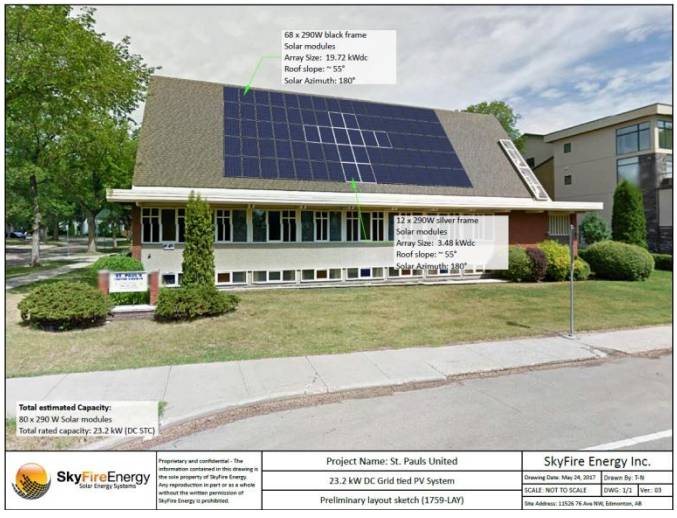
Intro

St. Paul's United Church is launching a project to pursue the installation of solar panels on the steep South facing slope of the sanctuary roof. With the introduction of funding programs and climate change policies at multiple levels of government there is a unique opportunity for action, and our church is very well suited to solar electricity generation.

We currently have 3 designs under consideration: an "open cross" design, a "silver cross" design (where the silver trim panels in cross shape are set within black trim panels) – both are pictured here – and the third is a straight rectangular array with no cross. We will be picking a design at the project launch on June 4, 2017



Check out the Frequently asked questions below to learn more about the project. Click the link on the right to donate. Feel free to contact us if you have questions or want to get involved.

"Solar St. Paul's": FAQs

Note: An excellent online resource for FAQs is hosted by the Solar Energy Society of Alberta (quoted below as Solar Alberta). Go to https://solaralberta.ca/content/faqs

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Specific St. Paul's Solar FAQs

1. Who can we contact for questions, more information, or to get involved in the Solar St. Paul's initiative?

The committee so far is Justin Wheler (Chair), Clare Irwin, Bob Miller, Chris Peet, Jocelyn Proby and Hami Razaghi. We also have a longer list of people who stay in the loop and volunteer occasionally, let us know if you want to be on the email list. Contact any of us or the main office!

2. Why would a church do this?

There are many potential reasons for a church or religious group to undertake this type of project, and many people in St. Paul's will have different views on why we should, or shouldn't do this. Environmental stewardship is theologically mandated in the Bible in Genesis. The care of creation is a distinctly human responsibility that is an inextricable part of the God-given meaning of human "dominion" over the earth. Outside Alberta churches "going solar" is gaining some momentum; for example Ontario's "Greening Sacred Spaces" initiative (http://greeningsacredspaces.net/) or the Anglican Church in England's "Shrinking the Footprint" initiative (http://www.churchcare.co.uk/shrinking-the-footprint/). Among Edmonton area United Churches to our knowledge only St. Albert has solar paneling

(http://www.stalbertunited.ca/solar-power-and-other-green-ideas/solar-power.html). (We might be wrong – if so let us know!).
The facts of global climate change due to human action are scientifically established. So are the correlations between environmental justice and social justice: the poor are disproportionately affected relative to the rich by environmental degradation. Energy use, particularly of non-renewable resources, has been and continues to be the key contributor to our carbon footprint and contemporary environmental crisis. We are called as Christians to take action and commanded to not bear false witness. A solar array that provides 100% of our electricity is one way of taking such action; its high visibility bears witness to our neighbours of the importance of our calling to be stewards of creation.

3. What is the project budget?

The budget depends on final design and contractor. The project budget is $63,000 to $70,000. Of that, $55,000 to $60,000 is the solar panel contract, including materials (solar panels, arrays, flashing & racking, electrical) and non-material (structural assessment, City of Edmonton Electrical, Building and Development Permits). There is an additional cost for hiring of a third-party independent evaluator, budgeted at ~$3000 and a contingency.

4. How much electricity does St. Paul's use? How much of this electricity could a solar paneled roof provide? How much would solar power save on energy bills?

St. Paul's uses around 28,600 kWh or 28.6 MWh per year. Up to 100% of this could be provided by solar panels. (78 panels are rated to provide 23 kW in full sun for one hour, which calculated over course of entire year would provide 28,350 kWh or approximately 100% of electricity. The 78 panels cover about 2/3 of roof. Covering entire roof would provide significantly more than 100%, which is not allowed – see below.) Here are the last 3 years of St. Paul's electricity use & costs to give an idea. (Very very roughly, $1500-2000 per year spent on electricity.)

St. Paul's electricity	Total kWh	Total $	Monthly Avg kWh	Monthly Avg $ /kWh	Monthly Avg $
2014	26,686	$2,052	2,224	$0.077	$171
2015	27,495	$1,553	2,291	$0.057	$129
2016	31,734	$1,356	2,645	$0.043	$113
Across All 3 yrs	*85,915*	*$4,962*	*7,160*	*$0.058*	*$413*
Average	**28,638**	**$1,654**	**2,387**	**$0.058**	**$138**

5. What is the cost of maintenance? Other than installation and maintenance, are there "hidden" costs (e.g. permit, license, inspections) involved?

The estimate suggested an annual maintenance cost of $150 in the first year, adjusted for inflation annually after that. There is also the cost of inverter replacement, inverters "will typically last 10-15 years before replacement". Itemized cost for inverters were not received and may change substantially over time.

6. Who will do the work? How were they chosen?

We have received quotes from two experienced contractors and are currently evaluating. A sub-committee of interested people will make a recommendation to the St. Paul's Solar Committee and then the official church board on contractor selection after reviewing the proposals and potential in person meetings.

7. What degree of electrical renovations would be required within the building?

The majority of the work will be on the roof. The inverters are placed under the panels on the roof and then wires are run to the main church panel and wire connection near the South East corner of the church, with some equipment to be installed on the interior wall alongside or above the main panel. No significant changes to the existing electrical system will be made or are required, minimizing cost.

8. Once installed, what maintenance is required?

Great Canadian Solar: "Solar photovoltaic systems have the advantage of needing little maintenance. There are situations where it may be appropriate to periodically remove the snow off the array, for instance on an accessible ground mount. However, for a roof top system the safety risk of clearing snow during winter may not make it worth the gain in kilowatt hours. If the array becomes particularly soiled by bird excrement or dust from long periods without precipitation, then the owner may consider it a worthwhile endeavor. Once the system is up & running maintenance consists of monitoring the system production & operation over the internet."

9. What is the frequency and cost for replacement of the array?

A decision would need to be made somewhere between the expiry of the 25 yr warranty on the panels and their projected 30-40 year lifespan. Cost would be at the future market price @ panel x number of panels. This assumes no damage to the support structure. Actual panel replacement is, ahem, a snap (like laminate).

10. Is there a risk to the roof due to installation? How do solar panels affect the longevity, e.g. of roof shingles?

On the one hand, this is what solar companies do, as many solar arrays are roof-mounted, so it is "built into" their contract that they should take care of any potential risk. That said, as with any purchase, buyer beware. This is why three experienced firms with excellent references were invited to bid on the project.

On the other hand, given the recent upgrades to the roof and the particulars of the insulation put into the roof, this is a good and serious and #1 priority question. The Solar St. Paul's committee will work with the property committee and the original roofing contractor to understand the impact, if any, on the roof warranty and mitigate any risk appropriately. The details of the updated roofing system were provided to the contractors and the mounting will ensure no compromise of the insulation (i.e. all load will be carried by the underlying structure). The proposals include provisions for structural engineering assessment of the roof to ensure structural integrity. In addition the committee plans to contract an independent 3rd party (e.g. engineer?) to oversee the work so as to ensure minimum risk. The city also requires inspection as part of the permitting process, coordinated by the contractors.

Solar paneling increases the longevity of roof shingles; the shingles receive extra protection from sun, wind, rain, snow and hail. If the roof is not fully solar paneled, the wear on the shingles would be uneven, but likely *all* shingles would need to be replaced at once determined by "unpaneled" longevity.

11. Can we sell electricity we produce back onto the grid? Is there a limit to how much roof space we could solar panel?

Yes, we can sell back to the grid. When production exceeds use (typically in the summer) this will happen; we will receive "credit" based on the net generation and price of electricity in a billing period. Practically, there is no limit, the entire roof could be covered. Legally however the limit to how much roof space is allowed, is determined by the "up to 100%" of electricity consumed. (A fully paneled St. Paul's roof would exceed annual consumption.) Solar Alberta: "Alberta's Micro-generation Act was designed to allow installations up to the size of the owner's annual consumption. In other words, net solar production at the end of a year should not exceed usage." The 100% limit was established so as to not overload existing infrastructure/system, distribution capacities. As long as the design is approved, there is no reason that in a sunny year with low usage the church could not be in a net credit position with respect to electricity use or payment. There will still be charges for distribution and administration though so it is very unlikely to be in an overall credit position for electricity bills.

12. In addition to covering electricity, could we also have "charging station" capacity (for charging solar batteries)?

Possibly. Unlike the electricity, there is not, or not yet, a clear existing need. Technology is upgrading as you read this and is becoming more available, more affordable, and more flexible, primarily by manufacturers building batteries with inverter settings to accommodate solar. Or, inverters can be installed that have battery-connection options.

13. Would microgeneration affect St. Paul's tax-exempt status?

Regarding tax-exempt status: a change in December 2008 to Section 292 of Bill 41 exempts taxation for microgeneration. Here is the rationale: "The amendments exclude micro generation from the definition of linear property. In this way, small green micro generation generating units are excluded from property assessment and taxation and will support the government's climate change strategy, which seeks to encourage advancements in small generation technologies." (If you want to read the Bill: http://www.assembly.ab.ca/net/index.aspx?p=bills_home)

14. Why not do energy efficiency first?

The St. Paul's property committee has completed a number of energy efficiency initiatives; we have successfully completed major roof upgrades including significant insulation improvements, installation of upgraded windows, and changeover of most of our lighting to LEDs. Of course there are more projects to do and the property committee continues to pursue them. We don't see the choice as an either/or, nor as a question of prioritizing in order of implementation. Let's do both! (Mother Nature is saying: do this yesterday!) Energy savings and cost recovery would begin immediately, as would greenhouse gas emission & carbon footprint reductions. In the longer term this becomes more evident as solar is a renewable energy unlike current electricity provision. There is some synergy politically at the present moment insofar as all three levels of government are explicitly supportive of renewable energy initiatives. Also, unlike most energy efficiency initiatives, solar panels have a high visibility that is public advocacy for energy sustainability and environmental awareness. In Biblical terms it's a bearing witness and one way of letting our light shine: "You are the light of the world--like a city on a hilltop that cannot be hidden." (Matthew 5: 16). For all these latter reasons going ahead with solar paneling ASAP seems right.

Finance FAQs

15. Is St. Paul's pursuing the solar paneling option at this time because it is our top priority? Will funding for a "Solar St. Paul's" take priority over other St. Paul's projects?

It is not our top priority. The church has a number of very important ongoing priorities and is very adept at keeping things moving on many fronts. This project is not meant to take priority over others and every effort will be made to not compete with other initiatives needing funding. It has been a long-term interest for a number of members and we have volunteered to 'step up' at this opportune time. The timing is entirely due to: political synergy just noted in previous answer; an informal general "go-ahead" given at an initial feed-back meeting; formal approval from the board to proceed with

forming a committee to undertake the project and commence fundraising; and a successful grant application - all in April 2017!

16. In addition to the Ecocity grant, are there other potential grants or sources of funding St. Paul's can apply for?

Yes. We are hoping for possible grants from all three levels of government (municipal, provincial, and federal) and will be on the lookout for these or any other programs or funding opportunities. The Alberta government just announced some incentives and it appears we qualify (for up to 25%).

> Do you know of any other sources? Let us know! We believe the remaining amount is well within our means to fundraise and a very worthwhile investment. It is rare to be able to make a charitable donation straight to a solar project and a number of people have already expressed interest for a variety of reasons. Stay tuned for exciting fundraising campaign announcements!

17. How can I donate? Will I get a tax receipt?

Yes, all donations will get a charitable giving tax receipt. You can donate to this project the same as any other donation to St. Paul's United Church (or any of our fundraising partnerships): Submit a cheque (to "St. Paul's United Church") or envelope in the offering plate, mail (11526 76 Ave NW, Edmonton, AB T6G 0K7), at the office, or donate online through our website (www.stpaulsunited.org - know that we lose a bit in PayPal fees) with "St. Paul's solar" or "solar sanctuary" in the memo. The value of the receipt depends on your income and other donations/deductions.

18. What should I donate to 'buy' one panel? How much clean electricity will my donation generate? Can I dedicate my donation?

Depending on the final design we will have 78-88 panels with an average cost per panel of about $800. If you would like to translate your donation into electricity generation you can assume that every $1000 donation will generate an average of about 410-475 kWh per year. Conversely, each kWh of annual average generation requires a donation of $2-2.45. Alberta Energy estimates that an "Average Alberta residence" consumes 600kWh/month or 7,200 kWh/year ($14,400-$17,640 to "go neutral"). Check your electricity bill for your usage.

We are still finalizing how to celebrate donations, especially those made in memorial, but we are planning some sort of permanent display in the friendship room including some educational information and a thank you for donations. Feel free to provide ideas! Attribution on the display will of course be optional.

General Solar FAQs

19. What are solar panels made of? How many types or varieties of solar panels are there? How much energy does a solar panel produce?

A solar panel is made up of a large number of smaller photovoltaic cells (that convert sunlight into DC electrical energy). The main material is silicon. There are a variety of solar panels out there, but the industry has also been standardized. Standard size is 65" x 39" for a home, larger for commercial. Standard energy produced is 265-365 W. (The St. Paul's estimate assumed panels producing 295 W. 78 panels x 295 W = 23 kW. In an hour of full sun this translates to approximately 23 kWh. Over the course of the year, accounting for average sunlight hours by season the average generation is expected to be 28,000 kWh (28 MWh) with the smallest design under consideration.)

20. Are solar panels dangerous, for example increased risk of fire?

No. (Well, no more dangerous than anything electrical!) An electrical issue can be power surges that damage the panel, or wiring or worse. One must ensure work is completed with qualified contractors, all permits and inspections are obtained and adequate insurance is purchased. This is a top priority, and luckily there are many experienced professionals in this field already. One of the contractors who bid on our project recently completed the panels on the Belgravia community hall one block south of the church, go have a look!

21. Do solar panels raise or lower property value? Raise or lower property taxes?

To confirm the answer to this, a City of Edmonton assessor would need to be consulted. The Government of Alberta made an amendment to bylaws some years ago so that an exemption to property value would be applied to encourage microgeneration initiatives like solar paneling. Anecdotal evidence is that the city of Edmonton is not currently assessing the value of these systems when considering property value, meaning it would not affect property taxes. There is a cost incurred for insurance premiums, however, as the panels must be insured. These costs vary depending on insurance provider. As a church, St. Paul's does not pay property taxes so this does not affect the church regardless.

22. What's the life of a solar panel? What is the degree of deterioration? What about hail?

Solar panels are typically warrantied for 25 years. Solar Alberta claims they last "30 to 40 or more years when installed properly and checked periodically". Solar providers calculate a yearly loss in % of efficiency due to wear (our estimate, following industry standard, put loss at 0.5% per year, meaning a 12.5% loss in efficiency over 25 years). Solar panels are designed using tempered glass with hail impact in mind and come

with a hail impact measure (size of hail in mm x wind speed in km/h). The steeper the panel angle the less direct the impact; our steep roof incline is a bonus in this respect.

23. Does adjusting the angle of the solar panels make a difference in terms of their energy production? If they can't be adjusted, is there an optimal angle?

Yes. One option is manual adjustment at particular changes of season. (Solar Alberta: "For summer production the ideal angle is latitude - 15°. For winter production set it at latitude +15°.") Manual adjustment is not a good option for roof mounted arrays. A second option is a tracker that adjusts the angle for maximum solar reception. Solar Alberta: "A Lakeland College Tracker study from 2013 compared two arrays: a stationary array and a dual-axis tracker. With the tracker, the annual output was 31% higher than the stationary array. The tracker also comes with an additional cost 30% higher than the stationary rack. It is also more vulnerable to break down since it has a number of moving parts."

The City of Edmonton with NAIT have done a study comparing optimal angles, as well as effect of snow cover: https://solaralberta.ca/content/alberta-solar-performance-data. Here are their optimal angles recorded by month:

May	18	August	27	November	90	February	53
June	18	September	53	December	90	March	53
July	18	October	53	January	90	April	45

The optimal angle for a stationary array is the latitude. Edmonton's latitude is 53°. St. Paul's south roof slope is approximately 55°.

24. Does a cloudy vs. sunny day make a difference? How much energy is lost if the panels are snow-covered?

Yes, more electricity is generated with direct sunlight. Electricity is still generated when cloudy, only not as much (a loss of 10-25%). Note if you have both – sunshine through a break in the clouds – it is possible to increase generation *beyond* a clear sky (panels are picking up direct sunlight *plus* light reflected off underside of clouds). Most relevant example: Germany is cloudy often but is #1 solar energy producer in world! Snow cover *can* reduce energy to zero but this is not automatic; more usually snow cover reduces efficiency by a small percentage. In the City/NAIT study the effect of snow cover was minor: "clearing your modules offers a gain of 0.85%-5.31% more energy depending on the module tilt angle". The steeper the tilt the more snow slides off. (55° is a relatively steep incline.)