# The How-To Guide to a More Efficient Home 

Is your home too cold? Drafty? Expensive? ... Wasteful?<br>You've come to the right place!

This toolkit was designed to help homeowners like yourself carry out renovations to increase the sustainability of your home. These types of renovations are known as green home retrofits. They benefit you by reducing your home's impact on the environment, making your home more comfortable and livable, lowering home maintenance costs, and decreasing your energy bills by reducing energy and water consumption.

Home systems are the systems that work to run the utilities and environment of your home, including water, energy, and building envelope. In order to increase the efficiency of your whole home, each home system must be evaluated and improved. One way to effectively evaluate your home systems is through an "Energy Audit". Once you have an understanding of where your home's lowest efficiencies are, you can begin completing system retrofits. This toolkit addresses three home systems:


## Energy Systems

Components of these systems are described and explained, and options to improve the efficiency of these system components are outlined in "Retrofit Options".

Many homeowners have a hard time knowing how to proceed once they have a plan for a home retrofit. The world of construction and housing requirements can be complicated and intimidating to enter. That's why we created resources to help you understand three important components of the home retrofit process:


Once you understand your home, the type of retrofit you want to carry out, the resources available to support you, and the processes you have to follow to be successful... you might as well get started!

Follow the roadmap below to make your way from the dreaming, to the planning, to the construction, and to the finished stage!


Begin by trying to understand your current home systems, and then consider carrying out a home energy audit to help identify places for improvement. Then go back and review the retrofit options to decide what an appropriate update for your home is. Don't forget to use the additional resources and contacts included throughout.

What are you waiting for? Get going and good luck!

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## ENERGY AUDIT

## What is an energy audit? Why is it useful?

An energy audit is the first step in the sustainable home retrofit process. It's an inspection that assesses the energy use and major sources of energy loss in your home. The audit will allow you to see how efficient your home currently is and which retrofits are most important to increase this efficiency and save you money. The homeowner can do certain assessments and tests, but a professional energy auditor is needed for a thorough inspection.

## What do inspectors look for?

Inspectors are looking to identify efficiency upgrades that could be made in your home. They will look for things like air leakage, wall insulation and framing type, moisture control, space heating, and water heating. The home energy auditor will most likely do the following in their energy audit:

- Examine past energy bills of the home
- Determine the day-to-day operations of the home and any existing problems
- Inspect the exterior of the house to determine its size and features
- Conduct a health and safety inspection
- Inspect the interior of the house
- Inspect the electrical system and combustion appliances
- A blower door test, which locates major air leaks in the home
- Analyze results and create a home energy report with recommendations for retrofits


## How do I find an energy auditor?

- Use this online service to find a company in your area that is licensed by Natural Resources Canada
- Look for an independent auditor, not someone who is a representative of a specific product
- Get references for the auditor or energy company before you contact them
- Contact the Better Business Bureau to inquire about any complaints against the company


## What should I do to prepare for an energy audit?

- Have copies of your home's past energy bills ready
- Be ready to answer questions about the number of people living in your home, how often the home is occupied, and how your day-to-day life is structured
- Make a list of any existing problems in your home
- Watch this video produced by the U.S. Department of Energy


## What can I do myself?

Although an inspector is needed for a thorough inspection, there are several checks that can be done by the homeowners themselves. Below is a checklist from the City of Vancouver that will give you ideas for things to look for around your house to assess your home's energy efficiency and identify places for upgrades. However, be aware that if you would like
to apply for government rebates for your home upgrades, a professional energy audit will need to be done.

## Tear-Out Checklist

Use this form to make oftaled notes as you inapect the various arnas of your nome The eheckist is sat un by iocation so you dont have to vist one area more than once for ejch area. you wil be checking for insulation air leaks, mosture probterts and the kesting system components

| Ceiling Above Heated Area |  |  | Comments/Concerns |
| :---: | :---: | :---: | :---: |
| Attic hatch | $\square$ insulated | $\square$ wowtharstripped |  |
| Attic floors | $\square$ insulated | $\square \mathrm{R}$-Value |  |
| Attic roof (sloped) | $\square$ insulated | $\square \mathrm{R}$-Value |  |
| Dropped celling | $\square$ inculatod | $\square$ R-Value |  |
| Cathedral celling | $\square$ inculated | $\square \mathrm{R}$-Value |  |
| Flat roof | $\square$ insulated | $\square$ R-value |  |
| Wall top plates | $\square$ insulated | $\square \mathrm{R}$-Value |  |
| Attic side walls | $\square$ insulated | $\square$ R-value |  |
|  | $\square$ blackod | $\square$ sosled |  |
| Chimney chase | $\square$ sasiod |  |  |
| Duct penetrations | $\square$ sealed |  |  |
| Plpe 8 wire penetrations $\square$ sealed |  |  |  |
| Recessed llghts | soalod baffled if not | inaulated IC rated |  |
| Exhaust fan 1 | $\square$ workne | $\square$ venteo to outside |  |
| Exhaust fan 2 | $\square$ working | $\square$ venteo to outside |  |
| Ducts | inculated joints seale | $\square \mathrm{R}$-Value |  |
| Hot water plpes | $\square$ insulated | $\square \mathrm{R}$-Valun |  |
| Vents vents vents | $\begin{aligned} & g h \# \\ & N \# \end{aligned}$ | total net free area total net free area | $\square$ cleared/oaffled cleared/oaffled |

Heating System (in Attic or Basement/Crawl Space)

| Furnace | filters clean sealed combustion | size/type $\qquad$ flame retention |
| :---: | :---: | :---: |
| Boller | pipes insulated soalod combustion | R-Value |
| Water heater | insulated shell pipes insulated sealed combustion | water temperature R-Value $\qquad$ heat traps |

Floor Below Heated Area (Basement or Crawl Space)

| Floor joists | $\square$ insulated | $\square$ R-value |
| :---: | :---: | :---: |
| Rim Joists | $\square$ insulated | $\square$ R-value |
| Ducts | inculatod connected | R-Value soalod |
| Hot water plpes | $\square$ inculatad | $\square$ R-Value |
| Ground cover (crawl space) $\square$ fully co |  |  |

Floor Below Heated Area (Garage and/or Cantilevered Floors)
Floor joists
$\square$ insulated
$\square$
value $\qquad$ Rim Joists $\square$ insulated $\square$ R-Value $\qquad$
$\qquad$


Image retrieved from http://vancouver.ca/files/cov/green-energy-audit-guide.pdf
Resources:
Green Energy Guide
Professional Home Energy Audits
An Energy Audit Manual and Tool

## RETROFIT OPTIONS: Building Envelope

## Insulation



Image created by Jennifer Yu.

## What is insulation and how does it work? ${ }^{1}$

Insulation retrofits of homes are performed to reduce energy consumption, lower utility bills and improve comfort in your home. Insulation can keep a house warm in the winter and cool in the summer by providing resistance to heat flow and increasing the thermal mass of the walls. In the winter, a house would be losing heat to the environment due to the temperature differences between indoors and outdoors. In the summer, a house could gain heat from warmer outside air temperatures. By installing proper insulation, the heat flow could be decreased and therefore provide a more comfortable and sustainable home.

## How effective are insulation retrofits? ${ }^{2}$

The resistance to heat flow is measured by the R-value. The R-value indicates the effectiveness of the insulating materials - the higher the value, the more effective. In Canada, provincial building codes require newly constructed homes to have specific

[^0]minimum R-value. Insulation materials and products are labeled with their R -values on the packaging. The $R$-value can vary depending on several factors - the type of insulation, the thickness of the insulation, and the density of the insulation. Furthermore, the installation process and the location of the installation could also affect the R -value.

## Types of Insulation and Materials:

Characteristics of Common Insulation Materials ${ }^{3}$

| Insulation Material | R/in. (RSI/m) | Appearance | Advantages / Disadvantages |
| :---: | :---: | :---: | :---: |
| Batt-Type <br> Good application for attics, new party walls and new exterior walls. |  |  |  |
| Fibreglass | $\begin{aligned} & 3.0-3.7 \\ & (21-26) \end{aligned}$ | All batts come in plasticwrapped bales. The products are like fibrous blankets, about 1.2 m (48 in.) long and wide enough to fit snugly between wall studs. | Readily available. |
| Mineral wool | $\begin{aligned} & 2.8-3.7 \\ & (19-26) \end{aligned}$ | Same as fibreglass. | Somewhat better fire resistance and soundproofing qualities than fibreglass. |
| Cotton | $\begin{aligned} & 3.0-3.7 \\ & (21-26) \end{aligned}$ |  | Not readily available. |
| Loose-Fill <br> All loose-fill insulations require a professional installer. Recommended only for roof-deck or attics |  |  |  |
| Fibreglass | $\begin{aligned} & 3.0-3.7 \\ & (21-26) \end{aligned}$ | A very light fibrous fill, usually pink or yellow. | Can be affected by air movement in attics. |
| Mineral fibre | $\begin{aligned} & 2.8-3.7 \\ & (19-26) \end{aligned}$ | A very light fibrous fill, usually brown. | Not readily available. |
| Cellulose fibre | $\begin{aligned} & 3.0-3.7 \\ & (21-26) \end{aligned}$ | Fine particles usually grey in colour, denser than glass or mineral fibre. | Provides more resistance to air movement than other loose fill insulations. Can have settlement problems if not installed properly. |

[^1]| Board-Stock |  |  |  |
| :---: | :---: | :---: | :---: |
| $\begin{array}{c}\text { Type I and II } \\ \text { (expanded) } \\ \text { polystyrene or } \\ \text { EPS }\end{array}$ | $\begin{array}{c}3.6-4.4 \\ (25-31)\end{array}$ | $\begin{array}{c}\text { White board of small - about } \\ 8 \mathrm{~mm} \text { (0.3 in.) in diameter - } \\ \text { foam beads pressed together. }\end{array}$ | $\begin{array}{c}\text { Typically hard coats } \\ \text { (HC) used in } \\ \text { production. Must be } \\ \text { covered. }\end{array}$ |
| $\begin{array}{c}\text { Type III and IV } \\ \text { (extruded) } \\ \text { polystyrene or } \\ \text { XPS }\end{array}$ | $\begin{array}{c}4.5-5.0 \\ (31-35)\end{array}$ | $\begin{array}{c}\text { Commonly blue or pink foam } \\ \text { board. }\end{array}$ | $\begin{array}{c}\text { Works well in wet } \\ \text { conditions, can act as a } \\ \text { vapour retarder. } \\ \text { Hydrofluorocarbon }\end{array}$ |
| (HFC) usually used in |  |  |  |
| production. Must be |  |  |  |
| covered. However, |  |  |  |
| HFCs should be |  |  |  |
| avoided due to its |  |  |  |
| negative impacts on |  |  |  |
| ozone layer. |  |  |  |$]$

All spray-applied insulations fill cavities very well. They must be applied by a specialized contractor.

| Wet-spray <br> cellulose | $3.0-3.7$ <br> $(21-26)$ | Fine particles held in place by <br> a binder. | Not readily available. |
| :---: | :---: | :---: | :---: |
| Open-cell light <br> density <br> polyurethane | 3.6 <br> $(25)$ | A soft, compressible spray <br> foam that expands into the <br> cavity. | Can act as the air <br> barrier if combined with <br> another material. Must <br> be covered with a <br> vapour barrier. |
| Closed cell <br> medium <br> density <br> polyurethane | $5.5-6.0$ |  |  |
| $(38-42)$ | A rigid spray foam that <br> expands into the cavity and <br> sets up fairly rigid. | Can act as the air <br> barrier and vapour <br> retarder. HFC used in <br> production. Must be <br> covered. |  |

[^2]Note: All values are approximate and for general comparison only. Some insulations may be irritants or hazardous during installation. Consult manufacturers' recommendations and insulation packaging for proper respiratory, eye and skin protection.

## For Existing Homes: ${ }^{5}$

## Walls

Wood-frame:
Loose-fill and spray-applied foams are most commonly used materials for insulation due to their ability to fill up the cavities inside the walls.

Steel-frame/concrete building:
A new cavity must be created since there is not a large enough cavity for insulation to take place. The new cavity wall could be insulated as a new wall.

## Attic

Spray-applied foams can significantly increase the R-value of the house and provide more air barriers. This type of insulation must be performed by certified installers. The other option is loose-fill insulation. This could be done and would be blown into and over the ceiling joists by a contractor and is possible for the homeowner to perform this insulation him/herself. However, spray-applied foams are much more effective than loose-fill. This is the most costeffective place to add insulation.

## Basement

As Canadian Mortgage and Housing Corporation suggests, it is best performing board-stock insulation for the basement. By insulating the outside wall with rigid insulation, it could keep the surface and groundwater away from the foundation of the house. Rigid insulation materials could also help keep the basement walls at room temperature and thus increase comfort.

This video from Canadian Mortgage and Housing Corporation provides a detailed explanation of insulation.

## Airtightness

Air leakage should be the number one priority when it comes to retrofitting a house. An efficient home starts with a good air system. This system should help resist the movement of air through the walls and roof of the house. By upgrading to a better air system, it could help the house to become less drafty and allow the insulation to become more effective.
Additionally, it could improve the indoor air quality and keep the heating bill low. Improving your windows and doors could also be a great place to start.

## How would I know if air leakage is happening?

[^3]An example of cold air being leaked into your house is if a particular room in your house is always cold and hard to warm up even with the heater turned on. Moreover, damp insulation or attic could also indicate air leakage. ${ }^{6}$ While cold air leaking into the house is easy to notice, warm air leaking out of the house is rather difficult to detect. Nonetheless, there are tests that could be carried out to examine the leaks throughout the entire house.

## Blower Door Test

A blower door test ${ }^{7}$ could either be done by a contractor or during the energy audit. The test involves depressurizing your house by using a fan. This would allow outside air to flow in through all the openings. The locations of leakage would be recorded by thermographic equipment. Common locations include: windows and doors, light and plumbing fixtures, basement, interior walls, electrical outlets, etc. ${ }^{8}$

This video gives a walkthrough of a blower door test.

## What You Can Do

Most air leakage problems could be solved by caulking and flashing. For instance, by applying weatherstrips and caulk to the windows, doors, and hidden openings to the attic, the gaps between the joints would be sealed so that they would not expand and contract. ${ }^{9}$ In addition, homeowners could also choose to upgrade or replace their windows. For more information, please consult Natural Resources Canada website: Air Leakage Control.

Resources:
How to weatherize a door
Weatherizing Doors and Windows - Step 3: Weatherstripping

[^4]

Image retrieved from U.S. EPA showing the common locations of air leakage in a home.

## RETROFIT OPTIONS: Water Systems

## Greywater Recycling System



Image retrieved from http://guelph.ca/living/environment/water/water-conservation/greywater-reusesystem/

Greywater is relatively clean wastewater that is generated in the home from baths, sinks, and washing machines. A greywater recycling system works to reduce water consumption by collecting this greywater and re-using it. Once the greywater is collected, it can either be directly diverted to the garden, or filtered and purified through a treatment system. If the greywater is treated and purified, it can be used to flush toilets in the home. Up to $30 \%$ of water used in Metro Vancouver homes is from flushing the toilet, so using treated greywater to flush toilets can result in a significant decrease in water usage, and potential financial savings for homeowners ${ }^{10}$.

There are two main types of systems for greywater recycling, and systems within these two categories can range from simple diversion valves and filters to complex piping and purification systems. The two main options are broken down in the following chart.

[^5]|  | Greywater Diversion System | Greywater Treatment System |
| :--- | :--- | :--- |
| Summary | Carries greywater from <br> bathroom or washing machine <br> to garden without treating it. | Collects and treats greywater to <br> various levels of purity by filtering <br> solids, removing pathogens and <br> unwanted chemicals, and disinfecting <br> greywater by chlorination or UV light. |
| Water <br> Source | Bathroom sink, kitchen sink, <br> washing machine, or shower | Bathroom sink, kitchen sink, washing <br> machine, or shower |
| Water <br> Usage | Garden | Garden or toilet |
| Components <br> Needed | Hose, diverter valves, surge <br> tank, filters | Piping, purification system, tank |
| Maintenance <br> Required | Filters need to be cleaned <br> regularly and replaced every <br> $6-12$ months | Yearly servicing and filter <br> replacements |
| Cost | $\$ 300-\$ 1000$ (as of 2016) | \$3500-\$15,000 (as of 2016) |

Resources:
Canadian Guidelines for Household Reclaimed Water for Use in Toilet and Urinal Flushing (2010)

## Drain Water Heat Recovery

Drain water heat recovery works to capture the heat from shower water that goes down the drain and uses it to pre-heat water that is entering the water heater or hot water tank.

When water enters the home, it is cold, and is heated to approximately $41^{\circ} \mathrm{C}$. With a drain water heat recovery system, the water entering the home can be pre-heated from $5-25^{\circ} \mathrm{C}$ before getting to the hot water heater. This pre-heating can cut your home water heating costs in half.

One of the common systems for drain water heat recovery is detailed in this video as well as in the image below. Here, a copper tube wrapped heat exchanger is installed onto the main drain line, where the thermal energy is collected.


Image retrieved from http://energy.gov/energysaver/drain-water-heat-recovery
This simple tube is an excellent energy saving option if you take a lot of showers, and depending on which company you choose to work with, can be installed for approximately $\$ 600$. With the money that you save on home water heating, this initial cost will be returned in savings within 2-6 years. Also, the system has no moving parts so no maintenance is required, and RenewABILITY Energy Inc. promises that their Power-Pipe Drain Water heat Recovery System will last more than 50 years.

## Resources:

Power-Pipe DWHR System

## Rainwater Harvesting

A rainwater harvesting system collects and stores rainwater, which can then be used for various needs in the home, including irrigation in the garden or, if there is enough rainwater capture, in toilet flushing. This system works to reduce the consumption of municipally treated water and can lower water bills for your home. There are four main components to a rainwater harvesting system:

1. Area to catch the rainwater, typically the roof.
2. A transport or conveyance system to move this water to a rainwater storage tank. Usually roof gutters and drains which drain to a pipe or eavestrough can be used to transport the water.
3. A storage tank to store rainwater, usually at ground level.
4. A distribution system that gets the rainwater to either the garden or the toilet.


Image retrieved from http://www.climatetechwiki.org/content/rainwater-harvesting-rooftops
Along with these key components, there are several optional components to increase the efficiency and durability of your system. This includes pre-filtration devices to stop contaminants such as leaves and twigs from running into your storage tank, a pump or pressure system to move the water more quickly, and a post-storage treatment system that reduces the potential for water contamination. Finding the best system for your home will require assessing what your water needs are and consulting an engineer or rainwater harvesting system designer.

## Resources:

Collecting and Using Rainwater at Home: A Guide for Homeowners

## Solar Hot Water Heating

Solar energy is a clean, long-lasting way to reduce your energy consumption. A solar hot water heating system collects energy from the sun and uses it to heat water for your home. This can cut your water heater energy costs by $50 \%$ and reduce your total household emissions. ${ }^{11}$

Typically, a solar water heating system will provide 35 to $55 \%$ of annual water heating needs, depending on the potential of solar capture of your home. For maximum capture, collectors should be located on a south-facing, slanted roof away from the shading of nearby buildings and trees. The energy that is captured is transferred to a water tank, where the energy is used to heat the water in the tank. The water is then transported into the home, usually into the main hot water heater. As the solar energy preheats the water, the main

[^6]water heater has less work to do. Due to this lighter workload, you can also reduce the size of your hot water tank heater.

These systems can certainly be effective in reducing energy consumption in a residential context, however, there are some drawbacks in the details of the system. For example, solar thermal systems are complicated because they have moving parts and there is greater capacity for parts to be damaged and require repair. ${ }^{12}$


Image retrieved from https://en.wikipedia.org/wiki/File:DirectSolarSystems.jpg
There are a wide variety of solar energy systems that can be used to heat water, and many can be customized in size, materials, and cost. The left image above (A) is a diagram of a passive system, and the right image above (B) is a diagram of an active system, in which a pump moves the water around from the collector to the storage tank. In order to make a decision that is best for your home, contact a solar consultant in your area. Though not an exhaustive list, the following companies are good places to start when looking for solar consultants around the Lower Mainland of British Columbia:

## Vancouver Renewable Energy

Terratek Energy Solutions
Sun Bright Solar

## Low-Flow Fixtures

Low-flow plumbing fixtures can significantly reduce water usage for residential homes. Fixtures such as toilets, faucets and showerheads are the main sources of wasted water. ${ }^{13}$ Standard toilets use about 23 liters per flush, while faucets and showerheads are accountable for $18 \%$ of indoor water use in a home. ${ }^{14}$

[^7]
## Toilets

There are several types of water-efficient toilets. A low-flow toilet allows only maximum of 6 liters per flush where as a HET (high-efficiency toilets) uses only 4.8 liters per flush. ${ }^{15} \mathrm{~A}$ single flush HET uses minimum 3 liters per flush and maximum 4.8 liters per flush. On the other hand, a dual flush HET, which allows consumers to choose between "full flush" and "reduced flush" (for liquids only), requires about 6 liters per flush for the full mode and 4.2 liters for the reduced mode. Ultimately, homeowners are recommended to purchase the 3L Proficiency Toilet offered by Water Matrix, a leading company that provides water efficiency services in Canada. ${ }^{16}$ This affordable product only requires maximum 3 liters per flush to have the same performances as other toilets. For more information please consult Water Matrix: Understanding Your Toilet.


Proficiency uses this BSB air transfer system to pressurize the trapway. Once activated, the swift and powerful flush evacuates all waste in the bowl. This new technology gives Proficiency the leading edge in water efficiency, achieving the lowest flush volume of any HET in the industry.

Image retrieved from Water Matrix.

[^8]
## Laundry Machines

Laundry machines also contribute significantly to a home's daily water usage. According to Jones ${ }^{17}$, clothes washers in Canadian households account for $20 \%$ of water use. In the United States, an average family washes about 300 loads every year. ${ }^{18}$ Compared to washers that were made in 1990s, present washers are at least $68 \%$ more energy efficient by using less water, energy, and detergent. There are two main types of clothes washers: top-loading and front-loading washers. For more information, please consult ENERGY STAR Website: Clothes Washers, Most Efficient 2016 - Large Clothes Washers, and Certified Products - Clothes Washers


ENERGY STAR
Image retrieved from https://www.energystar.gov/

## Top-loading

Top-loading washers use an agitator to pull clothes and submerge them into a full tub of water. However, instead of filling up a huge tub with water, newly designed top-loading machines spin clothes through a stream of water or spray clothes with high-pressure water. ${ }^{19}$


Image retrieved from https://www.energystar.gov/most-efficient/me-certified-clotheswashers/

## Front-loading

Front-loading machines wash clothes by allowing clothes to tumble in and out of a small pool of water instead of being pulled by an agitator. These type of machines tend to have better

[^9]performances by consuming less water, detergent, and gentler spinning actions that can allow the machines to last longer. ${ }^{20}$ Additionally, they could remove more water out of the clothes and reduce the amount of energy and time needed to dry them.


Image retrieved from https://www.energystar.gov/most-efficient/me-certified-clotheswashers/

## Dishwashers

Dishwashers could also be retrofitted for water saving purposes. Research shows that washing dishes using a dishwasher is actually more environmentally friendly and efficient than washing them by hand. ${ }^{21}$ The study suggests that a dishwasher could save half of the energy and about $80 \%$ of the water that an average hand-washer requires. For details on products, please consult ENERGY STAR Website: Certified Products - Dishwashers.

By upgrading to low-flow fixtures, homeowners can minimize water and electricity usage, and contribute to a more energy efficient home. Additionally, homeowners could also save money by being water efficient.

[^10]Low-Flow Fixture Options:

| Products | Old | New | Cost | Where to buy/Labels | Comments |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Showerheads | 9.5 <br> liters <br> (per <br> min) | less <br> than <br> 7.6 <br> liters | \$10 and up | Home Depot, Lowe's, EarthEasy/ WaterSense labels | Could save more than 370 kWh per year. Eartheasy website: http://eartheasy.com/g reen-home/greenwashroom |
| Faucets <br> Aerators | 8.3 <br> liters <br> (per <br> min) | 5.67 <br> liters <br> or <br> less | \$250 <br> and up <br> \$10 <br> and up | Home Depot, <br> EarthEasy/ <br> WaterSense labels | Could save about 2650 liters of water per year; Home Depot sells sets of showerheads and faucets together |
| Toilets <br> Single Flush <br> Dual Flush <br> 3L Flush | 23 <br> liters <br> (per <br> flush) | 4.8 <br> liters <br> or <br> less | $\$ 100$ and up <br> \$180 and up | Lowe's/ <br> WaterSense labels | Could save more than $\$ 100$ per year |
| Clothes washers | 87 <br> liters <br> (per cycle) | 49 liters | $\$ 800$ <br> and up | Home Depot/ Energy Star label | Could save more than $\$ 40$ per year |
| Dishwashers | 37.8 - <br> 56.7 <br> liters <br> (per <br> cycle) | 20.8 <br> liters <br> or <br> less | \$430 <br> and up | Energy Star label | Could save more than \$35 per year |

## RETROFIT OPTIONS: Energy Systems

Solar Photovoltaic (PV) ${ }^{22}$


Image created by Virginia Hermanson.
Photovoltaic solar panels convert sunlight into electricity that can be used in your home. Direct current (DC) is produced, which is converted into alternating current (AC) for domestic use. This technology allows you to capture renewable energy and use it instead of electricity provided to you by a utility company. This electricity can be used to power appliances in your home, and depending on the type of systems - heat your home and hot water. While the system and its installation are not free, the green energy it provides to you is!

Photovoltaic arrays can be connected to a municipal grid such that when the system is producing more than your home is consuming, you will be paid or given credit for the electricity you are producing. Homes in Maple Ridge can receive credits with BC Hydro for their surplus solar energy. This program is called "Net Metering", and is outlined in this video.


Image retrieved from Natural Resources Canada. Showing a 2.88 kW solar photovoltaic system installed on a residential home. (http://www.nrcan.gc.ca/science/story/1399)

[^11]Solar photovoltaic systems are priced based on the size of the system, which usually translates into the amount of energy that the system produces. There is also variety in the type of system and its components. Generally solar photovoltaic systems are sized and customized depending on the home, budget, available space and type of consumption that it will be providing for. South facing, stationary systems are the most effective residential system. This type of system would typically be installed on your roof or garage's roof. While installing one of these systems is an expensive home retrofit, it can last upwards of 40 years and requires minimal maintenance while continuing to perform effectively.
Before installing a PV system, it is important to consider if you have an appropriate place to install the module. What is the shading on your property? Could the module be positioned south facing? And further, consider how much electricity use you want to offset, and what your financial constraints are. It can then be helpful to make contact with an installer and supplier near you to discuss some of these factors, and get cost estimates on system components and installation. In some cases, providers will allow for the leasing of solar systems.

Here are a few potential contractors that you could contact with questions in the Greater Vancouver Area, or the Lower Mainland.
Please note that this list does not include all existing suppliers or installers.
Vancouver Renewable Energy Cooperative (Specialize in supplying and installing affordable renewable energy technology)
Contact: Rob Baxter, 778-869-8333, main@vrec.ca

- have specialized in photovoltaic installation since 2004
- now provide an extension of services to provide solar thermal technology for hot water and pool heating
- option to lease a solar system
- started a community owned renewable energy project called SolShare Energy


## Terratek Energy Solutions (Canadian Green Energy Company)

Contact: Scott Fleenor, 604-671-5812, scott@terratek.ca

- licensed electrical and plumbing contractor
- will construct solar system based on your desired energy offsets, available space, and budget for technology

Penfolds Roofing and Solar (Company based in Metro Vancouver. Originally just roofing, but have made significant transition to incorporate solar)
Contact: Ken Mayhew, 778-829-0424

- solar specialist will do evaluation of energy and water usage, look at your home, and give you options for cost and efficiency
- will use satellite imaging and software to best assess options for installation

[^12]

Image retrieved from U.S. Department of Energy (http://energy.gov/articles/energy-saver-101-infographic-home-heating)

Your home heating system is responsible for producing and distributing heat (and sometimes conditioned or cooled air) throughout your home. It is comprised of a heat source, heat distribution system and a control system. The efficiency and sustainability of a home heating system can be determined by how effectively the system converts its fuel into heat, combined with the type of fuel used ${ }^{23}$. In a cold climate, of all the energy used in a home, two thirds of it will be used to heat the home ${ }^{24}$. For this reason, having an efficient home heating system is incredibly impactful in terms of financial cost and environmental impact. To help you determine if you should replace your home heating system, consult the decision tree on this link.

Heating systems can be classified based on their heat source and distribution system. In a central heating system, air or water is heated in a central location in a home (by a boiler, furnace or heat pump), and then distributed by a fan through a duct, or by a pump into radiators or pipes. A central heating system is generally controlled by one thermostat. A direct or "zoned" heating system is composed of smaller heating units that are controlled individually throughout a home. In this type of system, each zone in your home would have a

[^13]separate thermostat to control the indoor environment. These are commonly electric heating systems, but other types of systems can be zoned for increased system efficiency. ${ }^{25}$
For an example of a cost comparison of a central versus a direct heating system, go to this link.

Summary of home heating systems, their pros and cons, and given the installed system components the most sustainable model/upgrade: ${ }^{26}{ }^{27}$

| System | Basics | Pros | Cons | Sustainable Upgrade |
| :---: | :---: | :---: | :---: | :---: |
| GeoThermal (Ground Source) Heat Pump | Transfers relative warmth from the ground in a fluid into pipes for distribution throughout a house. | Highly efficient. Sustainable option. Minimal maintenance. Quiet. | Installation can be a costly and complicated process (need to lay underground piping). | Run heat pump using a renewable energy source. (See Solar Photovoltaic section). |
| Air Source Heat Pump | Transfers heat from relatively warm air, to air for distribution throughout ductwork in a house. | Easier and less expensive installation compared to a geothermal system. | 25-45\% less efficient than Geothermal systems. ${ }^{28}$ Efficiency impacted by climate. | Run heat pump using a renewable energy source. |
| Boiler | Moves water heated by natural gas (and occasionally heating oil) through pipes/radiators which release heat throughout the home. | Option of creating "zoned" control system which eliminates unnecessary heating. | Pipe freezing can be problematic. | Condensing gasfired boiler. (Explained here!) <br> Distribute using radiant floor heating, or hydronic baseboards. |
| Furnace | Burns fuel to heat a metal heat exchanger, which warms air that is | Can be powered by multiple fuel types (natural gas, heating oil). | Old systems are 30\% less efficient than new systems. ${ }^{29}$ | Condensing furnace. (Explained here!) |

[^14]|  | then forced through <br> a distribution <br> system throughout <br> a home. |  | Fan in the <br> distribution <br> system can be <br> loud. |  |
| :--- | :--- | :--- | :--- | :--- |
| Electric | Uses resistors to <br> convert electrical <br> current into heat <br> which is released <br> into rooms from <br> baseboards. | Inexpensive <br> equipment. <br> High efficiency. <br> Option for zoned <br> control (electric <br> baseboards). | Expensive <br> system <br> operation. <br> High electricity <br> consumption. | A different <br> primary heating <br> system. |

For more comparisons of home heating systems (life expectancy, efficiency), check out this infographic created by the US Department of energy.

Before replacing or updating your home heating system, it is important to consider the types of systems that your home is equipped to operate and evaluate your existing system. You can use the checklist below to guide this thinking.

- How old is your current heating system? (Note: typical systems can operate for 20 years, in some cases product manuals will list shorter timespans)
- What is its efficiency?

What is the current distribution system in your home? Should you install a water of air based heat source?

- Could your heating system be powered by a renewable energy source, such as a solar photovoltaic system?

At this point it may be helpful to consult a professional to discuss the constraints that climate may have on the types of systems that will function effectively where you live, as well as to discuss the capacity that the system will need to heat your home.

Resources:
Heating system cost calculator
Energy saving tips for your current heating system
Heating system maintenance tips

## Geothermal (Ground Source) Heat Pump ${ }^{30}$



Image created by Virginia Hermanson.
A geothermal heat pump draws solar energy that has been stored in the ground into a transfer fluid (glycol) through heat exchange, and produces heated water or air for domestic use. The same system can function for the purpose of cooling. This would be the case if the pipes were buried to a depth of consistent temperature. However, geothermal systems can also function by taking advantage of extreme hot spots underground - such as hot springs.

It runs effectively in both cold and warm climates, but in some instances location can limit your ability to install - make sure you are consulting with a professional! If you need to replace your water heater, the benefits and reduced costs later-on will make the installation costs worthwhile. ${ }^{31}$

[^15]
## Air Source Heat Pump ${ }^{32}$



Image created by Virginia Hermanson.
An air source heat pump works by transferring heat from relatively warm air, to air for distribution throughout a house via ductwork. A forced air system similar to the distribution system for a furnace transports the heated air throughout the home. The system is installed similarly to an air conditioning unit, and it and the distribution system are powered by electricity. This type of system could also transfer the heat into water for distribution throughout the home. Heat could be distributed differentially throughout the home if a zoned system was installed.

The system can be used for both heating and cooling, but is most effective at heating in climates with moderate - warm winters. In colder climates, this type of system works most effectively when combined with another auxiliary heating system. ${ }^{33}$

[^16]
## Boiler ${ }^{34}$



Image created by Virginia Hermanson.

A boiler is a hydronic system (a system that circulates hot water) fuelled by natural gas or heating oil. Water is heated and then is then distributed throughout the home through radiators or another type of distribution system, such as a radiant floor distribution system. The heat is released and then the cooled water returns to the boiler for reheating.

These systems are most efficient with a condensing boiler. Increased ability to control the system can be acquired by installing "zoned" thermostats which enable the homeowner to turn off heat distribution in unoccupied spaces in the home. This type of system is more expensive to install but could provide financial savings as less heating would be required, and as a result less fuel would be consumed.

[^17]
## Furnace ${ }^{35}$



Image created by Virginia Hermanson.
A furnace is a central forced warm air system fuelled by natural gas or heating oil. Fuel is mixed with air and burned to heat air that is distributed throughout the home through ductwork by a fan. The system is controlled by a thermostat.

Condensing furnaces are the most efficient type of furnace system because they are designed to capture escaping heat.

[^18]
## Electric Heating ${ }^{36}$



Image created by Virginia Hermanson.
In electric heating, electricity is passed through resistors which produce heat that is released into a space in a home. Most commonly, this type of system does not include a distribution system because the heat is released directly from the source through a baseboard. Although this system is highly efficient in terms of heat production from quantity of power source, it is an energy and financially expensive system to operate.

This type of system is highly effective for intermittent heating, or to bolster another more sustainable system, but is inefficient compared to a hydronic baseboard system! In addition, it is considered an unsustainable type of heating system because of its energy consumption so is not recommended for that reason.

[^19]
## Lighting



Image retrieved from http://energy.gov/energysaver/tips-lighting
In an average Canadian home, four percent of the total energy use goes to lighting. ${ }^{37}$ There are two components to lighting: bulbs and fixtures. Low energy lighting fixtures can allow you to produce the same amount of light output while using less power than traditional lighting fixtures. Light output is the the amount of light provided by the bulb, measured in lumens. Power used by the bulb is measured in watts. When you are choosing between light fixtures, it is important to consider the correlated color temperature (CCT) of the bulb. CCT determines how warm or cool the light appears to be. The higher the light temperature (in Kelvin degrees), the colder the light source. A cold light source is a bluish color that could be good for task lighting.

## LIGHT APPEARANCE

Kelvin (K)


Image retrieved from http://www.nrcan.gc.ca/energy/products/categories/lighting/bulbs/13918

[^20]
## Bulbs

An average Canadian home has around 30 light bulbs. ${ }^{38}$ There are three types of bulbs that are commonly used in Canada: Compact fluorescent light bulbs (CFLs), Light-emitting diodes (LEDs), and Halogen bulbs.

Compact Fluorescent Light bulbs


Image retrieved from http://energy.gov/energysaver/lighting-choices-save-you-money
Compared to incandescent bulbs, CFLs are 75 percent more efficient and can last 10 times longer. They are also now dimmable. However, CFLs do contain mercury, which is toxic to human body and may damage nervous, digestive, and immune systems. ${ }^{39}$ therefore they should be carefully stored. ENERGY STAR certified CFLs can be purchased at many retail locations. For more information please consult: Facts About Compact Fluorescent Light Bulbs

Halogen


Image retrieved from http://energy.gov/energysaver/lighting-choices-save-you-money
Halogen bulbs are 30 percent more efficient than incandescent bulbs and can last up to three times longer. Halogen bulbs also do not contain any hazardous gases such as mercury. These bulbs are the least efficient out of the three.

[^21]
## Light emitting diodes



Image retrieved from http://energy.gov/energysaver/lighting-choices-save-you-money
These are the most energy efficient bulbs and have the longest life span. Additionally, they do not contain mercury or other hazardous gases. They require less energy than CFLs and can start quickly. LEDs are durable in all situations and weather conditions. Unlike other bulbs, LEDs do not need high temperatures to be operated at. ${ }^{40}$ LEDs that are qualified by ENERGY STAR can provide the highest energy savings. Homeowners should replace halogen and CFLs with LEDs if possible. For more information please consult: Learning about LEDs

## Fixtures ${ }^{41}$

A light fixture is composed of three parts: the bulb, the fixture body, and the wires that connect to power source. Fixture types may include lamps, chandelier, and any other types of lights in your home. It is important to note that only the same type of bulb and fixture should go together to allow maximum efficiency. There are many light fixtures that are ENERGY STAR qualified and sold in Canada.

This video from the U.S. Department of Energy provides great descriptions of each light bulb.

Resources:
Ten Ways to Save with Lighting

## Reducing Your Plug Load ${ }^{42,43}$

Your home's plug load is the amount of energy consumed by all devices plugged into electrical outlets, including appliances, computers, and audio-visual equipment. It is the

[^22]fastest growing form of residential energy consumption. ${ }^{44}$ Loads differ based on size, type and efficiency of appliances and computers/AV, but devices continue to draw energy even when they are turned off. This is sometimes called "vampire power", or "phantom load".

Working to constantly unplug your appliances, and reduce the energy drawn from all of your appliances can significantly reduce your home's energy consumption. Alternatively, smart power bars exist which automatically shut off devices when the master device is turned off.

To see some metrics on how your plug load is likely impacting your energy bills and consumption - check out this link!

To reduce your plug load:

- Eliminate unnecessary devices
- Plug devices into power bars so you can more easily unplug them, or buy "smart power bars"
- Make a commitment to unplugging all devices when not in use
- Replace appliances, computers and AV with Energy Star or EPEAT certified devices


Image retrieved from How Stuff Works.
(http://science.howstuffworks.com/environmental/green-tech/sustainable/smart-power-strip.htm)

[^23]
## PERMITS AND INSPECTION

## Permits

What is a permit?
A permit is a document that is issued by the City that authorizes homeowners to begin construction and retrofit work on their homes. The permit is necessary to make sure that homeowners are following local bylaws and building code requirements, and meeting minimum health and safety requirements.

What do you need a permit for?
There are many types of permits, including building, electrical, gas, and plumbing permits and whether or not a permit is needed depends on the type and scale of project that you are going to carry out. Typically, a permit is required for any project that involves additions, installations, removals, or alterations. ${ }^{45}$ To determine which permit(s) may be required for your project, contact the Maple Ridge Permits Department at permits@mapleridge.ca or 604-467-7311. If you live outside the City of Maple Ridge, please contact your local municipality.
Contacting the City to find out exactly what you need to apply for is a crucial step in the retrofit process and the importance of relying on professionals for this information should not be underestimated.

How do I apply for a permit?
Permits must be applied for in person at the Maple Ridge City Hall. Application forms for the different types of permits can be found here, but submission of the application cannot be done online or by fax. Although application and processing times will vary according to your municipality, applications in Maple Ridge typically take 2-3 weeks to process, after which a permit will be issued and homeowners can begin work on their home. ${ }^{46}$

## Hire a Contractor

Before hiring a contractor, you should know whether or not your project is feasible and have your project approved through acquiring the necessary permits. For more information on the steps you should take to effectively hire a project contractor, see the toolkit section "Outsourcing Work".

## Start Construction

Once a contractor has been decided on, construction work can begin. Construction must begin within 6 months from the date the permit is issued, and must be completed within 24

[^24]months from the date of issue. ${ }^{47}$ It is important to remember to budget more time than is originally expected for construction projects, as well as to add a minimum of $20 \%$ contingency to the renovation quote that you are given by a contractor, as many things are subject to change throughout the process. ${ }^{48}$ Another useful strategy is to request a fixed fee from your contractor on the original scope of your project. If the scope begins to change, be aware that every change could affect your budget, construction timeline, and the required permits and inspections.
As construction progresses, all homes and project sites are required to undergo inspections to ensure that the work is following the requirements outlined in the City bylaws and local building code.

## Inspection Process

When and why are inspections required?
Official inspections are required during home renovation whenever a permit for building, plumbing, gas or electrical work is issued. A rule of thumb for when this will be the case, is when things are being "moved or removed" in/from your home. Inspections are completed by a Maple Ridge inspector, between 9am and 3pm, Monday - Friday.

The extent of your renovation and the type of permit that you have will dictate how many, and when the inspections are needed. For a building project in Maple Ridge, generally 3-4 inspections are required, and for plumbing, gas or electrical projects generally 2 inspections are required. More information on the timing of required inspections can be gathered when you are awarded a permit.

It is important to remember that a final inspection is required before systems can be covered and your project completed ${ }^{49}$. All relevant documents and approved permits must be on site to complete the final inspection ${ }^{50}$.

## How to request an inspection

Inspections can be booked through the City of Maple Ridge by email, phone or fax, so long as the permit number, site address and type of inspection required is know. Details can be found on the City page: https://www.mapleridge.ca/184/Building. If you live outside the City of Maple Ridge, the process is likely similar, but would be carried out through your local municipality.

Once you have requested an inspection, you can familiarize yourself with the types of features that the inspector will be looking at. Ensure that you have project plans, drawings and permits with you when your project is being inspected.

[^25]
## Building Code

What is the BC Building Code?
The BC Building Code is a set of minimum standards specified by the province that aims to provide safely constructed buildings, including upgrades. All construction must meet code standards for legal purposes. The BC Building Code combines both requirements from the National Building Code and the specific needs of British Columbia. However, the City of Vancouver has its own building code called the Vancouver Building Bylaw that is based on the BC Building Code. This could potentially give the City of Vancouver more control in setting building standards considering the city's unique climate, building types, and environmental goals ${ }^{51}$. It should also be noted that the code only requires buildings to reach minimum efficiency and not higher. Therefore, in order to build a highly sustainable and efficient home, the house would need to be built above the baseline. In addition to BC Building Code, there are also BC Plumbing Code and Fire Code. More details can be found on the City page: http://housing.gov.bc.ca/building/code questions/index.htm. ${ }^{52}$

How does the building code apply to you?
The building code provides the rules that need to be followed while performing home retrofits. Furthermore, the code would help your home reach a certain amount of energy and water efficiency and allow your home to become more sustainable. Copies of full BC Building Code are available at public libraries or can be purchased online through www.bccodes.ca. Information could also be provided by your local building inspectors and contractors.

[^26]
## OUTSOURCING WORK

## Where To Begin

When you decide to take on a home retrofit, one of the first steps is determining who you will work with and rely on to help you complete your project. Your contractor should be someone who is experienced and knowledgeable in the area they are supporting you in, and should be effective technically, in business, as well as in communication. A good place to begin looking is through neighbours and friends who have completed similar retrofits, or alternately by looking for lists of contractors vetted by reliable sources.

In a larger project, there may be more individuals involved than just yourself and your contractor:

Stakeholders and their responsibilities in a home retrofit project: ${ }^{53}$

| Stakeholder | Responsibilities |
| :--- | :--- |
| Homeowner | Overall responsibility for the project sits with the homeowner. It is <br> their job to determine what the retrofits will be, to effectively choose <br> reputable designers and contractors to assist them, and to ensure <br> that the project follows the relevant laws. |
| Designer/Architect | Responsible for creating effective, detailed working drawings that <br> reflect the homeowner's wishes and comply with relevant laws. In <br> some cases they will carry out site reviews for the owner. |
| General Contractor | Responsible for the overall construction of the project. This includes <br> buying supplies, scheduling the project, the workmanship, managing <br> subcontractors and manufacturers. |
| Subcontractor | Responsible for the portion of work relevant to and allotted to them. |
| Manufacturer | Responsible for providing products that meet the advertised and legal <br> standards. |

## Important Steps ${ }^{54}$

## Find Potential Contractors

Once you have a few potential contractors, it is important to go through the process of interviewing and researching them to determine whether they will be a good fit. (For a list of some potential questions click here!) You can also ask potential contractors for references of past clients. It is not uncommon to contact these individuals who have worked with them in the past, even to visit the site and see the work that the contractor completed.

[^27]
## Do a Contractor "Background Check"

It is important to verify that your contractor has third-party liability insurance and workers' compensation. Contact your local Homeowners' Association to ensure that these values are in the right range. In addition, ensure that your contractor has all necessary certifications. You can ask them to provide you with proof of all of these! Also check with your local Better Business Bureau as they should be able to tell you if there have been complaints filed about your prospective contractor(s).
Here is a link for the Better Business Bureau of Mainland British Columbia.

## Acquire Cost Estimates

Once you have vetted one or more contractors for yourself, you should request cost estimates for the project. There are varying ways to do this. It is not uncommon for homeowners to request quotes from various contractors. The most effective way to do this is to present them with detailed drawings and project specifications - generally drafted by an architect or designer if there is one working on the project. It will likely then take the contractors two to three weeks to prepare accurate estimates. Alternately, some individuals may prefer to have rough estimates presented to them by the contractor, and make their decision based on whether or not the approximate cost will be affordable. This can save time for both the contractor and the homeowner, however makes it much more likely that unexpected costs will be encountered later on in the project. ${ }^{55}$

## Create a Contract

After selecting your contractor, it is important that all agreements made between them and yourself are put into writing. Creating a formal contract can prevent you from entering into an unfavourable partnership, be important for insurance reasons, and allows you to hold the work to a predetermined standard of quality. In this you should include an agreed upon cancellation fee. For a contract template created by the Canadian Mortgage and House Corporation, click here!

## Things to Remember

Your contractor is going to be the individual responsible for the quality and type of work completed on your retrofit. Make sure that they are someone who you are comfortable working with, and who you feel you can trust. Be sure to ask them lots of questions especially at the beginning of the process - so that you have a good understanding of their experience and skills. This being said, even a thorough vetting process and clear communication can sometimes lead to miscommunications. Ensure that your own homeowners' insurance covers you for the nature of your renovation. And in the event of a disagreement, look to the provincial consumer protection laws that are relevant to supporting homeowners in resolving disagreements with contractors. It is a good idea to make a detailed schedule with all participants of your project. An effective way to do this is through the 'Precedence Method'. Learn more here!

[^28]
## BUDGET AND INCENTIVES

## Budgeting

Performing a retrofit can be expensive. It is essential that you plan your budget carefully ahead of time. It is very common to go over budget while doing retrofits. Budgets should always include labour and materials, as well as a contingency fund (typically $10 \%$ to $20 \%$, but could vary due to uncertainties). Homeowners should keep in mind that there will be extra cost every time there is a change in the retrofit design, equipment, or materials. Thus, the most cost-effective way is to have the first design in greatest level of detail possible, in order to reduce the amount of possible changes that could take place later. ${ }^{56}$ Here are some rough estimates for installing insulation, solar and water systems:

## Insulation

The costs for installing insulations vary in a wide range, depending on what type of insulation you want to do, what kind of materials you want to use, and where the installation would be. According to Home Advisor ${ }^{57}$, it is estimated to cost about $\$ 1,500$ for roof insulation, \$1,300$\$ 2,000$ for attic insulation, and about $\$ 1.00$ per square foot for wall insulations, if you hire professionals. For more information please consult: How Much Does it Cost to Insulate a House? or Insulation Calculator

## Solar

In 2014, installing a solar PV panel could cost around $\$ 3.50$ to $\$ 4$ a watt. For a 4 kW panel, it could go up to $\$ 16,000$ plus $5 \%$ GST. ${ }^{58}$ The installation of solar PV will be paid off in about 25 years. ${ }^{59}$

## Water systems

In 2014, the cost to install a greywater system is about $\$ 1,000 .{ }^{60}$ This system includes two sources for water supply and two different discharges streams, whereas a traditional home would typically only have one sources and one stream. However, the cost can vary depending on the size of the house, type of storage system you install, and the source of the greywater.

[^29]
## Incentives and Rebates

Why is it important to consider incentives?
Incentives provided by governments and utilities such as BC Hydro and FortisBC could greatly benefit you. They could allow you to consider more retrofit options for your home by providing financial support.


Image retrieved from www.usairseal.com

## Insulation

BC Hydro:
Insulation Rebates

- May receive up to:
- $\$ 1,200$ for exterior wall insulation
- $\$ 1,000$ for basement and crawlspace insulation
- $\$ 600$ for attic (flat or cathedral ceiling) insulation
- \$450 for other (exposed floor, joist header) insulation
- If making three or more upgrades, may be eligible for bonus rebates (up to \$750):
- Bonus Home Renovation Rebates
- For full details of the program, have a look at the Home Energy Rebate Offer Program

CMHC Green Home:
Energy-Efficient Housing Made More Affordable with Mortgage Loan Insurance

- The following incentives may be available when you use CMHC insured financing to purchase an energy-efficient home or energy efficient upgrades
- $10 \%$ CMHC mortgage loan insurance premium refund
- Premium refund for a longer amortization period (if applicable)


## Water Systems

## City of Maple Ridge - Low-Flow Toilet Tax Credit Program

- Maple Ridge homeowners may be eligible to receive a $\$ 50$ utility tax credit when they replace their toilets with a low-flow toilet


## Rebates for Clothes Washer, Dryer, and Fridge

- Lists the models that qualify for rebates
- Appliances must be purchased and paid for in full between May 1, 2015 and November 30, 2016 in order to be eligible for the rebates
- Could receive either $\$ 50$ or $\$ 100$ rebate


## Qualified Clothes Washers with ENERGYSTAR Label

- Lists the clothes washers that are ENERGYSTAR certified


## Water Heater Program

- Must be replacing an existing water heater
- Up to a rebate of $\$ 1,000$
- Must purchase qualified heater between January 1, 2015 to December 31, 2016


## Heat Pump Water Heater

- $\$ 500$ rebate for upgrading to qualified models of heat pump model


## Energy

## PST Refunds (Residential Energy Products pg. 12)

- Homeowners may be eligible for a refund of PST if owners have paid PST on purchases of residential energy product used in residential dwelling


## Savings Based on Income

- May be able to get free energy-saving products such as compact fluorescent light bulbs and weatherstripping and professional advice if qualified for the income requirements


## Energy Saving Kit

- Receive free energy saving kit that includes low-flow fixtures and other energy saving products (list provided)
- Receivers must qualify for low income family


## Energy-Efficient Lighting (April 1 - April 30, 2016)

- Rebates on selected ENERGY STAR certified LED bulbs, fixtures, and lighting controls


## Vancity Home Energy Loan

- Must be making energy efficient upgrades to your home
- Personal loan at prime+1\% rate for up to 15 years
- Can borrow from $\$ 3,500$ to $\$ 50,000$

Air Source Heat Pump (Central System) Rebate (January 1, 2015 - November 30, 2016)

- Rebate of $\$ 200$ per ton for installing a qualified air source heat pump
- Must purchase and install the pump within the specified date


## Air Source Heat Pump Loan

- Loans are available up to $\$ 6,500$ at $4.9 \%$ over 10 years
- Must have electric heating system


## GOING FORWARD

We hope that our toolkit has given you a better idea of your options for completing a home systems retrofit, and that you understand the steps you need to take to complete this type of project. There are some details that you may feel like you are missing - even after reading the entire toolkit - so we encourage you to visit the websites, articles and videos that we have referenced throughout the toolkit. And remember, for municipality specific information you can consult your City's online resources, or get in touch with local contractors, suppliers, or City representatives. Good luck!

## Authors

## Virginia Hermanson

Virginia is a fourth year Environmental Science student at the University of British Columbia. Her area of focus is Ecology and Conservation. Virginia has some experience with home retrofit projects, and is very interested in sustainable building and the implementation of green technology. Her main introduction to green technology has been working on a carbon sequestration in algae research project at the University of Calgary.

## Melinda Yogendran

Melinda is a fourth year student at the University of British Columbia, studying Biology and Environmental Science, with a specialization in Conservation Biology. She has conducted research on renewable energy options for remote communities, and is interested in innovative energy solutions that increase efficiency, mitigate carbon footprints, and contribute to sustainable development.

Jennifer Yu
Jennifer is a fourth year Environmental Sciences student at the University of British Columbia. Her area of concentration is Land, Air, and Water. She is passionate about sustainability and air pollution issues, and hopes to make contributions in the green technology field.

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