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Building Retrofits for SMEs

Part 2: Making it Happen

2020

What is EnviroCentre?

EnviroCentre:
Your local environmental non-profit

Our mission is to provide people, communities, and organizations in Ottawa with practical solutions to lighten their environmental impact in lasting ways.

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Our work focuses on four main areas

Green Homes

Active Transportation

Green Lifestyles

Green Business

Energy Services

- Home and MURB Energy Audits
- Business Energy Analysis and Audits
- Business carbon accounting (through Carbon 613)
- Green Audits

Carbon 613:
EnviroCentre's program for businesses

- Membership based program for Ottawa businesses
- Access to events, resources, discounts
- Comprehensive tools for Carbon analysis and target setting
- Local network of businesses committed to climate action

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Who I am

- Greg Furlong, Senior Energy Analyst
- Energy Advisor – NRCan, CHBA Net Zero, ENERGY STAR etc.
- Certified Energy Manager (AEE)
- Over 100 MURBs assessed plus a dozen commercial audits
- More than 700 private homes since 2003
- Co-founder of a successful retail business in Toronto

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Our goals today

1. Energy efficiency overview and trends
2. Upgrade benefits, costs and incentives
3. Map the path to an effective business retrofit

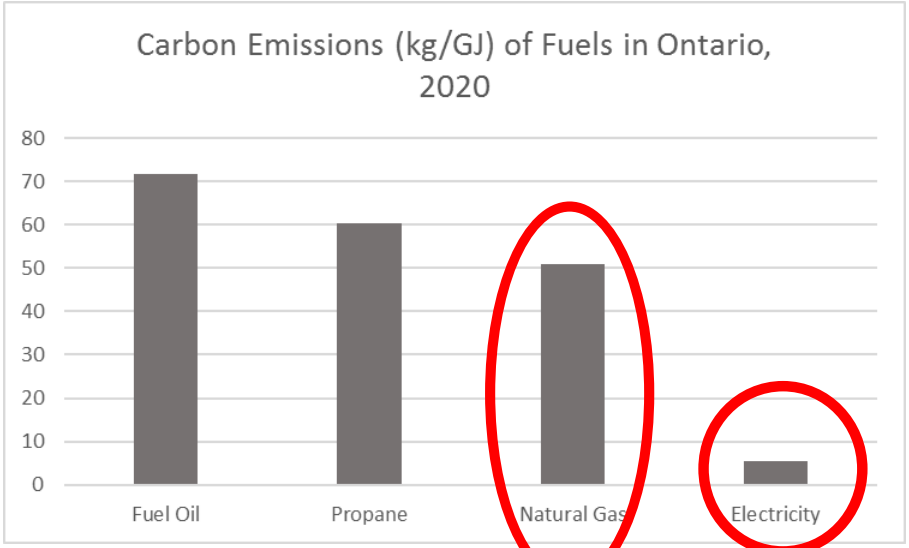

Energy
Efficiency

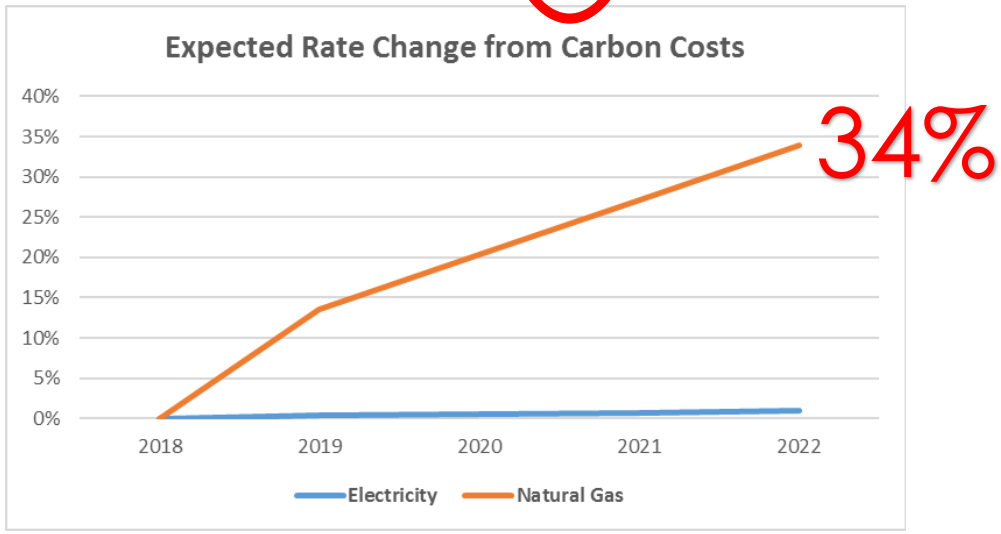
Energy Efficiency & Economic Gains

- Average building wastes 30% of its energy
- Efficiency: $ Savings, less waste, less CO_2
- Efficiency rising about 2.5% per year in Canada
- But energy use and carbon still rising 1.8% per year – growth etc.
- We need to reduce combustion – Stop Burning things!

Carbon Pricing

- Canada introduced $20/tonne in 2019, rising to $50 by 2022
- Ontario electricity: Only 1/10th the carbon of gas
- Carbon fees: electricity only rising 1%, but gas is going up 34% by 2022
- Efficiency will lower your carbon fees, especially if you fuel switch to electricity

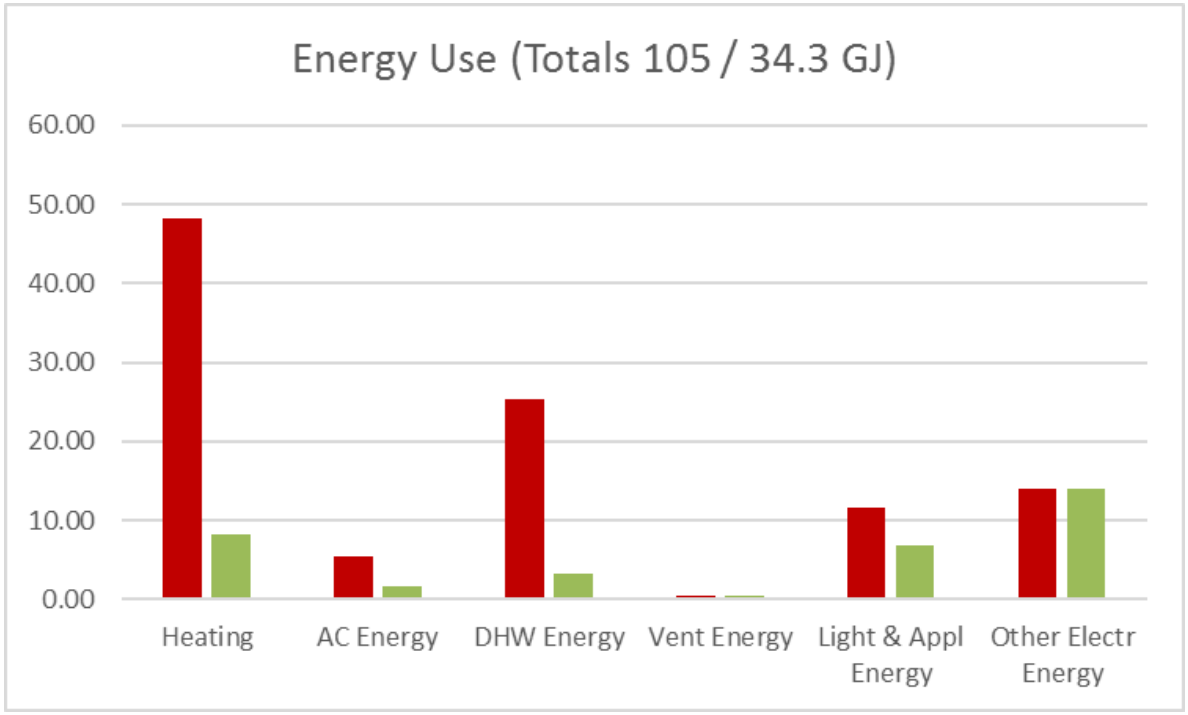




Net Zero targets: the changing world

- Net Zero energy means
  consumption = generation onsite
- Net Zero carbon is the same, but with carbon offsets
- Feds currently aiming at 30% below 2005 levels by 2030
- Feds and City of Ottawa: Net Zero carbon by 2050
- City of Copenhagen: Net Zero carbon by 2025

Net Zero

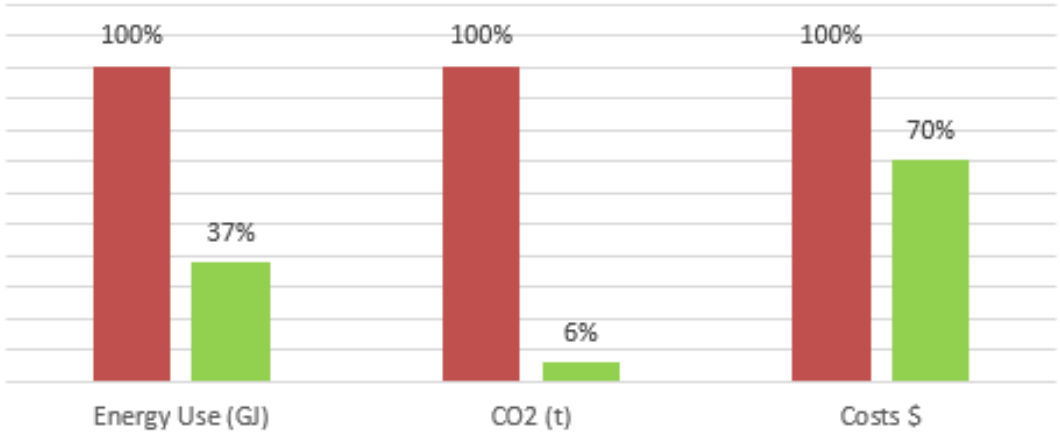


Net Zero Benefits

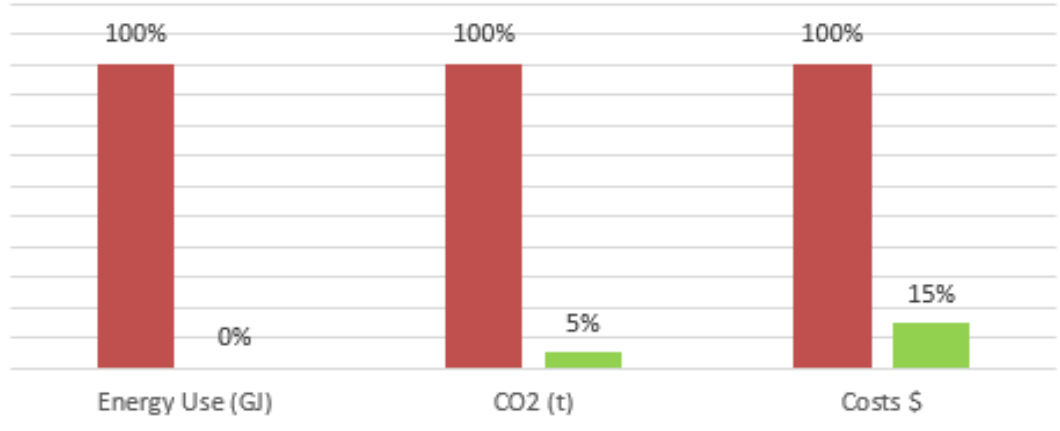
- Lower energy consumption (60-100%) - $ savings
- Electricity generation to offset consumption - $ savings
- Lower peak electricity use - $ savings
- Carbon Reductions of up to 95% - $ savings
- Less waste, higher efficiency: better $ returns

More Net Zero Benefits

- No combustion = Safer businesses = Lower Insurance
- Better workplace comfort
- Employee satisfaction
- Marketing advantages (e.g. IKEA, MEC)



Net-Zero Ready: Conservation Upgrades Only



Net-Zero: Including Solar Panel Production

Net Zero Example

Net Zero Energy Retrofit on 1980s row house, as follows:

1. Mid-efficiency gas furnace to ASHP & electric furnace
2. Standard gas DHW to HP water heater & DWHR
3. Air leakage reduced from 4.6 to 1.5 ACH50
4. Lighting and appliance upgrades
5. All windows replaced with triple-pane fiberglass
6. 500 sq.ft. of solar panels installed to match reduced usage

- Similar upgrades and benefits can apply to small businesses!

Moving Toward Net Zero

How?

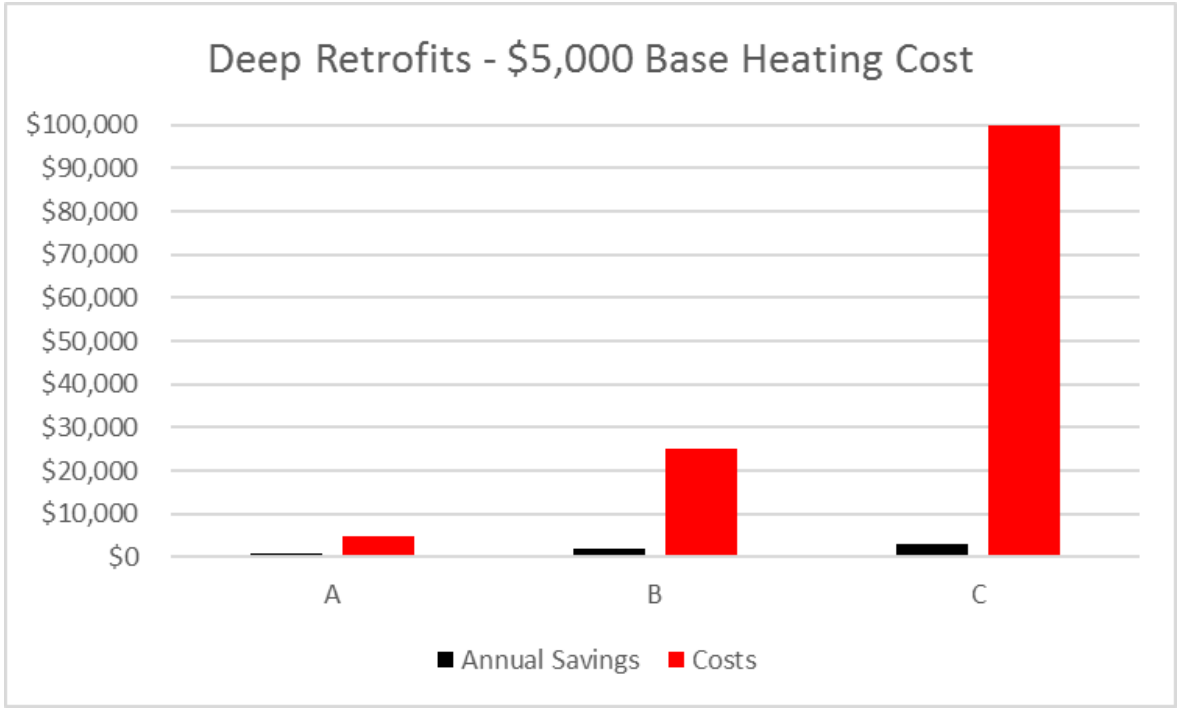
1. Lower heating/cooling demand
2. Less combustion of fossil fuels
3. Clean, local electricity supply

Toward Net Zero – The Price of Deep Retrofits

A. 20% reduction for modest investment:
   - Some insulation / airsealing

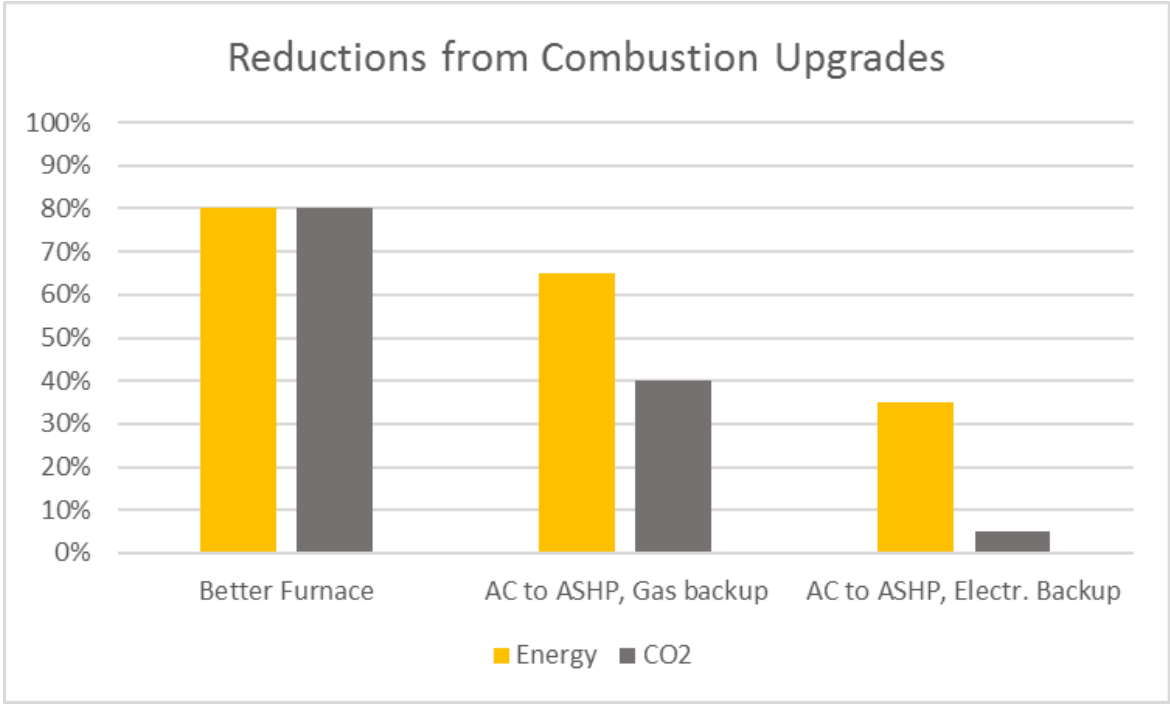
B. 40% reduction for high investment:
   - Extensive insulation / airsealing
   - Upgrade ventilation systems

C. 60% reduction for very high investment:
   - Full exterior insulation and air barrier
   - Foundation
   - All windows and doors



Toward Net Zero – Less Combustion

- Upgrading gas heating efficiency can get up to 20% energy/carbon reduction
- Upgrading AC to operational ASHP can get 45% energy, 60% drop in CO2
- Removing gas entirely and replacing with heat pump gets 65% energy, 95% CO2



Toward Net Zero – Clean Electricity

- Our current electricity grid is pretty clean
- Can our grid handle extra load?
- Probably yes... provided:
  - Upgraded insulation and air leakage
  - Heat Pump technology
  - Widespread rooftop Photovoltaics

Ontario electricity generation mix in 2017.[39]

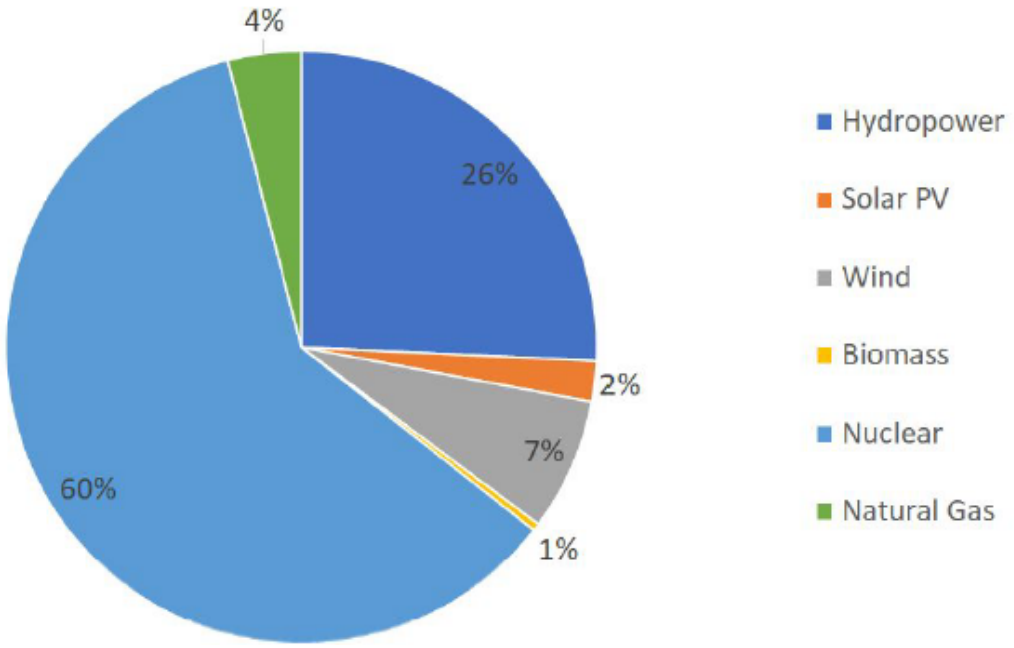


Chart: Ottawa Pathway Study, 2017

Upgrade Awareness Activity

Most effective retrofit projects?

Which of the following delivers highest %:
- Energy savings
- Cost savings
- Carbon savings

- Upgrade all **lighting** in an office tower to LED
- Install a **heat pump** instead of an air conditioner
- Insulate R30 **attic** to current code level of R60
- Upgrade uninsulated **basement** to R10
- Install triple-paned **windows**

Making it happen

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Where am I? *Benchmarking*

It's Canada's only standard benchmarking tool based on national, statistically valid data

Carbon 613 by envirocentre

More than just $: "Bookkeeping" that allows decisions based on the whole consumption picture

Data and analysis that accounts for

- kWh of Electricity
- m^3 of Natural Gas
- Litres of Oil
- m^3 of water
- Tonnes of CO_2

DIY, or help is available:

- **ENERGY STAR Portfolio Manager**
- Join **Carbon 613**
- Energy Audit – see next slide

Finding an evaluator

- **Office, retail, restaurant or workshop:** Energy Auditor or Energy Manager (Consulting Engineers, Utility Companies, Envari)

- **Rental properties:** Registered Energy Advisor (NRCan Service Organizations like EnviroCentre)

If you Rent, Lease or Share

Influence Your Workplace

- Reduce energy use through behaviour
- Some small upgrades have big impact
- Join Carbon 613 for ongoing support

Influence Your Landlord

- Landlord's utility share may motivate
- Improvements add value
- Better tenant retention
- Discuss renos during lease negotiations
- Tell them about these workshops!

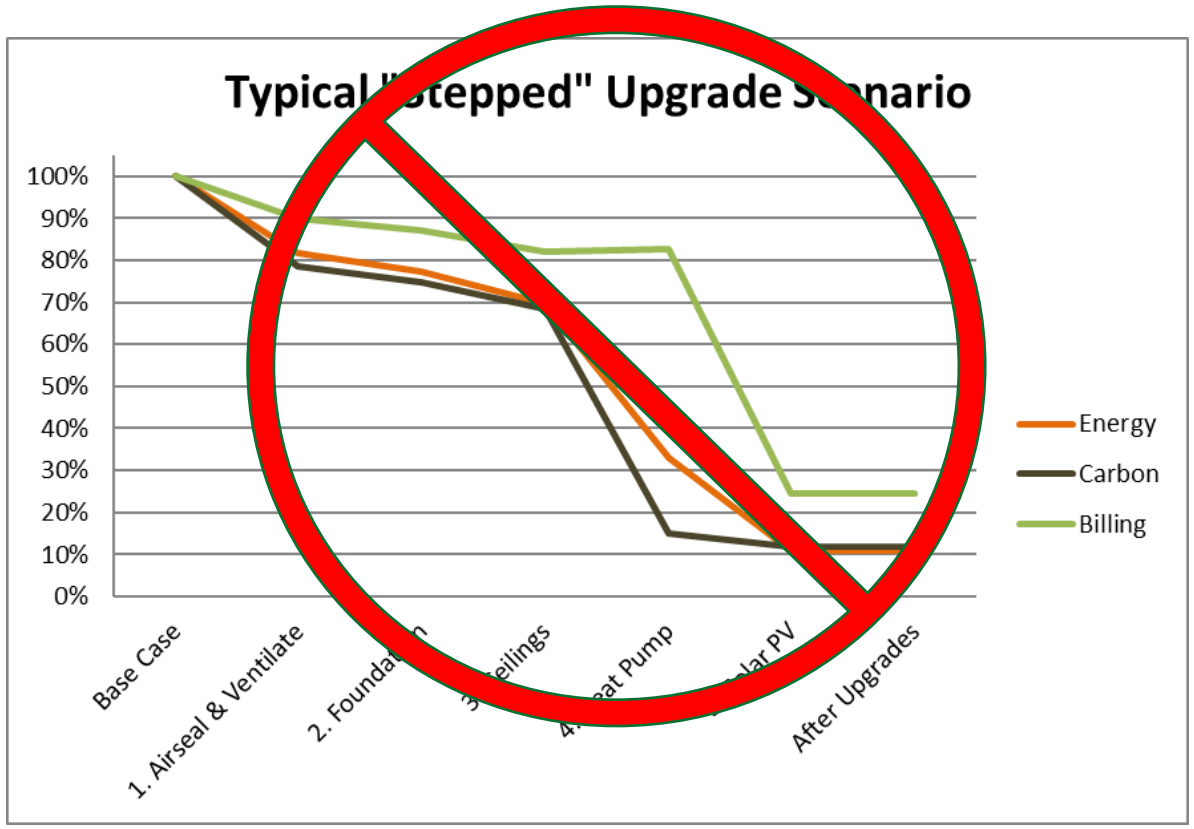
Making a plan

Upgrade Strategies for Net Zero:

Consider:

- Carbon reductions
- Cost of upgrades
- Yearly $ savings
- Cost-effectiveness
- Your goals and targets

Expert help may be required!

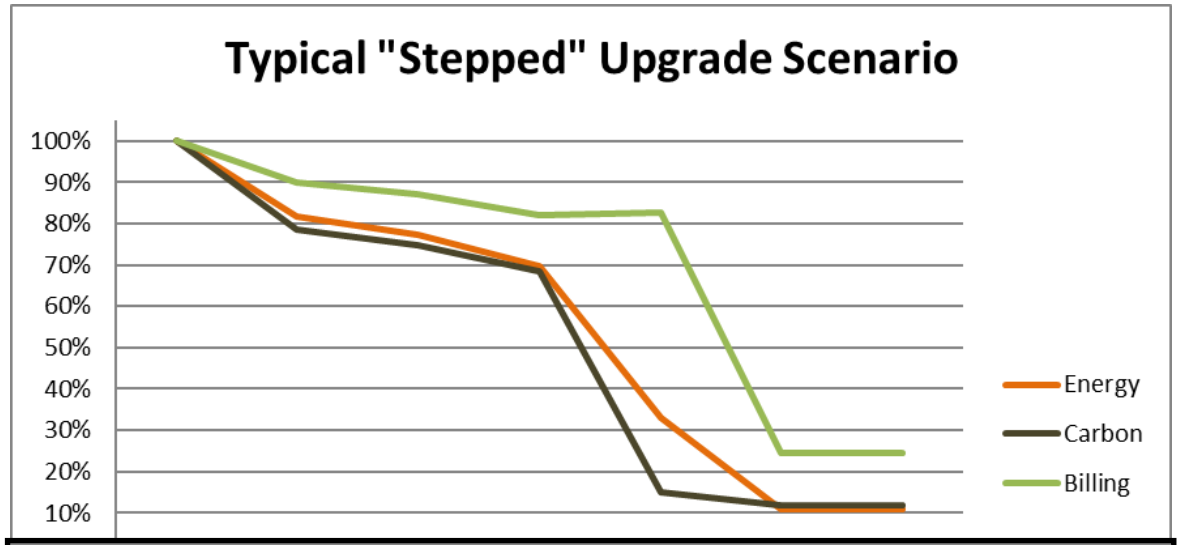


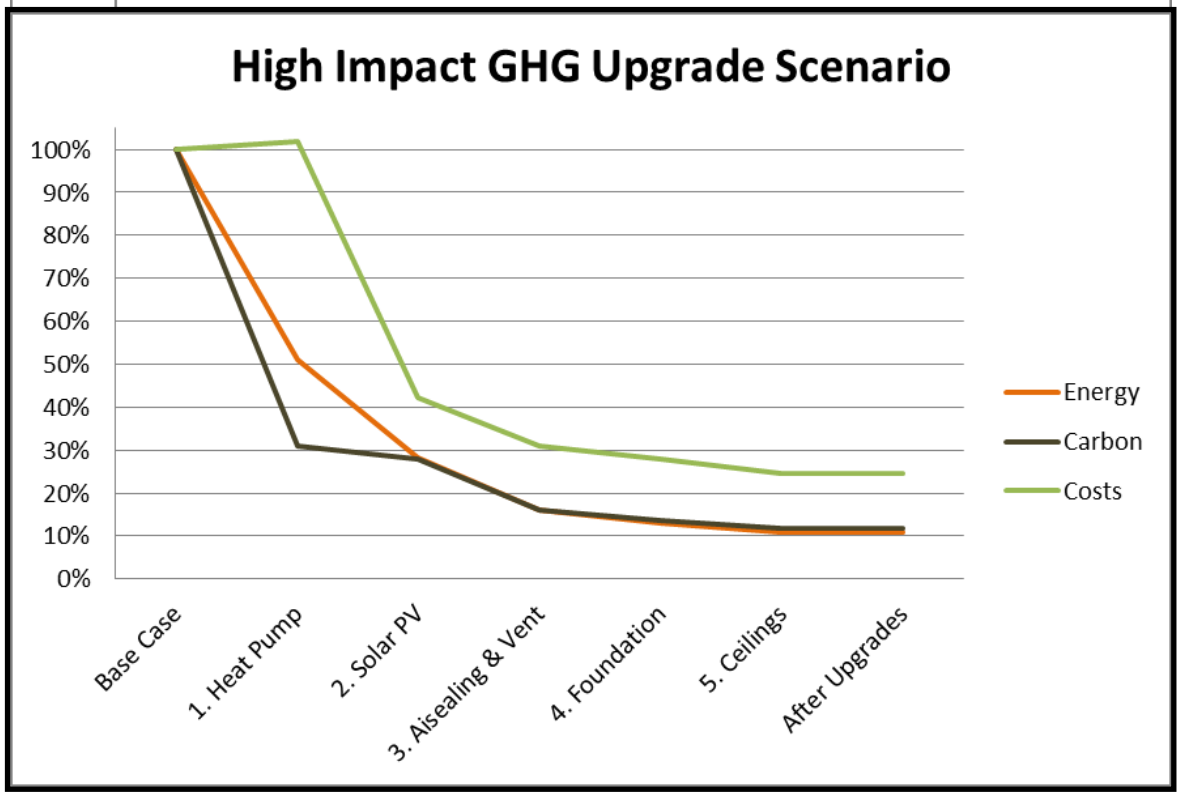
Stepped Retrofits for Net Zero

Stepped plans start with the most cost-effective upgrades and use savings to pay for other upgrades. Building envelope first!

However, compared to other plans, this results in

1. Smaller Energy savings
2. Smaller Carbon reductions
3. Smaller $ savings





Effective Strategies for Net Zero

Cut to the chase: Start with upgrades that have immediate significant impact on energy use, like ASHP and Solar PV.

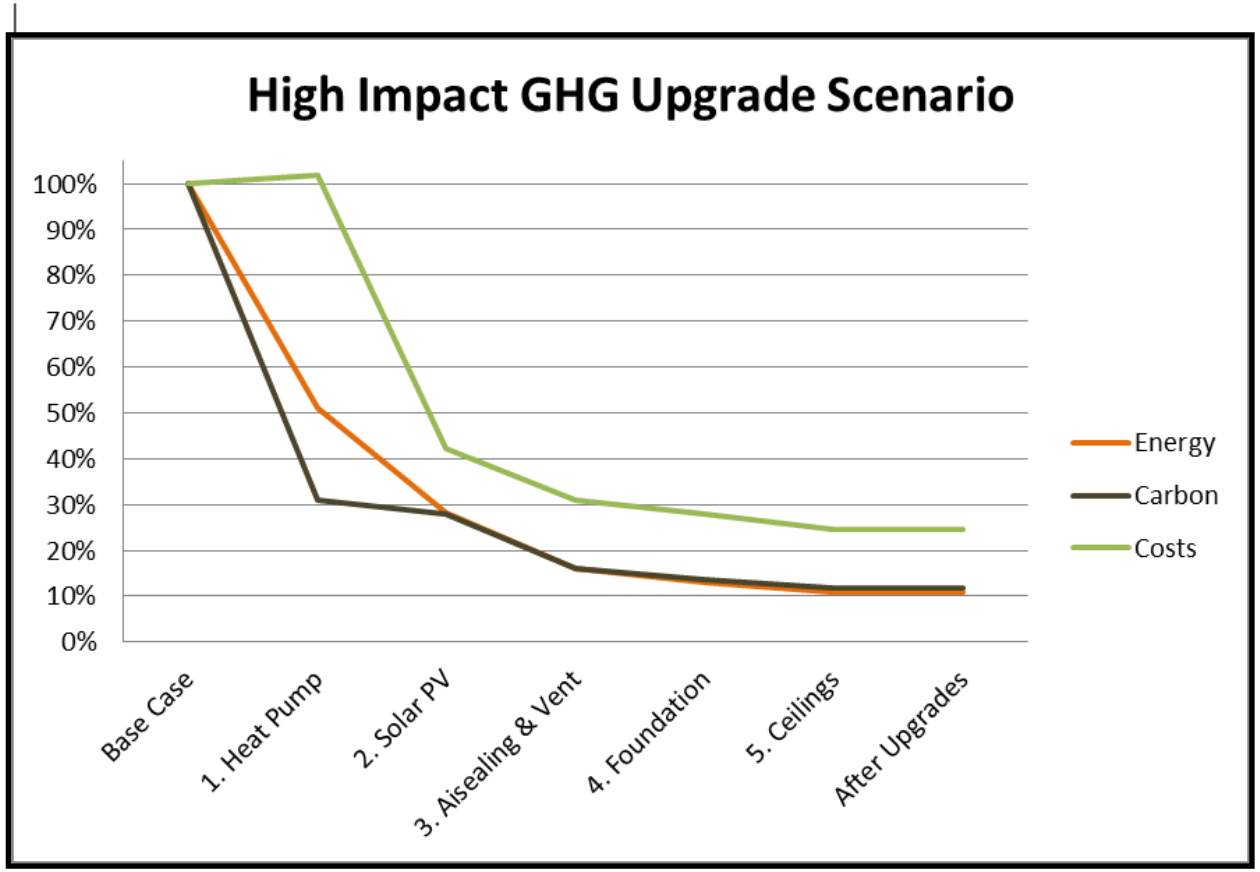
Compared with the stepped plan, this example had

- **56% less energy use - 740 GJ**
- **60% less carbon production – 33 tonnes**
- **38% lower utility costs - $9,700 extra cash**

Total cost of upgrades **was the same** in both cases!

High Impact Strategies

1. **Energy analysis is required** for projected sizing of equipment and solar PV
2. **Arrange financing** to support the upgrades
3. **Upgrade existing AC equipment** with heat pumps
4. **Keep existing heating** as back-up (for now)
5. **Install Solar PV**
6. **Perform viable envelope upgrades** in the most cost-effective order (deep envelope upgrades may not be necessary)
7. **Upgrade ventilation systems** with heat recovery
8. **Retire your combustion equipment**



Leverage Incentives

Incentives cut costs

- Hydro Ottawa / IESO: **SaveONEnergy Retrofit Program**
  - Substantial incentives for electrical savings
  - Certified Energy Manager training
  - https://saveonenergy.ca/For-Your-Small-Business

- Enbridge:
  - **Smart Savings** is similar, but for continuing gas users only
  - **Home Efficiency Rebate** for residential properties (gas users only, non-MURB)
  - https://enbridgesmartsavings.com/

SaveONEnergy Retrofit Program (IESO)

- **Don't start your upgrades** until you submit the application!
- **Prescriptive Track** for lighting upgrades, etc.
  - Incentive $ per unit of product
  - Application and documentation required
- **Custom Track** for everything else
  - Incentive $ per unit of demand or consumption
  - Covers up to 50% of project costs
  - Application includes your info to estimate energy savings
  - Can also be submitted by an applicant representative like EnviroCentre

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SAVE ON ENERGY
POWER WHAT'S NEXT

ENBRIDGE

SaveONEnergy Training and Support (IESO)

Apply in advance for incentives of up to 50% of course fees for:

- Dollars to $ense Energy Management Workshops
- Building Operator Certification
- Certified Energy Manager training
- Note that Enbridge also offers support for this training

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Enbridge Smart Savings Business Solutions (Natural Gas only)

- **Don't start upgrades until you contact Enbridge**
- Enbridge **Energy Solutions Consultant** works with you
  - Incentives cover up to 50% of project costs
- **Fixed incentive Program** for selected HVAC upgrades
  - Incentive $ per unit of product
  - Application and documentation required
- **Commercial Custom Retrofit Program -** everything else
  - Incentive $ per unit of gas consumption
  - Covers up to 50% of project costs
  - Application includes info to estimate energy savings
- **But.. be aware that most investments under this program will have only small impacts on carbon production, and may commit you to using Natural Gas for an extended period – "Lock-In"**

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Enbridge Smart Savings Home Rebates (Natural Gas only)

- Don't start upgrades until you contact Enbridge or a qualified **Service Organization** (SO) like **EnviroCentre**
- **Home Efficiency Rebate** is for Residential Properties (non-MURB gas users)
  - Requires energy assessments through SO
  - Rebates on assessment costs and for particular verified upgrades
- **Home Winterization Program** also for Residential Properties (non-MURB gas users) with qualified tenants
  - Tenants must qualify on income
  - Energy assessments performed at no cost
  - Attics, foundations and walls can be upgraded at no cost

Other Incentives

Financial Support for Industry: NRCan: **ISO 50001 Standard**

- Energy Management Systems Standard
- Participating companies have improved energy performance by 10%
- Assistance up to 50% of eligible project costs

Federal Tax Provision for Clean Energy Equipment:

- Classes 43.1 and 43.2 of Schedule II
- Fully expense your solar energy system and heat recovery equipment
- CCA rate of 100%
- Abolishment of the first-year rule

Small Business Incentives Elsewhere

Efficiency Nova Scotia

- $5014.75 is the average Small Business rebate
- More than 500 Small Business participants

Government of Yukon: Good Energy Program

- 25% rebate for businesses on approved project costs
- 40% for non-profit organizations or NGOs

Why no rebates from “Efficiency Ontario”?

Talk with the experts

- **EnviroCentre**
- **Carbon 613**
- **Envari** (large commercial, industrial, municipal)
- **Hydro Ottawa**
- **Enbridge**
- **City Electric Supply** and similar companies

Green Retrofit Success

Start the process with an open mind

The best upgrades are not always obvious

- Energy modeling
  - Takes in all the effects of each energy use
  - Is your best guide to upgrade impacts
- Ventilation and comfort need to be carefully considered
- Decide on the type of heating system that best fits the energy picture

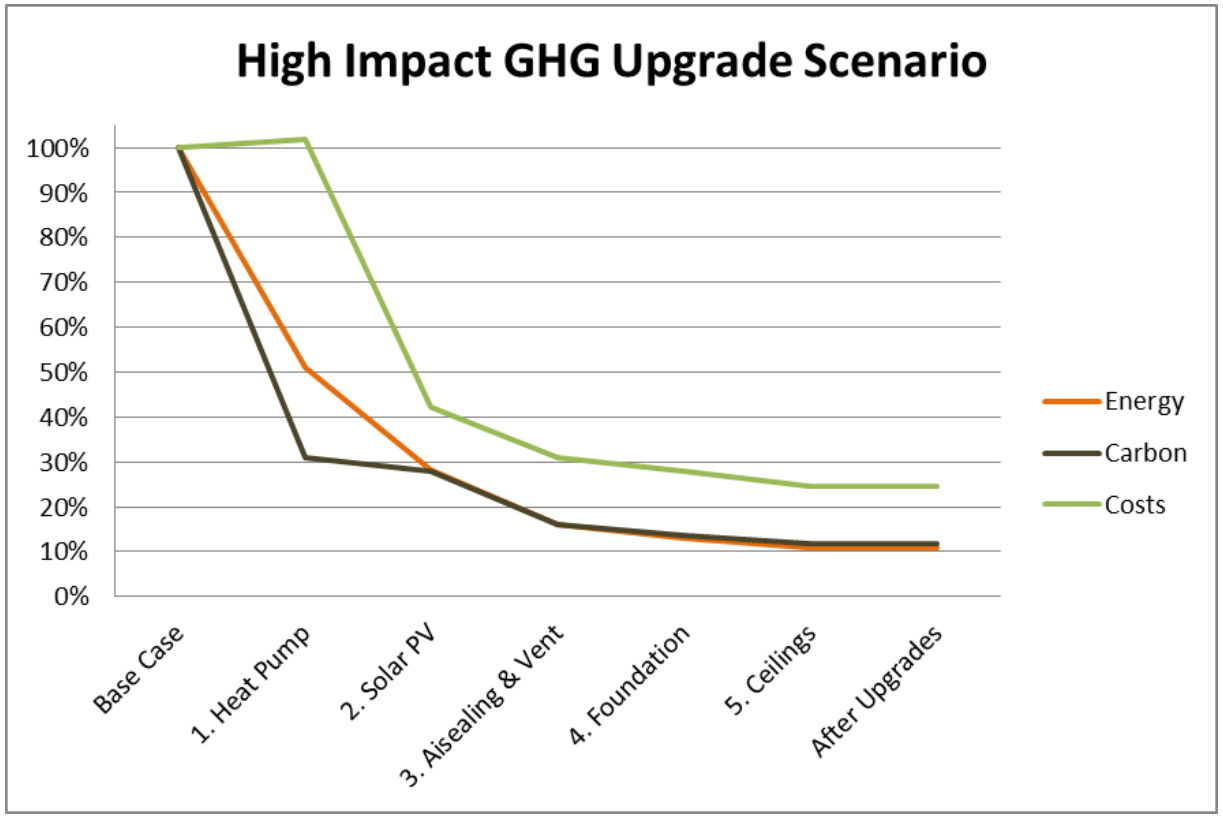
Consider the energy balance

For Net Zero, all energy use needs to be offset by recovery or generation

- HVAC (which depends on building envelope)
- Refrigeration
- Office equipment
- Motors for compressors and other machinery
- Lighting

vs:

- What heating or cooling energy can be recaptured and reused?
- How much electricity can you generate on your property?



For a Green Retrofit, order matters

- Biggest carbon reductions from reducing combustion first
- Start by replacing older central AC with heat pumps
    - Incremental cost is small, and operating costs similar
- Solar PV next - start producing kWh ASAP
- Then do other cost-effective upgrades

Easy Energy Efficiency Upgrades

Easy Upgrades

Reduce your heating bill by about 10%:

- **Poorly Insulated Attics** - insulate
- **Uncontrolled air leakage** - airseal
  - Testing tells you where and how much (e.g. EnviroCentre)
- **Idling or redundant equipment** – timers or shutdown
- **Exhaust fans with no heat recovery** - HRV or ERV systems
- **Older equipment that produces heat or cold** – upgrade at time of replacement
  - Heating, cooling, refrigeration, drying equipment
  - Savings will quickly pay for the incremental costs

Deeper Energy Efficiency Upgrades

Poorly insulated walls

Empty wall cavities:

- Speedy, inexpensive upgrade saves up to 20% on heating
- Cellulose is packed into the walls
- Also reduces air leakage

Exterior Board Insulation under new cladding:

- Also saves up to 20%, but more expensive
- Economical if you're upgrading siding/facing anyway
- Installing an air barrier here also helps air leakage

Foundation

Savings of up to 20% for interior or exterior insulation. Can be cost-effective, but requires expert advice.

- Any water leakage must be resolved first
- **Poured concrete** – very stable
- **Concrete block** – usually OK
- **Stone or Rubble** – proceed with caution! Exterior insulation is best

Windows

- Not usually cost-effective for energy (<10% savings)
- But increased property values
- Also help control sound and comfort
- Install the best you can afford – Fiberglass, triple-pane, long warrantee
- Awnings, blinds and storm windows can offer effective comfort improvements
- Window treatments may also help address summer overheating

Solar Energy

Big capital cost, but high returns. Site assessment is necessary, but your roof could be suitable for:

Photovoltaics (electricity)

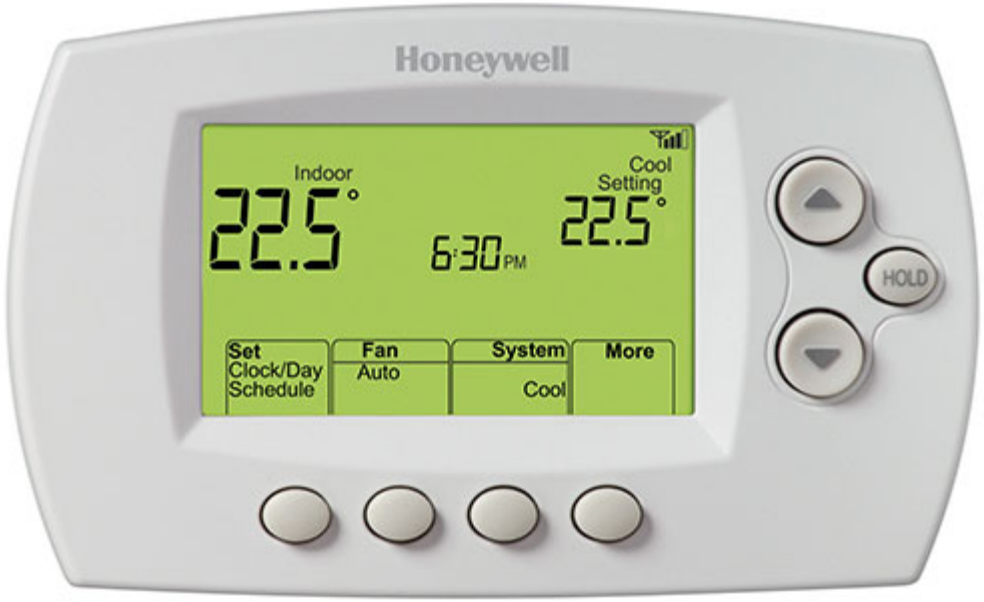
- Long life with little maintenance
- Net metering – can offset your entire electricity usage each year
- A necessary component of Net Zero
- Install costs $3 per Watt (~$15k for a 2,000 sq ft system)

Solar thermal - useful for some commercial situations:

- Water heating in summer (pools etc.)
- Air preheating for winter ventilation (e.g. SolarWall)

HVAC: All Heating and Cooling

- Servicing: Make sure it's working properly. Don't upgrade without considering your Energy Plan.
- Distribution: Evaluate, add zone controls if necessary
- Thermostat or BAS:
  - Occupied settings of 20°C during winter or 25°C in summer
  - Unoccupied: 17°C winter / 28°C summer



HVAC: Boilers

- Small hydronic systems: Mini-splits can supplement and eventually replace
- Large hydronic systems: service for best performance
- Efficiency upgrades to existing equipment can result in 10-30% savings, but don't upgrade without consulting your long-term energy plan.

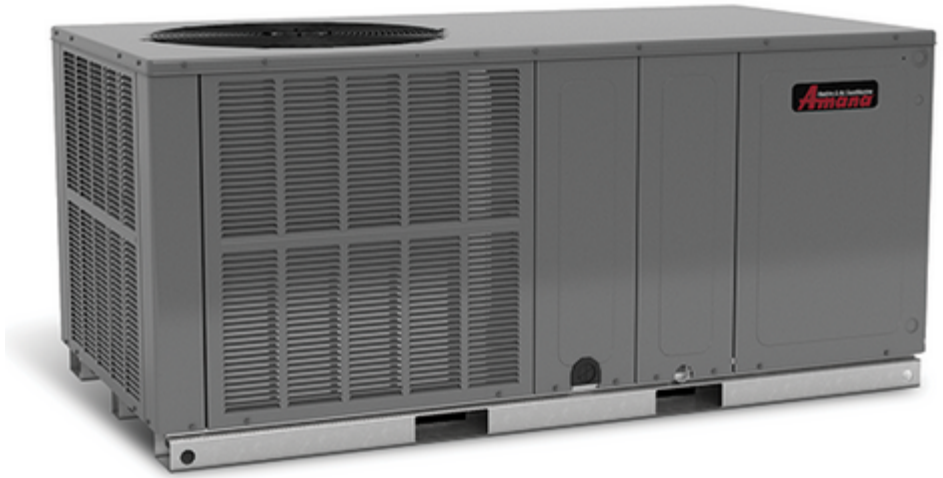
HVAC: Furnaces

When equipment approaches end of life,

- Packaged Rooftop Units: Upgrade to Heat Pump unit (Daikin, York, Trane, etc)

- Standard furnaces:
    1. Replace the central air conditioning unit with a heat pump, sized to 2/3 of the heating load
    2. Eventually upgrade to an electric furnace

- Heat pump replacement will reduce energy use by 40%, carbon by 60% while maintaining or lowering operating costs



ASK ABOUT ENERGY STAR

HVAC: Domestic Hot Water

- Offices without showers or heavy ongoing hot water use: Point-of-Use water heaters

- Heat pump water heaters are available in commercial sizes:
    - Energy from indoor air is used to heat the water
    - Also reduce cooling loads in summer
    - Can be located to take advantage of local hot zones such as kitchens
    - Reduces water heating energy by 40%

- Drainwater Heat Recovery (DWHR) unit: 15% reduction

HVAC: Ventilation

- All fan motors should be ECM
- Adding heat recovery to exhaust recaptures 50-75% of heat

Fresh Air Machines: HRV or ERV?

- HRV
  - More efficient
  - Good for exhausting high humidity (showers etc)
  - Better at reducing winter humidity
- ERV
  - Better at maintaining humidity levels
  - Better for air conditioning
  - No drain required
- Or have both – switch cores from winter to summer
- Can keep the washroom exhaust fans

HVAC: Air Conditioning

- Mini-split AC:
  - When adding AC, make sure the unit is also a heat pump
  - Size the unit to 2/3 of the heating load
  - Multiple indoor "heads" ensure good local climate control
- Central AC:
  - Replace the unit with a multi-stage heat pump, sized to 2/3 of the heating load
- With conservation and upgrades, these units can eventually supply all your heating and cooling

Refrigeration

Top Upgrades:

- Replace open vertical display with reach-in with glass or acrylic doors
- Reduce or eliminate anti-sweat controls
- Night covers for open horizontal cases
- Upgrade to high-efficiency compressor (5.2 EER or better)
- Walk-ins: Automatic door closer, door gaskets or strip curtains
- New evaporator efficiency controllers (replace defrost timers)
- LED lighting
- ECM motors for evaporator fans

LED Ceiling Panel, 50W, 2x4

Lighting

LEDs are the answer!

- Low energy use (75% less than incandescent for the same lighting)
- Low heat production
- Good quality light
- Long life (25 times longer than incandescent)
- Incentives

But…

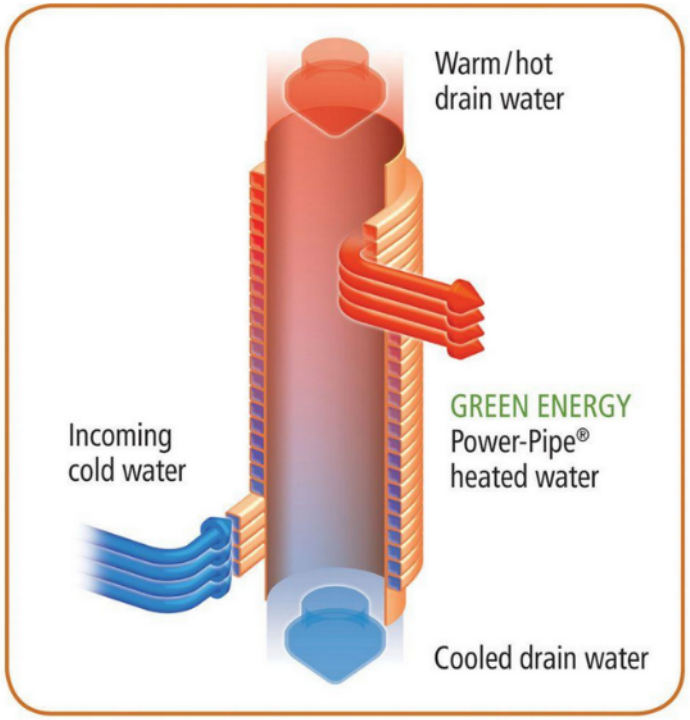
- lighting is typically less than 10% of a building's energy use – small savings
- Small or negative carbon savings for this and other interior electric upgrades

What energy can you recapture and reuse?

Recover heat from anything that flows out of the building:

- Exhaust air: HRV or ERV "Fresh Air Machines" - 75% heat recovery
- Drain from continuous hot water use: DWHR – 50% recovery
- Clothes Dryer exhaust: Ventless (heat pump) machine – 100% recovery
- Heat pump water heater: Cools air while heating water

What processes do you have that produce unwanted heat?



Energy Collaboration

District Heating & Cooling

- Shared central system can be configured for maximum efficiency
- Several large systems in Ottawa
- Can accommodate heating and cooling needs of many buildings simultaneously

Interseasonal Heat Transfer (IHT)

- Ambient Ground Loops
- Surplus heat can be stored in Thermal Banks
- Energy extracted from loop using heat pumps

Shared Building Heating

- Overheated buildings share with underheated
- The bakery next door?

Drake Landing Solar Community, Okotoks Alberta

- IHT, 12th year of operation
- COP = 30

How much electricity can you generate?

Rooftops:

- South sloping is best, but East & West combo is also OK
- Flat roofs are great – optimal angles are possible
- Snow and Dirt: roof mounted panels are harder to clean

Ground mount:

- More expensive due to piling and other requirements
- Produce more electricity – optimal angles are possible
- System capacity not limited by roof size

Any area on your property suitable for solar panels?

https://isolara.com/commercial/
http://ottawasolarpower.com/osp2012/faqs.htm

Finding the right Contractors

Contractors: Advice from CHBA

- ✓Know what you want
- ✓Have a realistic budget
- ✓Plan for the long term – sequencing avoids having to redo
- ✓Protect yourself with a written agreement
- ✓Don't compromise on quality
- ✓Don't choose contractor on price alone
- ✓Beware direct sales

Contractors

- Clear instructions and ongoing inspections are necessary with some contractors
- Consider changes of plan based on contractor advice, but first verify with your energy manager
- Consider hiring a **concierge service** to oversee upgrades

Choosing Contractors

- Get a permit if you need one
- You may have expertise in-house, but don't overextend
- Plumbing, electrical and gas work can all require licensed contractors
- Health and safety concerns in some situations

De-mystifying Green tools & certifications

Energy Tools

Natural Resources Canada (NRCan) Data analysis software and modelling tools

HOT2000

- The Canadian standard for evaluating the energy performance of houses and multi-unit residential buildings

RETScreen

- Clean Energy Management Software system for energy efficiency, renewable energy and cogeneration project feasibility

Heat Pump Pre-Screening Tool (HPAC)

- Provides rapid assessment of heat pump systems

These and other tools are available for free download at this site:
https://www.nrcan.gc.ca/maps-tools-publications/tools/modelling-tools/7417

Energy Tools

Natural Resources Canada (NRCan)

Retrofitting Buildings Page

- Minor retrofits
- Major retrofits
- Deep retrofits
- Major Energy Retrofit Guidelines

These and other topics at this site:

https://www.nrcan.gc.ca/retrofitting/20707

Certifying Your Building

- Zero Carbon Building Pilot Program
- LEED
- Passive House
- ENERGY STAR
- Net Zero Home Labelling

Certifications

Canadian Green Building Council (CaGBC)

- Zero Carbon Building Standard: Performance stream also applies to retrofits - $1500 base fee

Canada Green Building Council
Every Building Greener

Requirements of the Standard

	ZCB- Performance (existing buildings)
Demonstrate Zero Carbon Balance	✓
Provide Zero Carbon Transition Plan*	Every 5 years
Install Minimum 5% Onsite Renewable Energy	No requirement
Achieve Thermal Energy Demand Intensity Target	No requirement
Report Energy Use Intensity	✓
Report Peak Demand	✓
Report Embodied Carbon	✓
	* where fuels other than zero emissions biofuels are used onsite

Certifications

PASSIVEHOUSE CANADA

Passive House and EnerPHit – PHI

- Very low energy use buildings, not necessarily incorporating solar generation
- Primarily for residential new builds, but can also be commercial or retrofits
- **EnerPHit Standard** is suitable for older buildings that can't be retrofitted to the Passive House Standard
- **PHI** is suitable for buildings which do not fully comply with Passive House criteria

Certifications

Natural Resources Canada (NRCan) and CIPEC

ENERGY STAR Portfolio Manager

- benchmark your energy performance with this free tool

The following are mainly for larger industries or buildings:

ENERGY STAR for Industry certification

- score 75 or higher on the 0-100 scale, using the current version of their industry-specific Energy Performance Indicator (EPI)

ENERGY STAR Certified Building (commercial and institutional)

- must earn a score of 75, annually

Certifications

Canadian Home Builders' Association

Net Zero Home Labelling

- Part 9 buildings – private homes and MURBs
- Can also apply to renos
- Net Zero Homes produce as much clean energy as they consume
- Up to 80% more energy efficient than typical new homes
- Renewable energy systems produce the remaining energy
- 250+ labelled so far, including several in Ottawa
- Delivered through EnviroCentre and other qualified SOs
- https://www.chba.ca/CHBA/HousingCanada/Net_Zero_Energy_Program/NZE_Qualified_Homes/CHBA/Housing_in_Canada/Net_Zero_Energy_Program/NZE_Qualified_Homes.aspx?hkey=6dfe0bb7-cd34-4395-9052-64219fe31a99

Enjoy the outcome

Better Building

- Comfort: More constant, less drafty
- Costs: Operating and maintenance
- Resilience: Less affected by weather
- Health: Air quality

Better Business

- Business reputation
- Customer and Employee retention
- Operational knowledge and planning

Better City

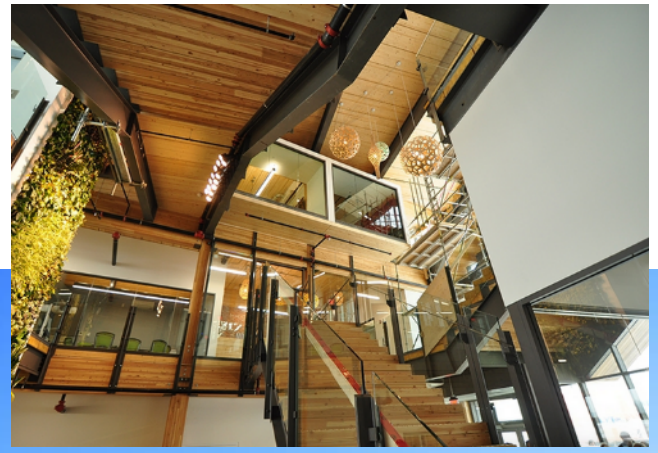
- Climate Action
- Public Health
- Resilience
- Green Economy
- $ stay in town

Salus Clementine: Karen's Place, Ottawa

- Certified Passive House
- Completed 2017
- 22,400 sq.ft., 42 bachelor units
- LEED Canada Platinum
- Heating costs only $1134 annually
- Upgrade cost premiums only 10%

Mosaic Centre, Edmonton

- Net-Zero energy commercial building
- Completed 2015
- 30,000 sq.ft.
- 213 kW of solar panels
- geoexchange or ground source heat pump system
- 32 boreholes going down 70 meters
- LEED Platinum



Wilkinson Avenue Warehouse
Dartmouth, Nova Scotia

- Zero Carbon Warehouse (CaGBC)
- Completed 2017
- 65,000 sq.ft.
- Continuous R-20 walls, R-40 roof
- 6 air-to-water heat pumps for radiant heating
- Backup condensing gas boilers
- Net-metered solar PV system
- https://www.youtube.com/watch?v=XGQknuxElDI&feature=youtu.be

Questions?

Thank You!

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