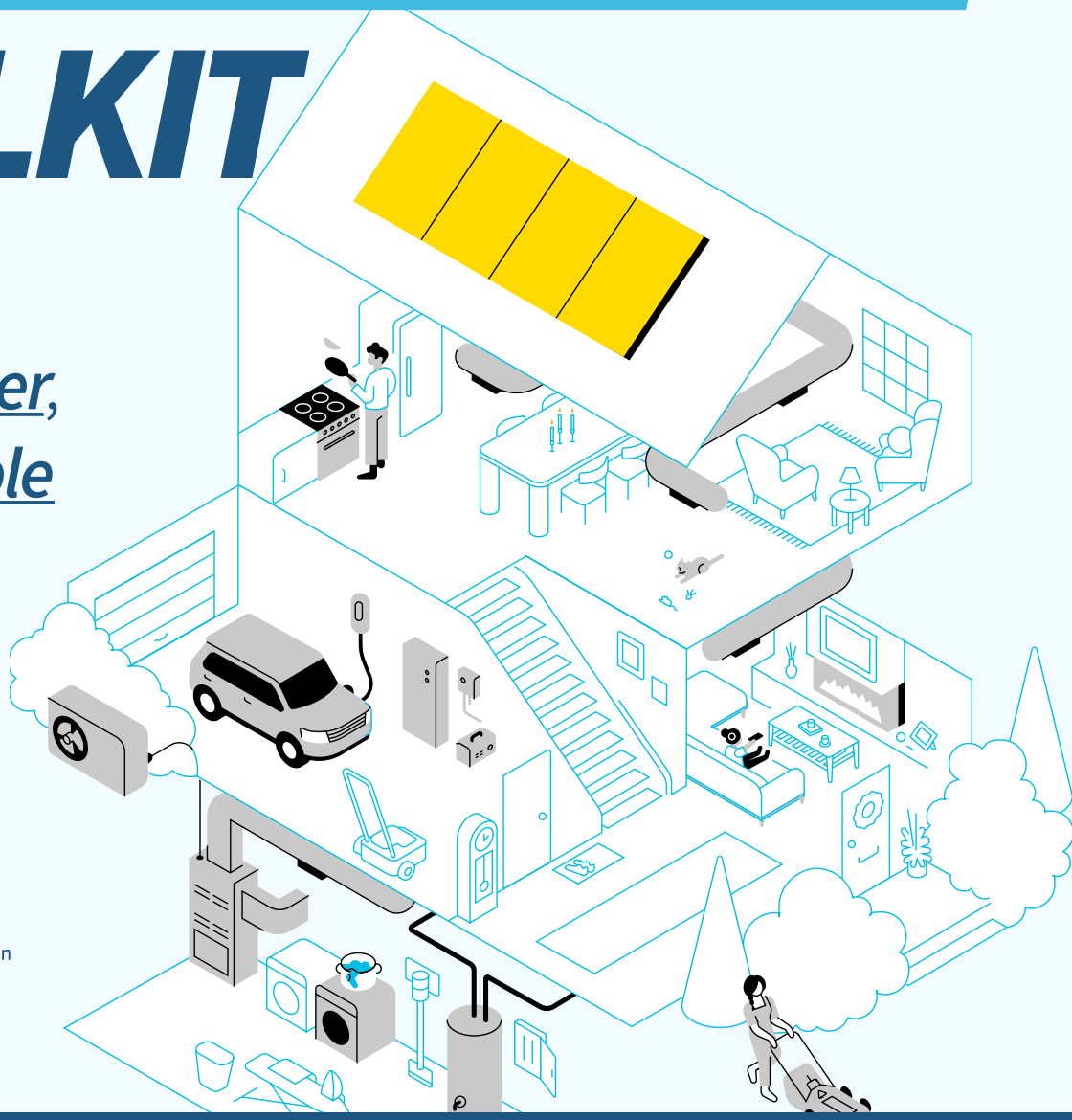
CANADA'S HOME ELECTRIFICATION TOOLKIT

Your guide to a ***cleaner, smarter, more affordable*** home



Building Decarbonization Alliance
pour la décarbonation des bâtiments

ELECTRIFY YOUR:

SOLAR POWER

Solar Power at a glance

> **If only there was some kind of an infinite power source that was free to use all day every day...**
>
> –
>
> author unknown

COST

Upfront costs:
$$-$$$

IMPLEMENTATION

Medium to difficult

ELECTRICAL NEEDS

120V 15-20amp
to 240V 20-30amp

EMISSIONS REDUCTION IMPACT

High

EQUIPMENT LIFESPAN

10-20 years

BONUS

Heat pump water heaters are many times more efficient than alternatives

Links to further resources:

- You can estimate the power generation for solar panels on your roof using this resource
- FAQs about rooftop solar panels
- Comprehensive guide to rooftop solar
- Guide to clean energy in Canada

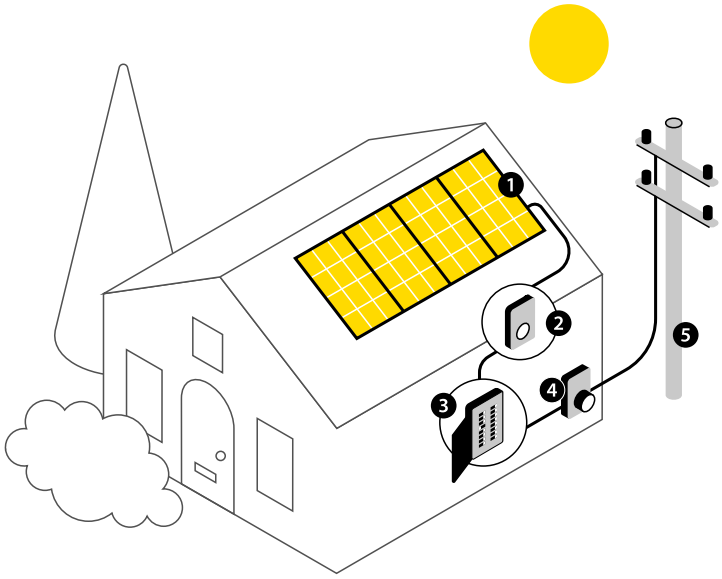
Solar Power

Solar photovoltaic (PV) panels generate free electricity from the sun, and the cost to install PV panels has dropped significantly over the past few decades. Adding solar panels to a home can reduce utility bills, reduce emissions, and may even increase a home's resale value. A home that can generate as much electricity as it uses in a year is considered net-zero electricity. If the home is both net-zero electricity and fully electrified, then it would also be net-zero energy and emissions. Now that is something to brag about! For those who do not own a roof but still want to use solar power, other ways to support renewable energy include buying green energy from your utility or retailer, or investing in or subscribing to a community solar project.

WHAT IS A SOLAR SYSTEM?

A solar system consists of panels that convert sunlight into direct current (DC) electricity and string inverters or microinverters that convert that electricity from DC to alternating current (AC), the form that powers our homes. Some systems also have optimizers to minimize losses.

Most solar systems use solar panels mounted on top of an existing roof surface.



1 Solar Panels
2 Inverter (DC-to-AC)
3 Electrical Panel
4 Electric Meter
5 Utility Grid

> **When there is a huge solar spill it's just called a nice day.**
>
> –
>
> author unknown

OPTIONS

Solar shingles:

Solar shingles are an alternative to solar panels that also protect the roof from the elements. They can be used alongside conventional roofing materials on surfaces that are not well oriented for solar.

String inverters:

One string inverter is used to convert the electricity generated from all panels into AC power. This results in simpler installation and lower upfront costs. However, these systems will have shorter warranties (10-13 years) compared to microinverters (25-30 years), and unless power optimizers are used, they may have lower outputs as shading on one panel can reduce the power output of the entire array.

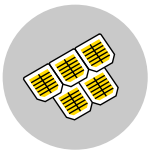
Microinverters:

A microinverter is installed on each solar panel to ensure optimal performance for each panel. While it is easier to add more panels when microinverters are in use, it can be difficult to access and replace a failed microinverter. Microinverters are more expensive upfront than string inverters but come with longer warranties (25-30 years vs 10-13 years).

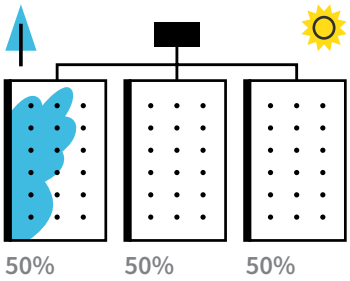
Power optimizers:

Power optimizers (aka Module Level Power Electronics or MLPE) can be installed on each solar panel when string inverters are used. They help ensure each panel can produce maximum power without being affected by the output of other panels. They have long warranties (20-25 years).

Solar shingles

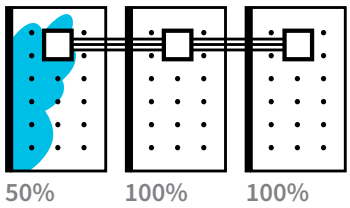


String Inverters



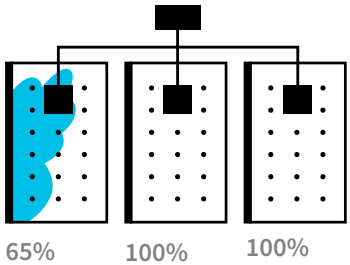
Shade cuts **ALL power** by 50%

Microinverters



Shade cuts power by 50% on **only one** panel

Power Optimizers



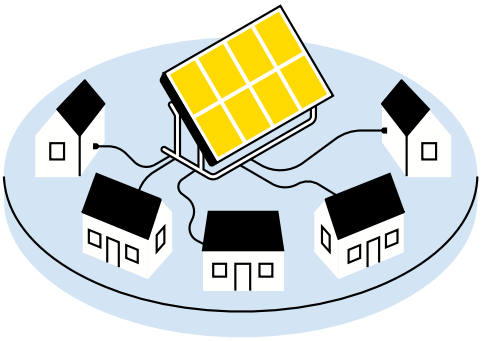
Shade cuts power by 35% on **only one** panel

SOLAR POWER

Green energy retailers:

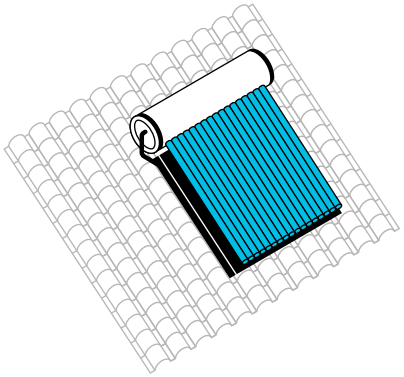
If you are a renter or otherwise not able to add solar panels to your roof, you can buy renewable electricity each month from a green energy retailer. The clean electricity that you pay for is added to the grid mix and you get credit for using that fraction of clean electricity while supporting the growth of renewables.

Community solar, solar farms, solar gardens:



These are large solar installations where community members can purchase some of the solar panels (ownership model) or commit to purchasing a fraction of the electricity generated by the installation (subscription model). Members then receive credits on their electricity bills for their share of the electricity generated by the system. It is a way for residents to invest in solar generation even when they cannot install systems where they live.

Solar hot water:



Solar hot water systems are more complex than solar PV and require backup hot water systems for cloudy days. Check out 'Water Heaters' section for more information on solar hot water.

BENEFITS

With solar panels, you can save on electricity costs. Most provinces and territories use net metering where the electricity generated is either used directly in the home or sent to the grid to earn credits toward your electricity bill.

Solar panels can add up to 3-4% to a home's sale price above those without. You can think of your solar system as an investment in your home's equity.

When solar panels are connected to batteries, they can power your home in the case of a power outage. This allows you to take advantage of both the electricity stored in the battery and the electricity generated by the solar panels. See 'Home Batteries and Backup Generators' section for more information.

Other than regular inspections, solar panels are a low-maintenance addition to your home.

CHALLENGES

- The upfront costs of solar systems are significant and, depending on local utility rates, the payback period can be quite long, especially for smaller systems. Ask about incentives and financing options that will improve the economics for you.
- Solar shingles have higher upfront costs than solar panels.
- Check with your local utility about the maximum inverter size for home batteries and solar installations that can be connected to the grid without paying for a grid impact assessment. The cap applies to the nameplate size of the solar system plus the batteries. The cap is 100 kW in most provinces, but in Ontario it is currently 10 kW.

SIZING ARRAYS

Sizing arrays will depend on your energy use, the space you have available, your electrical panel size, the amount of electricity you want to generate and your budget. To give a better idea of what it would take to go net-zero electricity or net-zero energy, here is what you would need to do:

1. Calculate your average annual electricity use in kWh from past bills.
2. Look for ways to reduce your total electricity use through more efficient equipment or changes to habits.
3. Using the PVWatts calculator, find out how much electricity you can generate with a 1 kW solar array on your home (4 kW is the default).
4. Divide your annual kWh of electricity use by the kWh/yr of generation in your location. This is the size of solar array needed to reach net zero.
5. Check your province's regulations for net metering to learn how the credits are calculated.

ADDITIONAL CONSIDERATIONS

- Expect to generate more electricity in summer and use these credits in winter, but avoid adding a large solar array that generates more electricity than you use in a year because utilities typically do not allow you to carry credits forward for more than a year.
- Solar panels will not provide power to a home during power outages unless they are connected to a battery and wired to safely produce backup power.
- Solar panels can last for decades. Ideally your roof should be made of long-lasting surfaces such as metal, or have been recently resurfaced. Removing solar panels and then reinstalling them to resurface a roof can be a major expense.
- Ideal roofs for solar panels are South, East or West facing, are unshaded, and have few gables, vents and other features.
- Solar panels have expected lifetimes of about 25 years, but in practice will continue to generate electricity for far longer. String inverters may have to be replaced sooner. There is also a market for older solar panels and growing options for recycling end-of-life panels.
- Connection fees and average time to connect solar panels to the grid can vary significantly by region.
- Sometimes permits for solar panels are denied due to grid constraints. Call your local utility to find out if your home is affected. If you are denied a permit, you may try again in a few years as the constraints may have been addressed.
- Electrical panel sizing can also limit the size of solar array that can be installed on your home. Your installer should assess the capacity of your electrical panel.
- Snow guards mounted on the roof can ensure that when the snow melts off the panels, the resulting avalanche is broken up, causing less damage when it hits the ground.
- Squirrels will sometimes build nests under solar panels and chew on the wires. Ask if this is a concern in your area and consider adding squirrel guards.

- You generally do not need to wash solar panels as rain and snow will do the work for you.
- Combining solar panels with batteries and/or an energy management system can maximize how much solar energy is used by your home. This can be important in areas such as Manitoba and Saskatchewan where grid electricity prices are higher than the credits earned for electricity sent to the grid. See 'Energy Management Systems' section on energy management for more information.

EXAMPLES OF QUESTIONS TO ASK AN INSTALLER

- ☐ How much experience do you have installing residential solar systems?
- ☐ Can you give me references for similar installs and show me the qualifications of the installers who will do the work? Do you have worker's compensation insurance?
- ☐ Do you check that my roof is structurally fit to support solar panels? Do you check if my electrical panel can support the proposed solar panels?
- ☐ What size system do you recommend? How much electricity do you expect it to generate per year?
- ☐ What is the total cost of the system, and the upfront deposit? What financing options do you offer?
- ☐ Will I be required to make any roofing or panel upgrades? If so, what would be the estimated cost?
- ☐ Will you be taking care of all permits?
- ☐ Are you aware of any incentives that I qualify for? Do you secure building permits for the installation?
- ☐ What will my net savings be? What utility rate assumptions are included in your calculations?
- ☐ If your province or territory has options for electricity rate structures, which rate structure provides the best savings?
- ☐ How long will the whole process take?
- ☐ Who deals with the utility and arranges for connections and inspections?
- ☐ How do you protect my roof surface during installation and ensure water cannot enter through the mountings?
- ☐ Where will you run the wires from the solar array to the electrical panel and how will you make these visually unobtrusive?
- ☐ What is the estimated cost to remove and reinstall the solar panels when my roof surface needs replacing?
- ☐ Can I add more panels later?
- ☐ Is the system configured so I can add a battery system later?
- ☐ What do the warranties cover and what are their durations? If the company fails, who should I contact about warranties and replacements?
- ☐ How can I monitor the performance of the system?

NOTE: It is always a good idea to get multiple quotes before selecting an installer.

Home electrification:

Amelie and Darren of Airdrie, Alberta dreamed of getting their home off the gas network.

It took professional air sealing, a ground-source heat pump pre-heater tank with an electric water tank, and a ground source heat pump (GSHP) with a vertical loop installed in their backyard.

As a bonus, they installed solar panels that should offset their annual electricity use.

The project achieved a 79% energy savings and was paid for with a renovation loan added to their mortgage, a Greener Homes Grant (GSHP) and a personal bank loan for the solar.

More details can be found at Green Communities Canada.

This section is part of the Canada's Home Electrification Toolkit. The Toolkit provides clear, concise, and up-to-date information on space heating, cooking, fireplaces, home batteries and backup options, and other household equipment. It also includes tips for renters, strategies for avoiding potentially costly electrical panel upgrades, and case studies from satisfied homeowners.

ADDITIONAL SECTIONS ARE AVAILABLE FOR DOWNLOAD BELOW:

Symbols and terms in this publication:

Upfront or operating cost (no incentives applied)

Symbol	Description
$	Up to $99
$$	$100-$999
$$$	$1,000-$9,999
$$$$	$10,000 and above

Implementation

Term	Description
Easy	Can be implemented by yourself if no electrical upgrade is required
Medium	Can be implemented by someone with DIY skills
Difficult	Generally requires a qualified electrician or other contractor

Emissions reduction potential (onsite emissions reductions using Canadian averages)

Term	Description
Low	1-9 kg CO2 per year
Medium	10-99 kg CO2 per year
High	100-999 kg CO2 per year
Very high	> 1,000 kg CO2 per year

When comparing electric to gas equipment on upfront costs, operating costs and emissions

Symbol	Description
=	Values differ by 10% or less
▽	Electric version is 10-50% lower
▼	Electric version is more than 50% lower
△	Electric version is 10-100% higher
▲	Electric version is more than 100% higher

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Visit buildingdecarbonization.ca/canadas-home-electrification-toolkit for digital downloads, updates, and other information about home electrification.

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