Conservation and Demand Management

Cost-Effectiveness Tool User Guide
Version 8

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1. Introduction

The Cost-Effectiveness Tool (the Tool) is an Excel Based tool intended to support Independent Electricity System Operator (IESO) staff, local distribution company (LDC) staff, and other external service providers or delivery agents to calculate resource savings, budget, and cost-effectiveness metrics for new and existing energy conservation programs in Ontario.

The Tool's structure, terminology, and analytic framework are based on a standard set of conservation program design and cost-effectiveness test concepts. These concepts are discussed in detail in the IESO Cost Effectiveness Test Guide and IESO EM&V Protocols Version 4,[1] which are available on the IESO website. It is recommended that users review the test guide prior to designing their conservation program and using the Tool. **This User Guide should be used with V8 of the Tool.**

1.1 How the Tool Supports the Conservation Program Life Cycle

The Tool is a mechanism to enable program modelling, estimate cost-effectiveness and support the full lifecycle of conservation programs (see Figure 1.1): program design, program tracking, and program evaluation. The Tool can be used to forecast, track and evaluate resource savings, GHG emissions reduction associated with savings, and cost-effectiveness test metrics using program-specific data, measure-specific data, and other relevant data (e.g., discount rate, transmission and distribution system losses, avoided cost, and ratepayer assumptions) need to be inputted into the model. Each step is discussed in more detail in the following sections.

Figure 1.1 | Conservation Program Life Cycle

1.1.1 Program Design (Before Implementation)

In this stage, the tool can be used to *forecast* resource savings, GHG emissions reduction and cost effectiveness test metrics. Before using the Tool for program design purposes, users need to develop a program concept and preliminary program design. This preliminary design should target a specific market and identify applicable measures and measure-specific assumptions for the following:

- Number of participants
- Incentive costs
- Net-to-gross ratios
- Program costs

All key program design elements are inputs to the Tool. All required fields need to be filled in for the tool to work appropriately. The tool prompts the user when all the fields are not completed.

1.1.2 Program Tracking (During Implementation)

During implementation, the tool can be used to calculate and *track* preliminary resource savings, GHG emissions reduction and cost effectiveness test metrics using actual and updated data. Before using the Tool for program assessment purposes, users need to prepopulate the Tool with the programs and measures the user wants to assess. The user must have participation data by measure, spending information by program, and any updates to initial program design concepts.

1.1.3 Program Evaluation (During / Post Implementation)

In this stage, the Tool can be used to *evaluate* resource savings, GHG emissions reductions and cost-effectiveness test metrics. Before using the Tool for program evaluation purposes, users need to verify measure-specific assumptions, the number of participants, actual incentive and program costs, and net-to-gross ratios.

1.2 Structure of User Guide

This rest of the User Guide is broken into three sections and three appendices:

- Section 1 introduces the modules that make up the Tool and discusses the Tool's features that assist users.
- Section 2 provides an overview of the Tool's architecture and a high-level description of each module's functionality.
- Section 3 contains step-by-step instructions on how to use the Tool, including the functions in each module.
- Appendix A Calculation Engine outlines the functionality within the Tool's Calculation Engine.
- Appendix B describes the specific text fields collected to define the Measure ID and Look Up Values.
- Appendix C shows how to import measures from older Tools, with visuals of the columns from an older Tool and the new Tool.

1.3 Tool Overview – Module Introduction

The Tool consists of four modules that provide different functionalities for the user.

- **Program Design** allows the user to select and create measures and specify program-level information to calculate cost-effectiveness metrics.
- **Results & Summaries** displays the cost-effectiveness metrics in varying levels of detail for the measures, programs, and sectors the user selected in program design.
- **Additional Capabilities** houses the repository worksheets that contain load profiles and incremental costs. This module allows users to create custom load profiles and define measure-level incremental costs and includes a supporting worksheet to integrate external cost-effectiveness results.
- **Admin Inputs** allows the Tool administrators to input consistent assumptions to ensure that all users are working with the same assumptions.

The **Program Design** module is the main location for user input. The Tool is prepopulated with standard IESO measures and program archetypes. A measure is one of the Tool's critical building blocks. Each measure is created and defined by multiple characteristics such as the program under which it is offered, end-use, technology type, and other related quantitative assumptions (e.g. savings, net-to-gross, incremental costs etc). Section 3.1 provides a list and detailed descriptions of each characteristic that make up a measure.

Users select existing measures or create new measures to build a portfolio of programs in the **Program Design** module, adding information such as program-level budgets. The **Calculation Engine** is then activated. The engine considers **Admin Inputs** (assumptions such as avoided costs), and the user views results in **Results & Summaries**. The diagram in Figure 1.2 illustrates this high-level process.
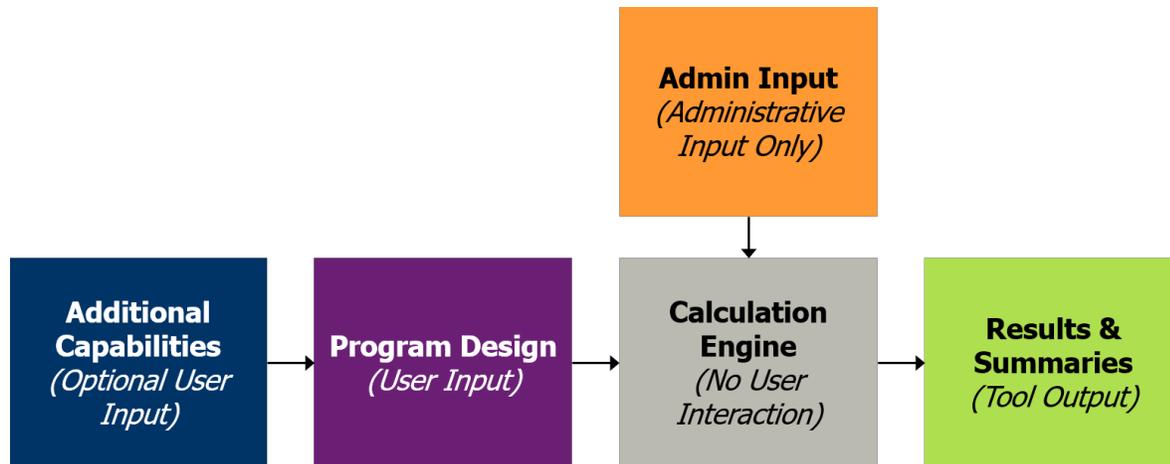

Figure 1.2 | High Level Tool Overview

1.4 Tool Features to Assist Users

The Tool has several features to assist users in navigating, understanding, and using the Tool. These features include internal hyperlinks, built-in instructions, and colour coding.

The first worksheet in the Tool is the Guide worksheet (illustrated in Figure 1.3). This worksheet lists each module and the worksheets within each module. Clicking on the module or worksheet name links the user directly to the appropriate location in the Tool.

Figure 1.3 | Guide Worksheet

Users will interact with instructions, descriptions, and tips found throughout the Tool. Each worksheet contains a high-level description of its purpose, functionality, and any instructions for using it. Tips are provided throughout the Tool in comment boxes.

The Tool is colour coded to assist the user with navigation and how to use each worksheet. The colour codes for text and cells are specified in Table 1.1 and are also found in the Guide worksheet.

Table 1.1 | Tool Legend

Code	Code Definition	Description
Blue Text	User input (mandatory)	These cells/columns provide the model with the parameters required to complete cost-effectiveness calculations. If these cells are not populated, the model will return an error.
Black Text	User input (optional)	These cells/columns provide the model with parameters that can be populated through a user input form (see Section 4.1.2). However, the user can update these cells/columns to manually override the information provided form the input form.
Black Text, Italics	Description or instructions	These cells contain information for the user to better understand the procedures or purpose associated with a particular worksheet.
Black Text	Calculated cell	These cells/columns contain formulas essential to the calculation of the Tool; in most cases, these cells are locked and cannot be modified by the user.
Black Text	Calculated columns	These cells/columns contain formulas essential to the calculation of the Tool; in most cases, these cells are locked and cannot be modified by the user.
Red Text	Caution	These instructions indicate a critical step or a common mistake that may result in an error in the Tool. Special care should be taken when encountering these instructions.

2. Architecture Overview

This section describes each module the user may interact with. Users do not interact with the Calculation Engine. However, it is described in Appendix A for informational purposes.

Figure 2.1 shows a map of the Tool's architecture and how each module interacts with the overall Tool.

- Each coloured shape represents a worksheet in the Tool.
- The dotted gray lines indicate the boundaries of each module.
- The arrows indicate how information flows between the modules.

The figure and the Tool itself are colour coded for easy navigation and reference. Users may need to interact with all modules in the Tool. However, specific use will depend on the type of user and assessment being performed.

Figure 2.1 | Cost Effectiveness Tool Architecture
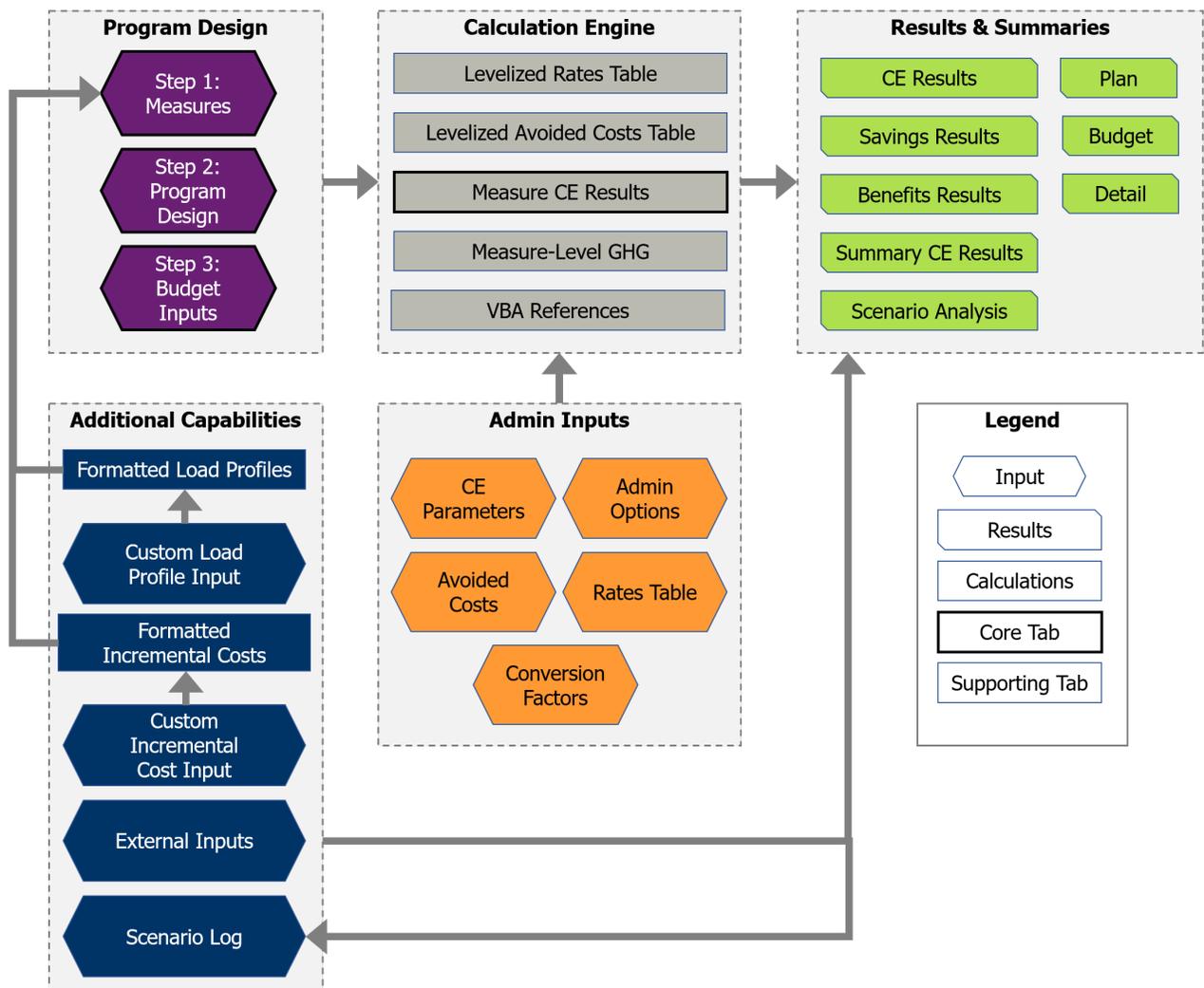
2.1 Program Design

The Program Design module contains three worksheets that outline the steps needed to design a program to assess for cost-effectiveness using the Tool.

Program Design
Step 1: Measures
Step 2: Program Design
Step 3: Budget Inputs

- The **Measures** worksheet is Step 1. It allows the user to review existing measures and create custom measures.
- The **Program Design** worksheet is Step 2. It contains a user interface to select the measures to assess for cost-effectiveness.
- The **Budget Inputs** worksheet is Step 3. It contains a dynamic user interface to input program budgets.
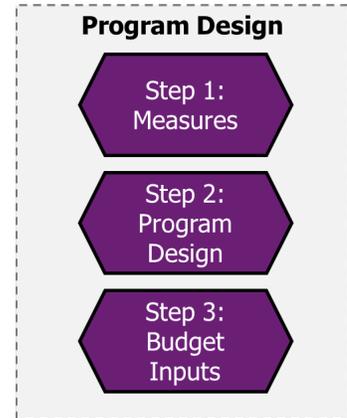
The Tool is initially populated with the measures from the IESO Measures and Assumptions List (MAL). A measure is defined more broadly than just the conservation technology. Table 2.1 describes each component that defines a measure in the Tool. Together, these components create a unique ID for each measure.

Table 2.1 | Components Defining a Measure (Look Up Value)

Measure Component	Component Description
Source	Include whether a measure is an IESO standard measure or a custom measure and whether the measure represents an individual technology or a project/aggregated metric
Sector	The marketplace sector in which the conservation technology will be implemented: Residential or Non-Residential
Program	The program that the conservation technology is mapped to and delivered through—e.g., Appliance Program, Heating & Cooling Program
End-Use	The high-level group of technologies—e.g., lighting, HVAC
Conservation Measure	A general description of the measure (the conservation technology offered/installed or the conservation action undertaken)
Measure Description	A concise description of the conservation technology or action that makes the measure easier to identify
Base Measure	The base technology used to determine the amount of savings that can be achieved by implementing the conservation measure
End Use Load Profile	The shape of the measure's annual electricity use in terms of eight season and time-of-use buckets, which should map to a load profile in the Formatted Load Profiles List (see Section 3.4 for more detail on the Formatted Load Profiles List worksheet)

Measure Component	Component Description
Dx or Tx Connected	A Dx/Tx flag specifying whether the conservation measure will be implemented by a customer connected to the distribution system (Dx) or the transmission system (Tx)

The **Measures** worksheet allows the user to review the existing measures and create any new measures not defined in the worksheet. Once measures are populated in this worksheet, they can be used in Step 2.

The **Program Design** worksheet allows the user to select any combination of measures found within the Measures worksheet to include in the program(s) that will be assessed for cost-effectiveness. At this stage, users input program design considerations such as the program year, participation, incentives, and any vendor performance pay. Once the measures are selected, the user can still modify these program design considerations and view cost-effectiveness results at the measure level.

The **Budget Inputs** worksheet dynamically populates the sectors, programs, and program years based on the measures selected by the user. The user can then input any program costs (i.e., not customer incentives) that are not incurred at the measure level—for example, marketing, evaluation, or overhead administration costs. The worksheet contains four cost categories:

- IESO Admin Costs
- Vendor Performance Pay
- Vendor Admin Costs
- Other Program Costs

> This worksheet will populate and allow users to input data for all sectors, programs, and program years regardless of whether a program is active in a given year. The user must ensure that budgets are input into the appropriate program year for each program.

Once the user completes the steps in this module, the information is passed to the Calculation Engine to calculate the cost-effectiveness metrics. Users can then view the results in the Results & Summaries module.

2.2 Results & Summaries

The Results & Summaries module contains eight worksheets that provide the cost-effectiveness results in varying levels of detail based on the inputs provided in the Program Design module.

- The **CE Results** worksheet provides detailed cost-effectiveness results by program and program year.
- The **Savings Results** worksheet breaks down the lifetime savings of the program(s) at the measure level.

Results & Summaries

CE Results	Plan
Savings Results	Budget
Benefits Results	Detail
Summary CE Results	
Scenario Analysis	
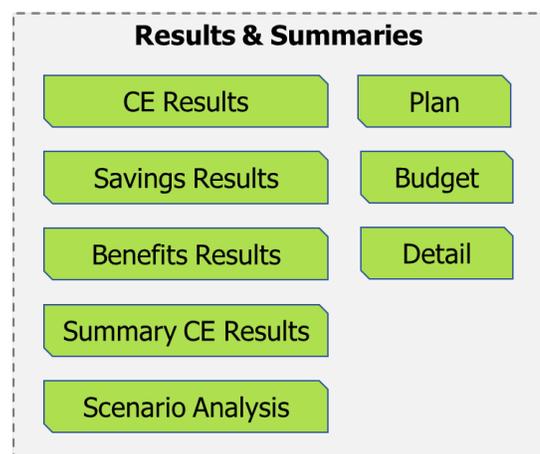
- The **Benefits Results** worksheet provides the lifetime benefits at the measure level.
- The **Summary CE Results** worksheet provides consolidated program/portfolio level cost-effectiveness results.
- The **Plan** worksheet provides summary tables with cost-effectiveness components and savings for the portfolio.
- The **Budget** worksheet provides a summary table with all cost components.
- The **Detail** worksheet provides summary tables with portfolio cost-effectiveness, persisting savings, and program-level cost details.
- The **Scenario Analysis** worksheet provides summary plots of cost-effectiveness, energy savings, and budget results for each scenario saved to the Scenario Log.

The **CE Results** worksheet breaks down the cost-effectiveness metrics— Total Resource Cost (TRC), Societal Cost (SC), Program Administrator Cost (PAC), Participant Cost (PC), Ratepayer Impact Measure (RIM), Levelized Cost (C)—for each program, sector, and program year. For each test, this worksheet provides:

- Benefits
- Costs
- Net benefits
- Net benefit ratio

The programs, sectors, and program years displayed will reflect those selected by the user in the Program Design module and the outputs from the external cost-effectiveness tools.

The **Savings Results** worksheet provides the total measure-level savings over the lifetime of the conservation measure. This worksheet populates after results are calculated on the CE Results worksheet. The savings begin in the program year specified by the user and stop at the end of the measure's effective useful life (EUL).The Tool accounts for any early retirement step down scenarios. The savings are displayed as net and gross annual peak demand and energy savings. The worksheet provides the savings for both the end user level and generator level (i.e., including transmission and distribution losses).

The **Benefits Results** worksheet provides the total measure-level benefits over the lifetime of the conservation measure. This worksheet populates after results are calculated on the CE Results worksheet. The benefits begin in the program year specified by the user and stop at the end of the measure's effective useful life (EUL); the Tool accounts for any early retirement step down scenarios. The benefits are displayed as net peak demand and energy savings from a Total Resource Cost (TRC) and Program Administrator Cost (PAC) perspectives.

The **Summary CE Results** worksheet provides a snapshot of the cost-effectiveness metrics, including the TRC ratio, the PAC ratio, and the LC metric. In this worksheet, only the net benefit ratio and the LC ($/MW-year and $/MWh) metrics are displayed.

The **Plan** worksheet provides three tables:

- Table 1 populates automatically and summarises the costs and benefits for the TRC, PAC, and LC by program year and for the total portfolio (all years).
- Table 2 populates automatically and summarises the persisting net peak demand and energy savings in the final framework year (specified on the **CE Parameters** worksheet).

- Table 3 populates the annual budget and energy savings for each program and an aggregate view including all program years when the user clicks the *Populate Program Rollout Schedule* button.

The **Budget** worksheet populates when the user clicks the *Update Budget Result* button. The table summarises program and incentive costs by program and program year. This worksheet combines measure- and program-level costs. The budget is broken down into four components:
- Incentives (Program Design worksheet)
- Program Admin (Budget Input worksheet)
- Vendor Performance Pay (Energy) (Program Design worksheet)
- Vendor Performance Pay (Peak Demand) (Program Design worksheet)

The **Detail** worksheet provides three tables:

- Table 5 populates automatically and summarises the costs and benefits for the TRC, PAC, and levelized costs at the portfolio-level for each program year.
- Table 6 populates automatically and summarises the persisting peak demand and energy savings for each program year.
- Table 7 populates the incentive, admin, and incremental costs for each program when the user clicks the *Generate Summary of Conservation and Demand Management (CDM) Portfolio Costs* button.

2.3 Admin Inputs Module

The Admin Inputs module contains five worksheets. Only administrative users will have access to and will be able to modify these worksheets.

- The **Admin Options** worksheet allows Tool administrators to set peak demand definitions.
- The **CE Parameters** worksheet allows the Tool administrators to set standard assumptions within the Tool.
- The **Avoided Cost Table** worksheet contains the avoided cost assumptions.
- The **Rates Table** worksheet contains the ratepayer assumptions.
- The **Conversion Factors** worksheet contains assumptions associated with GHG calculations.
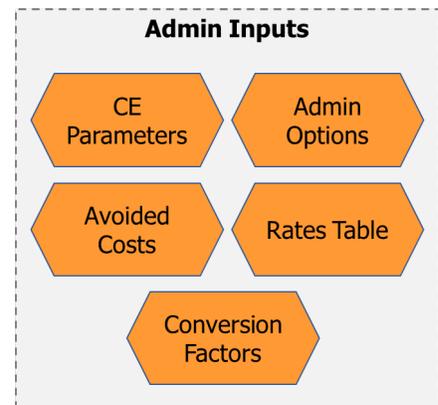
The **Admin Options** worksheet allows Tool administrators to set the definition of peak demand in the Tool to either summer peak or winter peak. The peak demand definition determines the proper savings used in the cost-effectiveness analysis. There is also an option for the administrator to specify the screen resolution that will be compatible with the Tool.

The **CE Parameters** worksheet allows Tool administrators to set the standard assumptions used to calculate cost-effectiveness results in the Tool, including:
- Discount rate
- Societal discount rate

- Inflation rate
- Base year
- Final framework year
- Transmission system losses
- Distribution system losses
- Non-energy benefits adder

All standard assumptions are used to calculate the lifetime benefits and costs for each measure, program, and sector. The discount rate, societal discount rate, inflation rate, and base year are used to calculate the results of the Tool in real dollars of the specified base year. The transmission and distribution losses are used to determine the proper savings for the cost-effectiveness analysis.

The **Avoided Cost Table** and **Rates Table** worksheets are used to calculate certain costs and benefits. Tool administrators input these assumptions to ensure that conservation measures are consistently valued.

The **Conversion Factors** worksheet contains the assumptions used for the greenhouse gas (GHG) emissions calculations.

2.4 Additional Capabilities

The Additional Capabilities module consists of six worksheets. The worksheets within this module are only used in limited circumstances.

- The **Formatted Load Profile List** worksheet is a repository that contains a critical component of the cost-effectiveness calculations.
- The **Custom Load Profile Input** worksheet contains a user interface to add custom load profiles to the Formatted Load Profile List worksheet.
- The **Formatted Incremental Costs** worksheet is a repository that contains user-specified incremental costs for certain measures. These incremental costs override the incremental costs that are specified on the Measures worksheet.
- The **Custom Incremental Cost Input** worksheet contains a user interface to add measure level incremental costs to the Formatted Incremental Costs worksheet.
- The **External Inputs** worksheet allows users to add cost-effectiveness data from other tools.
- The **Scenario Log** worksheet stores cost effectiveness, savings, and budget results for runs of the CE Tool that are saved by the user.

Additional Capabilities

Formatted Load Profiles

Custom Load Profile Input

Formatted Incremental Costs

Custom Incremental Cost Input

External Inputs

Scenario Log
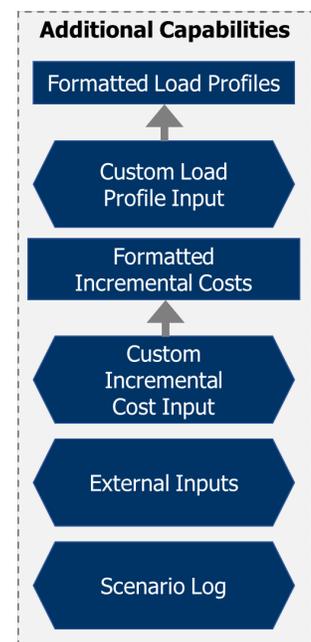
The **Formatted Load Profile List** worksheet contains the load profiles used in the measure definitions. The Tool is prepopulated with a standard list of Residential and Commercial/Non-Residential load profiles. These load profiles are used to calculate the peak demand savings for custom measures and to divide the annual kilowatt-hour savings into eight season and time-of-use buckets to develop the avoided supply cost component used in several cost-effectiveness tests. A

load profile cannot be referenced in the Measures worksheet or used to create a custom measure unless it is in the Formatted Load Profile List. One of the Tool's administrative functions is maintaining the integrity of the Formatted Load Profile List worksheet.

The **Custom Load Profile Input** worksheet contains the user interface to add new load profiles to the Formatted Load Profile List. Users can add load profiles using two methods:

1. **Hourly Method:** Load profiles are generated from 8,760 (hourly) load information for a desired custom load profile.
2. **Seasonal Method:** Load profiles are populated using an eight season and time-of-use breakdown of electricity use for a desired custom load profile. Users must know the peak demand metrics to use this method.

The **Formatted Incremental Costs** worksheet contains the user-defined incremental costs used in measure definitions. These incremental costs are used to calculate costs in certain cost effectiveness tests. Incremental costs can be added to the Formatted Incremental Costs list using the Custom Incremental Cost Input worksheet.

The **Custom Incremental Cost Input** worksheet contains the user interface to add a new incremental cost to the Formatted Incremental Costs list. Users can define simple incremental costs or life cycle incremental costs based on the project type of the measure in question. The **External Inputs** worksheet allows users to input cost-effectiveness data from an alternate source to integrate into the Results & Summaries worksheets. Users must ensure that the assumptions used are aligned with the Tool (e.g., base year, inflation rate, losses, etc.).

The **Scenario Log** worksheet stores cost effectiveness, savings, and budget results for runs of the CE Tool that are saved by the user by selecting the "Save Results to Scenario Log" button on the CE Results worksheet. The Scenario Analysis worksheet references the data on the Scenario Log worksheet to populate various plots of key metrics.

3. Step-by-Step Instructions for Using the Tool

This section provides detailed descriptions of each user interface worksheet and step-by-step instructions for the processes within each worksheet by worksheet name.

The Tool is designed using Visual Basic for Applications (VBA). It is critical that the user "Enable Macros" in Excel before beginning.

> **Tool Tip:** To enable macros in Excel: select "File" then "Options" then "Trust Center" then "Trust Center Settings" then "Macro Settings," finally select "Enable all macros." You may need to re-open the file for these changes to take effect. Alternately, a security warning may appear at the top of your worksheet; if this is the case, click "Enable Content."

3.1 Program Design Module

3.1.1 Measures Worksheet

The Measures worksheet contains all measures available for program design. The Tool is prepopulated with measures from IESO's MAL. Users can also add new measures directly into this worksheet using two methods.

Adding Custom Measures – Method 1: Copy Existing Measure/Measures

1. Select any cell on one or more contiguous rows of existing measures that are similar to the desired custom measure(s).
2. After one or more measures are selected, click the *Add Custom Measure* button. This will duplicate the selected rows and place them at the bottom of the measures list. These new measures will have a new source: CUSTOM Users can update any field, including the Source column.

Figure 3.1 | Adding a Custom Measure

3. Once the measure details have been added, click the *Validate Custom Measures* button to check the custom measure data added to the worksheet. If errors are identified, a message box will describe the issue and the affected cell will be selected. Required measure fields are listed in Appendix B.

> **Tool Tip:** When adding a new measure, select a similar measure to minimize required inputs (e.g., same load profile or program, etc.). It is important to make sure your new measure is unique because the Look Up Value contains the Measure ID. A simple method to create a unique Measure ID is to add a version number to the Measure Description field.

Adding Custom Measures – Method 2: Directly Input Measure(s)

1. Scroll to the bottom of the data and populate the row(s) with all required fields for the measure, including the Measure ID field (refer to Appendix B for the details required for the Measure ID).
2. Once all required measure details have been added, click the *Validate Custom Measures* button to check the custom measure data added to the worksheet. If errors are identified, a message box will describe the issue and the affected cell will be selected. Required measure fields are listed in Appendix B.

Deleting Custom Measure(s)

1. Select any cell on one or more contiguous rows of the measure(s) one would like to delete
2. Click the *Delete Formatted Measure* button

Validating Custom Measures

> To avoid Tool errors, this step is necessary before moving to the next step (Program Design worksheet).

The *Validate Custom Measures* button reviews all measures for issues that will result in an error in the savings or cost-effectiveness calculations. It will complete the following actions:

- Populate the Look Up Value column
- Confirm the Look Up Value is unique for each measure (see Appendix B for more information on how the Look Up Value is developed)
- Calculate peak demand savings for each measure
- Confirm that critical fields are populated with numeric values
- Ensure that the EUL is greater than zero and a whole number (no decimals)
- Ensure that the End Use Load Profile is in the Formatted Load Profile List worksheet
- Confirm that net-to-gross values are reasonable (i.e., not negative and less than 3)
- Confirm that acceptable values are populated for the Weather Sensitive, Early Replacement, Behind the Meter, and Tx/Dx fields

- Ensure that when measures are tagged as Early Replacement (Early Replacement = Yes) the savings decline year over year and the step-down year is less than the EUL but greater than the prior step down

If errors to the criteria are identified, a message box will describe the issue and the affected cell will be selected. The Tool will allow users to continue with an error in the cells. However, they will encounter errors (#N/A or #REF errors) as they run the Tool.

Tool Tip: To quickly determine the step down peak demand savings, copy the formula in column Q and modify the first term to the column containing the energy savings for your step down. For example, for step down 1, modify the first term in the copied formula from $O to AE.

Early Replacement Measures and Step Downs

Sometimes measure savings are not constant throughout the EUL of a measure. Typical examples include the following:
- **Early Replacement:** An existing measure is replaced with the conservation measure prior to its end of life. This tends to result in two savings estimates:
  - One from the installation year of the conservation measure until the existing equipment end of life
  - One from the existing equipment end of life until the conservation measure end of life
- **Step Down:** A code or standard is expected to be implemented during the EUL of a measure, modifying the baseline savings. This tends to result in two savings estimates:
  - One from the installation of the conservation measure to the effective date of the code or standard
  - One from the effective date of the code or standard until the EUL of the measure
- **Step Down:** A measure represents an archetype project or collection of measures. This case can vary considerably depending on the collection of measures and can include multiple reductions in savings estimates as measures within the archetype reach the end of their EUL.

The Tool can calculate savings for measures with up to four step downs in savings (i.e., the savings are reduced up to four times during the EUL of the measure).

1. If a measure is early replacement, the Early Replacement field must be tagged as "Yes."
2. The fields for the appropriate number of step downs must be completed. For each step down, the following information must be included:
   a. **Step Down Year #:** The number of years into the measure EUL where the savings decline (e.g., if an EUL is 10 years and the first step down in savings occurs 2 years after the measure is implemented, the Step Down 1: Year # would be equal to 2)
   b. **Energy Savings (kWh):** The new energy savings after the step-down year has been reached. The savings must be less than the base year savings and the prior step-down year savings.
   c. **Peak Demand Savings (kW):** The new peak demand savings after the step-down year has been reached. The savings must be less than the base year savings and the

prior step-down year savings (e.g., if the base year peak demand savings are 0.67 kW, the step down peak demand savings must be less than 0.67 kW).

    d. **Natural Gas Savings (MMBtu):** The new natural gas savings after the step-down year has been reached. If this value is not applicable, input 0.

    e. **Incremental Life Cycle Cost ($):** The new incremental life cycle cost. The values will be summed in the cost-effectiveness calculations. Do not duplicate the base measure costs to avoid double counting the costs.

Figure 3.2 | Early Replacement Fields

VARIATION IN SAVINGS OVER THE LIFE OF THE MEASURE >>>>>

EARLY REPLACEMENT	STEP DOWN 1					STEP DOWN 2				
	STEP DOWN 1: YEAR #	STEP DOWN 1: ENERGY SAVINGS (KWH)	STEP DOWN 1: PEAK DEMAND SAVINGS (KW)	STEP DOWN 1: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 1: INCREMENTAL LIFE CYCLE COST ($)	STEP DOWN 2: YEAR #	STEP DOWN 2: ENERGY SAVINGS (KWH)	STEP DOWN 2: PEAK DEMAND SAVINGS (KW)	STEP DOWN 2: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 2: INCREMENTAL LIFE CYCLE COST ($)
No										
No										
No										
No										
No										
No										
No										

## Example: Early Replacement Measure with Four Step Downs

Table 3.1 illustrates an early replacement measure with four step downs over the 10-year EUL of the measure.

Table 3.1 | Illustrative Stepdown Measure, Program Year = 2020

Year #	Step Down Year #/EUL	Energy Savings (kWh)	Peak Demand Savings (kW)	Natural Gas Savings (MMBtu)	Incremental Life Cycle Cost ($)
Base Year	10	10,000	0.67	0	40
1	2	8,000	0.54	0	5
2	4	6,000	0.40	0	5
3	6	4,000	0.27	0	5
4	8	2,000	0.13	0	5

Figure 3.4 shows the savings that would result in the Savings Results worksheet.

Figure 3.4 | Illustrative Savings From Stepdown Measure
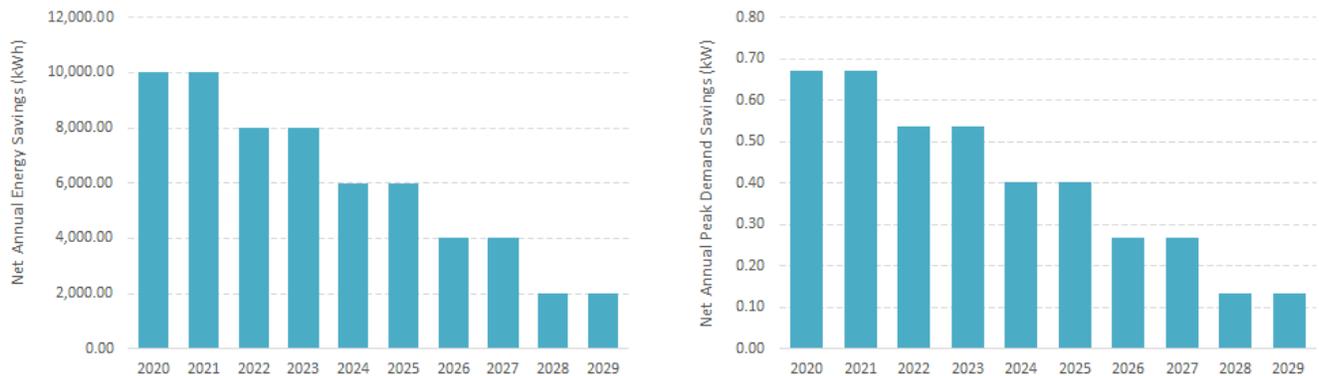
Water Savings Workaround

Rarely, an early replacement measure will have varying water savings over the life of the measure. To reduce calculation intensity, water savings were not included as a field for early replacement measures. When water savings are needed for early replacement measures, the water savings in column X of the Measures worksheet must be adjusted to reflect the lifetime value of these savings for cost-effectiveness purposes.

To adjust, replace the water savings value in column X with the following formula (*purple italicized text* means the user must enter a value). This formula will provide an adjusted annual value that reflects the change in value over the life of the measure.

> = PMT(discountRate, R*[relevant row]*, PV (discountRate, R*[relevant row]*, *[first year water savings]*) – (PV(discountRate, AD*[relevant row]*, *[first year water savings]* – *[first year water savings]* * (1+discountrate) ^ (AD*[relevant row]* – R*[relevant row]*))))

Importing Measures from Older Tools

The Measures worksheet was adjusted in this version to enhance the functionality of the Tool. The following instructions will guide users through the process to import measures from prior versions of the Tool. See Appendix C for these instructions with visuals of the columns from the older Tool and the new Tool.

Note that the instructions assume that the Measures worksheet in the older version only includes custom measures (i.e., no MAL measures). If the MAL measures are still in the Tool, adjust which row of data to copy first in Step 6 to whichever row the measure begins.

1. Copy cells in columns **B to O starting row 6** from the older version of the Tool and paste them into **column B** at the bottom of the Measures worksheet of the new Tool.
2. If you do not want your peak demand savings calculated, copy cells P6 to P[last row of data] from the older version of the Tool and paste them into column P of the new Tool. This will ensure all calculations are using the peak demand savings from the prior Tool rather than the calculated cells in the new Tool.

> Note: If your End Use Load Profile, Energy Savings, and Weather Sensitive flags have not changed and the peak demand savings are calculated correctly, after you run the validation and the peak demand savings are calculated, columns P and Q in the new Tool should be identical to those in the old Tool.

3. Copy cells **Q6 to W[last row of data]** from the older version of the Tool and paste them into **column R** at the bottom of the Measures worksheet of the new Tool.
4. Copy cells **AF6 to AI[last row of data]** from the older version of the Tool and paste them into **column Y** at the bottom of the Measures worksheet of the new Tool.
5. Copy cells **X6 to X[last row of data]** from the older version of the Tool and paste them into **column AC** at the bottom of the Measures worksheet of the new Tool.
6. If you have an early replacement measure:
   a. Copy cells **Y6 to Y[last row of data]** from the older version of the Tool and paste them into **column AD** at the bottom of the Measures worksheet of the new Tool.
   b. Copy cells **AA6 to AC[last row of data]** from the older version of the Tool and paste them into **column AE** at the bottom of the Measures worksheet of the new Tool.
   c. Copy cells **AE6 to AE[last row of data]** from the older version of the Tool and paste them into **column AH** at the bottom of the Measures worksheet of the new Tool.
   d. If there are water savings associated with an early replacement measure, update the water savings values in column X to reflect an adjusted lifetime value. See the Water Savings Workaround section for additional instructions.

Define Incremental Cost for Selected Measure

The Measures worksheet contains one additional button labeled *Define Incremental Cost for Selected Measure*. Pressing this button will load the incremental cost input user form, with the selected measure prefilled in the Measure ID field. Further information about using the incremental cost input can be found in section 3.2.3.

### 3.1.2 Program Design Worksheet

The Program Design worksheet allows users to select measures to include in the cost-effectiveness assessment and to specify program design parameters such as program year, incentives, participation, and vendor performance pay costs. This worksheet is protected (except for the columns with yellow headings, columns J-N) to keep the formulas in the Measure CE Results and Savings Results worksheets intact. The Measure CE Results and Savings Results worksheets provide the supporting calculations for all cost-effectiveness and savings results in summary tables in the Tool.

> **Tool Tip:** Compile and check all measure data for the program that will be assessed—i.e., program year(s), incentive costs, participation (quantity), incentives, and variable program costs—to ensure all data is consolidated and easily accessible.

To view the cost-effectiveness results in the Results & Summaries worksheets, certain buttons must be clicked. See Section 3.4 for more information.

The Program Design worksheet contains five buttons. The first three buttons add measures to the Program Design worksheet and populate formulas in the Measure CE Results and the Savings Results worksheets. The remaining two buttons allow users to delete measures, deleting them from the Program Design, Measure CE Results, and Savings Results worksheets.

Figure 3.5 | Program Design Module Buttons

Each button is described below. More detailed instructions are provided for the *Single Measure Selection* and *Bulk Measure Selection* buttons.

- **Single Measure Selection:** Activates a user form to add select measures and specify the program year, participation (quantity), and costs (incentive and vendor performance pay). Once the user clicks the *Add* button in the form, the measure is added to the table from column B to column BG in the Program Design worksheet.
- **Bulk Measure Selection:** Activates a user form to add all measures from a particular program. Once the user selects Add All Measures button, the measures are added in the table from the table in column B to column BG in the Measures worksheet. In this case, the program year, participation, and costs are modified directly in the spreadsheet in columns J-O.
- **Select All Measures:** Imports all measures populated in the Measures worksheet. The program year, participation, and costs are modified directly in the spreadsheet in columns J-O. Depending on the number of measures, this process can be time-consuming.
- **Delete Measure(s):** Deletes a measure(s) if the user selects any cell(s) from column B to column AV in the Program Design worksheet within the row of the measure to be deleted.
- **Clear All Measures:** Clears the table in columns B-BG.

Tool Tip: The user form does not close after each measure is selected. When filling out the Program Design module, the user can input measures for multiple program years one after another by selecting the measure and adding one program year, modifying the program year (and quantity and incentive if applicable), and adding the measure again.

Single Measure Selection

The Single Measure Selection form (shown in Figure 3.6 and Figure 3.7) is launched by clicking the *Single Measure Selection* button. This form allows the user to select a single measure to add to the cost-effectiveness analysis. To fill out the form:

1. Select the measure specifications in each dropdown. As each dropdown is selected, the options in the next dropdown will filter accordingly. For example, if a user selects Residential, only residential programs will appear as options to select.
2. Select Tx or Dx for the transmission (Tx)- or distribution (Dx)-connected selection. This field only presents both options when a measure is specified as both Tx- and Dx-connected in the measure list.
3. Input additional program information:
    - **Program year:** Specify the year the program will begin to deliver savings.
    - **Quantity (participation):** Specify the quantity of measures implemented. Note that the participation metric may be different for different measures (e.g., no. of projects, no. of units, etc.)
    - **Incentive level:** Specify the incentive level for the measure selected.
    - **Incentive structure:** Specify the structure of the incentive as $/unit, $/kW, or $/kWh.
    - **Vendor performance pay:** Specify any costs attributed to paying vendors based on measure performance. There is one field to input dollars per kWh of energy savings and one field for dollars per kW of peak demand savings.
4. Click *Add Measure* button (green) to include the measure in the cost-effectiveness analysis.

Figure 3.6 | Single Measure Selection Blank Form

Figure 3.7 | Single Measure Selection Completed Form
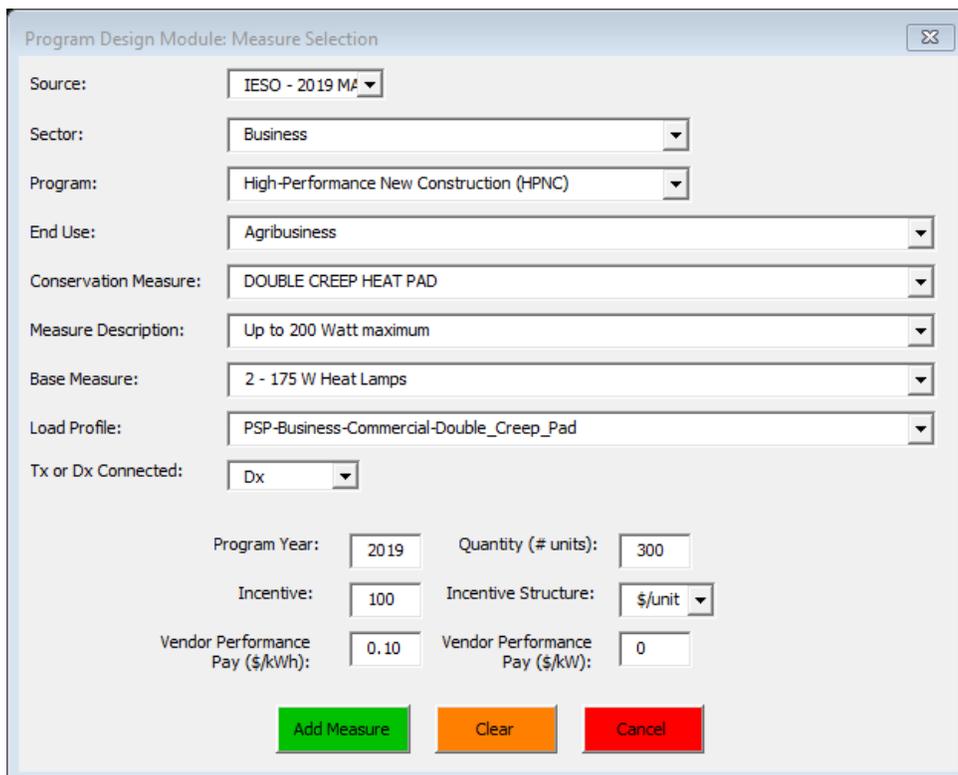
Bulk Measure Selection

The Bulk Measure Selection form (seen in Figure 3.8 and Figure 3.9) is launched by clicking the *Bulk Measure Selection* button. This form allows the user to add all measures mapped to a particular program into the Measures worksheet.

1. Select the measure specifications in each dropdown. As each dropdown is selected, the options in the next dropdown will filter accordingly. For example, if a user selects Residential, only residential programs will appear as options to select.
2. Specify the program year (the year the program will begin to deliver savings).
3. Choose to enter placeholder values for the quantity (participation), incentives, and vendor performance pay.
4. Click *Add All Measures in the Selected Program* button (green) to add all measures.

Figure 3.8 | Bulk Measure Selection Blank Form

Figure 3.9 | Bulk Measure Completed Blank Form

Select All Measures

If a user would like to import all measures from the Measures worksheet into the Program Design worksheet, they must click the *Select All Measures* button. Note: it will take some time for this to finish. After the import finishes, the user must input the program years, quantities, and other relevant information into the Program Design worksheet. This button must be clicked multiple times for multiple program years.

3.1.3 Budget Inputs Worksheet

The Budget Inputs worksheet allows users to input costs for each program and program year specified. The cost-effectiveness results will not populate if this worksheet has not been run (*Update Program Budget* button clicked).

> **Tool Tip:** Compile and check all program cost data associated with the measures and programs that will be assessed using the Tool. Ensure all data is consolidated and easily accessible. Understand where costs are reflected to avoid double counting.

The Budget Inputs worksheet contains two buttons:

1. **Update Program Budget:** Populates a table containing the sectors, programs, and program years specified by the user with four different cost types. This button must be clicked for the Results Module to function properly.

2. **Delete Budget:** Clears the sheet.

This worksheet allows users to input the costs not provided at the measure level—e.g., program evaluations, sector-level marketing, etc. Once the Single or Bulk Measure Selection form is complete, the sector, programs, and program year input will appear in the Budget Inputs worksheet.

Figure 3.9 | Program Budget Worksheet

The user must input the costs in the table in nominal dollars (the Tool will convert the costs to real dollars). If costs are incurred outside of a program year, the user must convert the dollars to reflect nominal amounts for a given year.

For example, if costs for a marketing campaign are $20,000 spent in 2020 (the year before a program is expected to begin delivering savings), these costs must be adjusted for inflation to reflect the costs in nominal dollars for the year the program is expected to begin to deliver savings (2021). Assuming the inflation rate is 2%, the costs for the marketing campaign input into the Tool for 2020 should be $20,000 \times (1.02)^{2020-2019} = $20,400$. Alternatively, the user can input a 2020 program year with no savings and populate the Tool with nominal dollars.

If the user has already started to create a portfolio by adding measures in the Program Design worksheet, they can create a budget, populate the budget, and continue designing the portfolio. Any new programs will be added to the Budget Inputs worksheet, and any removed programs will be removed from the Budget Inputs worksheet. However, any costs already populated will remain in the worksheet.

3.2 Additional Capabilities Module

These inputs are optional, and a user only needs to follow these instructions if they intend to customize a load profile, define a new incremental cost, or include external inputs.

3.2.1 External Inputs Worksheet

The External Inputs worksheet allows users to input the cost-effectiveness results from external cost-effectiveness tools—for example, the DR Cost Effectiveness Tool or prior years' evaluation results—to compute combined cost-effectiveness results at the portfolio level.

> **Tool Tip:** Complete the cost-effectiveness assessment in the external Tool for the measures and programs that will be incorporated into the portfolio-level cost-effectiveness. Ensure assumptions are aligned (e.g., inflation rate, discount rate, base year, etc.) and all costs are reflected.

It is important that the same parameters in the Admin Inputs module are used in an external cost-effectiveness tool to ensure the results can be properly aggregated.

Figure 3.10 | External Inputs Worksheet

3.2.2 Custom Load Profile Input Worksheet

The Custom Load Profile Input worksheet allows users to add and manage custom load profiles.

> **Tool Tip:** Before adding a new load profile, cross-check the load profile against the existing Formatted Load Profile List worksheet. If the profile does not exist, ensure all data is consolidated and easily accessible.

The Custom Load Profile Input worksheet contains six buttons (shown in Figure 3.11 and Figure 3.12).

Figure 3.11 | Custom Load Profile Input Buttons

Figure 3.12 | Custom Load Profile Hourly Method Buttons

Add Custom Load Profiles To Formatted Load Profile List: Transfers the custom load profiles to the Formatted Load Profile List worksheet once all new custom load profiles have been reviewed by the user.

1. **Add Custom Load Profile: Seasonal Method:** Populates the table in columns B-Q when 8,760 data is unavailable.
2. **Delete Selected Custom Load Profile:** Deletes a custom load profile when a user selects any cell from column B to column Q within the row of the load profile to be deleted.
3. **Clear All Custom Load Profiles**: Clears the table in columns B-Q.
4. **Add Custom Load Profile: Hourly Method:** Calculates the load profile when 8,760 data is available and populates the table in columns B-Q.
5. **Clear Hourly Data:** Clears the hourly data in the input table.

Add Custom Load Profile: Seasonal Method

The seasonal load profile method is used when a full calendar year of hourly data is not available, but the eight season and time-of-use buckets are known.

1. Click the *Add Custom Load Profile: Seasonal Method* button on the worksheet.
2. Input the data as specified in the form. Note that the dropdowns allow the user to select existing values (i.e., sector, segment, load profile name) or input custom values.
3. Review the results in the main table on the left side of the worksheet once all new custom load profiles have been input.

Figure 3.13 | Custom Load Profile Seasonal Method

Sector: Customer type (i.e., residential, commercial, industrial)

Segment: Further differentiates the customer (i.e., warehouse, restaurant)

Load Profile Name: Descriptive name of load profile, will appear in dropdowns

Energy Load Profile: Percentage of annual consumption segmented by eight season and time-of-use buckets, values must sum to 100

Demand Load Factor: Percentage of annual consumption that falls within summer peak and winter peak periods based on the definitions found in the IESO EM&V Protocols and Requirements

Add Custom Load Profile: Hourly Method

The hourly load profile method is used when a full calendar year of hourly data is available. This data is used to generate a load profile that specifies consumption over eight season and time-of-use periods.

1. Click the *Clear Hourly Data* button on the right side of the worksheet.
2. Input the sector, segment, and load profile name of the measure into cells T2-T4 in the worksheet. Note that the dropdowns allow users to select existing values (i.e., sector, segment, load profile name) or input custom values.
3. Input the measure data year in cell T5 of the worksheet. The measure data year represents the year the 8,760 data was taken from. Capturing this is important to ensure that the days are correctly allocated to weekdays, weekends, and holidays. If a leap year is input, the Tool will automatically adjust the hours and calculate accordingly.
4. Input the hourly kilowatt-hour data into column V of the worksheet.
5. Click the *Add Custom Load Profile: Hourly Method* button.

Figure 3.13 | Custom Load Profile Hourly Method

		Sector: Customer type (i.e., residential, commercial, industrial)
Sector:	Business	
		Segment: Further differentiates the customer (i.e., warehouse, restaurant)
Segment:	Other_Commercial_Buildings	Load Profile Name: Descriptive name of load profile
Load Profile Name:	London-SCP-600956	Add Custom Load Profile: Hourly Method — Clear Hourly I — Clear Ho—
Year:	2016	Year: Load data year; required to ensure season and time-of-use periods are calculated correctly; the Tool will automatically adjust if a leap year is selected

		Load (kWh)	0.06	0.07
Hour Index	Date (MM/DD/YYYY)	Load Profile (%)	6.45%	7.38%
		Hour Ending	kWh	Winter Peak	Winter Mid-Peak
1	1/1/2016	1	0.00	-	
2	1/1/2016	2	0.00	-	
3	1/1/2016	3	0.00	-	
4	1/1/2016	4	0.00	-	
5	1/1/2016	5	0.00	-	-

kWh: Hourly kWh consumption data input here

3.2.3 Custom Incremental Cost Input Worksheet

The Custom Incremental Cost Input worksheet allows users to define new incremental costs for specified measures. The Custom Incremental Cost Input worksheet has four buttons (shown in Figure 3.14).

Figure 3.14 | Custom Incremental Cost Worksheet

Defined Inputs Module: Custom Incremental Cost Input

Users can create incremental costs to add to the repository ("Formatted Incremental Costs"). If the incremental cost is not in the repository, it cannot be used in the next step in the program design module.
CAUTION: If the measure is already in the incremental cost repository, a new incremental cost cannot be added.

Use the buttons to add and remove incremental costs.
"Define Incremental Cost": Activates the form to input custom cost information and add it to the table below (if the entire form is not visible select "small format" in the drop down in the "ADMIN OPTIONS" tab)
"Delete Selected Incremental Cost": To delete costs in the table below, click or highlight any cell in the row of the costs you wish to delete and click the button
"Clear All Incremental Costs": Clears all incremental costs
"Add Incremental Costs to Formatted IC List": Once all incremental costs are added, click this button to add them to the repository ("Formatted Incremental Cost List").

Click here to see existing costs in the "Formatted Incremental Costs" List

Define Incremental Cost	Delete Selected Incremental Cost	Clear All Incremental Costs	Add Incremental Costs to Formatted IC List
Button 1	Button 2	Button 3	Button 4
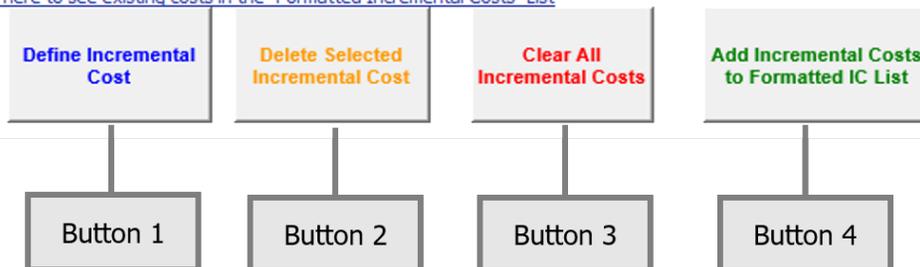
1. **Define Incremental Cost:** Launches user form to prompt user for inputs and define a new incremental cost.
2. **Delete Selected Incremental Cost:** Deletes an incremental cost when a user selects any cell from column B to column AL within the row of the incremental cost to be deleted.
3. **Clear All Incremental Costs**: Clears the table in columns B-AL.
4. **Add Incremental Costs to Formatted IC List:** Transfers the incremental costs to the Formatted Incremental Costs worksheet once all new incremental costs have been reviewed by the user.

To define a new incremental cost, the following steps should be taken:

1. Click the *Define Incremental Cost* button on the worksheet *or* navigate to the Measures worksheet, select a cell in the row where the measure of interest is stored, and click the *Define Incremental Cost for Selected Measure* button.
2. Enter the row number of the measure of interest from the Measures worksheet and click the *Select Measure* button to specify the measure for which an incremental cost will be defined. Note that this step is not necessary if the user form was activated from the Measures worksheet using the *Define Incremental Cost for Selected Measure button.* The Measure ID Preview window should be populated by the tool before continuing. **Only one incremental cost can be defined for each measure.**
3. Input the data as specified in the form.
4. Review the results in the worksheet once all new incremental costs have been input.

Figure 3.14 | Incremental Cost Calculator

Specify the row number of the target measure on the Measures tab and click Select Measure to continue. The View Measures Tab button will change the view to the Measures worksheet to allow users to more easily determine the measure row number.

Specify the project type (Replace-on-Burnout, New Equipment for Process, Early Replacement, Retrofit (No Baseline), or Undefined). Note that the project type selected will impact the type of calculation method that can be selected.

Specify Calculation Method (Simple Incremental Cost or Lifecycle Incremental Cost).

Specify costs of the baseline and efficient measures. The Incremental Cost fields are calculated automatically by the Tool.

If the Calculation Method is set to Lifecycle Incremental Cost, there are additional inputs that will appear on the right side of the user form as seen in Figure 3.15.

Figure 3.15 | Incremental Cost Calculator – Life Cycle Costs

3.3 Admin Inputs Module

ADMIN INPUTS SHOULD NOT BE MODIFIED UNLESS SPECIFIED AND APPROVED BY THE IESO.

3.3.1 CE Parameters

The CE Parameters worksheet allows administrative users to input standard assumptions into the Tool to enhance the comparability of results.

Table 3.1 | CE Parameter Descriptions

Parameters	Description
Base year of projections	The base year selected represents the year that is used as a basis for valuing costs and benefits. The analysis will be expressed in the base year dollars.
Discount rate	The discount rate expresses the time value of money. The higher the discount rate, the faster the dollar loses value as the delay in acquiring that dollar increases over time.
Societal discount rate	Some jurisdictions will vary the discount rate according to the perspective being evaluated. A societal discount rate is lower, reflecting the uncaptured value of CDM.

Parameters	Description
Inflation rate	Since the costs and benefits associated with the implementation of CDM are assessed over the EUL of a measure, they must be adjusted for forecast inflation.
Transmission system losses	Line losses occur between energy produced at the generator and energy consumed by the customer or end user. As a result, energy savings observed by the end user (the customer) understate true savings observed by the generator. Transmission system losses account for line losses experienced by transmission-connected customers and do not include line losses that occur from the distribution system.
Distribution system losses	Distribution system losses account for line losses experienced by distribution-connected customers and include losses that occur between the transmission system and the customer or end user.
Final Framework Year	The final framework year is used to specify the year for which persisting savings are calculated and saved in Table 2 of the Plan worksheet and the Scenario Log.
Non-Energy Benefits Adder	Additional non-energy benefits specified as a percentage, with distinct values for each sector. These factors are used to take into account additional non-energy benefits in the TRC and SC tests. If the sector specified for the measure does not match one of the sectors listed in cells E13:E19, the "General" non-energy benefits adder will be applied to the calculations.

Figure 3.16| CE Parameters Worksheet

Admin Input Module: Cost Effectiveness Parameters	IESO/admin users can modify the assumptions used in the calculation of lifetime benefits and costs for each measure, initiative, and program.
Input the assumptions in column F.	

Cost Effectiveness Parameters		
Base Year of Projections:		2020
Discount Rate (real):		4.00%
Societal Discount Rate (real):		4.00%
Inflation Rate:		2.00%
Transmission System Losses:		2.50%
Distribution System Losses:		4.20%
Final Framework Year (for persisting savings):		2022
Non-Energy Benefits Adder	Commercial	15.00%
	Consumer	15.00%
	Low Income	15.00%
	First Nation	15.00%
	Agricultural	15.00%
	Industrial	15.00%
	Institutional	15.00%
	General	15.00%

3.3.2 Admin Inputs

The Tool is designed to calculate cost-effectiveness using both a winter peak demand definition and a summer peak demand definition. Using the dropdown, users must select which peak demand definition to use in the calculations. The default in the Tool is summer peak demand. For peak demand definitions and policies, see the IESO EM&V Protocols Version 4.[2]

The Tool also contains a Display Format option to modify the user input forms to fit varying screen resolutions. When Small Format is selected, a scroll bar will be added to certain user forms to improve the user experience.

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[2] Integrated Electricity System Operator, EM&V Protocols, http://www.ieso.ca/-/media/Files/IESO/Document-Library/conservation/EMV/2019/IESO-EMV-Protocols-and-Requirements-V3-1Apr2019-vf.pdf?la=en

Figure 3.17 | Admin Inputs Worksheet

3.3.3 Rates Table

When the Rates Table worksheet is modified, the dollars must be input in real dollars (i.e., the table must be tied to a particular dollar year). Users must specify the base year of the ratepayer assumptions analysis year in cell F4 and then input the new values in the shaded area.

Tool Tip: The base year of the Rates Table assumptions does not need to align with the base year specified in the Tool. The Tool will align the base years.

Figure 3.18| Rates Table Worksheet

Admin Input Module: Rates Table	IESO/Admin users input the ratepayer cost assumptions provided by IESO.

Input ratepayer assumptions by year in column D. The value in cell F4 should reflect the dollar year of the ratepayer assumptions provided, the values used in the model are automatically converted from the year specified in this cell to the base year specified in the "CE Parameters" worksheet. If needed, the user can modify the ratepayer cost analysis years in column C.

Inflation Rate: **2%** *Adjusted for inflation* **2018**

Year #	Year	Electricity			Natural Gas	Water	Propane	Heating Oil
		2018 $/MWh	2018 $/kWh	2020 $/kWh	2020 $/MMBtu	$/L	2020 $/L	2020 $/L
1	2015	$135.23	$0.14	$0.14	$0.155	$0.000004016	$0.37	$0.44
2	2016	$135.35	$0.14	$0.14	$0.155	$0.000004016	$0.37	$0.44
3	2017	$136.07	$0.14	$0.14	$0.151	$0.003406800	$0.24	$0.28
4	2018	$136.14	$0.14	$0.14	$0.152	$0.003406800	$0.26	$0.31
5	2019	$136.86	$0.14	$0.14	$0.152	$0.003406800	$0.27	$0.32
6	2020	$138.72	$0.14	$0.14	$0.153	$0.003406800	$0.30	$0.35
7	2021	$138.59	$0.14	$0.14	$0.153	$0.003406800	$0.30	$0.35

3.3.3 Avoided Costs

When the Avoided Costs worksheet is modified, the dollars must be input in real dollars (i.e., the table must be tied to a particular base dollar year). Users must specify the base year in cell C4 and input the new values in the shaded area.

Tool Tip: The base year of the Avoided Costs assumptions does not need to align with the base year specified in the Tool. There is a calculated table below the Avoided Costs input table that will adjust the Avoided Costs to align with the user-specified base year.

Figure 3.19| Avoided Cost Worksheet

Admin Input Module: Avoided Cost Table	IESO/Admin users input the avoided cost assumptions provided by IESO.

Input the avoided cost values in the yellow cells. The value in cell C4 should reflect the dollar year of the avoided cost assumptions provided, the values used in the model are automatically converted from the year specified in this cell to the base year specified in the "CE Parameters" worksheet. Sources of the original data are provided at the bottom of the input table.

Year #	Year	Avoided Energy Cost by Season and Time-of-Use Period (2020$/MWh)								Avoided Capacity Costs (2020$/kW-yr)			Avoided Natural Gas Cost (2020$/MMBtu)		
	2020	Winter On Peak	Winter Mid-Peak	Winter Off-Peak	Summer On Peak	Summer Mid-Peak	Summer Off-Peak	Shoulder Mid-Peak	Shoulder Off Peak	Generation	Transmission	Distribution	Residential/ Commercial Space Heating	Residential/ Commercial Water Heating	Industrial Process
1	2015	$50.37	$46.96	$40.88	$36.42	$42.03	$34.50	$51.47	$44.13	$0.00	$4.14	$5.12	$8.97	$8.97	$8.97
2	2016	$39.05	$34.51	$34.43	$33.98	$39.67	$31.98	$45.73	$38.90	$0.00	$4.14	$5.12	$8.97	$8.97	$8.97
3	2017	$44.34	$37.84	$31.09	$30.29	$41.55	$33.28	$41.55	$36.28	$175.51	$4.14	$5.12	$5.77	$5.77	$5.77
4	2018	$45.42	$38.77	$35.38	$27.21	$39.69	$32.20	$34.39	$29.20	$175.51	$4.14	$5.12	$6.39	$6.39	$6.39
5	2019	$23.00	$19.00	$17.00	$15.00	$17.00	$13.00	$12.00	$12.00	$0.00	$0.00	$0.00	$6.61	$6.61	$6.61
6	2020	$16.73	$21.33	$16.87	$23.94	$27.44	$20.97	$19.17	$16.60	$0.00	$0.00	$0.00	$7.19	$7.19	$7.19
7	2021	$17.06	$21.76	$17.20	$24.42	$27.99	$21.39	$19.55	$16.94	$0.00	$0.00	$0.00	$7.19	$7.19	$7.19
8	2022	$23.32	$25.01	$26.97	$29.62	$28.83	$21.68	$24.45	$20.85	$0.00	$0.00	$0.00	$7.16	$7.16	$7.16
9	2023	$31.85	$30.79	$28.71	$34.08	$33.29	$27.02	$27.24	$25.25	$62.06	$0.00	$0.00	$7.07	$7.07	$7.07
10	2024	$33.49	$30.65	$32.74	$30.78	$31.97	$23.31	$26.55	$24.12	$44.65	$0.00	$0.00	$7.01	$7.01	$7.01

3.4 Results & Summaries Module

Once all other steps are complete (at a minimum, measures must be selected and inputs added to the Budget Inputs worksheet), users can view the results.

There are three ways to view cost-effectiveness results in the Tool:

1. Detailed cost-effectiveness results at the program and portfolio level
2. Detailed measure-level savings calculations
3. Summary-level cost-effectiveness results at the program, program, and portfolio level

3.4.1 CE Results Worksheet

The detailed cost-effectiveness results can be found in the CE Results worksheet. To view the results, the user must click the *Calculate Portfolio Cost Effectiveness Results* button. This button dynamically populates the table in the worksheet with the sector, program, and program year the user selected in the Program Design module. This button also collects the external inputs and aggregates them into the results. The user can also clear the results from the table.

When the *Save Results to Scenario Log* button is clicked, the user will be prompted to enter a unique "Scenario Name". After a scenario name is entered, a copy of the CE Results is saved to the table on the Scenario Log worksheet. The button will also save the Program Roll Out schedule (Table 3 of the Plan worksheet), the program budgets from the Budget worksheet, and the persisting savings (Table 2 of the Plan worksheet). Each of the scenarios saved using this feature will be referenced by the key metric plots displayed on the Scenario Analysis worksheet.

Figure 3.20| Detailed Cost-Effectiveness Results
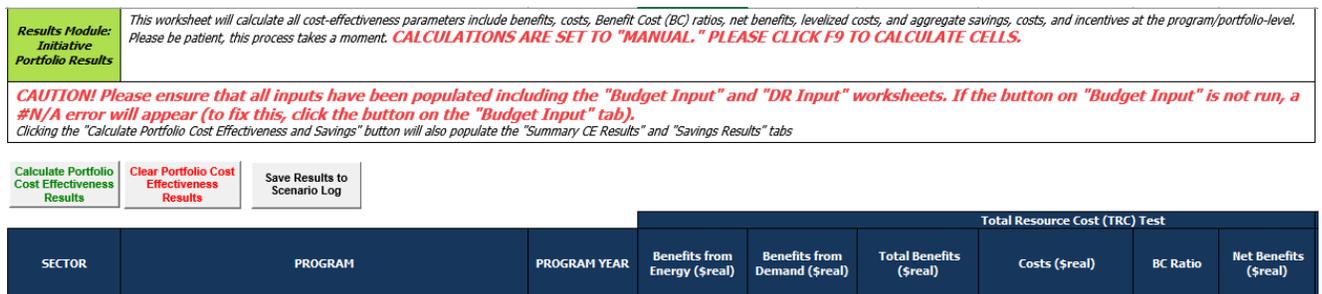
The table displays the results of each cost-effectiveness test (TRC, SC, PAC, RIM, PC, LC) and specifies the cost and benefit components for each test.

3.4.2 Savings Results Worksheet

The detailed measure-level savings results can be found in the Savings Results worksheet. This worksheet populates after results are calculated on the CE Results worksheet. To calculate the lifetime savings at the measure-level, press F9.. The user can also clear the results from the table.

Figure 3.20| Detailed Measure Savings

	SECTOR	PROGRAM	MEASURE DESCRIPTION	Distribution (Dx) or Transmission (Tx) Connected	Behind the Meter Project (True/False)	PROGRAM YEAR	PEAK DEMAND SAVINGS (KW)	FIRST YEAR ENERGY SAVINGS (KWH)	EFFECTIVE USEFUL LIFE (YEAR)	NET-TO-GROSS (ENERGY)	NET-TO-GROSS (DEMAND)
1	Business	Retrofit	≤ 28W ≥ 1600 Lumens	Dx	FALSE	2021	0.011216608	78.962	8	0.883	0.95
1	Business	Retrofit	≤ 28W ≥ 1600 Lumens	Dx	FALSE	2021	0.008991804	67.366	10	0.883	0.95

The savings are displayed as net peak demand and energy savings and gross peak demand and energy savings at the end-user level. The worksheet also shows net peak demand and energy savings and gross peak demand and energy savings at the generator level (i.e., including transmission and distribution losses).

3.4.3 Benefits Results Worksheet

The detailed measure-level benefits results can be found in the Benefits Results worksheet. This worksheet populates after results are calculated on the CE Results worksheet. To calculate the lifetime benefits at the measure-level, press F9. The user can also clear the results from the table.

The benefits are displayed as net peak demand and energy savings from a Total Resource Cost (TRC) and Program Administrator Cost (PAC) perspectives.

3.4.3 Summary CE Results Worksheet

The summary cost-effectiveness results can be found in the Summary CE Results worksheet. The table in this worksheet dynamically populates when the user runs the detailed cost-effectiveness. The table displays the TRC ratio, PAC ratio, and the LC in terms of $/MW-year and $/MWh for the sectors, programs, and program years selected in the Program Design module.

Figure 3.20| Summary Cost-Effectiveness Results

SECTOR	PROGRAM	PROGRAM YEAR	Total Resource Cost (TRC) Ratio	Program Administrator Cost (PAC) Ratio	Levelized Cost (LC) ($/kWh) ($real)	Levelized Cost (LC) ($/kW) ($real)
Business	Retrofit	2021	0.75	3.09	$ 0.02	$ 55.63
Business	Retrofit	2022	0.81	3.35	$ 0.02	$ 56.74
Business	Retrofit	All Program Years	0.78	3.22	$ 0.02	$ 56.18
Business	All Programs	All Program Years	0.78	3.22	$ 0.02	$ 56.18
Total	All Programs	All Program Years	0.78	3.22	$ 0.02	$ 56.18

3.4.4 Scenario Analysis Worksheet

The Scenario Analysis worksheet allows users to see comparative visuals for certain key metrics for scenarios that are saved to the Scenario Log. This worksheet has visuals for BC ratios for the Total Resource Cost and Program Administrator Cost tests as well as incremental and persisting savings, average levelized cost, and anticipated annual budget. An example of the typical use case for the Scenario Analysis worksheet is provided below:

1. The user completes the program design following the instructions laid out in this user guide.
2. The user generates cost effectiveness results on the CE Results worksheet and then saves the results to the Scenario Log using the *Save Results to Scenario Log* button.
3. The user makes modifications to the inputs and assumptions in the program design, generates new results on the CE results worksheet, and then saves the new results under a new scenario name using the *Save Results to the Scenario Log* button.
4. The user iterates step number 3 as many times as desired, changing inputs and assumptions.
5. The user navigates to the Scenario Analysis worksheet, clicks the *Refresh Charts* button to update the visualizations, and compares the key outputs of the scenarios created in steps 1 – 4.

Figure 3.22| Example of Scenario Analysis Dashboard

3.4.5 Plan Worksheet

This worksheet summarises the results of the portfolio in a similar format to the CDM Plan template, allowing the user to copy and paste the results into their CDM Plan.

3.4.6 Budget Worksheet

This worksheet aggregates and summarises all costs from a nominal perspective for each program. The budget is broken down by incentives, program administration, LDC variable costs, and central services costs.

3.4.6 Detail Worksheet

This worksheet summarises various cost-effectiveness, savings, and budget metrics.

Appendix A – Calculation Engine

The Calculation Engine calculates savings and cost-effectiveness at the measure level. The user does not have access to the worksheets included in this module. However, the calculations and logistics are outlined for interested users.

The **Levelized Rates Table** and **Levelized Avoided Cost Tables** worksheets translate the avoided cost table and rates table from the Admin Inputs module into a levelized value used in the Measure CE Results worksheet to easily compute the lifetime benefits and costs of CDM resources.

```
┌ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┐
      Calculation Engine
  ┌───────────────────────┐
  │  Levelized Rates Table │
  └───────────────────────┘
  ┌───────────────────────┐
  │ Levelized Avoided Costs Table │
  └───────────────────────┘
  ┌───────────────────────┐
  │   Measure CE Results   │
  └───────────────────────┘
  ┌───────────────────────┐
  │    Measure-Level GHG   │
  └───────────────────────┘
  ┌───────────────────────┐
  │     VBA References     │
  └───────────────────────┘
└ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ─ ┘
```
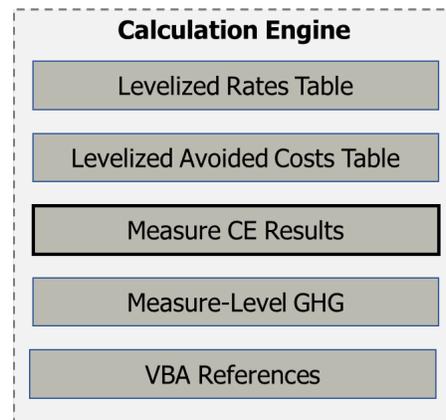
The **Measure CE Results** worksheet is the main calculation worksheet supporting the cost-effectiveness results in the Tool. The calculations in this worksheet are triggered when a measure is added to the Program Design worksheet. The calculations use both the user inputs (e.g., measures selected, program years, incentive levels, etc.) and the Measures worksheet assumptions (e.g., kW and kWh savings, EUL, etc.) to calculate the cost-effectiveness at the measure level. The calculations in this worksheet reflect measure level cost-effectiveness regardless of the quantity of measures specified in the Program Design module. At this point, the calculation only accounts for measure-specific program costs. Other program- and portfolio-level costs input into the Budget Inputs worksheet are not integrated into the calculations.

The **Measure-Level GHG** worksheet calculates the GHG metrics. The calculations in this worksheet are triggered when a measure is added to the Program Design worksheet. The GHG emissions factors are provided by the user on an hourly basis for the entire year in the Conversions Factors worksheet. This allows for the tool to calculate peak period GHG emissions factors. The GHG metrics calculations use these emission factors and the energy and peak demand savings from the Measure CE Results to calculate the GHG emissions reduction at the measure level.

The **VBA References** worksheet is essential to the mechanics of the cost-effectiveness tool and provide the equations required for the cost-effectiveness analysis.

Appendix B – Measure IDs and Look Up Values

Measures, as defined by the Tool, are one of the Tool's critical building blocks, and it is important that all measures are unique. Table 1 defines how the Look Up Value for each measure is developed within the Tool's logic. This information is intended to help users confirm new measures are unique.

The Tool's logic collects portions of the text for specific fields input into the Measures worksheet and concatenates the text into a Measure ID. Table 1 provides the specific text fields collected to define the Measure ID or Look Up Value.

Table 1| Developing the Measure ID

Measure Component	Text Used for Look Up Value	Component Description
Source	LEFT = 1 character RIGHT = 3 characters	Include whether a measure is an IESO standard measure or a custom measure and whether the measure represents an individual technology or a project/aggregated metric
Sector	LEFT = 10 characters	The marketplace sector in which the conservation technology will be implemented: Residential or Non-Residential/Commercial
Program	LEFT = 10 characters	The program that the conservation technology is mapped to and delivered through—e.g., Appliance Program, Heating & Cooling Program
End-Use	RIGHT = 25 characters	The high-level group of technologies—e.g., lighting, HVAC
Conservation Measure	LEFT = 20 characters RIGHT = 20 characters	A general description of the measure (the conservation technology offered/installed, or the conservation action undertaken)
Measure Description	LEFT = 40 characters RIGHT = 40 characters	A concise description of the conservation technology or action that makes the measure easier to identify
Base Measure	LEFT = 10 characters RIGHT = 10 characters	The base technology used to determine the amount of savings that can be achieved by implementing the conservation measure
End Use Load Profile	LEFT = 1 characters RIGHT = 25 characters	The shape of the measure's annual electricity use in terms of eight season and time-of-use buckets, which should map to a load profile in the Formatted Load Profiles list
Dx or Tx Connected	LEFT = 1 characters	A Dx/Tx flag specifying whether the conservation measure will be implemented

Measure Component	Text Used for Look Up Value	Component Description
		by a customer connected to the distribution system (Dx) or the transmission system (Tx)

Appendix C – Importing Measures from Prior Versions of the Tool

The instructions from Section 3.1.1 are repeated below with the columns from the older Tool (green) and the new Tool (dark blue).

1. Copy cells **B6 to O[last row of data]** from the older version of the Tool and paste them into **column B** at the bottom of the Measures worksheet of the new Tool. Columns A-O are the same in all versions of the Tool.

Table 2| Importing from Older Tools: Step 1, Same Columns in All Tools

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Look Up Value	SOURCE	SECTOR	PROGRAM	END-USE	CONSERVATION MEASURE	MEASURE DESCRIPTION	BASE MEASURE	ASSUMED ANNUAL OPERATING HOURS	BASE CASE KW	BASE CASE KWH	CONSERVATION CASE KW	CONSERVATION CASE KWH	FIRST YEAR DEMAND SAVINGS (KW)	FIRST YEAR ENERGY SAVINGS (KWH)

2. If you do not want your peak demand savings calculated, copy cells P6 to P[last row of data] from the older version of the Tool and paste them into column P of the new Tool. This will ensure all calculations are using the peak demand savings from the prior Tool rather than the calculated cells in the new Tool. *Note: If your End Use Load Profile, Energy Savings, and Weather Sensitive flags have not changed and the peak demand savings are calculated correctly, after you run the validation and the peak demand savings are calculated, columns P and Q in the new Tool should be identical to those in the old Tool.*

3. Copy cells **Q6 to W[last row of data]** from the older version of the Tool and paste them into **column R** at the bottom of the Measures worksheet of the new Tool.

Table 3| Importing from Older Tools: Step 2 and 3

P	Q	R	S	T	U	V	W
PEAK DEMAND SAVINGS (KW)	EFFECTIVE USEFUL LIFE (YEAR)	END USE LOAD PROFILE	INCREMENTAL LIFE CYCLE COST ($)	NET-TO-GROSS (ENERGY)	NET-TO-GROSS (DEMAND)	FIRST YEAR NATURAL GAS SAVINGS (MMBtu)	FIRST YEAR WATER SAVINGS (Litre)

P	Q	R	S	T	U	V	W	X
PEAK DEMAND SAVINGS (KW) OVERRIDE	PEAK DEMAND SAVINGS (KW)	EFFECTIVE USEFUL LIFE (YEAR)	END USE LOAD PROFILE	INCREMENTAL LIFE CYCLE COST ($)	NET-TO-GROSS (ENERGY)	NET-TO-GROSS (DEMAND)	FIRST YEAR NATURAL GAS SAVINGS (MMBtu)	FIRST YEAR WATER SAVINGS (Litre)

4. Copy cells **AF6 to AI[last row of data]** from the older version of the Tool and paste them into **column Y** at the bottom of the Measures worksheet of the new Tool.
5. Copy cells **X6 to X[last row of data]** from the older version of the Tool and paste them into **column AC** at the bottom of the Measures worksheet of the new Tool.

Table 4| Importing from Older Tools: Step 3 and 4

X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
EARLY REPLACEMENT	REMAINNG USEFUL LIFE (YEARS)	REMAINNG USEFUL / ANNUAL DEMAND SAVINGS	REMAINNG USEFUL / ANNUAL ENERGY SAVINGS	REMAINN / LIFE PEAK DEMAND SAVINGS (KW)	REMAININ / NATURAL GAS SAVINGS (MMBtu)	REMAININ / LIFE WATER SAVINGS (Litre)	REMAINING USEFUL / INCREMENTAL LIFE CYCLE COST ($)	Weather Sensitive Peak Demand	Distribution (Dx) or Transmission (Tx) Connected	Behind the Meter Project (True/False)	IESO Variable Program Costs

Y	Z	AA	AB	AC	AD	AE	AF	AG	AH
					STEP DOWN 1				
Weather Sensitive Peak Demand	Distribution (Dx) or Transmission (Tx) Connected	Behind the Meter Project (True/False)	IESO Variable Program Costs	EARLY REPLACEMENT	STEP DOWN 1: YEAR #	STEP DOWN 1: ENERGY SAVINGS (KWH)	STEP DOWN 1: PEAK DEMAND SAVINGS (KW)	STEP DOWN 1: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 1: INCREMENTAL LIFE CYCLE COST ($)

6. If you have an early replacement measure:
    a. Copy cells **Y6 to Y[last row of data]** from the older version of the Tool and paste them into **column AD** at the bottom of the Measures worksheet of the new Tool.
    b. Copy cells **AA6 to AC[last row of data]** from the older version of the Tool and paste them into **column AE** at the bottom of the Measures worksheet of the new Tool.
    c. Copy cells **AE6 to AE[last row of data]** from the older version of the Tool and paste them into **column AH** at the bottom of the Measures worksheet of the new Tool.

Table 5| Importing from Older Tools: Step 5

X	Y	Z	AA	AB	AC	AD	AE
EARLY REPLACEMENT	REMAINNG USEFUL LIFE (YEARS)	REMAINNG USEFUL LIFE ANNUAL DEMAND SAVINGS (KW)	REMAINNG USEFUL LIFE ANNUAL ENERGY SAVINGS (KWH)	REMAINNG USEFUL LIFE PEAK DEMAND SAVINGS (KW)	REMAINING LIFE NATURAL GAS SAVINGS (MMBtu)	REMAINING USEFUL LIFE WATER SAVINGS (Litre)	REMAINING USEFUL LIFE INCREMENTAL LIFE CYCLE COST ($)

AD	AE	AF	AG	AH	AI	AJ	AK	AL	AN	AO	AP	AQ	AR
	STEP DOWN 1				STEP DO...					STEP DOWN 3			
STEP DOWN 1: YEAR #	STEP DOWN 1: ENERGY SAVINGS (KWH)	STEP DOWN 1: PEAK DEMAND SAVINGS (KW)	STEP DOWN 1: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 1: INCREMENTAL LIFE CYCLE COST ($)	STEP DOWN 2: YEAR #	STEP DOWN 2: ENERGY SAVINGS (KW)	STEP DOWN 2: PEAK DEMAND SAVINGS (KW)	STEP DOWN 2: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 3: YEAR #	STEP DOWN 3: ENERGY SAVINGS (KWH)	STEP DOWN 3: PEAK DEMAND SAVINGS (KW)	STEP DOWN 3: NATURAL GAS SAVINGS (MMBtu)	STEP DOWN 3: INCREMENTAL LIFE CYCLE COST ($)

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