CITY OF Lethbridge

SOLAR PANELS AND ELECTRICITY COSTS

A comprehensive guide to understanding how solar panels can affect residential electricity costs within the City of Lethbridge

Introduction

City of Lethbridge Electric Design has developed a guide to help residents understand what to consider when thinking about adding solar panels to their home.

Calculating yearly power costs can be challenging because there are so many variables at play. Do you blast the air conditioner at home during summer heat waves? Do you crank the heat as soon as winter hits? Outside of your home power usage, your bill also depends on the dollar rate set by the Alberta Utilities Commission (AUC) to relay power from the province’s central generation to us here in Lethbridge.

As a distributor of power, the City of Lethbridge also charges a rate to get the power from the local substations to your home. This cost ensures we can monitor and safely maintain all of the electrical infrastructure within Lethbridge—so when you click the lights in your kitchen, they turn on!

Another layer of complexity is added when energy generation is included, like solar power.

Personal power usage habits, weather, rate cost changes, demand, sunlight hours—so many things can change day-to-day that will affect your monthly utility bill. It's important to be aware of all of these variables when discussing solar panel systems for your home, as some companies and consultants use promises of "guaranteed" savings to get you to sign on the dotted line. Truth is, it's almost impossible to know exactly what one month of power usage and cost might look like compared to the next.

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Calculating Your Yearly Power Costs

Your power bill is based on four factors:

1) How much energy do you use?
2) How fast do you use energy?
3) How much does that energy cost?
4) How much does it cost to get delivered?

How much energy do you use?

How much energy you use is the most important figure on your bill and almost all other line items are based on this value. The amount of energy used in your home depends on many things including what the outside temperature is, what type of appliances you use, how efficient your appliances are, how often you use them, and so on.

Each person and residence uses power differently, but your electrical meter is set up to measure how much total power your home has used over the month. This energy value is measured in kilowatt hours (kWh). A kilowatt hour is essentially the amount of energy consumed when something uses 1,000 watts of energy for one hour.

The amount of energy consumed can be found on the power bill provided by your retailer. This number is shown in kWh. To go through the yearly costs of electricity, the first thing you will need to do is find out how much power you used each month for a year. Let's say you look at your last year of billing and you find the values listed in this table.

This history shows that you use between 500 and 800 kWh each month and your yearly total was just over 8,000 kWh for the year. These numbers are not only important for billing purposes, but to figure out how much solar you can install, which will be discussed later.

Month	Energy used (kWh)
January	773
February	646
March	622
April	636
May	512
June	657
July	722
August	756
September	830
October	592
November	605
December	668
Year total →	**8,019 kWh**

How fast do you use energy?

How fast you use energy is called demand. Demand is measured in kilovolt-amperes (kVA) as a unit of power.

To better understand the difference between energy and demand, think of it like this:

> *Your neighbour has installed a new pool in their backyard and they need to fill it with water. There are many ways to fill the pool with water, but they're trying to decide between using a garden hose or calling the fire department and using a fire hydrant. One method (garden hose) is slow and inexpensive, while the other (fire hydrant) is fast and costly. The end result is the same—the pool is full of water—but how fast the water got there is quite different.*

Electricity is the same: the energy is equivalent to the amount of water and is just a sum at the end of the month, but the demand is how fast you bring the energy in. One person can use a small amount of power continuously for an entire month and use the same amount of energy that another would use by turning on a large appliance for a short period of time. This is the same as to using a garden hose instead of a fire hydrant. This value is important for the City of Lethbridge because the system has to be designed to accommodate your demand.

The City of Lethbridge has two residential electricity rates, 991 (typical consumption and demand) and 992 (higher consumption and demand).

991

- Consumption less than 800 kWh
- Uses a demand of 12 kVA or less for a majority of the year
- Demand is not a direct determinant into the cost of power

992

- Consumption greater than 800 kWh
- Uses a demand of 12 kVA or more for a majority of the year
- Demand value recorded by the meter is a direct determinant into the cost of power

Most homes in Lethbridge don't use 12 kVA in demand and fall under the 991 rate. For that reason, we won't factor in demand in our electricity costs in this example, but it may be necessary depending on the home.

How much does that energy cost?

Energy cost is the dollar amount per kWh agreed upon with your retailer when you signed up or entered a contract with them. This price can be a fixed amount, meaning it will not change over the life of the agreement, or it can be variable, meaning it will change monthly with the market rates. This is all based on consumer choice and offers from the retailer.

In the electricity market in Alberta, the energy is bought and sold in a regulated market similar to other goods. That energy needs to make it from where it is produced to where it is consumed. The cost to do that is called the delivery charge. Many groups or entities are involved in delivering energy and as a result the delivery charge is made up of many components.

How much does it cost to get delivered?

Transmission charges

A transmission charge is the cost to get the power from where it is generated across the province to the city. This is made up of a fixed charge and an energy charge and it’s typically represented as just a single transmission charge on your bill. This amount is set by the Alberta Utilities Commission along with the companies that provide the transmission facilities and can change throughout the year.

Distribution charges

A distribution charge is the cost for the City of Lethbridge Electrical Utility to bring the power from the substation through the city streets and to your home. This cost is also comprised of a fixed rate, an energy charge and demand charge. This rate is set by City Council along with Electric Utility.

The local access fee (LAF) is a fee charged by the City of Lethbridge. This fee is charged to use city lands to install electrical facilities to deliver power and is a percentage rate of the distribution charge.

Rate riders

The last portion of your bill, aside from the GST, is rate riders. These are costs to make up differences in forecasts from previous billing and is meant to clear up over or under billing on your account. These are charges set by the Alberta Utilities Commission and the City.

As you can see, there are several variables that factor into your power bill each month. These variables can change from month to month and make it difficult to forecast or draw comparisons.

Example 1.1 – Yearly power costs

To simplify this information, we've grouped each charge (delivery costs/charges, transmission charges, distribution charges, local access fees and rate riders) together and set it as a rate similar to energy cost as a price per kWh.

We've set the delivery charges at $0.137 per kWh which will give a close approximation of the actual billing. We've also used a fixed energy cost price throughout our calculations set at $0.125 per kWh.

If you want specific details about how these values are calculated, you can get in touch with City of Lethbridge Electric Design for further information by contacting 311.

When we calculate these values, we see the following results:

Month	Energy used (kWh)	Energy rate ($/kWh)	Energy cost ($)	Delivery charge ($/kWh)	Delivery cost ($)	Monthly cost ($)
January	773	0.125	96.63	0.137	105.90	202.53
February	646	0.125	80.75	0.137	88.50	169.25
March	622	0.125	77.75	0.137	85.21	162.96
April	636	0.125	79.50	0.137	87.13	166.63
May	512	0.125	64.00	0.137	70.14	134.14
June	657	0.125	82.13	0.137	90.01	172.13
July	722	0.125	90.25	0.137	98.91	189.16
August	756	0.125	94.50	0.137	103.57	198.07
September	830	0.125	103.75	0.137	113.71	217.46
October	592	0.125	74.00	0.137	81.10	155.10
November	605	0.125	75.63	0.137	82.89	158.51
December	668	0.125	83.50	0.137	91.52	175.02
Year total → 8,019 kWh → $2,100.98						

Using the monthly energy amounts with the cost of energy plus the cost of delivery, we find the yearly cost of power before solar equals $2,100.98.

Bi-Directional Metering and How It Works

Residential homes are generally set up to measure the amount of power the home uses and does not watch for energy moving in the reverse direction (i.e., excess energy sent back to the grid by solar). If there was solar production in the home and it was equipped with a uni-directional meter, this meter would only count the energy flowing into the house and miss the energy usage going out of the house.

If you had solar panels producing power and you were using a uni-directional meter, you would notice the expected energy usage on your bill is down, but you would receive none of the credit for making a surplus of power (solar energy generation). This is why the City of Lethbridge needs to install a bi-directional meter, so power moving in both directions can be measured.

Think of a bi-directional meter as a person counting with two hands.

If power moves towards the house, it counts on one hand. If power moves away from the house, it counts on the other. At the end of the month, you get two values: power received and power delivered. Power received is power the meter receives from the house, or excess solar production. Power delivered is power the utility supplies to the home when the solar is not producing enough to cover the energy the home is demanding.

Power received and power delivered are important factors in understanding how solar may affect your utility bill. The standard uni-directional residential power meter will only measure the energy flowing to the home and will ignore power moving out of the home. A bi-directional meter will measure both power flowing to the home and power flowing out of the home.

If the power used by the home matches the amount of power produced by the solar panels, a bi-directional meter will see neither power received nor delivered since the load and generation are balanced downstream of the meter. The only time a bi-directional meter would register power received is if the generation of the solar panels exceeds the power being used by the home.

Example 2.1 – Bi-directional metering

Let’s say a home uses 800 kWh of energy and has solar panels that produce 500 kWh of energy in one month. We also understand the home will use 60% of the monthly energy when it’s dark outside and the solar panels are not producing power. We also assume when the solar panels are producing, they can handle the energy needs of the home.

So, 60% of the energy used will show up in the energy delivered in the meter count, or 480 kWh. Because this is energy delivered, the customer will pay the energy price and the delivery costs for the power. What will the value of energy received be? Since 40% of the energy that the home uses is provided by the panels, you will see that same value reduced in energy received at the meter.

Let's calculate: 40% of 800 kWh is 320 kWh, which is the reduction you will see on the solar production. The energy received value on the meter will be 500 kWh minus 320 kWh, for a total of 180 kWh. The customer will only receive credit for the energy on this amount and cannot charge any delivery fees in reverse.

This is where the confusion for some customers comes in, as their solar panel system informs them that they produced 500 kWh in one month, but they're only getting credit for 180 kWh. This is because the home used the remainder of that energy before it was able to reach the meter.

It's difficult to anticipate how much of the home's energy will be supplied by the solar panels, and how much will need to be supplied by the utility when the sun isn't out. This all depends on what time of the day energy is used in the home the most. Do you throw your laundry on after work while you’re getting dinner ready? Or do you do that during the day? Each house is different—and this leads us to our next variable.

Nighttime energy use

Living in Canada means winter sunlight hours are drastically different than summer. Those long and dark mornings and early evenings make a huge impact on solar production. Unless you have a good understanding of how the power is used in your home, it can be difficult to anticipate the amount of energy used during nighttime hours.

In the example shown, our nighttime energy use in January is 90% of the energy in our home. This could make sense based on how short the sunlight hours are during that month and if the house is empty when the occupants are at work or school. During July, longer sunlight hours mean we could reduce the amount of energy used to 40%.

Note: This table is an estimation of the percentage of power a home might use at night when there is no solar production. It is provided for educational purposes only and cannot be used as example for your home. Actual percentages can only be determined by study.

Month	Nighttime energy use
January	90%
February	80%
March	70%
April	60%
May	50%
June	50%
July	40%
August	50%
September	65%
October	70%
November	80%
December	90%

Determining Your Home's Solar Output

Installing solar panels on your home falls under the provincial micro-generation guidelines for generation. These guidelines stipulate that you can't produce more energy than your home consumes over the year.

Solar companies and consultants can look over your past 24 months of billing to determine how much energy you used over that period. They will find which 12 consecutive months saw the largest total amount of energy used. From there, they can size the solar panel installation so the solar system does not produce more than 110% of that total from the most productive 12 consecutive months.

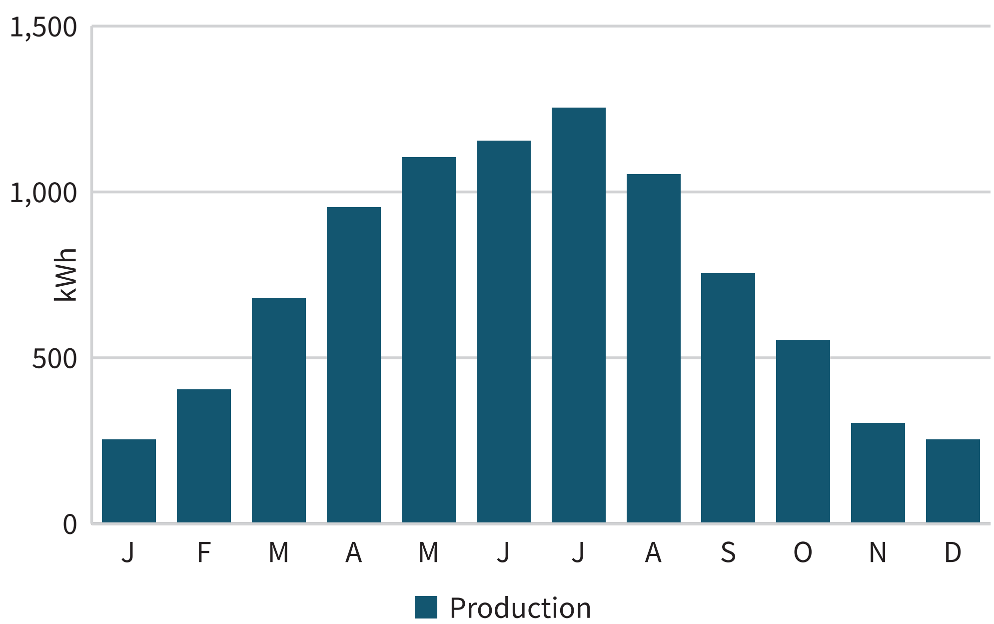
For a detailed example of this calculation, see our Solar System Sizing Guide.

Example 3.1 – Determining solar output

Earlier, we calculated that we used 8,019 kWh the previous year.

To size our solar installation, we will calculate 110% of 8,019 kWh to get our maximum of 8,821 kWh or 8.8 MWh (megawatt hours). The output of a solar production report from our solar consultant should not exceed that value. We use an additional 10% over the maximum to account for inaccuracies.

Here is an example report that shows the predicted generation amounts over 12 months. Remember, this is not the actual or guaranteed generation, but a calculated estimation based on many variables.



Month	Solar energy produced (kWh)
January	250
February	400
March	675
April	950
May	1100
June	1150
July	1250
August	1050
September	750
October	550
November	300
December	250
Year total →	**8,675 kWh**

The production totals 8,675 kWh or 8.7 MWh, meaning this installation is appropriately sized for this home. It's important to remember these are estimates which can change depending on many variables like dirty solar panels, cloudy weather, etc.

Estimating Your Power Bills With Solar Panels

When estimating potential power bills, we have to make a few assumptions for comparison:

1. The amount of energy used each month will be the same after the solar install as it was before
2. The energy price does not change the year before or after solar is installed
3. The delivery charges are maintained at the same rate through the time period
4. The time of the day the energy will be used

This is a tricky exercise and actual results can vary a lot from these estimates.

Example 4.1 – Estimating power bills after solar

First, we need to determine what our energy delivered and energy received values will be based on our estimation. Looking at January, the home uses 773 kWh, the panels produce 250 kWh, and the home uses 90% of the energy at night. The energy delivered value we expect to see at the meter would be 90% of the energy the home used, so [773 kWh x 0.9 = 696 kWh]. We expect the meter to show the home needed 696 kWh of energy from the utility. For the energy received, 10% of the home energy was provided by the solar panels during the day and the remainder went to the grid, so [250 kWh – (773 kWh x 0.1) = 173 kWh]. We expect the meter to tell us that 173 kWh of energy went to the grid.

For July, the home uses 722 kWh, the panels produce 1,250 kWh, and the home uses 40% of the energy at night. The energy delivered is [722 kWh x 0.4 = 289 kWh]. The energy received is [1,250 kWh – (722 kWh x 0.6) = 817 kWh].

When we calculate all months and put these into our chart we get the following:

Month	Energy used (kWh)	Solar energy produced (kWh)	Nighttime energy use	Energy delivered (kWh)	Energy received (kWh)
January	773	250	90%	696	173
February	646	400	80%	517	271
March	622	675	70%	435	488
April	636	950	60%	382	696
May	512	1100	50%	256	844
June	657	1150	50%	329	822
July	722	1250	40%	289	817
August	756	1050	50%	378	672
September	830	750	65%	540	460
October	592	550	70%	414	372
November	605	300	80%	484	179
December	668	250	90%	601	183

The next step is to calculate the costs for the energy delivered to the home.

January has 696 kWh delivered, so our charge would be [(696 kWh x $0.125) + (696 kWh x $0.137) = $182.27]. For July, the calculation would be [(289 kWh x $0.125) + (289 kWh x $0.137) = $75.67]. Next we find what our solar energy surplus credit would be. We take the energy received value and multiply it by the energy rate. January is [173 kWh x $0.125/kWh = $21.59]. July is [817 kWh x $0.125/kWh = $102.10].

Month	Energy delivered (kWh)	Energy received (kWh)	Energy rate ($/kWh)	Energy use cost ($)	Delivery charges ($/kWh)	Delivery cost ($)	Total energy used ($)	Energy produced credit ($)
January	696	173	0.125	86.96	0.137	95.31	182.27	21.59
February	517	271	0.125	64.60	0.137	70.80	135.40	33.85
March	435	488	0.125	54.43	0.137	59.65	114.07	61.05
April	382	696	0.125	47.70	0.137	52.28	99.98	86.95
May	256	844	0.125	32.00	0.137	35.07	67.07	105.50
June	329	822	0.125	41.06	0.137	45.00	86.07	102.69
July	289	817	0.125	36.10	0.137	39.57	75.67	102.10
August	378	672	0.125	47.25	0.137	51.79	99.04	84.00
September	540	460	0.125	67.44	0.137	73.91	141.35	57.44
October	414	372	0.125	51.80	0.137	56.77	108.57	46.55
November	484	179	0.125	60.50	0.137	66.31	126.81	22.38
December	601	183	0.125	75.15	0.137	82.36	157.51	22.90

When we combine the energy delivered costs and the solar production credits, we can find each month's bill total, with credits shown in parentheses.

The calculations show that we received a credit on our bill for three months of the year from our solar production. Our overall energy costs for the year comes out to $646.83, which indicates $1,454.14 in savings from the year before we had solar. To determine if the solar panels would save you money, you would need to factor in the yearly costs to install them.

The next questions we need to answer are:

- What happens if we use our power differently than what is shown?
- What if we don't use as much of our power at night as we had thought?
- What if we use much more power during the day while the panels are producing power?

Month	Total energy used ($)	Energy produced credit ($)	Monthly cost ($)
January	182.27	21.59	160.69
February	135.40	33.85	101.55
March	114.07	61.05	53.02
April	99.98	86.95	13.03
May	67.07	105.50	(38.43)
June	86.07	102.69	(16.62)
July	75.67	102.10	(26.43)
August	99.04	84.00	15.04
September	141.35	57.44	83.91
October	108.57	46.55	62.02
November	126.81	22.38	104.43
December	157.51	22.90	134.61
Year total → $646.83			

Example 4.2 – Estimating power bills after solar

If we change our values to simulate lesser nighttime use and greater daytime use, we get the following:

Month	Energy used (kWh)	Solar energy produced (kWh)	Nighttime energy use
January	773	250	60%
February	646	400	50%
March	622	675	40%
April	636	950	30%
May	512	1100	20%
June	657	1150	20%
July	722	1250	10%
August	756	1050	20%
September	830	750	35%
October	592	550	40%
November	605	300	50%
December	668	250	60%

When we carry out our new calculations, we get this:

Month	Energy used (kWh)	Solar energy produced (kWh)	Nighttime energy use	Energy delivered (kWh)	Energy received (kWh)
January	773	250	60%	464	0
February	646	400	50%	323	77
March	622	675	40%	249	302
April	636	950	30%	191	505
May	512	1100	20%	102	690
June	657	1150	20%	131	624
July	722	1250	10%	72	600
August	756	1050	20%	151	445
September	830	750	35%	291	211
October	592	550	40%	237	195
November	605	300	50%	303	0
December	668	250	60%	401	0

The energy received value shows zero when the entire solar production amount is used by the home. With these values, we can finish our calculations:

Month	Energy delivered (kWh)	Energy received (kWh)	Energy rate ($/kWh)	Energy use cost ($)	Delivery charges ($/kWh)	Delivery cost ($)	Total energy used ($)	Energy produced credit ($)
January	464	0	0.125	57.98	0.137	63.54	121.52	-
February	323	77	0.125	40.38	0.137	44.25	84.63	9.63
March	249	302	0.125	31.10	0.137	34.09	65.19	37.73
April	191	505	0.125	23.85	0.137	26.14	49.99	63.10
May	102	690	0.125	12.80	0.137	14.03	26.83	86.30
June	131	624	0.125	16.43	0.137	18.00	34.43	78.05
July	72	600	0.125	9.03	0.137	9.89	18.92	75.03
August	151	445	0.125	18.90	0.137	20.71	39.61	55.65
September	291	211	0.125	36.31	0.137	39.80	76.11	26.31
October	237	195	0.125	29.60	0.137	32.44	62.04	24.35
November	303	0	0.125	37.81	0.137	41.44	79.26	-
December	401	0	0.125	50.10	0.137	54.91	105.01	-

Month	Total energy used ($)	Energy produced credit ($)	Monthly cost ($)
January	121.52	-	121.52
February	84.63	9.63	75.00
March	65.19	37.73	27.46
April	49.99	63.10	(13.11)
May	26.83	86.30	(59.47)
June	34.43	78.05	(43.62)
July	18.92	75.03	(56.11)
August	39.61	55.65	(16.04)
September	76.11	26.31	49.80
October	62.04	24.35	37.69
November	79.26	-	79.26
December	105.01	-	105.01
Year total → $307.38			

This shows an additional $340 in savings compared to our first calculation. This also indicates that the way you use your energy makes a big difference in your bill.

If you're interested in learning more about the information we've outlined in this guide, you can get in touch with City of Lethbridge Electric Design by contacting our friendly and resourceful team at Lethbridge 311.