Going Solar | A guide for students, teachers and communities to develop successful school-based solar projects

SOLAR SCHOOLS CANADA

Want climate action?
Make it happen.

Our Challenge to Youth.

In 2019, millions of youth in over 125 countries walked out of class to demand their governments to take greater action to reduce greenhouse gas (GHG) emissions and address climate change. Student walkouts highlighted the disconnect between growing public awareness of the urgent need for climate action, and the perceived failure by governments to adopt policies that will reduce global emissions.

In describing the movement, one student leader said: "*[The youth] need to make sure that people in power start taking action because we don't have time to wait until we can.*"

The student leader is right. Government action is required to curb GHG emissions on the scale and scope necessary to check the advancement of climate change.

But, youth are not powerless to act in the face of climate change and do not need to wait on decision-makers to make change happen. Youth are citizens of local, national and global communities and can act meaningfully to curb emissions and combat climate change.

For this reason, we celebrate youth who have called out government decision-makers for inadequate climate action and putting our planet at risk. But, we also challenge youth to go beyond one-day protests. We challenge youth to take direct action each and every day to reduce emissions, to demonstrate to political decision makers public commitment to climate action, and ultimately, to protect the planet that we call home.

Youth are change agents. Youth are powerful. Want meaningful climate action? Make it happen.

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ABOUT THIS DOCUMENT & TECHNICAL DISCLAIMER

Solar Schools Canada (SSC) is a Canadian registered charity that works with public schools to develop and fund school-based solar projects and related educational curricula. We've prepared this guide to assist students, teachers, administrators and other stakeholders to explore how to develop school-based solar projects. In creating this guide, we attempted to distil past experiences developing school-based solar projects to inform and inspire students, teachers, administrators and community members to develop school-based solar projects in their own communities. Although the guide contains technical subject-matter which we believe to be accurate as of the date of publication, SSC is not an engineering, renewable energy or architecture company and makes no representations or warranties regarding the accuracy of the technical statements in this document. Students, teachers, administrators and community members should ensure they obtain the appropriate technical advice at all stages of developing their school based solar project.

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I. SOLAR SCHOOLS & CLIMATE ACTION

Developing a solar project at your school represents one channel - among many - to take action to address climate change. We've prepared this guide to assist students, teachers, administrators and other stakeholders to explore how to develop school-based solar projects. We hope you find it useful.

II. WHY SOLAR SCHOOLS?

1. Solar schools create a unique combination of environmental, educational and economic benefits.

Thousands of schools around the world have embraced solar because of the unique combination of benefits resulting from pairing solar with schools.

Schools reduce their carbon footprint by generating more of their electricity from clean, renewable sources.

A 50 kilowatt (kW) solar panel system will prevent the release of nearly 570 tonnes of carbon dioxide equivalent emissions, equal to: removing 121 passenger vehicles from the road annually; avoiding burning 283 tonnes of coal; or, preserving 671 acres of forest annually.[1]

Teachers can use the solar panels to instruct students in STEAM, energy & sustainability subject-matter and curriculum outcomes. Students will develop the ability to:

"Demonstrate an understanding of what is meant by a renewable and non-renewable resource and the concept of sustainable development" (Provincial Learning Outcome, Geology 12)

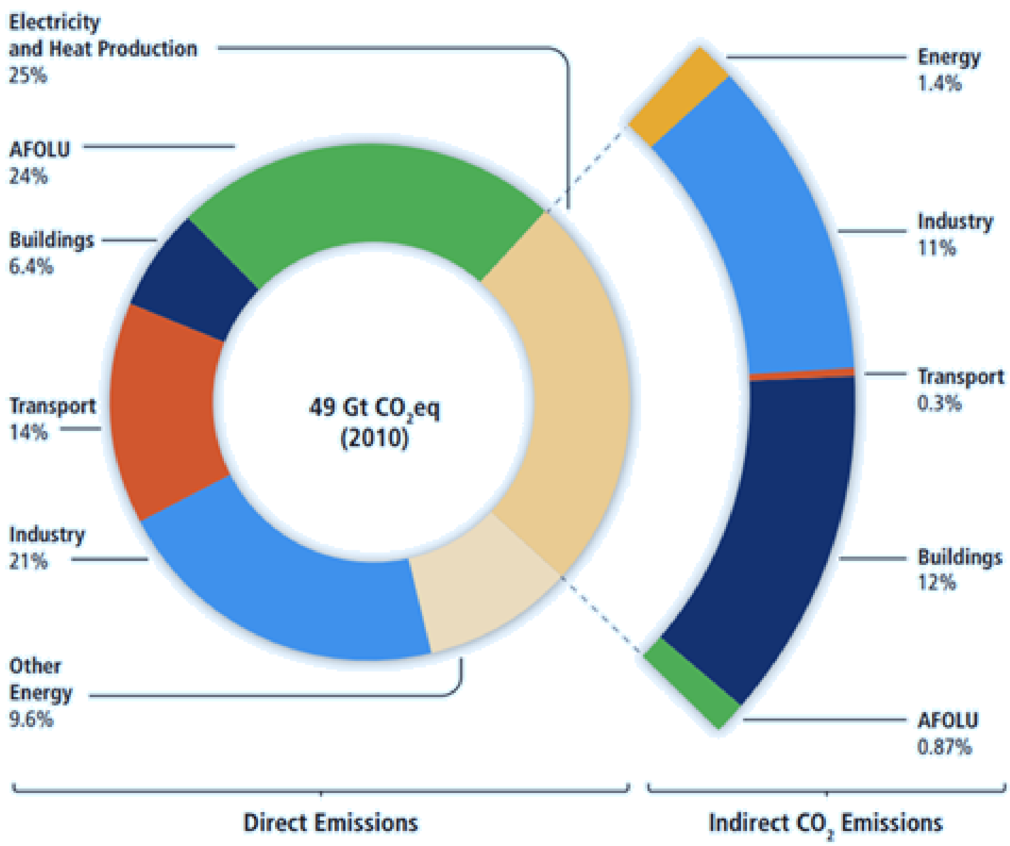
Schools can use solar panels to generate more electricity independently, reducing operating costs, re-investing savings in students, teachers and schools.

A 50 kW solar panel system will reduce school operating costs by nearly $90,000.00 over 25 years. If re-invested in education, that amount represents the salary of two Educational Program Assistants, providing over 2,500 hours of additional student assistance.

2. Solar schools address the primary cause of climate change: greenhouse gas emissions caused by fossil fuel combustion.

> "Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems." (IPCC, 2014) [2]

The science is clear: human activities are causing climate change and the resulting adverse impacts on natural and human systems. Specifically, the electricity and building sectors respectively contributed 25% and 12% to global emissions in 2010.[3]



Anthropogenic CO2e Emissions by Economic Sector 2010 (IPCC, 2014).

Developing a solar project in a location that generates its electricity from carbon intensive fossil fuels - such as coal, oil or natural gas - enables communities to decrease consumption of high-carbon, high-emissions electricity, replacing it with clean, renewable energy. In this way, solar projects address the primary cause of climate change: GHG emissions created by fossil fuel combustion in the electricity and building sectors.

In 2019, a 50 kW solar project developed in Nova Scotia, Canada, will prevent the release of approximately 571 tonnes of carbon dioxide equivalent emissions. This equals the volume of emissions prevented by:

Removing 121 average passenger vehicles from the roads for one year.

Avoiding burning over 283 tonnes of coal.

Avoiding consuming 212,000 litres of gasoline.

Recycling 200 tonnes of waste rather than sending that waste to a landfill.

Preserving 671 acres of forest for one year.

3. Solar schools & student-led climate action.

Students have shown they can play an instrumental role in climate action by leading efforts to develop school-based solar projects. Students not only address a defining contemporary challenge – climate change – they gain skills, experiences and a sense of individual empowerment that will last a lifetime.

Case Study │Sacajewea Middle School, Bozeman Montana

In Sacajewea Middle School in Bozeman, Montana, seventh-grade student Claire Vlases led a successful campaign to mobilize $115,000 in funding to purchase a 50 kW solar panel project for her school.[4]

Claire's idea to install solar panels on her school emerged during an independent student course, as a way "*to improve her school, her community, and the environment*."[5] Claire persisted with her idea, pitching it first to her school's principal and then to the school board, suggesting that solar panels should form an integral part of a renovation project the school was undergoing at the time.

Following Claire's pitch, the school board set aside sufficient funding to commission a feasibility assessment, which confirmed the school's structural ability to support a solar project. But, despite that confirmation, the school board could only commit to covering $25,000 of the project's estimated $115,000.00 cost.

Claire did not give up. With fellow students, teachers and community members, she launched a Solar Makes Sense campaign in her school and community. Over a two year period, their campaign raised the remaining $90,000 in funding through fundraising projects and grants.

Today, the solar panel project at Sacajewea Middle School in Bozeman, Montana, generates 25% of the school's electricity and saves the school approximately $8,000.00 in operating costs annually. Claire's example shows that with an idea and the commitment, dedication and strategy to see it through, students can play an extraordinary role in shaping their communities' responses to climate change.

Claire's advice to others pursuing this type of project?

> ***"Never give up. Even if it seems like a lot of hard work, it will pay off."***[6]

Photo Credit: Generation 180.

IV. MAKING IT HAPPEN: OVERVIEW OF KEY STEPS

The paragraphs below describe the key steps necessary to develop a successful school-based solar project.

1

Step 1: Understand whether my school is a suitable site for solar.

Before exploring the *How-to* of Solar Schools, it is important to understand whether your school is a suitable location for a larger-scale solar project. Factors that could affect whether your school is suitable for solar include:

- school age, layout and location;
- the emissions intensity of the energy mix in the specific school district; and
- the availability of more cost effective channels to improve energy efficiency or access renewable energy at the specific school.

To assist students, teachers, staff and community members in determining if their school may be a suitable site for solar, SSC is preparing a survey that will be published on our website in January 2020. We encourage you to review the factors set out in this survey before investing time and effort in pursuing a solar project for your school. The final determination of whether a school is a suitable site for solar should be completed by qualified professionals, such as a structural engineer, architect, or solar professional.

If you determine that your school is not a suitable candidate for a large scale solar project that does not mean that you and your school can't get involved in solar in other ways. You can acquire classroom solar kits, complete solar science experiments, integrate solar into your curriculum, or advocate for solar, sustainability and climate action in your community.

2

Step 2: Identify Solar Champion(s), Outreach & Education.

Pursuing a successful solar project at your school requires one or multiple solar champions, who may be students, teachers, staff, community members, or a combination of these contributors.

Solar champions’ roles will include:

- educating the school on the benefits and opportunities presented by solar (e.g. through informal discussions among students, teachers, parents and staff, or formal presentations delivered in classrooms, assemblies and student clubs);

- engaging with the school’s administration, facilities and operations representatives to introduce the project and explore the project’s technical feasibility; and

- exploring community interest in the project and identifying, understanding and responding to legitimate concerns.

The purpose of this outreach and education is to build grassroots support for developing a solar project at the school, while understanding and responding to legitimate concerns raised by the school and community.

Photo Credit: New Yorkers for Clean Power

3 Step 3: Energy Savings, System Size & System Costs Estimate

After solar champions confirm sufficient local interest for a school-based solar project, the next step involves completing a formal feasibility assessment.

This stage involves three primary steps:

- First, determine the energy-savings potential that the solar project can offer your school. This is accomplished by measuring the school's energy consumption and costs over a 1-3 year period through reviewing past utility bills.

- Second, use the energy-savings assessment to estimate the solar project size. There is no minimum size to a solar project: it can be as small as one panel. The maximum size will typically be no more than the school's peak load at any given time during the year. The maximum size will also be limited by the type and amount of space available at the school to accommodate a solar project.

- Third, use the size estimate to determine estimated project costs. It will be necessary to request multiple quotes from local solar installers to estimate solar project costs. However, you can obtain a rough estimate of project costs by multiplying the project size in kilowatts by the average installed cost of solar in Canada, which was approximately $2,800.00/ kW of installed capacity in 2019.[7]

Solar champions and their partners within the school and community should consider engaging an engineer, renewable energy professional or consultant at this stage to complete the technical aspects of the assessment. The table below explores the different racking options available for solar.

Standard Flush Mount

Description: Solar panels attach to sloped roof through rail and clamp mechanism.

Suitable for: South-facing pitched roof; medium load bearing capability; ground mounting not available

Example: Deer Lake First Nations Elementary School, NL. 152 kW.

Ballast System

Description: Solar panels attach to racking system bolted/ ballasted to flat roof

Suitable for: Flat roof; high load bearing capability; ground mounting not available

Examples: St. Elizabeth Catholic High School, Thornhill, ON. 185 kW.

Awning/ Façade Systems

Description: Solar panels attach to wall through rail and clamp mechanism/ awning-style racking

Best for: South-facing wall; roof/ ground mounting not available

Examples: [Maupeltuewey Kina'matno'kuom Membertou, Cape Breton, NS. 25 kW].

Single Axis Tracker

Description: Solar panels attach to array mounted to ground-based racking. Racking can be tilted on vertical axis according to the seasonal sun angle for maximum energy yield

Best for: Sites with large areas of unused space; no current or anticipated shading concerns; roof mounting not available

Examples: [DEGERenergie pole mounted racking system]

Dual Axis Trackers

Description: Solar panels attach to array mounted to pole fixed to concrete, gravity base. Racking can be tilted on horizontal and vertical axes to track the sun according to the daily seasonal sun angle for maximum energy yield

Best for: Sites with large expanses of unused space, no current or anticipated shading concerns, roof mounting not available

Example: [DEGERenergie pole mounted racking system]

Integrated System

Description: Solar panels integrated into building, bicycle rack, awning, or outdoor pavilion

Best for: All sites, especially sites where gound mounting not available

Examples: [Casey Middle School, Boulder, CO, USA.]

4

Step 4: Confirm the Project Regulatory Regime, Project Structure, and Project Funding or Financing Options.

After completing a formal feasibility assessment confirming the school's suitability for solar and an estimated project size and budget, the next step is to determine the project regulatory regime, structure and funding or financing options.

External consultants described under Step 2 are likely to provide recommendations on regulatory regime, project structure and financing options. However, solar champions and their partners should understand the concepts below to ensure they approach discussions with external consultants and other stakeholders with an informed perspective.

(a) *Project Regulatory Regime*

The regulatory regimes available to accommodate solar vary across each Canadian province. The paragraphs below explore three of the most common regulatory regimes.

- *Net Metering*. Enables customers who install solar to continue to draw electricity from the grid, reducing their electricity bills by an amount equivalent to the energy they produce and receiving credit for any excess energy they inject into the grid. Offered by most utilities in Canada. Net metering usually imposes maximum system size limits (100 kW).

- *Behind the Meter*. Enables customers to develop non-grid-connected solar installations for their individual consumption. Customers may continue to draw electricity from the grid if the solar installation does not produce sufficient electricity to meet the customers' electricity needs. Customers are usually prohibited from injecting excess electricity into the grid or receiving credit for excess electricity. Maximum size restrictions will be determined by customers' peak load.

- *Feed in Tariff/ Power Purchase Agreements*. Governments in some Canadian provinces will offer incentives to encourage the adoption of renewable energy through a combination of feed-in-tariffs and power purchase agreements. These programs enable customers or developers who install eligible renewable energy systems to sell the electricity generated by the system back to the grid for a set price. System size restrictions will vary by program.

Regulatory regime analysis should also consider local zoning, planning, environmental permitting and interconnection requirements applicable to the proposed project.

(b) ***Project Structure***

There are two primary means of structuring school-based solar projects in Canada:

- *School Ownership*. The school owns the solar project and owns all electricity generated by the project. The school is responsible for designing, building, installing, maintaining and operating the system and will usually rely on third party contractors to perform these tasks.

  Advantages:

  - ✓ The school will usually realize greater returns on capital under a direct ownership model, especially if relying on grants or other financial incentives to offset capital costs.

  - ✓ The school can hedge against increasing electricity costs by generating more of their electricity independently, reducing exposure to electricity price fluctuations.

  Disadvantages:

  - × The school will be responsible for funding or financing all project capital costs.

  - × The school will be subject to greater operational risk associated with project ownership and operation.

- *Third Party Ownership*. The school does not own the solar project. A third party renewable energy company owns the project and sells electricity generated by the project back to the school for a fixed, below market rate over a fixed term (e.g. twenty years). The third party is responsible for building, installing, maintaining and operating the system. The third party is usually responsible for funding or financing project capital costs.

  Advantages:

  - ✓ The third party will be responsible for funding or financing project capital costs, with little or no upfront capital investments by schools.

  - ✓ The third party will be subject to greater operational risk associated with project ownership and operation.

✓ The school can hedge against increasing electricity costs by generating more of their electricity independently, reducing exposure to electricity price fluctuations.

Disadvantages:

- ✗ The school does not realize any returns on capital, only reduced operating costs.

(c) *Project Funding*

If your school decides to develop its solar project under the school ownership model described above, the school will be responsible for funding or financing the project's capital costs.

Select examples of funding sources include school capital budgets, federal and provincial grants and incentives, and private donations from individuals, foundations or other grant-making bodies.

Select examples of financing sources include banks and other financial institutions.

Although the capital costs of solar power continues to fall, developing a successful solar school project can still require relying on a mix of different funding and financing strategies. For this reason, it's important for solar champions and their partners in the school to be fully engaged in discussions between external consultants and the school board or government department responsible for project funding. Allowing all project stakeholders a seat at the table ensures that all funding constraints and opportunities can be identified, understood, and acted on.

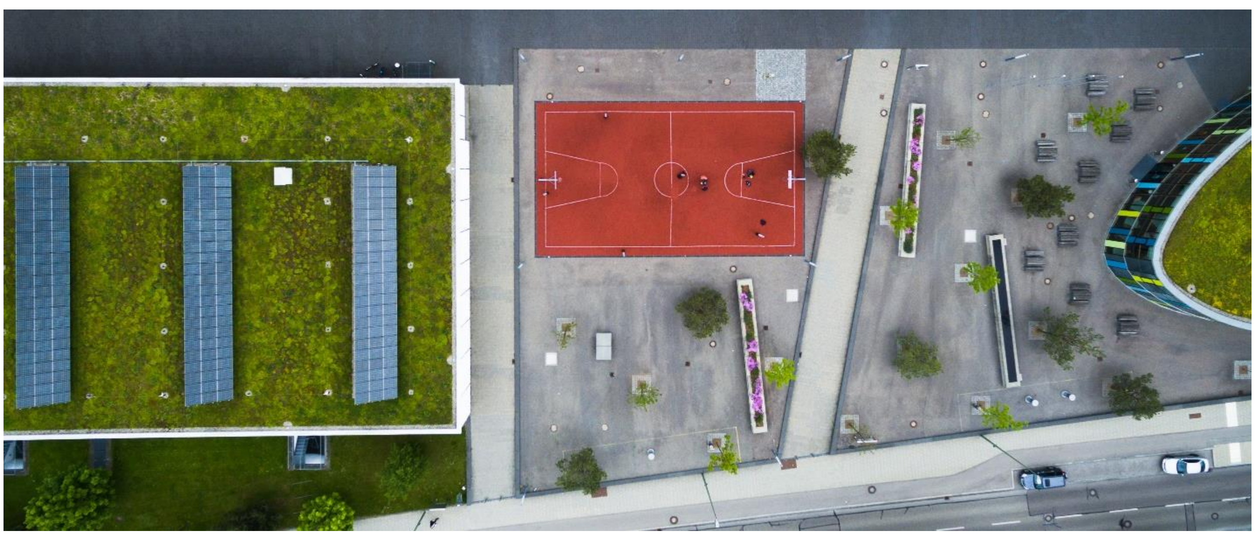


Photo Credit: Julian Wilder

5 Step 5: Prepare and Issue Request for Proposal

After completing the formal feasibility assessment covered in Step 3, confirming the project regulatory regime, structure and funding or financing options explored in Step 4, the next step will involve preparing a Request for Proposal (RFP) inviting renewable energy contractors to bid to design, build and install a solar project on your school.

The project RFP will usually be the responsibility of the school or school board's legal department, who must prepare and release the RFP in accordance with local procurement laws and standards.

Schedule "A" to this document contains a non-exhaustive list of provisions that schools should consider including in solar project RFP documents.

6 Step 6: Select the Successful Solar Contractor

After preparing and releasing the RFP, the school or school board is responsible for evaluating responses, and selecting and negotiating a contract with the preferred contractor. To evaluate bids objectively, the school should develop a framework setting out criteria, and corresponding weight attached to those criteria.

Schedule "B" to this document contains a non-exhaustive list of criteria that schools should consider when evaluating RFP responses.[8]

7 Step 7: Design, Install and Commission Solar Project

After the school or school board selects the proposal that best reflects the criteria in the evaluative framework, the successful contractor is responsible for designing, installing and commissioning the project.

Following the project's installation, the school or school board will be responsible for monitoring and maintaining the project under the direct ownership model. The school may delegate these responsibilities to the successful contractor responsible for installing the system or a third party engineer or consultant.

If the school develops the project under the third party ownership model, the successful contractor will be responsible for monitoring and maintaining the project.

8 Step 8: Engagement, Capacity Building and Education

(a) *Engagement & Capacity Building*

At all stages of the solar schools project lifecycle, solar champions and their partners should create opportunities to engage students, teachers, administrators and the community.

Students can play a leading role in:

- coordinating education and outreach activities to gauge public appetite for a school-based solar project and identify and respond to legitimate stakeholder concerns;
- commissioning a formal feasibility assessment of school capacity to accommodate a solar project; and
- contributing to discussions regarding the project structure, regulatory regime, financing and funding options, RFP processes.

(b) *Education*

Teachers can use school-based solar projects as a hands-on learning tool, leading students in exploring STEAM, energy, climate and sustainability subject matter.

Interested? Check out the library of P-6 lesson plans, activities and workshops created by Solar Schools Canada and Clean Nova Scotia coming to the SSC website in early 2020.

Oliver Rudkin. 10:10 UK

SCHEDULE "A" - SOLAR PROJECT RFP DOCUMENTS

KEY PROVISIONS

Scope of Work	The scope of work will be informed by the ownership structure chosen by the school. If the school decides to own the solar project directly, the scope of work will require the contractor to provide engineering, design, installation and commissioning services. If the school commissions a third party to own and operate the solar project, the scope of work will require the contractor to provide engineering, design, installation, commissioning, *operation*, *maintenance*, and *decommissioning* services.
Development Risk	RFP documents should require contractors to submit and adhere to a project schedule identifying milestones and expected completion dates. Milestone examples include: ● obtaining necessary permits; ● designing/ engineering system; ● purchasing equipment; ● installing system; ● interconnecting system; and ● final inspection & commissioning. RFP documents should make contractor payments contingent on the contractor fulfilling project milestones by defined deadlines.
Performance Risk	RFP documents should require contractors to provide an accurate estimate of system performance and to guarantee that the system once installed produces an amount of electricity equal to a defined percentage of estimated system performance. Financial compensation or penalties may be tied to system performance or underperformance.
Operational Risk	RFP documents should require the contractor to respond on a timely basis to any technical issues that arise after the system process.

Development/ Interconnection permits	RFP documents should require contractors to obtain all appropriate development and interconnection permits and agreements.
Operations & Maintenance	RFP documents should require the contractor to submit an operations and maintenance plan with an estimate of anticipated maintenance operations and costs spanning the project's lifecycle.
Team qualifications and Solar Project Experience	RFP documents should require the contractor to submit their qualifications to perform the job, including company profiles, list of licenses and industry qualifications, proof of insurance and solar project experience.

SCHEDULE “B” - RFP EVALUATION FRAMEWORK

Project experience.	What is the quality and quantity of the contractors’ knowledge, experience and expertise with solar projects of a similar size and type?
Regulatory knowledge.	Has the contractor successfully completed projects of a similar size and type in your school’s jurisdiction? Has the contractor confirmed its ability to comply with regulatory requirements, including zoning, electrical, interconnection, occupational health and safety, etc.?
***Technical specifications*.**	Has the contractor provided information about the quality of the project equipment (e.g., panels, inverters, monitors and balance of plant equipment), including manufacturer warranty, performance and replacement information.
Financial capacity.	Has the contractor confirmed financial capacity to meet any ongoing obligations under the project agreements, including ongoing maintenance or performance obligations?
***Financial returns*.**	Are the project cost and performance estimates consistent with the estimates produced by the project feasibility assessment under Step 2? If there is a difference, has the contractor provided a reasonable explanation explaining the discrepancy?
***Operations and maintenance plan*.**	If applicable, has the contractor provided a detailed and realistic operations and maintenance plan?
***Responsiveness*.**	Has the contractor responded to all requests included in the RFP? Are the contractor’s responses thorough, clear and consistent?

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[1] U.S. EPA, “Greenhouse Gas Equivalencies Calculator” (link).
[2] IPCC, 2014: “Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change” (IPCC, Geneva, Switzerland, 2014).
[3] IPCC, 2014, “Summary for Policymakers” in: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge University Press: Cambridge, United Kingdom and New York, NY, USA).
[4] The Solar Foundation (2017), Brighter Future: A Study on Solar in U.S. Schools”, pp 12, 13, online: www.thesolarfoundation.org/solar-schools. See also Generation 180, “Seventh grader switches her school to solar” (December 21, 2018), online: <https://blog.generation180.org/solar-makes-sense-at-sacajawea-school>.
[5] See note 4 above.
[6] See note 4 above.
[7] The $3,000.00 kW installed capacity is based on Nova Scotia data as of 2018. Wayne Groszko, Christie Chaplin-Saunders, Sarah Danielle Miller, “Prices and Productivity of Solar Electricity in Nova Scotia: 2017 Data (Solar Nova Scotia, 2018) (link).
[8] The evaluative criteria list is based on the criteria published in the following report: Generation 180, “Let’s Go Solar: A How-To Guide for Schools” (link).