Jericho Lands

A Global Sustainability Study

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Executive Summary

This project focuses on the Jericho Lands, a 36-hectare (90-acre) site located within Vancouver's West Point Grey neighbourhood. A comprehensive planning program is currently being developed at the request of the Jericho Lands owners, a joint venture ownership between the Musqueam Indian Band, Squamish First Nation and Tsleil-Waututh First Nation (MST Partnership) and Canada Lands Company (CLC). In July 2018, Vancouver City Council approved the development of a policy statement, directing City staff to undertake a planning program to guide the redevelopment of the site.

As one of the few remaining large-scale redevelopment sites within Vancouver, the Jericho Lands present a unique opportunity to realize ambitious sustainability goals owing to the significant size of the site. To inform the redevelopment of the Jericho Lands, it is important to consider existing global sustainability precedents on large-scale redevelopments to gain an appreciation for these developments and to better understand how their best practices could be adapted and applied to the Jericho Lands.

Conducting this form of exploratory study benefits the Jericho Lands by further elevating sustainability in the staff and public discourse and by providing inspirational examples of global peer cities that may be referenced during the planning process. Ultimately, this work will help to inform the final recommendations within the policy statement, providing guidance on the development of the Jericho Lands going forward.

The focus of the study is on existing sustainability practices for large-scale sites, including environmental, social, and economic dimensions. The primary deliverables include a research summary of sustainability precedents amongst global peer cities, an assessment of existing civic policies, and recommendations to enhance local sustainability policy and practices.

The study began with a review of all existing City policies pertaining to sustainability. This information was compared with international policy precedents to identify policy gaps and opportunities for further refinement. Thirteen case studies were then explored. A previous internal study was used to provide the initial assessment criteria, partial project data, and sustainability measurements. These elements were later expanded upon through the examination of online materials. Existing precedents were identified through interviews with City of Vancouver staff and an extensive review of online materials.

The Musqueam, Squamish, and Tsleil-Waututh Nations (the MST Nations) have lived on the Jericho Lands since time immemorial. For millennia prior, the land and waterways of the Jericho Lands were where the MST Nations resided, worked, and followed their cultural customs.

There is a strong cultural significance of the Jericho Lands amongst the MST Nations. The area now known as Jericho is referred to as ʔəy̓alməxʷ/Iy̓álmexw amongst the MST Nations, and part of an interconnected network of cultural sites that exist throughout the MST Nations' traditional territories.

The MST Partnership and CLC are now working with the City of Vancouver to undertake a planning program for the redevelopment of the two properties. The goal of this process is to create a policy statement that will guide redevelopment of the Jericho Lands. This will include the establishment of principles, objectives and policies related to a range of topics.

The Jericho Lands are situated within Vancouver's West Point Grey neighbourhood. The surrounding neighbourhood is primarily residential in character. The site is within close vicinity to a number of community amenities, including park space, libraries, childcare facilities, community centres, transportation services, cultural facilities, and neighbourhood houses.

A variety of existing City of Vancouver policies apply to large redevelopment sites like the Jericho Lands. These policies establish a general framework that will help shape redevelopment of the Jericho Lands and support City objectives related to affordability, climate change, social justice, and sustainability. The varying policies apply at different scales – including city-wide, local area, and site specific - and stages of the design and development process.

Large site redevelopment is an important factor in the development of cities globally, providing cities the opportunity to significantly alter their physical landscape while exploring new and innovative designs for development. This is especially true in terms of sustainability, as larger redevelopments present unique opportunity to balance the environment and assorted resources with growing urban populations.

To explore these ideas, a comprehensive review of large-scale redevelopments was undertaken to identify and detail global sustainability precedents that may be used to inform the redevelopment of the Jericho Lands. A total of 27 case studies were examined, with the final list consisting of 13 specific examples from municipalities around the world. These 13 examples were chosen for the prominence or ingenuity of their precedents, the accessibility of project information, and their relevance to the Jericho Lands. All of the cases explored are brownfield redevelopments with the exception of Wesbrook Village

The 13 case studies include: Bahnstadt in Heidelberg, Germany; Barangaroo South in Sydney, Australia; Dockside Green in Victoria, Canada; Fishermans Bend in Melbourne, Australia; HafenCity in Hamburg, Germany; Hammarby Sjöstad in Stockholm, Sweden; Kalasatama in Helsinki, Finland; Stockholm Royal Seaport in Stockholm, Sweden; Treasure Island in San Francisco, USA; Västra Hamnen in Malmö, Sweden; Vauban in Freiburg, Germany; Wesbrook Village in the University Endowment Lands, Canada; and the Wynyard Quarter in Auckland, New Zealand.

Several lessons can be discerned from the summarized sustainability policies and precedents around the globe. To explore these lessons, the discussion section was divided into three sub-sections, including existing policy gaps, present opportunities for reconciliation, and potential future applications for the research.

One area highlighted by the City of Vancouver's existing policies is environmental sustainability. First and foremost, the City should look to consolidating its primary sustainability documents, including the *Greenest City Action Plan*, the H*ealthy City Strategy* and the *Vancouver Economic Action Strategy*. Alternatively, a clear integration of the three in a manner that relays the interplay between each document should be considered. Another area for potential improvement includes the integration of a holistic metric for measuring a building's or district's overall sustainability performance. Additional consideration should also be given to include a quantifiable measure or target for biodiversity. Finally, following the Province of British Columbia's recent adoption of the *Zero-Emission Vehicles Act*, the City should look to expand upon the directions provided within the *Renewable City Strategy* and the *Vancouver EV Ecosystem Strategy* to develop a comprehensive and implementable strategy for the zero-emission mandate.

A second area for potential improvement is in regard to the City's reconciliation efforts with the local First Nations. While the *Framework for City of Reconciliation* provides recommendations to strengthen relations, promote culture, and incorporate First Nations perspectives into City services, it does not provide detail on furthering economic or employment opportunities. Further, there the other sustainability-related documents, including the social-centric Healthy City Strategy and the economic-focused Vancouver Economic Action Strategy. Barangaroo South and Wynyard Quarter present new approaches to reconciliation in terms of economic and cultural opportunities for First Nations while existing in a similar social context to Vancouver and the Jericho Lands. Special consideration should be given in how to best apply the practices discerned from the case studies. While the examples provided are exciting and innovative, they are also highly context specific, being closely connected to the environments and communities in which they reside. The case studies provided are best used as tools for inspiring a deeper and more effective conversation with the public and project stakeholders throughout the policy statement's formation.

In conclusion, the Jericho Lands are a unique opportunity to pursue ambitious sustainability goals at scale. Provided the existing mandate outlined within the City of Vancouver's sustainability policies, the Jericho Lands can be a contemporary model for sustainable redevelopment within the local context. Leadership in sustainability can be demonstrated on-site through the exploration and development of environmental, economic and social innovations. Inspiration for these sustainability initiatives can be derived from the case studies explored within this research. Alongside the City's existing sustainability policies, these examples provide an excellent starting point for the future redevelopment of the Jericho Lands.

Introduction

Context

This project focuses on the Jericho Lands, a 36-hectare (90-acre) site located within Vancouver's West Point Grey neighbourhood. A comprehensive planning program is currently being developed at the request of the Jericho Lands owners, a joint venture ownership between the Musqueam Indian Band, Squamish First Nation and Tsleil-Waututh First Nation (MST Partnership) and Canada Lands Company (CLC). In July 2018, Vancouver City Council approved the development of a policy statement, directing City staff to undertake a planning program to guide the redevelopment of the site.

Purpose

As one of the few remaining large-scale redevelopment sites within Vancouver, the Jericho Lands present a unique opportunity to realize ambitious sustainability goals owing to the significant size of the site. To inform the redevelopment of the Jericho Lands, it is important to consider existing global sustainability precedents on large-scale redevelopments to gain an appreciation for these developments and to better understand which best practices could be adapted and applied to the Jericho Lands.

Conducting this form of exploratory study benefits the Jericho Lands by further elevating sustainability in the staff and public discourse and by providing inspirational examples of global peer cities that may be referenced during the planning process. The primary limitation of this form of study is the transferability of case studies, given that policies from different contexts may not be directly applicable to the Jericho Lands without adaptations for local context. Ultimately, this work will help to inform the final recommendations within the policy statement, providing guidance on the development of the Jericho Lands going forward. There is also an opportunity for this work to tie in with the *Climate Emergency Response*, a recent Council resolution that contains accelerated actions to reduce Vancouver's carbon pollution and help fight climate change.

Scope

The focus of the study is on existing sustainability practices for large-scale sites, including environmental, social, and economic dimensions. The primary deliverables include a research summary of sustainability precedents amongst global peer cities, an assessment of existing civic policies, and recommendations to enhance local sustainability policy and practices.

Methodology

The study began with a review of all existing City policies pertaining to sustainability. This information was compared with international policy precedents to identify policy gaps and opportunities for further refinement. Thirteen case studies were then explored. A previous internal study was used to provide the initial assessment criteria, partial project data, and sustainability measurements. These elements were later expanded upon through the examination of online materials. Existing precedents were identified through interviews with City of Vancouver staff and an extensive review of online materials.

C. Busch

Background

Jericho Lands

The Jericho Lands are a 36-hectare site in Vancouver's West Point Grey neighbourhood. The site is located within the traditional unceded territories of the Musqueam, Squamish, and Tsleil-Waututh Nations and owned by the MST Partnership and CLC (CoV, 2019c). The area is bounded by West 4th Avenue to the north, Highbury Street to the east, West 8th Avenue to the south, and Queen Mary Elementary school and Trimble Park to the west (CoV, 2019c).

The Jericho Lands are composed of two distinct properties, the Jericho Garrison to the east and the Jericho Hill Grounds to the west.

The eastern 21-hectare parcel was previously owned by the Department of National Defence until 2014, when the property was transferred to the MST Partnership and CLC (Vancouver Sun, 2014). The Department of National Defence continued leasing the operational area from the MST Partnership and CLC until early 2018 when the 39 Canadian Brigade Group were relocated to Seaforth Armoury (CoV, 2019d). Onsite housing for military personnel continues to be provided through a lease agreement with MST Partnership and CLC. This area is currently zoned (RS-1) One-Family Dwelling District, which permits one-family dwellings, secondary suites, laneway houses, and two-family dwellings (CoV, 2019d).

The western portion of the site leases land to the West Point Grey Academy, a co educational private school, and the Jericho Hill Community Centre (CLC, 2019). The 15-hectare parcel was previously owned by the Department of National Defence prior to acquisition by the Province of British Columbia. Ownership of the site was then transferred from the Province to the MST Partnership in 2016 (Vancouver Sun, 2016). As of July 2000, this property has been zoned CD-1 (404) which permits a variety of uses including residential, cultural and recreational uses, parks, institutional uses, public utility (CoV, 2019d). The scale and density outlined in CD-1 (404) are generally consistent with single-family scale development of the surrounding neighbourhood

City of Vancouver

History

The Musqueam, Squamish, and Tsleil-Waututh Nations (the MST Nations) have lived on the Jericho Lands since time immemorial. For millennia prior, the land and waterways of the Jericho Lands were where the MST Nations resided, worked, and followed their cultural customs (CLC, 2019). These territories offered past residents a life of abundance with plentiful food and materials provided from both land and sea.

There is a strong cultural significance of the Jericho Lands amongst the MST Nations. The area now known as Jericho is referred to as ʔəy̓alməxʷ/Iy̓álmexw amongst the MST Nations, which is part of an interconnected network of cultural sites that exist throughout the MST Nations' traditional territories (CLC, 2019).

əy̓alməxʷ/Iy̓álmexw was connected to other villages and campsites by a network of trails that radiated across the land. In oral history, these lands provided a gathering place for warriors of the qiyəplenəxʷ/K̲iyapelánexw – an ancestor to many Musqueam, Squamish, and Tsleil-Waututh families - to defend against raiding northern people (CLC, 2019). It was also a site of cedar plank longhouses that welcomed guests from the Fraser Valley, Vancouver Island, and Puget Sound.

The ancestral village of ʔəy̓alməxʷ/Iy̓álmexw was located near the Jericho Lands well-before contact with European nations. The Spaniard Jose Narvaez and his crew sighted the shores of the Jericho Lands in 1791 and called it Langara Point (CoV, 2019f).

The following year, Captains Galiano and Valdez ran into Captain Vancouver in the same location, which led to the naming of two local areas: Spanish Banks and English Bay. In 1865, the first logging camp was established (CoV, 2019f). Much of the timber here went to Stamp's Mill at the Granville townsite where the modern City of Vancouver was founded in 1886. A whaling station was later established in the 1870s (CoV, 2019f).

The federal government soon took notice of the area and established military reserves in recognition of the area's strategic location. In 1921, construction began on the Pacific Coast Station of the Royal Canadian Air Force at Jericho Beach (CoV, 2019f). The site's strategic location made it ideal for an air station and anti-submarine reconnaissance leading into and during the Second World War. When the federal government decided to move the station in 1967, the future of the Jericho Lands was uncertain. After years of debate, citizens and politicians finally agreed to develop the former military base into a park. In the early 1970s, an additional 46 hectares of recreation land was made available to the public, which would eventually become Jericho Beach Park.

The Jericho Boys Industrial School, opened in 1905, was a prominent development on the site (VHF, n.d.). Upon the industrial school's closure in 1920, the British Columbia School for the Deaf and Blind moved in and opened in 1922 (VHF, n.d.). The school suffered from allegations of abuse on the school grounds in the 1970s and 1980s. Despite reforms done at this time, the school received further negative publicity in the 1990s, leading to the school's closing in 1992 (VHF, n.d.).

A notable event to take place near the Jericho Lands was the Habitat Forum which took place at Jericho Beach Park from May 27 to June 11, 1976 (Vancouver Archives, 2017). In conjunction with the first United Nations Habitat Conference on Human Settlements, the Habitat Forum provided a space for members of the public to engage with the conference and monitor the United Nations sessions. Successive Habitat conferences have since been held in Istanbul in 1996 and Quito in 2016

The redevelopment of the Jericho Lands is considered by the MST Nations as a generational opportunity to reaffirm past relationships that would honour heritage, rebuild local communities, and celebrate their unique identity (CLC, 2019). The future site will act as a reminder to local residents of the connections between the MST Nations and these lands which they have called home for many generations (CLC, 2019).

City of Vancouver

Planning Process

The MST Partnership and CLC are now working with the City of Vancouver to undertake a planning program for the redevelopment of the Jericho Lands. The goal of this process is to create a policy statement that will guide redevelopment of the site. This will include the establishment of principles, objectives and policies related to a range of topics, including: reconciliation, land use, density, height, public benefits, transportation, built form, character, sustainability, servicing infrastructure and development phasing (CoV, 2019c). The policy statement will be presented for Council's consideration at the end of the process and, if adopted, used to inform any future rezoning of the lands.

The planning process consists of four phases: information gathering, site concept development, preferred concept and emerging policies, and concept refinement and draft policy statement (CoV, 2019c). At present, the planning program is in the first phase, which consists of extensive community engagement and background studies. The input received through this process – alongside municipal policies, technical requirements, and the findings of this study - will be used to inform and inspire the site's preliminary design and eventual final plans (CLC, 2019).

Following the creation of the policy statement, the MST Partnership and CLC will have to continue through a rezoning process. This process includes the submission of a rezoning application, additional public engagement, and a Public Hearing with City Council. Development and building permits could be pursued after Council

(CoV, 2019d)

has supported a rezoning proposal and the zoning on the site changed, with eventual construction on the Jericho Lands occurring afterwards (CoV, 2019c).

The City of Vancouver considers the Jericho Lands as a unique opportunity for the City to work collaboratively with the MST Partnership, CLC, and the surrounding community and city residents to shape the future development of a significant large-scale redevelopment site (CoV, 2019d). Through the planning process, the City will explore redevelopment options that seek to:

- Advance our collective work toward reconciliation.
- Respond to existing and emerging Council policies.
- Establish a new model community that is sustainable, socially and culturally inclusive and highly-livable.
- Create new housing opportunities as well as shops and services, and employment space to support the new community.
- Deliver public amenities such as affordable housing, childcare, and community space, to serve the new development, the surrounding neighbourhood and broader community.
- Provide new housing within walking distance of existing and planned rapid transit routes.
- Protect cultural and heritage assets.
- Retain significant trees, and create new parks and public open spaces.
- Learn from best practices around the world (CoV, 2019d).

The MST Partnership and CLC aim to optimize the value of the Jericho Lands to create opportunities and careers for Nations members while generating a return on investment for all project partners (CLC, 2019).To achieve this, the MST Partnership and CLC have identified the following set of project aspirations to inform the site's development:

- Reflect and respect the past, present, and future legacies of the Musqueam, Squamish, and Tsleil-Waututh.
- Support healthy communities.
- Respect the land.
- Welcome all cultures.
- Provide a range of housing types.
- Bring innovative urban design and public realm.
- Bring a focus on environmental, social, and economic sustainability (CLC, 2019).

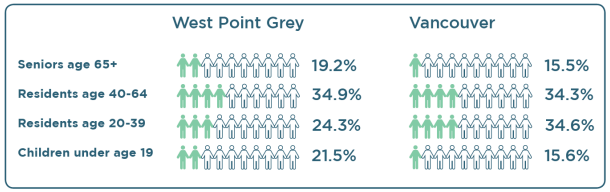
Community Snapshot

The Jericho Lands are situated within Vancouver's West Point Grey neighbourhood. The surrounding neighbourhood is primarily residential in character. The site is within close vicinity to a number of community amenities, including park space, libraries, childcare facilities, community centres, transportation services, cultural facilities, and neighbourhood houses.

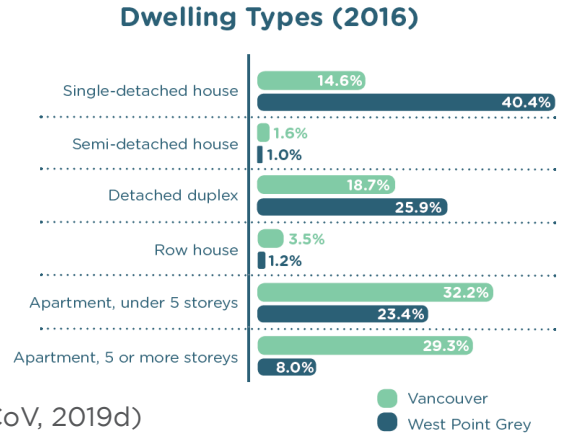
Demographics

West Point Grey has experienced a relatively small population increase compared to the broader City of Vancouver. The neighbourhood's population has increased by 1.4% between 1996 and 2016 (CoV, 2019d). In comparison, the City of Vancouver's population increased by 22.9% over the same time period (CoV, 2019d).

On average, West Point Grey's residents are older than the broader population. The median age of neighbourhood residents is 44.1 years compared to 39.3 years across Vancouver (CoV, 2019d). This variation in age is most apparent when examining the population of residents over 65. The number of elderly residents in West Point Grey is 19.2% in comparison to 15.5% for the City of Vancouver (CoV, 2019d). Notably, West Point Grey's population is continuing to age, as is indicated by the increase in the elderly population from 2011 when it accounted for 16% (CoV, 2019d). The proportion of children has increased by 0.5% since 2011 to 21.5% of the population in West Point Grey as of 2016 (CoV, 2019d). The largest demographic gap between the West Point Grey neighbourhood and the City of Vancouver is amongst young adults. Individuals between the ages of 20 and 39 represent only 24.3% of West Point Grey's population, a percentage that substantially lower than the City average at 34.6% (CoV, 2019d).



(CoV, 2019d)



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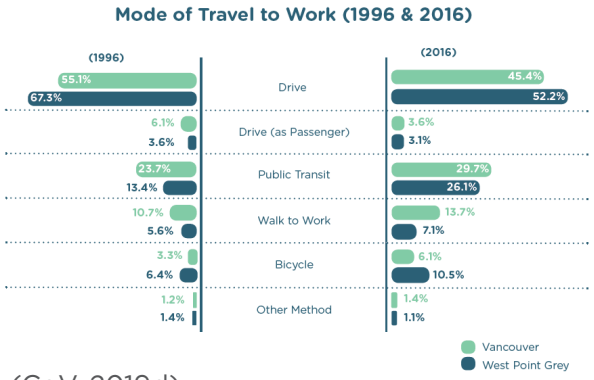


(CoV, 2019d)

Another notable difference between West Point Grey and the broader City of Vancouver is in regard to housing. West Point Grey has a considerably higher rate of home ownership when compared to Vancouver, with over 62.2% of residents own their homes in West Point Grey as compared to 46.9% in Vancouver (CoV, 2019d). Amongst the existing housing stock, 40.4% of all dwellings are single-detached houses in West Point Grey, a significantly higher rate in comparison to the whole of Vancouver which consists of 14.6% single-detached houses (CoV, 2019d). The neighbourhood also experiences a lower density of 12.1 dwelling units per hectare compared to 24.8 dwelling units per hectare in Vancouver (CoV, 2019d). By comparison, only 37.7% of dwellings are rented in West Point Grey, compared to 53.1% of dwellings in Vancouver (CoV, 2019d).

Transportation

Like much of Vancouver, the street network around the Jericho Lands is predominantly a grid pattern, with major east-west connections along West 4th and West 10th Avenues and north-south connections on Alma and Blanca Streets. These roadways provide the neighbourhood with access to significant destinations, including Jericho Beach, Spanish Banks, and the University of British Columbia. At present only one road connection exists on the Jericho Lands between West 4th and Broadway.

West Point Grey is well-served by transportation options, including several pedestrian, bicycle, transit and vehicle routes nearby. The Jericho Lands are within walking distance of popular local destinations, including Jericho Beach and the high streets along West 4th Avenue, West Broadway, and West 10th Avenue. Bike routes exist along West 8th Avenue and a segment of the Seawall along Point Grey Road.

TransLink provides transit service through numerous bus routes in the site's vicinity, including the 99 Commercial-Broadway/ UBC B-Line and 84 UBC/VCC-Clark Station. The Broadway Subway Project - a six-station extension of the Millennium Line from VCC-Clark Station to Arbutus Street - has been approved and funded. Construction is anticipated to begin in 2020, with completion scheduled for 2025.

In early 2019, Vancouver City Council and TransLink's Mayors' Council both endorsed the further design development of the SkyTrain past Arbutus Street to UBC. Development of route alignment and station options for this proposed extension will begin in the coming months and will include exploration of station locations either on or near the Jericho Lands.

In 1996, 70% of West Point Grey residents either drove or were passengers in a vehicle on their journey to work (CoV, 2019d). This percentage saw a decrease to 55% in 2016 (CoV, 2019d). Public transit ridership witnessed a near doubling from 13.4% in 1996 to 26.1% in 2016 (CoV, 2019d). Walking and cycling to work have also seen increases during this timeframe.

Compared to Vancouver as a whole, West Point Grey residents report driving to work more, being 45.4% and 52.2% respectively (CoV, 2019b). A higher number of West Point Grey residents report cycling to work than Vancouver residents, being 10.5% and 6.1% (CoV, 2019d). Fewer West Point Grey residents report walking or taking transit to work than Vancouver residents as a whole, being 7.1%/26.1% and 13.7%/29.7%, respectively (CoV, 2019d).

Community Amenities

The City of Vancouver provides public amenities as part of redevelopment through Community Amenity Contributions, Development Cost Levies, and capital plan investments. Public amenities can include park space, libraries, childcare facilities, community centres, transportation services, cultural facilities, and neighbourhood houses (CoV, 2019d).

The most prominent local amenity within close vicinity to the Jericho Lands is park space, including the 46-hectare Jericho Beach Park and the 3-hectare Trimble Park to the north and west of the site respectively.

Commercial retail and service districts can be found along West 4th Avenue, Broadway and West 10th Avenue.

Nearby recreation and cultural facilities include the Aberthau Mansion, Brock House Society, Jericho Hill Community Centre, Jericho Sailing Club, Lord Byng Pool & Fitness Centre, West Point Grey Branch of the Vancouver Public Library, and the West Point Grey Community Centre. The Jericho Hill Centre resides on the Jericho Lands. The facility is jointly operated by the West Point Grey Community Association and the Vancouver Board of Parks and Recreation to complement the recreational and cultural programming offered by the West Point Grey Community Centre (CoV, 2019d). At present, the Vancouver Board of Parks and Recreation leases the building from the MST Partnership on a short-term basis (CoV, 2019d).

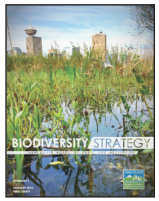
Several public and private schools reside within close vicinity to the Jericho Lands, including Bayview Elementary, Ecole Jules Quesnel, General Gordon Elementary, Kitsilano Secondary, Lord Byng Secondary, Queen Elizabeth Elementary, Queen Mary Elementary, Our Lady of Perpetual Help Catholic School, and West Point Grey Academy (CLC, 2019). Several smaller childcare and education spaces are sub-leased at the Jericho Hill Centre. The Jericho Lands are located within the Queen Mary Elementary and Lord Byng Secondary catchment areas (CoV, 2019d). West Point Grey Academy, an independent co-educational school, is located on the south-west corner of the site and is currently being leased (CoV, 2019d).

Policy Context

A variety of existing City of Vancouver policies apply to large redevelopment sites like the Jericho Lands. When considered in tandem, these policies establish a general framework that will help shape redevelopment of the Jericho Lands and support City objectives related to affordability, climate change, social justice, and sustainability. The varying policies apply at different scales – including city-wide, local area, and site specific - and stages of the design and development process.

City-Wide

Biodiversity Strategy



The Vancouver Park Board's *Biodiversity Strategy* aims to support biodiversity in parks and private spaces across the City of Vancouver. The strategy provides a foundation for protecting and restoring natural areas, species, and ecological processes, in addition to improving access to nature amongst Vancouver's neighbourhoods. It describes strategies to restore priority habitats as part of a city-wide ecological network, to change the Park Board's operations to better support biodiversity, and to celebrate biodiversity as an important part of urban life. The strategy's goal is to increase the amount and quality of Vancouver's natural areas to support biodiversity and enhance access to nature.

The report was adopted by Council on April 19, 2016.

Citywide Integrated Rainwater Management Plan

The *Citywide Integrated Rainwater Management Plan* is the culmination of over two years of technical analysis, stakeholder workshops and best management practice review. The plan provides a long-term green infrastructure strategy to protect and improve water quality in the waterbodies surrounding Vancouver. The document provides an integrated rainwater management plan that treats Vancouver's rainwater as a resource, reduces the demand for potable water by encouraging beneficial reuse, and restores the role of urban watersheds to support ecosystems and provide clean water. The report was adopted by Council on April 19, 2016.

Climate Change Adaption Strategy

The *Climate Change Adaptation Strategy* focuses on understanding the present and future impacts of climate change. It provides a framework for identifying and prioritizing vulnerabilities and risks, guiding development of policies and programs that build resilience into infrastructure and exploring measures to reduce the risk from climate change impacts. The strategy aims to embed resiliency into everyday operations and to maintain or enhance short and long-term infrastructure, as well as City programs and services. The report was adopted by Council on July 24, 2012.

Climate Emergency Response

On April 29, 2019, Vancouver City Council approved the *Climate Emergency Response,* including a series of short and long-term actions to tackle climate change in Vancouver. The report builds upon past progress to reduce carbon pollution, improve energy efficiency, and transition to renewable energy. Six big moves to reduce Vancouver's carbon pollution by building and expanding on our existing work to fight climate change were approved, along with 53 accelerated actions that will help the City to ramp-up local action in the near future.

Community Benefit Agreement Policy

The *Community Benefit Agreement Policy* aims to reach the poverty reduction and community economic development goals established within the Healthy City Strategy. Developers of future large-scale sites that are greater than 1.98 acres are required to commit to actions, targets, or outcomes on three main components: first source hiring, making 10% of new entry level jobs

available to people in Vancouver first, specifically those who are equity-seeking; social procurement, valuing the positive social and environmental impacts created by purchasing select goods and services; and supplier diversity, purchasing from organizations that are at least 51% owned by members of a minority group. The policy was adopted by Council on August 21, 2018.

Framework for City of Reconciliation

This report outlines a proposed framework for Vancouver to become the world's first City of Reconciliation. The long-term commitment will move forward the City's ongoing work on raising awareness, creating partnerships, and addressing capacity for the City of Vancouver, focusing upon strengthening relations with the Musqueam, Squamish, and Tsleil-Waututh First Nations. The report outlines the first steps to strengthen understanding and relationships with First Nations and the Urban Indigenous community. The framework's vision is to create an inclusive city that embraces all cultures, facilitating opportunities for communities to live, work and play together. The report was adopted by Council on September 18, 2014.

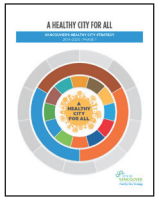
Greenest City 2020 Action Plan / Greenest City Action Plan 2015-2020 Strategy

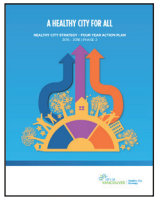
The *Greenest City Action Plan* is a strategy for staying on the leading edge of urban sustainability. The plan is a vision to create opportunities today while building a strong local economy, vibrant and inclusive neighbourhoods, and an internationally recognized city that meet the needs of future generations. Through the plan's 11 targets, the City of Vancouver is moving towards becoming the greenest city in the world by 2020. Annual implementation updates are disseminated back to Council to detail the City's progress in achieving each of the plan's goals and targets. The reports were adopted by Council on July 12, 2011 and November 3, 2015, respectively.

Heather Lands Policy Statement

The Heather Lands is a 21-acre site located between 33rd Avenue and 37th Avenue along Heather Street. The planning program was developed at the request of the Heather Lands owners - the MST Partnership and CLC – and included several opportunities for residents, community members, and stakeholders to provide feedback on the site. Vancouver City Council approved the *Heather Lands Policy Statement* on May 15, 2018, which will inform any future rezoning of the Heather Lands. While the *Heather Lands Policy Statement* is not directly applicable to the Jericho Lands, the planning program will follow a similar process and involves the same landowners for both sites. The policy statement was adopted by Council on July 26, 2018.

A Healthy City for All: Vancouver's Healthy City Strategy 2014-2025 / A Healthy City for All: Healthy City Strategy – Four Year Action Plan 2015-2018





The *Healthy City Strategy* is a long-term, integrated plan for healthier people, healthier places, and a healthier planet. The document's guiding vision is of a healthy city for all; a city where conditions are being continuously improved upon as to provide everyone with the highest level of health and well-being possible. The strategy is comprised of 13 long-term goals, 21 aspirational targets and 45 indicators to measure progress, with the strategy running until 2025. The reports were adopted by Council on October 29, 2014, and July 8, 2015, respectively.

Housing Vancouver Strategy

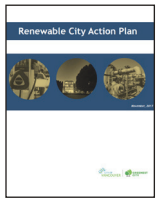
The *Housing Vancouver Strategy* is a 10-year housing strategy for the City of Vancouver to foster a diverse, vibrant community. The strategy addresses housing affordability by focusing efforts on supporting new housing affordable to a range of local incomes, including rental, social and supportive

units. The strategy is based upon three principles: creating the right supply of housing and addressing speculative demand, protecting existing affordable housing, and ensuring support for vulnerable residents. The strategy's overall goal is to produce 72,000 units of new housing units by 2027 - including 12,000 units for low-income residents - while preserving an additional 90,000 units of existing rental housing stock. Annual progress reports are provided to Council detailing the City's progress in achieving the strategy's targets. The report was adopted by Council on November 28, 2018.

Making Space for Arts and Culture: 2018 Cultural Infrastructure Plan

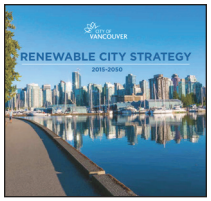
On July 10, 2018, Vancouver City Council approved the *Making Space for Arts and Culture: 2018 Cultural Infrastructure Plan*. Informing the larger *Creative City Strategy,* the plan recommends optimizing City policies, tools, programs and investment priorities to secure, enhance and develop vibrant, affordable, and accessible arts and cultural spaces in Vancouver.

Renewable City Action Plan



The *Renewable City Action Plan* is a 10-year roadmap to achieving a clean energy future for Vancouver. The document contains guiding principles, short and long-term targets, and specific actions. It details how the City of Vancouver will focus its efforts upon improving energy efficiency, increasing renewable energy usage in buildings and transportation, and increasing the supply of renewable energy through solar power and renewable natural gas. A clean energy future means cost savings, clean air, a healthy environment, and a strong, vibrant economy for Vancouver residents and businesses. The report was adopted by Council on November 1, 2017.

Renewable City Strategy



The *Renewable City Strategy* establishes how Vancouver will achieve its 100% renewable energy goal. The strategy is the foundation for more detailed planning in coming years and sets a goal for Vancouver to become energy self-sufficient, employing only renewable sources of energy to power the city. The project's future directions will be assessed to ensure that it remains technically, economically and socially responsible. The report was adopted by Council on November 3, 2015.

The Vancouver Economic Action Strategy: An Economic Development Plan for the City

The *Vancouver Economic Action Strategy* provides the City of Vancouver a roadmap for enhancing present and future economic performance. The strategy focuses on three tenets for managing the economy: a healthy climate for growth and prosperity; supporting local business, new investment and global trade; and attracting and retaining human capital. The strategy's vision targets a high performing economy with thriving growth sectors, reinforcing Vancouver as both a destination and producer of global investment and talent. The anticipated outcomes of the document are to create jobs, cultivate innovation and promote responsible prosperity in Vancouver. The report was presented to Council in September 2011.

Transportation 2040

Transportation 2040 is a long-term strategic vision to guide future transportation, land use, and public investment decisions in Vancouver. It provides a blueprint for Vancouver to move forward, build upon past successes, and rise to meet new and emerging challenges. The plan establishes long-term targets to achieve this vision, with both high-level policies and specific actions providing further direction. These targets are aligned with transportation goals established within the *Greenest City Action Plan*, including: making the majority of trips on foot, bike, and transit; eliminating dependence on fossil fuels; and breathing the cleanest air of any major city in the

world. The City's transportation decisions are to reflect a hierarchy of modes for moving people, beginning with walking as the primary mode of transportation, followed by cycling, transit, taxi/commercial transit/shared vehicles, and finally private automobiles. *Transportation 2040* is part of the City's larger strategy to ensure an inclusive, healthy, prosperous, and livable future for all Vancouver's residents. The report was adopted by Council on October 31, 2012.

Vancouver's EV Ecosystem Strategy

The *EV Ecosystem Strategy* builds upon the City's experience with electric vehicles and formalizes its role in the expansion of charging options until 2021. As part of the *Renewable City Strategy,* the City of Vancouver committed to the development of an electric vehicle infrastructure strategy to support the transition towards renewable energy. The document's three goals are to improve access to charging infrastructure, to reduce the cost barriers associated with electric vehicle uptake, and to develop the electric vehicle market in support of private sector operation of charging infrastructure. The report was adopted by Council on November 16, 2016.

VanPlay Report 2: Goals to Shape the Next 25 Years

VanPlay is a policy document that sets the values and goals for current and future parks and facilities. The report assists the Vancouver Parks Board in determining service gaps, analyzing growth trends, and identifying opportunities for improvements. The document establishes ten goals intended to guide the provision of more equitable, accessible, inclusive, and resilient parks and recreation over the next 25 years. The goals were developed through public, staff and stakeholder input, in addition to best practice research from existing global precedents. The report was adopted by Council on July 9, 2018.

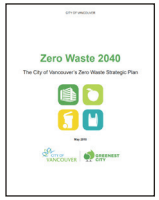
What Feeds Us: Vancouver Food Strategy

The *Vancouver Food Strategy* is a tool that will help the City of Vancouver meet its social, environmental, economic, and health goals. The strategy focuses on creating a just and sustainable food system for Vancouver. It builds upon years of food systems initiatives and grassroots community development, considering all aspects of the food system in the policy's directives. The report was adopted by Council on January 30, 2013.

Zero-Emissions Building Plan

The *Zero-Emissions Building Plan* details four strategies for mandating zero emissions buildings in all new construction by 2030. The four strategies employed by the plan include: establishing greenhouse gas and thermal energy limits, requiring municipal projects to demonstrate zero-emission approaches where viable, developing tools to catalyze the private sector, and building industry capacity through information sharing tools. These strategies were developed to ensure comfortable and healthy indoor environments, maximize economic development, ensure long-term building resilience, protect housing affordability and to help achieve targets within the *Renewable City Strategy*. The report was adopted by Council on July 12, 2016.

Zero Waste 2040



Zero Waste 2040 is a long-term strategic vision for achieving zero waste in Vancouver by 2040. The document guides future decisions and investments relating to solid waste by analyzing past successes of zero waste policies and programs. The plan includes forward looking policies and actions to help stimulate, support, and allow Vancouver to become a zero waste community. The timing of these actions varies, with some occurring right away while others are expected to progress over long periods of time. Focus areas for actions found within the document include: the built environment and residuals, food and residuals, products, the City leading by example, and enhanced and expanded City roles. The report was adopted by Council on May 16, 2018.

Local Area

West Point Grey Community Vision

The *West Point Grey Community Vision* is the result of a comprehensive, collaborative local planning process. The Community Visions Program was launched in 1997 in an effort to bring CityPlan to the neighbourhood level. This program involved communities working with City staff to create their visions for the future, based on CityPlan directions and community needs and aspirations. West Point Grey was the last of the nine community visions to be created alongside with CityPlan, being adopted by Council on September 23, 2010. The document identifies what people value and want to preserve, what improvements are needed, and how change should occur over the next 20 years. The City of Vancouver will use the vision to help set priorities for capital projects, direct civic programs and services, and make decisions affecting the community.

Site Specific

Green Buildings Policy for Rezoning

The *Green Buildings Policy for Rezoning* stipulates that all new buildings associated with a rezoning must be updated to be either near zero emissions or low emissions. The document provides developers with a choice of one of two paths to satisfy the policy's requirements. The first option requires that all new buildings are certified LEED Gold at a minimum. As an alternative, developers may also use the Passive House standard as an equivalent method in achieving building performance. The policy was adopted by Council on June 22, 2010, and most recently amended on May 2, 2018.

Rezoning Policy for Sustainable Large Developments

The *Rezoning Policy for Sustainable Large Developments* details how redevelopment sites of 1.98 acres or more are to achieve a higher level of sustainability. The intent of the policy is to accelerate sustainability goals through the scale of opportunity present on large sites. These developments are expected to demonstrate leadership in sustainable design by using an integrated design approach and employing district-scale solutions where appropriate. The policy requires submission of defined plans and studies to address eight objectives: sustainable site design, access to nature, sustainable food systems, green mobility, rainwater management, zero waste planning, affordable housing, and low carbon energy supply. The policy was adopted by Council on December 15, 2010 and most recently amended on July 25, 2018.

City of Vancouver

Case Studies

Large site redevelopment is an important factor in the development of cities globally, providing cities the opportunity to significantly alter their physical landscape while exploring new and innovative designs for development. This is especially true in terms of sustainability, as larger redevelopments present a unique chance to lessen the load on the surrounding environment and its associated resources while balancing growing urban populations. An opportunity unique to large-scale redevelopments is the use of district-wide systems that would otherwise be unavailable to smaller developments. Such systems, in addition to strong environmental regulations and design guidelines, can provide significant reductions in terms of greenhouse gas emissions. Opportunities to improve a city's economic prospects and social equity are also available through larger redevelopments.

To explore these ideas, a comprehensive review of large-scale redevelopments was undertaken to identify and detail global sustainability precedents that can be used to inform the redevelopment of the Jericho Lands. A total of 27 case studies were examined, with the final list consisting of 13 specific examples from municipalities around the world. These 13 examples were chosen for the prominence or ingenuity of their precedents, the accessibility of project information, and their relevance to the Jericho Lands. All of the cases explored are brownfield redevelopments with the exception of Wesbrook Village.

Each section follows a similar pattern. Sections begin with the redevelopment's name and location. This is followed by a sub-header that demonstrates the project's three primary areas of focus, which are based upon the City of vancouver's *Greenest City Action Plan* (GCAP) and the *Healthy City Strategy* (HCS) goal areas.

A brief description of the project's context and specific sustainability precedents are then provided alongside site-specific metrics. The metrics examined for each site include: area, density, land use, public amenities, existing relationships, ownership, and timeframe. These metrics were chosen to provide comparability between the various projects and to standardize the different measurements used.

Following each case study's title page, three existing sustainability precedents are detailed on the following pages. Each sustainability precedent is followed by an area of focus based upon the GCAP and the HCS goal areas.

C. Busch

Greenest City Action Plan Goals

Goal 1: Climate and Renewables	Goal 2: Green Buildings	Goal 3: Green Transportation	Goal 4: Zero Waste	Goal 5: Access to Nature
Goal 6: Clean Water	Goal 7: Local Food	Goal 8: Clean Air	Goal 9: Green Economy	Goal 10: Lighter Footprint

Healthy City Strategy Goals

Goal 1: A Good Start	Goal 2: A Home for Everyone	Goal 3: Feeding Ourselves	Goal 4: Healthy Human Services	Goal 5: Making Ends Meet and Working Well
Goal 6: Being and Feeling Safe and Included	Goal 7: Cultivating Connections	Goal 8: Active Living and Getting Outside	Goal 9: Lifelong Learning	Goal 10: Expressing Ourselves
Goal 11: Getting Around	Goal 12: Environments to Thrive In	Goal 13: Collaborative Leadership		

Map of Case Studies

Bahnstadt

Heidelberg, Germany

Focus Areas: Green Buildings, Lighter Footprint & Green Transportation

Bahnstadt is a large former freight and switch yard in Heidelberg, Germany. An urban redevelopment process was initiated for the site after it sat abandoned and decrepit for nearly a decade, re-envisioning the space as the world's largest zero-emission district. This ambitious goal would help achieve the city's target of 95% greenhouse gas reductions to 1990 levels by 2050 (Sustainia et al., 2015).

All structures built within the district comply with the Passive House standard to support the goal of a zero emission district. Bahnstadt employs stringent regulations in terms of building standards, rooftop vegetation, and non-motorized transportation to achieve the design standards. At 116 hectares in size, Bahnstadt will be the largest passive housing development in the world upon completion (Sustainia et al., 2015).

Bahnstadt has also established progressive housing and employment targets. The district is aiming to house upwards of 6,800 people. In terms of employment, it is expected that between 5,000 to 6,000 people will work at Bahnstadt, with emphasis being placed on occupations in science, technology, and medicine (CoH, 2017). It is estimated that a total of CAD$3 billion will be invested into the site's development through public and private investors (CoH, 2017).

(CoH, 2017)

Metrics	Area	Density	Land Use
	116 ha	5,682 residents/km^2; 5,172 workers/km^2	6800 residents; 6000 jobs; 22 hectare science campus

Amenities	Relations	Ownership	Timeframe
Mixed-use community centre; daycare; elementary school	City of Heidelberg	City of Heidelberg; Aurelis & Heidelberg	2008-2022

The Energy Concept of Heidelberg Bahnstadt

GCAP Goal 2: Green Buildings

Perhaps the most striking idea to emerge from Bahnstadt is the development of a showcase district that proves the feasibility of energy efficient buildings and a district energy supply on a large-scale redevelopment. All of the buildings within Bahnstadt are being constructed in accordance with the Passive House Standard, requiring dense insulation for walls and roofs and windows that retain as much heat inside the building as possible (C40 Cities, 2017). Each building's orientation to the sun is carefully considered to accommodate the maximum amount of solar passive heating (C40 Cities, 2017). A comprehensive ventilation system with accompanying heat recovery affords a high air quality and increases in energy efficiency (C40 Cities, 2017). When considered as a whole, the energy requirements for properties designed to the Passive House Standard are 50-80% lower than conventional residential buildings (CoH, 2017).

All Passive House developments must meet a minimum energy threshold of no more than 15 kWh per m^2 per year of energy overall (C40 Cities, 2017). To achieve this standard, it is important that all stakeholders discuss potential challenges and solutions for the project's construction, including municipal institutions, investors, developers, architects, engineers, and construction workers (C40 Cities, 2017). A post-occupancy evaluation of the energy consumption after the first two years of usage demonstrated that the energy demand of the residential buildings in Bahnstadt complies with the Passive House Standard and that resident's feedback was mainly positive (C40 Cities, 2017). In a follow-up survey, Bahnstadt residents indicated that they were very satisfied with their living conditions, the overall air quality, and the ambient temperatures in winter (CoH, 2017).

In accordance with the City of Heidelberg's goals, Bahnstadt aims to be fully supplied by carbon neutral energy. To do this, a large wood chip-powered combined heat and power plant was constructed as part of the neighbourhood to supply Bahnstadt with enough energy and heating to meet the entire district's demand, reducing the net carbon dioxide emissions of Bahnstadt to near-zero percent (Sustainia et al., 2015).

(CoH, 2019)

Environmental Protection Measures in Bahnstadt

GCAP Goal 10: Lighter Footprint

Several environmental protection initiatives have been carried out at Bahnstadt, including a sophisticated soil management scheme that was developed to reduce the impact of transportation to and from construction sites (C40 Cities, 2017). During construction, soil that was removed from construction areas was transferred to nearby on-site areas where no construction was going on, resulting in substantial fuel savings while minimizing the impact of construction on the surrounding population (C40 Cities, 2017).

A second issue that arose during construction was soil sealing, a problem that occurs when permeable areas are covered with impervious surfaces, impacting ground water retention and leading to increased runoff, resulting in water management issues. A rainwater management system was employed to account for this issue by maintaining the natural functions of the soil and increasing the proportion of rainwater allowed to evaporate (C40 Cities, 2017). This technique employs the use of green roofs, with two-thirds of all flat rooftops being equipped with greenery, dissipating 70% of all rainwater through plant storage and evaporation (C40 Cities, 2017). This is in addition to the 710 metres of interconnected waterways and ponds that collect and store excess rainwater. The remaining rainwater is then allowed to infiltrate back into the local aquifer at similar rates to natural conditions.

One side-effect of Bahnstadt's decade of abandonment is that a rich diversity of flora and fauna has entered into the area, including rare and protected species of lizards (C40 Cities, 2017). Prior to the start of the construction work, thousands of sand and common wall lizards were relocated to specially created habitats for their protection until after construction was completed, whereby they would be returned to the site (C40 Cities, 2017). Several areas within the district that are of ecological importance to local ecosystems are deliberately left undeveloped in the form of unmaintained natural space (C40 Cities, 2017). This habitat is further supplemented by the established green rooftops found throughout the district.

Generational behavior change is embedded into Bahnstadt through the Education for Sustainable Development program. The program is designed to teach children from an early age how their behavior can impact the environment (CoH, 2017). This initiative is supported by the popular series of events titled *Naturally Heidelberg*, which teaches parents and children the importance of nature and environment protection (CoH, 2017).

(CoH, 2019)

(CoH, 2019)

Transportation Networks

GCAP Goal 3: Green Transportation

Bahnstadt is well-integrated into the existing transportation network, with the district occupying a central location in Heidelberg that is adjacent to the main railway station that provides easy access to the city's public transportation network consisting of trams, buses and commuter rail (Sustainia et al., 2015). This is in addition to Bahnstadt's active effort to disincentivize the use of private vehicles and instead promote the use of sustainable modes of transportation amongst residents (Sustainia et al., 2015).

Bahnstadt has also developed a large carsharing fleet of electric vehicles for use by residents, with the plan to expand upwards of 1,800 electric vehicles by 2020. The primary method for travel among Bahnstadt residents remains the bicycle, an important part of how the City of Heidelberg will achieve its greenhouse gas reductions of 95% by 2050 (Sustainia et al., 2015).

1,800 electric carshare vehicles by 2020

Barangaroo South

Sydney, Australia

Focus Areas: Green Buildings, Cultivating Cultures & Clean Water

Barangaroo is a large-scale inner harbour redevelopment in Sydney, Australia. The site is centrally located within the region, lying directly adjacent to the downtown core of the municipality. At a total cost of CAD$5.5 billion, Barangaroo South and its accompanying Central and North counterparts are transforming the area into one of Sydney's most vibrant districts while also being Australia's first carbon neutral community (Landlease, n.d.).

Barangaroo South is being developed by the Barangaroo Delivery Authority (BDA), a public agency authorized by and working on behalf of the New South Wales State Government (BDA, 2017). Preceding the beginning of construction, the New South Wales State Government committed Barangaroo to the Climate Positive Development Program in 2009 (BDA, 2017).

A number of innovative sustainability measures have been developed to ensure Barangaroo South achieves its commitments to the Climate Positive Development Program. Extensive centralized infrastructure has been developed to lower the district's greenhouse gas emissions, including an innovative water-cooling network, recycled water treatment plants and on-site solar power energy generation (BDA, 2017).

(Landlease, n.d.)

Metrics	Area	Density	Land Use
	22 ha	7,272 residents/km^2; 104,545 workers/km^2	143,000 m^2 residential; 16,000 m^2 retail; 270,000 m^2 office

Amenities	Relations	Ownership	Timeframe
11 ha of public space; 2 km of waterfront; 6 ha of park	New South Wales Government; Landlease; Eora Nation	New South Wales Government	2012-2023

District Infrastructure

GCAP Goal 2: Green Buildings

To become Australia's first large-scale carbon neutral precinct, Barangaroo South has developed extensive centralized infrastructure to lower the district's greenhouse gas emissions, including an innovative water-cooling network, recycled water treatment plants and on-site renewable energy generation through the use of solar panels (Landlease, 2013a).

Air conditioning in Barangaroo South is provided to all buildings through a district cooling plant, which employs water from Sydney Harbour for heat rejection. The process works by filtering sea water through a series of screens, filters and strainers to protect and remove marine life, cooling this water through a series of refrigeration units, passing the cooled water by heat sources to absorb waste heat, and then subsequently returning the heated water to the harbour for recycling (Landlease, 2013a). A single, centralized cooling system lowers energy consumption and increases cost savings over having separate systems for each building. This system also avoids the use of drinking water for dissipating heat from buildings, reducing demand on local aquifers and water resources.

A decentralized solar power station has been constructed on the rooftops of various buildings within Barangaroo South. As decentralized solar power plants are comparable in efficiency, faster to bring online, and more cost-effective than utility-scale solar plants, they have become an attractive option for developers to install (Energy Matters, 2011). With over 6,000 square metres of on-site solar panels installed, these units collectively generate 1,000 mWh of electricity each year, enough to cover the energy demand for public spaces and waste water recycling facilities (Landlease, 2013a). The BDA is also exploring options for on-site low carbon energy generation within the district, such as opportunities for co-generation and tri-generation (Landlease, 2013a).

(Landlease, 2013)

The Eora Nation

HCS Goal 7: Cultivating Cultures

Barangaroo South is being developed on the traditional lands of the Aboriginal Cadigal people of the Eora Nation. In an act of reconciliation, the Barangaroo Delivery Authority has incorporated several measures that aim to benefit Indigenous Australians, and in particular people of the Eora Nation.

The effort begins with the name of the development itself – Barangaroo – which is in honour of a powerful Cammeraygal leader of the Eora Nation at the time of colonization (BDA, 2017). All of the official communications and supporting documentation for Barangaroo South includes the acknowledgement that "We acknowledge the Cadigal people of the Eora nation as the First Peoples and Traditional Custodians of this land. We offer our respect to their Elders both past and present."

Moving beyond written text, Barangaroo South aspires to provide cultural opportunities for people of the Eora Nation. An effort to showcase Eora artists has been made through the City of Sydney's project *The Eora Journey*, a walking trail which reasserts Aboriginal history while celebrating this ancient and living culture (City of Sydney, 2016). The *Barangaroo Public Art and Cultural Plan* provides for substantial opportunities to collaborate with future projects, including additions to *The Eora Journey* (BDA, 2015).

Economic opportunities are also being made available to Indigenous Australians. Barangaroo South aims to provide upwards of 500 jobs for Indigenous workers, with the development also investing in Indigenous enterprises to support their further expansion (Landlease, 2013a). Opportunities for on-the-job training and mentorship will be provided to Indigenous workers with the aim of promoting Indigenous engagement within the project team (Landlease, 2013b). Further engagement amongst non-Aboriginal team members will include providing Aboriginal cultural and historical awareness through inductions, events and educational material (Landlease, 2013a).

500+ Indigenous workers will be involved on the project

(Landlease, n.d.)

Water Positive Precinct

GCAP Goal 6: Clean Water

Barangaroo South aims to be a water positive precinct, meaning the district is designed to export more recycled water than the potable water it uses. This is achieved through a five-step approach to water management: avoid, reduce, reuse, recycle and export (Landlease, 2013a).

To avoid water use, Barangaroo South replaces cooling towers with harbour water heat rejection. The centralized chilled water plant is designed to support the cooling systems for all of the buildings at Barangaroo South. Once the development is complete, the harbour water cooling system has the potential to save upwards of 100 million litres of water per year, in addition to significant energy savings (Landlease, 2013a). As Lendlease anticpates that up to 500,000 litres of potable water will be used per day at Barangaroo South, this system will save the equivalent of 200 days' worth of drinking water, amounting to a dramatic 55% reduction overall (The Guardian, 2016).

100 million litres of water per year in water savings

To reduce water use, the district looks to green building standards and water efficient appliances combined with education and behavioural initiatives. Education efforts led by the BDA will focus on the use and over use of water amongst all of the development's patrons, including workers, building managers, residents and visitors.

In reusing water, Barangaroo South captures rainwater and repurposes it for other uses. Stored rain and treated water is used for flushing toilets, irrigation, cleaning outdoor surfaces and fire suppression. An advanced water re-use system captures, stores and re-uses rainwater for the irrigation of the local park Barangaroo Reserve (Landlease, 2013a). The two tanks beneath the park's surface can hold up to 1.4 million litres of water collectively (Landlease, 2013a).

In recycling water, a localized treatment plant supplies recycled water to the site. Upon completion, the water recycling system will be capable of processing 1 million litres of water each day to the district and surrounding suburbs (Landlease, 2013a). Recycled water is exported at a greater rate than that which the district uses for potable water. This has the benefit of reducing demand on local aquifers and water resources in a region that has faces ongoing drought concerns.

(Utility Magazine, 2018)

Dockside Green

Victoria, Canada

Focus Areas: Green Buildings, Green Economy & Clean Water

Dockside Green is the largest development in Victoria's history, involving the reclamation and redevelopment of 12 hectares of formerly industrial waterfront property. The site has been envisioned as a quaint seaside neighbourhood that creates economic opportunities while promoting environmental responsibility and healthy, vigorous and dynamic urban living. It is also intended to act as a global showcase for large-scale integrated sustainable development, being one of the first developments to be awarded LEED for Neighbourhood Development (LEED ND) Platinum.

Dockside Green has been described as a model for holistic, closed-loop design (Atlantic, 2011). The development has been designed to function as a total environmental system in which form, structure, materials, mechanical and electrical systems are connected and interdependent. As such, the waste produced by one sector of the community will be used as fuel for another sector, creating a largely self-sufficient, sustainable community. This dynamic environment is one where residents, employees, neighbouring businesses and the broader community continually interact in a healthy and safe environment. In recognition of this, Dockside Green has been recognized internationally by C40 Cities as a model Climate Positive Development (C40 Cities, 2019).

(Dockside Green, 2014)

Metrics	Area	Density	Land Use
	12.1 ha	20,661 residents/km^2	2,500 residents; commercial centre with office space

Amenities	Relations	Ownership	Timeframe
Greenway; wastewater treatment plant; district energy facility	City of Victoria; Songhees Nation	Dockside Green Limited	2005-2027

Leadership in Energy and Environmental Design for Neighbourhood Development

GCAP Goal 2: Green Buildings

Dockside Green is one of the world's first developments to be awarded the LEED ND Platinum designation under the Leadership in Energy and Environmental Design (LEED) program, a globally recognized rating system for sustainable development and construction. The developers of Dockside Green were the first to apply for the LEED ND program in 2007 (Atlantic, 2011).

The fourth iteration of LEED ND was released in 2018 and is built around contextualizing projects in relation to their environments, incorporating principles of sustainable growth, new urbanism, and green building processes and technologies into the certification. A LEED ND designation for Dockside Green signifies that the project is working to protect and enhance the overall health of the natural environment and the quality of life for residents within and around the community.

At present, Dockside Green has achieved LEED ND Platinum for every element of its first two phases, with five more to go (Dockside Green, 2019a.) Dockside Green Limited remains committed to completing a LEED certified neighbourhood as the development moves forward, working with the developers of future phases to ensure that all buildings meet the project's standards.

Achieved LEED ND Platinum for every element of its first two phases

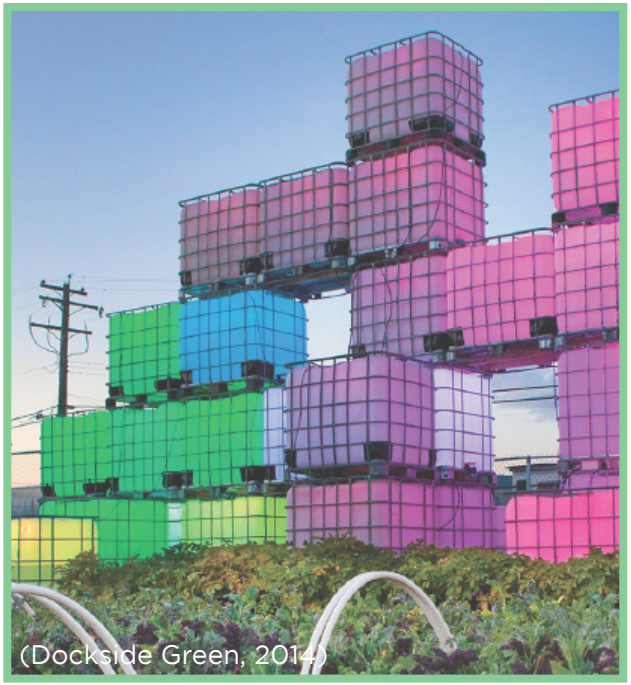
(Dockside Green, 2014)

BETA at Dockside Green

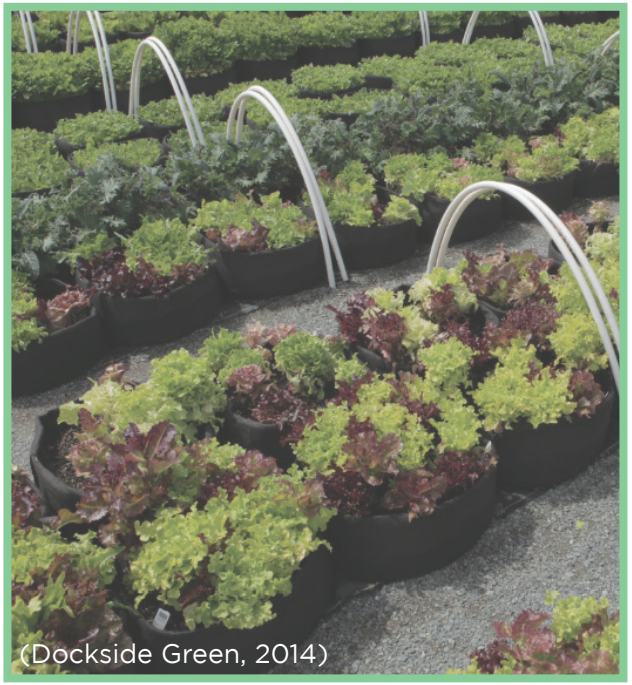
GCAP Goal 9: Green Economy

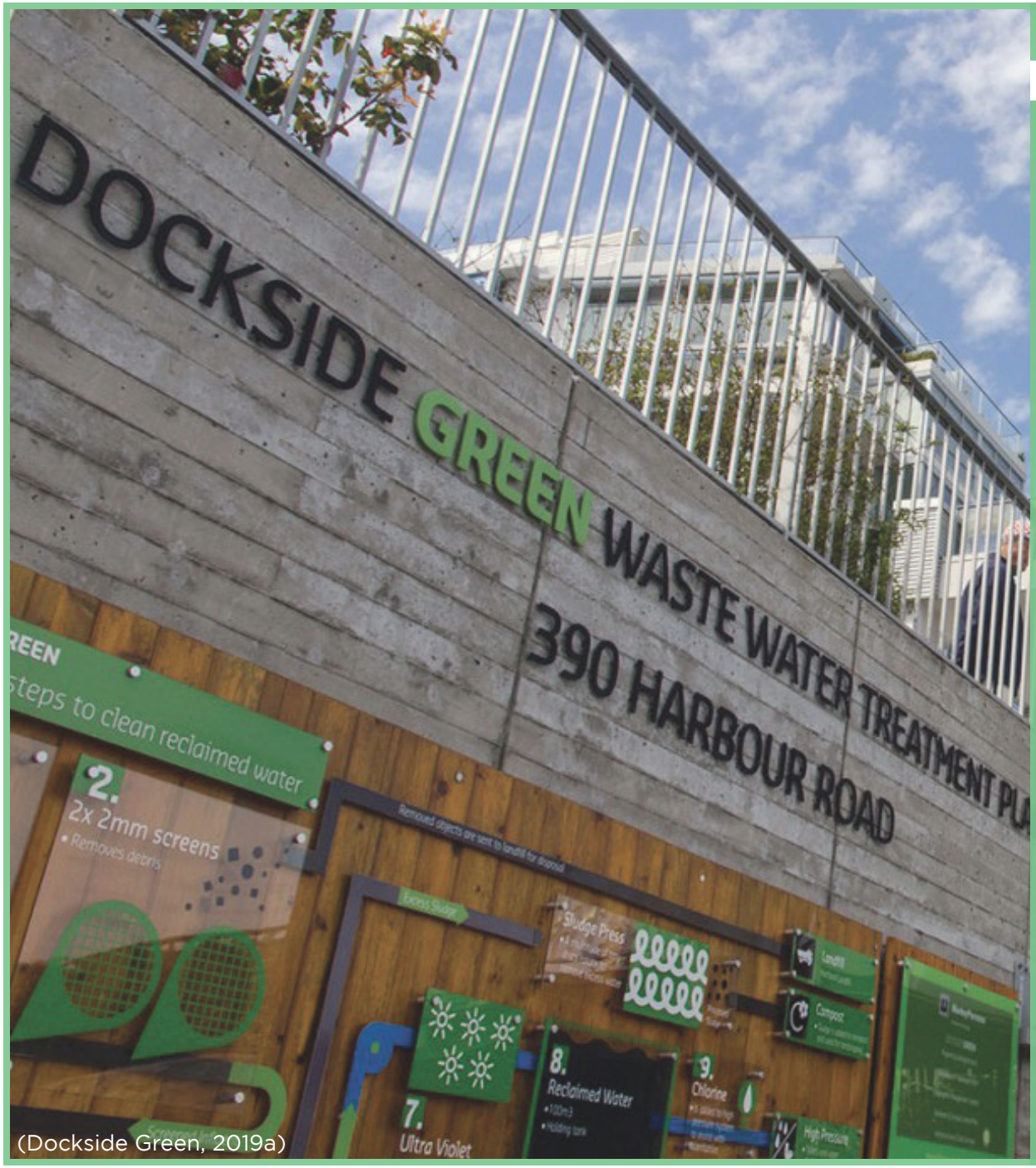
The developer of Dockside Green has expressed an interest in economic sustainability and an aim of fostering a vibrant local economy that provides opportunities to work, create and learn close to home. To achieve this, the developer intends to deliver a feasible plan that leverages existing resources and measures success against long-term financial metrics. Commercial areas within Dockside Green are intended to connect to nearby communities and have a positive impact on the economic well-being of the overall community. Dockside Green also supports local initiatives beyond those on-site, including the purchase of products and services amongst local business. This has the added benefit of supporting local employment and post-secondary education through collaborations with local learning institutions that provide education and training opportunities.

Consistent with Dockside Green's commitment to fostering a vibrant local economy, BETA at Dockside Green (BETA) is a new concept developed through community dialogue that seeks to temporarily transform a portion of the undeveloped project site to support local creative enterprise (Dockside Green, 2019b). BETA works by activating undeveloped land at Dockside Green as temporary space for activities that support the community in place today, with the repurposed areas being developed in later phases. BETA has since gone on to provide the staging ground for activations with local and community based organizations to showcase their work. This includes providing space for several initiatives, including: ThinkCubes, an interactive art installation; Thinklandia, Victoria's largest arts and culture event; and an urban agriculture initiative from local startup Topsoil (Dockside Green, 2019b).


(Dockside Green, 2014)

(Dockside Green, 2014)


(Dockside Green, 2014)



(Dockside Green, 2019a)

Water Management

GCAP Goal 6: Clean Water

Wastewater management and treatment at Dockside Green is completed on-site at the wastewater treatment plant. This new facility was created to treat and filter all of the sewage and gray water generated by residents and commercial tenants of Dockside Green (Dockside Green, 2019a). The plant employs membrane bioreactor technology with nutrient removal which produces UV-disinfected reclaimed water with very low levels of total suspended solids, biological oxygen demand and nutrients (McDonald, 2014). The residual reclaimed water is then reused on-site for toilets, rooftop garden irrigation, and for landscape irrigation (McDonald, 2014).

Stormwater collected on-site at Dockside Green is either absorbed by rain gardens or directed into a local watercourse through permeable paving and exposed drainage routes (Dockside Green, 2019a). The developer's intent behind this design is to allow residents and visitors to become aware of how water moves and is collected throughout Dockside Green. At its terminus, the watercourse flows into Victoria's Upper Harbour.

Fishermans Bend

Melbourne, Australia

Focus Areas: Healthy Human Services, Green Economy & Getting Around

Fishermans Bend is Australia's largest urban renewal project, covering approximately 485 hectares of land in the heart of Melbourne. Fishermans Bend is comprised of five precincts across two municipalities – the City of Melbourne and the City of Port Phillip – connecting Melbourne's central business district to Port Phillip Bay (VSG, 2019).

The transformation of Fishermans Bend is guided by the *Fishermans Bend Framework,* a plan developed by the Victoria State Government detailing civic services, facilities and infrastructure that will ensure a high livability as the district grows over the next 30 years into a thriving place that is a leading example for environmental sustainability, livability, connectivity, diversity and innovation (VSG, 2017). Embedded within the framework are eight sustainability goals that together form the basis for strategy development and implementation. The *Fishermans Bend Framework* was developed through an extensive engagement process with the community and project stakeholders, with further support provided by a suite of research reports, strategies and plans.

The Fishermans Bend Development Board, a ministerial advisory committee, will guide the planning and development of this landmark project for Melbourne, with support provided by the Fishermans Bend Taskforce, a group within the Victoria State Government (VSG, 2019).

(VSG, 2018)

Metrics	Area	Density	Land Use
	485 ha	16,495 residents/ km^2; 16,495 workers/ km^2	250 ha medium to high density, mixed-use development

Amenities	Relations	Ownership	Timeframe
Educational facilities; multi-purpose health, arts, sports and community hubs	City of Melbourne; City of Port Phillip; Victorian Traditional Owners	Victoria State Government; private developers	2012-2050

An Inclusive and Healthy Community

HCS Goal 4: Healthy Human Services

The *Fishermans Bend Framework* describes an inclusive and healthy community as one which invites a diversity of people and supports them in having a high quality of life. This is important for increasing community participation and sense of belonging, community resilience and individual health and wellbeing (VSG, 2018).

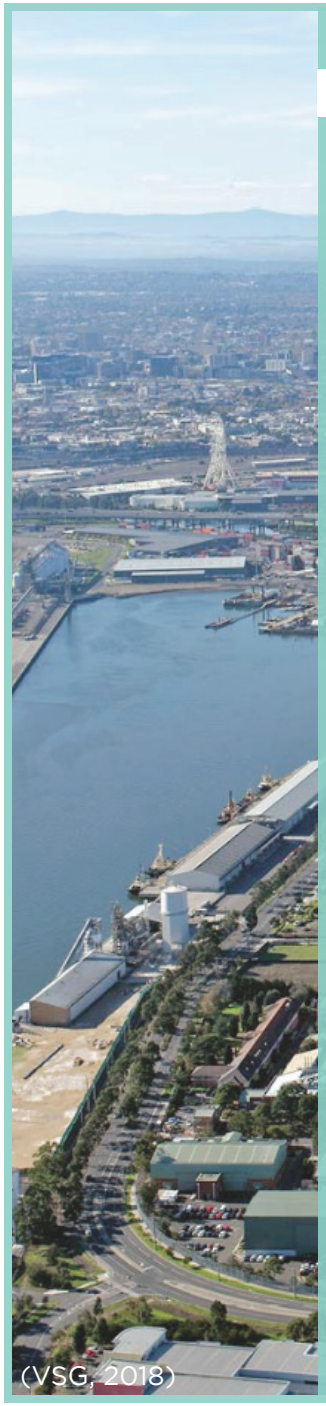
Fishermans Bend will be a community for people of all ages and backgrounds supported by a range of housing options for different living arrangements and household incomes, including a minimum six per cent affordable housing across the district (VSG, 2018). This will include a range of affordable housing models, typologies, and occupancies, from short-term crisis accommodation to long-term secure housing for people with special needs, the aged and key workers employed in essential services (VSG, 2018). To accommodate this, collaboration between all levels of government, private industry and the not-for-profit sector will be required, with a new social housing uplift scheme guiding the deployment of social housing across Fishermans Bend (VSG, 2018).

Community facilities play an important role in supporting residents' creativity, collaboration, social cohesion and learning. Community services such as schools, health services, meeting spaces, library services, sporting facilities and public space will ensure that people have opportunities to lead healthy lives (VSG, 2017).

Fishermans Bend will coordinate the district's infrastructure to support its growing community, with the development of an *Infrastructure Contributions Plan* facilitating this process (VSG, 2018). Partnerships between government, private sector and not-for-profit organizations will be the primary model for delivering community infrastructure in Fishermans Bend. Key design requirements and specifications for different types of community facilities will be developed in collaboration amongst project partners to ensure they fit the desired purpose and are adaptable (VSG, 2018).

Minimum 6% affordable housing across the district

(VSG, 2018)



(VSG, 2018)

A Prosperous Community

GCAP Goal 9: Green Economy

Fishermans Bend will promote a diverse array of employment and education opportunities through the support of local and regional jobs across a range of sectors and complemented by education and training opportunities (VSG, 2017). Opportunities for commercial and creative industries will be actively preserved to ensure that a balanced mix of land uses is provided, reinforcing the district's existing connections to Melbourne's central business district and the Port of Melbourne (VSG, 2017).

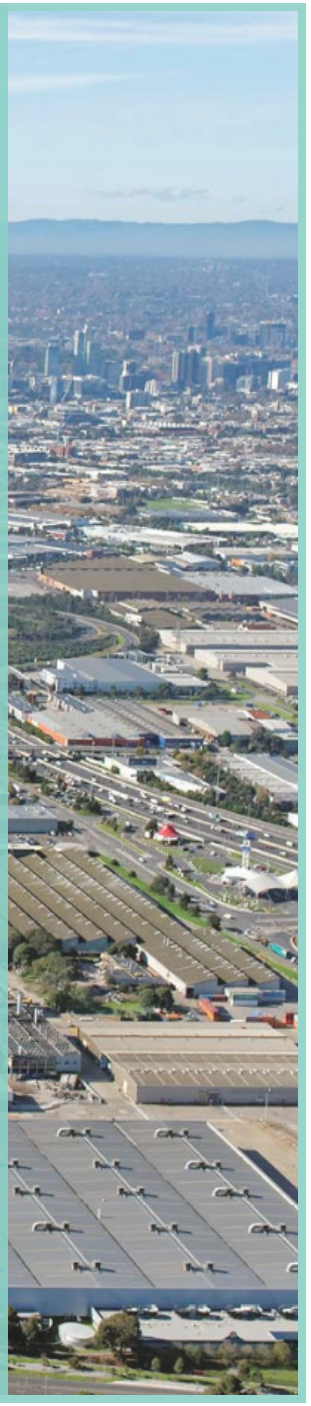
The objectives and strategies outlined in the *Fishermans Bend Framework* will encourage the development of a range of economic activities within the district's precincts. This will include space for office facilities, creative industries and innovation hubs, in addition to traditional street retail, hospitality strips, and residential uses (VSG, 2018). The retention of select industrial buildings will help to facilitate this economic transformation through the adaptive reuse of space, providing a reference point to the district's past.

As a neighbour to the Port of Melbourne - Australia's largest container port – Fishermans Bend will aim to protect the viability of its operations, ensuring the facility remains a significant generator of jobs and economic prosperity for Victoria and Australia (VSG, 2018).

High capacity and high speed data connections are being provided to the community and businesses to connect them with the global economy (VSG, 2018). Smart technologies within the district will also enable the real time control of infrastructure – improving services, boosting efficiency, maximizing capacity and minimizing faults (VSG, 2018).

The inclusion of a 230-hectare Employment Precinct within Fishermans Bend will provide a unique opportunity to create 21st century jobs centered on innovation, entrepreneurship and excellence in manufacturing and design (VSG, 2018). The Victoria State Government's purchase of a former manufacturing site within Fishermans Bend is intended to catalyze development within the district, transforming the Employment Precinct into Australia's leading design, engineering and technology district. Small-scale tenants, urban manufacturers, creative industries and start-ups will also be central to the success of the Fishermans Bend's Employment Precinct, complementing the area's larger tenants and research institutions.

As of 2050, Fishermans Bend will aim to: host up to 80,000 jobs, have strong economic resilience and diversity, provide high capacity internet across the district, ensure the viability of the Port of Melbourne, have several universities establish campuses within the district, and have the Employment Precinct as an internationally renowned centre for innovation in design and manufacturing (VSG, 2018).



A Livable Community

HCS Goal 11: Getting Around

Creating a livable community, one where people can live, work and study in an environment that supports their general wellbeing and makes life enjoyable, is a core concept for Fishermans Bend (VSG, 2017). A holistic approach to livability has been adopted across the district with the aim of providing workers and residents alike with a sense of community and connection to place (VSG, 2018).

Mixed-use districts are foundational to the development of sustainable cities through the locating of jobs, homes, shops, entertainment and community services near one another, creating walkable, accessible neighbourhoods. Additionally well-designed buildings that contribute to the distinct character of the neighbourhood, providing ample civic amenities while including sustainability measures, will be critical to the neighbourhood (VSG, 2018). Overall densities in Fishermans Bend will be carefully managed through the *Fishermans Bend Framework* to ensure that the area is not over-developed through the combination of dwelling densities and height controls (VSG, 2018).

Three livability targets were established within the *Fishermans Bend Framework*: a focus on community interaction, acknowledgment of the district as a place of architectural excellence, and a successful activity core for businesses to thrive and meet residents' everyday needs (VSG, 2018). From these targets, several objectives were created, including: focusing on access to public spaces and community facilities, incorporating new development to existing and future infrastructure and land uses, creating distinctive mixed-use neighbourhoods that foster social cohesion, ensuring housing options for families with children, aligning the provision of infrastructure and amenities with density, delivering a diverse range of housing choices, and designing buildings to protect internal amenities and deliver a high-quality public realm (VSG, 2018).

(VSG, 2018)

HafenCity

Hamburg, Germany

Focus Areas: Climate and Renewables & Green Buildings

HafenCity is a large-scale harbour redevelopment in Hamburg, Germany. The district is located on former Port of Hamburg land, just south of the city centre. HafenCity will reclaim 157 hectares of land along the Elbe River, expanding the physical boundary of the City of Hamburg by 40% (HafenCity, n.d.). As a result of its large size, HafenCity has the potential to definitively impact Hamburg.

In acknowledgement of the project's significance to Hamburg and Germany, HafenCity aims to act as a role model for future large-scale developments through its high prerequisites for sustainable and resilient urban development (HafenCity, n.d.). The development of HafenCity is also considered to be an important example for revitalizing public spaces through the regeneration of abandoned inner-city areas (HafenCity, n.d.).

HafenCity focuses on mixed-use neighbourhoods and the synergies resulting from proximity to promote social, economic and environmental sustainability (HafenCity, n.d.). Public places within HafenCity encourage social and cultural interactions between residents, employees and visitors. Public spaces account for 25% of the land area in HafenCity, with an additional 13% consisting of private open spaces which are publicly accessible, including squares, parks, sidewalks and boulevards (HafenCity, n.d.).

(HafenCity, n.d.)

Metrics	Area	Density	Land Use
	157 ha	11,000 people/km^2; 35,400 people/km^2	880,000 m^2 residential; 880,000 m^2 commercial; 380,000 m^2 institutional
Amenities	**Relations**	**Ownership**	**Timeframe**
Concert hall; museums; universities; 27 ha public open space	City of Hamburg	HafenCity Hamburg GmbH	1997-2025

Flood Protection

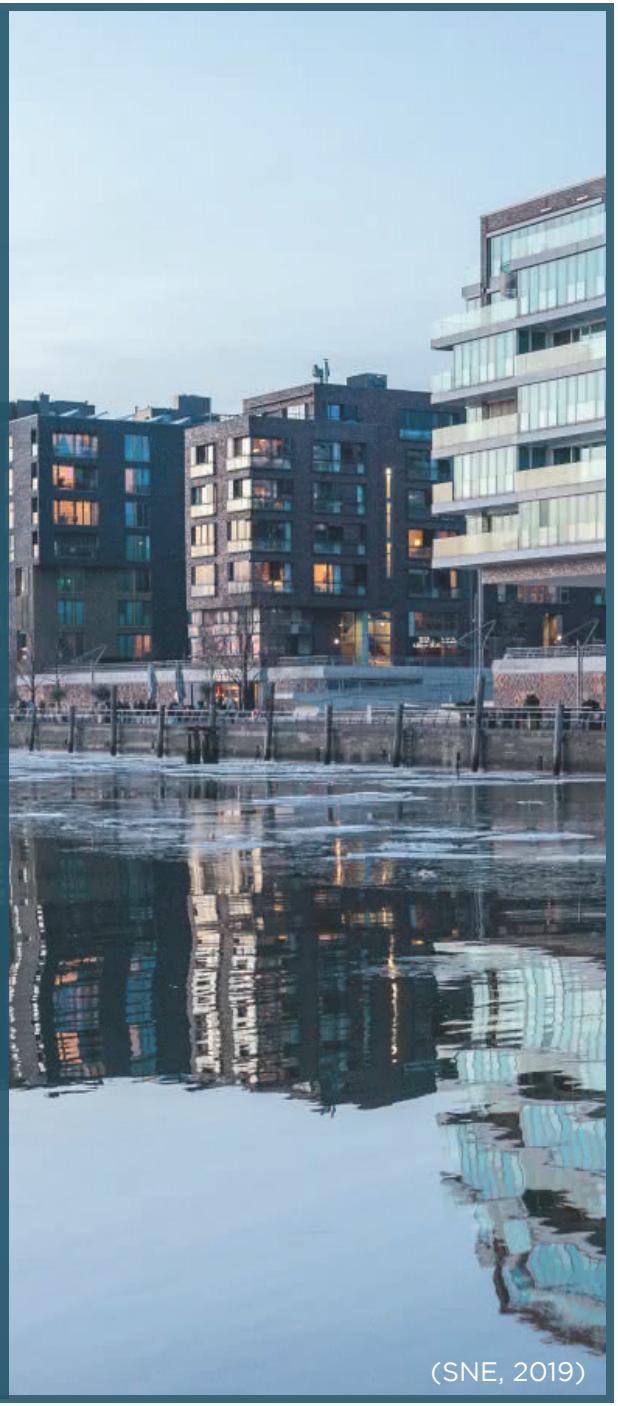
GCAP Goal 1: Climate and Renewables

As a result of the district's location on the Elbe River, a new flood protection concept was developed for HafenCity that requires all buildings to be built upon artificially structured pedestals that are raised 8 to 9 metres above sea-level (HafenCity, n.d.). Setting buildings to this height assures protection to both residents and developers from even the most extreme high-water events. These podiums are then connected to one another through a series of streets and bridges, allowing for travel around the district. Importantly, HafenCity's street infrastructure has also been developed to flood-protected levels, sitting between 7.8 and 8.5 metres above sea-level (HafenCity, n.d.). Doing so ensures that traffic can remain functioning and uninterrupted within the district even during the most intense storm surges.

All buildings in HafenCity are arranged 8 to 9 metres above sea-level

Effort has gone into infrastructure that is both cost-efficient and multifunctional in HafenCity. To accommodate the public along the waterfront, promenades by the water remain at the previous lower level of the port, allowing residents, local employees and visitors to enjoy the water and the associated views (HafenCity, n.d.). At the same time, the lower level of the promenades provides an overflow surface for flood waters to accumulate and be reabsorbed into the ground, helping to reduce the peak flood levels by extreme weather events (HafenCity, n.d.). Areas below buildings function as space for parking vehicles, with additional flood protection measures implemented to protect vehicles during storm surges (HafenCity, n.d.). Bringing vehicles below the surface reduces the amount of parking required on streets and opens the roadways for greater vehicle movement.

A co-benefit of the flood protection concept is a reduction of the urban heat island effect. This is caused by the vicinity of buildings to ocean water, cooling the climate and resulting in a reduced need for air-conditioning and increased comfort for people in the district (HafenCity, n.d.).



(SNE, 2019)

HafenCity Ecolabel

GCAP Goal 2: Green Buildings

Since 2007, the developer of the district - HafenCity Hamburg GmbH - has been awarding the HafenCity Ecolabel for outstanding and special accomplishments in the construction of sustainable buildings (HafenCity, n.d.). As the first certification system of its kind in Germany, the label has been made a condition for all developments within HafenCity since 2010.

There are four steps required to be granted the HafenCity Ecolabel. First, developers must meet with HafenCity Hamburg GmbH to establish concrete goals for sustainability in five categories, achieving platinum status in three. Following this, an evaluation by an independent institute is commissioned by HafenCity Hamburg GmbH to ensure compliance with the pre-established sustainability goals. Once the completed building is fully operational, independent consultants prepare an inspection report. To conclude the process, an energy inspection is required one year later, with efforts to rectify any target levels that are not achieved.

Recent updates to the HafenCity Ecolabel have brought the certification in accordance with the Germany Sustainable Building Council's standards. Additional specifications were added regarding electric mobility, increased solar energy entrapment, and additional building lifecycle approaches, while extending energy monitoring to all building types (HafenCity, n.d.).

As of 2019, the certification has been granted to 36 buildings in HafenCity out of a total of 68 (HafenCity, n.d.).

(HafenCity, n.d.)

(Wikipedia, 2018)

HafenCity's Energy Concept

GCAP Goal 1: Climate and Renewables

HafenCity's energy concept makes use of potential energy synergies, including remote and local district heating sources, to complement each other for an effective energy mix.

The heating supply of HafenCity is provided by a cogeneration-based district heating network and supplemented by solar thermal power. In total, over 1,800 square metres of solar thermal systems have been installed on rooftops in the western neighbourhoods of HafenCity, providing over 40% of the hot water requirements for those neighbourhoods (HafenCity, n.d.). This is in addition to the district's power plants that utilize steam turbines to provide an efficient mix of energy while reducing overall carbon dioxide emissions. Together, these efforts have reduced carbon dioxide emissions in western HafenCity to a rate of 240 g/kWh, a significant reduction in comparison to the national average of 560 g/kWh (HafenCity, n.d.).

The eastern portion of HafenCity utilizes a decentralized, modular approach to local heating supply that is designed to grow in tandem with the development over time. This concept is operated by Enercity, a Hanover public utility subsidiary, and features substantial use of renewable and decentralized geothermal energy, producing 92% of all power through renewable sources within eastern HafenCity (HafenCity, n.d.).

In future, waste process heat from a local copper refinery will be diverted and used to supply eastern HafenCity with additional heating, producing no additional carbon dioxide pollution as a result. Thanks to this unique heating supply network, eastern HafenCity has been able to reduce carbon dioxide emissions to a rate of only 89 g/kWh (HafenCity, n.d.).

92% of all power from renewable sources

(HafenCity, n.d.)

Hammarby Sjöstad

Stockholm, Sweden

Focus Areas: Climate and Renewables, Lighter Footprint & Green Buildings

Hammarby Sjöstad is a 160-hectare district built atop a former industrial site located on the south side of Hammarby Sjö, a watercourse that connects Stockholm City Centre to the Baltic Sea (ITDP, 2011). The site is globally recognized for its integrated approach to district planning, which incorporates sustainable resource use, ecological design and low-carbon transport together within the site's design (ITDP, 2011).

The origin of the redevelopment can be traced back to Stockholm's bid to host the 2004 Summer Olympics. Hammarby Sjöstad was initially envisioned as part of an ecological Olympic Village that would form the foundation of 'Europe's First Green Capital' (ITDP, 2011). Although Stockholm did not win the bid to host the Olympics, planning moved forward and construction of the project began in 1999 (ITDP, 2011).

Hammarby Sjöstad demonstrates how high environmental targets can be met on a large-scale redevelopment through effective planning, significant investment in infrastructure, and a focus on green building standards.

(Study in Sweden, n.d.)

Metrics	Area	Density	Land Use
	160 ha	17,187 residents/km^2; 6,876 workers/km^2	900,000 m^2 residential; 250,000 m^2 retail and office

Amenities	Relations	Ownership	Timeframe
Library; cultural centre; childcare facilities; 30 ha park space	City of Stockholm	City of Stockholm; private developers	1999-2025

‘Twice as Good’ Environmental Goals

GCAP Goal 1: Climate and Renewables

Hammarby Sjöstad has developed a list of environmental goals that aim to be ‘twice as good’ as the highest standards for sustainability currently available. This establishes strong environmental goals that work to push the development’s sustainability objectives forward.

Taking inspiration from relevant environmental directives of the early 1990s – including the United Nations’ Brundtland Report and Agenda 21 - the City of Stockholm wanted to create a sustainable urban district in Hammarby Sjöstad. In light of this, an ambitious vision for Hammarby Sjöstad was developed, stating that the environmental performance of the district should be ‘twice as good’ as the state of the art technology available in the present day construction field (CDBC, 2015). The vision further stipulated that operational goals must continue to evolve in this specific direction in order to remain relevant (CDBC, 2015).

An Environmental Program was adopted by the Stockholm City Council in 1996 following completion of the district’s vision (CDBC, 2015). The environmental goals established within the Environmental Program are multi-faceted, covering urban form, transportation, energy and resources (CDBC, 2015). The overall goal for Hammarby Sjöstad was to reduce district emissions by 50% to comparable housing areas from the early 1990s (CDBC, 2015). Additional operational goals developed by the City Planning Administration included: energy, transportation, material flows, water and drainage, building materials, land use, contaminated soil, lake restoration, and emissions and disturbances (CDBC, 2015).

With these goals in mind, the City of Stockholm formulated several development strategies for the district, including: reusing developed land, locating new development in areas with good access to public transportation, respecting and enhancing the character of the city, redeveloping regional town centres and transforming industrial areas, and aiming to develop in accordance with local demand (CDBC, 2015).

(UNCTAD, 2013)

(Ignatieva, 2014)

Environmental Load Profile

GCAP Goal 10: Lighter Footprint

The second key lesson to arise from Hammarby Sjöstad was the development of the Environmental Load Profile (ELP). The ELP was developed as an assessment tool that monitors and provides feedback on the environmental performance of the built environment (CDBC, 2015).

The ELP is a mechanism to ensure that the district's 'twice as good' environmental goals were being accomplished. The ELP defines relevant activities from an environmental perspective and quantifies the environmental loads from these activities (CDBC, 2015). Two concepts were foundational in the development of the tool: environmental systems analysis (ESA) and life cycle assessment (LCA). ESA is a methodology aimed at analyzing, interpreting, and simulating complex environmental problems from different perspectives (CDBC, 2015). LCA is a proxy measure used to evaluate the total environmental impact of the whole life-cycle of a product, process, or activity (CDBC, 2015).

The computerized tool takes into account several inputs, including: individual activities (such as cooking or laundry); buildings (such as domestic heating and commercial electricity); unbuilt real estate area; and materials and transport (such as materials, personal transport, and the transportation of goods) (CDBC, 2015). From these inputs, the system records information on emissions, soil pollutants, waste, and the use of water and non-renewable energy resources on site (CDBC, 2015). Once each of these elements have been collected and calculated, a number is provided that details the environmental load for a district.

The value provided by the ELP is that it provides an understanding of the energy input required for a whole city district and not just the individual buildings or properties within it. The ELP also provides a metric to evaluate whether policy goals are being achieved, providing a useful tool for urban planners and developers to assess the environmental performance of the built environment. In application, the ELP demonstrates how local governments can plan for and monitor the most suitable societal and financial environmental measures to guide the development of a district.

The Hammarby Model

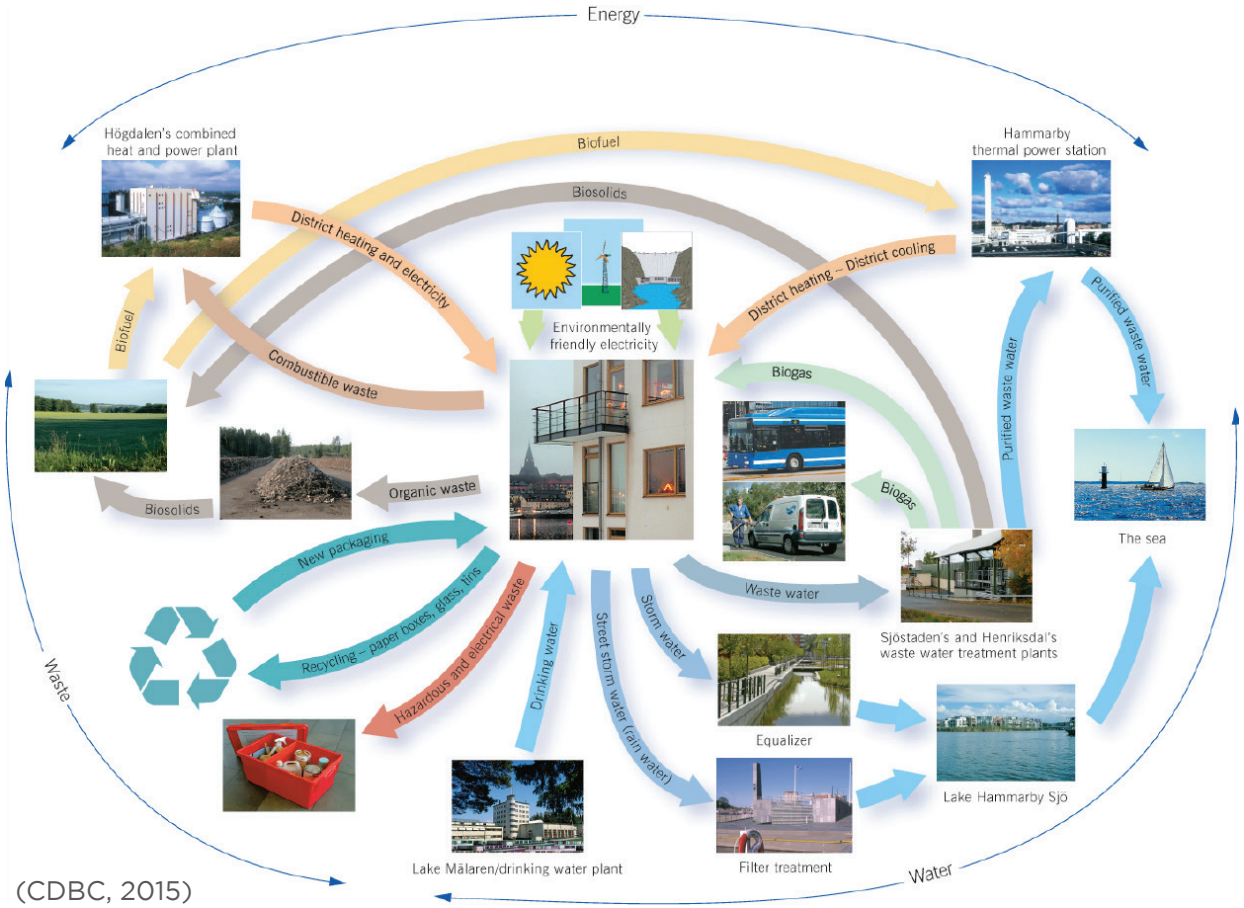
GCAP Goal 2: Green Buildings

The Hammarby Model is a closed-loop system incorporating housing, offices and other commercial structures into an integrated system that reduces the amount of energy and resources needed to maintain the overall system (CDBC, 2015). The model optimizes the use of resources by feeding the energy, waste, and water systems into one another, thereby minimizing waste by streamlining infrastructure and service systems to achieve achieving sustainability objectives (CDBC, 2015). Each of the three systems employs a series of scaled solutions, ranging from individual homes to the district writ-large.

The waste cycle uses waste that is transported through a series of underground pipes and converts it to energy. Waste to energy flows vary depending on the specific waste: organic waste is used for the production of biogas and fertilizer, combustible waste is provided for district heating and electricity, recyclable material is recycled, and hazardous waste is either incinerated or recycled (CDBC, 2015). Waste is managed at three separate levels in Hammarby Sjöstad: property-based sorting for the bulk of household waste, block-based recycling rooms for packaging, bulky waste and electrical waste, and area-based collection stations for hazardous waste and chemicals (CDBC, 2015).

The energy cycle focuses on connecting the different energy sources into a single comprehensive network. The district system actively manages the import of externally produced energy entering Hammarby Sjöstad with the energy that is produced within the district depending on current demand (CDBC, 2015). This includes energy produced from the local heat and power plant in addition to the biogas production.

The water cycle integrates the management of rainwater, wastewater, and sewage into one system. Rainwater from yards and roofs is collected and drained into Hammarby Sjö, while rainwater from streets is treated using settling basins and then drained into the watercourse (CDBC, 2015). Onsite sewage is addressed through a local wastewater treatment plant that employs anaerobic digestion methods to extract biogas from sewage sludge and fertilizer from residual material (CDBC, 2015). Water consumption within the district is further reduced through the use of low-flush toilets and tap aerators (CDBC, 2015).



(CDBC, 2015)

Kalasatama

Helsinki, Finland

Focus Areas: Environments to Thrive In, Lighter Footprint & Green Economy

Kalasatama is 175-hectare former harbour and industrial area northeast of the city centre of Helsinki, Finland. The district presents itself as a platform for urban innovation, aiming to develop smart urban infrastructure and services alongside future-oriented organizations. The overall aim of Kalasatama is to give back to residents one hour per day through the intelligent management of resources and innovative projects within the district (Nordregio, 2018).

Kalasatama has gained international attention for its efforts to become a model smart city. The district will support the City of Helsinki's vision of becoming carbon neutral by 2035 through the application of innovative and experimental projects (Sustainability Times, 2019).

Kalasatama functions as a living lab, operating several innovative projects within the district. To get a project approved in Kalasatama, its proponents must demonstrate how it contributes to freeing up an hour of time for residents to spend on their lives (Sustainability Times, 2019). Spaces such as the Kalasatama Urban Lab provide opportunities for residents, companies, city officials and researchers to collaboratively create smart and clean urban infrastructure and services (Nordregio, 2018). At present, the smart platform has already produced 25 innovative infrastructure and building projects (CoH, n.d.).

(Rakennusleti, 2018)

Metrics	Area	Density	Land Use
	175 ha	14,285 residents/km^2; 5,714 workers/km^2	1,200,000 m^2 residential; 400,000 m^2 commercial

Amenities	Relations	Ownership	Timeframe
Health and well-being centre; 6 km waterside promende	City of Helsinki	City of Helsinki	2009-2040

Time Savings

HCS Goal 12: Environments to Thrive In

As time is often considered by many to be one's most precious resource, Kalasatama has developed an interesting concept that prioritizes and signifies the importance of personal time. Created collaboratively between residents and the project stakeholders, the vision for Kalasatama is that, though efficient time management, all residents gain an extra hour of free time every day (CoH, n.d.).

Innovative smart services are being developed and implemented across the district to improve both the quality of life and time management (CoH, n.d.). Time that would otherwise be used for trivial tasks - such as queuing up, grocery shopping and commuting - are being streamlined and increased in efficiency. Time savings will result primarily through logistic improvements, including: improvements to traffic flow and logistics, as well as providing flexible facilities for remote working (CoH, n.d.). The extra hour earned each day by residents can be spent on time with family and friends or recreational activities.

(Smart Kalasatama, n.d.)

(Smart Kalasatama, n.d.)

(Smart Kalasatama, n.d.)

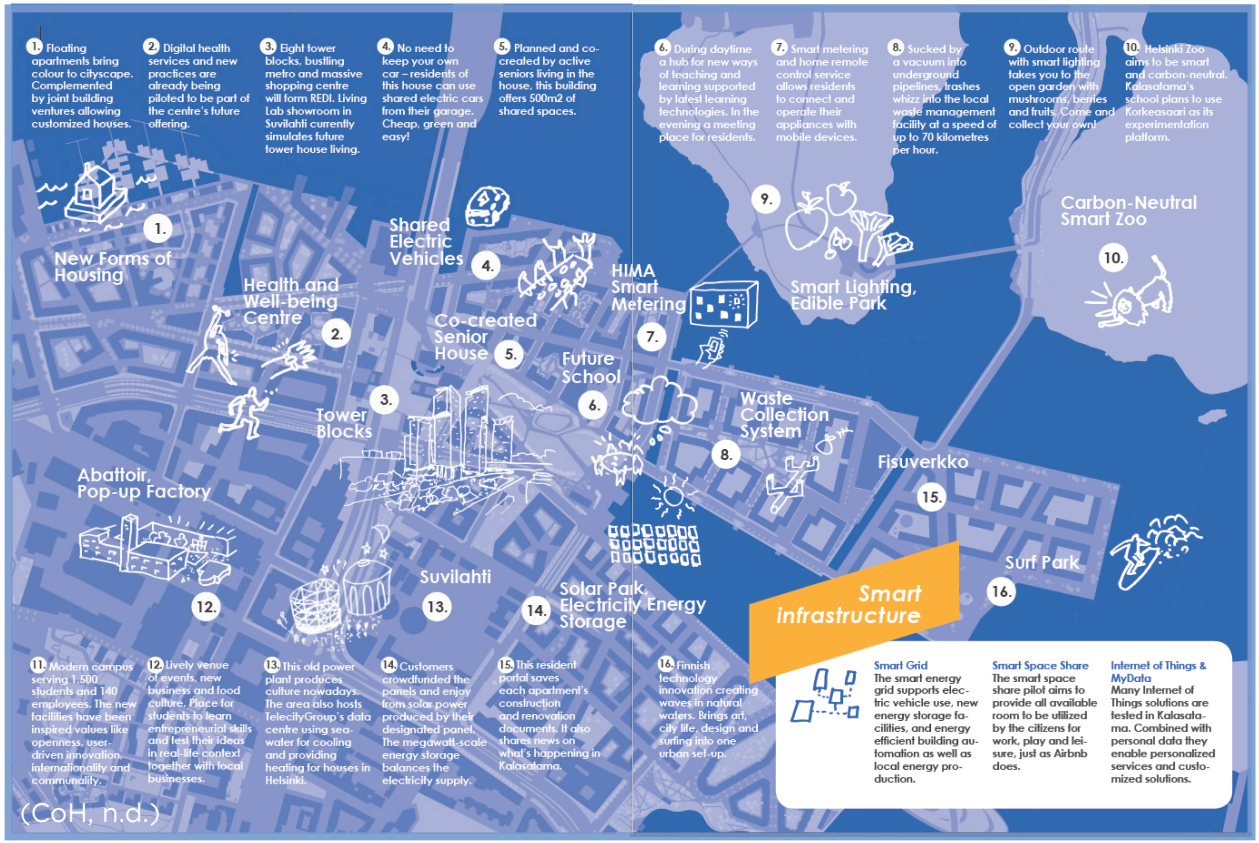
Smart Kalasatama

GCAP Goal 10: Lighter Footprint

Smart Kalasatama is the civic branding for the district, designed through a flexible process known as 'agile piloting' that involves collaboration between residents, companies, city officials, and researchers. The area is being utilized as a smart city experimental innovation platform, which employs co-creation by companies, entrepreneurs, researchers, the public sector, and residents together to experiment on the delivery of civic services. (CoH, n.d.). This model allows for new projects and businesses to be developed and drive innovation in sustainability.

The platform has already developed 25 innovative infrastructure and building projects (CoH, n.d.). In addition to the larger projects, Smart Kalasatama hosts smaller experimental projects, allowing new organizations to co-develop smart solution prototypes with residents in the district (CoH, n.d.). To date, several projects have been developed relating to smart waste management, smart mini grids, mobility as a service, resource efficiency and energy behaviour.

A waste management centric agile pilot is Foller, an app that focuses on reducing food waste through automated real-time pricing and communication (Foller, n.d.). Foller's application reminds residents about products in their refrigerators that are close to their expiry date, encouraging them to explore different ways to use these foods and thus reducing food waste.



An example of an agile pilot focused on local economics is the crowdsourcing app Nifty Neighbour (Mesenaatti, 2015). The application acts as a social media platform for neighbourhoods, allowing residents of Kalasatama to generate and test ideas locally through the use of crowdfunding. Nifty Neighbour allows residents to develop local services that respond to the actual needs and desires of residents.

A transportation focused agile pilot is the app Kyyti, which looks to combine mobility services in one mobile application (Kyyti, 2019). Kyyti aims to bring different mobility services together into one application, including information on parking, public transportation, taxis, rental cars and bicycles. In the Kalasatama neighbourhood, Kyyti is testing different methods to influence residents' mobility choices, with a focus on increasing the use of shared vehicles.

Kalasatama Urban Lab

GCAP Goal 9: Green Economy

At the heart of the Smart Kalasatama movement is the Kalasatama Urban Lab, a space where agile pilot developers can meet with the public to host events, meetings and networking opportunities (CoH, n.d.). The lab focuses on four key elements: providing a space for co-creation, an area for climate-friendly and smart events, a smart living showroom, and a 'super flexi-space' for independent use (CoH, n.d.).

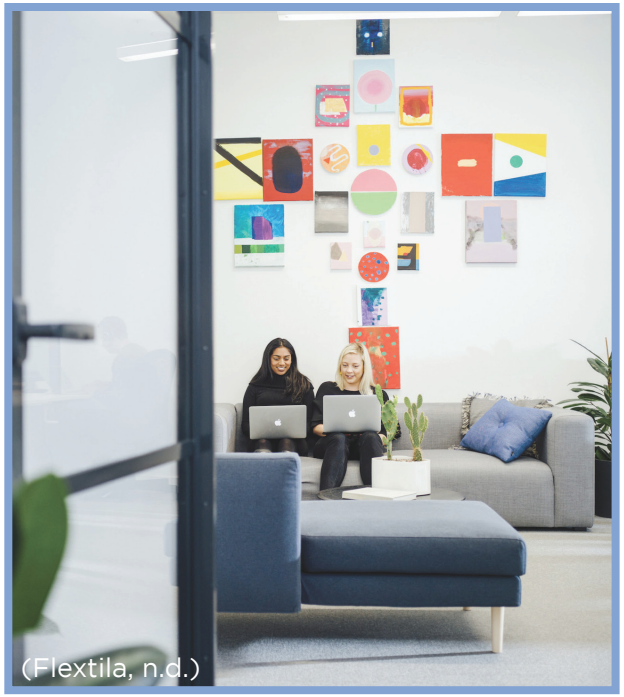
Kalasatama Urban Lab is a space for co-creation

The Kalasatama Urban Lab presents the most recent climate-friendly and smart living innovations first hand for residents and visitors to interact with, including recent agile pilots in Kalasatama. The lab also provides interest groups with the ability to reserve the space for independent use (CoH, n.d.). The use of the space facilitates further innovation in that the data generated can be used for the development of new solutions.

(Flextila, n.d.)

(Flextila, n.d.)

(Flextila, n.d.)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Stockholm Royal Seaport

Stockholm, Sweden

Focus Areas: Climate and Renewables, Access to Nature & Green Transportation

In 2009, the City of Stockholm decided to develop the abandoned brownfield area known as Stockholm Royal Seaport into a modern, sustainable city district. Several aspects of sustainable urban development, including waste management, power production and water management, are integrated into the district's development (Sustainia et al., 2015).

Stockholm Royal Seaport's vision establishes three primary targets for the district to achieve: restraining carbon dioxide emissions to less than 1.5 tonnes per person by 2050, adapting the district to future climate change, and making the district fossil fuel free by 2030 (SRS, n.d.). As a baseline, the average resident in the City of Stockholm produced 2.7 tonnes of emissions in 2014 (CoS, 2017). To achieve these targets, Stockholm Royal Seaport will focus on energy use, environmentally efficient transport, adaptation to climate change, interconnected district systems, and lifestyle change (SRS, n.d.).

To tackle the impacts associated with climate change, the City of Stockholm decided that Stockholm Royal Seaport should be given a distinctive environmental profile (SRS, n.d.). The environmental program aims to solidify Stockholm's position as leader in climate work while supporting the development of Swedish environmental technology.

(SCDA, 2012)

Metrics	Area	Density	Land Use
	236 ha	10,169 residents/km^2; 14,830 workers/km^2	12,000 residential units; 600,000 m^2 commercial

Amenities	Relations	Ownership	Timeframe
Preschools; 5 ha of park space	City of Stockholm	City of Stockholm	2009-2030

Fossil Fuel Free & Climate Positive Development

GCAP Goal 1: Climate and Renewables

At Stockholm Royal Seaport, significant emphasis is being placed upon resource efficiency and climate responsibility for the new district. The idea behind this is that if the buildings and facilities are designed from inception to be robust and built with high quality materials, the district will last for a longer timeframe. The district's design therefore takes into account materials, water and energy inputs as to use them efficiently through the use of eco-cycles (SCDA, 2018). Other considerations, such as the use of non-hazardous materials, can reduce the impact the built environment has upon human health and the natural environment (SCDA, 2018). The generation and use of renewable energy is encouraged throughout the district to make the area as close to fossil fuel free as possible, with the aim of becoming fully capable by 2030 (SCDA, 2018).

Fossil fuel free by 2030

One of the central aims of this initiative is to move Stockholm Royal Seaport towards being a fossil fuel free urban district. Challenges emerge when a district attempts to achieve the fossil fuel designation, including that transport is regional and governed by national instruments and that the residual waste that is used to fuel Stockholm's district heating system contains fossil matter. At present, a roadmap has been produced according to the Climate Positive Development Program's framework showing that Stockholm Royal Seaport could reduce its greenhouse gas emissions by about 60% compared with Hammarby Sjöstad, an achievement in itself (SCDA, 2018).

Low-energy buildings are a second component of this initiative. The buildings in Stockholm Royal Seaport are close-to-zero energy buildings, meaning they are well-insulated, airtight and have energy efficient installations (SCDA, 2018). To compensate for the energy that is consumed on site, energy is produced locally through the use of photovoltaics on rooftops (SCDA, 2018).

Stockholm Royal Seaport has looked to collaborate with international partners on achieving their goals. In 2017, the district became an official member of the Climate Positive Development Program, under C40's Urban Planning & Development Initiative (SCDA, 2018). The program assists in the development of the district by prescribing a framework for strategy development to assist in becoming a climate-positive urban district. The roadmap development process has been instructive, since it has created an understanding and knowledge of choices based on a climate positive perspective during operation.

(SCDA, 2012)

Leaving Nature to Do the Work

GCAP Goal 5: Access to Nature

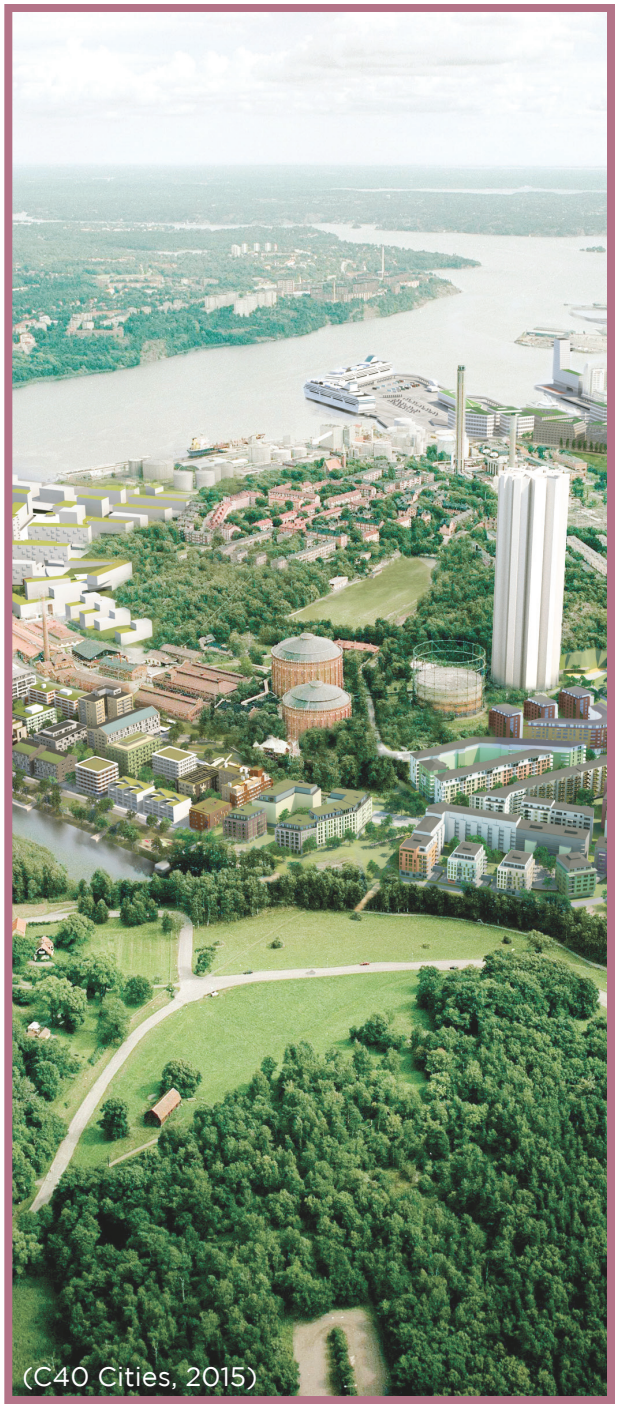
One of Stockholm Royal Seaport's goals is 'leaving nature to do the work' (SCDA, 2018). In the planning process for Stockholm Royal Seaport, water and green structures have been designed in a manner that they provide important ecosystem services, such as flood protection, temperature regulation, recreation opportunities, greater biodiversity and strengthened dispersal patterns for key species (SCDA, 2018). A series of parks, courtyards and other green spaces distributed throughout Stockholm Royal Seaport form a green network that helps to create a more resilient urban district.

The Green Space Index (GSI) is a planning tool developed to provide a metric to compare disparate sites, ensuring that green infrastructure provides essential ecosystem services for Stockholm Royal Seaport. (SCDA, 2018). The GSI is a tool used for calculating ecosystem services for public open space, including the public greenery on streets, parks and city squares (SCDA, 2018). When factoring in the different elements, the GSI then provides a score for public open space that indicates the proportion of the space's area that is eco-efficient (SCDA, 2018). The index promotes the design of eco-efficient areas that deliver multiple ecosystem services while also making it easier to communicate the importance of green infrastructure.

Green courtyards are important in Stockholm Royal Seaport for creating and improving the quality of life amongst residents. Blocks are used to strengthen the area's green structure and ensure multi-purpose functions (SCDA, 2018). Green courtyards and roofs are important for stormwater retention, strengthening biodiversity and creating recreational opportunities (SCDA, 2018).

Stockholm Royal Seaport is also a dispersal zone for the city's green space. The nearby Royal National City Park has significant ecological values with high biodiversity and cultural heritage stocks of sensitive species. The northern section of Stockholm Royal Seaport is part of a network of green spaces that provides travel corridors for oak-dependent species and amphibians (SCDA, 2018). By preserving and promoting ecosystems for amphibians and oak-dependent animals, Stockholm Royal Seaport strengthens these habitats.

At Stockholm Royal Seaport, the pollinators are not forgotten. Plants with different flowering times are placed throughout the district to provide pollinators with a constant supply of food. Dead wood, nesting cavities, and access to fresh water create ideal habitats for pollinators to proliferate. In traveling between resources, green connections along paved surfaces are available to make it easier for the pollinators to move across large areas (SCDA, 2018).



(C40 Cities, 2015)

An Accessible, Sustainable Neighbourhood

GCAP Goal 3: Green Transportation

The accessibility and proximity of the built environment are important considerations in the design of Stockholm Royal Seaport. From inception, appropriate infrastructure was designed and instituted to promote the uptake of walking, cycling and electric vehicles. The street structure of Stockholm Royal Seaport has been designed in a manner to give priority to pedestrians, cyclists and public transport (SCDA, 2018).

Walking and cycling pathways have been expanded throughout the district. Access to bicycle parking at ground level has been a key incentive for facilitating sustainable travel. As a result of having fewer on-street parking spots to comparable developments, more space is available for public spaces and landscaping. Development follows a phased approach, with the first development phases providing parking spaces only for loading, visitor parking and carpools. Later development phases restrict the streets even further to become almost car free and traffic free zones.

An accessible neighbourhood relies upon public transportation for the efficient movement of people. Public transport in Stockholm Royal Seaport is based upon the subway, tram and bus systems which connect the district and the city. This is supplemented by the design of the district, whereby high population density and access to jobs, shops and services makes it easier to live without a car.

Similar to the Green Space Index, a tool was developed to promote and evaluate measures with a positive impact on sustainable travel, referred to as the Mobility Index (SCDA, 2018). The design of a property is important, with security-related measures, access to parking, goods management and mobility services all contributing to opportunities for sustainable travel. The five modules included in the Mobility Index are the walkable city, the cycling city, stationary vehicles, goods management and mobility services (SCDA, 2018).

Decentralized garage solutions were developed within portions of Stockholm Royal Seaport in an effort to create a better urban environment. A decentralized garage for residents, workers and visitors has been planned in an area adjacent to two of the district's neighbourhoods, leaving the streets as an area for social interaction, cyclists and public transport (SCDA, 2018).

In terms of logistics, a centralized logistics facility was developed to bring all property developers and city staff together, referred to as the Construction Consolidation Centre. By coordinating and combining transport to the various construction sites, the number of vehicle trips was reduced both in and across the urban development area, while increasing accessibility and safety during the construction period (SCDA, 2018). Further, all visitors who visit the construction site must be informed of the district's sustainability mission in an effort to unify vision and provide perspective, including developers and builders (SCDA, 2018).

(SCDA, n.d.)

Treasure Island

San Francisco, USA

Focus Areas: Climate and Renewables, Green Buildings & Expressing Ourselves

Treasure Island is a small artificial island in the San Francisco Bay, connected by the Bay Bridge to San Francisco and Oakland. The 182-hectare island was built by the Army Corps of Engineers as a naval base in 1936 atop the shoals of neighbouring Yerba Buena Island with mud dredged from the Bay (TIM, 2017). Upon the closure of the naval base in 1997, Treasure Island was subsequently leased to the City and County of San Francisco (TIM, 2017).

The Treasure Island Development Authority (TIDA) is a non-profit organization that was established by the municipal government and tasked with overseeing the administration and development of the islands. The Treasure Island Community Development is a private, for-profit organization that will develop the project site in accordance with the *Development Agreement* and all related project documentation (TIDA, 2015).

At present, the former military base consists primarily of low-density residential uses, along with vacant and underutilized non-residential structures (TIDA, 2015). In the future, Treasure Island will provide a vibrant new, high-density, mixed-use community with a variety of housing types and retail core. This will be paired with new public benefits like affordable housing units, increased open space, transportation improvements, extensive infrastructure improvements, and recreational and entertainment opportunities.

(TIDA, 2011)

Metrics	Area	Density	Land Use
	182 ha	10,241 residents/km^2; 1,648 workers/km^2	8,150 residential units; 15,793 m^2 retail; 9,290 m^2 office

Amenities	Relations	Ownership	Timeframe
28,000 m^2 community space; 121 ha of parks; transit hub	Treasure Island Development Authority; U.S. Navy	City and County of San Francisco	2016 - 2030

Sustainable Urban Design

GCAP Goal 1: Climate and Renewables

The redevelopment of Treasure Island is a rare opportunity to create an exemplary model of sustainable living founded on the best practices in smart urban design, low-impact development and green building (TIDA, 2011).

Treasure Island is committed to achieving LEED ND Gold certification and making a good faith effort to achieve the higher Platinum certification (TIDA, 2015). The project is also seeking recognition through the C40 Cities' Climate Positive Development Program (Arup, 2014). Specifically, these targets will be achieved through building-integrated energy efficiency strategies alongside passive design relating to street and building orientation and the use of public transit within a dense, mixed-use community.

The island's redevelopment will result in substantial changes to the existing physical landscape as single-family homes are removed in favour of new multifamily units and residential towers concentrated on the island's south and west edges (Popular Mechanics, 2009). Housing density will increase from 8 to 75 units per acre on developable land, which in turn will allow for double the amount of open space while accommodating five times as many people (Popular Mechanics, 2009).

The large street blocks that dominate the island will be reduced from 2,000 feet in length to a more walkable distance of 400 feet, with 90% of residents being within a 10 minute walk of the island's new downtown (Popular Mechanics, 2009). The downtown portion of Treasure Island will provide access to neighbourhood-serving retail and services.

Following an analysis of the San Francisco Bay Area's weather patterns, developers decided to rotate street grids 35 degrees west of due south to optimize solar exposure and protection from the prevailing westerly winds (TIDA, 2011). This diagonal alignment will not only foster a more comfortable outdoor environment for patrons of the space, but it will provide energy saving on heating, cooling and lighting structures (Popular Mechanics, 2009).

Renewable energy sources, including solar panels covering 70% of all rooftops, will provide some of the island's demand for energy (Popular Mechanics, 2009). Small-scale vertical wind turbines will provide individualized power. Solar water heating systems in the residential areas will supply up to 80% of hot water needs (Popular Mechanics, 2009).

Other opportunities for energy production are currently being considered, including tide-driven turbines on the floor of the Golden Gate channel that would harness the energy of the narrows and a biogas generator that would capture the hydrogen and methane gas produced at the wastewater treatment plant (Popular Mechanics, 2009). Combined together, on-site renewable energy production could account for 100% of Treasure Island's energy demands, which otherwise would have to be imported from an external power producer (Popular Mechanics, 2009).

(TIDA, 2015)

Urban Agricultural Park

GCAP Goal 7: Local Food

The Urban Agricultural Park on Treasure Island, at 8-10 hectares when complete, will be the largest urban farm in the Bay Area.

Largest urban farm in the Bay Area

The park lies at the heart of Treasure Island and is intended to serve as an educational and recreational amenity for the community, providing an opportunity for residents and visitors to experience farming and taste locally produced goods. The Urban Agricultural Park will have a series of interpretation and demonstration areas to allow people to learn and appreciate sustainable agriculture.

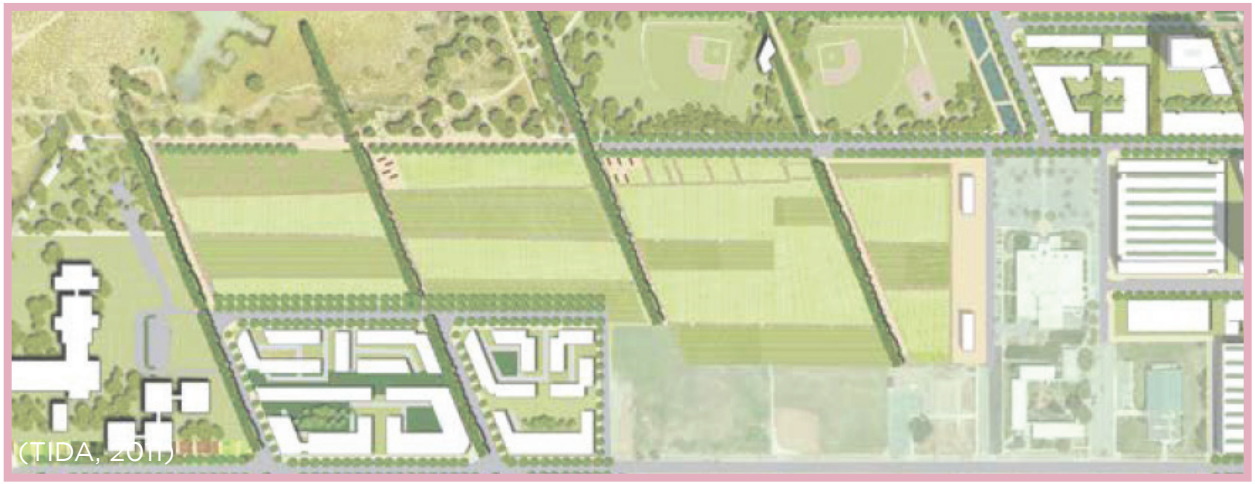
In addition to the educational components, local farmers and community members will have the opportunity to manage plots and create produce that satisfies the needs of the community and market conditions (TIDA, 2011). A portion of the Urban Agricultural Park might also be operated as a commercial farm, producing crops that can be then sold to residents on the island or at other local farmers' markets. Nearby buildings will provide space for grocery stores, areas for food production, or food service that directly utilize the urban farm's production (TIDA, 2011).

Urban farms many countless health and social benefits to the communities around them. In modern times, people residing in cities tend to experience a disconnect between the food they eat and how it is sourced. Organic urban farms provide an opportunity for people to become familiar with agricultural processes, further nurturing an appreciation for their food and the environment at-large.

The Urban Agricultural Park plays an important role in closing the resource loops for water and organic waste on the island (TIDA, 2011). A portion of the waste water generated on the island will be treated and used for irrigation. Organic waste generated on Treasure Island will be composted and used to enrich the soils. Growing foods adjacent to large consumer base has the added benefit of reducing consumption and transportation related carbon emissions (TIDA, 2011).

(TIDA, 2011)

(TIDA, 2011)


(TIDA, 2011)

Treasure Island Arts Master Plan

HCS Goal 10: Expressing Ourselves

The *Treasure Island Arts Master Plan* is the guiding document for arts and culture on the island. The purpose of the document is to create a unique arts program that provides a compelling and ongoing set of attractions that will bring people to Treasure Island and enhance the quality of life for residents (SFAC, 2017). The *Treasure Island Arts Master Plan* was prepared by the San Francisco Arts Commission in collaboration with CMG Landscape Architecture and participation from TIDA, Treasure Island Community Development and members of the public (SFAC, 2017).

The plan provides direction for the Treasure Island Art Program, a program funded by a fee of one percent on the construction costs of Treasure Island's redevelopment (SFAC, 2017). The funds will be used exclusively to enhance and activate the public realm with artwork and ongoing art programming. The plan will work to familiarize artists with the art program's vision and objectives while providing additional context as to the island's history, the overall redevelopment plan, potential sites and corresponding art opportunities (SFAC, 2017).

The large-scale of Treasure Island's redevelopment provides an opportunity to commission bold, imaginative and forward-thinking contemporary art projects, both permanent and temporary, in a diverse array of media and inclusive to all art practices (SFAC, 2017). Artwork commissioned for the island will embody the spirit of innovation that characterized the 1939 Golden Gate International Exposition (SFAC, 2017). The goal of the *Treasure Island Arts Master Plan* is to create a vibrant and robust art program that affirms the island's reputation as a remarkable place to live and visit and establish it as a magnet for cultural tourism (SFAC, 2017).

(SFAC, 2017)

(SFAC, 2017)

(SFAC, 2017)

The Treasure Island Art Program will be managed and implemented by the municipal-led agency the San Francisco Arts Commission over a twenty-year period that coincides with the construction cycle of the island, which is set to commence in 2019 (SFAC, 2017). Each year's projects will include a balance of permanent and temporary commissions for the island's many public spaces.

Upon Treasure Island's completion, the redevelopment will generate over CAD$32.7 million to be invested in public arts and public art programs on the island, in addition to the complement of private investment that is anticipated to follow suit (SFAC, 2017).

$32.7 million of investment in public arts and programming

Västra Hamnen

Malmö, Sweden

Focus Areas: Green Buildings, Green Transportation & Access to Nature

The development of Västra Hamnen began back in 1997, when the City of Malmö was interested in hosting a housing demonstration project for the 2001 European Housing Expo (CoM, n.d.). The first phase of Västra Hamnen - referred to as Bo01 - envisioned a new and modern mixed use neighbourhood that was committed to sustainable principles (ITDP, 2011). The residences constructed for Bo01 incorporated a sustainability focus, emphasizing architectural quality, material choice, energy consumption, transportation options, green issues and technical infrastructure (ITDP, 2011). Following its success at the Housing Expo, Ba01 would go on to serve as a model for subsequent phases of development in Västra Hamnen (ITDP, 2011).

In the following decades, Västra Hamnen has been transformed from an industrial park into a lively, mixed-use district. The aim for Västra Hamnen is to become a leading example of environmental adaptation among dense urban district (ITDP, 2011). Västra Hamnen has subsequently received international acclaim, both for its innovative sustainability features and its striking architecture (ITDP, 2011). The development aims to show that modern city districts can be environmentally conscious and aesthetically pleasing simultaneously.

(Castor, 2008)

Metrics	Area	Density	Land Use
	187 ha	5,347 residents/km^2; 7,523 workers/km^2	76 ha developed; 37 ha mixed-use neighbourhoods

Amenities	Relations	Ownership	Timeframe
Educational facilities; 20 ha university district; 18 ha green space	City of Malmö; Sydkraft	Government of Sweden; City of Malmö; private developers	1998-2015

One-Hundred Percent Renewable Energy

GCAP Goal 2: Green Buildings

Västra Hamnen was developed to be a district that could run on 100% locally produced renewable energy that was generated through commercially accessible technologies (E.ON, n.d.). As a result, wind power became integral to the functioning of the district's energy system. Since 2001, Västra Hamnen's wind power plant has consistently delivered electricity with almost no interruption (E.ON, n.d.).

To achieve this goal, strict building standards were established for the district's construction. Buildings were required to not exceed 110 kWh/m^2, a significant reduction when compared to the city's baseline of 218 kWh/m^2 in 2001 (CoM, n.d.). All construction was to be completed with primarily renewable materials and to completely avoid toxic substances (CoM, n.d.). Waste reduction was heavily emphasized at all stages construction and unavoidable waste products were required to be sorted for recycling.

An innovative heating and cooling system for the district resulted in further energy savings. The local aquifer beneath Västra Hamnen was incorporated into the site's design as an underground reservoir for energy storage. Ten large boreholes were drilled 70 metres into the aquifer at equal distances to create the aquifer thermal energy storage system (National Geographic, 2012). In the winter, water is drawn from the wells at a temperature of 15 degrees Celsius and used as a heat source for the district's heating network (E.ON, n.d.). Cooled water is then pumped back into the aquifer to be heated once more and recirculated. The process is reversed in the summer to cool the entire district (E.ON, n.d.). The energy produced through this innovative system meets 90% of the district's energy requirements for a year (E.ON, n.d.).

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(Skyscraper Cities, 2008)

Promoting Public Transport

GCAP Goal 3: Green Transportation

Västra Hamnen was planned for future transport needs and to minimize car dependency. Policies promoting cycling and public transport were developed for the district as to reduce car dependency and to improve the quality of life amongst residents (ITDP, 2011).

Within the Bo01 neighbourhood, the area is nearly car-free, giving priority to both cyclists and pedestrians through the use of dedicated pathways (ITDP, 2011). The district contains over 8 kilometres of cycle paths including a long route that connects Västra Hamnen to the southern districts of Malmö. In addition to the standard compliment of cycling infrastructure, innovative features are being tested along the district's bike paths to improve safety and ease of use. This includes rails at traffic lights for riders to rest against and mirrors placed at intersections to improve visibility around corners (ITDP, 2011). The City of Malmö is also testing giving priority signaling to cyclists at traffic lights across the city, including several areas within the district.

Public transport has been made more attractive to residents through numerous small improvements. Every apartment within Västra Hamnen has at least one bus stop within 300 metres of it, with buses running at seven minute intervals throughout the day (ITDP, 2011). Bus stops have elevated platforms that make the boarding process faster and more accessible (ITDP, 2011). Many of the city's bus stops have been equipped with electronic timetables to alert passengers of arrival times, in addition to real-time information being available electronically (ITDP, 2011). Lastly, buses are given priority at all traffic lights.

Carsharing is present and prominent within the district. Beginning in 2005, the City of Malmö started a carshare program with the aim of reducing resident's dependence on private vehicles (ITDP, 2011). Several carshare locations have since sprung up throughout Malmö and Västra Hamnen, with all of the program's vehicles running on natural gas, biogas, or E85 (ITDP, 2011).

Västra Hamnen recognized the importance of limiting parking in order to reduce car use and has consequently implemented policies that address this. Västra Hamnen's newest neighbourhood requires a minimum of 0.75 parking spaces per household for new developments, which is a considerably lower than the 1.1 parking spaces per household that is standard across the municipality. Significantly, this requirement does not restrict developers from building additional parking spaces; it simply provides them with the option of instead providing carshare memberships to residents for five years following a project's completion (ITDP, 2011).

Parking prices within Västra Hamnen are also used to discourage excess driving. On-street parking in popular Västra Hamnen neighbourhoods receives markedly higher parking fees in comparison to other districts in the city.

(ITDP, 2011)

Biodiversity

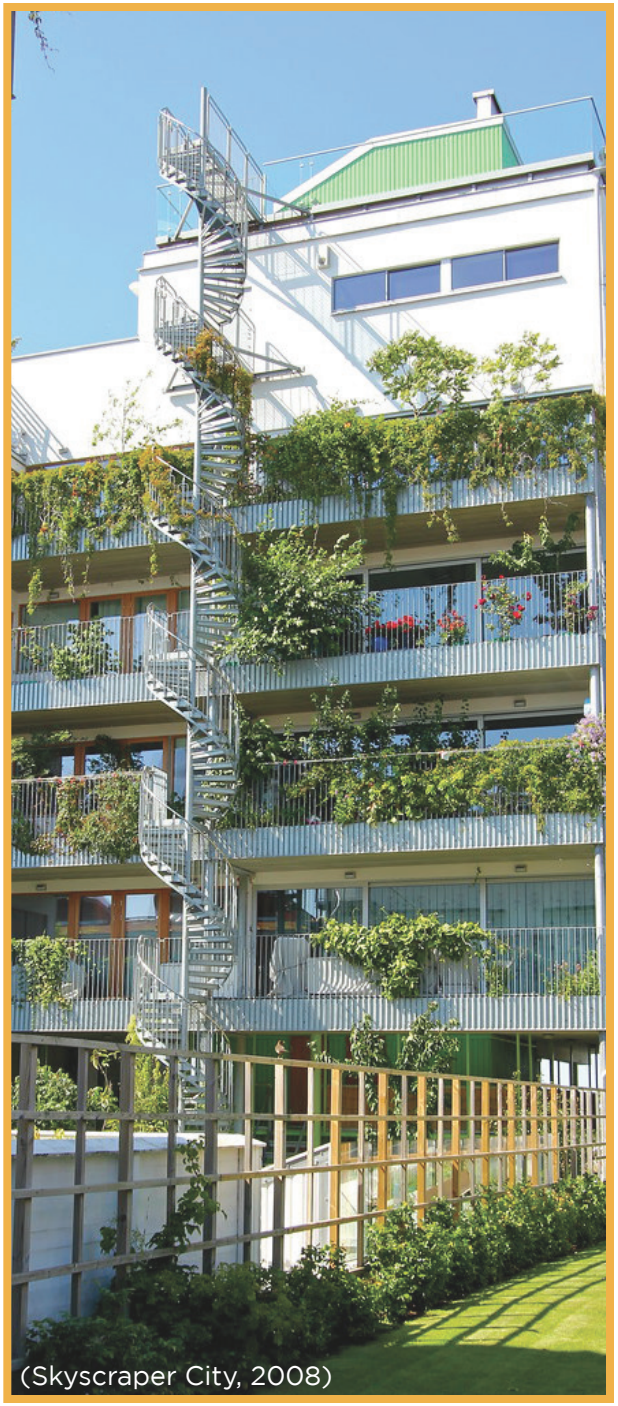
GCAP Goal 5: Access to Nature

The design of Västra Hamnen emphasizes the importance of biodiversity in the built environment. The primary design document for the district emphasizes the importance of biodiversity, looking to incorporate a variety of different habitats within the inner city to promote breeding opportunities for varied flora and fauna and the overall flourishing of the environment (CoM, n.d.).

Several strategies were used to promote biological diversity in Västra Hamnen. Portions of public courtyards were designed to emulate dry fields, meadows, and groves that would attract various migratory bird species. Stormwater from the development was collected and siphoned into centralized ponds that emulated marshes with similar vegetation. Roofs and courtyards were designed to simulate a seashore habitat, with sand, gravel and seashore-vegetation present. The walls of buildings and surrounding stone pathways were designed to imitate a cliff habitat.

Several courtyards were planted with pollinator friendly plants that would provide ample food and resources for pollinators. Portions of other courtyards were left to grow wild in addition to natural debris being left for hedgehogs to live in. Finally, potential nesting sites were left for bees in the area, such as reeds or small holes within walls.

(Skyscraper City, 2008)



(Skyscraper City, 2008)

Vauban

Freiburg, Germany

Focus Areas: Green Transportation, Lighter Footprint & A Home for Everyone

The Vauban neighbourhood in Freiburg, Germany was created through a cooperative decision-making process, aimed at creating a model district for holistic environmental planning and eco-friendly living.

In the mid-1990s, local thought leaders developed a vision for an ecological, largely car-free district (Freiburg-Vauban, n.d.). The City of Freiburg developed an urban design competition to flesh out the core principles for the district, which included: a mix of work and living; priority for pedestrians, cyclists and public transport; preservation of trees and habitat; a mix of social groups; good connection of the apartments to the open spaces; and local heating supply and residential buildings in low-energy construction (Freiburg-Vauban, n.d.). Following this design competition, the planning for Vauban began in 1993 and the district was completed in 2010.

Since its founding, Vauban has achieved remarkable results in the fields of energy-saving, traffic reduction, and social integration (GEN, 2018). Particular emphasis was placed upon sustainable transportation options for the district, with the district's car-reduced traffic concept garnering significant attention (GEN, 2018).

(Dittmeyer et al., 2019)

Metrics	Area	Density	Land Use
	41 ha	13,414 residents/km^2; 1,463 workers/km^2	160,000 m^2 residential; 16,000 m^2 industrial

Amenities	Relations	Ownership	Timeframe
Community centre; educational facilities; comprehensive transport network	City of Freiburg	City of Freiburg; private developers	1993-2010

Car-Reduced Traffic Concept

GCAP Goal 3: Green Transportation

Pedestrian and bicycle paths form an interconnected, efficient green transportation network for the district, with every home being within five minutes walking distance of a tram stop, schools, businesses, and shopping centres (SCD, n.d.). The results match the aspirations, as 57% of households that previously owned a vehicle deciding to sell it after moving to Vauban and 70% of residents living without a vehicle (SCD, n.d.).

Vauban residents who do own a vehicle can park it in one of the district's two solar-powered parkades at a cost of CAD$26,300 per year plus a monthly maintenance cost (The Guardian, 2008). The main thoroughfare passing through the district has a reduced speed limit of 30 kilometres per hour, with the inner residential streets being further reduced to traveling no faster than walking speed (The Guardian, 2008).

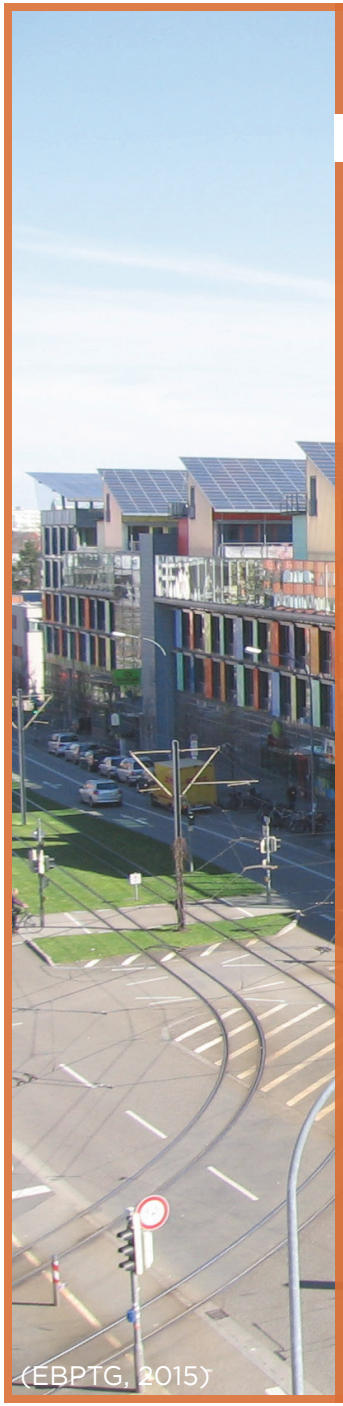
Other modes of transportation complement the district's car-reduced policies. A tram line with three stops has been operating in Vauban since 2006 (Freiburg-Vauban, n.d.). Several carsharing operators provide further flexibility to residents looking for increased mobility options. With all of these measures put in place, the number of cars in Vauban is only about 180 per 1000 inhabitants (Freiburg-Vauban, n.d.). In comparison, the national average for car ownership in Germany is more than 500 cars per 1000 inhabitants (Freiburg-Vauban, n.d.).

The City of Freiburg pursued the car-reduced traffic concept for Vauban following the adoption of the initial development plan, albeit by a narrow majority (Freiburg-Vauban, n.d.). Despite this approval, however, city staff have been hesitant to fully enforce the "car-free living" concept (Freiburg-Vauban, n.d.).

Vauban has decoupled the cost of housing from the cost of owning a parking space, passing the source-related cost savings provided to the developer onto the residents. The car-reduced concept also benefits car owners financially as it reduces overall congestion (Freiburg-Vauban, n.d.). Further, fewer roadways are needed to be constructed and maintained, reducing overall taxation. All of this results in lowered development costs that help to keep real estate prices lower than in conventionally planned neighbourhoods (Freiburg-Vauban, n.d.).

In a traditional development of similar scale to Vauban, 2,300 parking spaces would have to be built to accommodate both residents and public parking spaces (Freiburg-Vauban, n.d.). As a result of Vauban's parking policies, this number was reduced to 470 parking spaces in the two district parkades and 400 underground parking spaces outside this area (Freiburg-Vauban, n.d.). In addition, there are 220 public parking spaces for visitors along the main boulevards with 100 spaces for commercial enterprises on their properties (Freiburg-Vauban, n.d.). In total, Vauban has approximately 1,200 parking spots across the district (Freiburg-Vauban, n.d.).

(ITDP, 2011)



(EBPTG, 2015)

Global Emission Model for Integrated Systems

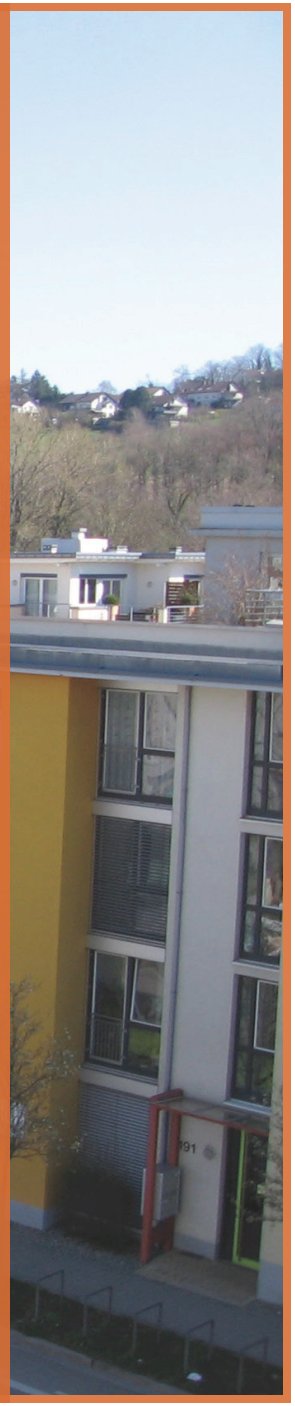
GCAP Goal 10: Lighter Footprint

Vauban was developed to incorporate an extensive, neighbourhood-wide monitoring system. This monitoring system is known as the Global Emission Model for Integrated Systems (GEMIS), a life-cycle analysis program and database that was developed by the International Institute for Sustainability Analysis and Strategy (Thorpe, 2014).

GEMIS analyzes lifecycle and regional material flow on an ongoing basis to provide city staff with real time information (SCD, n.d.). This monitoring system is the first time that an urban neighbourhood has been able to be analysed with a full life-cycle perspective and regional data (SCD, n.d.). To achieve this, the system collects information on buildings, infrastructure, electricity supply, heat supply, water, waste, traffic and private consumption (IINAS, 2019).

The results produced by GEMIS provide information on environmental flows, including aggregated values for: resources as cumulated energy demand, greenhouse gases emissions as carbon dioxide equivalents, air emissions as sulphur dioxide equivalents and ozone precursor equivalents, and external environmental costs (IINAS, 2019). GEMIS can also be used to analyze regional costs and employment figures (IINAS, 2019). All results can be further broken down into the contributions produced by each process or aggregated into sectoral or regional sub-totals (IINAS, 2019).

Applying GEMIS to Vauban, the system calculated that the district achieves an annual energy savings of 28 gigajoules, reduces 2,100 tonnes of carbon dioxide equivalents per year, reduces 4 tonnes of sulphur dioxide equivalents per year, and saves 1,600 tonnes of mineral resources per year (SCD, n.d.).



Baugruppen

HCS Goal 2: A Home for Everyone

In Vauban, a unique form of cooperative housing has sprung up known as baugruppen. Translated from German as 'building group', baugruppen represent a form of self-initiated, community-oriented living where residents share the responsibility of the community's upkeep.

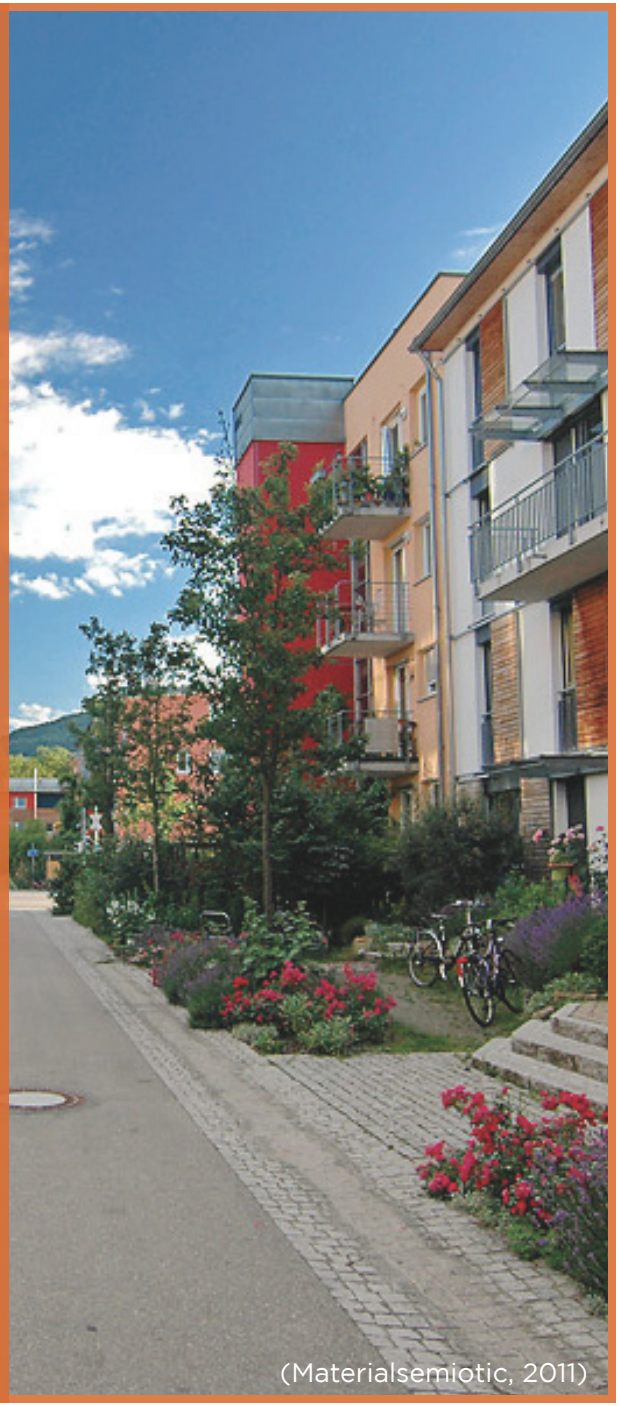
As every project differs in its financing, social make-up, and community aspirations, there is no one method to create a baugruppen. The individual and collective needs of residents are provided through the development of a joint plan. These plans are developed through a participatory planning process that encourages collaboration and the sharing of common interests between potential neighbours, resulting in an increased social cohesion amongst the community (Franko, 2010). Community goals - such as social mix, land use, environmental standards or non-profit constraints - can all be regulated within land allocation policies (The Conversation, 2018).

To provide social opportunities, a mixture of open spaces and structural solutions are provided. Green, open and community spaces are important in this form of development, serving as gathering spaces for the greater community (The Conversation, 2018). It is also quite common for baugruppen to have a shared garden that is open to the public (The Conversation, 2018).

Baugruppen have proven to be a major success in Vauban and Germany, leading to a greater variety of options available to potential homeowners. One benefit of the collective nature of these projects it that the future users decide what to invest in and where money can be best saved (The Conversation, 2018). Typically, baugruppen are cheaper to own when compared to similar finished building units, leading to a potential savings of up to 30% on the cost of housing for multi-residential development buyers (Dream Planet, 2018). As a result, this innovative form of development has directly enabled lower income families to become homeowners.

Savings of up to 30% on the cost of housing

In Vauban, the majority of housing blocks have been acquired by small cooperatives consisting of owner-occupied households, forming several baugruppen (Franko, 2010). Learning from Vauban, other municipalities can look to baugruppen as a means of providing an adequate supply of suitable, affordable housing that is sustainable in nature.



(Materialsemiotic, 2011)

Wesbrook Village

University Endowment Lands, Canada

Focus Areas: Clean Water, Green Buildings & Zero Waste

Wesbrook Village is a residential neighbourhood at the south end of the University of British Columbia (UBC) in Vancouver, Canada. The site was formerly inhabited by the Coast Salish peoples, in particular the Musqueam Nation (UBC, 2018). Following its establishment as a public research university in 1908, UBC was quick to expand, growing to a population of 55,000 students and 15,000 faculty and staff as of 2019 (UBC, 2019).

Wesbrook Village was designed around a vision to be a vibrant, complete, ecologically sensitive neighbourhood that contributes to the larger community of UBC (UBC, 2016). To achieve this vision, Wesbrook Village targets a high level of sustainability in both the physical environment and consumption behaviour, targeting factors such as energy and water use, waste, the environment, community health and economic vitality.

Several strategies were developed to complete these objectives. Stringent building standards for sustainable building practices were developed (UBC, 2018). Transportation systems within the district were developed to reduce environmental impact and to improve safety, accessibility, convienance and choice (UBC, 2016). The landscape and open space system was structured to accommodate a wide range of recreation needs while enhancing the biological functioning of the surrounding ecosystem (UBC, 2016).

(Rennie, 2018)

Metrics	Area	Density	Land Use
	46 ha	27,173 residents/km^2	556,000 m^2 residential; 10,000 m^2 retail

Amenities	Relations	Ownership	Timeframe
Community centre; secondary school 10 ha open space; bike and car share	Musqueam Nation; Province of British Columbia	University of British Columbia	2005-2028

South Campus Stormwater Management Strategy

GCAP Goal 6: Clean Water

During the initial planning process for Wesbrook Village, stormwater management was identified as an important aspect for the long-term development of the neighbourhood. The hydrogeologic and stormwater issues present in the local watershed were complex, providing ample opportunity for innovation. Several area-specific conditions that impacted Wesbrook Village included: the soil composition of the aquifer, erosion of peninsula cliff faces and other channels, drainage issues with Booming Ground Creek, the addition of impervious surfaces with new development, and overall stormwater quality (UBC, 2015).

The *South Campus Stormwater Management Strategy* provides guidance on the development, design and operational strategies for Wesbrook Village. The strategy recognizes the ecological integrity and health of the landscape, providing safe conveyance of large stormwater flows to protect people and property (UBC, 2015). A wide-array of approaches to stormwater management were discussed within the document, many of which were employed in the district's final design.

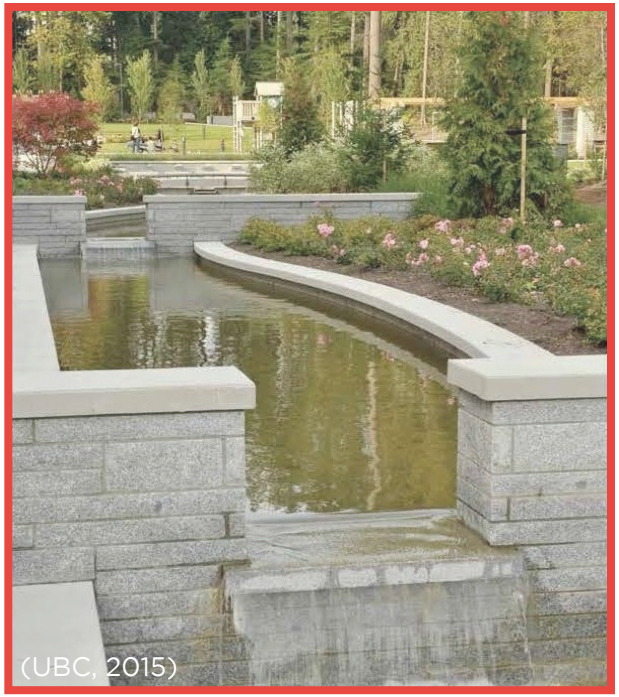
The district's buildings and private realm were designed to emphasize green rooftops and private yards with infiltration trenches, rock pits, and rain gardens, each providing opportunities for stormwater to permeate the ground. Careful plant selection and xeriscape techniques for the vegetated environment were also employed to reduce watering requirements for landscaping (UBC, 2015).

Several different approaches to stormwater management were incorporated into Wesbrook Village's street design. Green streets - multi-use corridors designed for pedestrian and non-motorized circulation, stormwater management, habitat, biodiversity and recreation – were prioritized with trees planted alongside (UBC, 2015). The use of permeable paving for increased stormwater infiltration was used on road surfaces and parking lots (UBC, 2015). Swales, linear detention or infiltration basins, and rock pits line many of the district's streets (UBC, 2015).

The public realm of Wesbrook Village incorporated public art as an integral part of the stormwater management system. Cisterns, stormwater fountains, and stormwater treatment facilities were designed in a creative manner to enrich the environment for residents (UBC, 2015). Waterways and wetlands provided the basis for form in community design, integrating these elements into the community's open space (UBC, 2015).

Stormwater facilities in Wesbrook Village enhance the habitat of the community. As many of the interventions rely on natural processes to purify stormwater, the associated vegetation creates potential new habitat for small animals, birds and other creatures (UBC, 2015).

Many benefits result from the integration of stormwater infrastructure into communities, including providing opportunities for education, interpretation and stewardship and the preservation of wildlife habitat and environmentally sensitive areas. Additionally, opportunities for human interaction with water and using native vegetation and landscape features to reinforce local identity are benefits of this system (UBC, 2015).



(UBC, 2015)

(UBC, 2015)

Residential Environmental Assessment Program

GCAP Goal 2: Green Buildings

The *Residential Environmental Assessment Program* (REAP) is a framework for mandating and measuring sustainable building practices for multi-family residential developments located within the neighbourhood housing areas at UBC's Point Grey campus (UBC, 2018). Developed specific to the university's context, REAP is integrated into the community planning and development approval process, playing a key role in the build out of the university neighbourhoods such as Wesbrook Village (UBC, 2018).

REAP evaluates a building's performance across seven categories. The system is a credit-based certification system, with credits being either mandatory or optional to complete. For a developer to be permitted to build on campus, the project must meet all the mandatory credits and a certain number of the optional credits across seven categories (UBC, 2018).

Four levels of certification can be achieved through REAP. The minimum development standard is Gold followed by Gold Plus, Platinum, and Platinum Plus (UBC, 2018). While only the minimum certification is required of developers, seeking higher REAP ratings is encouraged and may help attract prospective buyers by differentiating a development in the marketplace.

Beyond the aspirational goals detailed above, the wider objectives for establishing REAP are to ensure that multi-family neighbourhoods are of higher quality and have lower environmental impacts than standard construction in the Lower Mainland, benefiting both individual consumers and the wider university community (UBC, 2018). Compared to standard residential buildings, REAP has been proven to lower consumption of water, energy and resources, while maintaining higher-quality indoor environments and construction practices (UBC, 2018).

***REAP has been proven to* lower consumption of water, energy and resources**

C. Busch

Waste Reduction

GCAP Goal 4: Zero Waste

Wesbrook Village has made several strides forward in tackling the issue of waste reduction through the University Neighbourhoods Association (UNA), a local not-for-profit organization tasked with providing the residents of UBC's residential neighbourhoods with services, including infrastructure and the public realm (UNA, n.d.). The UNA was incorporated in 2002 to provide the residents of UBC's residential neighbourhoods with services that encourage a sustainable community life (UNA, n.d.). The association is active in the major residential neighbourhoods around UBC's Vancouver campus, including Wesbrook Village.

One initiative that the University Neighbourhoods Association has spearheaded is the Green Depot, a community recycling centre for residents, staff, faculty and students (UNA, n.d.). The Green Depot offers community members with socially and environmentally responsible waste repurposing and disposal options. The facility is located at the Wesbrook Community Centre and is operated by the Waste Warriors, a group of community volunteers who dedicate their time to strengthen the community by decreasing the amount of unnecessary waste going into the landfill (UNA, n.d.).

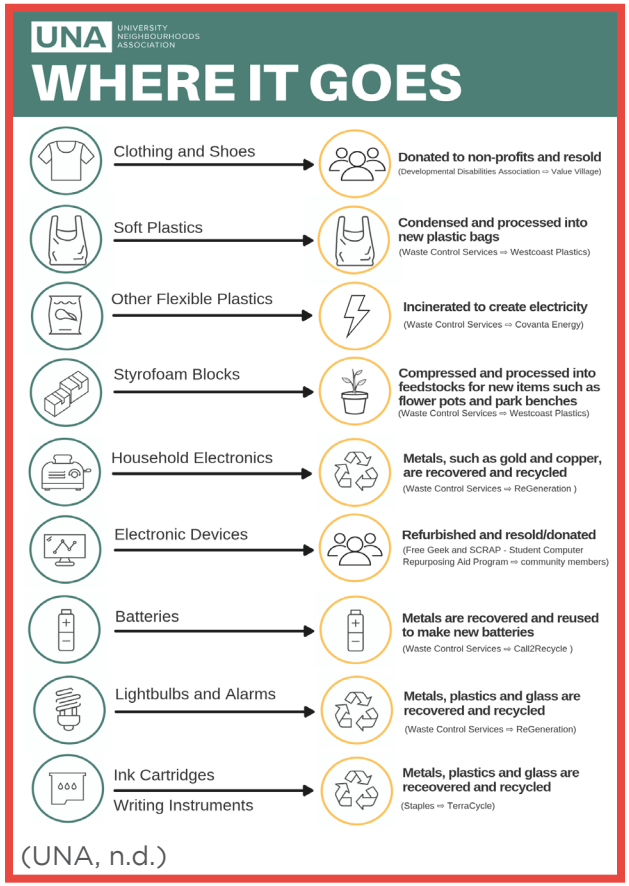
Another initiative introduced by the UNA is household composting. All UNA residents are freely provided household compost bins as well as educational materials to encourage responsible behaviour and reduce the amount of food waste that goes into landfills (UNA, n.d.).

The UNA also hosts an annual yard sale to encourage community members to reduce unnecessary production and waste through the reuse of material goods (UNA, n.d.). The event has the added benefit of building community cohesion while reducing environmental and economic wastes (UHA). By reusing items, materials are kept out of the landfills and oceans, thereby decreasing costs associated with purchasing and disposing of new items (UNA, n.d.).

A newer initiative that has sprung up at the UHA is a sharing app known as UHUBOR. The app is designed specifically for the campus community, allowing users to share and sell marketplace goods and services with other community members (UNA, n.d.). This app helps to extend the life of products and provides an accessible way for residents and other community members to pass on their useable goods before being tossed out (UNA, n.d.).

(UNA, n.d.)

(UNA, n.d.)



(UNA, n.d.)

Wynyard Quarter

Auckland, New Zealand

Focus Areas: Lighter Footprint, Cultivating Connections & Climate and Renewables

The Wynyard Quarter of Auckland, New Zealand, is the largest urban revitalization project in the country's history. Bordered on three sides by the Waitematā Harbour, the 37-hectare site has been home to the marine and fishing industries for decades and the Māori people for centuries prior. Directly northwest of Auckland's downtown, the renovated waterfront is expected to be a major driver of Auckland's economic future, with the redevelopment expected to contribute CAD$5.6 billion to Auckland's economy by 2040 (C40 Cities, 2016).

Panuku Development Auckland (PDA) was set up as a council-controlled organization by Auckland City Council in September 2015 to redevelop and rejuvenate the Wynyard Quarter in an environmentally sustainable way (C40 Cities, 2016).

The vision for the Wynyard Quarter is to create a mix of residential, retail and commercial development to enable the growth of a strong, diverse, resilient and vibrant community whilst retaining and celebrating the existing successful industries (PDA, 2019c). To guide the development of Wynyard Quarter, PDA has created an ambitious *Sustainable Development Framework*. The framework establishes sustainability aspirations and commitments relating to improving water quality, reducing land contamination, lowering stormwater associated risks and protecting biodiversity (Waterfront Auckland, 2013a).

(Architectus, 2014)

Metrics	Area	Density	Land Use
	37 ha	8,108 residents/km^2; 67,567 workers/km^2	48,000 m^2 commercial and shared working space

Amenities	Relations	Ownership	Timeframe
Theatre; 4 ha waterfront park; 2 km waterfront access; 11,000 m^2 lanways	City of Auckland; Mana Whenua	Waterfront Auckland	2005-2030

Wynyard Quarter Smart

GCAP Goal 10: Lighter Footprint

Wynyard Quarter Smart is an interactive data visualization tool that allows residents and developers to see the progress and implementation of sustainability initiatives within the district. The tool aims to stimulate creativity and innovative partnerships that result in dynamic, beautiful and sustainable communities, the tagline for Wynyard Quarter Smart (PDA, 2019b).

Wynyard Quarter Smart provides a platform to track and demonstrate the district's progress on sustainability initiatives as established within the *Sustainable Development Framework*. As Wynyard Quarter continues to grow and develop, so too will the richness of data provided on the website.

The tool provides users with a visual representation for each of the six categories of issues established within the *Sustainable Development Framework*. These categories include: resource efficiency; economic vitality; transport, movement and connectivity; social, cultural and heritage; climate change and natural hazards; and environmental quality (PDA, 2019b). Upon selecting one of the six categories, users will then be able to scroll through the goals and development expectations for Wynyard Quarter regarding that specific issue.

The second section of Wynyard Quarter Smart is the Smart Console. The console provides data visualization for specific developments within Wynyard Quarter, detailing each development's progress towards achieving specific sustainability targets (PDA, 2019a). Once a building is selected, the user will gain information on building performance, car parking provision, renewable energy generation, demolition waste, energy use, and water usage (PDA, 2019a). This information is presented in simple graphics that, alongside the targets listed below, allow users to understand the building's sustainability progress.

(PDA, 2019b)

Mana Whenua Partnership

HCS Goal 7: Cultivating Connections

The waterfront of Auckland has a diverse and interesting cultural history, boasting a number of important Māori, colonial and natural heritage sites and features. The area was important for the Māori, containing numerous settlement sites as a result of its strategic location with hilltop vantage points of the Waitemata Harbour (Waterfront Auckland, 2013a). Māori utilized the waterfront for fish and shellfish gathering, harvesting of crops and as a hub for trade (Waterfront Auckland, 2013a). In 1840, Te Kawau, the most prominent chief of the Ngati Whatua tribe at the time, offered Governor Hobson of the British Crown land around the present central city of Auckland in return for guarantees respecting their lands, possessions and rights as British subjects (NZTG, 2019). He and six other chiefs travelled to the nearby Bay of Islands to make the offer, signing the Treaty of Waitangi on March 20, 1840 (NZTG, 2019).

In the Wynyard Quarter, PDA seeks to acknowledge and celebrate the rich history of Māori settlement in the area and allow people to celebrate their own cultural heritage and enable occupants, residents and visitors to share a sense of place and community (Waterfront Auckland, 2013a). Mana Whenua are Māori with ancestral and territorial rights in respect to Auckland, acting as guardians to protect their tribal lands and waterways (Waterfront Auckland, 2013a). The Mana Whenua have been active participants throughout the development of the Wynyard Quarter, beginning from the project's inception to its current development.

PDA is working to establish and foster a continued relationship with the Mana Whenua. In delivering the *Sustainable Development Framework*, PDA will endeavour to:

- Engage with Mana Whenua at a high level and as a partnership.
- Revive names and genealogical connections to ancestors and associated narratives.
- Acknowledge significant landmarks and their cultural connections.
- Explore opportunities for incorporation of natural landscape elements with cultural associations.
- Enhance environmental health in the wider site.
- Harness creative talent to inscribe narratives into the built environment.
- Create opportunities for the Mana Whenua to maintain a presence in the area through living, commercial, customary or cultural activities as part of a partnership (Waterfront Auckland, 2013a).

The celebration of cultural heritage is a fundamental strength of Wynyard Quarter. By highlighting the importance of culture in sustainability, Wynyard Quarter seeks to be a model district for other redevelopments to follow. To this end, PDA has commissioned the development of a Māori design toolkit which will assist the development of future projects at Wynyard Quarter.

(Waterfront Auckland, 2013a)

Climate Change Adaptation Pathway

GCAP Goal 1: Climate and Renewables

As the climate of Auckland continues to change, the city is expected to see hotter average temperatures, more extreme weather events, an increased frequency of heavy rainfall and storm inundation, higher storm surges and waves, and an overall rise in sea levels (Waterfront Auckland, 2015b). As such, PDA recognizes the potential impacts of a changing climate as an issue of strategic significance for the current and future operations of the organization and its redevelopment of the waterfront (Waterfront Auckland, 2015b). PDA has responded to these concerns through the development of the *Climate Change Adaptation Pathway,* a document that considers several mitigation and adaptation measures for the development of Auckland's waterfront, including Wynyard Quarter.

The document has been structured into three action areas which represent the phases one would experience when learning to adapt to changing climate: reacting, reframing, and transforming (Waterfront Auckland, 2015b).

Reacting, reframing, and transforming

(Waterfront Auckland, 2013a)

The reacting phase presents the current understanding of the risks associated with climate change on Wynyard Quarter, including the adaptation measures and approaches that have already been utilized. Some of these measures include adapting and maintaining infrastructure, updating urban development requirements to incorporate sustainability principles, developing early warning systems, standardizing emergency management procedures, and restricting access to the waterfront during periods of high risk to the public (Waterfront Auckland, 2015b).

The reframing section is built upon the understanding that an adaptation pathway needs to reflect the dynamic nature of climate change and its associated uncertainty. As a result, the actions in this area focus on gathering knowledge, integrating climate-related risk into organizational processes, building organizational capacity, monitoring and reviewing current conditions, communicating information and leading by example (Waterfront Auckland, 2015b). To this effect, the document is set up to be reviewed and updated over time to correlate with the conditions relating to climate change as they may evolve.

The final phase, transforming, identifies how the PDA can take advantage of opportunities that arise from a changing climate over the long-term (Waterfront Auckland, 2015b). This action area is the least well defined of the three as it expected to evolve and be shaped over time in relation to changing conditions. Possible opportunities within this area include: designing for a changed future, adaptive urbanism, smart city technology, and participatory processes (Waterfront Auckland, 2015b).

Discussion

Several lessons can be discerned from the summarized sustainability policies and precedents around the globe. To explore these lessons, this section has been divided into three sub-sections, including a discussion of existing policy gaps, present opportunities for reconciliation, and potential future applications for the research.

Policy Analysis

In collecting and summarizing the City of Vancouver's sustainability policies, it is clear that a large contingent of policies exist that are applicable to the Jericho Lands. Research into the case studies provided a number of interesting approaches that can be considered by the City of Vancouver through these unique policy perspectives, revealing potential gaps for further exploration.

One area highlighted by the City of Vancouver's existing policies is environmental sustainability. The City's preeminent sustainability document – the *Greenest City Action Plan* – heavily emphasizes environmental sustainability, with less attention paid to the economic or social dimensions of sustainability. Other City policies, such as the *Healthy City Strategy* and the *Vancouver Economic Action Strategy*, provide the City with direction in these areas. Having these three dimensions of sustainability separated from one another creates the risk of a hierarchical dynamic between these various aspects without distinct prioritization. Consolidation of these documents, or a clear integration of the three in a manner that relays the interplay between and complementary nature of the dimensions should be considered, as has been done in several of the case studies.

Another potential area for improvement is the City of Vancouver's policies in regard to reconciliation efforts with the local First Nations. Vancouver is on the traditional territories of the Musqueam, Squamish, and Tsleil-Waututh First Nations. The City has begun this work through designating itself as a City of Reconciliation in 2014 and by adopting the *Framework for City of Reconciliation*, a document detailing the City's long-term commitment to increasing cultural competency, strengthening relations, and effective decision-making within the City's service provision and ongoing relationships with the local First Nations. While the document provides recommendations to strengthen relations, promote culture, and incorporate First Nations perspectives into City services, it does not provide detail on furthering economic or employment opportunities.

The discussion of reconciliation is largely absent in the other sustainability-related documents. The *Vancouver Economic Action Strategy* discusses the economic development opportunities for First Nations partners as of increasing importance to the City, in addition to a strong commitment to working with local First Nations governments to enhance their overall economic prosperity, but additional specific actions are not prescribed. Opportunities to improve these efforts will be further discussed in the next sub-section.

The City of Vancouver has a robust environmental policy framework. From climate change adaption to renewable energy production, urban resilience and more, the City's policies are comprehensive and well-thought. As the primary environmental policy document, the *Greenest City Action Plan* provides goals, targets, and actions that are realistic, yet ambitious. Most importantly, the associated metrics can be quantified and analyzed to track progress. Despite such high praise, there are areas that the document can work upon. Biodiversity is sparingly discussed within the document, with no quantifiable measure or target being set. The *Vancouver Biodiversity Strategy* by the Vancouver Board of Parks and Recreation, provides an excellent set of goals, targets, and metrics that should be considered for adoption into the *Greenest City Action Plan.*

Another area of potential improvement for the *Greenest City Action Plan* includes the integration of a holistic metric for measuring a building's or district's sustainability performance overall. As it currently exists, the City's various sustainability measures are considered by themselves and not in conjunction with other measures. Similar to what is done in Hammarby Sjöstad, Vauban and Stockholm Royal Seaport, a single metric could be adopted to give an overall indication for the City's progress into sustainability.

To achieve this, a framework, ranking and valuation criteria would have to be developed to create such a metric. While an example of such holistic index metric was not explored in the case studies, several less comprehensive, more specific metrics were explored, including the Environmental Load Profile at Hammarby Sjöstad, the Global Emission Model for Integrated Systems at Vauban, and the Green Space Index and Mobility Index at Stockholm Royal Seaport. The City would

be wise to look to these indices for potential lessons and adaption strategies for a future metric. It should be noted that the City is working on a similar metric that relates to resilient neighbourhood design through the Urban Design Studio.

As a side note, one topic that has been recently discussed amongst news outlets is the Province of British Columbia's adoption of the *Zero-Emission Vehicles Act* on May 29, 2019. The targets established within the act begins with 10% of all new light-duty cars and trucks sold within the province being zero-emission by 2025 and then ramps up to all light-duty cars and trucks to be emissions free by 2040 (CBC, 2019). The zero-emission mandate includes battery electric, plug-in hybrid electric, and hydrogen fuel-cell vehicles (CBC, 2019). While several of the City's policies speak to electric or zero-emission vehicles, only the *Climate Emergency Response, Renewable City Strategy,* and *Vancouver's EV Ecosystem Strategy* give much direction as to the implementation of zero-emissions vehicles and their associated infrastructure.

The most relevant policy in this regard is from the recent *Climate Emergency Response*, where the third big move aims to achieve 50% of the kilometres driven on Vancouver's roads be by zero-emissions vehicles by 2030, including light, medium and heavy duty vehicles (CoV, 2019b). An action detailed within the document discusses the establishment of zero-emission areas, where access by combustion engine vehicles are restricted or deterred, and active transportation and zero-emissions transit are encouraged, in order to explore innovative emissions reduction programs (CoV, 2019b). This idea is currently being worked upon by City staff, who are exploring areas where this approach can be implemented and identifying replicable lessons for city-wide implementation.

The *Renewable City Strategy* speaks to renewably powered transportation priorities, including the target of transitioning light-duty vehicles to be predominantly electric, plug-in hybrid or sustainable biofuel powered (CoV, 2015b). Importantly, the document discusses developing support infrastructure that meets the needs of renewably powered vehicles (CoV, 2015b). While the strategy supports the expansion of renewable fuel infrastructure for personal vehicles, the plan at present does not discuss a method to introduce charging infrastructure in existing and new developments, an oversight that should be addressed provided recent provincial legislation.

Fortunately, the strategy does detail the City's intention for this, stating that the City will develop a comprehensive strategy to address how to expand the provision of charging infrastructure in both new and existing buildings while also identifying strategic partnerships to solve challenges where no immediate solution is apparent (CoV, 2015b). This strategy for mandating electric vehicle infrastructure should be hastened to provide direction for developers in redeveloping properties as to ensure the necessary infrastructure is in place to accommodate the uptake of zero-emissions vehicles resulting from the provincial legislation. The *Vancouver EV Ecosystem Strategy* provides a solid foundation to base and expand upon.

Reconciliation Opportunities

Opportunities for reconciliation were presented in two of the case studies: Barangaroo South in Sydney, Australia and Wynyard Quarter in Auckland, New Zealand. Both examples present new approaches to reconciliation while existing in a similar social context to Vancouver and the Jericho Lands.

Barangaroo South demonstrates how to incorporate Indigenous culture into the built environment through the use of place making, art installations and economic opportunities. The development – Barangaroo – is named in honour of a historic member of the Eora Nation. An effort to showcase Eora artists has been made through the district in The Eora Journey, a walking trail which reasserts Aboriginal history while celebrating this ancient and living culture. The *Barangaroo Public Art and Cultural Plan* details how the district will offer opportunities for Indigenous Australians to collaborate upon future projects. Finally, the district is ensuring economic opportunities for Indigenous Australians, including the employment of 500 Indigenous workers and significant investment into Indigenous enterprises.

Wynyard Quarter has taken a different approach to reconciliation efforts with the Māori, forming a partnership with the Mana Whenua. The Mana Whenua have been active participants throughout the development of the Wynyard Quarter, beginning from the project's inception to its current development. The project developer for Wynyard Quarter is working to establish and foster a continued relationship with the Mana Whenua through the goals established

within the *Sustainable Development Framework*. Further, the project developer has commissioned the development of a Māori design toolkit which will assist the development of future projects at Wynyard Quarter.

It is important to note that while these two case studies provide unique examples of reconciliation efforts in similar conlonial histroic contexts to Vancouver and the Jericho Lands, they are not identical. As such, it would not be appropriate or recommended to simply lift these policies and put them in place as a means of fulfilling the City of Vancouver's reconciliation mandate. With the Jericho Lands in particular, the MST Nations are seeking to act as a private developer, adding further complexity to the situation. Further, it is not known how the Cadigal and Māori people feel about the redevelopments presented within the case studies as the information available during the period of this study was from the project proponents' perspective.

If anything is to be learnt from these case studies, it is that an important component of the act of reconciliation is open and transparent dialogue with the affected parties, namely the MST Nations. The City should continue its conversation with the three First Nations and their representatives to discuss how and in what manner they want to be engaged in, while navigating the relationship between regulator and developer.

Best Practice Implementation

Special consideration should be given to how to best apply the practices discerned from the case studies. While the examples provided are exciting and innovative, they are also highly context specific, being closely connected to the environments and communities in which they reside. In most cases, the established precedents would need to be reconfigured to the context of Vancouver and the Jericho Lands. In other instances, certain precedents may not be appropriate or are difficult to apply given differing local conditions. Provided this, it is important to consider the case studies for what they are: examples of global sustainability precedents on large redevelopment sites that provide inspiration for what could be done on the Jericho Lands.

In light of the interest to-date in certain topics amongst the public, this section will briefly elaborate on how the case studies within this report can provide direction upon transportation, water management, system-scale sustainability innovations, and natural systems.

Transportation

Several of the case studies provided interesting directions for how to implement sustainable transportation solutions. Perhaps the most well-studied and prominent example is of the car-reduced traffic concept of Vauban. In this example, pedestrians and cyclists are given priority, with a network of dedicated pathways and transit options providing an interconnected and efficient transportation network that is sustainable. In terms of home ownership, Vauban has effectively decoupled the cost of housing from the cost of owning a parking space, which in turn passes the source-related cost savings onto residents. Centralized parkades have been provided along the district's main roadways for those that wish to drive, but the inner streets remain off-limits for automotive traffic and parking. Stockholm Royal Seaport followed a similar car-reduced concept in several of its neighbourhoods. Development of the district is set to follow a phased approach, with the first development phases providing limited parking spaces and later phases restricting the streets even further to become almost car free and traffic free zones.

Most of the case studies had developed some form of a comprehensive transit network into the neighbourhood's design. Bahnstadt provides a well-integrated transportation network for its residents, utilizing buses, trams and commuter rail as options for travel. Stockholm Royal Seaport aims to provide accessible and sustainable neighbourhoods through the implementation of walking, cycling and electric vehicle infrastructure. Västra Hamnen encourages public transport through the use of policies promoting cycling and public transport as a means of reducing car dependency and improving residents' quality of life.

Electric and carshare vehicles were also a popular focus of the case studies. Bahnstadt developed a large carsharing fleet of electric vehicles for use by residents with plans to grow the program considerably in coming years. Carsharing is also present and prominent within Västra Hamnen.

Water Management

Three strategies for water management were employed within the case studies. Reducing water consumption was achieved at Barangaroo South through the development of an innovative water-cooling network and

recycled water treatment plants. All of the air conditioning in Barangaroo South is provided through a district cooling plant, which employs water from Sydney Harbour for heat rejection. This single, centralized system lowers energy consumption, increases cost savings, and avoids using drinking water to dissipate heat from buildings, reducing demand on local aquifers and water resources.

The reuse of water was achieved at Dockside Green through an on-site wastewater treatment plant. This new facility was created to treat and filter all of the sewage and gray water generated by residents and commercial tenants of Dockside Green. The residual reclaimed water is then reused on-site for toilets, rooftop garden irrigation, and for landscape irrigation. Barangaroo South aims to repurpose and export water as a part of becoming a water positive precinct.

The diversion and management of water was achieved at Wesbrook Village through the implementation of a comprehensive stormwater management strategy. The *South Campus Stormwater Management Strategy* provides guidance on the development, design and operational strategies for stormwater management at Wesbrook Village, providing a wide-array of approaches for developers to employ. Several different approaches to stormwater management were incorporated into the village's design, including green rooftops, infiltration trenches, rock pits, rain gardens, greens streets, swales, linear detention or infiltration basins, cisterns, stormwater fountains, stormwater treatment facilities, waterways and wetlands. Dockside Green managed stormwater within the district through a series of rain gardens and permeable paving surfaces that direct water into a local watercourse that flows into Victoria's Upper Harbour.

System-Scale Sustainability Innovations

System-scale sustainability innovations were the most common example presented within the case studies. These district-wide systems provide an excellent opportunity to reduce infrastructure costs while increasing energy savings. Three primary district systems were discussed within the case studies: energy, water and waste.

In terms of energy systems, the energy concept of Bahnstadt proved the feasibility of energy efficient buildings and a district energy supply at scale. To do this, Bahnstadt employed a large wood chip-powered combined heat and power plant to supply the district with enough energy and heating to fully meet demand while reducing the net carbon dioxide emissions to near-zero percent. Barangaroo South created a decentralized solar power station atop the rooftops of various buildings, producing enough power to cover the energy demand for public spaces and waste water recycling facilities. HafenCity made use of decentralized geothermal and solar thermal power to supplement the standard complement of renewable and standard energy sources.

Hammarby Sjöstad developed a closed-loop energy system for houses, offices and other commercial structures that became known as the Hammarby Model. The energy cycle of the model focuses on connecting the different energy sources into a single comprehensive network, actively balancing imported external energy and local energy from the power plant. Västra Hamnen achieved energy self-sufficiency by producing on-site renewable energy, with an emphasis placed on wind power. The district also employed an innovative heating and cooling system that made use of a local aquifer beneath Västra Hamnen for further energy savings and storage.

District-wide infrastructure for water was popular amongst the case studies. In addition to the three examples detailed within the water management discussion, Hammarby Sjöstad integrated the management of rainwater, wastewater, and sewage into one system.

Unique to Hammarby Sjöstad, the Hammarby Model also managed neighbourhood waste through a series of underground pipes that transported discarded materials to a centralized area for conversion to energy. Waste to energy flows varied depending on the specific waste: organic waste was used for the production of biogas and fertilizer; combustible waste was provided for district heating and electricity; recyclable material was recycled; and hazardous waste was either incinerated or recycled.

Natural Systems

The last point of interest - natural systems – includes the topics of permaculture and ecology. In regard to permaculture, Treasure Island's Urban Agricultural Park establishes an exciting precedent for urban food production. The large urban farm is intended to serve as an educational and recreational amenity for the community, providing an opportunity for residents and visitors to experience farming and taste locally produced goods. In addition

to the educational components, local farmers and community members will have the opportunity to manage plots and create produce that satisfies the needs of the community and market conditions. Consideration is also being given to dedicating a portion of the Urban Agricultural Park for commercial purposes, producing crops that can be then sold to residents on the island. Along with the countless health and social benefits provided to the surrounding community, the Urban Agricultural Park will play an important role in closing the resource loops for water and organic waste on the island.

The proper functioning of urban environments involves the integration and support of natural systems. Ecology is concerned with the interactions between organisms and their environment, including both the natural and urban environments. Two examples within the case studies provided interesting insights with how to support natural systems. Stockholm Royal Seaport, with their 'leaving nature to do the work' goal, focuses on integrating water and green structures into the built environment as to provide important ecosystem services.

These ecosystems services include flood protection, temperature regulation, recreation opportunities, greater biodiversity and strengthened dispersal patterns for key species. This goal is achieved through a series of parks, courtyards and other green spaces distributed throughout Stockholm Royal Seaport, forming a green network that helps to create a more resilient urban district. Stockholm Royal Seaport also developed a planning tool known as the Green Space Index to provide a metric to compare sites and ensure that green infrastructure provides essential ecosystem services for the district.

Västra Hamnen focused on strategies to promote biodiversity within the region, looking to incorporate a variety of different habitats within the inner city to encourage breeding opportunities for varied flora and fauna and the overall flourishing of the environment. Several biodiversity strategies were employed in Västra Hamnen, including the emulation of natural environments and the planting of pollinator friendly plants.

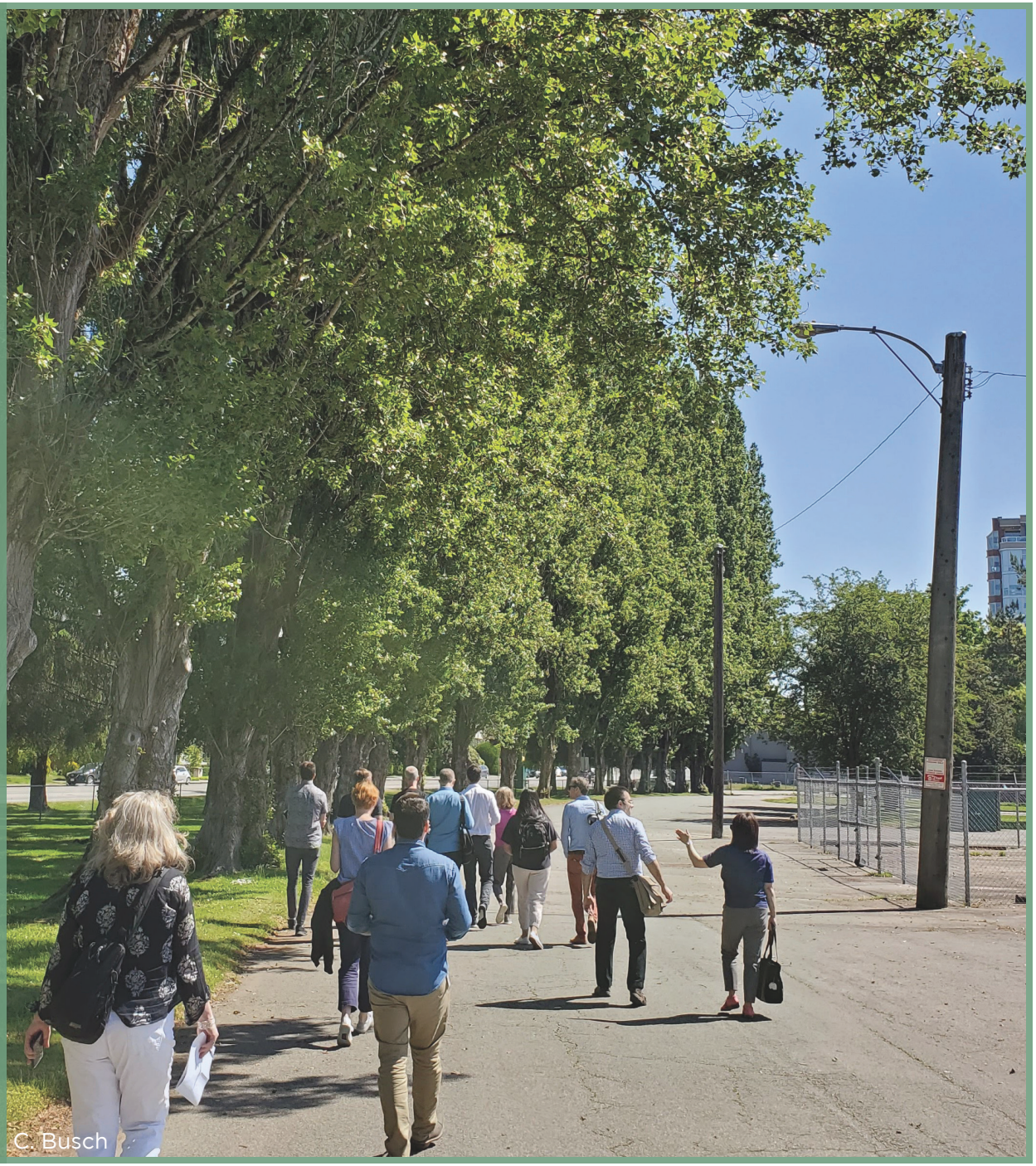
Final Notes

The case studies provided are a tool for inspiring a deeper and more effective conversation with the public and project stakeholders during development of the policy statement. This information can be expressed through several methods, including presentations, information boards, or as a report made available on the City of Vancouver's project website. All of the resources used in the creation of this report, including documents and pictures, are available and freely accessible through the internet. In particular, the media collected for this report should prove helpful in the City of Vancouver's ongoing engagement activities.

It should be noted that while the 13 case studies presented within this report are considered by the author to be the best examples of global sustainability precedents, they do not represent an exhaustive list. Several other examples of innovative sustainability solutions in large-scale redevelopment sites exist, each of which are well worth consideration.

Conclusion

The Jericho Lands are a unique opportunity to pursue ambitious sustainability goals at scale. Provided the existing mandate outlined within the City of Vancouver's sustainability policies, the Jericho Lands can be a contemporary model for sustainable redevelopment within the local context. Leadership in sustainability can be demonstrated on-site through the exploration and development of environmental, economic and social innovations. Inspiration for these sustainability initiatives can be derived from the case studies explored within this research. Alongside the City's existing sustainability policies, these examples provide an excellent starting point for the future redevelopment of the Jericho Lands.



C. Busch

References

Architectus. (2014). Wynyard Quarter urban design framework. Retrieved from https://www.panuku.co.nz/downloads/assets/4983/1/wynyard%20quarter%20urban%20design%20framework.pdf

Arup. (2019). Transportation planning and sustainability consulting. Retrieved from https://www.arup.com/projects/treasure-island

The Atlantic. (2011). Is this the world's greenest neighbourhood? Retrieved from https://www.theAtlantic, 2011.com/international/archive/2011/08/is-this-the-worlds-greenest-neighbourhood/244121/#.TlfelYgBaMU.twitter

Barangaroo Delivery Authority. (2015). Public art and cultural plan. Retrieved from https://barangaroo.zendesk.com/hc/article_attachments/115016038028/Barangaroo%20public%20art%20and%20cultural%20plan%202015.pdf

Barangaroo Delivery Authority. (2017). The Barangaroo project. Retrieved from https://www.barangaroo.com/the-project/

Canadian Broadcasting Company. (2019). B.C. passes law to increase sales of zero emission vehicles. Retrieved from https://www.cbc.ca/news/canada/british-columbia/zero-emission-vehicles-2040-b-c-1.5155274

Castor, D. (2014). Skyskrapan Turning Torso höjer sig högt över resten av Västra Hamnen. Retrieved from https://sv.wikipedia.org/wiki/V%C3%A4stra_hamnen#/media/Fil:V%C3%A4stra_hamnen%E2%80%93flygbild_06_september_2014.jpg

C40 Cities. (2015). Stockholm – Stockholm Royal Seaport. Retrieved from https://www.c40.org/awards/2015-awards/profiles/70

C40 Cities. (2016). Auckland – Wynyard Quarter redevelopment. Retrieved from https://www.c40.org/awards/2016-awards/profiles/110

C40 Cities. (2017). The Bahnstadt project in Heidelberg. Retrieved from https://www.c40.org/case_studies/the-bahnstadt-project-in-heidelberg

C40 Cities. (2019). Climate positive development program. Retrieved from https://www.c40.org/other/climate-positive-development-program

Canada Lands Company. (2019). Inspire Jericho. Retrieved from https://inspirejericho.ca/

China Development Bank Capital. (2015). Hammarby Sjöstad: An urban development case study of Hammarby Sjöstad in Stockholm, Sweden. Retrieved from http://www.hammarbysjostad.eu/wp-content/uploads/2017/10/Hammarby-Sjostad.pdf

City of Freiburg. (n.d.). Solar settlement & sun ship. Retrieved from https://visit.freiburg.de/en/attractions/solar-settlement-sun-ship

City of Heidelberg. (2017). Bahnstadt. Retrieved from https://www.heidelberg.de/1003686.html

City of Heidelberg. (2019). Heidelberg – City and citizens together for climate protection. Retrieved from https://www.heidelberg.de/1003686.html

City of Helsinki. (n.d.). Smart Kalasatma. Retrieved from https://fiksukalasatama.fi/wp-content/uploads/2015/08/Fiksu_KS_MIPIM_FINAL_web_spreads.pdf

City of Malmö. (n.d.). Summary of Västra Hamnen's goals and design principles. Retrieved from http://www.monitoringmatters.org/ppdfc/malmoe1.pdf

City of Stockholm. (2017). Strategy for a fossil-fuel free Stockholm by 2040. Retrieved from https://international.stockholm.se/globalassets/rapporter/strategy-for-a-fossil-fuel-free-stockholm-by-2040.pdf

City of Sydney. (2016). Eora Journey economic development plan. Retrieved from https://www.cityofsydney.nsw.gov.au/business/build-your-skills-and-knowledge/business-research-and-data/business-in-your-sector/cross-sector-themes/aboriginal-employment-enterprise

City of Vancouver. (2010a). Point Grey. Retrieved from https://vancouver.ca/news-calendar/point-grey.aspx

City of Vancouver. (2010b). West Point Grey community vision. Retrieved from https://vancouver.ca/docs/planning/west-point-grey-community-vision-full-report.pdf

City of Vancouver. (2012a). Climate change adaptation strategy. Retrieved from https://vancouver.ca/green-vancouver/climate-change-adaptation-strategy.aspx

City of Vancouver. (2012b). Greenest city:

2020 action plan. Retrieved from https://vancouver.ca/files/cov/Greenest-city-action-plan.pdf

City of Vancouver. (2012c). Transportation 2040: moving forward. Retrieved from https://vancouver.ca/files/cov/transportation-2040-plan.pdf

City of Vancouver. (2013). What feeds us: Vancouver food strategy. Retrieved from https://vancouver.ca/files/cov/vancouver-food-strategy-final.PDF

City of Vancouver. (2014). Framework for city of reconciliation. Retrieved from https://council.vancouver.ca/20141028/documents/rr1.pdf

City of Vancouver. (2015a). Healthy city strategy – four year action plan: 2014-2025. Retrieved from https://vancouver.ca/files/cov/Healthy-City-Strategy-Phase-2-Action-Plan-2015-2018.pdf

City of Vancouver. (2015b). Renewable city strategy: 2015-2050. Retrieved from https://vancouver.ca/files/cov/renewable-city-strategy-booklet-2015.pdf

City of Vancouver. (2016a). Rainwater management plan and green infrastructure. Retrieved from https://council.vancouver.ca/20160419/documents/rr2.pdf

City of Vancouver. (2016b). Vancouver's EV ecosystem strategy. Retrieved from https://vancouver.ca/files/cov/EV-Ecosystem-Strategy.pdf

City of Vancouver. (2016c). Zero-emissions building plan. Retrieved from https://vancouver.ca/files/cov/zero-emissions-building-plan.pdf

City of Vancouver. (2017a). Housing Vancouver strategy. Retrieved from https://council.vancouver.ca/20171128/documents/rr1appendixa.pdf

City of Vancouver. (2017b). Renewable city action plan. Retrieved from https://vancouver.ca/files/cov/renewable-city-action-plan-november-2017.pdf

City of Vancouver. (2018a). Community benefit agreement policy. Retrieved from https://council.vancouver.ca/20180918/documents/rr2.pdf

City of Vancouver. (2018b). Green buildings policy for rezonings. Retrieved from https://guidelines.vancouver.ca/G015.pdf

City of Vancouver. (2018c). Greenest city - 2020 action plan: 2017-2018 implementation update. Retrieved from https://vancouver.ca/files/cov/greenest-city-action-plan-implementation-update-2017-2018.pdf

City of Vancouver. (2018d). Heather Lands policy statement. Retrieved from https://vancouver.ca/files/cov/heather-lands-policy-statement.pdf

City of Vancouver. (2018e). Making space for arts and culture: 2018 cultural infrastructure plan. Retrieved from https://vancouver.ca/docs/council/Making-Space-for-Arts-and-Culture-2018-Cultural-Infrastructure-Plan-Report-2018-07-10.pdf

City of Vancouver. (2018f). Rezoning policy for sustainable large developments. Retrieved from https://council.vancouver.ca/20180725/documents/pspc3.pdf

City of Vancouver. (2018g). Vancouver's changing shoreline: Preparing for sea level rise. Retrieved from https://vancouver.ca/files/cov/vancouvers-changing-shoreline.pdf

City of Vancouver. (2018h). Zero waste 2040. Retrieved from https://council.vancouver.ca/20180516/documents/pspc2a.pdf

City of Vancouver. (2019a). Climate change adaption strategy. Retrieved from https://vancouver.ca/files/cov/Vancouver-Climate-Change-Adaptation-Strategy-2012-11-07.pdf

City of Vancouver. (2019b). Climate emergency response. Retrieved from https://council.vancouver.ca/20190424/documents/cfsc1.pdf

City of Vancouver. (2019c). Jericho Lands planning program. Retrieved from https://vancouver.ca/home-property-development/jericho-lands.aspx

City of Vancouver. (2019d). Jericho Lands engagement boards. Retrieved from https://vancouver.ca/files/cov/jericho-lands-city-information-display-march-2019.pdf

City of Vancouver. (2019e). Resilient Vancouver. Retrieved from https://vancouver.ca/files/cov/resilient-vancouver-strategy.pdf

City of Vancouver. (2019f). West Point Grey. Retrieved from https://vancouver.ca/news-calendar/point-grey.aspx

The Conversation. (2016). Reinventing density: how baugruppen are pioneering the self-made city. Retrieved from https://

theconversation.com/reinventing-density-how-baugruppen-are-pioneering-the-self-made-city-66488

Dittmeyer, R., Klumpp, M., Kant, P., & Ozin, G. (2019). Crowd oil not crude oil. Nature Communications. Retrieved from https://www.researchgate.net/publication/332770876_Crowd_oil_not_crude_oil

Dockside Green. (2014). Dockside Green 2014 annual report. Retrieved from http://www.docksidegreen.com/2014-annual-report/

Dockside Green. (2019a). Dockside Green. Retrieved from http://www.docksidegreen.com/

Dockside Green. (2019b). BETA. Retrieved from http://www.docksidegreen.com/beta/

Dream Planet. (2018). Baugruppen: A new housing affordability model. Retrieved from https://www.dreamplanet.com.au/baugruppen-a-new-housing-affordability-model/

EcoDistricts. (n.d.). Stockholm Royal Seaport. Retrieved from https://ecodistricts.org/information-exchange/stockholm-royal-seaport/

Energy BPT Group. (2015). A field trip to the Vauban Ecodistrict. Retrieved from https://energybptgroup.wordpress.com/2015/04/12/a-field-trip-to-the-vauban-ecodistrict/

Energy Matters. (2011). Centralized vs. decentralized solar power. Retrieved from https://www.energymatters.com.au/renewable-news/em1480/

E.ON. (n.d.). The sustainable city: 100 percent locally renewable energy in the Västra Hamnen district. Retrieved from https://www.ukgbc.org/sites/default/files/Malmo%2520-%2520Case%2520study%2520-%2520sustainable%2520community%2520infrastructure.pdf

Flextila. (n.d.). Kalasatama urban lab. Retrieved from https://flextila.com/spaces/349

Foller. (n.d.). Foller. Retrieved from www.foller.fi

Franko, A. (2010). Vauban: A sustainable brownfield. Retrieved from http://blogs.ubc.ca/landscapesofenergy/files/2010/12/Vauban-Georgepdf1.pdf

Freiburg-Vauban. (n.d.). Vauban. Retrieved from https://freiburg-vauban.de/en/quartier-vauban-2/

Global Ecovillage Network. (2018). Forum-Vauban: Building a sustainable urban future. Retrieved from https://ecovillage.org/project/forum-vauban/

The Guardian. (2008). Is this the greenest city in the world? Retrieved from https://www.theguardian.com/environment/2008/mar/23/freiburg.germany.greenest.city

The Guardian. (2016). Barangaroo: Sydney's largest urban renewal project aims to recycle more water than it uses. Retrieved from https://www.theguardian.com/sustainable-business/2016/sep/05/barangaroo-sydneys-largest-urban-renewal-project-aims-to-recycle-more-water-than-it-uses

HafenCity. (n.d.). Overview. Retrieved from https://www.hafencity.com/en/overview.html

Huffpost. (2016). Helsinki: A very smart city. Retrieved from https://www.huffpost.com/entry/helsinki-a-very-smart-cit_b_10436858

Ignatieva, M. (2014). Hammarby Sjöstad — A new generation of sustainable urban eco-districts. Retrieved from https://www.thenatureofcities.com/2014/02/12/hammarby-sjostad-a-new-generation-of-sustainable-urban-eco-districts/

IINAS. (2019). GEMIS: Global emissions model for integrated systems. Retrieved from http://iinas.org/gemis.html

Institute for Transportation & Development Policy. (2011). Europe's vibrant low car(bon) communities. https://www.itdp.org/2011/09/22/europes-vibrant-new-low-carbon-communities-2/

Kyyti. (2019). Kyyti makes daily travel easy. Retrieved from https://www.kyyti.com/

Landlease. (n.d.). Barangaroo South. Retrieved from https://www.barangaroosouth.com.au/

Landlease. (2013a). A world class sustainability plan for a world class precinct: Barangaroo South. Retrieved from https://www.llwebstore.com/flippingbook/Development/BarangarooSouth/SustainabilityPlan/

Landlease. (2013b). Barangaroo provides more than 500 indigenous employment and training opportunities. Retrieved from https://resource.barangaroo.com/hc/article_

attachments/115015152988/20130220%20Barangaroo%20provides%20more%20than%20500%20indigenous%20employment%20and%20training%20opportunities.pdf

Materialsemiotic. (2010). Vauban, learning while playing. Retrieved from https://materialsemiotic.wordpress.com/tag/baugruppen/

McDonald, L. (2014). Dockside green wastewater treatment plant: A review of plant performance and regulatory compliance. Retrieved from https://pdfs.semanticscholar.org/e/3e12494c351ac40038b9cfe884b15fc837a6.pdf

Mesenaatti. (2015). Nifty neighbor – place to care. Retrieved from http://mesenaatti.me/en/nappi-naapuri-valittamisen-paikka/

National Geographic. (2012). Europe's 'first carbon-neutral neighbourhood': Western Harbour. Retrieved from https://www.nationalgeographic.com/environment/great-energy-challenge/2012/europes-first-carbon-neutral-neighbourhood-western-harbour/

New Zealand Tourism Guide. (2019). Auckland history. Retrieved from https://www.tourism.net.nz/new-zealand/about-new-zealand/regions/auckland/history.html

Nordregio. (2018). Smart Kalasatama. Retrieved from http://www.nordregio.org/sustainable_cities/smart-kalasatama/

Panuku Development Auckland. (2019a). Smart Console. Retrieved from http://www.wynyard-quarter.co.nz/wqsmart/smart-console

Panuku Development Auckland . (2019b). WQ Smart. Retrieved from http://www.wynyard-quarter.co.nz/wqsmart/

Panuku Development Auckland. (2019b). Wynyard Quarter .Retrieved from https://www.wynyard-quarter.co.nz/

Popular Mechanics. (2009). Why Treasure Island is the super-green city of the future. Retrieved from https://www.popularmechanics.com/science/environment/a2442/4239381/

Rakennusleti. (2018). Rakennus on paljon vartija – Osataanko rakennetussa ympäristössä arvioida riskejä oikein? Retrieved from https://www.rakennuslehti.fi/2018/04/rakennus-on-paljon-vartija-osataanko-rakennetussa-ymparistossa-arvioida-riskeja-oikein/

Rennie. (2016). In the heart of UBC's Wesbrook Village. Retrieved from https://rennie.com/rennie-post/ubcs-wesbrook-village

Sandeman's New Europe. (2019). Speicherstadt & HafenCity tour. Retrieved from https://www.neweuropetours.eu/sandemans-tours/hamburg/speicherstadt-and-harbor-city-tour/

San Francisco Arts Commission. (2017). Treasure Island arts master plan. Retrieved from https://www.sfartscommission.org/sites/default/files/pdf/SFAC_MasterPlan%20AKL%20070717.pdf

Skyscraper City. (2008). Copenhagen/Malmö: Two nations, one metropolis. Retrieved from https://www.skyscrapercity.com/showthread.php?p=30871604&

Skyscraper City. (2012). Sustainable Malmö. Retrieved from https://www.skyscrapercity.com/showthread.php?t=1375085&page=2

Smart Cities Dive. (n.d.). The world's most successful model for sustainable urban development? Retrieved from https://www.smartcitiesdive.com/ex/sustainablecitiescollective/words-most-successful-model-sustainable-urban-development/229316/

Smart Kalasataam. (n.d.). Cook book: Recipes for agile pilots. Retrieved from https://helsinki-finland.fi/materials/Smart_Kalasatama_Agile_Pilots_CookBook.pdf

Stockholm City Development Administration. (2012). Vision 2030. Retrieved from https://international.stockholm.se/globalassets/ovriga-bilder-och-filer/visionsrs2030_medium.pdf

Stockholm City Development Administration. (2018). Stockholm Royal Seaport sustainability report: 2017. Retrieved from https://vaxer.stockholm/globalassets/omraden/-stadsutvecklingsomraden/ostermalm-norra-djurgardsstaden/royal-seaport/media/sustainability_report_2017_uppslag_eng_juni_2018.pdf

Stockholm City Development Administration. (n.d.). Sustainable urban development programme. Retrieved from https://växer.stockholm/globalassets/omraden/-stadsutvecklingsomraden/ostermalm-norra-djurgardsstaden/royal-seaport/media/sustainable_urban-development-programme.pdf

Study in Sweden. (n.d.). Accommodation.

Retrieved from https://studyinsweden.se/life-in-sweden/accommodation/

Sustainability Times. (2019). A small smart city in Finland shows the way on sustainability. Retrieved from https://www.sustainability-times.com/clean-cities/a-small-smart-city-in-finland-shows-the-way-on-sustainability/

Sustainia & C40 Cities. (2015). Cities100. Retrieved from https://www.mm.dk/pdffiles/Cities100_2015.pdf

TransLink. (2019). Broadway Subway Project. Retrieved from https://www.translink.ca/Plans-and-Projects/Rapid-Transit-Projects/Broadway-Subway-Project.aspx

Terrain. (2017). Dockside Green. Retrieved from https://www.terrain.org/unsprawl/25/

Thorpe, D. (2014). The 'one planet' life: A blueprint for low impact development. Routledge.

Treasure Island Development Authority. (2011). Treasure Island/Yerba Buena Island sustainability plan. Retrieved from https://sftreasureisland.org//sites/default/files/Documents/Master_Develpment_Submittals/2011_Entitlements_Presentations/04.21.11_TIDA_Joint_Hearing_Materials/Treasure_Island_2011.04.13_screen_versionPART2.pdf

Treasure Island Development Authority. (2015). Treasure Island & Yerba Buena Island major phase 1 application. Retrieved form https://sftreasureisland.org/majorphase1

Treasure Island Museum. (2017). Island history. Retrieved from https://www.treasureislandmuseum.org/island-history

The University of British Columbia. (2005). A sustainable drainage strategy for the south campus neighbourhood. Retrieved from http://blogs.ubc.ca/saladesigncharrette/files/2017/05/South-Campus-Stormwater-Mgmt-Strategy_2005.pdf

The University of British Columbia. (2015). A brief history of UBC. Retrieved from https://archives.library.ubc.ca/general-history/a-brief-history-of-ubc/

The University of British Columbia. (2016). Wesbrook Place neighbourhood plan. Retrieved from https://planning.ubc.ca/sites/planning.ubc.ca/files/documents/planning-services/policies-plans/WPNP-Apr2016.pdf

The University of British Columbia. (2018). Residential Environmental Assessment Program (REAP 3.1). Retrieved from https://planning.ubc.ca/sites/planning.ubc.ca/files/images/planning-services/policies-plans/REAP%203.1%20Reference%20Manual.pdf

The University of British Columbia. (2019). UBC overview and facts. Retrieved from https://www.ubc.ca/about/facts.html

University Neighbourhoods Association. (n.d.). Sustainability. Retrieved from https://www.myuna.ca/sustainability/

United Nations Conference on Trade and Development. (2013). Science, technology and innovation for sustainable cities and peri-urban communities. Retrieved from https://unctad.org/meetings/en/Presentation/cstd2013_Miroux.pdf

United States Department of Energy. (n.d.). Zero energy buildings. Retrieved from https://www.energy.gov/eere/buildings/zero-energy-buildings

Utility Magazine. (2018). The basement powering Barangaroo. Retrieved from https://utilitymagazine.com.au/the-basement-powering-barangaroo/

Vancouver Archives. (2017). Habitat Forum photographs now online. Retrieved from https://www.vancouverarchives.ca/2017/09/26/habitat-forum-photographs-now-online/

Vancouver Board of Parks and Recreation. (2016). Vancouver biodiversity strategy. Retrieved from https://vancouver.ca/files/cov/biodiversity-strategy.pdf

Vancouver Board of Parks and Recreation. (2018). VanPlay report 2: Goals to shape the next 25 Years. Retrieved from https://vancouver.ca/files/cov/vanplay-report-2-goals-to-shape-the-next-25-years.pdf

Vancouver Economic Commission. (2011). The Vancouver economic action strategy: An economic development plan for the city. Retrieved from https://vancouver.ca/files/cov/vancouver-economic-action-strategy.pdf

Vancouver Heritage Foundation. (n.d.). Jericho School for the Deaf. Retrieved from https://www.vancouverheritagefoundation.org/place-that-matters/jericho-school-for-the-deaf/

Vancouver Sun. (2014). Huge land deal opens big tracts of Vancouver to development. Retrieved from http://www.vancouversun.com/business/commercial-real-estate/+land

+deal+opens+tracts+Vancouver+development/10252565/story.html

Vancouver Sun. (2016). Remaining Jericho Lands sold to three First Nations for $480 million. Retrieved from https://vancouversun.com/business/local-business/remaining-jericho-lands-sold-to-three-first-nations-for-480-million-2

Victoria State Government. (2016). Fishermans Bend vision: The next chapter in Melbourne's growth story. Retrieved from https://www.fishermansbend.vic.gov.au/__data/assets/pdf_file/0023/30389/Final_Vision_LR_single_page.pdf

Victoria State Government. (2017). Fishermans Bend sustainability strategy. Retrieved from https://www.fishermansbend.vic.gov.au/__data/assets/pdf_file/0020/31682/Sustainability-Strategy_-FB-Taskforce_14-September-2017_hi_res.pdf

Victoria State Government. (2018). Fishermans Bend framework. Retrieved from https://www.fishermansbend.vic.gov.au/__data/assets/pdf_file/0020/35093/Fishermans-Bend-Framework.pdf

Victoria State Government. (2019). Fishermans Bend. Retrieved from https://www.fishermansbend.vic.gov.au/

Waterfront Auckland. (2013a). Sustainable development framework. Retrieved from http://wynyard-quarter.co.nz/www/uploads/widgets/files/sustainable-dev-framework-8c78bcfbe5.pdf

Waterfront Auckland. (2013b). Wynyard Quarter design guidelines. Retrieved from http://www.wynyard-quarter.co.nz/wqsmart/www/pdfs/social/wynyard-central-design-guidelines.pdf

Waterfront Auckland. (2015). Climate change adaptation pathway. Retrieved from https://wynyard-quarter.co.nz/wqsmart/www/pdfs/climate/waterfront-auckland-climate-change-adaptation-pathway-february-2015.pdf

Wikipedia. (2018). Elbphilharmonie, Hamburg. Retrieved from https://cs.m.wikipedia.org/wiki/Soubor:Elbphilharmonie,_Hamburg.jpg