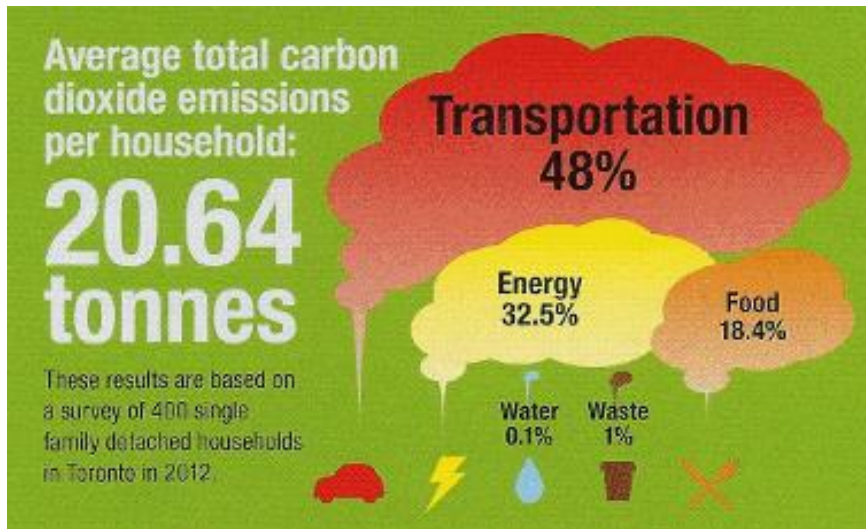




GREEN HOME AND CAR UPGRADE PROGRAM

The Intergovernmental Panel on Climate Change (IPCC) has outlined ways in which temperature rise on the earth can be reduced. Much of the action takes place at the local level, in cities and municipalities.

The program outlined here focuses on existing residential homes and personal vehicles. In Burlington, the building sector is responsible for 40% of greenhouse gas emissions. 27% is from the residential sector. Reductions of 2 to 4 tonnes annually of equivalent carbon dioxide per home are achievable. This represents 50% to 85% of the household emissions produced from heating and cooling in Ontario. Vehicles account for another 40% and switching from a gasoline car to an electric or plug-in hybrid can save 3 to 4 tonnes a year.



Program Outline

Home Heating/Cooling

This program looks at the existing housing stock where implementation can best occur. Single family detached/semi-detached and townhouse developments (condominiums) are addressed initially but any other housing type can receive the same benefits such as social housing. The program is divided into two groups of housing units:

- Electrical baseboard heated homes
- Fossil fuel (natural gas, propane and oil) heated homes

Four approaches to carbon reduction upgrades are included:

- Addition of electrical heat pumps
- Addition of attic and basement sealing and insulation



- Addition of Heat Recovery Ventilators (HRV)
- Addition of solar electrical panels

There are other things a homeowner can do to reduce energy costs and carbon but the above are considered to be the “best bang for your buck and the planet”. For example, changing water heaters and windows can be effective but usually have longer paybacks. We will help anyone who is interested in other approaches.

Three scenarios have been developed as follows:

- Electrical baseboard or hot water fossil fuel radiator heated homes will receive a mini split ductless heat pump, sealing/insulation, solar panels and a small HRV that exchanges bathroom exhaust with incoming fresh air
- Fossil fuel heated homes with central ducting with or without electrical air conditioning where the furnace is not due for replacement will receive a hybrid heat pump system that uses the existing gas furnace, sealing/insulation, solar panels and an HRV that interfaces with the central ducting system to exchange warm stale indoor air with incoming fresh air
- Fossil fuel heated homes with central ducting with or without electrical air conditioning due for a replacement furnace will receive a full replacement central heat pump, sealing/insulation, solar panels and an HRV that interfaces with the central ducting system to exchange warm stale indoor air with incoming fresh air

The intent is to implement these improvements at the most appropriate time in the age and condition of the buildings. Electrically heated homes are paying the highest rates for heating and can dramatically reduce those costs and add cooling at the same time. This applies to housing of any age. Forecasts for increased electricity costs will make the upgrades highly effective in reducing costs. The carbon reductions are not as dramatic as for gas heated homes but are still significant. Natural gas prices have risen recently and will continue to do so. Apart from producing greenhouse gas emissions, since 2013, Ontario natural gas heated homes receive their natural gas from toxic fracking in the Appalachian Mountains in the US and have reduced natural gas from Alberta.

Adding solar power generation also reduces the load on the distribution system and provides an element of resiliency during power outages.

Each of the items identified are intended to be cost effective. A homeowner can select any of the four items and know that the improvement is cash flow positive from day one as well as being a significant way to reduce carbon emissions.

A staged approach will occur naturally as heating and cooling systems deteriorate over time. So a homeowner can start with the energy/carbon reducing items that will be effective at any time and wait to replace their heating/cooling system at the appropriate time.



Heat Pumps

The heat pump system consists of an outdoor unit and a wall hung (or ceiling ducted) indoor unit with air passing over the coils in each unit to deliver and remove heated or cooled air.

The heat pump will provide lower electricity costs, filtered air movement and cooling. Because the heat pump uses free energy from the air, it uses 33% to 40% as much energy as electric resistance (baseboard) heating and of natural gas furnace heating. The same unit reverses in the summer to provide cooling.

The split system inverter technology heat pump will provide most of the heating during the winter but the existing electric baseboard heaters will remain in place. The systems can be unducted for smaller homes or ducted for larger homes or a combination of both. Usually one outside unit will serve all indoor units.

For unducted heat pump units, baseboard heaters will help when room doors are closed. During the cooling season, the heat pump will provide cooling. Customers have the option of installing a secondary ducted system to give better heating and cooling for closed rooms.

Natural gas heated homes are spending the least on energy but producing the most carbon, aside from propane and oil heated homes. With a ducted distribution system, the addition of a heat pump is simple, whether the home currently has central air conditioning or not. The approach is to address homes where the existing heating and or cooling systems are nearing the end of their effective lifespan. When equipment has to be replaced anyway, the cost of a heat pump is the same as for a high efficiency natural gas furnace and Tier 2 central air conditioning. The carbon reduction, however is dramatically lower with the electrical heat pump in the order of 85%. Currently, the operating costs are lower with gas but not by much. With assistance from the government, this can be changed. And the issue of importing natural gas from US shale fracking operations can be avoided.

This program looks at two scenarios. Firstly, hybrid heat pumps for fossil fuel heated homes are on the market. They have the standard outdoor unit and an indoor coil that fits in the existing furnace ductwork above the heating section. The furnace remains intact and only provides heat when the heat pump is incapable, typically for 25% of the heating season when temperatures are at their coldest. In the summer, the heat pump provides all the cooling needed. The advantage here is that the older gas furnace will last much longer because it doesn't run as often.

Secondly, for homeowners who prefer a completely new system, a full central heat pump replacement is available at higher cost than the hybrid option.



Sealing and Insulation

An extensive study conducted by the Central Mortgage and Housing Corporation (CMHC) found that energy costs can best be reduced by adding insulation to attic space and the perimeter basement walls and sealing all potential sources of air leakage. The amount of carbon reduction is dependent on the type of heating and cooling system in the home.

Heat Recovery Ventilators

These devices, along with Energy Recovery Ventilators save energy by preheating the incoming cold air with the outgoing warm stale air from building exhaust systems. They also work in the summer to help cool, Humidity control is another benefit.

Solar Electricity Generation

Solar panel installations have come down in price to the point where they produce electricity at a lower rate than purchasing from Ontario's electrical grid. However, where homes are already connected to the grid, the capital cost has to be considered. Prices are such that with longer term financing, the energy savings are greater than the finance costs. Net metering allows any electricity generated but not used to be put back into the grid. The systems proposed here are intended to produce less than is needed on an annual basis so that a net excess will not occur. The electricity can power not only the heat pump but other electrical loads including electric vehicles which operate as storage devices using the built in batteries. During power outages, the batteries can feed the stored power back into the house.

Government Assistance

The program described here is feasible under current legislation in Ontario. No restrictions exist for homeowners who want to upgrade their heating/cooling systems and reduce energy consumption. Solar panel installations are permitted and have been encouraged in the past under government programs such as microFIT.

Financing

This program is being funded by private sources without relying on any government rebates, incentives or grants. Although such incentives may be available now, their future is not guaranteed so any use of them will be considered a bonus. Private investors have seen that the program is self-sustaining. Some of the improvements require longer term financing than others and assistance to homeowners from local government and utilities is encouraged. For example, most of these improvements are based on financing over 10 to 20 years. Some people can use a line of credit or a mortgage when it comes up for renewal at lower interest rates than the private funding.



Property Value Increase

Preliminary studies have shown that the improvements discussed here can increase the value of homes by 5% to 15%. This results in a profit when the home is sold. For example, an investment of \$10,000 can result in a property value increase of up to \$30,000. The new owner then benefits from the reduced operating costs and general increase in comfort. With energy labelling now in Ontario, purchasers are much more likely to buy an efficient home than one that is not.

Typical Scenarios

Examples of improvements are summarized in the tables below.

Ductless Heat Pump							
Electric Baseboard Heated Home							
20,000 kWh(72 GJ)/yr							
							Tonnes
Improvement	Capital	Finance	kWh/yr		Cost	Net	Carbon
	Cost		Savings	%	Savings	Surplus	Savings
Ductless Heat Pump	\$9,000	\$1,028	10,000	50%	\$1,300	\$272	0.7
Insulation packages	\$2,000	\$228	2,000	10%	\$260	\$32	0.1
HRV	\$1,060	\$121	3,000	15%	\$390	\$269	0.2
Solar Arrays, 3 kW	\$3,000	\$343	3,000	15%	\$390	\$47	0.2
Total	\$15,060	\$1,720	18,000	90%	\$2,340	\$620	1.3
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Carbon kg per kWh	0.07						

Hybrid Heat Pump							
NG heated home							
and elec. A/C							
30,650 kWh(110 GJ)/yr							
							Tonnes
Improvement	Capital	Finance	kWh/yr		Cost	Net	Carbon
	Cost		Savings	%	Savings	Surplus	Savings
Hybrid Heat Pump	\$5,000	\$571	16,488	54%	\$1,254	\$683	3.1
Insulation packages	\$2,000	\$228	3,065	10%	\$71	(\$158)	0.6
HRVs	\$1,060	\$121	4,598	15%	\$106	(\$15)	0.9
Solar Array, 3 kW	\$3,000	\$343	3,000	10%	\$390	\$47	0.2
Total	\$11,060	\$1,263	27,150	89%	\$1,821	\$558	4.7
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Gas cost /kWh	\$0.036						
Carbon kg per kWh, elec.	0.07						
Carbon kg per kWh, gas	0.185						



Hybrid Heat Pump							
Propane heated home and elec. A/C							
30,650 kWh(110 GJ)/yr							Tonnes
	Capital	Finance	kWh/yr		Cost	Net	Carbon
Improvement	Cost		Savings	%	Savings	Surplus	Savings
Hybrid Heat Pump	\$5,000	\$571	16,488	54%	\$1,614	\$1,043	3.1
Insulation packages	\$2,000	\$228	3,065	10%	\$272	\$43	0.6
HRVs	\$1,060	\$121	4,598	15%	\$408	\$286	0.9
Solar Array, 3 kW	\$3,000	\$343	3,000	10%	\$390	\$47	0.2
Total	\$11,060	\$1,263	27,150	89%	\$2,683	\$1,420	4.7
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Propane cost /kWh	\$0.094						
Carbon kg per kWh, elec.	0.07						
Carbon kg per kWh, gas	0.185						

Ductless Heat Pump							
Hot Water Gas Heated Home							
No A/C							
25,500 kWh(92 GJ)/yr							Tonnes
	Capital	Finance	kWh/yr		Cost	Net	Carbon
Improvement	Cost		Savings	%	Savings	Surplus	Savings
Ductless Heat Pump	\$9,000	\$1,028	11,750	47%	(\$235)	(\$1,263)	3.0
Insulation packages	\$2,000	\$228	2,525	13%	(\$51)	(\$279)	0.6
HRVs	\$1,060	\$121	3,788	15%	(\$76)	(\$197)	1.0
Solar Array, 3 kW	\$3,000	\$343	3,000	12%	\$390	\$47	0.2
Total	\$15,060	\$1,720	21,063	86%	\$29	(\$1,691)	4.8
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Gas cost /kWh	\$0.036						
Carbon kg per kWh, elec.	0.07						
Carbon kg per kWh, gas	0.185						



Central Heat Pump							
NG heated homes and elec. A/C							
30,650 kWh(110 GJ)/yr							Tonnes
	Capital	Finance	kWh/yr		Cost	Net	Carbon
	Cost		Savings	%	Savings	Surplus	Savings
Central Heat Pump	\$11,000	\$1,256	20,590	67%	\$327	(\$930)	3.6
Insulation packages	\$2,000	\$228	3,065	10%	\$49	(\$180)	0.5
HRVs	\$1,060	\$121	4,598	15%	\$73	(\$48)	0.8
Solar Array, 3 kW	\$3,000	\$343	3,000	10%	\$390	\$47	0.2
Total	\$17,060	\$1,948	8,412	102%	\$838	(\$1,110)	5.1
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Gas cost /kWh	\$0.036						
Carbon kg per kWh, elec.	0.07						
Carbon kg per kWh, gas	0.185						

For comparison, the alternative of replacing and aging natural gas furnace and electric air conditioning is shown below. Even though the furnace and A/C show a negative cash flow, it is still less than converting to a heat pump. The reason is that switching fuels when electricity is more expensive than gas the energy is reduced but not the cost.

High Efficiency Gas Furnace							
NG heated homes and elec. A/C							
30,650 kWh(110 GJ)/yr							Tonnes
	Capital	Finance	kWh/yr		Cost	Net	Carbon
	Cost		Savings	%	Savings	Cost	Savings
HE Furnace and A/C	\$8,000	\$914	5,913	19%	\$419	(\$495)	0.8
Insulation packages	\$2,000	\$228	3,065	10%	\$217	(\$11)	0.4
HRVs	\$1,060	\$121	4,598	15%	\$326	\$205	0.7
Solar Array, 3 kW	\$3,000	\$343	3,000	10%	\$390	\$47	0.2
Total	\$14,060	\$1,606	16,576	54%	\$1,351	(\$254)	2.1
Financing at 10% 20 yrs.							
Factor	0.1142						
Electricity cost, /kWh	\$0.13						
Gas cost /kWh	\$0.036						
Carbon kg per kWh, elec.	0.07						
Carbon kg per kWh, gas	0.185						

Homes like this represent a large portion of the existing housing stock. Although there are carbon reductions, they would be more than twice as much by switching to electricity. As natural gas prices continue to rise, it will not take long until electric heat pumps will be less costly.



Electric/Plug-in Hybrid Electric Vehicles

In Ontario, rebates for the purchase of new electric and hybrid vehicles has ended. But in the last few years, the electric car market has increased substantially. The used car market benefits from the rebates that the original owners received and many models are less costly to own and operate than their gasoline equivalent. A comparison is given below.

Vehicle Life Cycle		5 Years	
Date	1-Feb-2019	Electric/Hybrid	Comparison
Vehicle Year		2016	2016
Vehicle Make		Chevy	Chevy
Vehicle Model		Volt PHEV	Cruze
Purchase Price		\$27,000	\$15,000
HST		\$3,510	\$1,950
Government Rebate		\$0	\$0
Dealer Rebate			
Net Cost		\$30,510	\$16,950
Annual mileage (km)		20,000	20,000
Unit Gasoline Cost		\$1.25	\$1.25
Unit Electricity Cost		\$0.13	
Annual Fuel Cost*		\$567	\$1,900
Annual Insurance		\$800	\$1,318
Annual License Fee		\$120	\$120
Annual Repairs		\$50	\$336
Annual Maintenance		\$50	\$845
Years of ownership		5	5
Resale Value		\$11,424	\$6,666
Net Cost per Year		\$5,405	\$6,576
Net cost per km		\$0.27	\$0.33
Monthly Purchase Cost**		\$318	\$171
Monthly Fuel Cost		\$47	\$158
Monthly Repair/Maint.		\$8	\$98
Total Monthly Cost		\$374	\$428
		12.7% less	



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*For the Volt, assume 5,000 km using gas at 2 litres/100km
and 15,000 km using electric at 0.241 kWh/km

Gas	\$150.00		
Electricity	\$417.30		
Total	\$567.30		
Litres/100 km		2.4	7.6
GHG g/km gasoline		147.0	179.0
GHG g/km electric		12.0	
GHG tonnes per year*		0.92	3.58
** Purchase cost less rebate divided by months owned			
Operating Cost		\$1,587	\$4,519

PHEV Purchase Offer

Jade Environmental Services is offering second hand Chevrolet Volt vehicles on a limited volume basis at competitive pricing and financing options. Call us for details.