Quayside: Sustainability

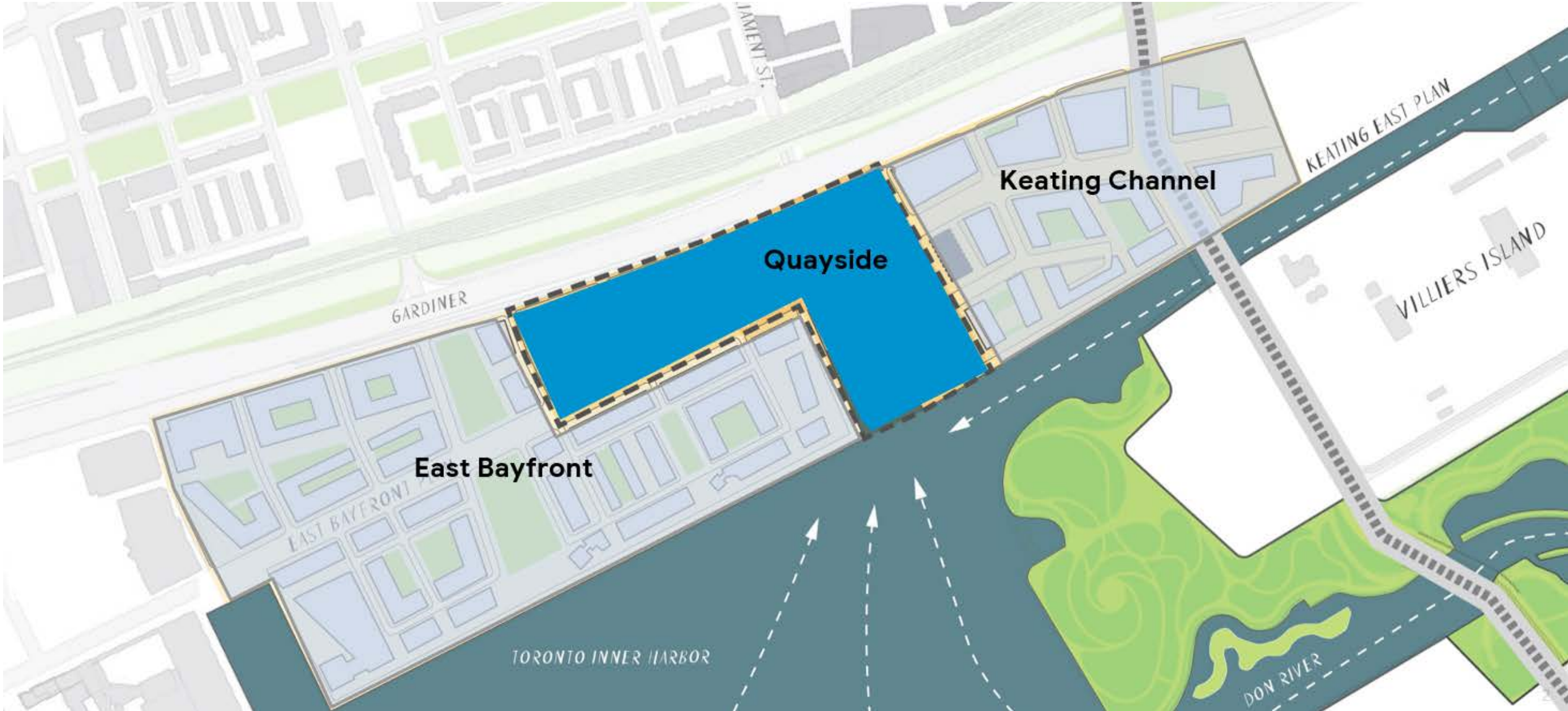
Issues Identification

January 23rd, 2019

Quayside Context

Site Location

WATERFRONToronto



Quayside Context

East Bayfront & Keating Channel Precinct Plans

WATERFRONTToronto

Quayside Context

East Bayfront & Keating Channel Precinct Plan Principles

Encourage and support **pedestrians, cyclist and transit** users over private automobile use

Create a district that serves as a model for **environmental sustainability**

Support the integration of **infrastructure systems**

Publicly accessible water's edge promenade

Strengthen **visual connections** to the water from the city

Create a **series of special public spaces** at major north-south connections

Establish **Queens Quay** as an urban boulevard

Encourage active and **engaging ground floor** uses

Support a wide variety of residential and employment **uses and flexibility** across the precinct

Create an overall **mid-rise** built form stepping down to the water's edge

Support economic and social **diversity**

Foster connectivity to adjacent waterfront neighbourhoods

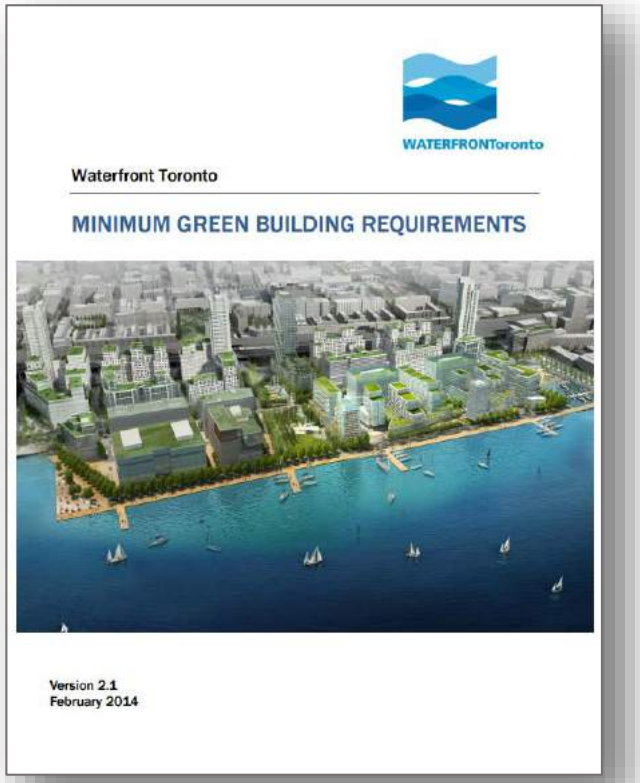
Create a wide range of **open spaces** will be the backbone of the precinct.

Quayside Context

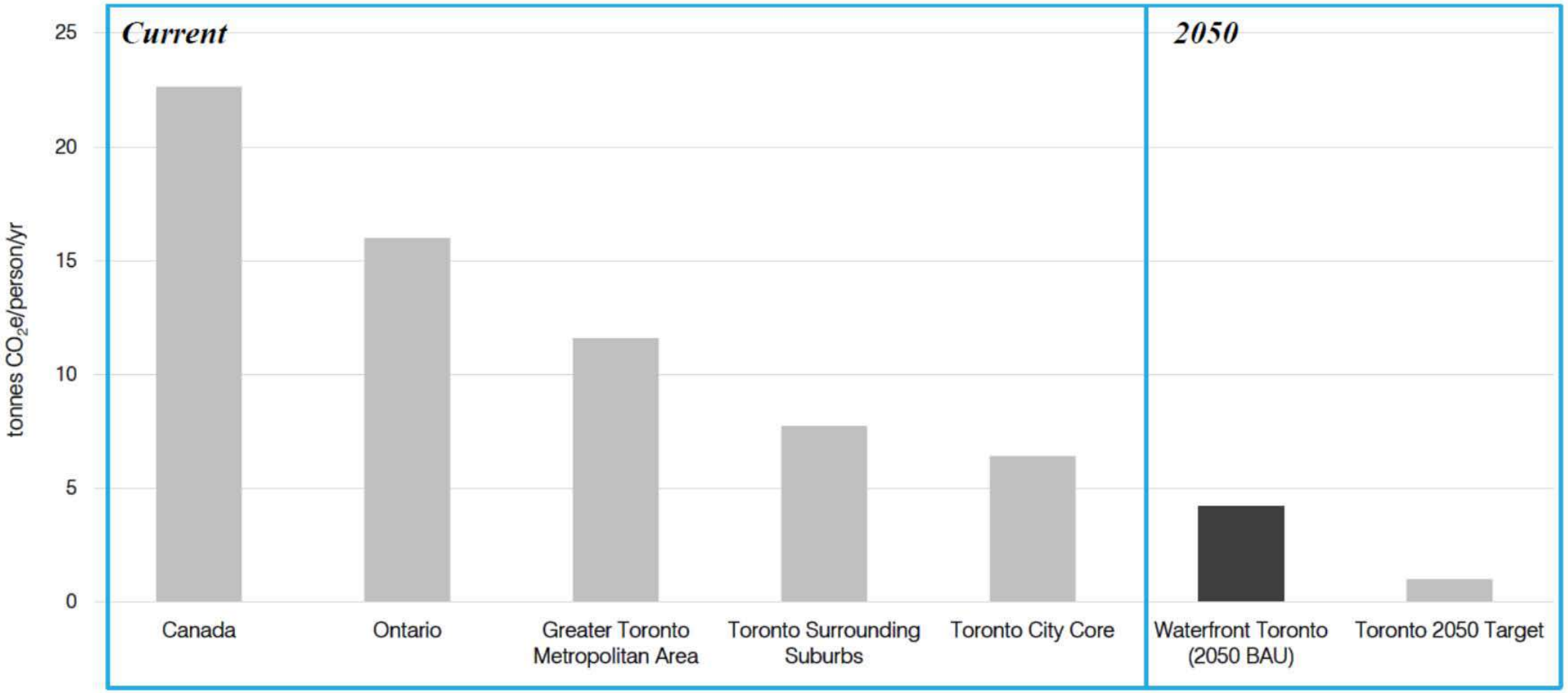
Background: Sustainability at Waterfront Toronto

- Minimum Green Building Requirements Version 2.1 (2014)
- Aiming to raise the bar on low-carbon development
- Contractually binding with penalties for noncompliance

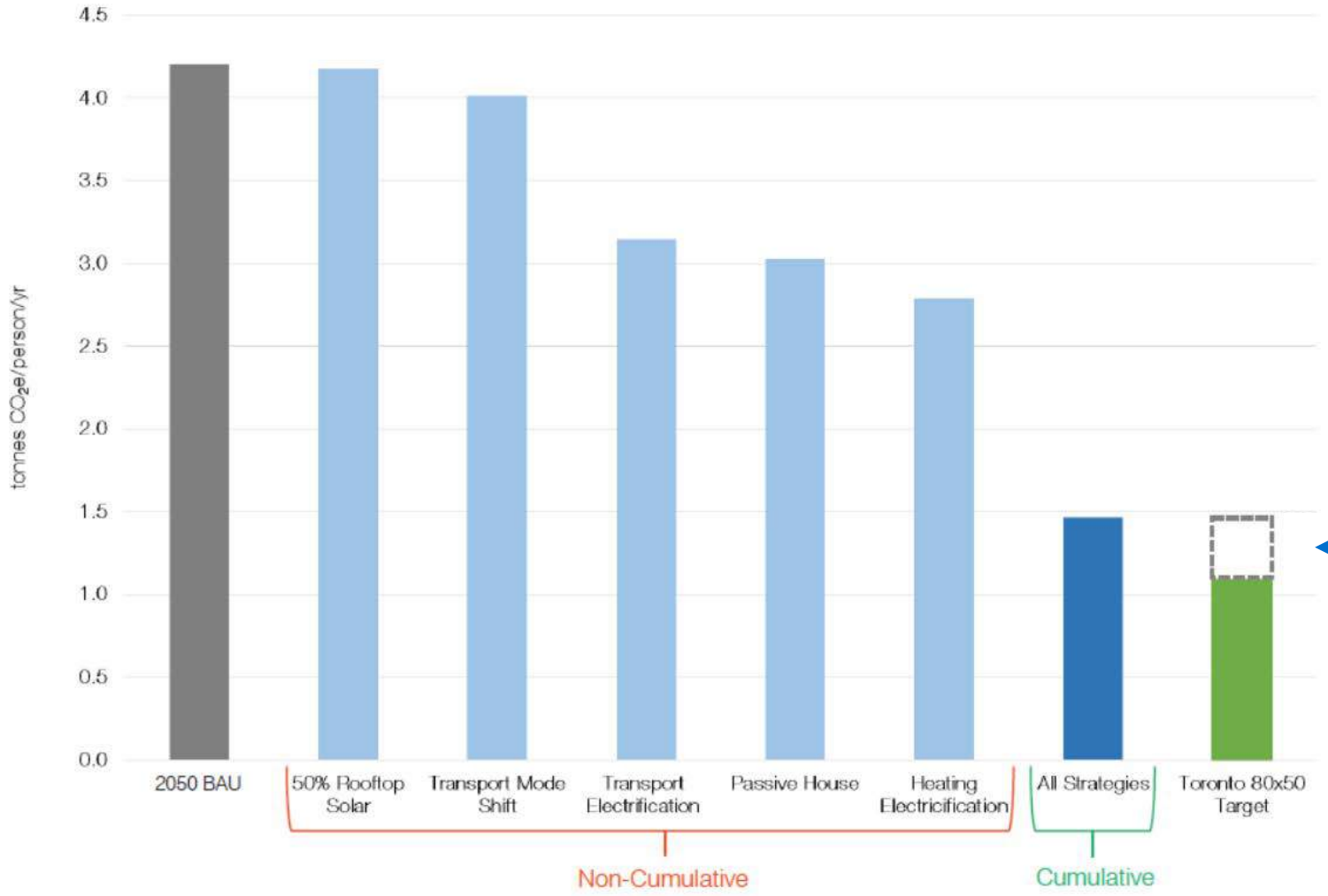
1. LEED Gold [energy, water]
2. Smart Building
3. Electric Vehicle Infrastructure
4. Green Roof
5. Engagement and Support
6. Bicycle Parking and Storage
7. Waste Management
8. District Energy
9. High Efficiency Appliances
10. Community Integration
11. Long Term Flexibility
12. Integrated Design Process



WT Business-as-Usual GHGs in 2050 vs. 80x50 Target

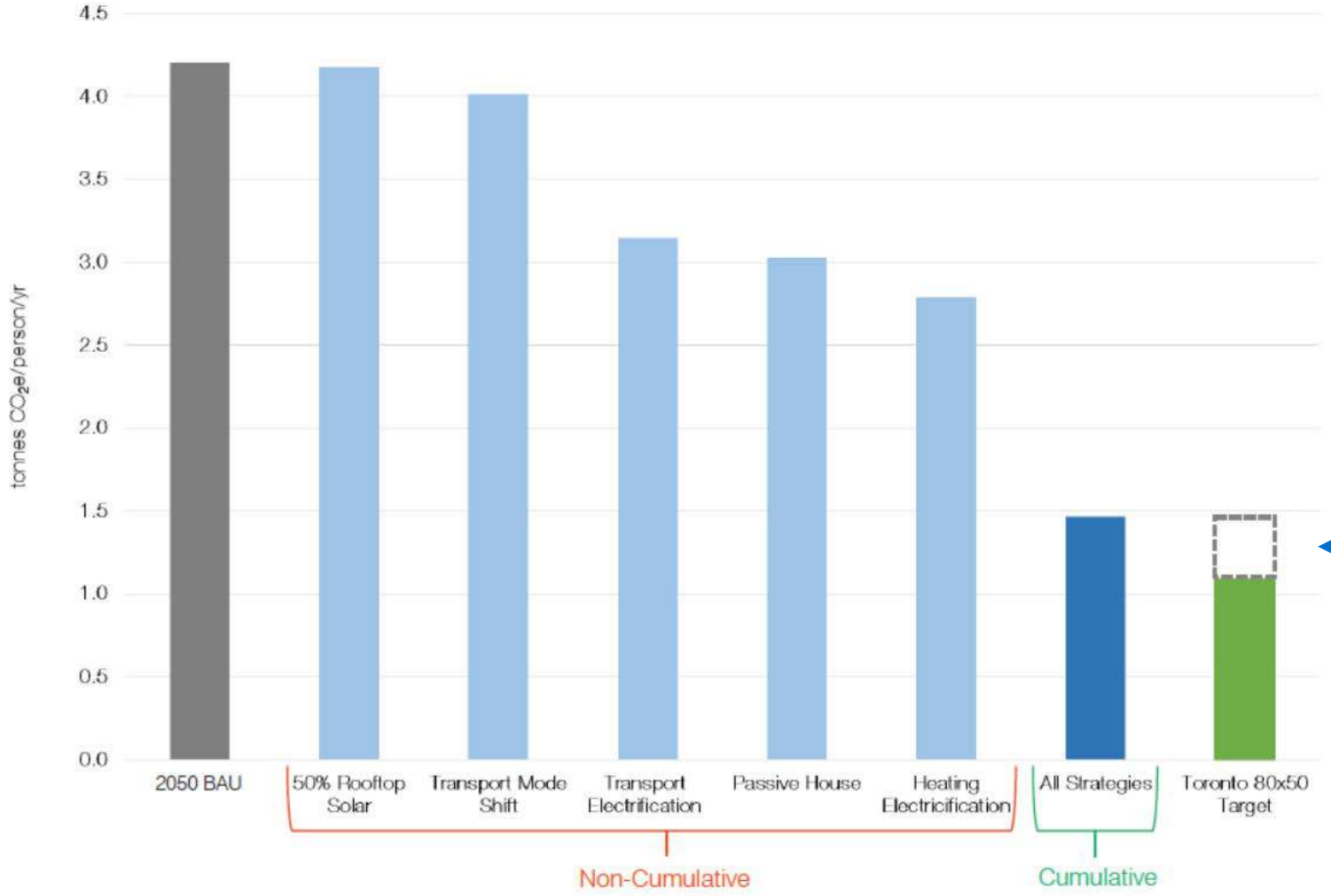


Background: Potential Strategies for GHG Reductions



Still 26% higher than Toronto 80x50 target

Background: Potential Strategies for GHG Reductions



Still 26% higher than Toronto 80x50 target

and CLIMATE+ Climate Positive Development Program **?**

Quayside Context

Waterfront Toronto RFP Objectives

1. Sustainability, Resiliency and Urban Innovation:

Create a globally significant demonstration project that advances a new market model for climate-positive urban developments.

2. Complete Communities:

Establish a complete community that emphasizes quality of place, and provides a range of housing types for families of all sizes and income levels within a robust mix of uses, including public open space, culture, recreation, vibrant retail, education-related activities and offices.

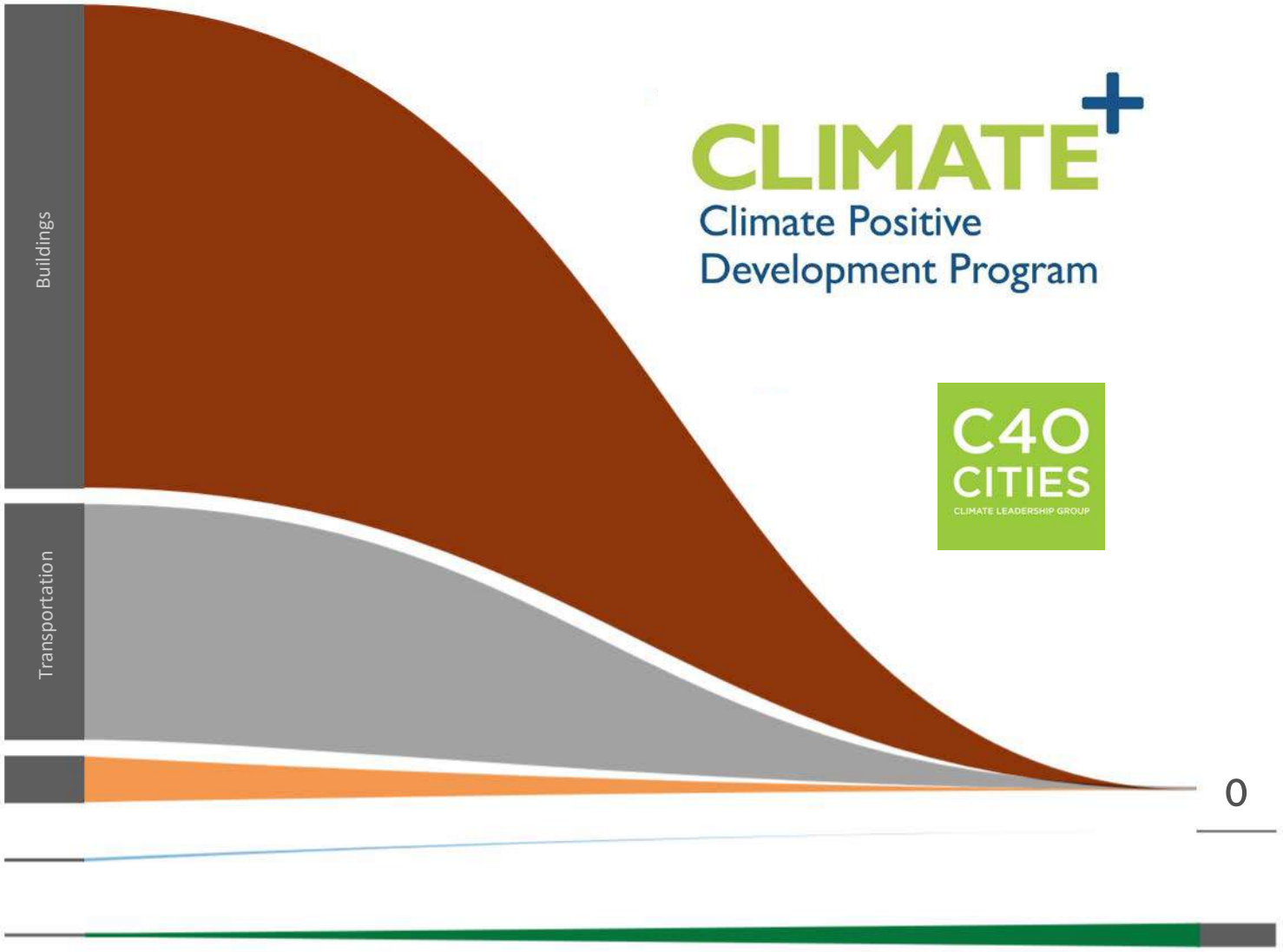
3. Economic Development and Prosperity:

Provide a testbed for Canada's cleantech, building materials and broader innovation-driven sectors to support their growth and competitiveness in global markets.

4. Partnership and Investment:

Develop a new partnership model that ensures a solid financial foundation, manages financial risk and secures revenue that funds future phases of waterfront revitalization.

What is ‘Climate Positive’ urban development?

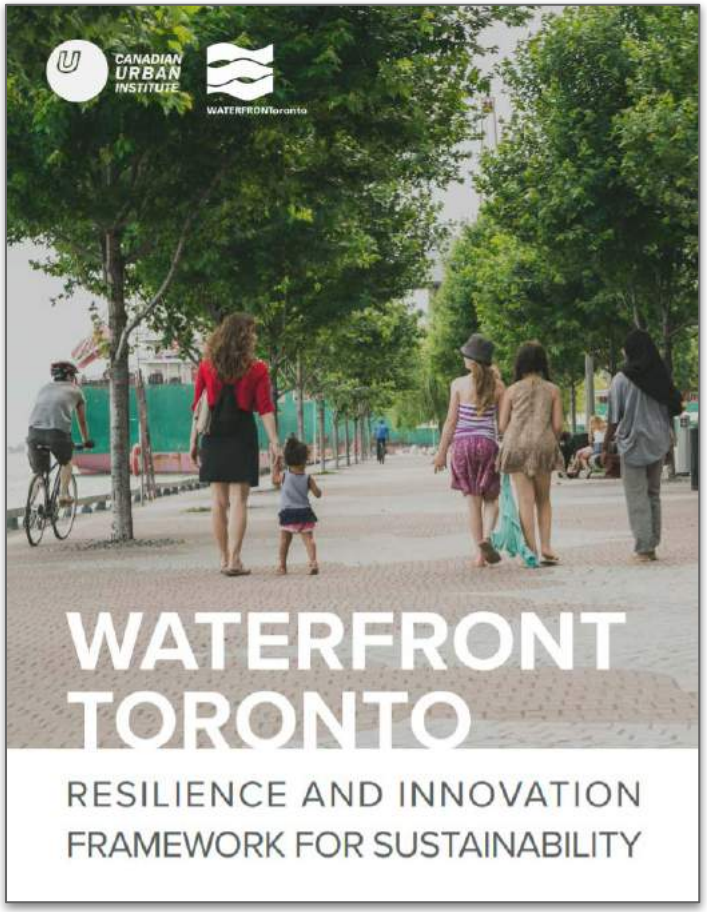


The Climate Positive Development Program supports the development of urban projects that seek to meet an emissions target of **net-negative operational greenhouse gas (GHG) emissions** associated with energy, waste and transportation.

This ambitious outcome is achieved by **reducing emissions on-site, and offsetting emissions by reducing carbon** in neighbouring communities.

What is 'Climate Positive' urban development?

- Aiming to create **replicable models** for large-scale urban communities that reduce GHG emissions to greatest possible extent.
- Seeking to **achieve the highest standards of sustainability** and deploy innovative climate resilient solutions.
- Projects often include **close collaboration with the public sector and private sector** to enable holistic planning and development.
- Currently 18 projects across six continents including the **Stockholm Royal Seaport** in Sweden, **Barangaroo** in Sydney, Australia, and **Elephant & Castle** in London, UK.



Published May 31, 2017

Waterfront Toronto Priority Objectives

Sustainability and Climate Positive Development

Enable the development of a neighborhood with below-zero annual greenhouse gas emissions at full build-out, as defined by the C40 Climate Positive Framework, with a further focus on:

- ✓ **Exemplary Building Standards** - Building design that supports Waterfront Toronto's climate positive aspirations, including aligning with the highest tier of the latest Toronto Green Standard. Buildings represent 60% of GHG emissions in Toronto.
- ✓ **Sustainable Mobility** - Infrastructure and policies that enable carbon emitting vehicles to be replaced with electric vehicles to achieve zero emissions and climate positive targets. Transportation represents 32% of GHG emissions in Toronto.
- ✓ **Affordable Utilities** - Ensure levels of affordability comparable to the average cost of utilities in Toronto.
- ✓ **Circular Economy** - Accelerate a local transition towards a circular economy that establishes a pathway to zero operational waste.
- ✓ **Resilient Infrastructure** - Address the Resilient TO initiative by better preparing buildings and infrastructure to survive and thrive in response to a changing climate and in emergencies.

Topics for Panel Consideration

- In your opinion, does the Sidewalk Toronto draft sustainability proposal meet or exceed Waterfront Toronto's objectives?

- Are there any other strategies or technologies would you like to see included in the Sidewalk Toronto draft sustainability proposal?

Sidewalk Labs

Sustainability

DRAFT

Consultants Engaged for MIDP Development

In addition to the generous contributions of multiple stakeholders and advisors, Sidewalk Labs' Sustainability strategy has been informed by the following consultants:

- Smarter Grid Solutions
- Stantec - Design engineering work
- Kerr Wood Leidal
- Lawrence Berkeley Labs (US National Lab)
- WSP - Sustainability and Energy
- BuildingGreen Inc.
- *Building Studies:* Building EQ, Urban Equations and Energy ProfilesOpti RTC
- Lion Advisors
- SD Global Advisors, LLC
- Deloitte (Infrastructure)
- TWG (The Working Group) - Software Company

Sidewalk Toronto also engaged an Advisory Group to provide feedback throughout the process with representation from MaRS Cleantech, the Canada Green Building Council, the Atmospheric Fund, the Centre for Social Innovation, Project Neutral, Canadian Urban Institute, Quality Urban Energy Systems of Tomorrow (QUEST), among others.

Sidewalk Toronto: Our Vision for Sustainability

At Quayside, we are creating a **fossil-fuel free, resilient neighbourhood** with **sustainable material use** and an **ecologically-enriched public realm.**

The project will set a new standard of sustainability that builds upon the vision of Waterfront Toronto and all three levels of government and shows a pathway to a climate positive community on the waterfront.

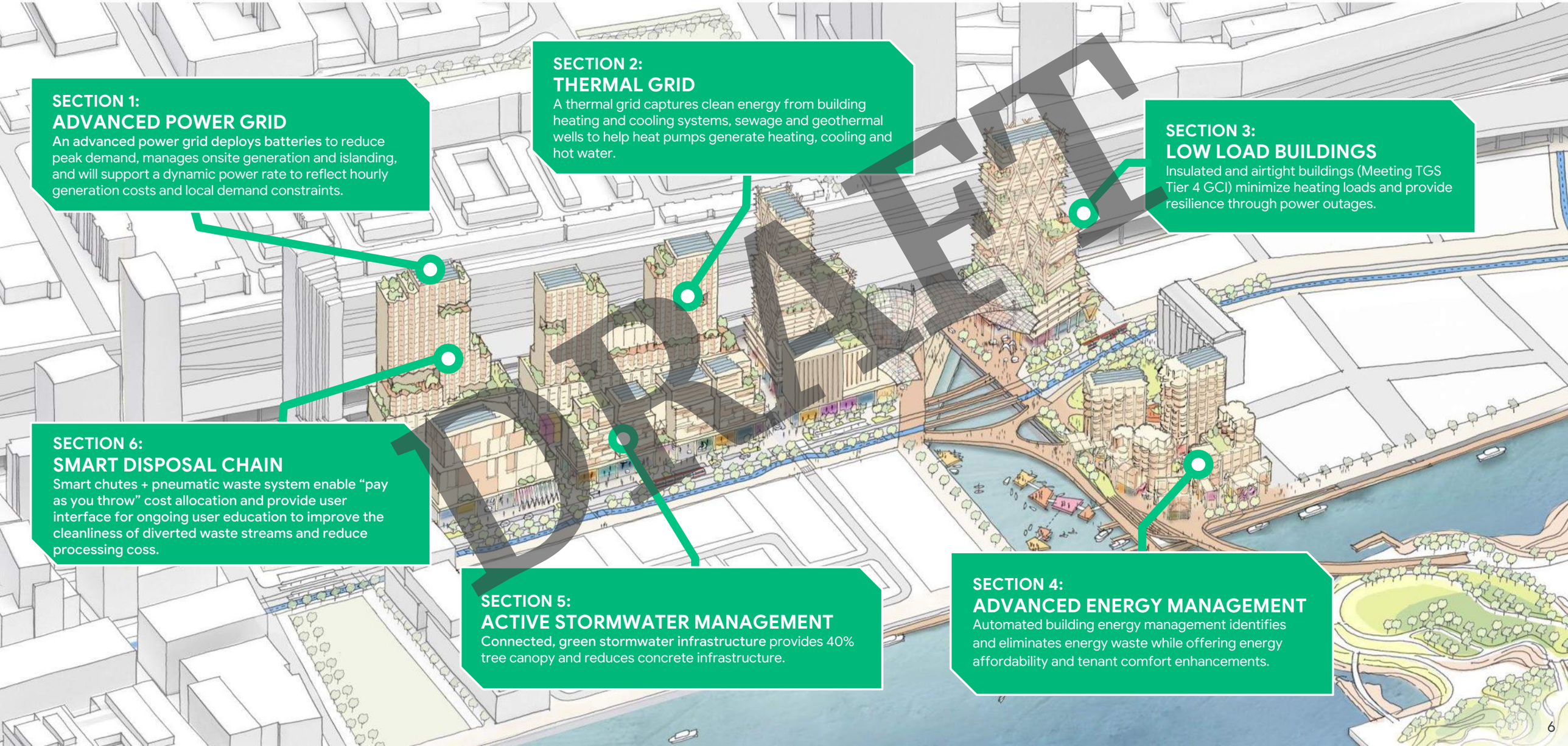
Alignment with City Policies and Goals

CITY OF TORONTO POLICY OR GOAL	SIDEWALK TORONTO VISION
Toronto Green Streets Technical Guidelines	Sidewalk Toronto will feature extensive green infrastructure (including **>40% tree canopy** and permeable pavers) to maximize capture of stormwater on-site, coupled with **sensors and active monitoring** to manage stormwater quantities and qualities (e.g. salinity, TSS).
Long Term Waste Management Strategy	Sidewalk Toronto is targeting **80% waste diversion from landfill**, enabled by feedback to residents & tenants and end use brokers on waste stream contents; reduced contamination via tri-chute pneumatic conveyance and “pay-as-you- throw” fees.
TransformTO	GHG modeling of Sidewalk Toronto’s strategy for Quayside calculates a **75% per capita GHG reduction**, on a path to net-negative. This exceeds the City’s targets of a **65% reduction in GHG emissions by 2030**, and **80% reduction by 2050**.
Wet Weather Flow (WWF) Management Guidelines	Sidewalk Toronto will deploy active management and monitoring to optimize extensive green infrastructure in the public realm, allowing for more than **25mm of stormwater retention**.
Resilient Toronto	Sidewalk Toronto will install DERs (**backup generation**, energy storage, solar PV) that can operate in a blackout; highly insulated buildings that maintain temperature for extended periods, a cooling center for extreme heat, and **flood-mitigating** public realm design.
Toronto Green Standard Version 3	Sidewalk Toronto is committed to **Tier 3 of Version 3 of the Toronto Green Standard,** and in many cases will achieve or exceed the highest levels, e.g., **Tier 4 greenhouse gas intensity** in pursuit of climate positive - currently modelled at **2.85 kg CO_2/m^2/year.**

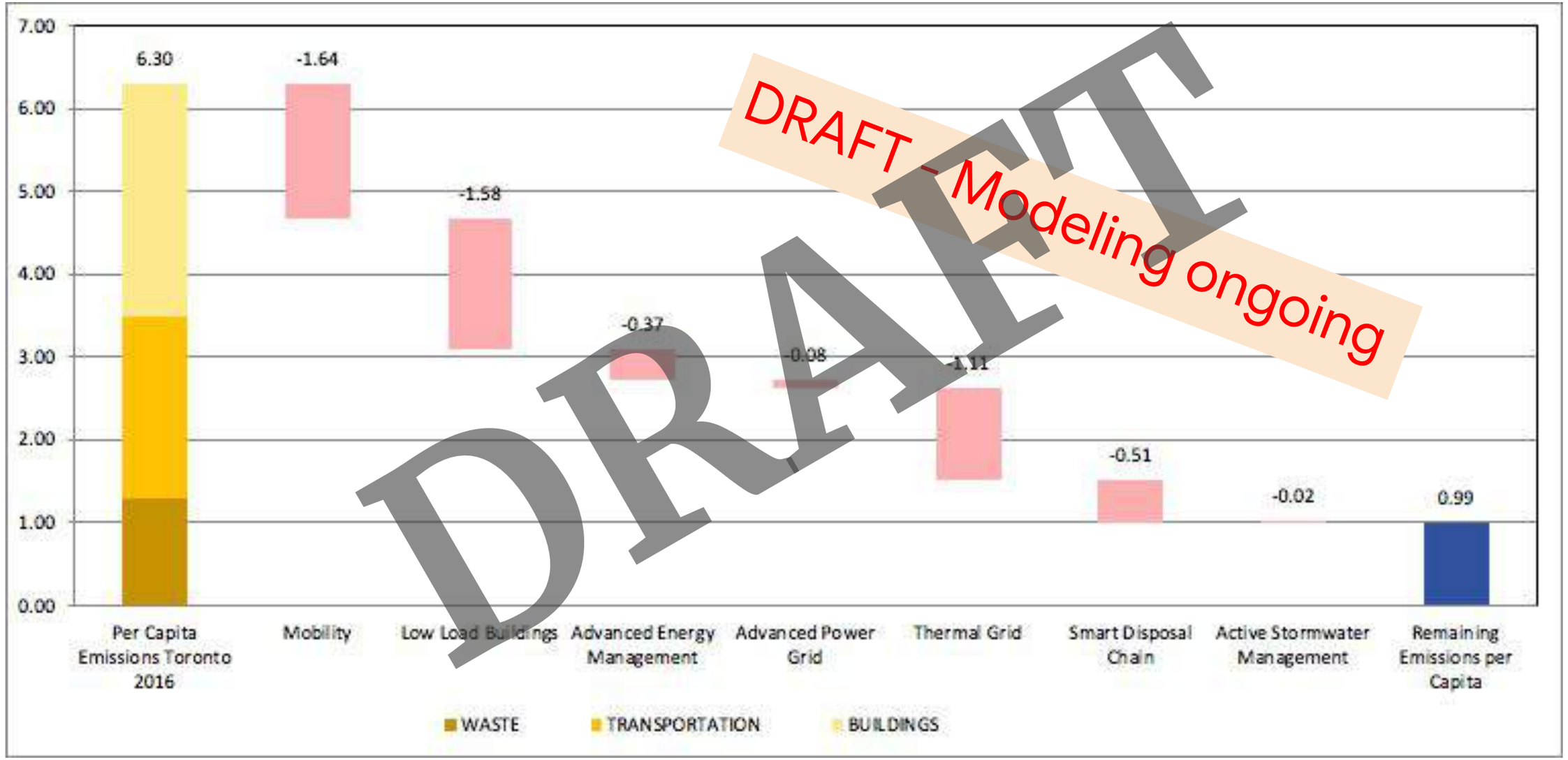
Deep Dive: Alignment with Toronto Green Standard

Toronto Green Standard Version 3		Sidewalk Toronto is committed to **Tier 3 of Version 3 of the Toronto Green Standard,** and in many cases will achieve or exceed the highest levels, e.g., **Tier 4 greenhouse gas intensity** in pursuit of climate positive - currently modelled at **2.85 kg CO_2/m^2/year.**
GHG 1.3	**High Performance, Low Carbon Pathway**	TEUI Minimum of Tier 3 (of 4) TEDI Minimum of Tier 3 (of 4) GGI Tier 4 (of 4)
GHG 2.2	**On-Site Renewable Energy (Optional)** a) Onside renewable energy capacity >5% of building's total energy load; **or** b) Geoexchange >20% of building's total energy load.	Tier 2 (of 2) **Currently 14% from onsite Solar PV and 100% geothermal and sewer heat recovery**
GHG 4.3	**Air Tightness Testing (Core)**	Tier 3 (of 3); Targeting 0.6 ACH
WQ 2.3	**Stormwater Retention & Reuse (Core)**	> 25mm retention; Tier 3 (of 3)
EC 1.1	**Tree Planting Areas and Soil Volume**	> 40% of site area; Tier 1 (of 1)

Today's Discussion: Creating a Pathway to Climate Positive Communities



Quayside Progress: >75% GHG Reduction from Current Emissions



The Affordability Challenge of Electrification

Using clean electricity for heating and hot water is a crucial step to achieving climate positive in Toronto, but it must also be affordable to be credible and scalable.

60%

Percentage of Toronto's GHG emissions from buildings, similar to other dense urban environments globally

GTHA GHG Inventory. TAF, 2017

87%

Percentage of building GHG emissions in Toronto are from the combustion of natural gas for heating and hot water

GTHA GHG Inventory. TAF, 2017

5x

Electricity prices are 5x as much as natural gas, but clean electricity is critical to GHG reductions

Published rates, Ontario. 2017

Sidewalk Toronto's Path to Affordable Electrification

No Natural Gas Infrastructure

Use heat pumps and fossil-fuel free energy harnessed by thermal grid in lieu of boilers and maximize solar potential on rooftops

Manage Electrical Demands

To maintain typically-sized infrastructure, develop and operate low load buildings, install battery storage and employ dynamic "time of use" utility pricing

Eliminate Energy Waste

Weed out the electricity use no one cares about or that actually degrades comfort, like overheating and air-conditioning

= Affordable Electrification

Sidewalk Toronto's Path to Typically-Sized Grid Infrastructure

Sidewalk Toronto has committed to the goal of squeezing all energy uses into an electricity grid of similar size to the business-as-usual case, and to keep total energy bills comparable to current costs.

The impact of individual Sidewalk Toronto measures on Quayside's electrical grid sizing:

Scenario	Design Peak
1. **Business as Usual (BAU):** Typical new construction and gasoline-based mobility	**7.5 MW**
2. **Unmanaged Electrification:** All building loads and mobility electrified (assumes air source heat pumps)	**15.4 MW**
3. **SWT Building Envelopes:** Above with building heating and cooling loads significantly reduced through Passive House inspired building design	**13.3 MW**
4. **Thermal grid:** Above with heating, cooling and hot water generated by water source heat pumps tied into building waste heat, sewer heat recovery and geothermal wells	**8.4 MW**
5. **Advanced Power Grid:** Above with rooftop solar, batteries, dynamic power rate and automated equipment control	**7.7 MW**

Sidewalk Toronto's Path to Affordable Electrification by Component

Ontario power, distributed through Toronto Hydro, is 90% GHG-free; remainder is high-GHG at peak time

Rooftop solar PV yields 1.1 MW (14% of peak demand); available for community "subscription"

4 MW/16 MWh of energy storage (~50% of peak demand) owned by Toronto Hydro or other; available for community "subscription"

All-electric transportation including public transit; charging infrastructure for electric vehicles (EV)

Space and hot water heating with water source heat pumps tied into sewer heat and thermal grid with geothermal wells

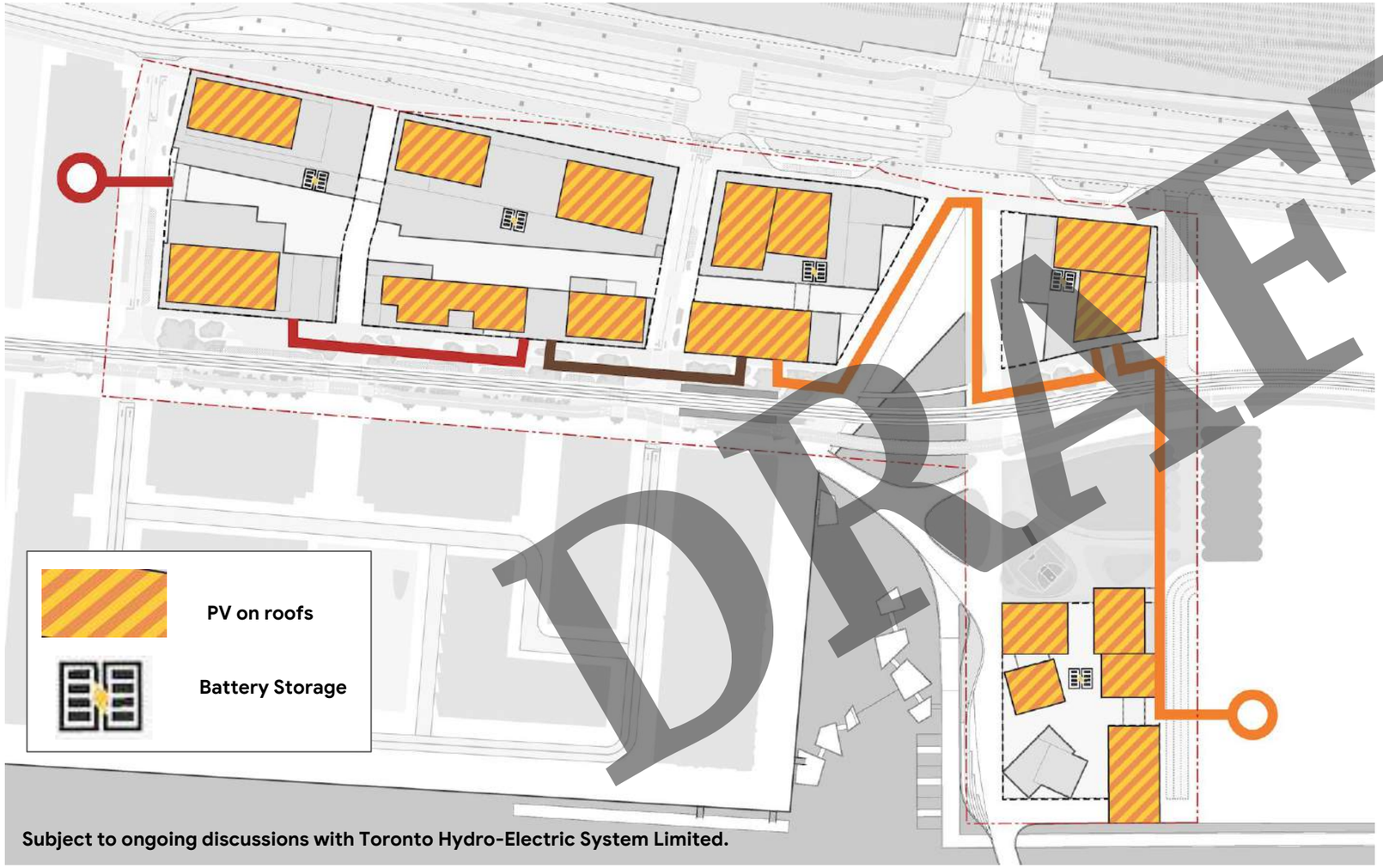
TGS V3 Tier 3* TEUI and TEDI and Tier 4 GGI buildings. Designed to stay warm through 3-day power outage

New dynamic rates to reward load-shifting and use of renewable energy and battery storage

Conversion of TGS modeled targets into operational targets, plus automated equipment control

* This is project commitment. Latest modeling shows Tier 4 TEUI and TEDI may be attainable.

Quayside Plan: Designed for Rate Pilots, Resiliency, and Islanding Capabilities



- **Served by two independent substations**, each with the ability to serve the entire neighbourhood
- **Designed for islanding of the neighbourhood and individual buildings** to allow use of onsite resources during a power outage
- **On-site energy resources** include solar PV and biodiesel emergency generators, supplemented by battery storage

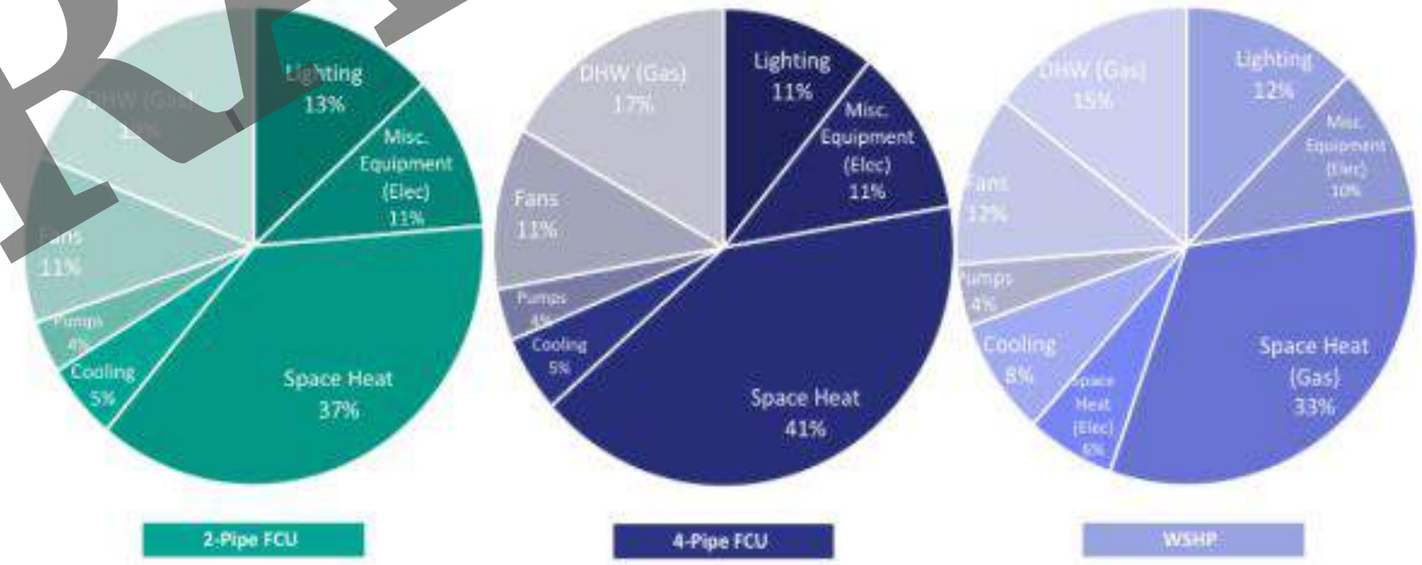
The Challenge of Heating without Use of Fossil Fuels

Sidewalk Labs commissioned a study of existing Multi-unit Residential Buildings (MURBs) to quantify and diagnose the “Performance Gap” - the difference between building energy use as modeled and actual.

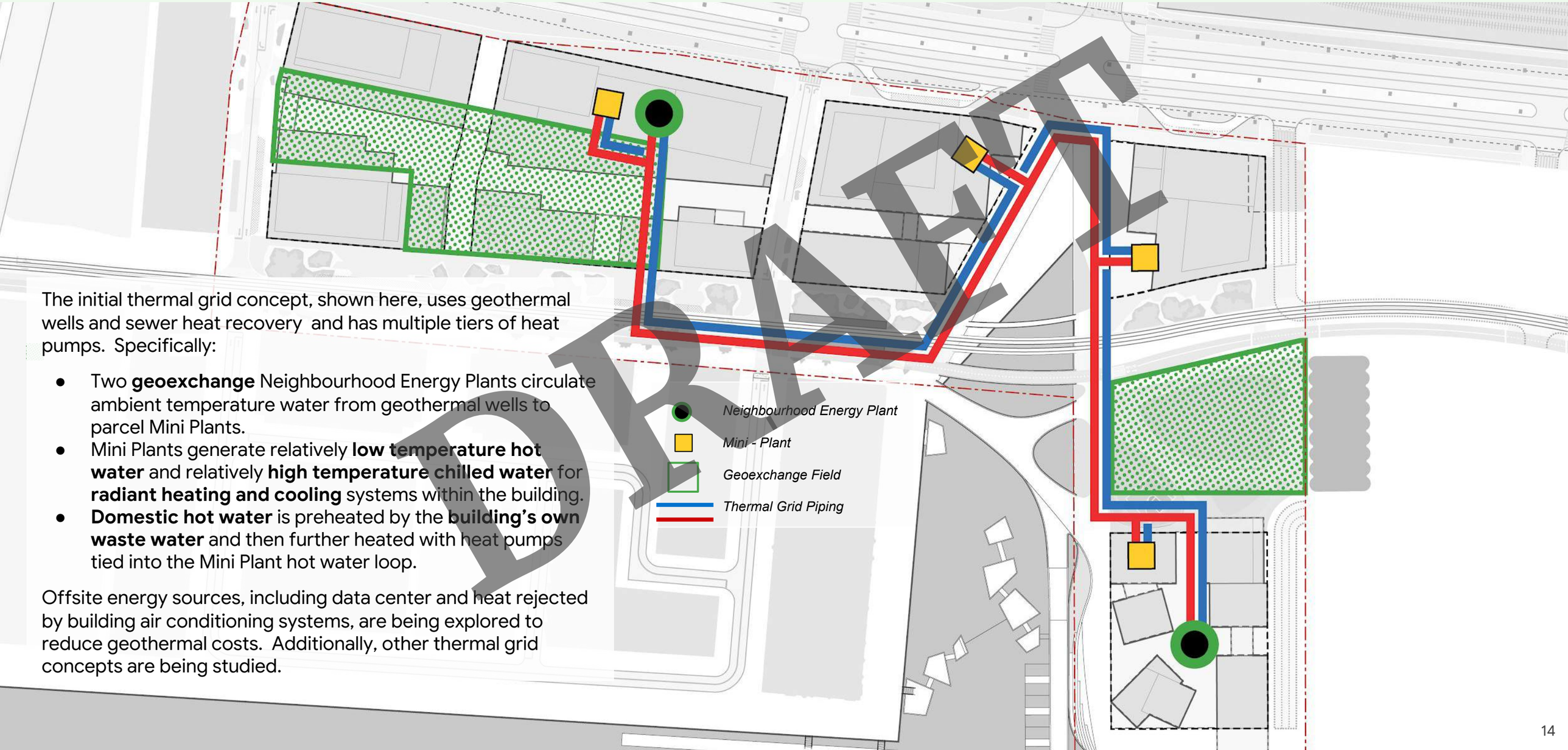
The study of Toronto MURBs found that buildings with water source heat pumps use nearly as much gas as those with traditional hot water heating.

Learning: Heat pump loops require considerable tempering, most often provided by boiler fed hot water.

End use energy breakdown of Toronto MURBs, categorized by HVAC system type.



Quayside Plan: Replaces Boilers with Geothermal Wells and Sewer Heat



The initial thermal grid concept, shown here, uses geothermal wells and sewer heat recovery and has multiple tiers of heat pumps. Specifically:

- Two **geoexchange** Neighbourhood Energy Plants circulate ambient temperature water from geothermal wells to parcel Mini Plants.
- Mini Plants generate relatively **low temperature hot water** and relatively **high temperature chilled water** for **radiant heating and cooling** systems within the building.
- **Domestic hot water** is preheated by the **building's own waste water** and then further heated with heat pumps tied into the Mini Plant hot water loop.

Offsite energy sources, including data center and heat rejected by building air conditioning systems, are being explored to reduce geothermal costs. Additionally, other thermal grid concepts are being studied.

Scaling a Fossil Fuel-Free Thermal Grid Across the Eastern Waterfront

***Target:** Mini Plant Heating and Cooling Supply Temperatures*

Winter hot water supply: 45°C
Summer chilled water supply: 5°C

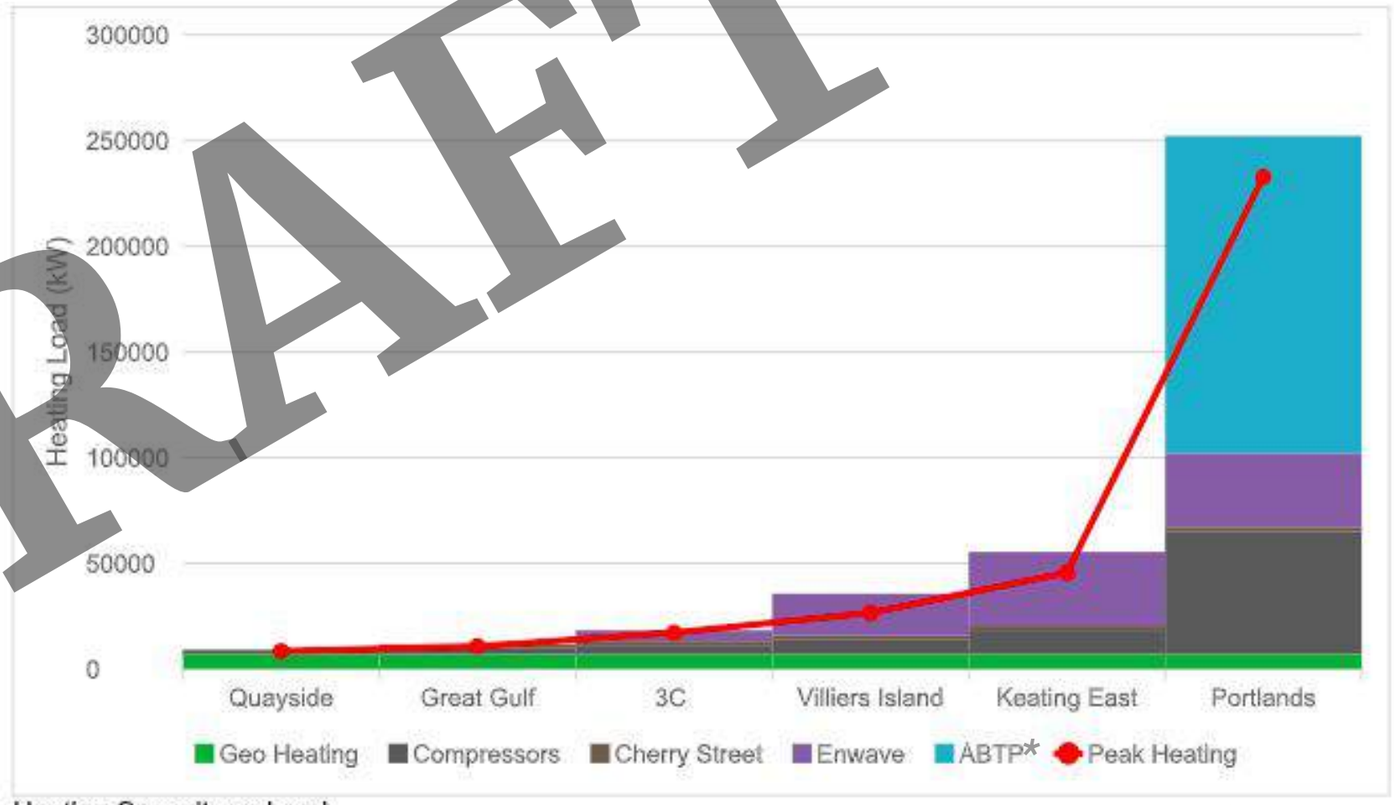
1. **Geoexchange**
   Winter: -1°C
   Summer: 35°C
   Est. Construction Cost: $3,500/kW*

2. **Enwave Chilled Water Return**
   Winter: 10°C
   Summer: 5°C
   Est. Construction Cost: $1,000/kW*

3. **Sewage Heat Recovery**
   Winter: 15-18°C
   Summer: 25°C
   Est. Construction Cost: $2,000/kW*

**Costs are high-level and based upon consultants' equivalent project experience; no engineering study conducted*

The Eastern Waterfront hosts additional energy resources that are more cost effective than geothermal and can support future development without use of fossil fuels.



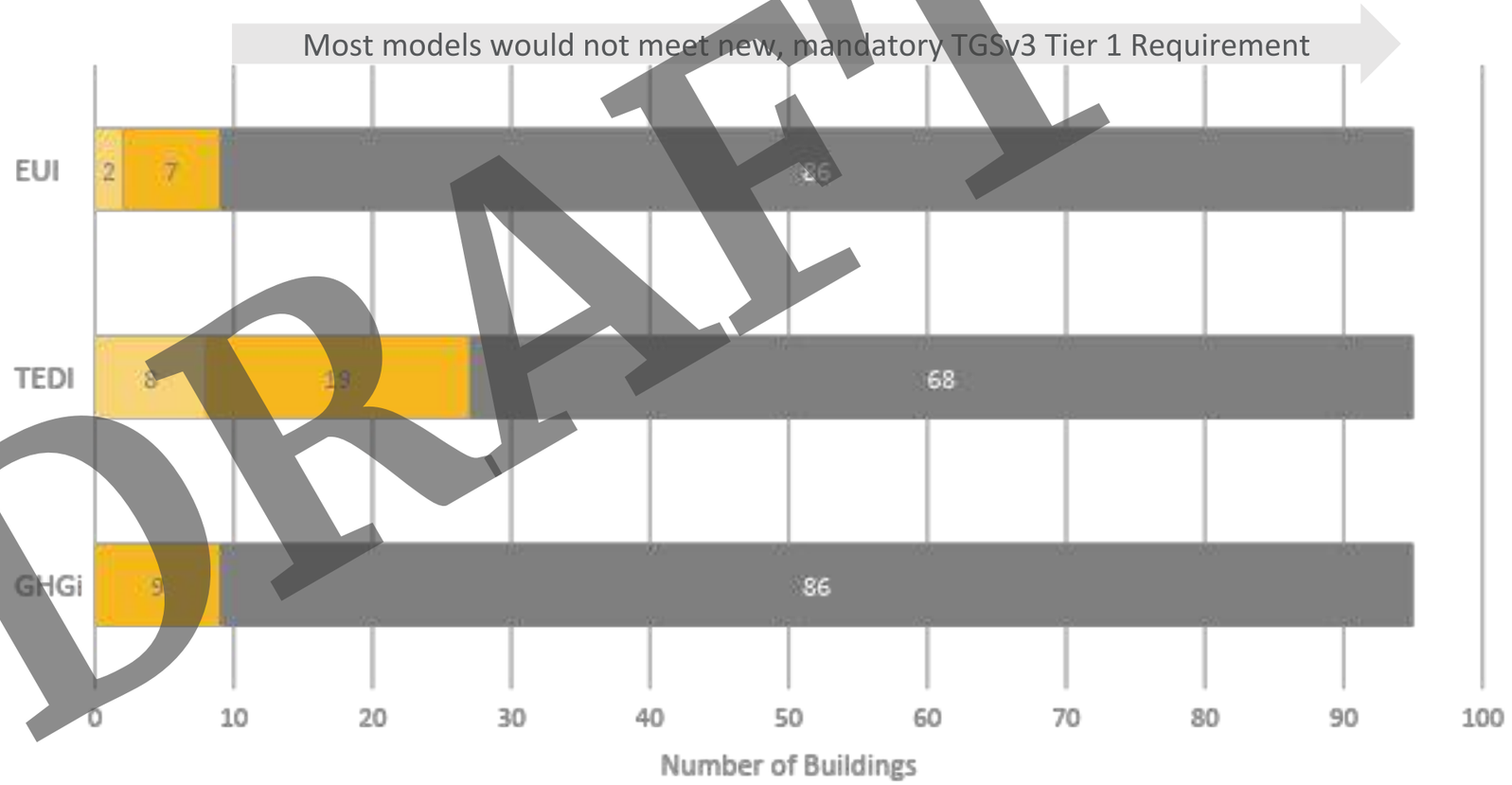
Heating Capacity vs Load

**Availability of sewer heat recovery Ashbridges Bay Treatment Plant (ABTP) subject to detailed hydraulic analysis with Toronto Water.*

Study: How Recent MURB Projects Stack up Against TGS v3

An examination of 95 Toronto MURB projects in design and construction from 2015-2017 did not find any projects that meet the TGS v3 Tier 3 energy and GHG intensity criteria.

Sidewalk Toronto is committed to achieving Tier 3 of the Toronto Green Standard and the Tier 4 Greenhouse Gas Intensity target. This puts it well in front of the market.



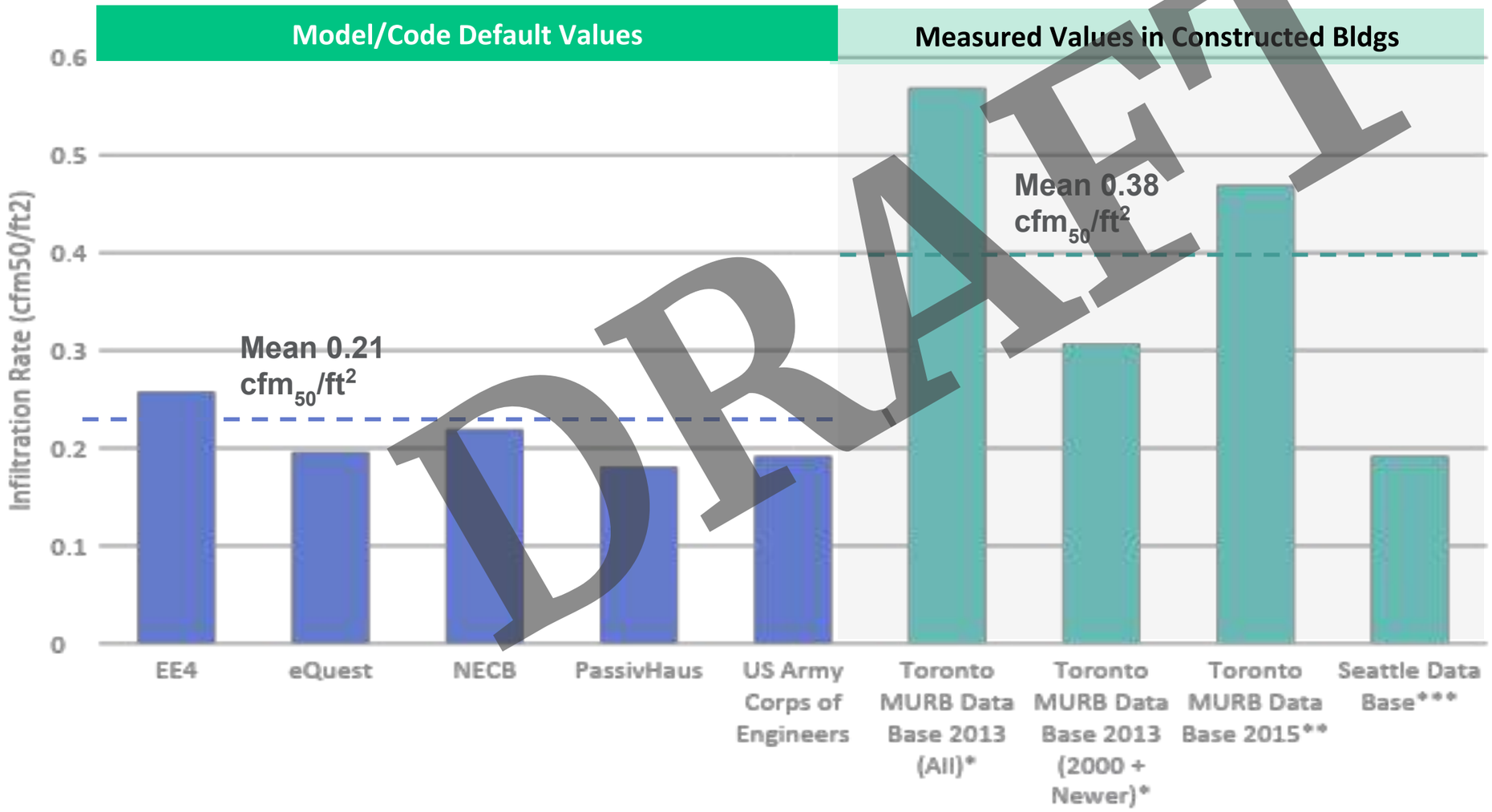
No Models would meet TGSv3 Tier 3 and Tier 4

Meet TGS v3 Tier 1

Meet TGS v3 Tier 2

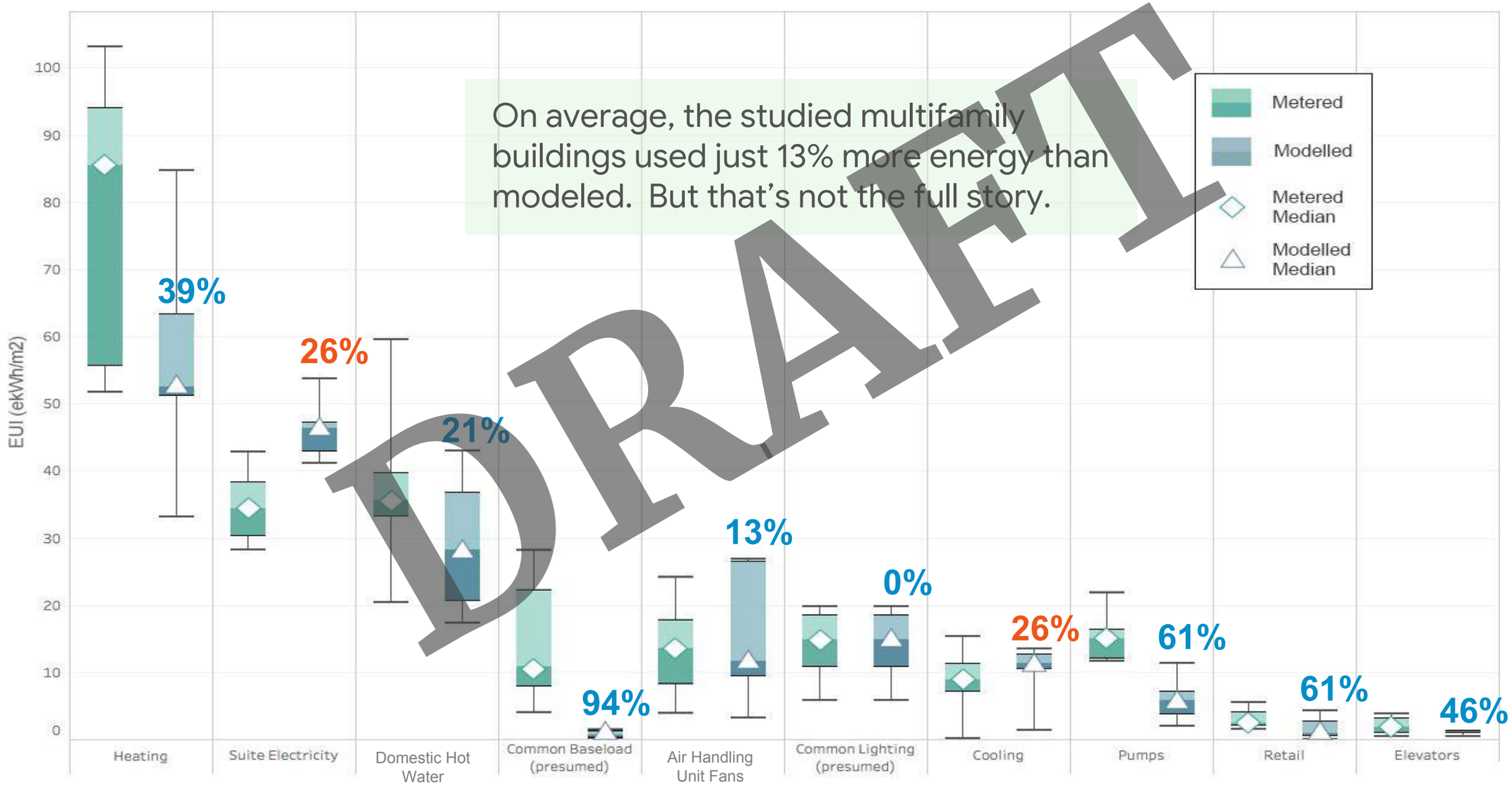
Study: Importance of Air Tightness Testing for Passive House

Modeling tools assume air tightness on par with Passive House, but measurements show leakage is typically twice as high. The exception is when air tightness testing is conducted for certification or code.



Note: Air Tightness can be improved by requiring air tightness testing, as demonstrated in Seattle.
**Source: Air Leakage Control in Multi-Unit Residential Buildings – RDH Building Engineering Ltd.*
*** Source: Study of Part 3 Building Airtightness – RDH Building Science Inc.*
**** Source: Building Enclosure Airtightness Testing in Washington State – RDH Building Science Inc.*

Study: Modelled vs. Metered Energy Use of Toronto Multifamily Buildings

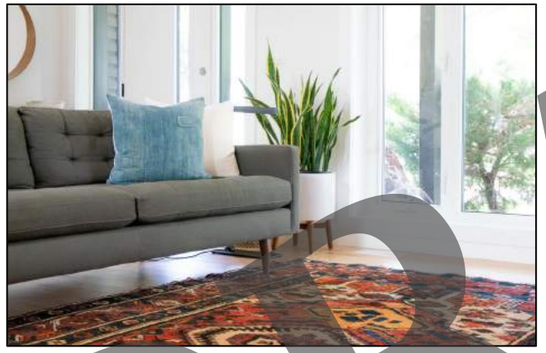


The Challenge in Driving Building Energy Use Efficiency

Developers Demonstrate Code Compliance with Energy Models

Studies show that buildings generally use more energy than their code compliance models and green building ratings predict and energy use intensity (kWh/m2) varies widely between buildings, even those of a similar age and rating.

Tenants Do Not Respond to Utility Price Signals without Automation



Time-of-use utility rate pilots with automated control of thermostats, water heaters and appliances show significantly greater peak demand reductions and customer cost savings than those without.

Tenants are Not Actively Controlling the Energy Uses Under Their Control

Well over half of building energy use is attributable to tenant space temperature, hot water, lighting, and plug loads. No one in the office is actively controlling these uses with an eye to waste or cost.

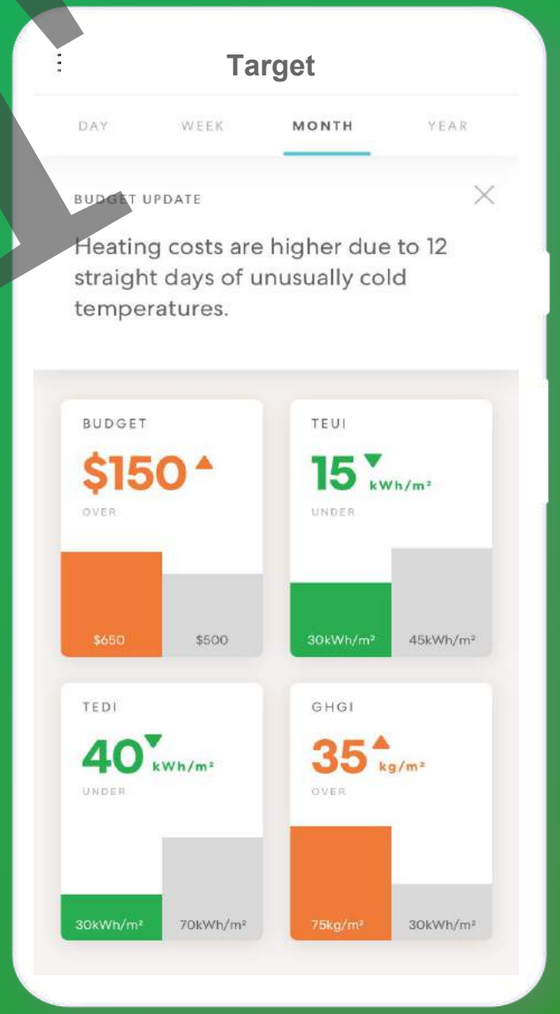
So Much Equipment is Left On or Operated According to a PreSet

Most equipment is run with a “set it and leave it” approach. This wastes energy and can even degrade comfort in the gap between the programmed setting and schedule and what tenants want and when they want it.

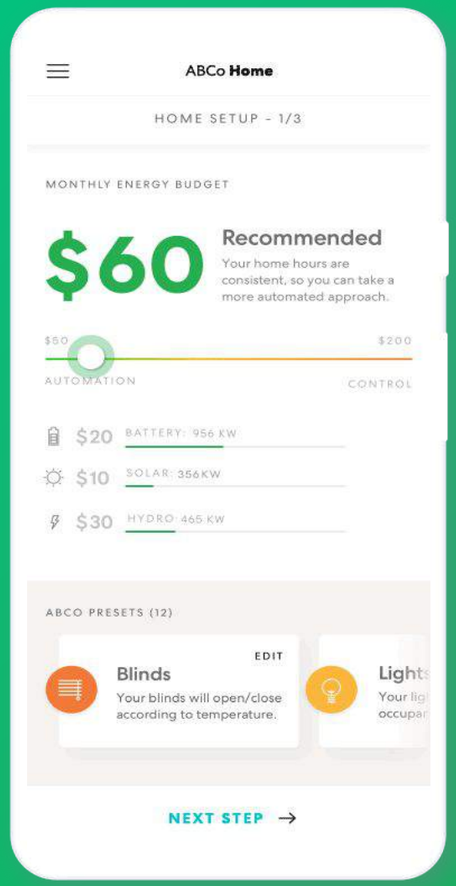
Sidewalk Labs' Vision for a Tool to Enable an Outcome Based Code

Translating the City of Toronto's Energy Use and GHG Intensity Budgets into Dynamic Targets for Comparison with a Building's Actual Energy Use, in Near Real Time.

Quayside buildings will track and report energy use, occupancy counts and other key data points (yet to be defined) to validate energy modeling assumptions and enable the development of a tool that translates weather, occupancy and other key building use characteristics into a dynamic maximum EUI, TEDI and GGI metric for buildings.



Sidewalk Labs' Vision to Give Residents the Utility Cost that they Choose

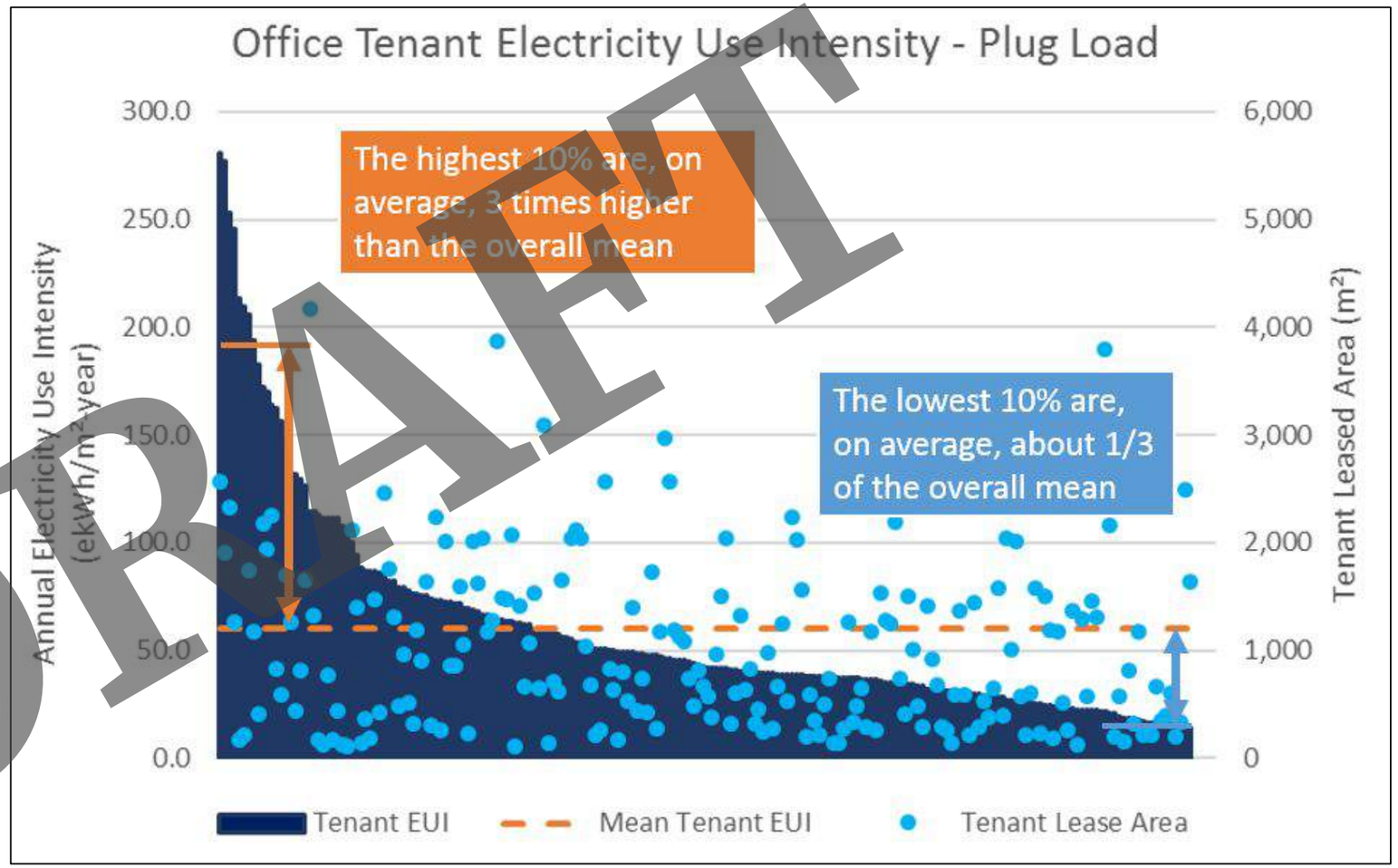


Smart Adjustments

Sidewalk Labs is working on a home solution, inclusive of smart thermostats and Smart Grid enabled appliances, that will enable Quayside residents to set their utility bill cost and have their home adjust accordingly. The tool will also offer solar PV and battery share purchase recommendations, and allocate central heating and cooling costs to residents based upon their time of use.

Study: Realizing the Extent of Commercial Tenant Energy Waste

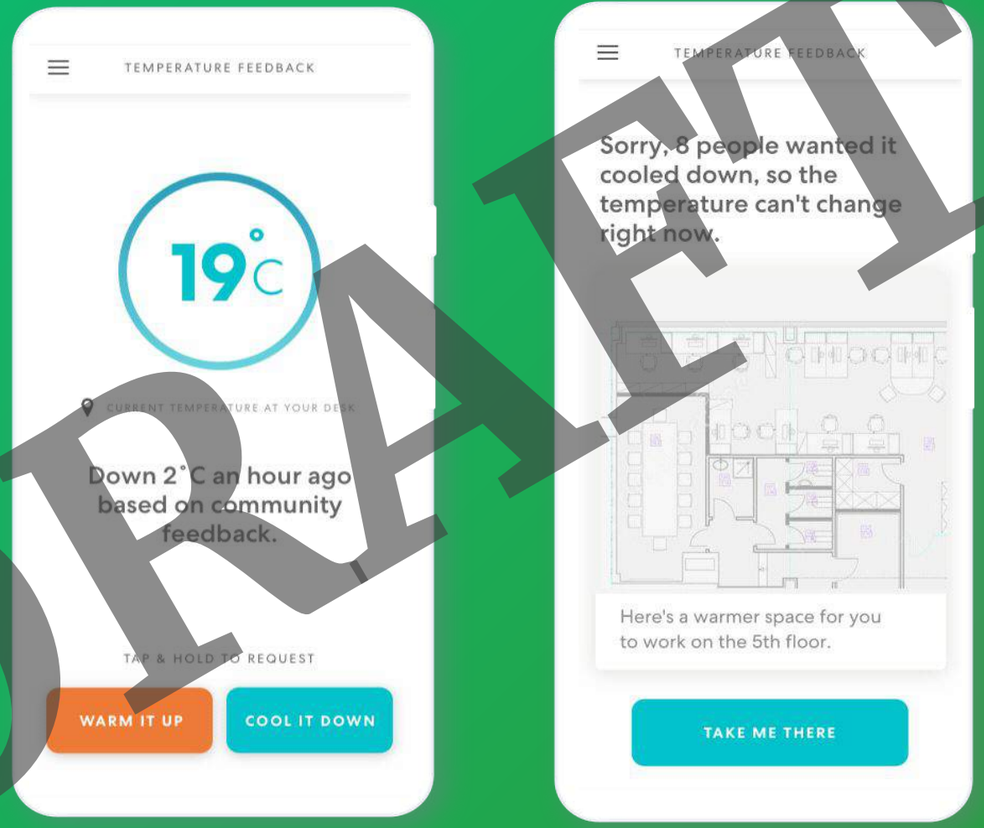
Sidewalk Labs commissioned a study of Commercial Office buildings in Toronto and Canada to understand the breadth of commercial building and tenant energy use.



In-suite office electricity loads (plug loads and lighting) for approximately 75 sub-metered tenants in Toronto office buildings.

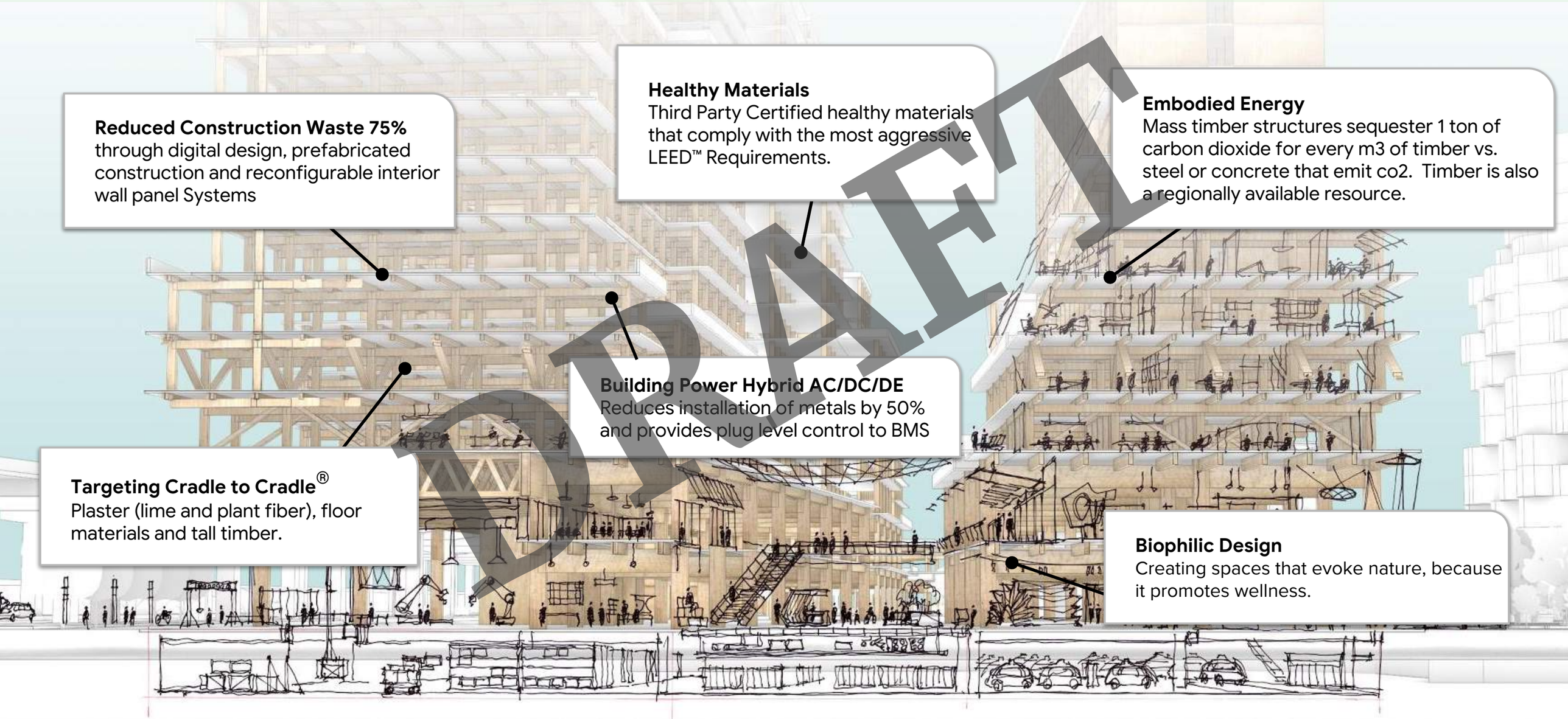
Sidewalk Labs' Vision to Eliminate Energy Waste in Commercial Buildings

Sidewalk Labs is addressing energy waste in commercial offices through several strategies, including the dynamic control of building systems and equipment to serve (and not over-serve) tenant comfort requests.



Enabling workers to conveniently communicate their comfort preferences and receive direct feedback on how their preferences can be met.

Sustainable Buildings are About More Than Energy



Reduced Construction Waste 75%
through digital design, prefabricated construction and reconfigurable interior wall panel Systems

Healthy Materials
Third Party Certified healthy materials that comply with the most aggressive LEED™ Requirements.

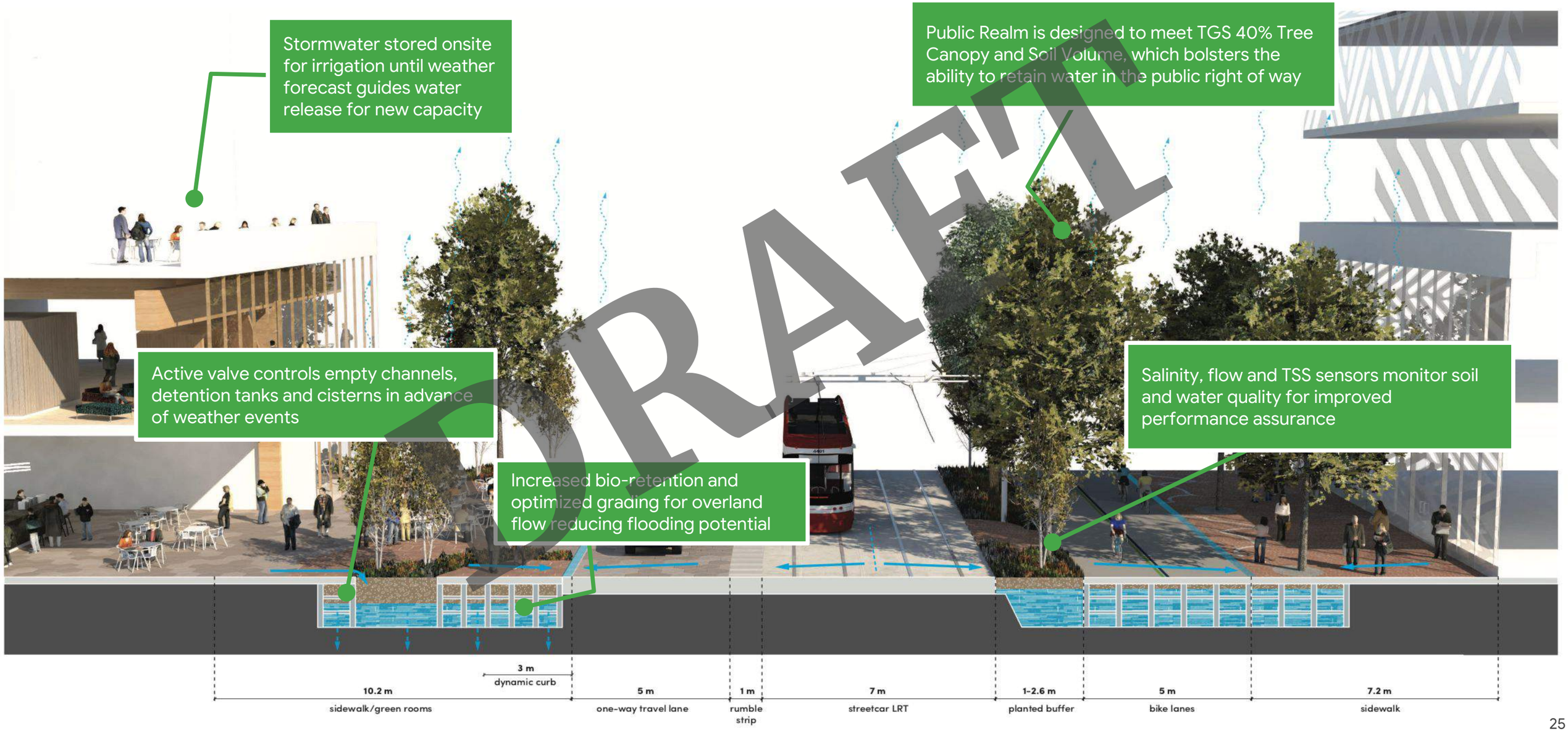
Embodied Energy
Mass timber structures sequester 1 ton of carbon dioxide for every m3 of timber vs. steel or concrete that emit co2. Timber is also a regionally available resource.

Building Power Hybrid AC/DC/DE
Reduces installation of metals by 50% and provides plug level control to BMS

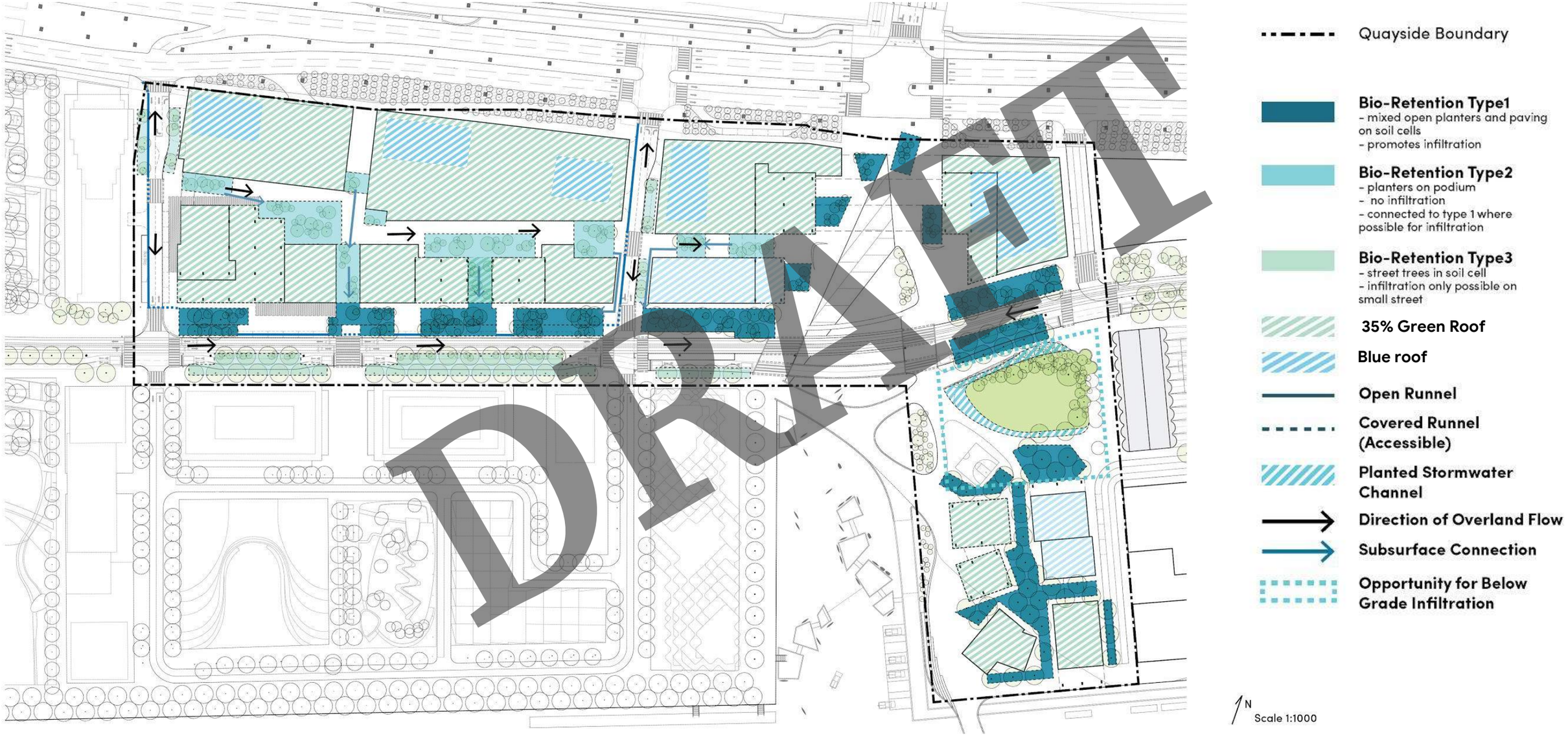
Targeting Cradle to Cradle®
Plaster (lime and plant fiber), floor materials and tall timber.

Biophilic Design
Creating spaces that evoke nature, because it promotes wellness.

Quayside Section: Queens Quay Green Infrastructure



Quayside Plan: Green Infrastructure for Stormwater and Tree Canopy

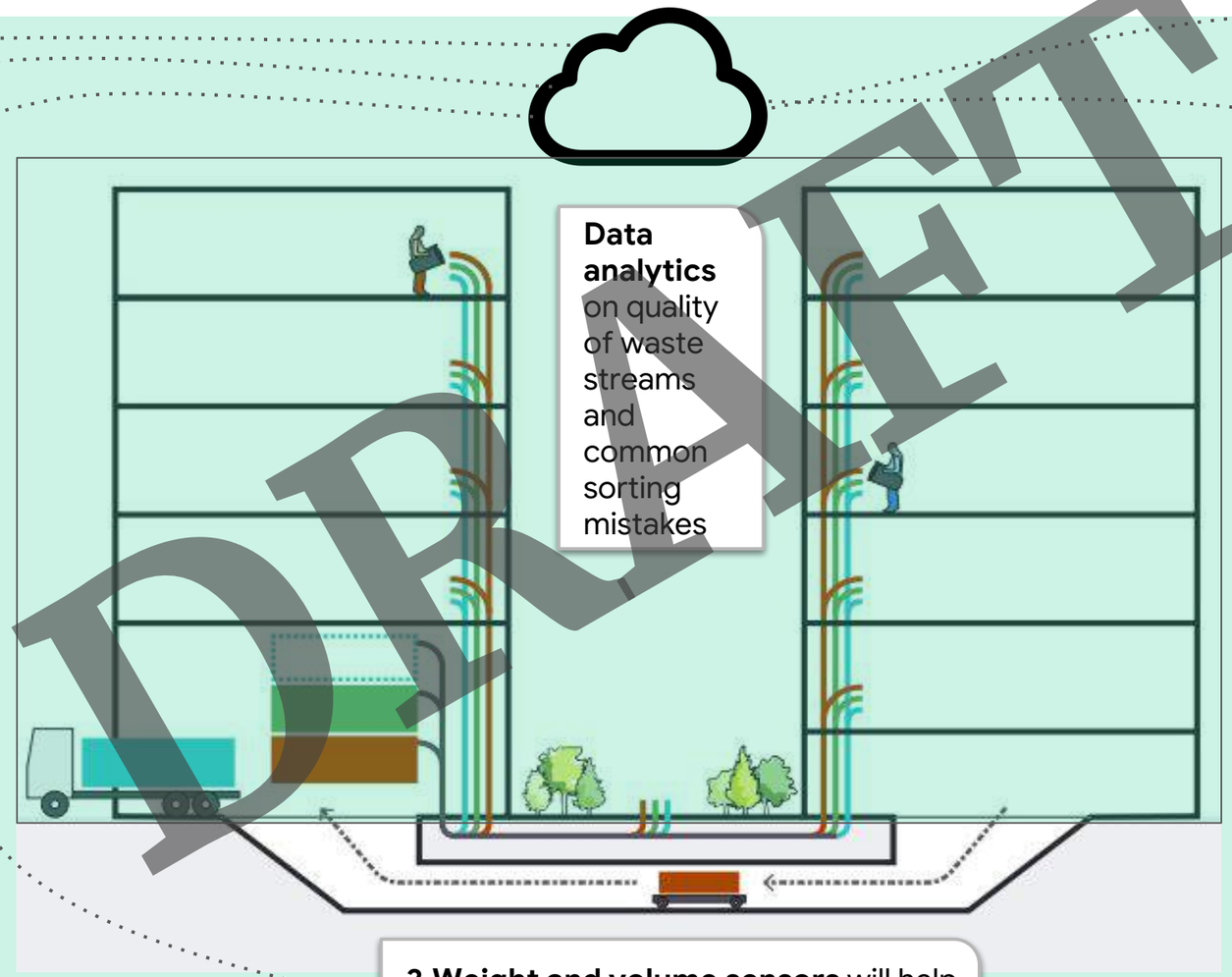


Sidewalk Toronto's Path to 80% Waste Diversion from Landfill

Currently, just 27% of Multi-Unit Residential and 17% of Commercial building waste is diverted from landfill in Toronto.

1. Three chutes for recycling, landfill and organics

2.User Interface for education on correct sorting and "pay-as-you-throw" waste charges



Data analytics on quality of waste streams and common sorting mistakes

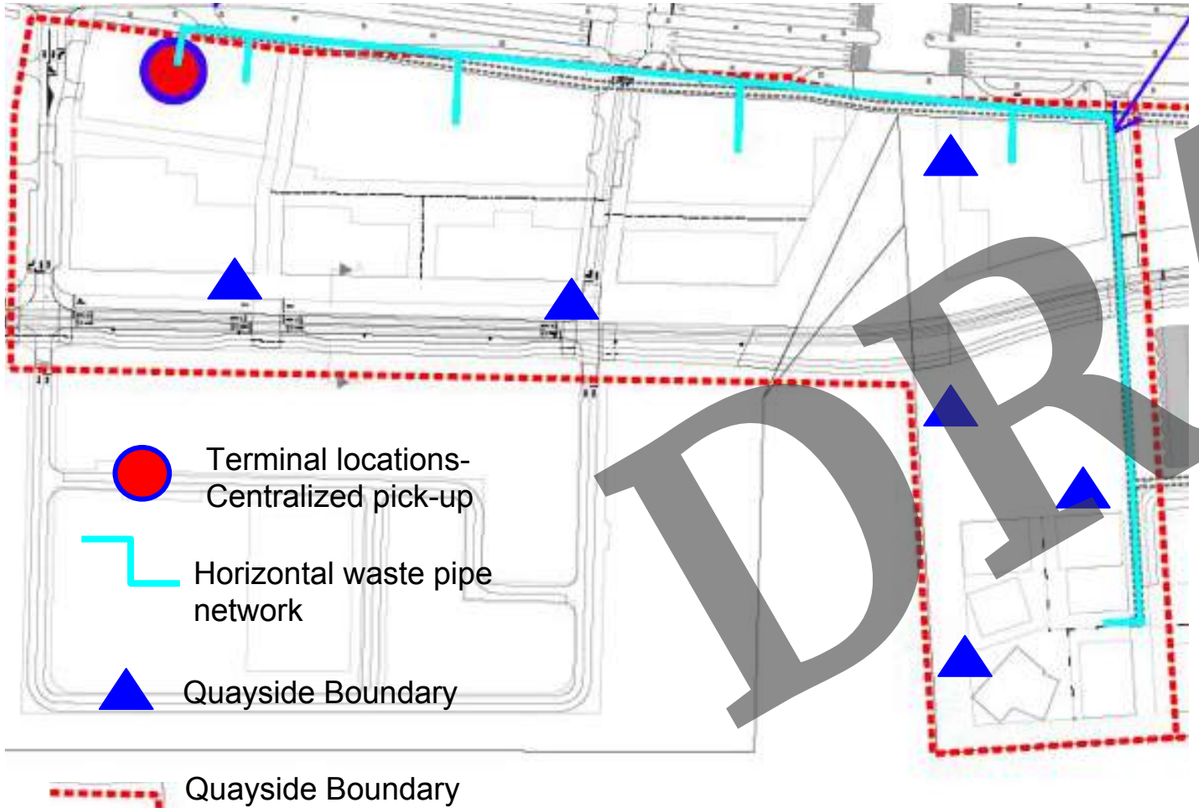
3.Weight and volume sensors will help track waste by unit to accommodate a Pay-as-you-throw system

4.Waste characterization at Material Recovery Facility using computer vision

5.Commodity brokers receive accurate information on waste contents to improve accuracy of valuation

Sidewalk Toronto's Path to 80% Waste Diversion by Component

Quayside Plan:



Pneumatic Conveying System moves waste to a single pick up location, reducing truck emissions and the number of handoffs that can introduce contamination

Smart Robotic Carts will move oversized waste from buildings to the central collection point through underground tunnels

Inlet points to the pneumatic conveying system in the public realm will be used as opportunities to educate visitors about recycling and organics

Deployable Smart Bins, with volume sensing technology, will accommodate flexible use of the public realm

Thank You