Measuring Energy Saving Initiatives Reference Guide

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Overview

The EnergyWise@YVR program is designed to help you save energy and money in your business locations at YVR. This reference guide provides you with options for measuring the energy and cost savings results of your energy conservation initiatives. Energy and cost savings is often a good indicator of how successful your initiative has been and can help you build support for future energy conservation projects or campaigns. For ideas on other ways to energy saving initiative success, see the EnergyWise@YVR Toolkit.

Determine the Measurement Time Period

Determine the best time period to measure your initiative results. To assess the change associated with your initiative, the best practice is to measure three different time periods:

- Baseline: The time period before your initiative is considered the baseline. The longer you can collect baseline data the better (ideally a year), however this is normally not realistic. A minimum of a month is recommended.

- During the Campaign: This is the time your initiative is actively being implemented. Measuring data during this time allows for 'real-time' progress updates to your target audience and is needed to measure results at the end of the campaign.

- Persistence: This is the time period after your campaign. Measuring results after your campaign ends gives you a sense of how persistent the behaviour change or project results you achieved during your campaign is. A significant drop in savings may indicate the campaign needs to be run for longer or redesigned ensure potential savings are seen on an on-going basis.

Measurement Methods

You can determine energy and cost savings through monitoring utility bills, using direct measurement or calculating estimations. Below is a description of each type of measurement method.

Monitoring Utility Bills

Utility bills provide electrical usage in kWh and the associated cost based on your BC Hydro billing rate. Bills are provided for each BC Hydro meter or sub meter installed in your business locations. Bills can be significantly impacted by weather, occupancy and changes to building systems. Therefore only initiatives with estimated savings of at least 2% of overall electrical usage can be tracked using utility bills, without a statistical analysis.

*Note: Not all YVR tenants pay for electrical usage directly, some may pay a pre-determined proportion to the Airport Authority. In this case, calculating estimates or direct measurement will be the best way to measure your energy saving initiative.

Using Direct Measurement

There are a number of tools such as loggers and meters that can help you measure your energy savings initiative results. These tools are connected or attached directly (or close) to lights or equipment to provide exact energy usage for each individual light or piece of equipment. Depending on the size of your project, tracking every light or piece of equipment may be unrealistic. However, measuring a sample of your project area and using this to estimate savings across the entire project can be useful. Using measurement tools to directly track energy usage can allow you to measure your impact more accurately than utility bills.

Calculating Estimations

Estimations can be used to calculate electrical savings in terms of kWh and associated cost savings based on the number of devices, device energy usage, hours of usage and predicted change based on the project intervention. Estimations are often calculated at the beginning of a project to understand where in your business the best opportunities for energy savings projects are. They can also be used to estimate savings at the end of the campaign if direct measurement tools weren't available to measure campaign results or if savings are not showing up on utility bills.

Choosing a Method

The best measurement method for your energy saving initiative will depend on the estimated electrical savings of your project, what operational or building changes have happened in your locations within the last year, and availability of time and resources that can be dedicated to measurement.

Utility Bills

Utility bills provide electrical usage and cost by month. They are a reliable and consistent data source that doesn't require additional time from project or campaign coordinators to track or compile measurement data. As long as your business has been operating in the same location for at least a year, you will also have good baseline data.

Utility bills however represent electrical usage of your entire business location and can make it difficult to measure initiatives such as behaviour change campaigns or projects that are 'Low Cost' or 'Operational/no cost' opportunities. For these kinds of initiatives, Direct Measurement will most often be a better measurement method.

Direct Measurement

Using a logger or meter to directly measure electrical usage can give you the most accurate savings associated with your initiative. It does require time and resources to select, install and collect data from the tool in addition to comparing data to a baseline time period to calculate savings. Unlike with utility bills, baseline data is not already available, so you will need to collect it. Put your loggers or meters in place at least 1 month before your implement your campaign or project. If using direct measurement tools is not feasible for your energy saving initiative, you can use the Calculating Estimates method.

Calculating Estimations

Using the Energy consumption formulas found in the Applying the Method section of this guide, you can calculate electrical savings in kWh and costs. Using this method, you will also need to collect baseline data to calculate savings associated with your initiative. By observing and tracking how much a behaviour or procedure such as turning off lights is being done during your campaign in comparison to before the campaign, you can calculate estimated savings. This method is not as accurate as using Utility Bills or Direct Measurement, however it can estimate smaller energy saving impact initiatives that won't show up on a utility bill and is not as time intensive as the Direct Measurement method.

Applying the Method

Monitoring Utility Bills

Use the following approach to measure your energy savings initiatives using utility bills.

Electricity bills can be accessed through the My hydro web portal. If you don't already have access, contact the YVR Commercial Leasing department or the Climate and Environment Department through: environment@yvr.ca

You may see fluctuations in your electricity bill usage due to weather, occupancy or building system changes. See Figure 1 below where the 2020 electricity usage at YVR buildings drops significantly in April 2020, compared to 2019 due to COVID and resulting levels of lower occupancy at YVR.

Figure 1: Electricity Usage for YVR Buildings, 12 Month Comparison, 2018-2020-PUMA Report
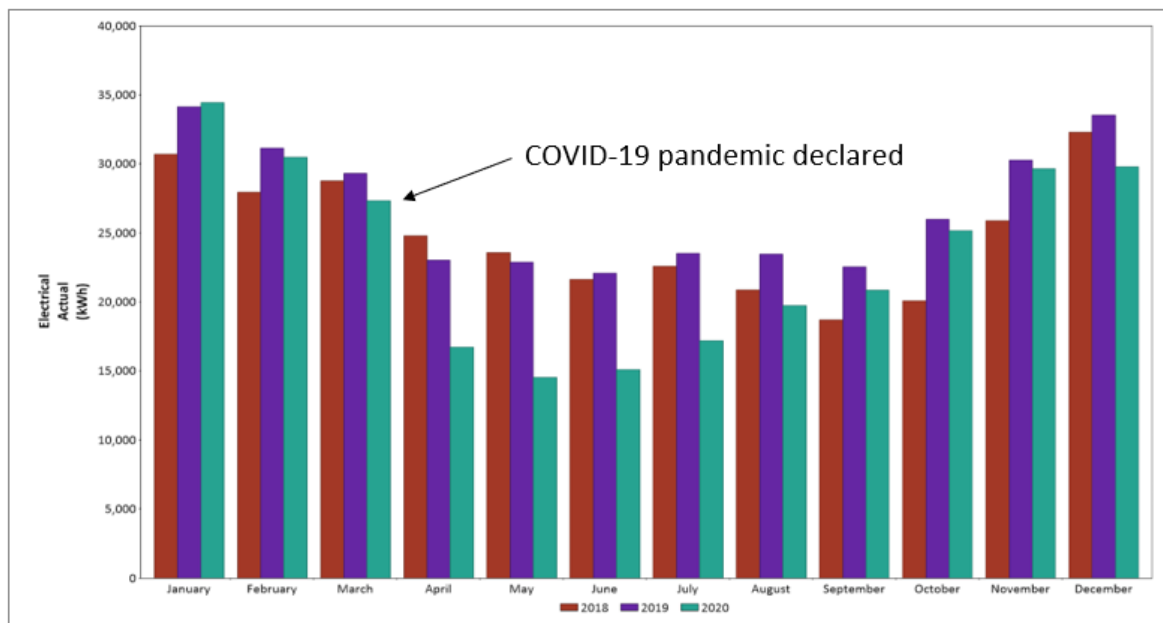
Given the drastic change COVID had on the volume of air travellers (occupancy) in 2020 and 2021, data from these years or months should not be used as comparisons. 2019 will be the most appropriate baseline year for electricity saving initiatives implemented in 2021 and 2022. For initiatives implemented beyond this time period, 2022 can be used as a baseline year.

Assuming no major changes in occupancy or building changes between baseline and project implementation years, comparing usage during the same month from the previous year will generally give you the most comparable time period. Figure 2 on the next page shows the Electricity Usage table provided in your BC Hydro bill with same time period last year comparison data.

Figure 2: BC Hydro Utility Bill - Electricity Usage Table
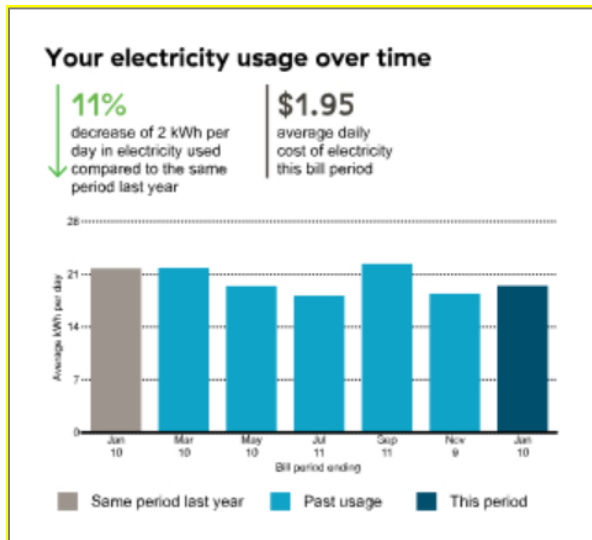
In Figure 3 below, electrical usage is shown for a Downtown Vancouver office building. In 2015, a number of energy management projects were implemented in the building. The graph shows electrical usage is lower every month in 2016 than it was in 2015. Given there were no major changes in occupancy or building systems, we can assume the drop in electrical usage is related to the implemented energy conservation projects.

Figure 3: Electricity Usage for Downtown Vancouver Office Building, 12 Month Comparison, 2014-2017-PUMA Report
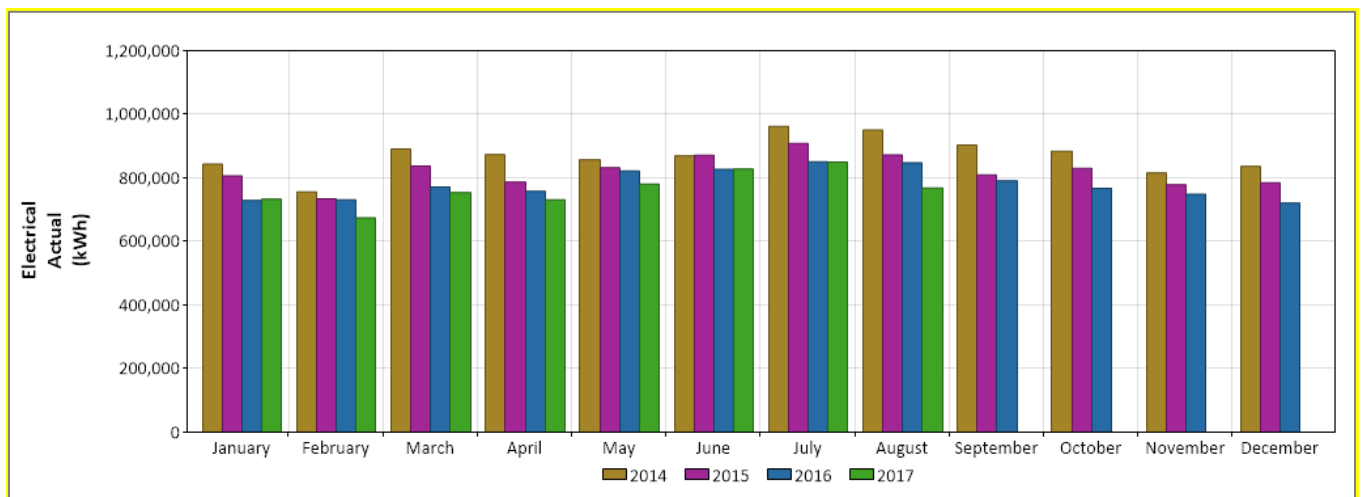
Using Direct Measurement

A number of factors need to be considered when using direct measurement to measure your energy saving initiative. This section guides you on how to select, install and measure results using this measurement method.

Select the Measurement Tool

Use the Measurement Tool Overview table on page 9 as a starting point for selecting the best kind of tool to measure results from your initiative. The table provides information on the kinds of initiative types that could be measured with each tool, what kind of data each type of tools can track and other considerations such as installation requirements and software needed to access the results. How to videos, user manuals and specification sheets are also provided. Note that the list of tools is not exhaustive and additional models and brands are available.

In selecting a tool to measure your initiative, it's best to have identified the behaviour focus of your campaign, how your targeted energy devices (such as computers) operate, where they are located and the limitations of the measurement tool you plan to use. For example, installing a Lighting Logger beside a light that is in close proximity to a window could cause the logger to mistakenly track the light being on during daytime hours.

Keep in mind that campaigns listed in the table below are provided based on which campaign types each tool could measure. Whether the measurement tool is appropriate or not will depend on the focus of your campaign.

You may need to use more than one measurement tool or energy savings calculation method to accurately measure your campaign impact.

Install + Test the Measurement Tool

After selecting your measurement time period, give yourself some time in advance of your baseline collection period for tool installation, testing and adjustments. Follow the steps below to ensure you are collecting data accurately and effectively throughout your measurement time period.

1. Determine who will install the measurement tool. Is it you, or does a maintenance staff member or someone else need to do it?

2. Review the instruction sheets for your chosen instrument or give them to whoever is installing the measurement tool. Links for these are found in the Other Considerations column of the Measurement Tool Overview table.

3. Get approval from the manager in your campaign area to install the measurement tools.

4. Inform groups such as housekeeping, maintenance and security about the initiative. If they don't know about it, they may remove your measurement tools.

5. Determine when results will be collected, who will do it and the amount of time required to do so.

6. Make sure you or the person who will be collecting the results has access to the software needed to download and read the data.

Measure the Results

Some tools, like the Kill-A-Watt plug load logger, provide cumulative kWh and cost savings directly from the tool. Others, like the Lighting Logger, track duration of time on/off and require downloading data into a spreadsheet, summarizing hours, assigning a power draw value (watts) to each light measured and applying kWh billing rates to determine kWh and cost savings.

For further support with measuring your energy conservation results, including how to access Direct Measurement tools, contact the Airport Authority Climate and Environment Department at: environment@yvr.ca

Measurement Tool Overview

Measurement Tool	Campaign-type	What is measured	Other Considerations
Lighting Logger (DENT TOUL-4G) ![Lighting Logger device]	· Lights Off	Measure the duration of time a light is on. Time-of-use and run-time data is collected.	· Professional installation not required · Up to 32,000 records are stored in internal memory. Data can be downloaded to a PC using SMARTware software and a USB communication cable · Not for use in cold environments such as a walk in freezer · Retrieving data requires a software download onto a PC · Not adjustable to various light levels · **How to video**: https://youtu.be/R-FGF3lkxUU · **Full specs & user manual:** https://34pcm21rj3lzgtrup1e2b7b1-wpengine.netdna-ssl.com/wp-content/uploads/2021/04/SMARTware_manual78dc.pdf
Motor Logger (DENT MAGlogger TOUM-4G) ![Motor Logger device]	· Turn if Off · Heating + Space Heaters (hood fans)	Measure the duration of time that a **motor** is on. Time-Of-Use + Run-Time.	· Professional installation not required · Adjustable to above 40 mGauss · Up to 32,000 records are stored in internal memory. Data can be downloaded to a PC using SMARTware software and a USB communication cable · **How to video**: https://youtu.be/R-FGF3lkxUU · **Full specs & user manual:** https://34pcm21rj3lzgtrup1e2b7b1-wpengine.netdna-

Measurement Tool	Campaign-type	What is measured	Other Considerations
			ssl.com/wp-content/uploads/2021/04/SMARTware_manual78dc.pdf
Plug Load Logger (Kill A Watt) 	· Turn it Off · Heating + Space Heaters (plugs)	Cumulative Kilowatt-Hour Monitor – allows you to track electric usage of devices when they are on as well as 'phantom loads'. Enter your utility rate to display projected operating costs for the given device by hour, day, week, month or year.	· Professional installation not required · Large LCD display · Displays Volts, Amps, Watts, Hz, VA · 0.2% Accuracy · Maximum Current Rating: 15 Amps · **How to video**: https://youtu.be/1l_mo1jwh8Y
Sub Meters (Permanent) 	· Turn it Off · Lights Off · Heating + Space Heaters	Provides load profiles (can see how much energy being used as specific times) and can be set to log data from once every second to once every 99 minutes.	· Requires electrical engineering to design and electrician to install. · Single or multi-point metering (single or 3-phase) · Same specs as temporary metering but can also be "revenue grade". · Can be set up to automatically upload data to network or cloud.

Measurement Tool	Campaign-type	What is measured	Other Considerations
Electrical Panel Meters (Temporary)	· Turn it Off · Lights Off · Heating + Space Heaters (plugs)	Provides load profiles (can see how much energy being used at specific times) and can be set to log data from once every second to once every 99 minutes.	· Requires installation by an electrician. · Single or 3-phase metering · Must connect PC to meter to download data · **Full specs and user manual:** http://www.powersight.com/FILES/MANUALS/PS2500-43Manual.pdf

Calculating Estimations

Use the following formulas for creating your own equipment energy savings calculations:

- **Energy Consumption Savings for Equipment**

  [[(Number of devices) X (Watts X Load Factor) X [(Hours on per day pre-campaign) – (Hours on per day at campaign end)] X (Operational days in a year)]] / (1000 conversion to kWh) = kWh savings/year

  e.g. Twenty 74W computers with a load factor of 14.24% that were previously left on continuously for 8 hours a day, 7 days a week were found to be turned off for 4 hours a day during your campaign. Therefore your calculation is:

  20 X (74*14.24%) X [8-4] X (365) = 308 kWh savings over the course of a year

          1000

- **Energy Consumption Savings for Lights (per light)**
  (Watts) X [(Hours on per day pre-campaign) – (Hours on per day at end of campaign)] X (Operational days in a year) / [1000 conversion to kWh] = kWh savings/year

  e.g. A 60W light that was previously left on continuously during operating hours (8 hours a day, 7 days a week) was found to be tuned off for 4 out of 8 hours a day during your campaign. Therefore your calculation is:

  [(60) X (8-4) X (365)] / 1000) = 87.6kWh savings for this particular light over the course of a year.

- **Cost Savings**

  To calculate the cost, multiply the kWh/year by the cost of kWh, based on your utility billing rate.

  (kWh savings/year) X (kWh billing rate) = $ savings/year

  e.g. In the same equipment scenario as above, where the billing rate is $0.11 per kWh, your calculation is:
  (308) X (0.11) = $34 cost savings annually for this group of twenty computers

  e.g. In the same lighting scenario as above, where the billing rate is $0.09 per kWh, your calculation is:
  (87.6kWh) X (0.09) = $7.88 cost savings annually for a single light.

If you are running an initiative focused on different types of office equipment or lights (different wattages) or that report differing hours equipment is turned off, you'll need to repeat this calculation for each device or light.

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Materials created for YVR by Prism Engineering