



# The Case for Ground-Source Heat Pump Retrofits in EMURBs

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February 22, 2017



## ABOUT THE ATMOSPHERIC FUND

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- Toronto City Council created Toronto Atmospheric Fund (TAF) in 1991
- \$23 million endowment for grants & mandate related investments – recently increased by \$17 million
- Helping Toronto meet its GHG emissions reduction targets
  - Financing Energy Efficiency
  - Technical Research
  - Policy Development



## WHY TAF CARES ABOUT HEAT PUMPS

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**48% of urban GHG emissions from buildings**  
→ majority of building emissions from space conditioning

**Advocating deep carbon reductions in buildings**

**Heat pumps acknowledged globally as a potential key in achieving a low-carbon future**

## Ontario committed to heat pump deployment

More info on retrofit feasibility for Ontario context & rollout strategy needed now

Climate Change Action Plan

Actions and investments in the plan



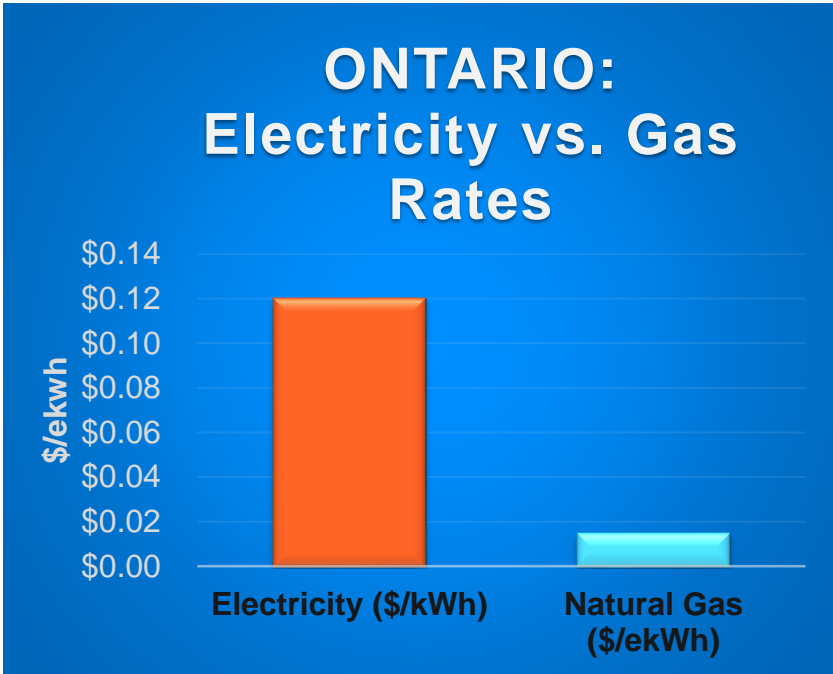
### Action Area: Buildings and Homes

	Action	Intended GGRA Funding	Est. GHG Reduction In 2020*	Est. Cost Per Tonne	Timetable: Action Start
4	Help homeowners reduce their carbon footprints by supporting additional choice				
4.1	Boost low-carbon technology in homes: Ontario will help homeowners purchase and install low-carbon energy technologies such as geothermal heat pumps and air-source heat pumps, solar thermal and solar energy generation systems that reduce reliance on fossil fuels for space and water heating.	\$500,000,000 to \$600,000,000			2017/18

## Project name: Pumping Energy Savings

Project Focus →	Increasing heat pump adoption in Electrically-heated Multi-Unit Residential Building (EMURB) sector
Objectives →	1) Demonstrate technical potential & business case 2) Develop recommendations

**Target Rationale:**  
→ EMURBs strongest business case in Ontario Multi-Residential Building sector



# PUMPING ENERGY SAVINGS (PES): Activities & Accomplishments

## PUMPING ENERGY SAVINGS:

Ontario EMURB Market Characterization Study  
Advancing the conservation opportunities of air and ground source heat pumps in the Ontario Electrically-heated Multi-unit Residential Building (EMURB) sector.



Ontario EMURB Market Characterization Study

**COMPLETED**



EMURB Retrofit Feasibility Study

**SPRING 2017**



Ontario-Wide GHG Reduction & Energy Savings Assessment  
For EMURB sector

**SPRING 2017**



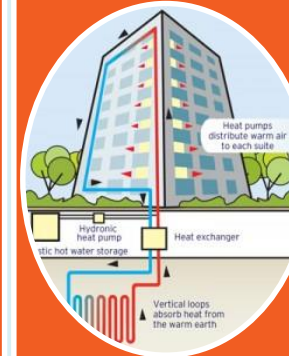
Retrofit Guidelines & Business Case Assessment Tool

**SPRING 2017**



Barriers/Opportunities Analysis & Recommendations Report

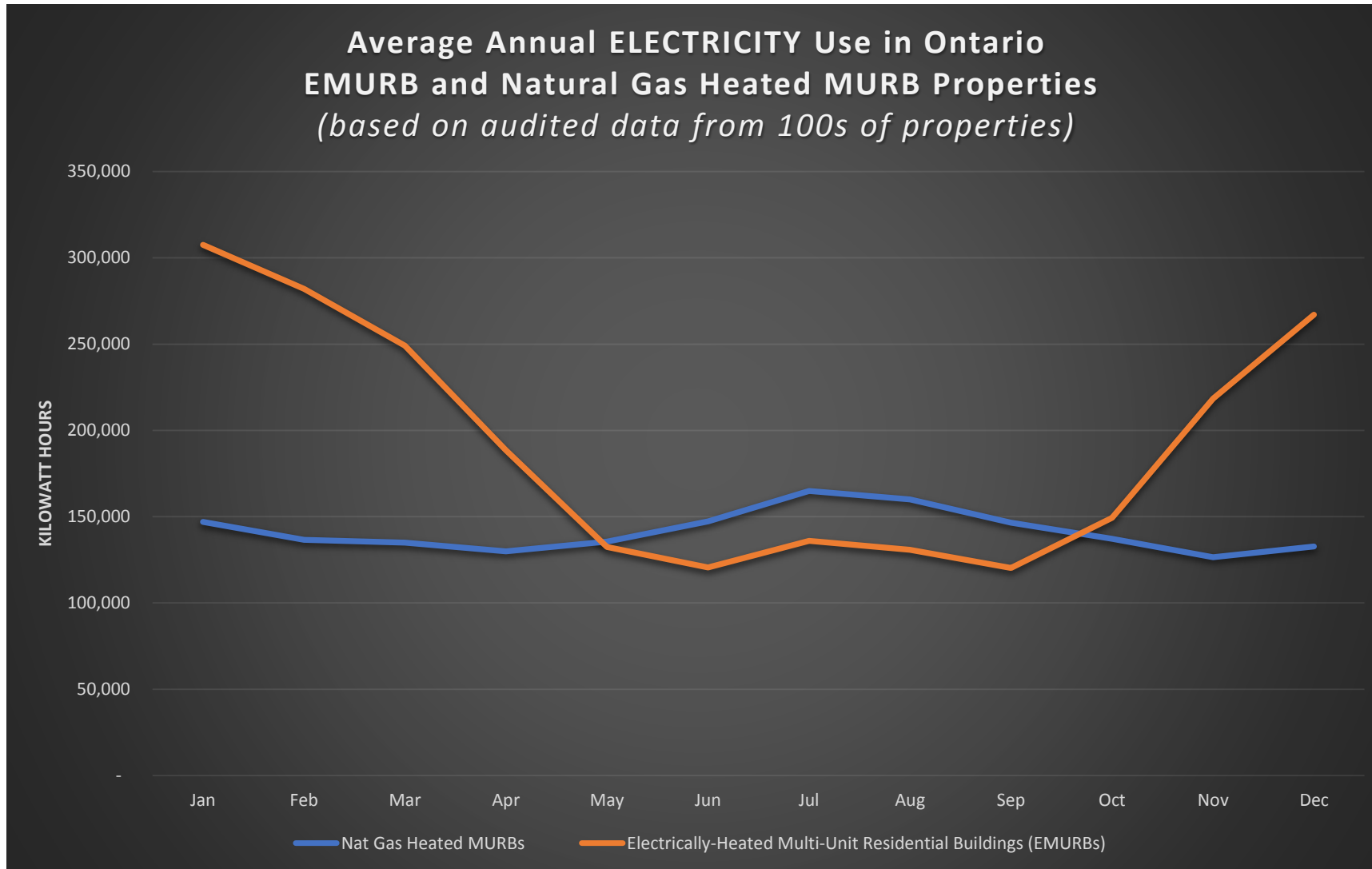
**SUMMER 2017**



AFTER PES Demonstration Projects

**2018**

## FINDINGS: Higher electricity use in EMURBs vs. MURBs during heating season



## FINDINGS: SIZE OF EMURB SECTOR

**24%**

**of multi-unit  
residential buildings  
in Ontario are  
electrically heated.**



## FINDINGS: Electrically-Heat Multi-Unit Residential Building (EMURB) Hot Zones

<b>Top 5 Ontario Census Subdivisions (CSD) with Highest Estimated # EMURBs</b>				
RANK	CSD	TOTAL EMURB UNITS	ESTIMATED TOTAL ELECTRICITY USE FOR SPACE HEATING (GWh/year)**	THEORETICAL CONSERVATION POTENTIAL Retrofitting all EMURB units with Heat Pumps [Assuming 60% energy savings achieved]
1	<b>Toronto</b>	125,582	596	358
2	<b>Ottawa</b>	35,998	171	103
3	<b>Mississauga</b>	26,675	127	76
4	<b>Hamilton</b>	16,758	80	48
5	<b>London</b>	15,407	73	44

\*\*Based on "Total EMURB Units" multiplied by estimated EMURB Space Heating EUI (4,745 kWh/unit/year)

## FINDINGS: EMURB electricity use

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**405,000**

Approx. EMURB units in Ontario.

**42%**

of electricity use in EMURBs  
for space heating.

**4,745 kWh/a**

Average annual EUI for electric  
space heating in EMURB units.

## FINDINGS: EMURB Market Characteristics

FACTOR	% OF EMURB MARKET SHARE
YEAR BUILT	1960 – 1969: 15.6% <b>1971 – 1980: 51.6%</b> <b>1981 – 1990: 22.5%</b> 1991 – 1993: 10.2%
AIR CONDITIONING (In-Suite)	<b>Window Units (Intermittent): 41%</b> PTAC: 39% Central AC: 16% No AC: 4%
HEATING EQUIPMENT (In-Suite)	<b>Electric Resistance Baseboards: 70%</b> PTAC: 17% Other: 11% Heat Pumps: 2%
OWERSHIP TYPE	Co-operatives: 3% <b>Condominiums: 30%</b> Public Housing: 17% <b>Rental Apartments: 50%</b>
STRUCTURAL TYPE	Row House: 9% Low Rise (< 5 stories): 22% Mid Rise (5 – 9 stories): 23% <b>High Rise (10+ stories): 46%</b>
SIZE	<b>68% EMURB <u>properties</u>: &lt;150 units</b> <b>66% total EMURB <u>units</u>: in properties &gt;150 units</b>

## Feasibility Study Business Case Summary for EMURB GSHP retrofit

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Figures solely for Ground Source Heat Pump Retrofit; other measures recommended to accompany the retrofit not factored below:

**76%**

**Energy Savings for Space Heating  
(or 3,100,000 kWh/year)**

**\$5,200**

**Retrofit Cost Per Residential Unit\***

**6.8 (5.3)**

**Simple Payback in years  
(with incentives)**

*\*Estimate includes cost of analysis, design, contract admin, materials and labour, construction review, commissioning, controls, project management, and contingencies, and HST.*

## EMURB Characteristics that make a site viable for GSHP

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**Existing equipment that can be reused**

→ (i.e. hydronic cooling loop with in-suite fan-coils)

**Sufficient space for boreholes**

**Existing central cooling**

## Bundling RCMs improves business case

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Aging condition of EMURBs creates opportunity to leverage savings from implementing multiple resource conservation measures (RCMs) simultaneously

Retrofit Scenario: **ONLY GEO**

**6.8 (5.3)**

Simple Payback in years  
(with incentives)

Retrofit Scenario: **GEO** + **OTHER RCMs**

**5.8 (4.5)**

Simple Payback in years  
(with incentives)

EXAMPLE RCMs: LED lighting, low-flow aerators, high efficiency toilets, DHW upgrades, VFDs for various mechanicals

## Incentive programs supportive of geo

PROGRAM	OFFERING	REQUIREMENTS
IESO SaveOnEnergy (SOE) Retrofit Program – CUSTOM Track	<b>\$0.10/kWh</b> - 1 <sup>st</sup> year savings	Must follow SOE M&V requirements for CUSTOM Track projects
Pay for Performance Program (P4P) – [IESO finalizing program design]	<b>\$0.04/kWh/year</b> – Up to 4 years (effective incentive rate of \$0.16/kWh)	IPMVP Option C – Whole Building Analysis  All measures implemented captured, no need to separate M&V for each measure.
Process and Systems Program	<b>\$0.20/kWh</b> – one year electricity savings	Only for measures resulting in 100MWh savings or greater  M&V Terms (incentive size):  1 yr M&V (<\$1,000,000) 10 yr M&V (>\$1,000,000)

## NEXT STEPS

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**Develop Recommendations for  
advancing the use of heat pumps**

**Demonstration Projects (up to 4 retrofits)  
– Build market confidence**

**Assess industry capacity building  
opportunities**



STAY CONNECTED!



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