Affordable Electrification in Buildings
Who is Sidewalk Labs?

Bridging the Urbanist + Technologist Divide
Who is Sidewalk Labs?

Bridging the Urbanist + Technologist Divide

- URBAN SYSTEMS
- OPERATIONS
- SOCIAL INFRASTRUCTURE
- CORPORATE DEVELOPMENT
- ENGINEERING, PRODUCT & DESIGN
- DEVELOPMENT
- POLICY & COMMS

Project Goals for Quayside, Toronto

- 9,000+ Construction Jobs
- Canadian Mass Timber Factory
- 40% Below-Market Housing
- Towards Climate Positive
- Streets that Work
- Civic Data Trust
In addition to the generous contributions of multiple stakeholders and advisors, Sidewalk Labs’ sustainability strategy has been informed by the following consultants:

- TurnCraft Advisors
- BuildingGreen Inc.
- Lawrence Berkeley Labs (US National Lab)
- Smarter Grid Solutions
- WSP - Sustainability and Energy
- Stantec - Design engineering work
- Kerr Wood Leidal
- 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.
What is climate positive?

Development that **reduces** city’s overall GHG emissions

1. Reduce onsite GHG emissions to near zero

2. Use the development’s infrastructure or technology to offset existing city emissions
Path to climate positive - advanced systems

- Low energy buildings
- Smart mobility
- Thermal grid
- Advanced power grid
- Optimizing building system operation
- Smart disposal chain
- Active stormwater management
In Toronto, electrifying everything is a path to climate positive..

<table>
<thead>
<tr>
<th>Category</th>
<th>GHG Emissions (gCO2/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toronto Power Grid</td>
<td>36</td>
</tr>
<tr>
<td>New York City Power Grid</td>
<td>257</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>257</td>
</tr>
<tr>
<td>Greater Toronto and Hamilton Area</td>
<td>183</td>
</tr>
</tbody>
</table>

This data is compiled by the Toronto Atmospheric Fund (TAF) for the Greater Toronto and Hamilton Area (2017). TAF uses a different GHG accounting protocol than C40.

- **Buildings**: 60% of emissions
- **Transportation**: 32% of emissions
- **Waste**: 4% of emissions
- **Industry**: 4% of emissions

87% of New York City's emissions are from natural gas.
..But electrifying without reducing the load is unaffordable

Price of electricity vs. natural gas, which would increase if electrification means new power plants and infrastructure expansion.

Published rates, Ontario. 2017

Ontario projects unmanaged electrification could quadruple peak demand and force new generation to be built by 2024.

For Quayside, it would double the size of our local grid.

Unmanaged Electrification

Business as Usual (BAU)

11.5 MW

5.5 MW
Sidewalk Toronto’s path to typically-sized electrical grid

- **Business as Usual (BAU)**: 5.5 MW
- **Unmanaged Electrification**: 11.5 MW
- **Low Energy Buildings**: 7.9 MW
- **Thermal Grid**: 6.1 MW
- **Advanced Power Grid + Optimizing Building Controls**: 5.3 MW
Passive House-inspired design reduces heating and cooling loads

- Unmanaged Electrification: 11.5 MW
- Low Energy Buildings: 7.9 MW
- Thermal Grid: 6.1 MW
- Advanced Power Grid + Optimizing Building Controls: 5.3 MW

Business as Usual (BAU): 5.5 MW
On average, the studied multifamily buildings used 13% more energy than modeled, but generated 28% more GHG emissions. And that’s not the full story...
Low Energy Buildings

Passive House-inspired buildings: more than just the envelope

Insulation and Thermal Breaks
Carefully sized windows, adding gaskets and manufactured “thermal breaks”

Air Tightness
Blower door tested to meet compliance standards

Balanced Ventilation
Balanced supply and exhaust with ducted ventilation to all living spaces (incl. bedrooms)
Buildings will meet cutting edge performance goals

- **Assessment type**
  - Representative model: LEED and Code
  - Performance data: Toronto Green Standard (TGS) and Passive House

- **Update Frequency**
  - Updates every 4 years, gradually increases energy and emissions performance requirements over time

- **Exporting to other cities**
  - City of Vancouver is a notable leader in the recent implementation of their Zero Emissions Buildings Plan.
**Factory-based mass timber buildings**

- **Faster Build Times**
  Less on site construction time due off-site prefabrication

- **Digital Design**
  Coordination of construction and operation managed digitally

- **Improved Sustainability**
  Mass timber structures generate 1/10th the amount of carbon vs. concrete equivalents, sequester carbon, and produce less construction waste due to factory’s economy of scale

- **Reduced Costs**
  Up to 10% cheaper than other structural options and trending to become less expensive in many markets

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

- **Targeting Cradle to Cradle®**
  Shikkui plaster (lime and plant fiber), floor materials and tall timber
Sustainable supply chain that supports local industry
Thermal grid reduces grid size to 6.1 MW

- **5.5 MW**: Business as Usual (BAU)
- **11.5 MW**: Unmanaged Electrification
- **7.9 MW**: Low Energy Buildings
- **6.1 MW**: Thermal Grid
- **5.3 MW**: Advanced Power Grid + Optimizing Building Controls
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.
A tool to enable outcome based codes

- **Stagnant targets → dynamic targets**

- Data on energy use, occupancy, weather, etc → dynamic maximum EUI, TEDI and GGI metric for buildings

Toronto → New York City
Heating and cooling at Quayside: geothermal wells and sewer heat
At scale, thermal grid could connect to other resources and export clean energy.
Advanced power grid reduces grid size to business as usual with PV + battery + automated demand response

- **11.5 MW**: Unmanaged Electrification
- **7.9 MW**: Low Energy Buildings
- **6.1 MW**: Thermal Grid
- **5.3 MW**: Advanced Power Grid + Optimizing Building Controls

- **5.5 MW**: Business as Usual (BAU)
Quayside Plan: Designed for rate pilots, resiliency, & 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

Subject to ongoing discussions with Toronto Hydro-Electric System Limited.
Energy will be priced to reflect real time GHG intensity

Dynamic Rate Engine” Exposing customers to the hourly cost of electricity generation and demand

Solar and battery transaction platform:
Pricing and allocating shares of solar and batteries to customers; offering insulation from highest-priced power
Sidewalk Labs’ vision to give residents the utility cost that they choose

Home Scheduler:

- Integrates smart thermostats and Smart Grid enabled appliances
- Offers solar PV and battery share purchase recommendations
- Allocates central heating and cooling costs to residents based upon their time of use
- Enables residents to set their utility bill cost and adjusts home accordingly
Study: Realizing the extent of commercial tenant energy waste

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

Enabling workers to conveniently communicate their comfort preferences and receive direct feedback on how their preferences can be met.
Getting over the finish line
Tapping the full potential of wastewater from Ashbridges Bay would enable the project to give back 70,444 annual tonnes of CO2, or nearly 0.9 tonnes per person. Sidewalk Labs could achieve an additional 0.1 tonnes per capita offset through the creation of biogas from anaerobic digestion.
Currently, just 27% of Multi-Unit Residential and 17% of Commercial building waste is diverted from landfill in Toronto.
Green infrastructure uses monitoring to measure performance and predict flows.

- **Active valve controls empty channels, detention tanks and cisterns in advance of weather events.**
- **Stormwater stored onsite for irrigation until weather forecast guides water release for new capacity.**
- **Increased bio-retention and optimized grading for overland flow reducing flooding potential.**
- **Salinity, flow and TSS sensors monitor soil and water quality for improved performance assurance, and tree health.**
- **Public Realm is designed to meet TGS 40% Tree Canopy and Soil Volume, which bolsters the ability to retain water in the public right of way.**
ACTIVE STORMWATER MANAGEMENT

Combination of green roofs and blue roofs for detention and retention

- Bio-Retention Type 1: mixed open planters and paving on soil cell, promotes infiltration
- Bio-Retention Type 2: planters on podium, no infiltration, connected to type 1 where possible for infiltration
- Bio-Retention Type 3: street trees in soil cell, infiltration only possible on small street
- 35% Green Roof
- Blue roof
- Open Runnel
- Covered Runnel (Accessible)
- Planted Stormwater Channel
- Direction of Overland Flow
- Subsurface Connection
- Opportunity for Below Grade Infiltration
Thank You