Mattamy Springwater Geo-Exchange System

December 1, 2021

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Agenda

- Overview of Mattamy Springwater Geo-Exchange System
- Geo-Exchange Design Concepts
- Project Agreements
- Reflection
- Next Steps
- Power.House Hybrid Pilot Project

Mattamy Springwater Geo-Exchange System

Objective: Construct a new ~310 home neighbourhood to be heated and cooled using an underground geo-exchange system, low carbon community

- Largest system in North America, first in Ontario
- Community-wide vertical loop geo-exchange system for heating and cooling
- Potential to reduce each home's emissions by ~1,200 tCO_2e annually
- Market competitive – targeted total cost of ownership housing prices to match standard natural gas furnaces over a 25-year period

Partners: Mattamy Homes Canada, Enwave Energy Corporation and The Atmospheric Fund (TAF)

TAF Support

- Accessing funding to initiate innovation is essential for projects like this
- Partners become jelled around the opportunity supported by incentives
- Commitment from stakeholders and governments to a process is amplified by incentives
- TAF Funding supported the preliminary engineering process as well as the initial workshop that engaged internal and external stakeholders
- Incentive commitments can drive scale up from successful demonstration

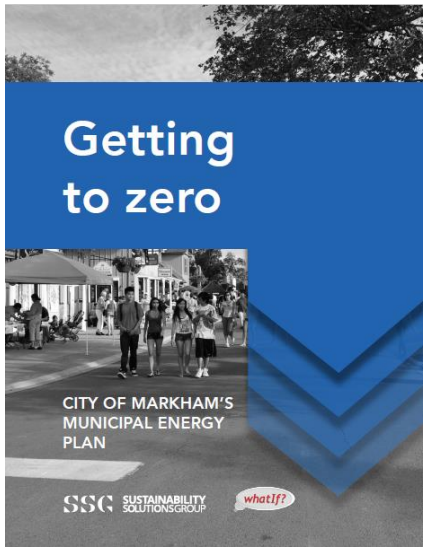
Mattamy Springwater Project Site

- North Markham – Elgin Mills west of Warden Ave
- 64 Acre Site
- Geo-exchange system is currently only being developed for Phase 1 (i.e. highlighted area)

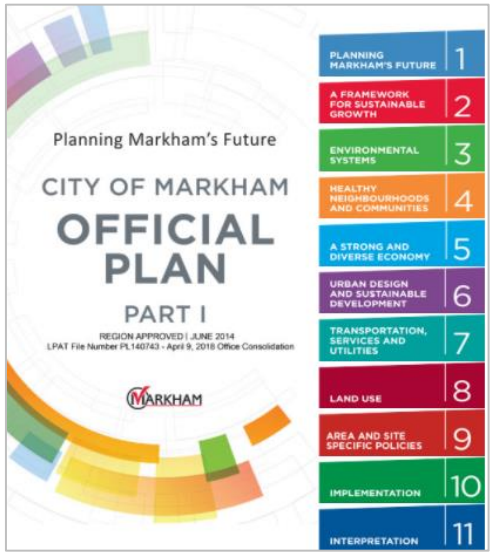
Mattamy Springwater - Milestones

- 2017, Mattamy and Enwave proposes geo-exchange opportunity to Markham staff
- 2018, joint press release to announce project collaboration between the partners
- 2019, attended conferences (i.e. OPPI) as panelists to discuss partnership, early lessons learned and opportunities
- 2020, finalize key Municipal Access Agreement (MAA) points between Enwave and City of Markham to progress project
- 2021, Mattamy launched sales centre and marketing for geo-exchange technology and homes to the public

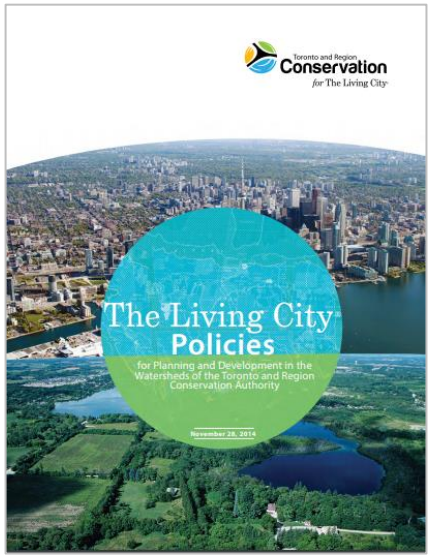
Policy Framework



Municipal Energy Plan (2018)

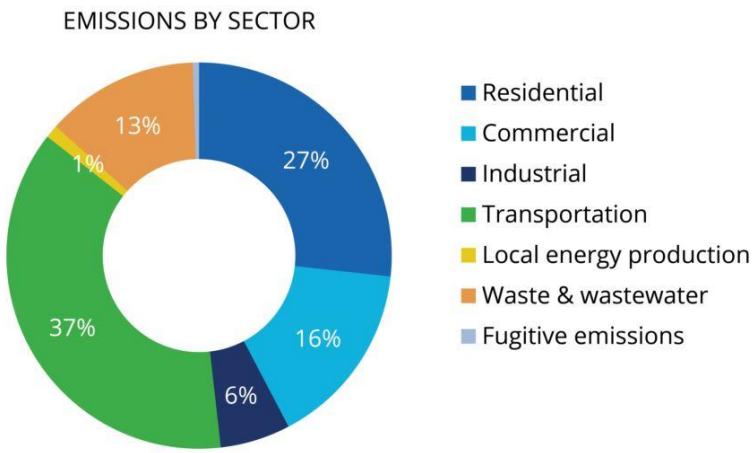


City of Markham Official Plan (2014)



The Living City Policies for Planning and Development in the Watersheds of the Toronto and Region Conservation Authority (2014)

Markham's Context



The City of Markham emitted 1,778,000 tCO_2e in 2011

- Fast growing – 23% increase to approx. 440,000 residents by 2031
- Net zero emissions by 2050 objective
- Open and flexible policy framework
- Future Urban Area – 1,300 Ha of land, 12,000 residential units, 38,000 people, 19,000 jobs
- Strong political will and senior level support to innovate and battle climate change
- Resulted in ability to partner with Mattamy, Enwave and TAF to bring this project to reality

Geo-Exchange Design Concepts

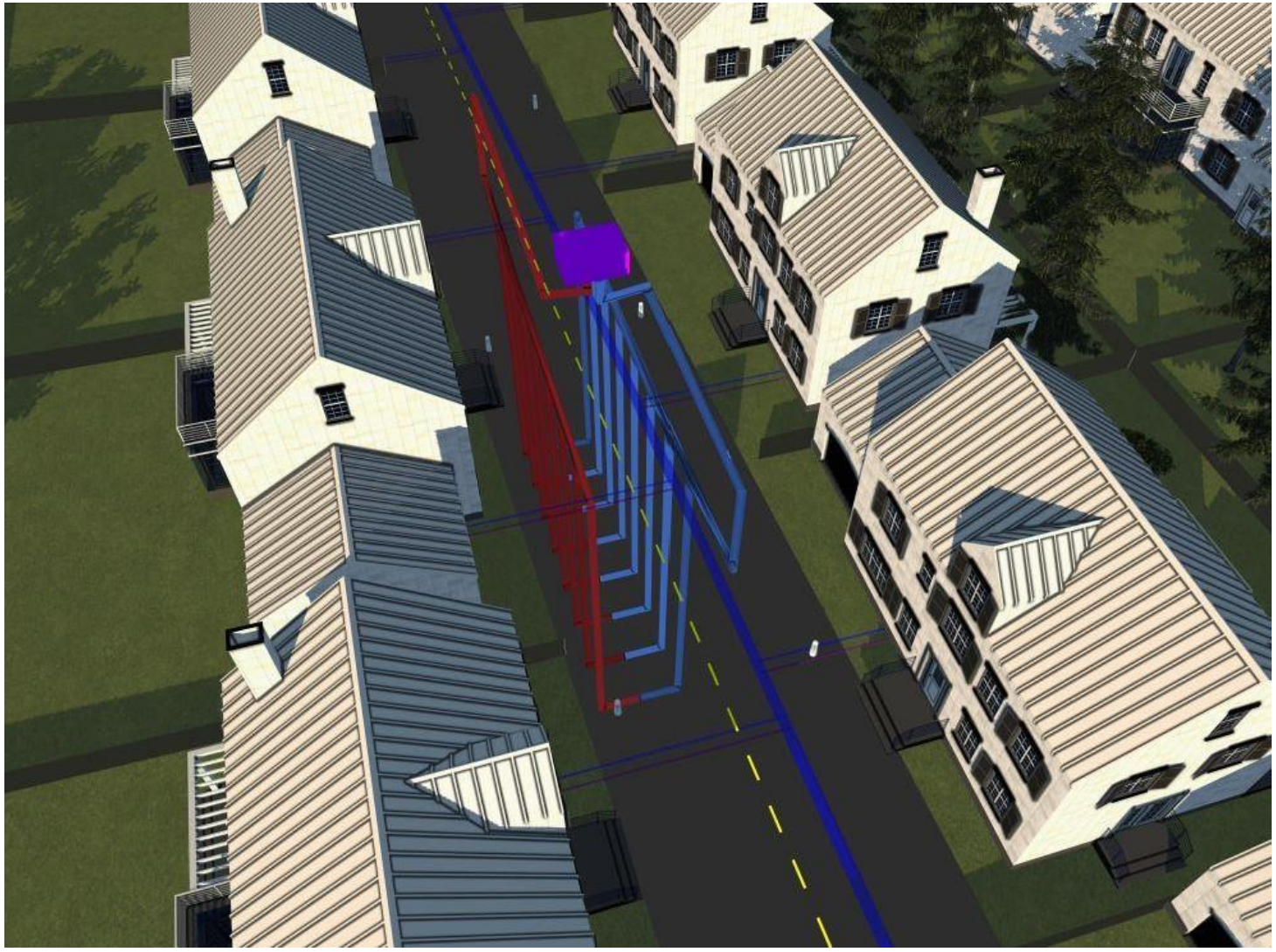
Design Options

Three types of systems were considered:

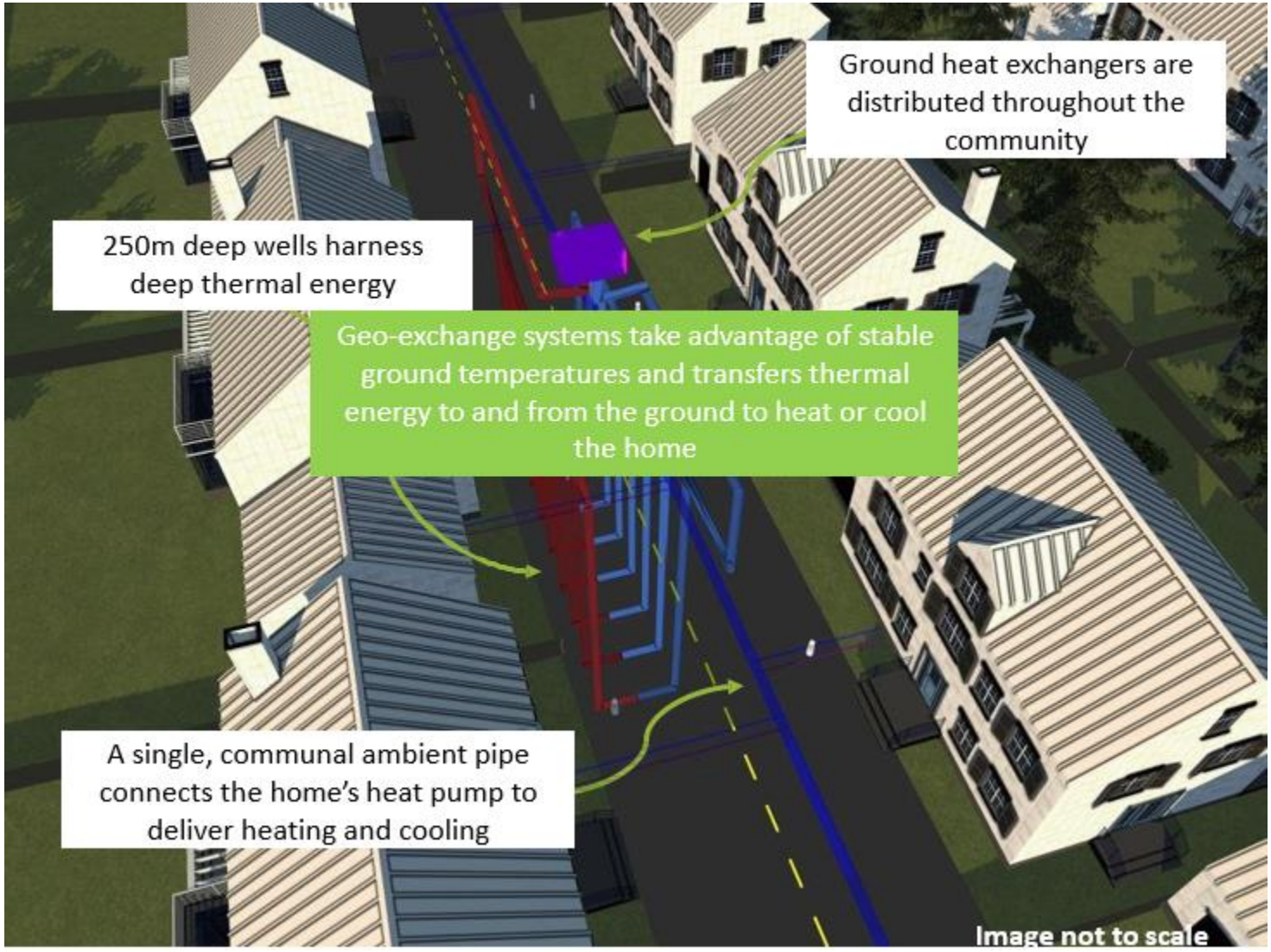
1. **Vertical Loop Geo-Exchange Bore System** – comprised of 16 vertical boreholes per vault and located under the district pipe loop within the ROW
2. **Horizontal Loop Geo-Exchange Bore System** – consists of horizontal racetrack style loops and located underneath larger bodies of green space in the Natural Heritage Network
3. **Open Loop Geo-Exchange Bore System** – uses a supply well and a return well to ensure that the water flowing within the piping meets the required temperatures

The design team settled on a simplified design of vertical geo-exchange boreholes due to the more complex approvals, construction complexity and operational variability of horizontal or open loop.

Geo-Exchange Vertical Loop System - Diagram



Geo-Exchange Vertical Loop System - Diagram



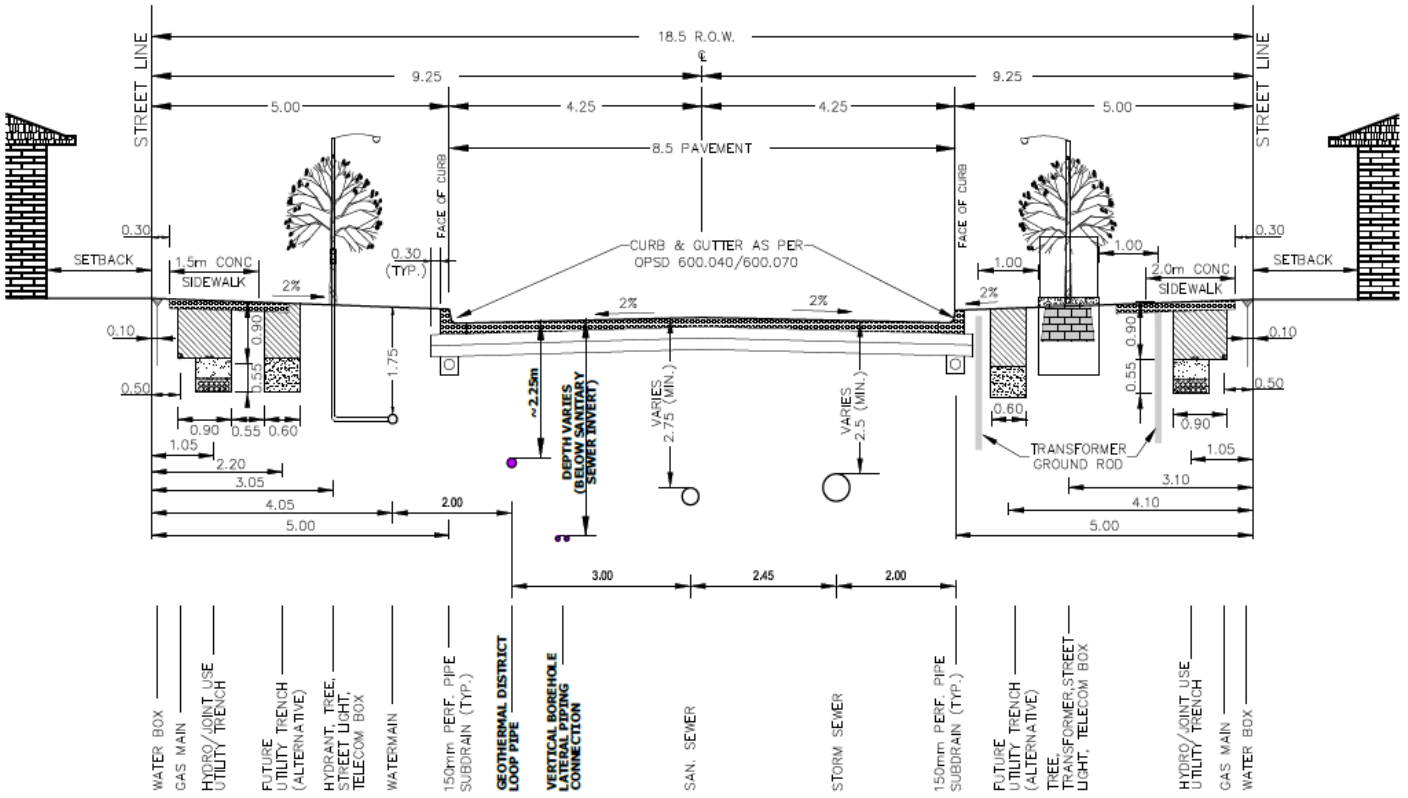
ROW Infrastructure Coordination

Objective: Focused on necessary infrastructure needs and approvals.

- Plan included a district piping loop within the public **Right of Way (ROW)** and amidst public utility infrastructure that shares energy between homes and the geo-exchange modules that act as thermal energy sources or sinks.

- System design had several criteria to meet:
  - Vertical versus horizontal well ratio
  - Size and location of module fields
  - Vault locations and connections to homes

Road ROW Design



18.5m RESIDENTIAL LOCAL ROAD

Example of City of Markham ROW cross-section with the integrated geo-exchange infrastructure.

ROW Design Implications

- **Objective**: Analyze best opportunities for infrastructure using public and private spaces
- Project team considered space requirements, design performance, long term maintenance, policy, and approvals
- Challenges to locating geo-exchange infrastructure within private lands related to maintenance, policy, and approvals
- Enwave and Mattamy's engineering teams collaborated to incorporate the infrastructure within Markham's approved standard engineering ROW cross-sections
- Integrated approach reduced the design time since the same consultants locating the traditional infrastructure and other utilities were also designing the location of the district energy piping

Project Agreements

Municipal Access Agreement (MAA)

Objective: Primary form of agreement to address expectations and requirements for implementation and continued operation of the system.

The MAA was informed by the following key issues:

- **Technical** – analysis, standards, and approval process for studies
- **Process Approvals** – special clauses & based fees
- **Risk Management** – indemnification for the City of Markham & homeowner protection

Required legal discussions between the City of Markham and Enwave Energy Corporation.

Stakeholder Engagement

- **Objective**: Establish an approach to support understanding and expectations to advance the project
- Early engagement and education with all stakeholders reduced construction conflicts and provided cost-effective installation
- Collaboration and agreements followed precedents from the City of Markham and City of Toronto's experience with district energy
- Identified barriers or challenges to successful approval and implementation, with support from the mayor and senior executives
  - Initial consultations included provincial and industry agencies, such as Alectra Utilities and Enbridge Gas Distribution

Project Reflection

- Implemented integrated design process
- Explored multiple design options
- Limited public space
- Setback refinement required
- Integrated within existing development process
- Municipal Access Agreement was critical
- Geo-exchange is just another utility
- City resources and Champions
- Wholistic natural gas infrastructure assessment
- Spectrum of Geo-Exchange opportunities potentially based on densities
- TAF support was critical to get past conceptual designs

Next Steps

- Continue construction with anticipated home closings in 2022
- Continue assessing real data of costs and implementation
- Assess the feasibility of continuing geo-exchange in future phases and consider all Geo-Exchange options (i.e. district, micro-district, and independent)
- Continue to share project results, processes, and lessons learned with stakeholders

Power.House Hybrid Pilot Project

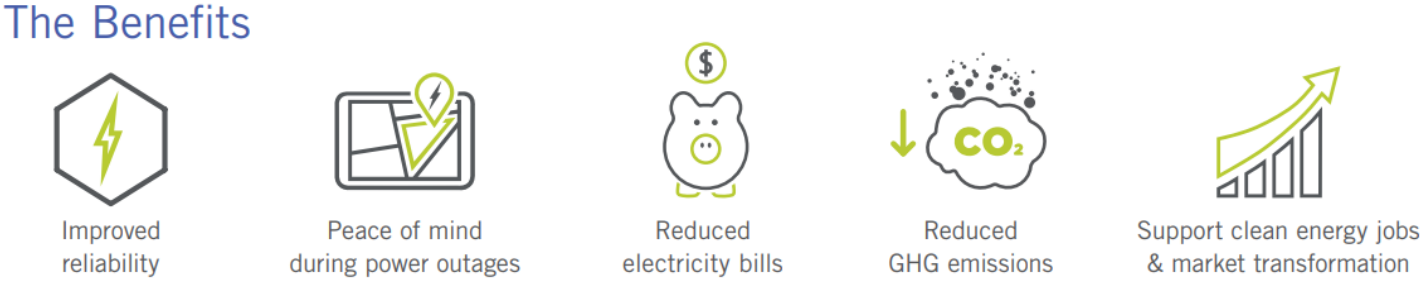
Objective: Retrofit 10 homes in Markham to reduce greenhouse gas (GHG) emissions and improve energy efficiency

Project equipment installed:

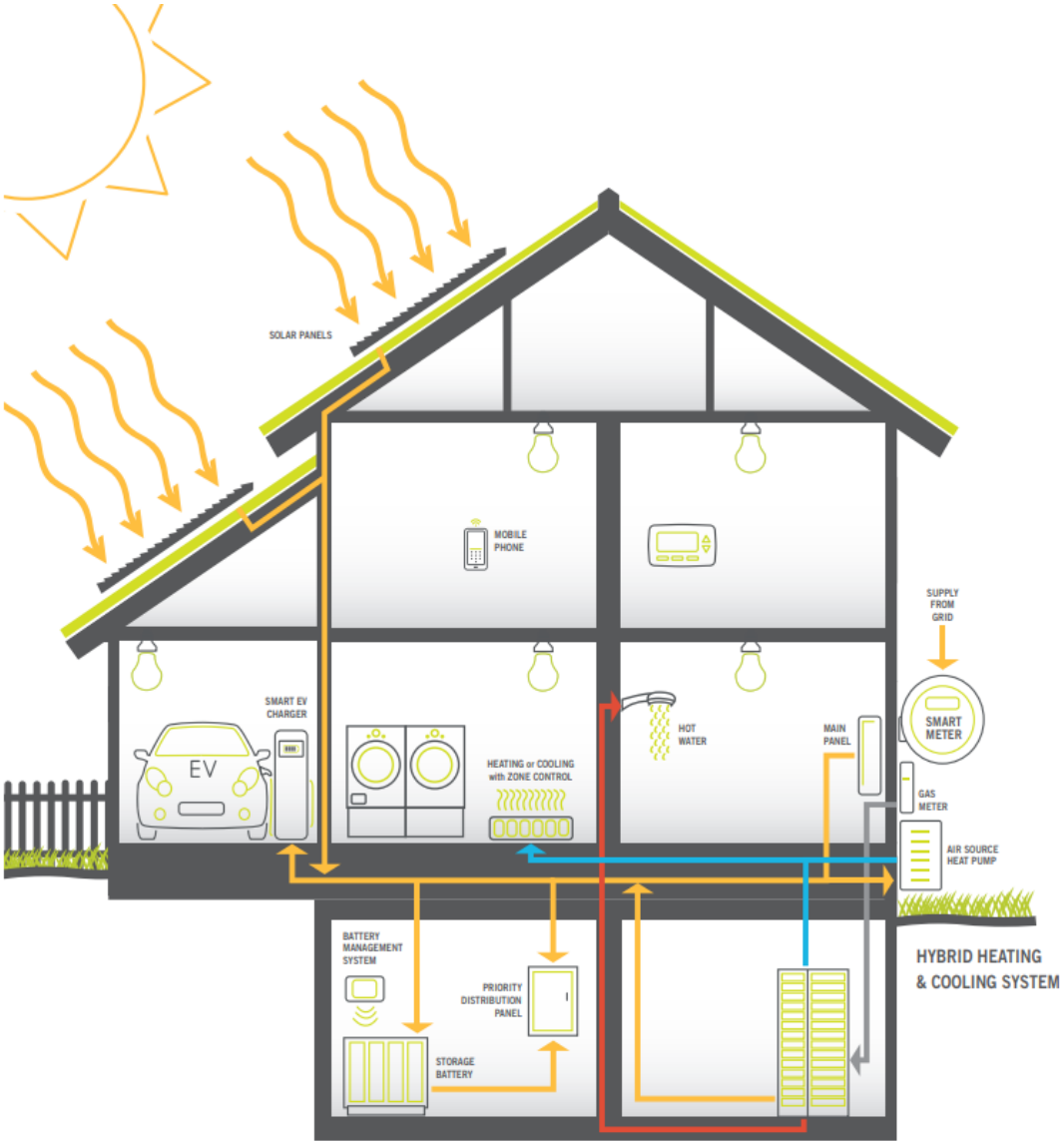
- **Electrical** – Integrated Virtual Power Plant (VPP), roof-mounted solar panels, battery storage, L2 EV charger
- **Hybrid thermal** – Micro combined heat pump (mCHP), high efficiency boiler, air handling unit, air source heat pump, storage tank

Estimated GHG Reductions: 81 tCO2e annually by 2030

Project Partners: Alectra Utilities, Enbridge Gas Distribution, Natural Resources Canada and Ryerson University



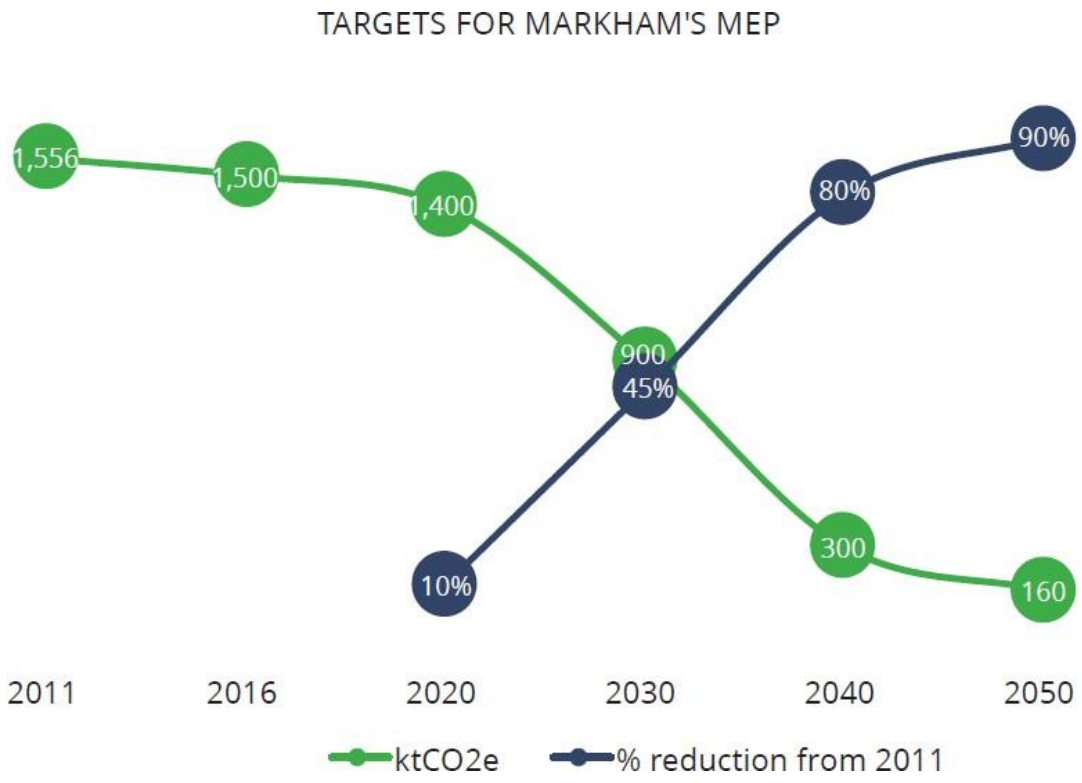
Power.House Hybrid Pilot Project - Diagram



Other key benefits:

- Empower households to generate and store clean energy
- Optimize electrical and thermal technologies to minimize GHG emissions
- Lead the shift from large centralized power generation to decentralized, cleaner generation

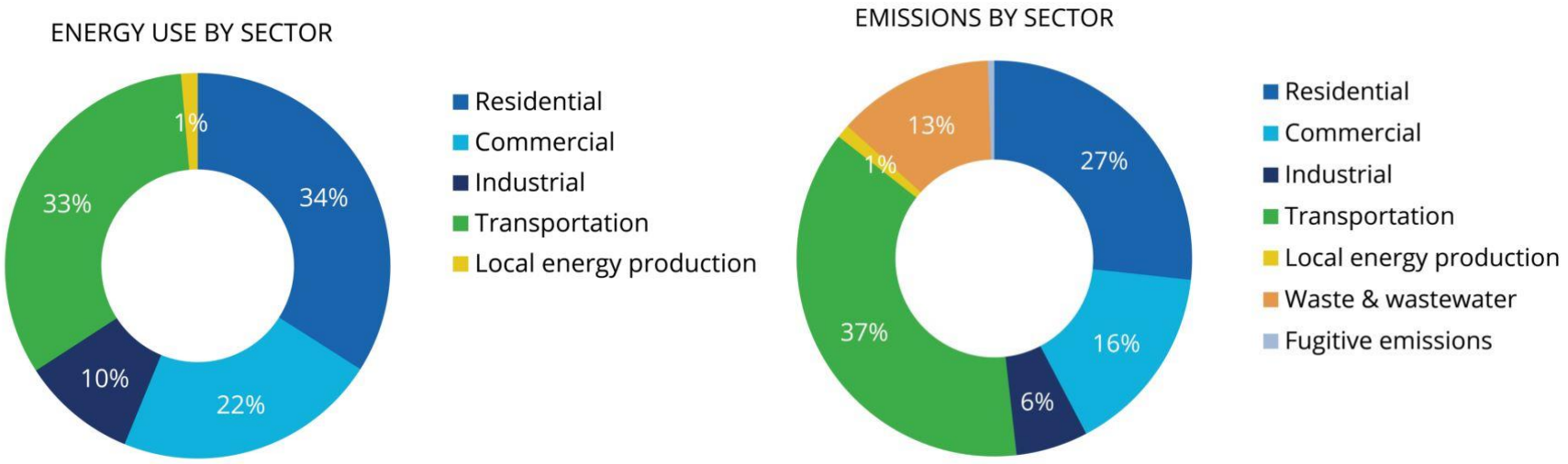
Road Map to Net Zero by 2050



Net zero emissions by 2050 is achievable with rigorous energy management strategies and offsets

Municipal Energy Plan (MEP) – Getting to Zero

2011 Baseline: Energy and Emissions by Sector



Markham's emissions were nearly 1,800,000 Tonnes of CO_2 in 2011.