

Green Buildings: Living Walls

Greenest City Action Plan 2.0

SD 499

Jennifer Kumph, Kaylee Royce, Irene Feng

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Introduction

Under Vancouver's Greenest City 2020 Action Plan, the theme of Green Buildings has two major targets: 1) require all buildings constructed from 2020 onward to be carbon neutral in operations and 2) reduce energy use and GHG emissions in existing buildings by 20% over 2007 levels. With these targets in mind, our group identified three areas within the theme of Green Buildings that needed to be addressed: the inclusion of greenery into citizens' daily lives, facilitation for better construction techniques, and citizen awareness and inclusion in efficiency practices. In order to address each area of concern, our group conceptualized the implementation of 'Living Walls' within the City of Vancouver. Living Walls, or green walls, are defined as "...self-sufficient vertical gardens that are attached to the exterior or interior of a building" (Green Over Grey, n.d.). This project would fall under the existing GCAP 1.0 strategy of financing tools and incentives to green existing buildings. The project would also benefit other GCAP goals, such as Climate Leadership, Access to Nature, Clean Air, and Local Food. Feedback on our final presentation indicated that Living Walls have the potential to benefit other GCAP topics. With this feedback in mind, our project proposal focused on meeting other GCAP target areas beyond our outlined goal.

Methods

Our group was first inspired by the Piccadilly Circus CityTree bench (Scott, 2018) and the Vertical Forests from various European cities ("Vertical Forest," n.d.). Under the GCAP 1.0 strategy of financing tools and incentives to green existing buildings, our group conceptualized the idea of implementing 'green' fixtures on 'grey' infrastructure (existing buildings). From here, we discovered Living Walls, a common practice in the field of architecture. Our group gathered information primarily from online resources. However, in order to gain a better understanding of Living Walls in Vancouver, our group conducted interviews with corporations such as Green Over Grey and Pan American Nursery. These interviews informed us of current projects and best practices for implementing Living Walls in our geographical context.

Project Description

In the field of architecture and design, the concept of "Living Walls" is integrated into a term called Living Wall Systems (LWS), which is classified as a Building Integrated Vegetation (BIV) (Giordano et al., 2017). According to this paper, LWSs can be described as self-sufficient vertical planting units that are fixed to the exterior or interior of a building. According to Green Over Grey (n.d.), a design firm that specializes in vertical gardens, "[Living Walls] differ from green façades (e.g. ivy walls) in that the plants root in a structural support which is fastened to the wall itself. The plants receive water and nutrients from within the vertical support instead of from the ground." Few examples of Living Walls exist in Metro Vancouver. However, the

implementation of Living Walls is increasing within urban settings due to its innovative design and aesthetic value. The nearest example is a Living Wall affixed within the atrium of SFU Harbour Centre. Blusson Hall at SFU Burnaby is also home to a 655-square foot exterior Living Wall system.



Image 1: Interior Living Wall in the atrium of SFU Harbor Centre. Image Source: Irene Feng



Image 2: Exterior Living Wall outside of Blusson Hall at SFU Burnaby. Image Source: GSky.

Benefits

Living Walls are environmentally sustainable alternatives to ‘grey’ infrastructure, providing a multiplicity of benefits. Benefits include aesthetic value, air quality, acoustics (noise reduction), and building protection. Living Walls also provide economic benefits, which will be

elaborated upon in a later section. Additionally, Living Walls generate benefits in other GCAP topic areas, such as Climate Leadership, Access to Nature, Clean Air, and Local Food.

1. Aesthetic Value

Plants typically utilized in Living Walls have a variety of colours, textures, patterns, and colours. This diversity of plants generates the potential to create “living art” (Green Over Grey, n.d.).

2. Air Quality

Living Walls increase air quality by absorbing and cleaning pollutants from the air. Exterior Living Walls reduce air pollution and the urban heat island effect. However, toxic fumes also exist indoors. Interior Living Walls can filter pollutants such as “formaldehyde, VOCs, trichlorethylene, carbon monoxide, benzene, toluene, and xylene” (Green Over Grey, n.d.). Specific plant species used in Living Walls may help to reduce toxic chemicals both indoors and outdoors.

3. Acoustics (Noise Reduction)

Plants and trees are often used in urban settings to reduce noise pollution. Living Walls on the exterior of buildings “insulate against noise, absorb echo bouncing and vibrations, and reduce sound penetration” (Green Over Grey, n.d.).

4. Building Protection

Building deterioration (including cracks and fractures) is generated by a constant flux in temperature, which leads to the “expansion and contraction of building materials” (Green Over Grey, n.d.). Building protection is enhanced by Living Walls. According to Green Over Grey (n.d.), “The waterproof living wall panels and the exterior envelope are separated by a layer of air, allowing the building to *breathe*.” Covering provided by Living Walls also shields buildings from precipitation, wind, ultraviolet radiation, and acid rain, thereby increasing longevity (Green Over Grey, n.d.).

Business Model

The cost of implementing a Living Wall varies depending on the type of framework and plants (Architek, n.d.). System provided by Green Over Grey typically consist of a frame, waterproof panels, an automatic irrigation system, special materials, lights (when needed), and vegetation (Green Over Grey, n.d.). Generally, the average cost for the one-time installation

ranges from \$195 to \$65 per square feet (Architek, n.d.). This quote includes the costs for the planting system, as well as the plants. Upon installation of the living walls, ongoing maintenance will be required. However, Living Walls are often low maintenance with the assistance of an automatic irrigation system (Green Over Grey, n.d.). Once installation costs are covered, the Living Wall is generally self-sufficient.

Generally, Living Walls do not directly generate revenues. However, as stated previously, Living Walls generate economic benefits. Firstly, Living Walls increase property values by providing additional green space to the City of Vancouver. According to Green Over Grey (n.d.), real estate values can increase up to 20% from the addition of vegetation. Proximity to green space is valuable within cities due to ecosystem services and aesthetic values. Living Walls may function as a marketable feature, thereby potentially increasing patrons at nearby businesses. Secondly, Living Walls generate cost savings through up to 20% in energy conservation by demand on heating and cooling systems. In warmer seasons, Living Walls function to protect building surfaces from solar radiation and heat penetration (Green Over Grey, n.d.). Living Walls can reduce the temperature of a room from 3-7°C, thereby generating up to 20% in energy savings required for cooling (Green Over Grey, n.d.). In cooler seasons, Living Walls function as an additional layer of insulation, thereby reducing the demand for heating.

Feasibility

Our group found multiple sources and examples of Living Walls around Metro Vancouver. Our design recommendations were informed by Living Wall systems at the Semiahmoo Library, Mounted Police Station, Guildford Town Center overpass in Surrey, British Columbia. All three of these projects were conceptualized and constructed by Green Over Grey (mentioned previously). Another case study our group used to inform our project framework was the Piccadilly Circus CityTree Bench, made by Green City Solutions. Our group looked at ideas from these successful projects, such as the vegetation involved, the methods employed to create their designs, and the long term maintenance and viability. From these examples, our group derived a framework appropriate for the City of Vancouver.

1. Semiahmoo Library and Mounted Police Station

This location plays host to a massive Living Wall consisting of 10,000 individual plants and almost 3000 square feet (Cattermole, 2010). This wall system, created by Green Over Grey, was created from a series of porous panels that lock on to a frame. The frame was built in front of the pre-existing wall in order to allow ventilation and prevent damage to the building (Green Over Grey, n.d.). The plants are embedded into the porous material and provided with additional grow lights should they become necessary. An example of this lighting system can be viewed at Living Wall at SFU Harbour Centre. While hydroponic irrigation generally uses 90% less water

than standard soil cultivation, the water supply does not affect the building behind it and in fact protects it from the elements (Schattenberg, 2015). Due to the insulating properties, the Living Wall is estimated to drop electricity use by almost 20% and drop summer temperatures inside by an estimated 7°C (Cattermole, 2010).

2. Guildford Mall Overpass

The Guildford Mall Overpass has the current largest Living Wall in North America at approximately 10,000 square feet. The framework for this system is made of porous recycled plastic panels recovered from recycled water bottles and plastic bags. It works with an automatic hydroponic system that drips a mixture of municipal water and nutrients into the top of the wall and allows it to percolate down to the plants, minimizing water waste. The plants used are native species to British Columbia that thrive on cliff faces and on trees.

Maintenance involves taking a rolling platform out across the overpass and trimming back any overgrowth, such as wilting leaves or spent flowers. Each 215 square feet of the wall absorbs approximately the same amount of carbon as 47 trees. The wall also acts as a heat sink in the summer and an insulating barrier in the winter, contributing to the building's gold LEED certification (Contemporist, 2014). In a phone interview, a Green Over Grey representative informed us that outdoor maintenance usually takes place 8-10 times each year, with the most occurring in the spring to ensure growth continues in its designed pathway (personal communication, June 11, 2018).

3. The Piccadilly Circus CityTree Bench

Built by Green City Solutions, the Piccadilly Circus CityTree bench is an interesting example of a Living Wall system this company has developed (Scott, 2018). This innovative design operates by collecting rainwater in a cistern located at the base, at the bench portion. The solar panels located at the top of the bench collect power to run the water pump that provides drip irrigation to the plants as necessary, and also operates the gentle fans that draw air into the moss for particulate filtration. The mosses each have individual potting structures that slot in with their neighbours, making it simple to swap out units that require more care. To cut down on maintenance, this bench uses one very effective type of moss rather than ambitiously attempting to achieve biodiversity.

Implementing Agency

Based on this research, our group recommends that the city implement two stages in the installation of Living Walls. In the first stage, public buildings would be used to construct a framework made of porous recycled plastic products incorporating a network of pipes connected

to a rainwater collection cistern. This framework would have pockets for plants to be swapped out and maintained by the companies that rent the advertisement space from the city (Green Over Grey, n.d.). In this stage, the City of Vancouver would absorb the cost of the framework and the interested parties would pay for the design, plants, and maintenance. In the second stage, walls would be constructed on businesses or residencies with the cooperation and partial funding of the inhabitants and, again, paid for by the party putting out their advertisement. This would encourage a sense of community ownership and collaboration. While each location would require an initial consultation with a botanist or landscape designer to assess the varieties of plants that would flourish in the environment, the design can be flexible and can be changed when the term runs out. Potential agencies could include businesses from the private sector, corporate advertisement, or agronomists; there is even the opportunity for collaborations between communities through the implementation of public art.

Other Implementation Considerations

There are a few barriers that may restrict the implementation of Living Walls within the City of Vancouver. While the winter season in British Columbia is far more forgiving than the rest of Canada, there are still a few factors that we need to take into consideration. One of these is temperature in conjunction with the cistern and water pipes. Another is the continued aesthetics of vegetation in its dormant state.

Temperature is a relatively simple problem to overcome, as was revealed in a phone interview with Green Over Grey. Although their Living Walls are often plumbed directly into municipal water, Green Over Grey have dealt with multiple scenarios across Canada and are confident in the number of options available to fit each situation. These include, but are not limited to: specialized pipes that withstand cold temperatures, a freezing sensor, and gravity drains to prevent water freezing leading to broken pipes.

According to Green Over Grey, each location needs to be fine-tuned based on solar exposure and the individual tastes of their clients. One source of their plants, the Pan American Nursery, provided us with a list of plants likely to do well in a Living Wall environment. These include ferns and succulents that are accustomed to seasonal drought and heavy rainfall, as well as some food products such as tomatoes and strawberries (thereby supporting local food provision).

Once these barriers are accounted for and removed, the implementation of Living Walls can be facilitated. It is important, therefore, to recognize the geographical diversity of each place in order to determine the feasibility of implementing Living Walls. Due to our mild climate and resource accessibility, we believe that Living Walls are a suitable project for the City of Vancouver to undertake.

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