

Baseload vs. Peak Demand

How do patterns of electricity consumption affect the electrical grid and how can those patterns be altered to minimize negative impact on the environment?



overview

LESSON CONTEXT

Canada's electricity consumption has two major components: baseload (constant, steady demand) and peak demand (surges in electricity consumption). Patterns of electricity demand affect what types of electricity generation are used (e.g. nuclear and hydro for baseload and natural gas for peak). By altering patterns of usage, there is less reliance on generation methods which have greater environmental impact.

LEARNING GOALS

- Understand basic concepts related to electricity generation and consumption.
- Gather and organize data using appropriate formats, including tables and graphs.
- Produce a plan of action to modify electrical energy consumption at home.

LEARNING ACTIVITIES

In this lesson, students will gather data on their classroom's and their home's electricity consumption to find patterns, then devise an action plan to flatten their family's electrical consumption curve and minimize their impact on peak demand.

BIG IDEAS

Altering patterns of electricity consumption can ease strains on the electrical grid and reduce the environmental impact of energy production.

assessment & evaluation

PRIOR KNOWLEDGE AND SKILLS

- Awareness of energy sources and their environmental impact, and familiarity with the costs and benefits of different types of electricity generation
- Experience charting data and making graphs

SUCCESS CRITERIA

- Students complete the home electrical consumption charts
- Students develop achievable action plans

ASSESSMENT STRATEGIES

- Review of completed student work: Home electricity consumption charts, graphs showing the student's home electrical consumption over the 24-hour period when data was collected and an action plan that proposes at least three behaviours which could be modified to shift home electricity consumption away from peak demand times.



time

75-90

MINUTES PLUS TIME
OUTSIDE OF CLASS



subjects

SCIENCE
PHYSICS




ENVIRONMENTAL SCIENCE



skills

CRITICAL THINKING
COMMUNICATION

resources & materials required

-   **BLM – Home Electricity Consumption Chart** – one per student
-   **BLM – Baseload vs. Peak Demand Rubric** – one per student
-   **BLM – How Electricity Generation Works Info Sheet** – one per student
-  Curriculum alignment

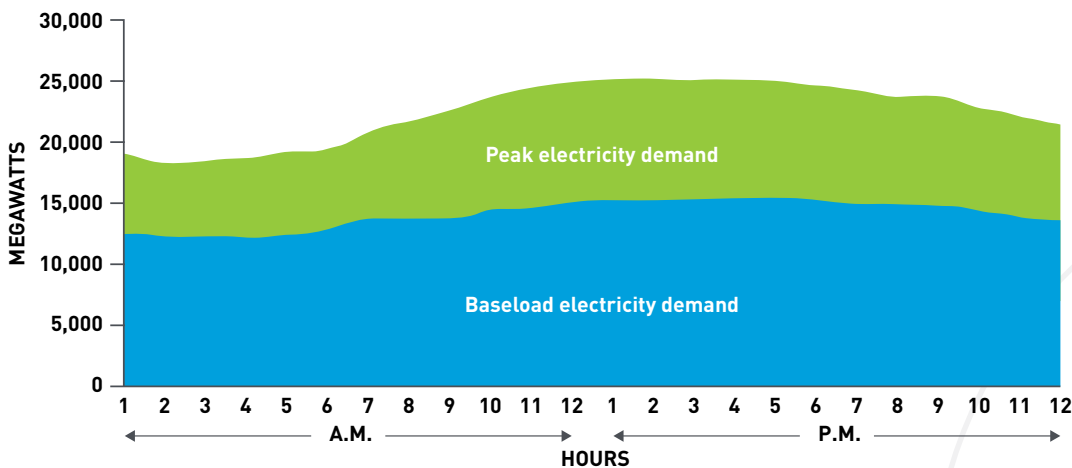
- Kill-A-Watt Power Monitor* (optional) – one per student
- LCD projector or interactive white board
- Electronic device with internet access

* See Background Information for sources.

minds-on

 15 MINUTES

- Using the internet and an LCD projector or interactive whiteboard, bring up the **How Electricity Generation Works Info Sheet BLM**.
- Have one or more students read aloud the text in the paragraph with the title “Baseload vs. Peak Demand”.
- Discuss the differences between baseload electricity demand and peak demand, particularly the different types of generators which supply baseload and peak demand, and the environmental impact of each type shown in the text.



action

 20 MINUTES PLUS TIME OUTSIDE OF CLASS

PART I – WHOLE CLASS

- Conduct an energy audit of the classroom for one class period. Begin by finding every electrical device in the classroom that draws electricity from the grid (not battery-powered devices, but including devices wired directly to the school's electrical system, such as overhead lighting, PA system, etc.). Determine each device's consumption in kilowatt-hours, either through examination of the device (many devices have placards on them which list power consumption and light bulbs are rated in terms of power consumption – i.e. a 60 W light bulb consumes 60 watt-hours of power if it is on continuously for one hour) or through research.
- Record which electrical devices are operating in the classroom and how many minutes each device was operating, including start and stop times. Students can determine how much power a device has used by multiplying its power rating by how long it was running: for instance, a 1000 W microwave oven that ran for 15 minutes would have consumed 250 watt-hours of electricity. Students will also have to make sure that devices which draw “phantom power” are included in data gathering (see **Did You Know?** at right).
- If you wish, students can graph the results to show how much power was consumed in the classroom and at which times, along with total electricity consumption (in watt-hours) for the class period.

PART II – INDIVIDUAL STUDENT ACTIVITY

- Provide each student with a copy of the **Home Electricity Consumption Chart BLM** and the **Baseload vs. Peak Demand Rubric BLM**. Students will be charting their home electricity consumption over a 24-hour period.
- This assignment is best completed on a weekend, preferably when at least one family member will be home for the entire time. Students will use the **Home Electricity Consumption Chart BLM** to keep track of which electrical devices in the home are turned on and off over a 24-hour period. It would be best to post the Home Electricity Consumption Chart in a common area, such as on the refrigerator, so that all family members can help to compile the data.
- As part of the investigation, students will:
 - » conduct an inventory of all electrical devices in the home that are plugged in (draw electricity from the electrical grid);
 - » determine which devices run constantly and calculate how much power they use (e.g. refrigerator);
 - » determine which devices run for short periods of time and calculate how much power they use (e.g. laptop, TV);
 - » determine which devices use phantom power and calculate how much power they use (e.g. DVD player);
 - » calculate the total household consumption for each hour of the day;
 - » calculate the average hourly consumption as well as the peak and lowest hours of consumption;
 - » convert the hourly data into a graph; and
 - » create an action plan that lists at least three ways that their families could shift some of their electrical consumption from the peak demand times to lower demand times.
- Review the assignment requirements and the rubric with the students.



DID YOU KNOW?

“Phantom power” (or standby power) is the electricity consumed by electrical appliances that are switched off. Many electronic devices, such as televisions and DVD players, consume 10-15 W to power remote control functions and digital clocks. AC power adapters also consume standby power.

IMPLEMENTATION OPTIONS

- Create an electronic spreadsheet for the students to input their data and post this on a class portal to supplement the paper data collection tool.
- The class electricity consumption could be recorded on other days to compare results, or results from different classes could be compared. An electricity audit of the entire school could also be conducted over one day or an entire week.
- An alternative to having students complete individual **Home Electricity Consumption Chart BLMs** is to have each student or the entire class devise an action plan to modify the classroom's electricity consumption pattern.

consolidation

 40-50 MINUTES

- Provide each student with the opportunity to present his/her consumption data to the class. Each student should discuss whether he/she considers the data collected as representative of a typical day in his/her home. If not, what was unusual about the day?
- Tally each student's peak consumption hour and lowest consumption hour. As a class, discuss what patterns were observed using questions such as:
 - » *Which hours showed the greatest consumption? Why do you think this was?*
 - » *Which hours showed the lowest consumption? Why do you think this was?*

IMPLEMENTATION OPTION

- Tally each student's hourly consumption to create a class graph for electricity consumption. Compare students' individual consumption graphs to the class graph. How similar are the consumption patterns?

extensions

- Time permitting, students could do independent research projects in which they explore and discuss different efforts to manage electricity consumption, such as smart meters. Information about smart meters can be found [here](#) (Retrieved Mar. 1, 2019).
- Students can compare their personal consumption patterns to their provincial consumption pattern. When does their home's peak load occur compared to that of the province as a whole?
- How would large-scale adoption of electric cars affect power consumption and peak load in their province? If 10% of cars were replaced with electric cars, what impact would that have on electrical consumption, gasoline consumption and greenhouse gas emissions?
- How have electrical consumption patterns changed over the past 30 years in their province? How might they change over the next 30 years?

additional resources

CANADIAN NUCLEAR ASSOCIATION WEB PAGES

- [Baseload supply](#)
- [Dependable resource](#)
- [Climate change](#)
- [Life-cycle emissions](#)

RELATED TEACHNUCLEAR LESSON PLANS

- [Costs & Benefits of Electricity Generation](#)
- [How Green is Canada's Electricity?](#)

VIDEOS

- [What is a Kilowatt Hour? – ONgov](#)

background information

[Retrieved August 2019]

- [Electricity: yesterday, today, and tomorrow – Canadian Electricity Association](#)
Learn about the history of electricity, what it looks like today, and how it may look in the future.
- [About Electricity – Natural Resources Canada, Government of Canada](#)
Information on electricity generation and consumption in Canada.
- [National Energy Use Database \(NEUD\) – Natural Resources Canada, Government of Canada](#)
Natural Resources Canada (NRCan) launched the National Energy Use Database (NEUD) initiative in 1991 to help the department improve its knowledge of energy consumption and energy efficiency at the end-use level in Canada. The NEUD's most important role is to secure the development of a reliable, Canada-wide information base on energy consumption for all energy-consuming sectors.
- [2018 Sustainable Electricity Annual Report: A Future Worth Investing In](#)
This annual report examines how the electricity sector is working towards more sustainable practices.
- [Canada's Energy Future 2013: Energy Supply and Demand Projections to 2035: An Energy Market Assessment – National Energy Board, Government of Canada](#)
This report examines energy market projections for Canada over a 23-year period.
- [Ministry of Energy, Government of Alberta](#)
Information on different energy sources and resource systems.
- [The Kill-A-Watt Electricity Monitor – The Home Depot](#)
A kilowatt electricity monitor measures electricity consumed by individual electrical devices. It can be purchased from The Home Depot or scientific supply stores. Many public libraries also have kilowatt electricity monitors available for borrowing.