Home Energy

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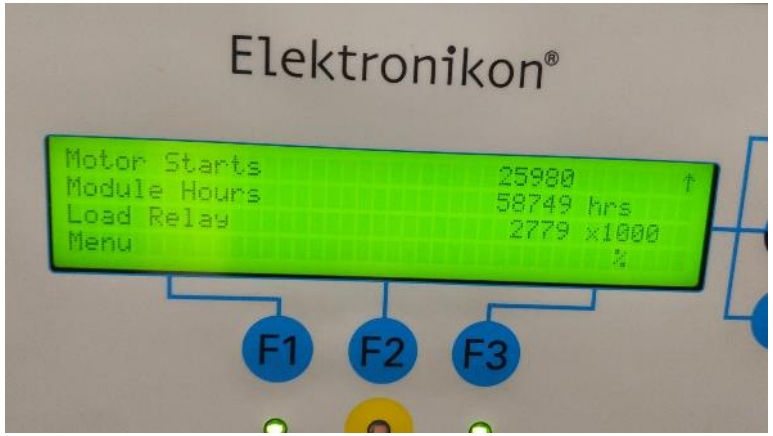
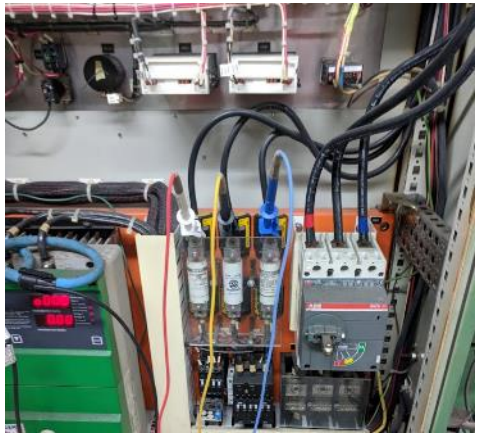
SUSTAINABLE Queen's

Sustainable Queen's is the hub and voice for campus sustainability, working with the Queen's community on sustainable initiatives and programs.

David Gerrish Dave Gerrish is the Energy Specialist, joining the team in April 2019. In this role Dave looks for opportunities to improve the efficiency of existing buildings and influence the design of new builds with an eye to the institutional goal of carbon neutrality by 2040. Dave works collaboratively with Physical Plant Services project managers, designers, and skilled trades; as well as academic departments, suppliers, and local utilities to find and implement cost and emission avoidance solutions. Prior to joining the team at Sustainable Queen's Dave had over 10 years experience as an energy efficiency consultant for industrial, commercial, institutional, and residential clients across Ontario.

For the last 10 years I have worked in commercial / industrial energy efficiency…





… but I started my energy career doing Home Energy Audits!

Agenda

1) Residential utility billing
2) Home energy myths and facts
3) What uses the most energy in a typical home?
4) Ways to reduce home energy use
5) Questions

Residential utility billing – Water

- In Kingston the 2020 water rate is around $2.70 per m^3
- This changes each year, usually increasing faster than inflation, around 8% /year
- 1 m^3 of water is equal to about:
  - 160 toilet flushes (6L/flush toilet)
  - 17 showers (10 minutes each using a 6L/minute showerhead)
  - 70 dishwasher loads

WATER

USAGE

For 7 ARTHUR ST
Billing Period of 28 days
Aug 18, 2020 to Sep 15, 2020

Current Usage

--------- Meter W62373 --------

Sep 15, 2020 Actual:	624.0000	m3
Aug 18, 2020 Estimate:	614.0000	m3
	10.0000	m3
Billing Multiplier:	1	
Total Usage:	10.0000	m3

YOUR WATER CHARGES

Utilities Kingston

WT Monthly Serv Chg (based on the 28 days)	$	20.80
Distribution & Treatment	$	13.96

10 m3 x $1.3961

Total WATER Charges	$	34.76
Total WATER Amount	**$**	**34.76**

SEWER

USAGE

For 7 ARTHUR ST
Billing Period of 28 days
Aug 18, 2020 to Sep 15, 2020

Current Usage

Based on Water Usage: 10.0000 m3

YOUR SEWER CHARGES

Utilities Kingston

SW Monthly Serv Chg (based on the 28 days)	$	28.54
Collection & Treatment	$	13.00

10 m3 x $1.3002

Total SEWER Charges	$	41.54
Total SEWER Amount	**$**	**41.54**

Residential utility billing – Gas

- Gas averages around $0.35 /m3, this fluctuates based on market rates
  - The Federal Carbon Charge is part of this cost
- 1 m3 natural gas is equal to around:
  - 30 minutes of running an average furnace

Federal Carbon Charge	Approximate Cost/m3
2020	$0.06
2021	$0.08
2022	$0.10
2023 and beyond..	?

GAS

USAGE

For 7 ARTHUR ST
Billing Period of 28 days
Aug 18, 2020 to Sep 15, 2020

Current Usage

---------- Meter G38135 ----------

Sep 15, 2020 Actual:	1169.0000	m3
Aug 18, 2020 Estimate:	1156.0000	m3
	13.0000	m3
Your Billing Multiplier:	1.00776	
Your Factored Usage:	13.1009	m3

YOUR GAS CHARGES

GS Monthly Serv Chg (based on the 28 days)	$	20.50
Commodity Chg 13.1 m3 x $0.1456	$	1.91
Federal Carbon Charge 13.1 m3 x $0.0602	$	0.79
Delivery 13.1 m3 x $0.0951	$	1.25
Transportation Chg 13.1 m3 x $0.0512	$	0.67
Total GAS Charges	$	25.12
HST	$	3.27
Total GAS Amount	**$**	**28.39**

Now things get more interesting:

Electricity!

- **Not a simple charge per unit the way gas and water are billed**
- **You have options in how you are charged per kWh**
- **Rates are currently subsidized**

Residential utility billing – Electricity

Things to note on your bill:

- **Usage broken down by “On Peak” / “Mid Peak” / “Off Peak”**
- **“Ontario Electricity Rebate”, temporary tax-funded discount**

Winter
(November 1 – April 30)
Weekdays

BILLING DETAIL

ELECTRICITY

(Kingston Hydro Corporation is the licensed distributor and provider of standard supply service; Utilities Kingston is an affiliate providing billing services)

USAGE

For 7 ARTHUR ST
Billing Period of 31 days
Aug 18, 2020 to Sep 18, 2020

---------- Meter E70744 ----------

Sep 18, 2020 Actual:	61457.5300 KWh
Aug 18, 2020 Actual:	60885.8200 KWh
	571.7100 KWh
Billing Multiplier:	1
Total Usage:	571.7100 KWh
Factored Usage: (571.7100 X 1.0393*)	594.1782 kWh

** = Total Loss Factor*

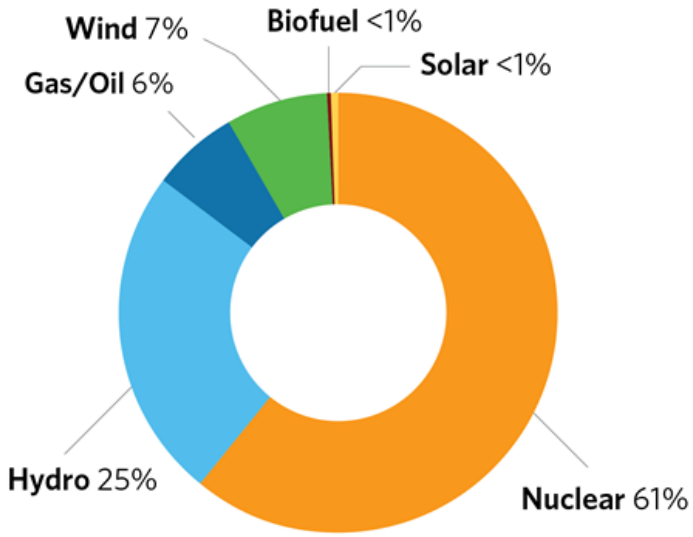
YOUR ELECTRICITY CHARGES

Electricity		$ 73.18
On Peak: 120.72 KWh x $0.128	15.45	
Mid Peak: 110.4 KWh x $0.128	14.13	
Off Peak: 340.59 KWh x $0.128	43.60	
Delivery		$ 39.62
Regulatory Charges		$ 2.57
Total ELECTRIC Charges		$ 115.37
HST		$ 14.98
8% Provincial Rebate		$ 0.00
Ontario Electricity Rebate		$ -36.69
Total ELECTRIC Amount		**$ 93.66**

Residential utility billing - Electricity

- Electricity is billed by the kilowatt-hour (kWh)
- 1,000 watts = 1 kilowatt
- 1 kilowatt consumed for 1 hour = 1 kilowatt-hour

Ontario's electricity supply mix



Nuclear	90.4 TWh or 61%
Hydro	36.4 TWh or 25%
Gas/Oil	9.5 TWh or 6%
Wind	11.0 TWh or 7%
Biofuel	0.4 TWh or <1%
Solar	0.7 TWh or <1%

- 1 kWh is equal to around:
  - 20 hours use of a modern 52" flatscreen TV, or a typical laptop
  - Daily consumption of a typical refrigerator
  - 3 days of "60W equivalent" LED light bulb (13W)
  - 40 **minutes** of running a plug-in space heater
  - 12 **minute** shower (electric hot water tank)

Residential utility billing - Electricity

- **NEW option in Ontario Nov 2020 to either be billed on "Tiered" pricing or "Time Of Use"**
- **Tiered pricing has a higher rate for use over 1,000 kWh/month, but only slightly**

Winter TOU Price Periods	November 1, 2020 TOU Prices
Off-Peak (Weekdays 7 p.m. – 7 a.m., all day weekends and holidays)	10.5 ¢/kWh
Mid-Peak (Weekdays 11 a.m. – 5 p.m.)	15.0 ¢/kWh
On-Peak (Weekdays 7 a.m. – 11 a.m. and 5 p.m. – 7 p.m.)	21.7 ¢/kWh

New!

	Winter Tier Thresholds	November 1, 2020 Tiered Prices
Tier 1	Residential – first 1,000 kWh/month Non-residential – first 750 kWh/month	12.6 ¢/kWh
Tier 2	Residential – for electricity used above 1,000 kWh/month Non-residential – for electricity used above 750 kWh/month	14.6 ¢/kWh

Should you switch to Tiered pricing? Next slide…

Residential utility billing - Electricity

- **Should you switch from TOU to Tiered Pricing?**
- Online calculator available to help you decide

- **Example small house, 600 kWh/month**

On-Peak:	150	kWh
Mid-Peak:	110	kWh
Off-Peak:	340	kWh
Total:	600 kWh	

Winter
(November 1 – April 30)
Weekdays

Kingston Hydro Corporation - RESIDENTIAL

SAMPLE MONTHLY BILL
Time-of-Use Pricing

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Electricity Charges

Electricity	
On-peak @ 21.7 ¢/kWh	$32.55
Mid-peak @ 15 ¢/kWh	$16.50
Off-peak @ 10.5 ¢/kWh	$35.70
Delivery	$40.56
Regulatory Charges	$2.68
Total Electricity Charges	**$127.99**
HST	$16.64
Ontario Electricity Rebate	**(-$42.49)**
Total Amount	**$102.14**

SAMPLE MONTHLY BILL
Tiered Pricing

Account Number: 000 000 000 0000
Meter Number: 0000000

Your Electricity Charges

Electricity	
600 kWh @ 12.6 ¢/kWh	$75.60
Delivery	$40.20
Regulatory Charges	$2.68
Total Electricity Charges	**$118.48**
HST	$15.40
Ontario Electricity Rebate	**(-$39.34)**
Total Amount	**$94.54**

Compare

- **Time Of Use** is only better if almost all your use is off-peak
- **Most homes will see a modest savings by switching to Tiered Pricing!**

- **Monthly savings are $7.60**

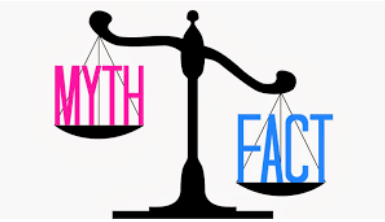
Residential utility billing - Electricity

Switching to Tiered electricity pricing is easy

If you are a Utilities Kingston customer, fill out this form:
https://utilitieskingston.com/Accounts/ElectricityRateChoice

If you are a Hydro One customer, go to this website:
https://www.hydroone.com/rates-and-billing/rates-and-charges/customer-choice

Next:
Let's deal with a few home energy myths



MYTH

FACT

Setting the temperature back in your home **wastes** energy because it takes more energy to bring your home back up to temperature.

Thermostat setbacks **always** save some energy, but longer setbacks are more effective

Setting your hot water tank temperature back is a good way to save energy in your home

Hot water tanks are well insulated, setting back saves little energy and can cause bacterial growth

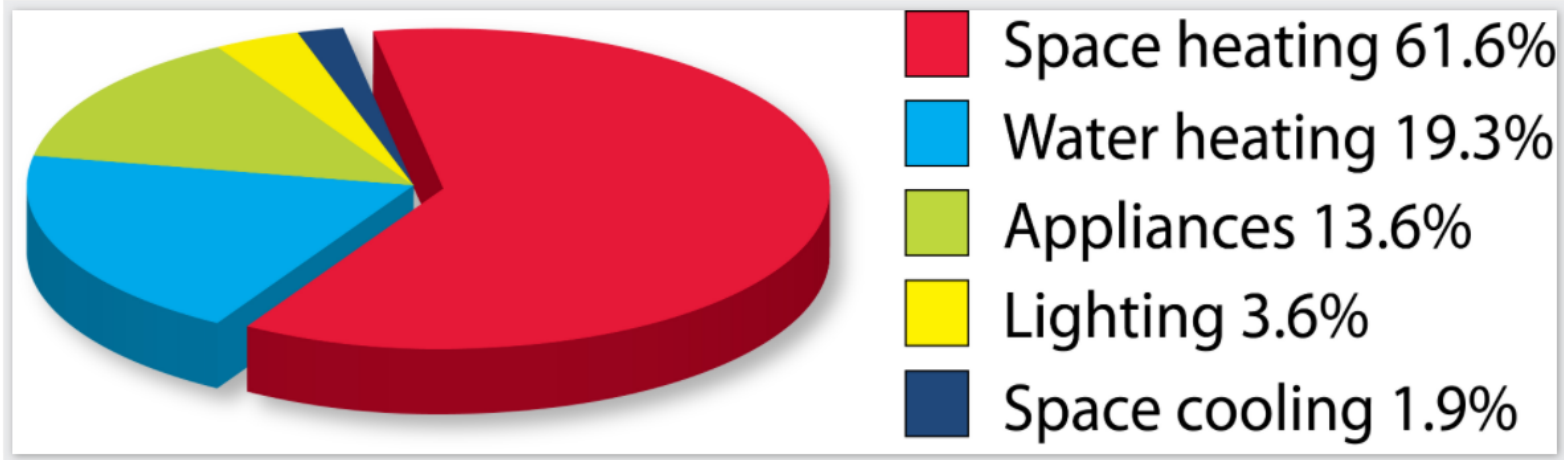
Upgrading windows is the most important thing you can do to reduce your heating bill

Windows are important but costly! Most homes have better, lower cost energy saving options

What uses the most energy in a typical home?

Natural Resources Canada says it well:

Canada's cold climate means that space heating accounts for **a remarkable 61.6% of the energy used in the average Canadian home.** No wonder you should look to heating to find energy savings opportunities!



Source: Natural Resources Canada, 2017
https://www.nrcan.gc.ca/energy-efficiency/energy-efficiency-products/product-information/heating-equipment-residential-use/13740

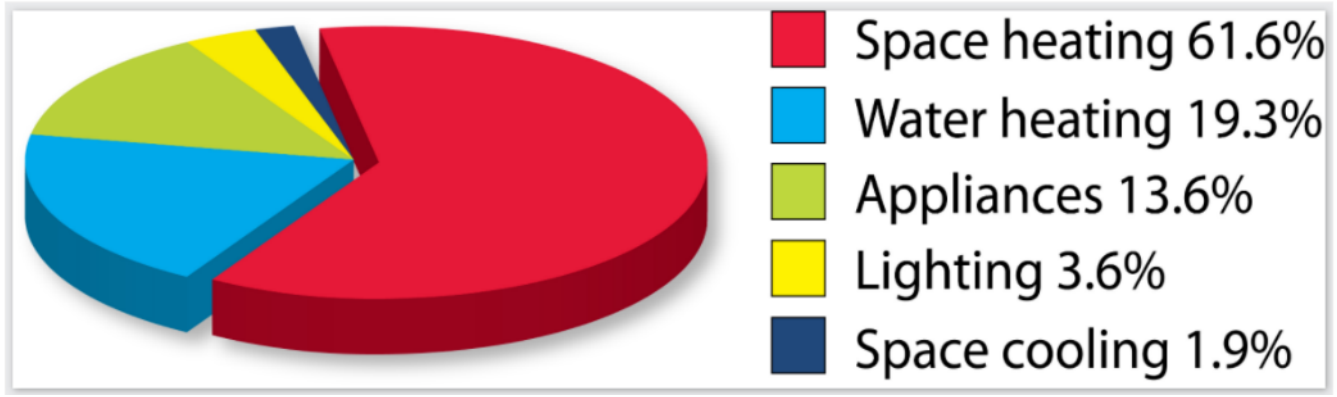
This chart shows average Canadian total home <u>energy</u> consumption including all sources: electricity, natural gas, propane, heating oil, and wood

Canadian average data is used here, in the South Eastern Ontario climate:

- **Heating may be closer to 50% of total energy use**
- **Space cooling may be higher if you have central air and keep your home cool all summer**

What does this mean?

Home heating and hot water have the most potential for energy savings!



1. We often focus on lighting, but it is a small portion of energy use
2. Appliances also typically use a small fraction of total home energy
3. Heating air and water is 80% of average Canadian home energy use

How can you save energy on home heating?

1. Reduce heat needed by turning down your thermostat
2. Reduce heat lost by improving insulation and weatherstripping
3. Reduce energy needed by upgrading to a more efficient heating system

How can you save energy on home heating?

1. **Reduce energy output needed by turning down your thermostat**
2. Reduce heat lost by improving insulation and weatherstripping
3. Reduce energy input by upgrading to a more efficient heating system

- Setting your thermostat back to 16C from 21C reduces energy consumption about 10%
- Longer setbacks have more benefit (an 8 hour setback is better than 4, 2 hour setbacks)
- “Smart” Thermostats like the Nest or ecobee can help by automating temperature setbacks

Utilities Kingston has a $100 Rebate on Smart Thermostats only until Dec 31!
https://utilitieskingston.com/MultiUtility/SmartThermostats

Enbridge has a $75 Rebate on Smart Thermostats
https://enbridgesmartsavings.com/smart-thermostats

How can you save energy on home heating?

1. Reduce energy output needed by turning down your thermostat
2. **Reduce heat lost by improving insulation and weatherstripping**
3. Reduce energy input by upgrading to a more efficient heating system

Sealing drafts is usually the best, cheapest, way to save energy, especially in older homes

More insulation is always better, if you have an attic make sure insulation is at *least* 12” deep

Adding insulation to main walls is typically only an option for houses with siding

How can you save energy on home heating?

1. Reduce energy output needed by turning down your thermostat
2. Reduce heat lost by improving insulation and weatherstripping
3. **Reduce energy input by upgrading to a more efficient heating system**

- **Most Kingston homes are heated by natural gas furnaces**
- **Modern furnaces (sold within the last 20 years) are already >90% efficient**

There is really only one option for higher home heating system efficiency – heat pumps

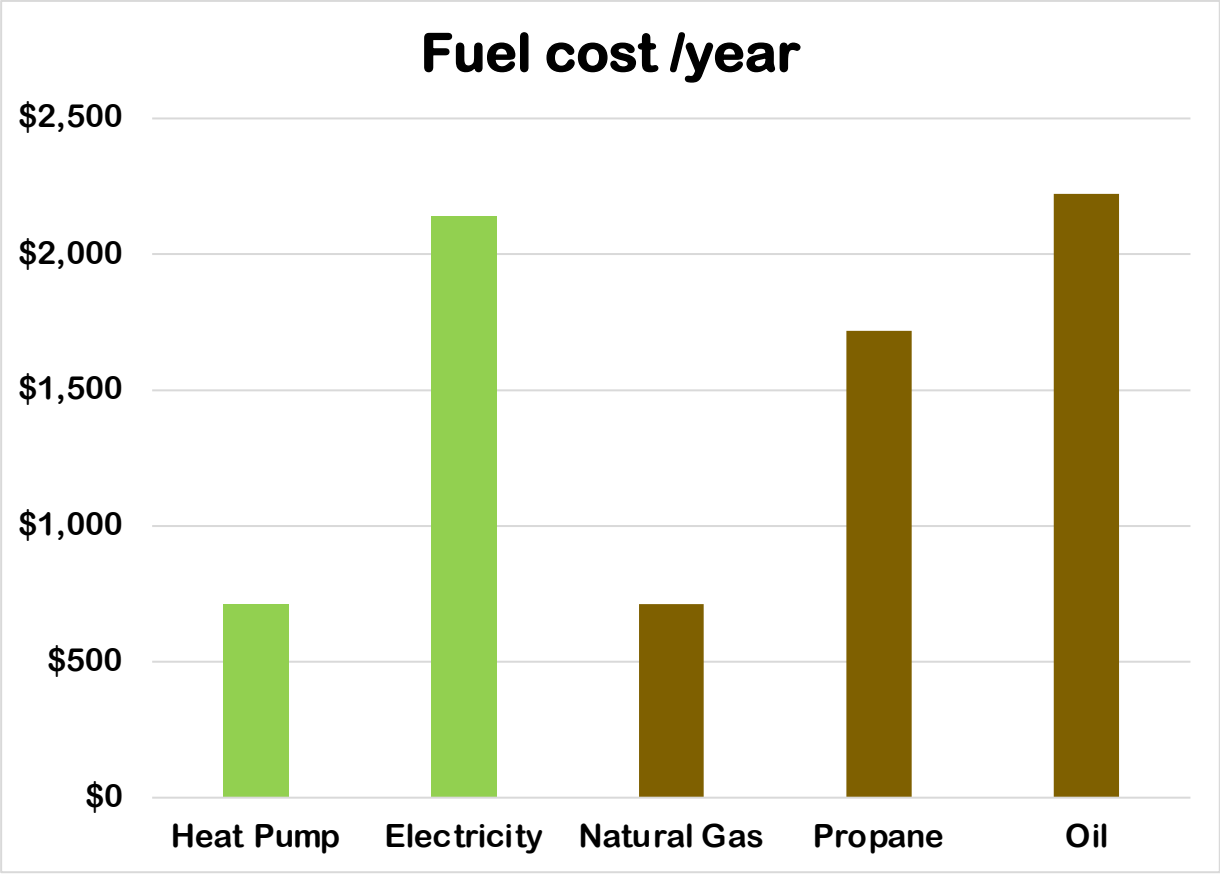
Heat Pumps – An efficient home heating option

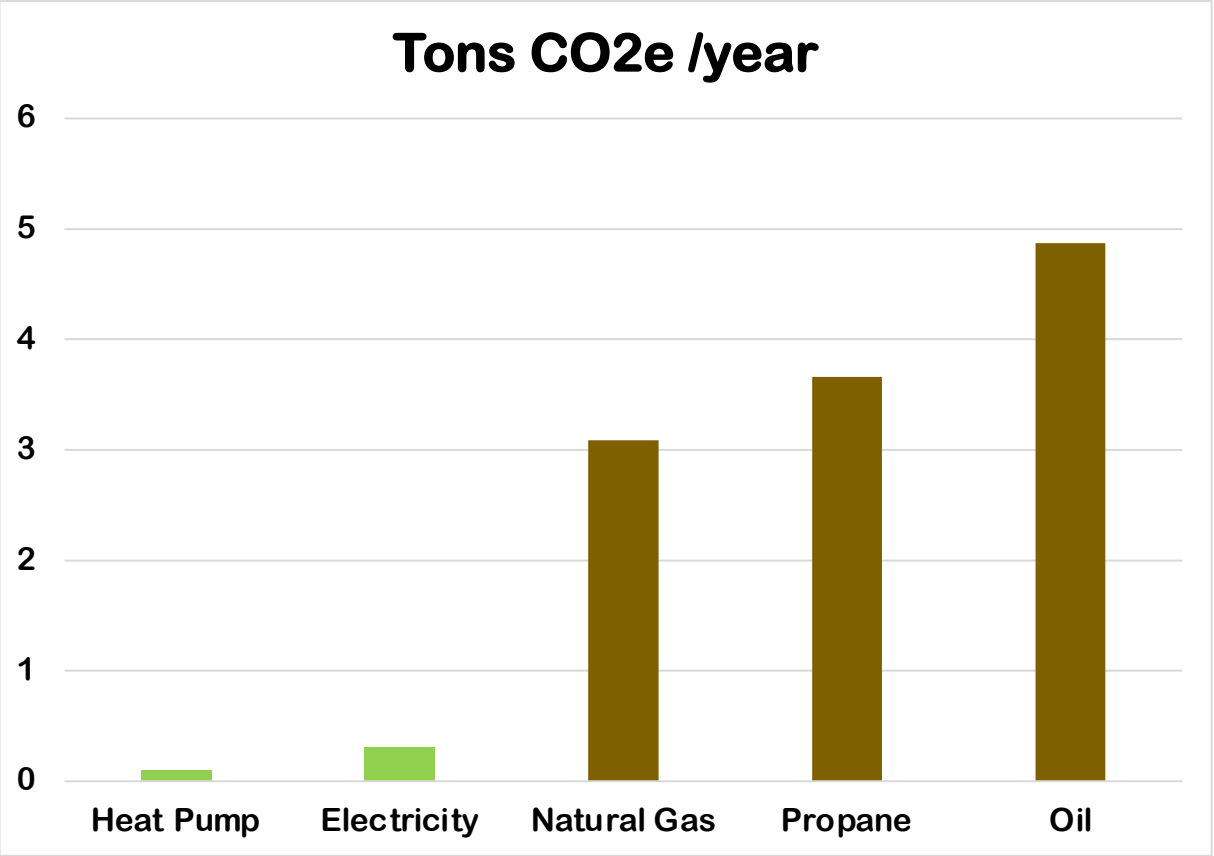
- Heat pumps look like an air conditioner
- Operate in the same way, except that they can heat *or* cool your home
- Run on electricity instead of fossil fuels, **emit no greenhouse gas**

- Install cost is similar to a furnace + air conditioner, and it replaces both

Heat Pumps - An efficient home heating option

Example cost and emissions, various heating systems – Small Kingston home





Heat pump operating cost is similar to a natural gas furnace, without the emissions of fossil fuel systems

Heat Pumps - An efficient home heating option

Because heat pumps run on electricity, replacing a natural gas furnace with a heat pump is the home heating equivalent of buying an electric car

Although heat pumps are not as much fun to drive...

Comparison – Upgrading to a heat pumps vs an electric car

Example: Dave has a 10-year-old gasoline car and a 15-year-old natural gas furnace, so both are going to need replacement in the mid-future.

Dave wants to reduce his carbon footprint, but also has a limited budget.

What should he do to:

1. **Reduce his greenhouse gas emissions**
2. **Keep energy costs down**
3. **Not break the bank**

Comparison – Upgrading to a heat pumps vs an electric car

Detailed analysis (summary on next page)

Assumption

Distance driven per year:	15,000 km

Gasoline Car

Fuel Efficiency 2020 Ford Fiesta	7 L /100 km
Total gasoline / year	1,050 L
Gasoline price	$1.00 /L
Annual gas cost	$1,050
Emissions / L	0.0023 tons CO2e /L
Annual emissions	2.4 tons CO2e
Cost of vehicle	$17,000
15 Year cost of ownership	$32,750
15 Year emissions	35.5 tons CO2e

Electric Car

Energy Efficiency 2021 Nisssan Leaf	16.4 kWh /100 km
Total electricity / year	2,460 kWh
Electricity price (tax incl.)	$0.16 /kWh
Annual electricity cost	$394
Emissions / kWh	0.00002 tons CO2e /kWh
Annual emissions	0.049 tons CO2e
Cost of vehicle	$42,000
Federal rebate	$5,000
Home charger	$1,000
Total cost	$38,000
15 Year cost of ownership	$43,904
15 Year emissions	0.7 tons CO2e

Assumption

Annnual heat output required:	55 GJ

Natural Gas Furnace

Fuel efficiency	92%
Total natural gas / year	1,600 m3
Natural gas price (incl. tax)	$0.46 /m3
Annual natural gas cost	$741
Emissions /m3	0.001927 tons CO2e /m3
Annual emissions	3.1 tons CO2e
Cost of furnace	$5,000
15 Year cost of ownership	$16,119
15 Year emissions	46 tons CO2e

Heat Pump

Fuel efficiency	300%
Total electricity / year	5,078 kWh
Electricity price (tax incl.)	$0.16 /kWh
Annual electricity cost	$813
Emissions / kWh	0.00002 tons CO2e /kWh
Annual emissions	0.10 tons CO2e
Cost of heat pump	$10,000
15 Year cost of ownership	$12,188
15 Year emissions	1.5 tons CO2e

Comparison – Upgrading to a heat pump vs buying an electric car

	Initial Cost	15 Year Cost	15 Year Emissions
Gas Car	$17,000	$32,750	35.5
Electric Car	$38,000	$43,166	0.7
Savings	-$21,000	-$10,416	34.8
Natural Gas Furnace	$5,000	$16,119	46.2
Heat Pump	$10,000	$20,665	1.5
Savings	-$5,000	-$4,545	44.7

"15 Year Cost" is total operating cost over 15 years including initial cost

- Ideally Dave would buy both an electric car and a heat pump, both significantly reduce emissions!
- If Dave can only afford one, the heat pump is less cost up front and has greater emissions reduction

Comparison – Upgrading to a heat pumps vs an electric car

	Initial Cost	15 Year Cost	15 Year Emissions
Gas Car	$17,000	$32,750	35.5
Electric Car	$38,000	$43,904	0.7
Savings	-$21,000	-$11,154	34.8
Natural Gas Furnace	$5,000	$16,119	46.2
Heat Pump	$10,000	12,188.0	1.5
Savings	-$5,000	$3,931	44.7

A few other thoughts…

- Electric vehicles are very visible and may help in developing a green "herd mentality" (nobody is likely to see your heat pump)
- If you do a lot of driving, say over 35,000 km/year, the low energy cost of driving an electric vehicle will likely outweigh the higher purchase cost
- Electric vehicles may require less maintenance than gasoline cars
- If you do not have air conditioning, heat pumps heat *and* cool, meaning for the price you also get air conditioning – enjoy! (But remember to turn off that new AC when not at home!)

I’m not planning to get a new car or heating system, how about low cost ways to save energy?

Don’t worry about this:

Worry about this:

Phone chargers and other power packs use very little energy.

Instead of patrolling your home looking for things to unplug, look for drafts!

I'm not planning to get a new car or heating system, what about low cost ways to save energy?

1. Do not wait for incandescent bulbs to burn out to upgrade to LED
   - ⓘ Over a 2000-hour lifespan a $1 incandescent bulb uses around $20 worth of electricity!

2. Invest in a good-quality low-flow showerhead, use aerators on faucets
   - ⓘ The power required to heat the flow of hot water in a shower is around 5kW even with a low-flow showerhead, older high flow showerheads can be 10kW or more!
3. Use a radiant heater where you are, turn down the rest of the house!
   - ⓘ If you read or watch TV before bed, consider an inexpensive plug-in radiant heater (don't be bamboozled by costly units – they all work the same)
   - ⓘ A plug-in heater uses around 1kW, a furnace is around 20kW while running

Misinformation - Points of caution

The internet is also full of home energy tips that are not *wrong* but save so little energy it is basically meaningless…

- **“Freezers are more efficient when full, so keep it stocked”**
- **“Phone chargers are energy vampires, unplug when not in use”**
- **“Set back your hot water tank temperature” (also potentially dangerous)**

There are lots of expensive products that claim energy savings but do nothing, little, or do it no better than a much cheaper version. Before you buy anything get guidance from a trusted source, or if you can’t find one, call me!

Key Take-Aways:

1) Sealing drafts is the best, cheapest, way to save energy at home

2) Tiered electricity pricing is available in Ontario as of Nov 2020, use the online calculator to find out if you will save by switching from time of use

3) Other low-cost and effective ways to save energy include LED bulbs, good low-flow showerheads, faucet aerators and setting back your thermostat / only fully heating the room you are in using a space heater

4) If it is time to replace your furnace and you are interested in reducing your carbon footprint, consider a heat pump

Questions?

Queen's University

SUSTAINABLE Queen's

https://www.queensu.ca/sustainability