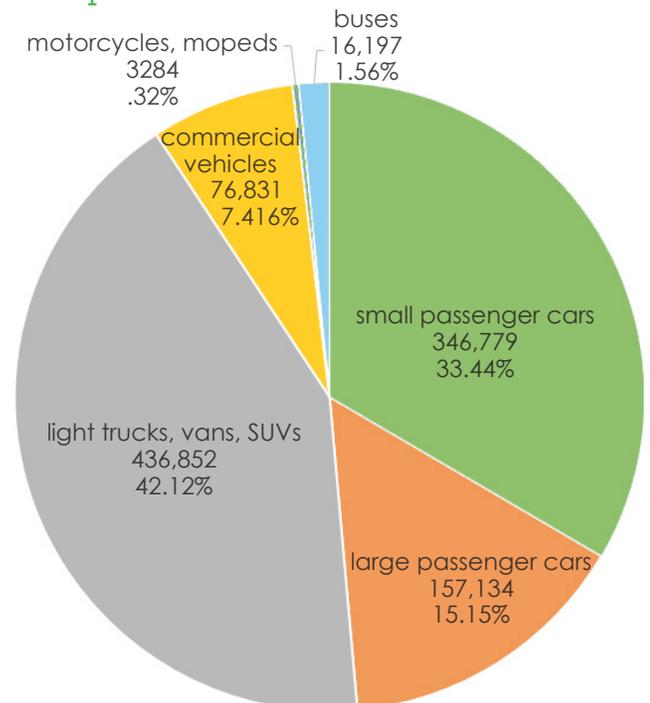
There're 4 retail shops, 9 agencies related to service (including policing center, career center, educational agency, banks and clinics), 18 restaurants (including cafés and pubs) and 8 parking lots (two pictures for parking solution).

If each business planted just one tree, the amount of carbon sequestration would double in Downtown Vancouver!

Carbon Emissions:



Transportation Carbon Emissions:



WHAT ARE THE BENEFITS?



Improved Air Quality

Problematic gaseous pollutants are absorbed through the stomata on the underside of leaves.



Energy Conservation

Natural cooling in summer from mature trees, and insulation potential in winter from rooftop gardens.



Improved Water Quality

Improved water quality - reduction in stormwater quantity due to increased evaporation on leaf surfaces.



Reduction in Noise Pollution

Natural buffer from noise of people and cars.



Improved Wildlife Habitat

Nesting and food sources.



Improved Appearances

Vegetation breaks up hard lines of built structures.



Enhanced Psychological Well-Being

Green spaces have been shown to lower stress levels.



Increased Property Value

5% to 25% increase in value with increased canopy cover.

PRECEDENT WORK

WHERE CAN YOU LOOK FOR HELP?

There are plenty of resources to look at to gain knowledge and ideas about increasing the urban forest:

City of Vancouver’s Greenest City 2020 Action Plan”

City of Vancouver’s Open Data Datalogue

Neighbourhoods Tree Inventory Report

You can also look to other cities that have already begun to implement some of these sustainable ideas!



Remodelling of Passeig de St Jaon Boulevard

Location: Barcelona, Spain

Area: 31.455m²

Designer: Lola Domènech, architect

Photographer adrià goulà

Year: 2010-2011

First built in 1859, the remodelling of paseo de St Joan proposed to convert the ancient boulevard into a pleasant urban park.



To promote the passeig de St Joan as a new and sustainable urban green zone, the park has been projected as the city's new green zone. To achieve this, two new rows of trees will be planted on both sides of the existing hundred year old specimens to create an area of natural shade that will accommodate added recreational zones, children's playgrounds, and bar terraces. Proper drainage of the subsoil and a mixed pavement system around the trees helps increase the sustainability of the project. The treatment of the soil with mixed pavements and the automatic watering system that uses phreatic water are key to ensuring substrata drainage guarantees the survival of the vegetation. Local shrubs species also contribute to enriching subsoil biodiversity.



Lessons:

This street's urban transformation has revitalised its commercial life and recreational uses, while at the same time respecting its historical value as a main boulevard through the city. Simple interventions in already existing space can be done to any street, in any city.

PRECEDENT WORK

CITIES HAVE ALREADY DONE THIS, VANCOUVER CAN TOO!



Project: Rooftop Haven for Urban Agriculture

Location: Chicago, USA

Area: 8160 square foot

Designer: Hoerr Schaudt Landscape Architects

Photo: Scott Shigley

Year:2010

The Gary Comer Youth Center Roof Garden is an after-school learning space for youth and seniors in a neighborhood with little access to safe outdoor environments. It is capable of producing over 1,000 pounds of organic food used by students, local restaurants and the center's café in just one year. It is a typical working vegetable garden, and a place of beauty and respite.



Floor-to-ceiling windows transform this working garden into a highly graphic viewing garden as students move from one classroom to another. The visibility helps bring awareness and education to the positive effects of urban agriculture and green roofs.

The roof reduces climate control costs and provides an outdoor classroom space, while also able to withstand the activities of the people using it. Differences between ground temperatures and those on the roof mean that the rooftop is in a different climate zone and can be utilized throughout the year.

Lessons:

The green roof is an excellent model for using traditionally underutilized space for urban agriculture and exceptional in its balance of an aesthetic vision with practical needs.



Project: One Central Park

Location: Sydney, Australia

Area: 64,000m²

Green Walls: Patrick Blanc

Photographs: Murray Fredericks, Simon Wood,
John Gollings

Year: 2014



One Central Park built an integrated experience for living that is in harmony with the natural world. The public park at the heart of the neighborhood climbs the side of these glass towers to form a lush canopy cover within the city. Over 250 species of flowers and plants were used to form the composition on the façade.

The park is a lush tranquil meeting place where one can unwind and relax with friends and family, walk, or cycle through the groves, or simply sit on the lawns for informal dining.

Lessons:

An urban forest canopy does not need to be a horizontal feature. By utilizing the vertical planes of buildings, the urban green space is exponentially increased without eliminating essential infrastructure and public space.

URBAN FORESTRY

WHAT ARE THE PIECES?

Urban forests are not only the trees in urban communities, they also encompass the environments that they live in. Both public and private property can participate, as urban forest are key assets in cultivating more livable, healthy, sustainable and economically vibrant cities.

There are many tools and strategies that can be used to help communities enhance the values in their urban forest, much more than only increasing tree planting.

Here are the pieces of your toolkit!



Street Trees

The most prominent element of urban forestry. Proper tree management provides aesthetic value, shade, regulates temperature of streets and buildings, shelters, and creates habitat within our cities.

Includes:

- Trees in parks
- Personal Yards
- Along pathways, boulevards, roads, and any other green spaces,
- Trees found in Natural Areas.

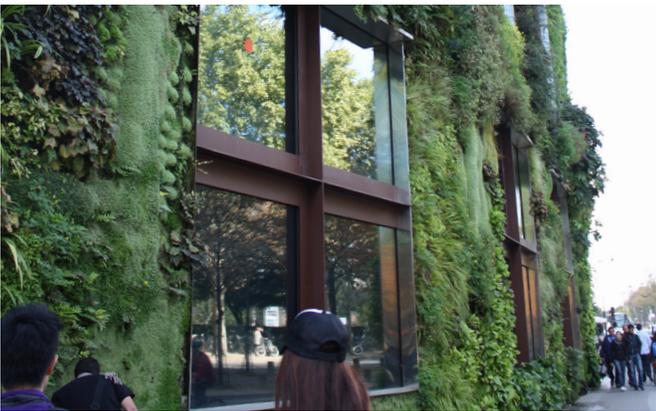


Parks and Greenways

Parks and greenways are the arteries, nodes, and connections that weave through our urban areas.

Includes:

- City Parks
- Lawns
- Playgrounds
- Habitat Corridors
- Recreational Fields
- Natural Habitat Areas



Green Infrastructure

Incorporating green elements into our cities can be tricky, with limited space and built structures already in place. These strategies allow the urban environment to become more resilient and productive by installing green elements on already existing infrastructures.

Includes:

- Roof Gardens & Green Roofs
- Green Walls
- Stormwater Management Systems
- Soil and Root Reinforcement



Urban Agriculture

The act of growing, processing, and distributing the food we eat within our own city may become a necessity in the future. Urban agriculture not only benefits our basic needs, but contributes to the urban forest landscape.

Includes:

- Community Gardens
- Personal Production
- Orchards
- Nurseries

WHAT ARE THE DETAILS?

Urban Tolerant Species



Celtis occidentalis - Hackberry
Prunus virginiana - Chokecherry
Larix decidua - European Larch
Picea pungens - Blue Spruce

Cotoneaster integerrimus - Cotoneaster
Rhus glabra - Smooth Sumac
Spiraea prunifolia - Bridalwreath Spiraea
Syringa vulgaris - Common Lilac

Permeable Paving Options



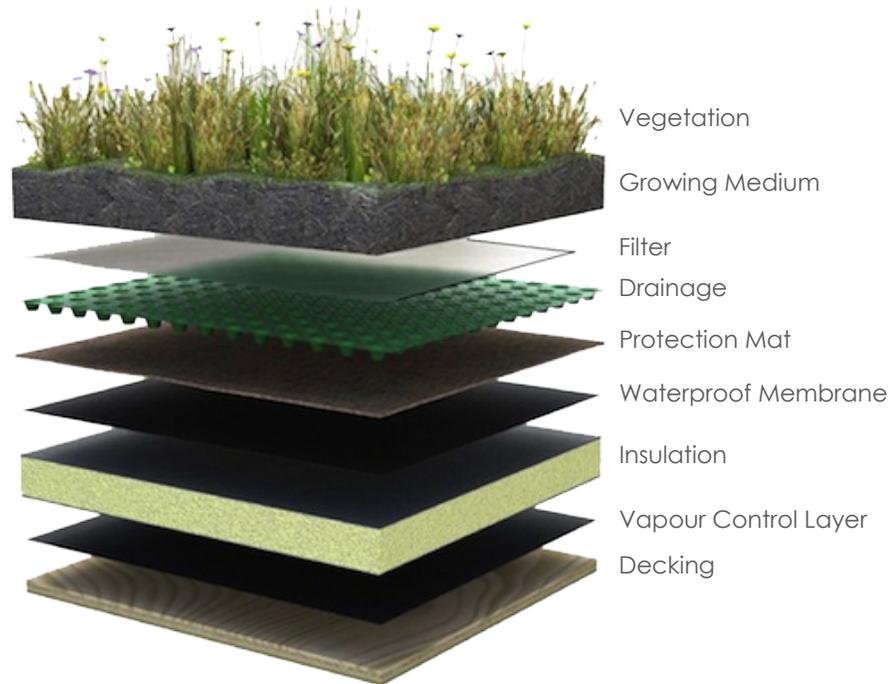
Green Roof

Can be implemented on any structurally sound surface: if you can safely walk on the roof then it can hold the weight of a growing surface. Building codes and structural engineers can be consulted to be absolutely positive of the safety, but most residential and commercial roofs should be green roof fit!

At \$15-\$35 per square foot, lasting about twice as long as a standard roof, a green roof is a great investment for cities.

Need:

1. Low roof slope
2. Structural support check
2. Modular growing pieces

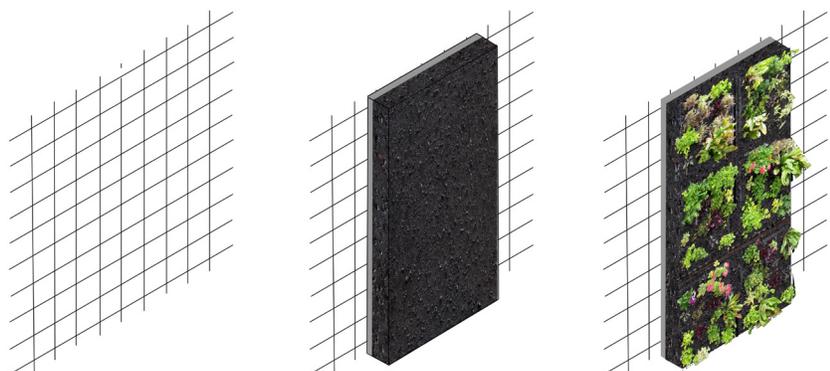


Green Wall

Can be installed on any structurally sound surface. The infrastructure can be detached from existing building walls, making it a great option for older buildings.

Need:

1. Hardy vines/climbers
2. Modular panels
3. Irrigation system
4. Catch Basin
5. Structural support check



IMPLEMENTATION

HOW TO USE THESE PIECES?

Choose each of these...

THE SITE

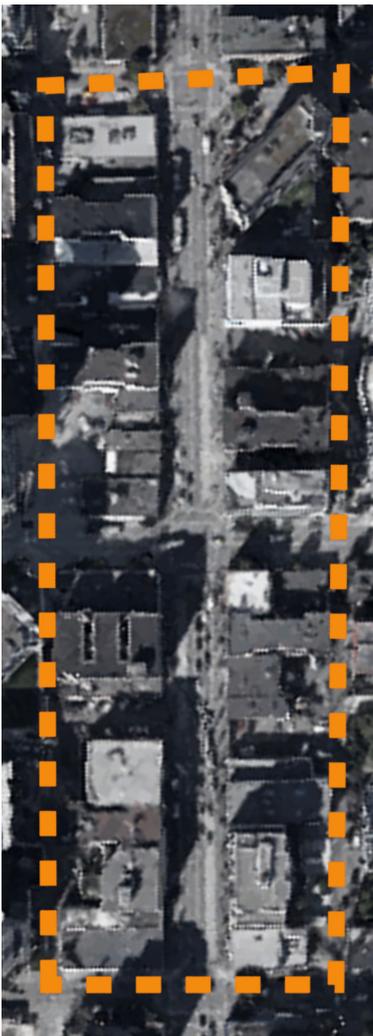
+

THE TOOL

+

THE DETAILS

Granville Street



Street Trees



Parks and Greenways



Green Infrastructure



Urban Agriculture



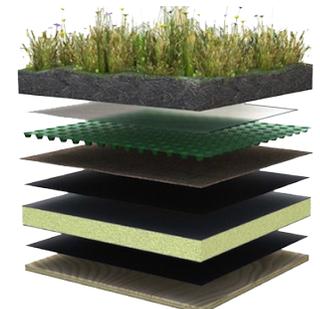
Plant Species



Materials



Infrastructure



...and you will have these!

= THE BENEFITS + IMPROVED URBAN FOREST



POTENTIAL SCENARIOS

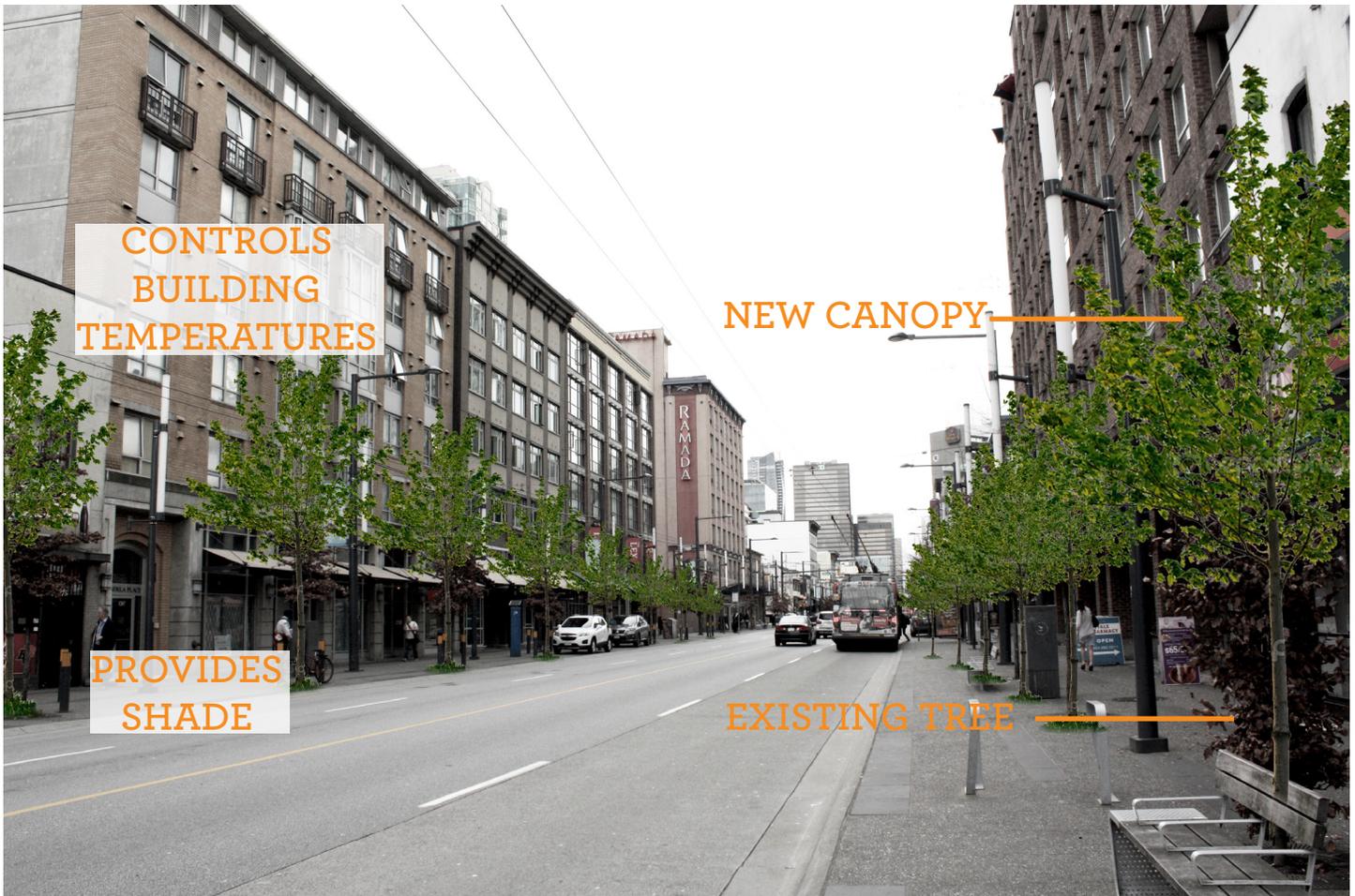
WHAT COULD YOUR STREET LOOK LIKE?

Replace Street Trees



By simply replacing the current street trees with appropriate species for an urban environment, the new trees will have the opportunity to thrive. A healthy tree canopy will provide shade for pedestrians, parked cars, and buildings, reducing heating/cooling costs, as well as create a much more comfortable atmosphere and aesthetically appealing street.

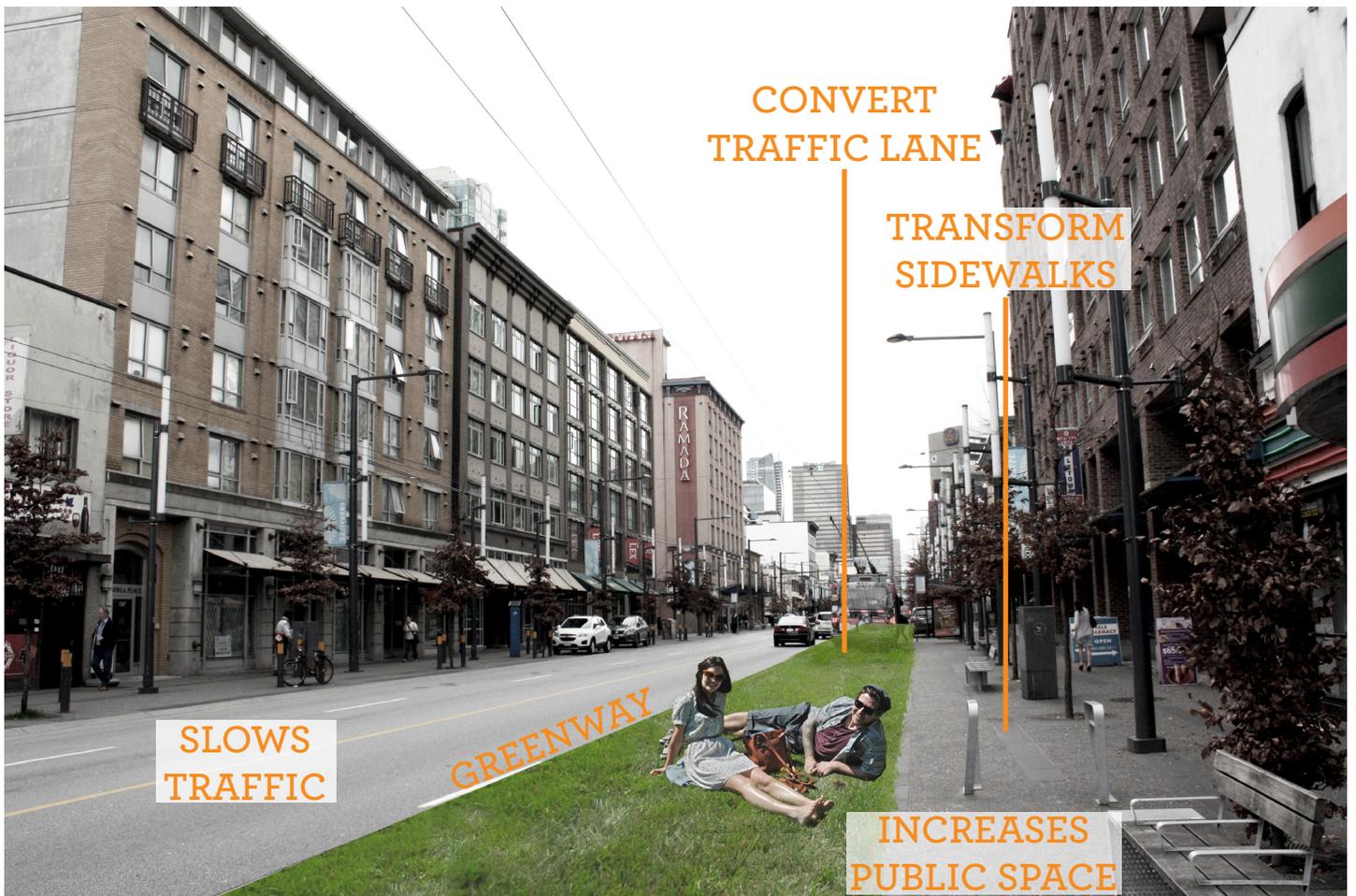
New street trees is the simplest and most visible alternation to your street. Businesses, residents, and visitors will notice a huge difference in only a few short years.



Implement Greenway

Greenways, long segments of parks, lawns, or open natural space, can be implemented in urban areas by eliminating a lane of traffic, extending sidewalks, or incorporating them into existing public walkways. Green surfaces not only help stormwater runoff and beautify the street, but they provide places for pedestrians to socialize and linger, and are exciting spaces for business to expand out to. They encourage destination points, and guide visitors through the site.

Segments of Granville St are closed to pedestrians for much of the year, why not make the street into a park?



Walls and Roofs

If no alternation to the street level is made, the urban forestry cover can still be increased with the installation of green walls and roofs. Any structurally sound surface is safe to install growing infrastructure on, and can be done by both businesses and residents in any quantity. Residential units are especially easy to convert, as the individual can participate in planting habits right on their very own balconies!

No room on the street? Installing green wall or roof infrastructure can have an impact too!



The Full Toolkit



Eventually, if every part of this toolkit is implemented, your street can be transformed into a beautiful, lush, thriving urban forest! Phasing and gradual installation makes visions like this a realistic experience to achieve, and can be done with the participation of businesses, residents, and the City of Vancouver.

Transform your street into a spectacular urban forest.



Improved Air Quality



Energy Conservation



Improved Water Quality

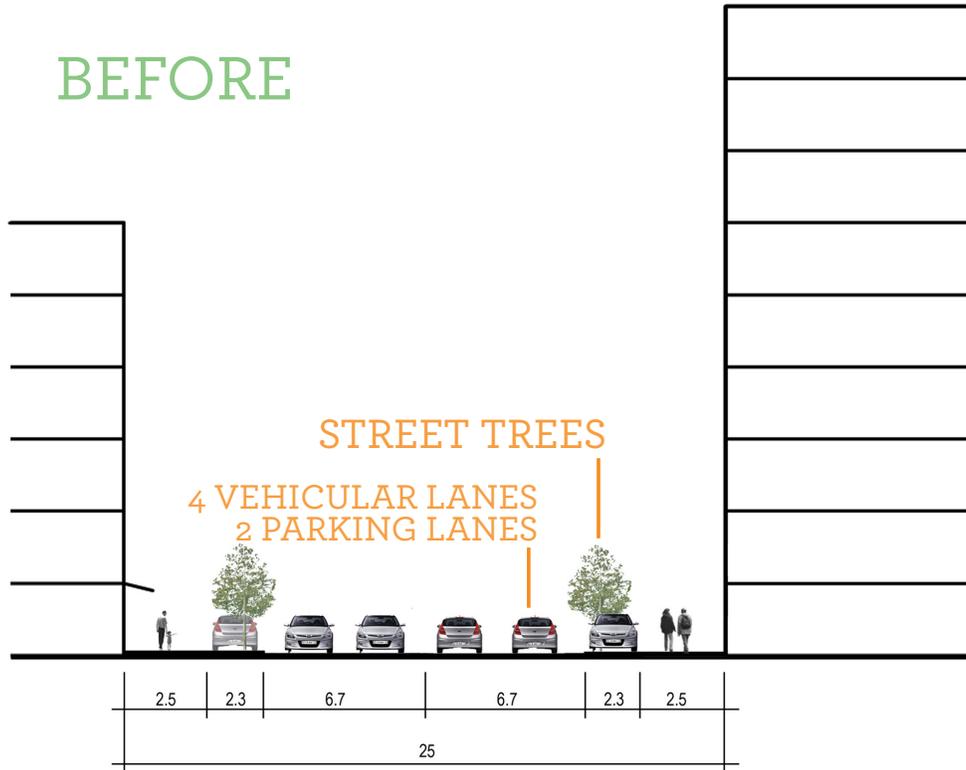


Reduction in Noise Pollution

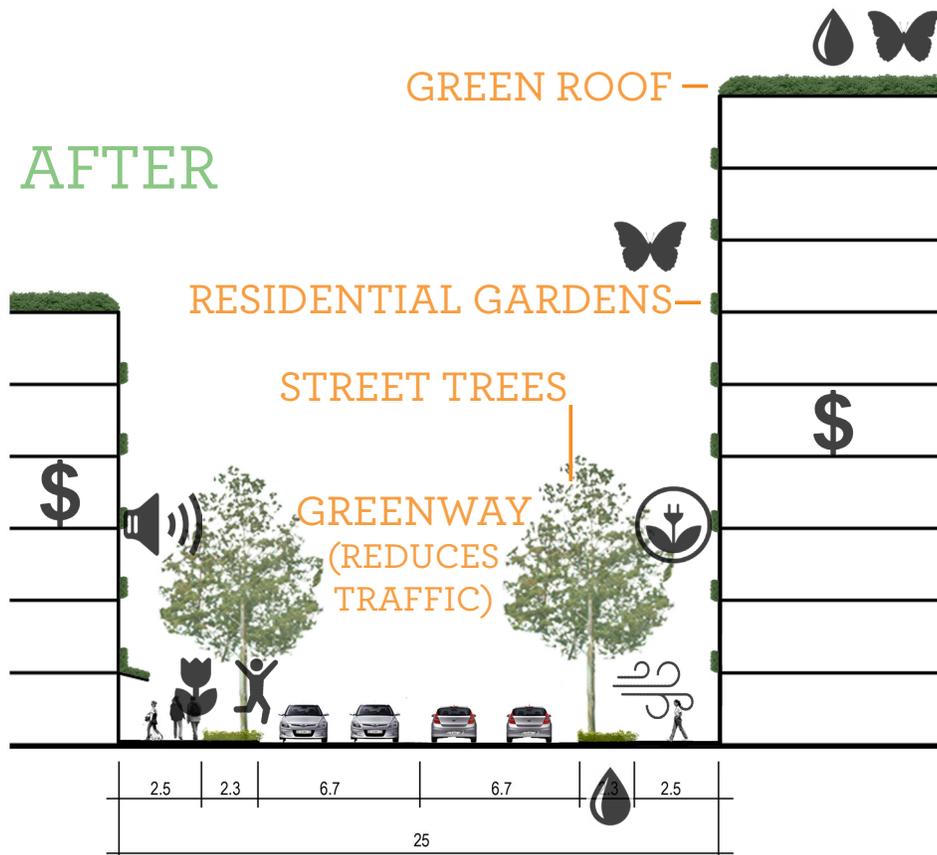


RESIDENTIAL IMPROVEMENTS

BEFORE



AFTER



Improved Wildlife Habitat



Improved Appearances



Enhanced Psychological Well-Being

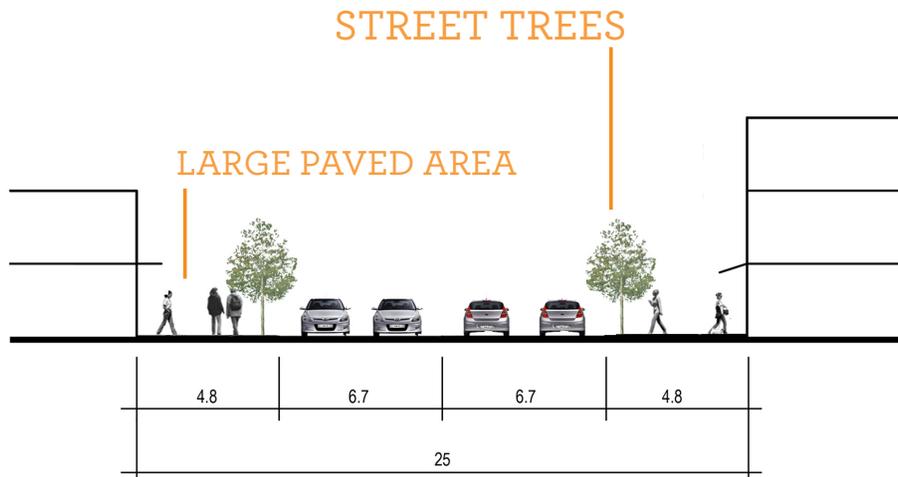


Increased Property Value

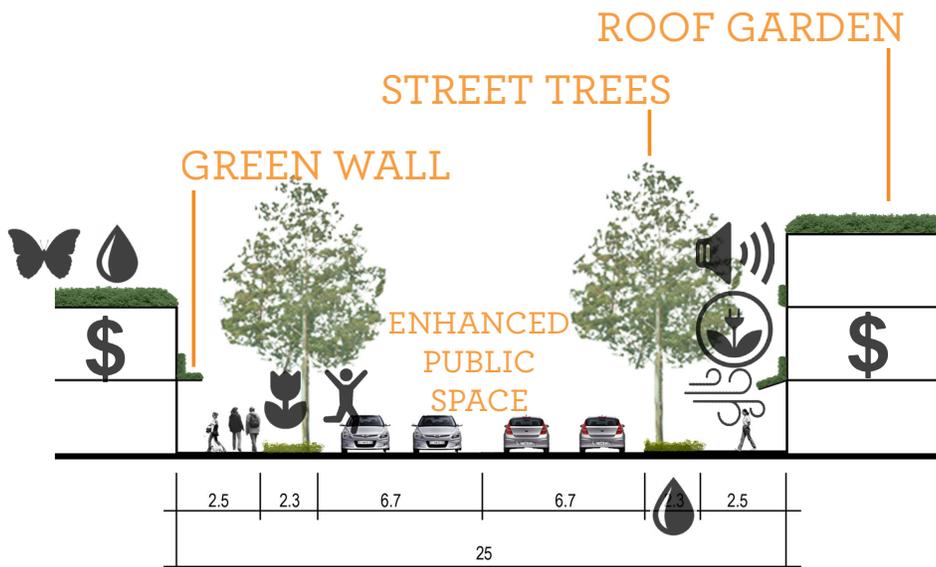


COMMERCIAL IMPROVEMENTS

BEFORE



AFTER



CONCLUSIONS

YOUR NEW URBAN FOREST

WHAT IS THE IMPACT?

GREEN ROOF

1.38 kg/m² CO₂ sequestered. The estimated rooftop area of our field is 15179 m²; so the predicted carbon sequestration of rooftop is 20.9 tons CO₂/yr (this data can be easily derived by anyone with Google Earth).

Green roofs can also mitigate roof temperature, making the roof 10-30 degrees cooler than conventional ones! (Getter et al., 2009)

Will reduce electricity use by 2% and natural gas useage will reduce 9-11%.

Based on the Downtown Vancouver boundaries as stated in the Vancouver Urban Forestry Strategy 2014, 42.5% of Downtown Vancouver has potential rooftop area. If 1.38kg/m² of carbon can be offset, increasing green roof area to its full potential can equal 2111 tons of Co₂! This however is unlikely to be a realistic estimate as ALL rooftops are unlikely to be suitable. **Let's say half of rooftops are green roofs, that still equals 1055 tons of Co₂/yr!**

GREEN WALL

Vines used on green walls are more efficient in carbon sequestration: 60-100 times more than a tree of equivalent mass. This is because the mass of tree is concentrated in its trunk! (Wood et al., 2014)

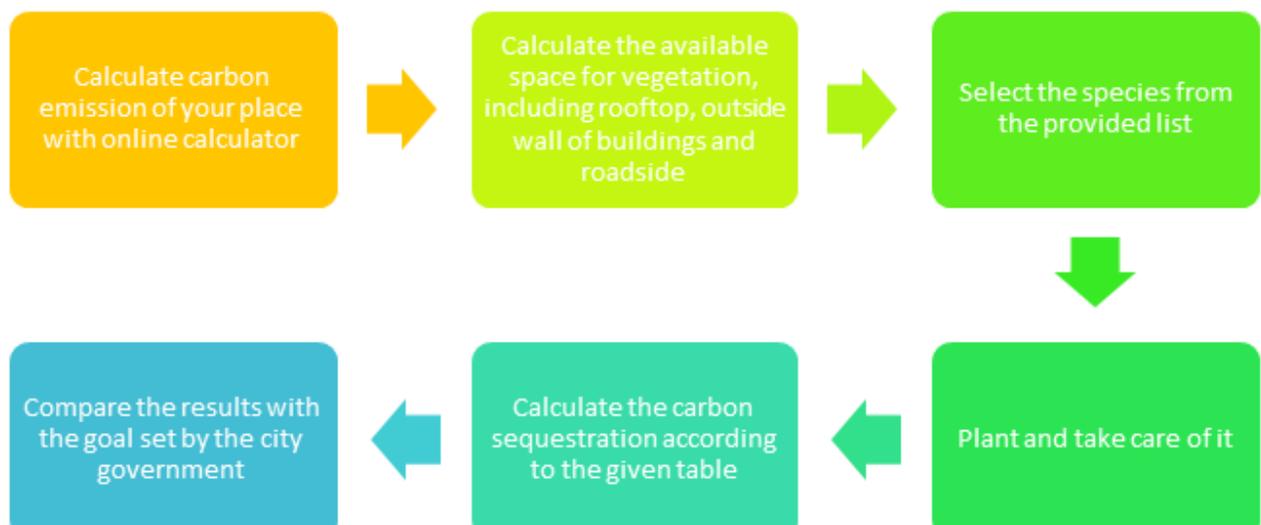
URBAN AGRICULTURE

Food and agricultural sectors' global contribution to GHG emissions at almost 25% (Toronto Food Policy Council, 1999).

The energy use in agriculture: 20 calories to produce 1 calorie food!. (Hollan Barrs Planning Group, 2002)

If just half of the people in this study area participate in urban agriculture, the GHG emission can decrease by 4133 ton/yr!

GET INVOLVED!



This flow chart is an easy step-by-step guide to get everyone involved in increasing urban forestry coverage. The government, local owners or managers can even give incentive rewards for residents and businesses, such as "the greenest shop/citizens". It does not cost much to help green this city, but encouraging more people to participate can make a huge impact on the greening of Vancouver.

You can help **now** by **starting a garden,**
planting a tree,
talking to local shopowners,
and encouraging others!

Enjoy your improved urban forest!

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