



## Investigating Output from Solar Panels – Case Study

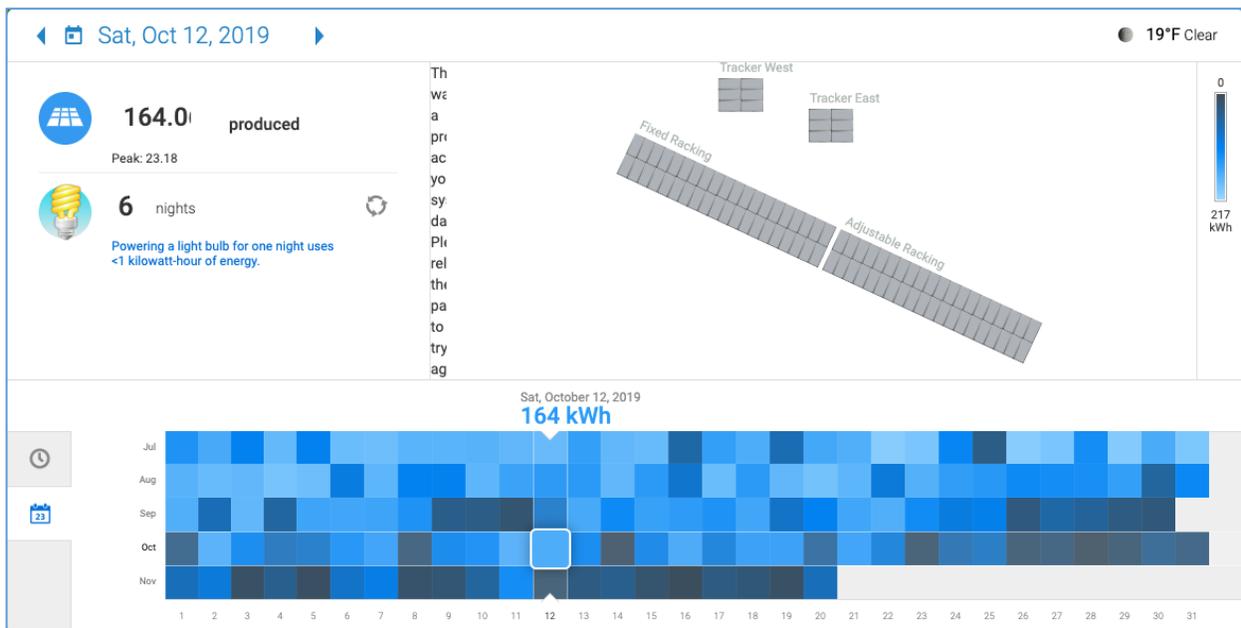
The City of Saskatoon has photovoltaic or PV solar panels (PV panels generate electricity) set up at the Landfill Gas Collection site. More information about the project, and live energy production from the site is here. [Solar Power Demonstration Site](#)

Read the demonstration project description and answer these questions:

- Where is it?
- Find the current power being generated by the panels.
- Look at the daily energy data graph. What is the largest amount of power produced on this day? What time did that occur? When is power not being produced by the panels? Why is that?
- In total, how many solar panels are at the site?
- What is the electricity generating capacity of the solar panel installation?
- What is the electricity used for?

### Further energy information and historic trending

This screen shot is from [Enphase](#), the company that tracks the energy production of the panels. It shows energy production from individual days - very dark squares in November are low production days, much lighter squares in July through October show higher production. In the screen shot the cursor was hovering over Oct 12 and it shows the actual kWh produced on that day (164kWh). Go to the link and hover over dark and light days to see the different energy production of each, then answer the questions on page 2.





- Find a low production day – how much energy did the panels produce? Why do you think the panels didn't produce much energy on this day?
- Find a higher production day – how much energy did the panels produce? Why do you think the panels produced more energy on this day?
- In the last year, which 3 months had the highest energy production? Why do you think those months have higher energy production? *Note: you can scroll up and down to see more months on the grid.*

### SES Solar Co-op Two Twenty Rooftop

The SES Solar Co-op tracks the [real time power production](#) of the PV solar panels on the roof of The Two Twenty office building on 20<sup>th</sup> St W. in Saskatoon. This information shows both the power output and the energy output of the panels. Look over the site and then answer these questions:

- How much energy have the panels produced this month?
- What is the highest amount of power produced today?
- What time did the panels start producing power today? *Think:* how that might be different at a different time of year? How would that affect energy production?
- Which day produced the most energy in the last week?
- The page lists 2 environmental benefits. What do they show?
- Why is reducing greenhouse gases (CO<sub>2e</sub>) important? *Think:* what are greenhouse gases contributing to?

#### What is the difference between power and energy?

##### Energy = Power x Time

**Power:** Each solar panel has a generating capacity – that is the maximum power the panel could produce under ideal conditions. When the sun shines on it, either directly, or from an angle, or through cloud cover, the panel will generate a portion of that capacity, depending on the strength of the sun's rays. Power is measured in Watts or kilowatts.

**Time:** Over the course of one day, the panels will generate electricity for as long as the sun is shining on them. So, if the sun comes up at 6am and goes down at 10pm, and shines throughout the day, the panels will generate energy over 14hours. On another day, if it rains all day, the panels won't generate much energy. Time is measured in hours.

**Energy:** This is the amount of power, multiplied by the amount of time that power is being generated. Energy is measured in watt hours, or kilowatt hours.

<b>Energy =</b>	<b>Power</b>	<b>x</b>	<b>Time</b>
<b>Energy =</b>	<b>Watts x (kW/1000W)</b>	<b>x</b>	<b>hours/day=kWh</b>

A kilowatt is 1000 Watts  
Watts(W), and kilowatts(kW) are a measure of power.  
Watt hours (Wh) and kilowatt hours(kWh) are a measure of energy.



## Curriculum Connections

**Grade 5 Mathematics P5.1** Represent, analyse, and apply patterns using mathematical language and notation. **SP5.1** Differentiate between first-hand and second-hand data. **SP5.3** Describe, compare, predict, and test the likelihood of outcomes in probability situations.

**Science WE5.2** Investigate local, national, and global weather conditions, including the role of air movement and solar energy transfer.

**Social Studies RW5.1** Explain the importance of sustainable management of the environment to Canada's future. **RW5.2** Hypothesize about economic changes that Canada may experience in the future.

**Grade 6 Mathematics P6.1** Extend understanding of patterns and relationships in tables of values and graphs. **SP6.1** Extend understanding of data analysis to include: line graphs, graphs of discrete data, data collection through questionnaires, experiments, databases, and electronic media, interpolation and extrapolation.

**Science EL6.1** Assess personal, societal, economic, and environmental impacts of electricity use in Saskatchewan and propose actions to reduce those impacts.

**Social Studies RW6.2** Contribute to initiating and guiding change in local and global communities regarding environmental, social, and economic sustainability.

**Grade 7 Mathematics P7.1** Demonstrate an understanding of the relationships between oral and written patterns, graphs and linear relations.

**Social Studies RW7.2** Investigate the influence of resources upon economic conditions of peoples in circumpolar and Pacific Rim countries. **RW7.3** Assess the ecological stewardship of economies of Canada and the circumpolar and Pacific Rim countries.

**Grade 8 Health Education USC8.6** Examine and assess the concept of sustainability from many perspectives, and develop an understanding of its implications for the well-being of self, others, and the environment.

**Mathematics P8.1** Demonstrate understanding of linear relations concretely, pictorially (including graphs), physically, and symbolically. **SP8.1** Analyze the modes of displaying data and the reasonableness of conclusions. **SP8.2** Demonstrate understanding of the probability of independent events concretely, pictorially, orally, and symbolically.

**Social Studies RW8.1** Analyze the social and environmental consequences of living in the Canadian mixed market economy based on consumerism. **RW8.3** Critique the approaches of Canada and Canadians to environmental stewardship and sustainability.

**Grade 9 Science CE9.3** Assess operating principles, costs, and efficiencies of devices that produce or use electrical energy. **CE9.4** Critique impacts of past, current, and possible future methods of small and large scale electrical energy production and distribution in Saskatchewan.

**Grade 10 SCI10-CD1** Assess the implications of human actions on the local and global climate and the sustainability of ecosystems.

**Environmental Science 20 ES20-AH1** Assess the impact of human activities on indoor and outdoor air quality and the need for regulations and mitigating technologies to minimize risks to human health.

**ES20-HP1** Investigate technologies and processes used for mitigating and managing resource use, waste generation and pollution associated with a growing human population.