

## Proposal for Burlington CAP Carbon Reduction in Existing Townhouses

Heat pump technology can be used to reduce carbon emissions and heating costs in existing townhouses. This proposal outlines how converting electric baseboard heated townhouses to electric cold climate heat pumps for heating and cooling and converting natural gas heated townhouses to electric cold climate heat pumps for heating and cooling can reduce occupant heating and cooling bills while not increasing the electrical supply demand and reduce carbon emissions by approximately 85%.

To implement this concept, existing townhouse owners would be found with both types of heating systems and be converted. There would be no cost to the City or Burlington Hydro other than administrative because the Green Municipal Fund would subsidize the capital cost and the monthly savings in utility bills would cover the financing for the remaining capital cost for the baseboard homes. The gas homes would pay a little more but less than if they had conventional air conditioning.

Burlington has approximately 4,000 electrically heated homes. Many are baseboard heated townhouses in the urban area not serviced by natural gas. Also, the City has many natural gas heated townhomes burning environmentally disastrous fracked gas from the US.

With lower electricity costs and increasing natural gas costs, the potential exists for occupants to save money, reduce emissions and cool their homes. In addition, the value of the homes will rise due to the lower operating costs and added feature of cooling.

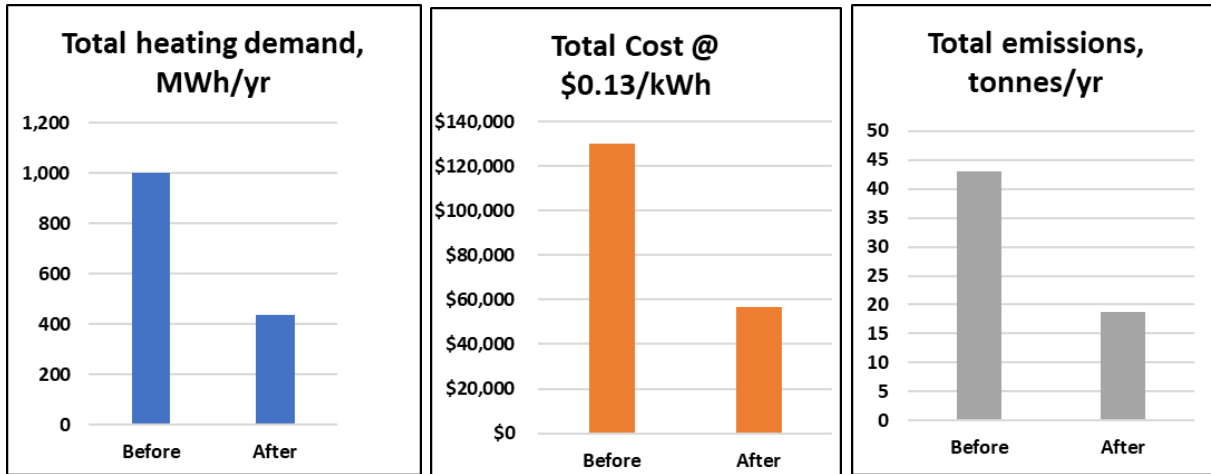
The concept is that heating with a heat pump saves 65% of the electricity demand and cost which can be used to convert natural gas heated homes that will now be using more electricity. Done on a multiple unit scale, converting electrically baseboard heated townhouses would allow about 1.3 times as many natural gas heated homes to convert to heat pump heating and cooling.

The following shows this concept.

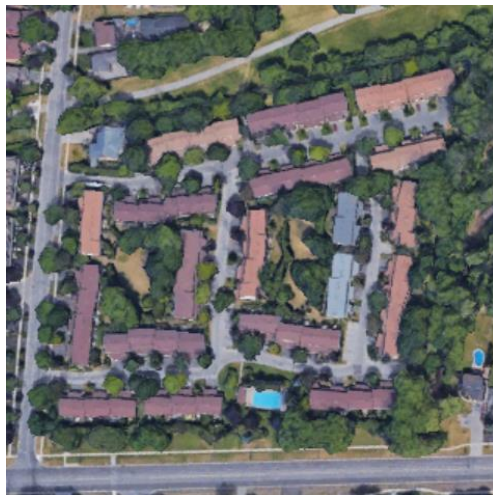


50 Electric Baseboard Heated Townhouse  
Condominium Units  
Typical heating demand = 20,000 kWh/yr./unit  
Total heating demand = 1,000 MWh/yr  
Total Cost @ \$0.13/kWh = \$130,000/yr  
Carbon emissions @ 43 g/kWh = 860 kg/kWh/yr/unit  
Total emissions = 43 tonnes/yr.

Switch to cold climate heat pump:  
Heating demand = 6700 kWh/yr/unit (COP=3)  
Cooling demand = 2000 kWh/yr/unit (COP=3)  
Total electrical demand = 8700 kWh/yr/unit =  
435 MWh/yr  
Total Cost = \$56,550/yr  
Total emissions = 18.7 tonnes/yr



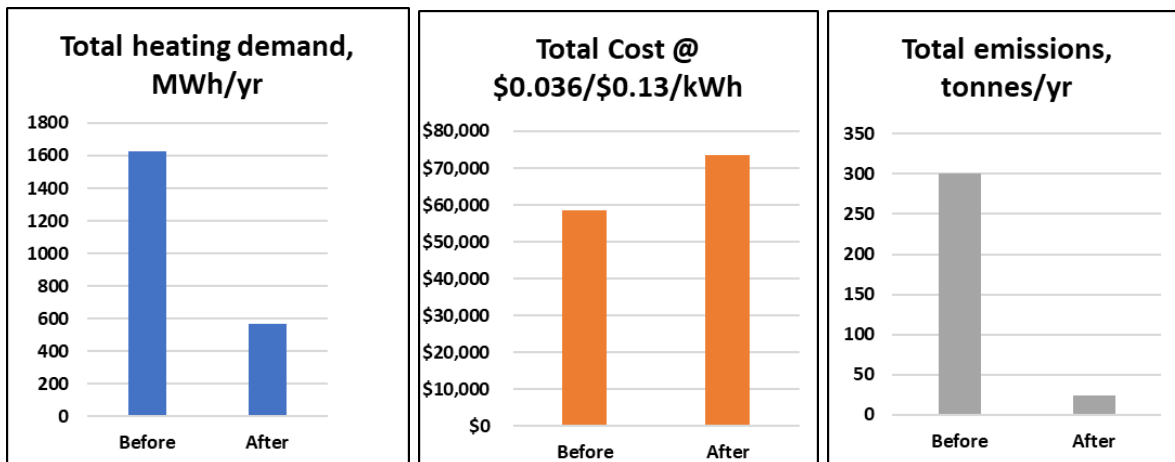
Total electricity savings available for gas conversions = 565 MWh/yr  
 Number of units at 8700 kWh/yr = 65 units



**65 Natural Gas Heated Townhouse Condominium Units**

Typical heating demand = 25,000 kWh/yr./unit  
 Total heating demand = 1,625 MWh/yr (COP=0.8)  
 Total Cost @ \$0.036/kWh = \$58,500/yr  
 Carbon emissions @ 185 g/kWh = 4625 kg/kWh/yr/unit  
 Total emissions = 301 tonnes/yr.

Switch to cold climate heat pump:  
 Heating demand = 6700 kWh/yr/unit (COP=3)  
 Cooling demand = 2000 kWh/yr/unit (COP=3)  
 Total electrical demand = 8700 kWh/yr/unit = 565 MWh/yr  
 Total Cost @\$0.13/kWh = \$73,450/yr  
 Total emissions@ 43 g/kWh = 24.3 tonnes



## Savings Summary

Item	Electricity MWh/yr	Natural Gas MWh/yr	Emissions Tonnes/yr	Cost \$/yr
50 BB TH	1,000		43	\$130,000
50 HP TH	435		18.7	\$56,550
Savings	565 (57%)		24.3	\$73,450 (57%)
65 NG TH		1625	301	\$58,500
65 HP TH	565		34.3	\$73,450
Savings	1,060 (65%)		266.7	(\$14,950) (26%)
Combined Savings	1,625		291	\$58,500
	40%		85%	31%
Value of A/C	2000 kWh/home (\$260)			\$29,900

### Capital Cost Financing:

Typical Capital Upgrade Cost \$7,500 installed cost

50 baseboard plus 65 natural gas homes = 115 x \$7500 = \$862,500

15% Green Municipal Fund grant of \$1,125 per home

Green Municipal Fund loan of \$6,375 + HST at 4% for 15 years = \$53/month

### Energy Savings:

Baseboard TH savings = \$1,469 per home/year = \$122/month

NG TH savings = (\$230) per year = (\$19) more per month but has the benefit of cooling.

NG TH savings with cooling = \$33/mo.

### Net Cash Flow:

Baseboard TH savings = \$122 – 53 = \$69/mo.

NG TH savings with cooling = \$33 - \$53 = (\$20)/mo.

### Balance baseboard with natural gas to have equal savings for all homes.

\$3450 - \$1300 = \$2150 for 115 homes = \$19/mo. average savings

## Calculations

### 20 Year Cash Flow Analysis of Heat Pump vs. Gas Conversion

Individual Townhouse Summary			
Source	Electric Baseboard	Electric Heat Pump	Gas and Electric A/C
Heating			
Cost/kWh	\$0.13	\$0.13	\$0.037
COP	1	2.5	0.8
Net \$/kWh	\$0.13	\$0.052	\$0.046
Annual increase	0.1	0.1	0.1
20 yr factor	57.27	57.27	57.27
kWh heating load	20000	20000	25000
Heating Cost	\$148,902	\$59,561	\$52,975
kWh cooling load		6000	8500
Cooling cost		\$16,495	\$24,342
Capital Cost	\$4,000	\$7,500	\$10,000
Total Heat and Cool	\$152,902	\$67,061	\$62,975
Savings		\$85,841	\$89,927
Payback, years		1.8	1.7

Natural Gas Cost per kWh =	m <sup>3</sup> per Year
0.241 \$ rate per m <sup>3</sup>	20000 kWh/yr
2390 x m <sup>3</sup>	25000 /0.8 COP
575.99 = \$ per year	10.46 /kWh/m <sup>3</sup>
\$650.87 x 1.13 HST	2390 = m <sup>3</sup> per yr
\$284.76 + Service	
\$935.63 =Total	
25000 /kWh/yr	
\$0.037 = \$/kWh	

Individual Townhouse Summary - First Year			
Source	Electric Baseboard	Electric Heat Pump	Gas and Electric A/C
Heating			
Cost/kWh	\$0.13	\$0.13	\$0.037
COP	1	2.5	0.8
Net \$/kWh	\$0.13	\$0.052	\$0.047
Heating load, kWh	20000	20000	25000
Heating Cost	\$2,600	\$1,040	\$1,170
Cooling load, kWh		6000	8500
Cooling cost		\$312	\$398
Capital Cost	\$4,000	\$7,500	\$10,000
Finance Cost	\$354.26	\$664.23	\$885.65
Total Annual	\$2,954	\$2,016	\$2,453
Savings		\$938	\$501
Payback, years		3.1	5.9
4%, 15 yrs. Factor =	0.088565		

