

Optimal Energy Portfolio Screening Tool User Guide

For PST Version 2.07



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List of Abbreviations

BTU	British Thermal Unit
C&I	Commercial & Industrial
CFL	Compact Fluorescent Lamp
GWh	Gigawatt-Hour (10^9 Watts)
kW	Kilowatt (10^3 Watts)
kWh	Kilowatt-Hour
MMBtu	Million British Thermal Units
MW	Megawatt (10^6 Watts)
MWh	Megawatt-Hour
NDR	Nominal Discount Rate
NG	Natural Gas
O&M	Operations and Maintenance
PST	Portfolio Screening Tool
RAM	Random Access Memory
RIM	Ratepayer Impact Measure (RIM cost-effectiveness test)
RDR	Real Discount Rate
TJoule	TeraJoule (10^{12} Joules)
TRC	Total Resource Cost (total resource cost-effectiveness test)
VBA	Visual Basic for Applications (used to control the Excel application and perform calculations)

1. Introduction

In planning, budgeting, and managing the delivery of multifaceted energy efficiency efforts, it is necessary to examine the costs and benefits of energy-saving measures, both individually and relative to each other. It is also useful to organize them as a portfolio of programs and services. This facilitates market analysis, cost-effectiveness screening, and establishing priorities within the market to achieve overall goals. It also supports development of implementation strategies and tactics that are tailored to specific sectors of the market. The Portfolio Screening Tool (PST) was developed to facilitate such analyses.

The PST is a Microsoft Excel-based spreadsheet application used to support the planning, implementation and evaluation of electric and/or natural gas energy efficiency programs and services. The PST provides a transparent and systematic framework for calculating the cost effectiveness of a set of energy efficiency measures, programs, and portfolios in comparison to the conventional energy supply resources they displace. Starting at the highest level, the primary use of the PST is to help energy planners and policy makers examine the following questions:

- How much energy could be saved by implementing a specified portfolio of efficiency programs?
- How do the costs of efficiency investment compare to energy supply costs?
- What markets can the efficiency savings come from?
- What end uses and technologies are associated with the efficiency savings?
- How much do the costs, savings, technologies, and markets change over time?
- How can resources be allocated to maximize savings while meeting other policy objectives?
- What is the magnitude of environmental and non-energy benefits and costs associated with different types and levels of energy efficiency investment?

As a planning tool, the PST can be applied prospectively to measures, programs, and portfolios that are being developed or proposed. For evaluation purposes the PST can be used to track and account for the cost effectiveness of measures, programs, and portfolios as they are implemented.

This User Guide describes the workflow for using the tool, the structure of the PST, and the tool's inputs and outputs.

1.1. High-level Workflow

The PST evaluates the cost-effectiveness of energy efficiency measures by comparing the present values of measure costs and benefits, based on avoided generation capacity and energy costs, and avoided transmission and distribution costs. The PST takes into account the economic impacts of changes in measure energy consumption (electric, oil, natural gas and propane) and non-energy costs and benefits (e.g., labor and water).

The fundamental workflow for using the PST is shown in the following flow chart:

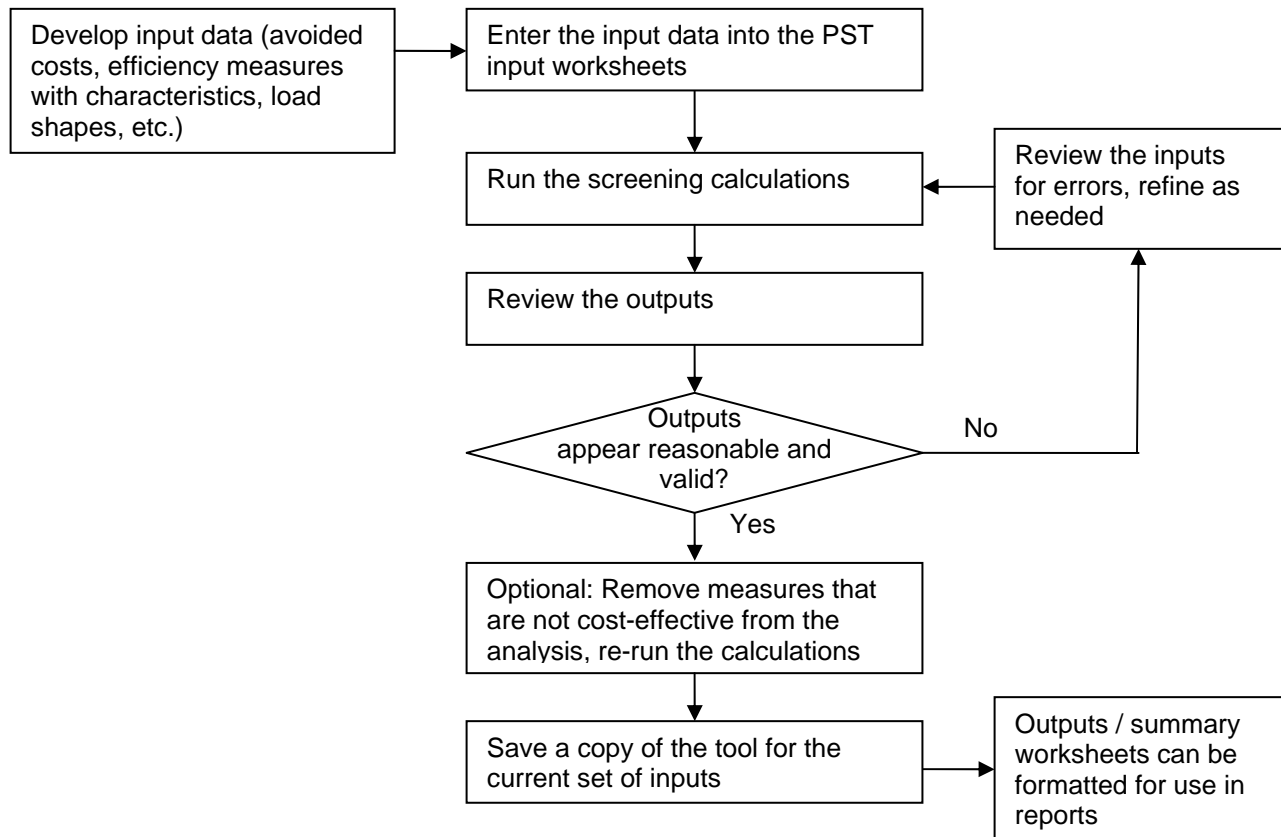


Figure 1. High-level workflow for using the Portfolio Screening Tool

The inputs, formulas, and outputs all reside in a single Excel workbook. To capture the analysis for a specific set of inputs, a copy of the workbook should be saved.

The next section provides detail on the actual tool calculations.

1.2. Screening Calculations Process

The inputs for cost-effectiveness screening include the efficiency measures grouped into sector-based programs, avoided costs (for savings of energy, demand, fossil fuels), load shapes, and penetration rates (baseline and due to programs). The inputs are described in detail in Section 3, including a summary on page 14.

The high-level flow chart below illustrates the screening model calculations sequence from inputs to intermediate results to summary results.

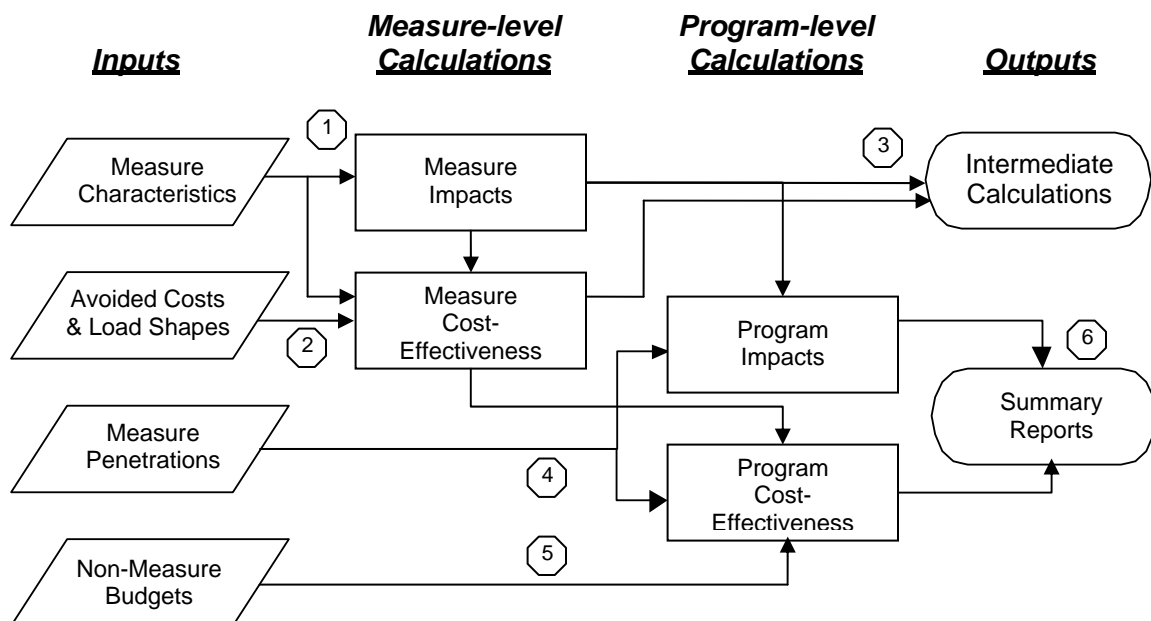


Figure 2. Portfolio Screening Tool calculations flow chart

The following steps refer to the flow points in the figure above:

1. Measure characteristics are used to compute each measure's impact in terms of electric and capacity savings (kWh and kW), fossil fuel savings, and other savings (water, wood, etc.). The impacts are computed by usage period.
2. Avoided costs are applied to each measure's impacts and load shape to determine the cost-effectiveness of each measure.
3. Intermediate measure-level calculations can be viewed as outputs after each run of calculations (e.g., on the 'MeasReview' output sheet). However, these calculations are *not* saved when the tool workbook is closed; they can be re-generated by re-running the calculations.
4. Measure penetrations are combined with the measure impacts and cost-effectiveness for all years of the analysis period and aggregated to determine total program impacts and cost-effectiveness.
5. Non-measure budgets (other than measure incentives) are included in calculations of program cost-effectiveness (for relevant cost-effectiveness tests).
6. Program-level computations are used to generate summary output reports.

The hierarchical structure of the PST allows for analysis of an individual energy efficiency measure, as well as a full portfolio of efficiency programs. In the latter case, the PST can account for the combined costs and savings for hundreds of measures simultaneously. These measures can be grouped into distinct programs serving various efficiency markets and opportunities. The time-differentiated energy and demand savings for each measure are inputs to the PST, along with measure cost information. Based on these inputs and avoided cost information (which is also user defined¹), the PST calculates the economic cost effectiveness of

¹ The calculation of electrical benefits is typically based on a specified set of detailed, year-by-year avoided energy, capacity, and transmission and distribution costs, developed for the purpose of assessing an example portfolio. The

individual measures from multiple economic perspectives. While providing highly detailed economic analysis of electric costs and savings, the PST also accounts for fossil fuel and other resource and non-resource savings associated with the analyzed measures.

Year-by-year implementation/participation rates can be modeled in the PST, which, together with inputs on program service and implementation costs, allows cost-effectiveness analysis of an implementation that includes non-measure costs such as marketing, administration, and evaluation.

The PST's intermediate results and summary reporting capability includes annual incremental and cumulative energy and capacity savings, benefits and costs, and avoided emissions. Review of these results by individual measure as well as at the program and portfolio level allows the user to verify expected outcomes and troubleshoot or fine tune analyses at the micro and macro level as necessary. Summary reports and tables can be easily exported for use in written reports.

The analysis period can extend for up to 20 years, including program years and market effect years. Currently 1000 measures can be screened at one time, and the costs and savings for those measures may be different for each year that measures are installed (up to 20 years). If necessary, the number of measures can be expanded (though this would affect the tool performance). The PST can screen new equipment having up to two replaceable components with different economic lives. These and other input parameters are summarized in Section 2.5 on page 11.

1.3. Cost-effectiveness Tests

The PST applies standard practices to account for the benefits and costs of efficiency measures and programs in cost-effectiveness tests. These cost-effectiveness tests are based on methodologies outlined in the California Standard Practice Manual: Economic Analysis of Demand-side Programs and Projects². For each test, cost-effectiveness can be determined in terms of the net benefits (gross benefits minus gross costs) or the benefit-cost ratio (gross benefits divided by gross costs).

The following cost-effectiveness tests are supported by the PST:

- Societal Cost Test (SCT)
- Total Resource Cost Test (TRC)
- Electric System / Utility Test (Electric Program Administrator test)
- Natural Gas System / Utility Test (Natural Gas Program Administrator test)
- Electric Rate Impact Measure (RIM) Test
- Participant Test
- Program Efficiency (a non-standard test).

The costs and benefits contributing to each test are summarized below in Table 1. Note that for measure-level cost-effectiveness tests, non-measure (i.e., non-incentive) costs due to program budgets are not included in the tests. Non-measure program budgets are only included at the program and portfolio levels.

avoided costs used in the PST can be changed to conduct sensitivity analyses of the results, or as market and resource conditions change the expected long-run avoided costs over time.

² California Standard Practice Manual: Economic Analysis Of Demand-Side Programs And Projects, July 2002, http://www.calmac.org/events/SPM_9_20_02.pdf

Table 1. Contributing factors to cost-effectiveness tests

Monetized Benefits / Costs	Benefits (B) and Costs (C) Contributing to Each Test ¹						
	Societal	Total Resource Cost (TRC)	Electric Utility System	Gas Utility System	Elec. Rate Impact Measure (RIM)	Participant	Program Efficiency ²
Measure cost (incremental - above baseline)	C	C				C	
Electric utility incentives			C		C	B	C
Electric utility non-measure program costs	C	C	C		C		C
Electric lost revenue / customer bill savings					C	B	
Electric energy & capacity (demand, transmission, distribution) savings	B	B	B		B		B
Natural gas utility incentives				C		B	C
Natural gas utility non-measure program costs	C	C		C			C
Natural gas savings or increased usage	B, C	B, C		B, C		B, C	B, C
Other fossil fuel savings or increased usage (non-natural gas)	B, C	B, C				B, C	B, C
Non-utility incentives ³	C	C				B	C
Non-utility non-measure program costs	C	C					C
Water / Wood / Other resource savings	B	B				B	B
Operations & Maintenance cost/savings	B, C	B, C				B, C	B, C
Other non-resource benefits ⁴	B	B				B	B
Early replacement deferral credit ⁵	B, C	B, C				B, C	B, C
Risk discount ⁵	B, C	B, C					
Electric externalities	B						
Fossil fuel externalities	B						

¹ “B, C” means an item can be configured as either a benefit or a cost on the ‘Screening Info’ sheet (see p. 16).

² The Program Efficiency Test is a non-standard test that is not included in the California Standard Practices Manual.

³ If non-utility incentives are used (configured in the ‘Screening Info’ sheet), these can be configured as to whether they affect Societal and TRC tests. See *Non-utility Contributors*, page 18.

⁴ Other non-resource benefits (one-time and annual, entered on the ‘Meas Non-Resource’ worksheet) can be excluded from the affected cost-effectiveness tests based on a configuration option on the ‘Screening Info’ worksheet.

⁵ As described for the ‘Screening Info’ worksheet (section 3.2, p. 14).

1.4. Real vs. Nominal Accounting and Discounting

The PST user should have a good understanding of real versus nominal dollars and discounting as applied to cost-benefit analysis and economic modeling. This section provides a brief overview of how these are applied in the PST calculations. Further information on the practice of economic analysis is beyond the scope of this User Guide.

Nominal dollar values refer to values in a specific year. For example, a cup of coffee cost about a dime in 1930 and about a dollar in 2000 – both of these are nominal values for their respective years.

Energy efficiency alternatives can only be meaningfully compared with the energy supply they avoid when all costs are stated in a common year’s dollars (i.e., the “real” value). The PST must be configured for a specific year’s real dollars as the “base year”. Therefore, “nominal” values of avoidable supply costs and energy efficiency measure and program costs (including equipment, installation labor, maintenance, fuel, and other costs) must be converted to the common base year’s real dollars. All costs and benefits must be expressed in the base year’s dollars. If the

PST must be modified to express benefits and costs in a different year's dollars, that change should only be done by an experienced user to assure all inputs (e.g., the avoided costs) are expressed in the same year's dollars.

The value of future benefits and costs are also discounted to the base year to account for the time value of money, i.e., even if inflation were zero, \$100 today has more value than \$100 in the future. Future costs and benefits are discounted using a Real Discount Rate (RDR). The RDR can be entered directly in the 'Screening Info' sheet, or it can be calculated by entering a Nominal Discount Rate and a Long-term Inflation Rate. The RDR does not include the effect of inflation since all dollar inputs and calculations are based on the base year's dollars.

Note that if the program years start before the base year for discounting, then dollar values from earlier years are compounded (increased) to the base year's dollars using the RDR.

Efficiency measures are typically installed throughout any given year (the program years in the PST can be calendar years or fiscal years). However, the costs and benefits for the first year of the measure life are all allocated to its installation year, even though the first year of the measure life may extend into the following accounting year. This is common practice when accounting for efficiency program savings, however users should be aware that it does have the effect of accounting for savings on average a half year before they occur.

Costs and benefits are discounted differently depending on when they occur. Costs incurred at the time of installation (e.g., incentive & incremental cost) are immediate costs and are thus discounted a whole number of years to the base year. (One-time non-resource benefits, like productivity gains, are also considered immediate.) The discounting calculation in this case is:

$$\text{Base_Year_Value} = \text{Install_Year_Value} / \text{RDR}^{(\text{Install_Year} - \text{Base_Year})}$$

Note that if the first program year is also the base year for discounting, then there is no discount to installation costs in that year since they're already in the base year's dollars.

Benefits and costs that are realized throughout the measure's first year (e.g., due to energy savings, or operation and maintenance costs or savings) are assumed to occur on average half way through the year. These benefits and costs are therefore discounted by a half year to align with the initial installation costs. The discounting calculation in this case is:

$$\text{Base_Year_Value} = \text{Install_Year_Value} / \text{RDR}^{(\text{Install_Year} - \text{Base_Year} - 0.5)}$$

1.5. Summary of Key Features

In the context of the workflow described above, the most important features of the PST include:

- Proper accounting for the benefits of electric energy and demand savings from efficiency, load control and renewable technologies, calculated using annual values of long-run avoided costs;
- Full accounting of technology costs, including capital, fuel, operating and maintenance, and cost offsets such as non-electricity savings (e.g., natural gas) and non-energy benefits (e.g., operations and maintenance, or water);
- Precise treatment of various timing effects, including different equipment lifetimes, multiple electricity costing periods, and proper handling of cost and savings shifts over

time due to early-retirement retrofits of existing inefficient equipment with high-efficiency technologies; and

- The capacity to conduct in-depth treatment of long-term market effects, including changes in technology costs and performance over time (e.g., reductions in technology costs due to market transformation), and projections of market penetrations under business-as-usual and under different policy initiatives.

In this light, the PST can provide a valuable analytic framework and functional platform for planning, review, and development of efficiency programs and market intervention strategies and help to support cost effective implementation.

2. Portfolio Screening Tool Structure and Specifications

2.1. Worksheet Structure

The PST is an Excel workbook made up of more than two dozen linked worksheets. The input sheets (with yellow tabs) are located on the left side of the workbook, where information is entered on costs and savings, measures with their lifetimes and other characteristics, load shapes, program budgets, and market penetration rates. Output sheets are located to the right. Intermediate calculation results can be reviewed as part of the outputs, as further described below.

Figure 3 shows the ‘Screening Info’ sheet with the Screening toolbar (further described in section 2.2). The toolbar ‘Inputs’ drop-down helps the user navigate through the required input pages. The inputs can be entered in any order, and some sheets (e.g., ‘Avoided Costs’) will only need to be set up once for each program year.

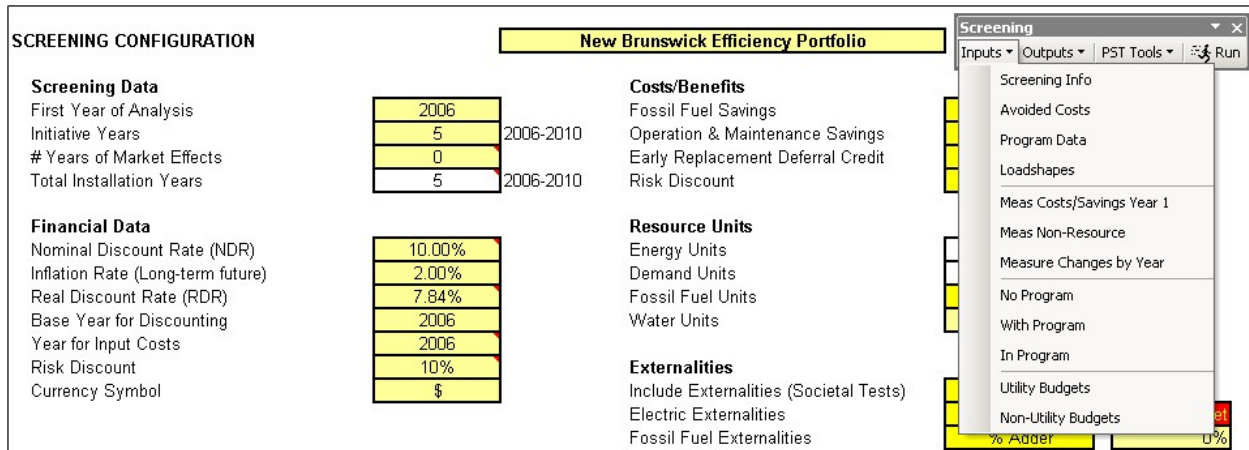


Figure 3. ‘Screening Info’ worksheet with Screening Toolbar

The worksheets that follow the input sheets – beginning with the “Review” sheet – provide summary results. The ‘Tool Notes’ sheet to the far right contains an index of the workbook sheets, the last revision date of the model and other notes regarding the screening tool. Table 2, below, provides a brief description of each worksheet, in the order in which they appear from left to right.

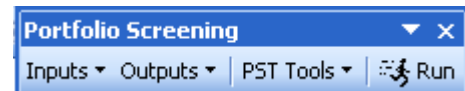
Table 2. List of worksheets and their functions

SHEET NAME	SHEET FUNCTION
INPUT SHEETS	
Screening Info	Screening-level inputs (program duration, discount rate, base year, etc.)
Avoided Costs	Avoided costs, line losses, externalities, emission factors
Program Data	Program codes/names with corresponding type and sector
Load Shapes	Load shapes and coincidence factors used in the measure characterizations
Meas Cost & Save Yr1	Characterizations (costs, savings, life, etc.) for efficiency measures installed
Meas Non-Resource	Characterizations for measures installed (O&M and other non-resource savings)
Meas Cost & Save Changes	Changes in measure characterizations by year
No Program	Number of measures installed by year if the program did not exist
With Program	Number of measures installed by year with the program
In Program	Number of measures installed by those that participated in the program (i.e. received an incentive)
Penetration Profiles	Penetration curves that can be selected for each measure in the 'In Program' sheet
Elec Budgets	Electric utility program costs
Gas Budgets	Natural gas utility program costs
Non-Utility Budgets	Non-utility program costs (configured in the 'Screening Info' sheet as the first non-utility contributor)
OUTPUT AND SUMMARY SHEETS	
Penetrations	Summary with graph of the penetrations by year for a selected measure
Budgets Summary	Summary of program budgets
MeasReview	Main review of energy savings, benefits and costs results by individual measure (not including penetration rates)
MeasScrn	Results of measure screening and cost effectiveness NPV by installed year, calculated from inputs
MeasSaveYr	Results of measure energy savings calculations by year, calculated from inputs
Program Cost-Effect	Summary of program cost-effectiveness, by measure and total (Societal/Total Resource, Electric & Gas System)
BenefitsCosts Review	Summary of Benefits and Costs by year and by Societal/Total Resources, Electric and Gas System
Net Benefits	Summary of program cost-effectiveness by year, cumulative and annual (Societal/Total Resource, Electric & Gas System)
Costs Summary	Summary of program costs
Benefits Summary	Summary of program benefits, by component (energy, capacity, fossil fuel, etc)
Energy Summary	Energy saved by measure and year, calculated from inputs in other sheets
Electricity Savings	Summary of energy and peak electricity savings by program, and weighted average lifetime of savings by program
Elec Utility Costs	Summary of electric program non-incentive costs
Elec Utility Cost per kWh	Levelized program costs per kWh for each program year
Economic Cost per kWh	Levelized societal (or total resource) costs per kWh for each program year
Elec Utility Benefits	Electric system net benefits and benefit/cost ratio by program
Economic Benefits	Societal (or total resource) net benefits and benefit/cost ratios by program
Gas Savings	Natural gas savings
Gas Saving	Natural gas savings as % of sales
Emissions	CO ₂ , SO ₂ and NO _x emissions reductions by program
Report	Consolidated output report created using a pivot table from the results data
Elec Rate Impact	Electric rate impacts used for calculating the Rate Impact Measure test
Elec Savings by Period	Electric savings by energy period, by year

2.2. Portfolio Screening Toolbar

The PST toolbar provides the following functions:

- Quick navigation to the PST worksheets ('Inputs' and 'Outputs' menus)
- Several PST Tools
- The 'Run' button for performing the PST calculations.



The PST Tools include:

Zoom all worksheets... Select a magnification and zoom all worksheets at the same time.

Configure worksheets... Enables the user to select individual worksheets to show/hide. The user can also choose to prevent calculations for some worksheets, which decreases the time needed to run the calculations. A sheet is automatically hidden if its calculations are prevented.

Show/Hide all comments (this sheet). Some sheets have many comments. This tool is useful for quickly reviewing those comments.

Hide measure rows... On the 'Meas Cost & Save Yr1' sheet, select any cells in the rows of measures you wish to hide, then select this option. The measure rows will be hidden on **all** measure-based sheets ('Measure Non-Resource', 'MeasReview', etc.). This is intended to be used **only** for unused measure rows - hiding valid measures does **not** remove them from the analysis calculations.

Unhide measure rows... On 'Meas Cost & Save Yr1', select cells that span any hidden rows (e.g., click and drag over the hidden rows), then select this menu item to unhide those measure rows on **all** measure-based sheets.

Clear inputs and outputs... Used to clear (erase) the user inputs and the calculated outputs for selected worksheets. You cannot "undo" these changes, so make sure you have a backup of any inputs/outputs you wish to keep.

Copy measures from another PST... Used to copy measure-level inputs from another PST into the active PST. The user selects the PST to be copied from (it must be open), and the start row where the measure inputs will be pasted (only values are pasted, not formulas). All measures having measure names are copied from the source PST, for worksheets 'Meas Cost & Save Yr1', 'Meas Non-Resource', 'Meas Cost & Save Changes' (optional), 'No Program', 'With Program', and 'In Program'.

Add measure rows... Enables the user to add new measure rows across all measure-level worksheets. The users selects a row in the 'Meas Cost & Save Yr1' sheet and enters the number of rows to be added above the selected row. For each measure-level worksheet, the values in the row above the selected row are copied down into the new rows, thus you should normally select a row beneath an empty measure row. The measure numbers in the far-left column are automatically updated to be sequential.

Delete measure rows... Enables the user to delete a set of measure rows across all measure-level worksheets. The rows selected on the 'Meas Cost & Save Yr1' sheet will be deleted. The measure numbers in the far-left column are automatically updated to be sequential.

Show version and license agreement. Show the PST version and Optimal Energy, Inc. license agreement for use of the PST.

User Guide. Launch and display the PST User Guide. The filename and path must be entered in the 'Screening Info' sheet.

The 'Run' button is described below in section 2.4.

Forcing Excel to show all menu commands. By default, Excel's toolbars only list the commands that have been recently used (starting with Excel 2000). If you would like all menu commands to be displayed when a menu is clicked, including on the Screening toolbar, follow these steps:

1. Select View | Toolbars | Customize from the Excel menu bar.
2. Click on the Options tab.
3. Depending on the Excel version, check "Always show full menus, or uncheck "Menus show recently used commands first".

2.3. Worksheet Protection

The workbook has been protected so users can only change the contents of the yellow cells to prevent accidental entries into cells with formulas. It is recommended that worksheets remain protected to prevent inadvertent corruption of the PST. However, in some cases it may be necessary to unprotect a worksheet (e.g., to make formatting changes). To unprotect any sheet, choose Tools / Protection / Unprotect Sheet from the Excel menu bar. (For further security in preventing unwanted changes, the PST can be modified to require a password in order to unprotect the sheets.)

The ability to select non-input cells is also restricted due to limitations of Excel.

2.4. Running the Calculations to Generate Outputs

Once all the inputs have been entered, and after any changes to the inputs, the tool needs to be "run" to execute the calculations and write the results to the output worksheets. Simply click on the "Run" button on the screening tool menu to execute the calculations.



The calculations must be run manually to refresh the outputs any time the inputs are updated. As well, some of the outputs (e.g., the 'MeasReview' sheet) display intermediate calculations that do not persist when the PST (or Excel) is closed. Running the calculations will refresh these outputs.

The "Run" button invokes Visual Basic routines that carry out many of the calculations, as further described in the next section.

2.5. Cut, Copy and Paste Functions

Excel's cut, copy and paste functions can easily cause problems when used on the input sheets. By default, Excel will cut or copy cell formulas, formatting, conditional formatting, data validation, comments and named ranges. If these are cut from or pasted to the input sheets, those features of the input sheets can be lost. Worse yet, named ranges may be moved that could cause errors in the PST's calculations.

To avoid cut-and-paste errors, users should rely instead on copy and paste, even if this means having to then delete the original, copied values in a separate step. As well, users should use "paste special" (under the Edit menu) to paste values, and thus avoid accidentally pasting

conditional formatting or other cell features. More experienced users who choose to use Excel's default cut/copy/paste must take care not to impact the integrity of the tool inputs and outputs.

2.6. Use of Visual Basic for Applications

Visual Basic for Applications (VBA) is a programming language that comes bundled with Microsoft Excel. VBA is used by the PST for application control, data validation and protection, and for carrying out most of the screening calculations. When the calculations are run, intermediate calculations are stored in memory, thus they do not persist when the application is closed (they can be re-generated by re-running the calculations).

The primary purpose for using the VBA code is to reduce the size of the workbook and to increase the speed of screening calculations.

The VBA code is closely intertwined with the Excel formulas in the spreadsheet. Therefore, users should not modify the spreadsheet formulas unless directed to do so by this User Guide. See also Section 5 on PST Support.

2.7. Limits for Numbers of Inputs

The PST has the following limits for numbers of inputs. These limitations cannot be changed by end users, but instead require development updates to the PST.

		<u>Worksheet</u>
20	Number of program years + market effect years	'Screening Info'
20	Number of program years (if market effect years = 0)	'Screening Info'
30	Number of programs	'Program Data'
5	Number of sectors	'Avoided Costs'
6	Number of electricity usage periods (e.g., Summer Peak, Winter Peak, etc.)	'Avoided Costs'
4	Number of electric capacity / demand categories	'Avoided Costs'
16	Number of fossil fuel categories	'Avoided Costs'
200	Number of load shapes	'Load shapes'
Varies ¹	Number of efficiency measures	'Meas Cost & Save Yr1'
3	Number of fossil fuel types/impacts per measure	'Meas Cost & Save Yr1'
2	Number of separate measure components (or maintenance tasks) for a measure's Operation and Maintenance costs	'Meas Non-Resource'
20	Number of custom one-time non-resource benefits	'Meas Non-Resource'
20	Number of custom annual non-resource benefits	'Meas Non-Resource'

¹The number of efficiency measures is limited only by Excel. The user can add or remove measure rows using the PST tools (see the Portfolio Screening Toolbar, p. 10).

2.8. Software and Hardware Requirements

The screening tool has been developed and maintained in Microsoft Excel 2003. It has not yet been tested on Excel 2007.

A Pentium™ III-class processor or similar is recommended with at least 1 GHz processor speed, with at least 512 MB of RAM. With large numbers of measures the speed of calculations and

other spreadsheet operations will decrease. Increasing the RAM or processing speed of the computer will increase the performance.

The PST has not been tested on the Apple platform.

3. Portfolio Screening Tool Input Sheets

The user should generally begin entering inputs in the 'Screening Info' sheet and continue to the adjacent sheet to the right until all of the inputs are completed, including the program budgets. Below is a summary of the tool inputs, followed by a detailed description of each of the input worksheets. These are best reviewed while viewing the sheets in the PST.

3.1. Summary of Tool Inputs

The inputs for cost-effectiveness screening can be summarized as follows:

- Analysis period (first year of analysis, # of program years, # of market effect years)
- Financial inputs (real or nominal discount rate, inflation rate, base year for discounting)
- Avoided costs for energy saved by time period
- Zones for separate sets of avoided costs that can be allocated across programs
- Avoided costs for fossil fuel and other resource savings
- Avoided costs due to electric and fossil fuel externalities
- Line-loss factors (% of meter) by sector
- Greenhouse gas emissions impacts (metric tons / MWh)
- Load shapes for allocating energy and capacity savings across time periods
- Measures with their characteristics (lifetimes, incentives, load shape, energy and demand savings, fossil fuel savings, operation & maintenance components, non-resource benefits, etc.)
- Program for each measure
- Changes to measure costs and savings at any point in the analysis period
- Measure penetrations, or installation rates, for each year of the program period, for the baseline (no program) and with programs.

3.2. 'Screening Info' Worksheet

This sheet is used to configure the PST for a specific screening project, including general economic and cost-effectiveness assumptions.

Organization Name

At the top of the worksheet, enter the name of the organization delivering the energy efficiency programs. This name will appear in the header of some of the output sheets. This input is for information and labeling only.

First Year of Analysis

Enter the first year of program operation that this cost-effectiveness analysis is covering. This is not necessarily the first year that the program began, but rather the first year of this analysis.

Program Years

Enter the number of program years included in the cost-effectiveness analysis, during which the programs are actively running.

of Years of Market Effects

Market effects resulting from the program may extend beyond the program years. For example, after a program is completed, contractors may offer and promote new efficiency options as a result of the program. As an illustration, the graph below shows the penetrations for an efficiency measure with and without a program in place, for a five-year program. After five years, installs decline briefly but then continue to increase well above the rates expected if no program was put in place.

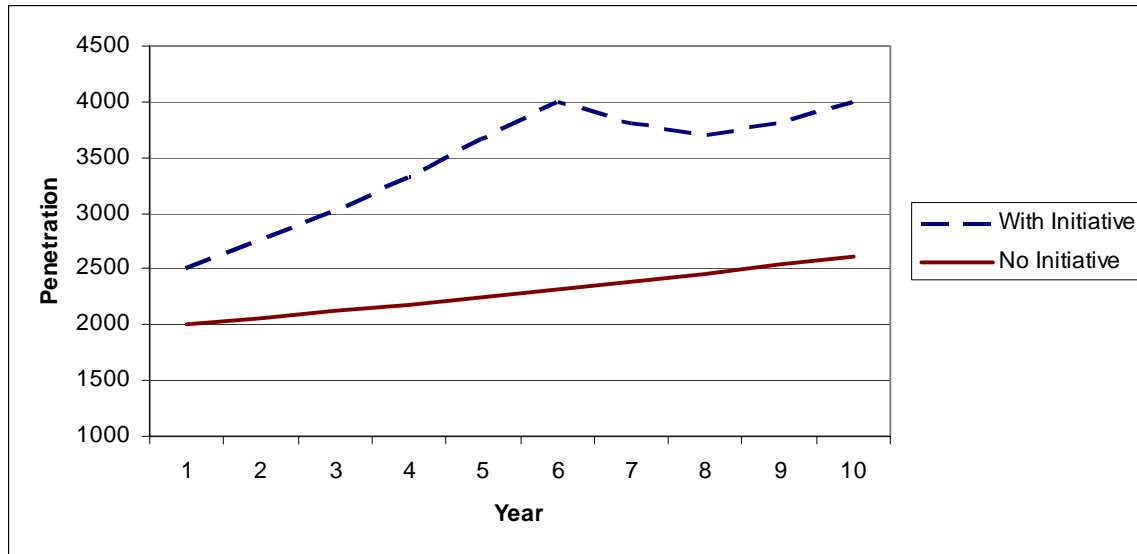


Figure 4. Illustration of market effects.

To capture post-program market effects, enter the number of years following the program to include in the cost-effectiveness results. If zero is entered, only the impacts of the program years are counted, and the benefits beyond the program years will be ignored.



If market effects are to be captured, the penetration rates must reflect that there are no “In Program” installations after the program years. Therefore, you cannot use the free rider/spillover method for specifying penetrations, because with this method there is no way to specify penetrations with no program in place. Instead, you must use the “No / With / In Program” method. See section 3.9, page 32, on specifying penetration rates.

Total Installation Years

This is a calculated cell – the sum of the program years and market effect years. It cannot be greater than 20 years.

Nominal Discount Rate (NDR)

The nominal discount rate is used to calculate the real discount rate used in calculating the cost-effectiveness results.

Inflation Rate

This input is the projected long-term future inflation rate. It is used by the PST only for calculating the real discount rate from the nominal discount rate, or vice versa if a real discount rate is entered.

Real Discount Rate (RDR)

This cell is calculated from the nominal discount rate and inflation rate inputs. The formula is:

$$\text{RDR} = (1 + \text{NDR}) / (1 + \text{InflationRate}) - 1$$

Base Year for Discounting

All costs and benefits are discounted back to this year. It is normally the same as the “First Year of the Analysis,” but could be different, if needed.

Year for Input Costs

Costs entered into the screening tool (e.g., avoided costs) need to be in this year’s dollars. Typically this will be the same as the “Base Year for Discounting”, but can be different. For example, suppose an analysis was performed for which the “First Year of Analysis,” “Base Year for Discounting,” and “Year for Input Costs” were all set to 2005. An analysis could be run in the following year, but in 2005 dollars to avoid having to update the cost inputs. In this case the “First Year of Analysis” and “Base Year for Discounting” could be changed to 2006, while leaving the “Year for Input Costs” set to 2005.

Risk Discount Factor

A Risk Discount Factor can be used to reflect the risk-mitigating advantages of energy-efficiency programs. Such advantages may include the ability to acquire resources in stages, and the tendency of efficiency savings to vary directly both with hourly load fluctuations and cyclical and secular economic trends.

For each efficiency measure, risk discount costs are calculated by applying the Risk Discount Factor to the incremental installed cost, any operation and maintenance costs, and any deferred replacement credit. The societal or total resource cost-effectiveness test costs are then reduced by the risk discount costs. If configured as a benefit, the risk discount costs are added to the societal or total resource benefits (see *Costs/Benefits*, below).

Currency Symbol

The currency symbol entered here will be used throughout the tool.

Labels

The inputs in this section affect the labels displayed elsewhere in the application (e.g., as column or row headers). The “Program” label is typically set to “Program” or “Initiative”. The “Program” abbreviation is typically “Prgm” or “Init.”

Costs/Benefits

The inputs in this section allow the user to determine whether certain economic details will be counted in the cost or benefit category. In the case of fossil fuels, the “Costs & Benefits” choice counts savings as a benefit and increased usage as a cost. The “Early Replacement Deferral Credit” is described under section Data Only for Early-retirement Retrofit *Measures*, page 27.

The choice of cost or benefit doesn’t affect the net benefits (the primary cost-effectiveness metric) since a cost is a negative benefit and vice versa. Nor does it affect whether the

benefit/cost ratio (BCR) is greater than or less than one. However, increasing (or decreasing) the benefits relative to the costs will increase (or decrease) the magnitude of the BCR.

Resource Units

Electric, fossil fuel, and water units are defined in this section. The avoided costs entered in the 'Avoided Costs' sheet must be in these same units. Note that energy units must be in kWh, and demand in kW, as some calculations require input values to be in these units.

Include Externalities (Societal Tests)

If set to "Yes", electric and fossil fuel externalities are added to total resource costs and benefits and "Societal" screening tests are displayed in the outputs. If set to "No", the externalities are not included with total costs and benefits and "Total Resource" costs and benefits are displayed in the outputs. Externalities are only included in societal cost-effectiveness tests. See the table of factors contributing to cost-effectiveness tests in section 1.3, page 4.

Electric and Fossil Fuel Externalities

Electric and fossil fuel externalities may be calculated as either a percentage adder to the energy impacts or by applying user-defined values in the 'Avoided Costs' sheet. These have no effect on cost-effectiveness tests if "Include Externalities (Societal Tests) is set to "No".

Cost-effectiveness Test

The cost-effectiveness test selected here is used to determine if a measure is cost-effective based on its net benefits, as invoked by the "Update 'Include in Calc's'" Button (p. 25). The routine invoked by that button can be used to exclude non-cost-effective measures from being included in program-level outputs.

Include other non-resource benefits in total benefits?

The "other" non-resource benefits include any special one-time and annual non-resource benefits entered on the 'Meas Non-Resource' sheet. These could include, for example, increased productivity, price effects or macroeconomic effects, etc.

This toggle allows the user to include or exclude these non-resource benefits from the affected cost-effectiveness tests, as shown in Table 1 on page 5. Typically the non-resource benefits would be included in the total benefits, but there may be cases where users wish to exclude these. This setting does not affect any Operations & Maintenance benefits.

If set to Yes, the non-resource benefits are included in total benefits shown as either "Total Resource" or "Societal" benefits (depending on whether externalities are included, as described above for "Include Externalities"). The Total Resource or Societal benefits appear in the following outputs: 'MeasScrn', 'MeasReview', 'BenefitsCosts Review', 'Program Cost-Effective', 'Net Benefits', and 'Benefits Summary (including the "Non-Resource Savings" column). They are also included in the total benefits for the Participant and Program Effectiveness Tests.

If set to "No", the one-time and annual non-resource benefits defined in the 'Meas Non-Resource' sheet show up only in the 'Benefits Summary' output table, in the "Non-Resource Savings" column, and the "Individual Non-Resource Benefits" columns if displayed (see "Output individual non-resource benefits?" below).

If set to "No", and non-resource benefits were entered for at least one measure, then the following warning:

"Non-resource benefits were not included in the total benefits"

is displayed at the top of the following output worksheets:

'MeasReview', 'MeasScrn', 'Program Cost-Effect', 'BenefitsCosts Review', 'Net Benefits', 'Benefits Summary', 'Economic Cost per kWh' 'Economic Benefits', 'Report'.

Output individual non-resource benefits?

This switch enables the user to display specific non-resource benefits (defined in the 'Meas Non-Resource' sheet) in the 'Benefits Summary' output table. If set to Yes, the first two one-time non-resource benefits, and the first two annual non-resource benefits, will be displayed as separate columns in the 'Benefit Summary' table. If set to no, these columns will not be displayed.

Enable multiple zones?

If set to Yes, the user will be able to define up to 15 geographic zones with different electric avoided costs for each zone. The avoided costs can then be allocated across zones for each program. This enables the definition of programs by specific zones which may have different avoided costs. The user can also enter separate retail prices by sector (for the participant test) for each zone.

The zones are defined in the 'Program Data' sheet, as described for that worksheet (page 22).

Once the zones are defined, the electric avoided costs can then be entered for each zone in the 'Avoided Costs' sheet (the input areas for additional zones appear beneath the Electric Avoided Costs area). Note that the zone definition input cells in the 'Program Data' and 'Avoided Costs' sheets are only displayed if "Enable multiple zones?" is set to Yes.

Non-utility Contributors

Incentive contributions from up to three non-utilities can be configured here. Leave these labels as "Unused" if there are no non-utility contributors.

Each configured non-utility contributor can provide incentives for efficiency measures, entered in the 'Meas Cost & Save Yr1' sheet. The total non-utility contributions are output by program in the 'Costs Summary' sheet. The first label also represents the entity for which budgets can be entered in the 'Non-Utility Budgets' sheet. The labels entered here for non-utility contributors are used in the respective columns and headings for the affected worksheets.

For each non-utility contributor you can also specify whether the incentives will affect the societal or total resource tests. Ordinarily incentives are considered transfer payments from one party to another and thus have no affect on cost-effectiveness tests done from a societal or total resource perspective. However, in some cases one may define the boundaries of "society" to exclude incentives from outside the boundary. Thus by default these options would have a value of "No". If a non-utility contributor is configured to affect societal/total resource tests, then any incentives from that contributor will be subtracted from the total costs.

User Guide PathName

Enter the full path and name of the User Guide file. For example:

C:\Tools\Portfolio Screening Tool\PST User Guide.pdf

If entered, the User Guide can be accessed via Screening toolbar (PST Tools menu). You can enter any Universal Resource Locator (URL), as long as the file type (e.g., PDF) will be recognized by your Microsoft Windows operating system.

3.3. 'Avoided Costs' Worksheet

Avoided costs are used to determine the monetized value of electric, fossil fuel and other resource savings (or increased usage) associated with efficiency measures. The avoided costs and related inputs entered on this input sheet include the following:

- Line losses
- Electric energy and capacity avoided costs
- Fossil fuel costs
- Water, wood and 'other' resource costs
- Ratepayer Impact Measure (RIM) test inputs
- Electric and fossil fuel externality costs (if used, per 'Screening Info' configuration)
- Electric and fossil fuel emissions factors.

Electric Energy and Capacity Avoided Costs

In the section for "Electric Avoided Costs without losses," begin by entering the labels for up to six energy (kWh) costing periods, and up to four capacity (kW) costing periods. Typical energy periods might be Summer Peak, Summer Off-Peak, Shoulder Peak, Shoulder Off-Peak, Winter Peak, Winter Off-Peak. The capacity periods for Summer and Winter Generating Capacity are hard-coded in the PST and can't be changed. The third and fourth capacity periods are optional but are typically used for Transmission Capacity and Distribution Capacity avoided costs.

The exact hours and days for each seasonal costing period should be well-documented for a project (e.g., Summer Peak might be weekdays from 11:00 AM to 9:00 PM, June through September). For energy costing periods these must account for all hours and days of the year. These costing periods correspond to the load shapes that are used to distribute electric savings across the year for each measure, for applying the appropriate avoided costs (see section 3.5, p. 23).

The electric avoided costs are entered in the table beneath the costing period labels, and must be entered in the "Year for Input Costs" defined in the 'Screening Info' sheet. The avoided cost years must include the first year of analysis (configured in 'Screening Info'), and must extend for at least the total installation years plus the longest measure lifetime.

If multiple zones are being used (as configured in 'Screening Info'), then the electric avoided costs must be entered for each zone (see *Enable multiple zones?*, page 18).

Note that depending on available supply, energy efficiency programs may result in saved energy that can be sold into the market. In this case, the electric avoided costs should reflect the value of selling any freed-up energy supply into the market.

Line Loss Factors by Sector

This section is where sectors are defined and entered for the cost-effectiveness screening. Each efficiency program defined in the 'Program Data' sheet (page 22) is allocated to one of these sectors.

Sectors	LINE LOSS FACTORS (% of meter)									
	Winter Peak	Winter Off-Peak	Summer Peak	Summer Off-Peak	not used energy	not used energy	Summer Gener. Capacity	Winter Gener. Capacity	Transm. Capacity	Distribution Capacity
Residential										
Commercial										
Industrial										
Com/Ind										
All Sectors										

Figure 5. 'Avoided Costs' worksheet: sectors and line loss factors

The line loss factors are used to calculate the electric savings at generation from the savings at the customer level (at the meter). Line loss factors need to be entered for each sector and for all of the costing periods. The line loss factors should be expressed as a percent of meter-level usage:

$$\text{Savings at meter} * (1 + \text{line loss factor}) = \text{Savings at generation.}$$

End Use Fuel Costs

To enter fossil fuel avoided costs, start by entering the labels for each of up to 16 types of fossil fuel. Up to three of these fuel types can be selected for each efficiency measure to enter fossil fuel savings (or increased usage). For each fuel type, select the Fuel Class from the drop-down selector in the dark yellow input cells. The fuel classes are used to summarize fuel usage and emissions by fuel class.

The special fuel class "NG Peak Day" is used for natural gas impact analysis. The avoided costs for this class are those associated with reducing system loads on the peak day of natural gas usage.



When selected for an efficiency measure, the natural gas peak day usage must be a subset of the annual natural gas usage recorded for another natural gas type (e.g., "NG Space Heat").

The fossil fuel units will be those configured in the 'Screening Info' sheet. Enter the avoided costs in the "Year for Input Costs" (configured in 'Screening Info') for each of the analysis years.

Period/ Category:	1	2	3	4	5	6	7	8	9	10
	Res. Oil	Com. Oil	Res. Propane	Com. Propane	NG Baseload	NG Space Heat	NG DHW			
Fuel Class:	Oil	Oil	Propane	Propane	Nat. Gas	Nat. Gas	Nat. Gas			
Units:	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule	\$/GJoule
2006	18.48	14.78	33.83	27.07	21.21	21.21	21.21			
2007	17.80	14.24	32.59	26.07	20.46	20.46	20.46			
2008	17.45	13.96	31.95	25.56	16.08	16.08	16.08			
2009	17.84	14.37	32.66	26.13	13.93	13.93	13.93			

Figure 6. 'Avoided Costs' worksheet: end use fuel costs

Retail Fuel Cost Adders

Any costs entered here will be added to the fuel avoided costs, and will be included as a benefit or cost (depending on the configuration for fossil fuels on the 'Screening Info' sheet). For natural gas, any retail fuel cost adder will be included in the gas system test. Note that fossil fuel externalities can be entered separately on the 'Avoided Costs' sheet, as described below.

Other Resource Avoided Costs

Enter the avoided costs for Water, Wood and “Other” (as desired). These will be applied for any of these other resource savings defined for each efficiency measure in the ‘Meas Cost & Save Yr1’ sheet (page 24). The units for water are configured in the ‘Screening Info’ sheet.

		Other Resource Avoided Costs		
Period/ Category:		Water	Wood	Other
Units:		\$/litre	\$/cord	\$/unit
2006				
2007				
2008				

Figure 7. ‘Avoided Costs’ worksheet: other resource avoided costs

Electric and Fossil Fuel Externalities

Electric and Fossil Fuel Externalities are typically included to reflect the monetized societal benefits for emissions reductions or similar benefits to society. Externalities are only included in the societal cost-effectiveness tests, and only if configured to be included by the toggle in the ‘Screening Info’ sheet (see *Include Externalities (Societal Tests)*, page 17).

The user-defined electric externalities are defined for each costing period and year of analysis. Fossil fuel externalities are defined for each fuel category. All values must be entered in the “Year for Input Costs” configured in the ‘Screening Info’ sheet.

RIM Inputs

If the Ratepayer Impact Measure (RIM) test is to be used, enter the annual revenue requirements and annual native (retail) sales here. These are used in the ‘Elec Rate Impact’ sheet (page 43) to compute the base case average electric rates, which are then compared with the projected efficiency case to determine the potential impact of efficiency measures on electric rates.

		RIM INPUTS	
		Base Case	
Period/ Category:		Annual Revenue Requirement (2006\$)	Annual Native Sales
Units:		\$million	GWh
2006			
2007			
2008			

Figure 8. ‘Avoided Costs’ worksheet: RIM inputs.

Emissions Coefficients

Enter coefficients for the quantity of emissions of CO₂, NO_x and SO₂ corresponding to electric and fossil fuel savings. For fossil fuels the coefficients must be consistent with the fossil fuel units configured in the ‘Screening Info’ sheet.

				EMISSIONS IMPACTS		
				CO ₂	NO _x	SO ₂
Electric Impacts (metric tons/MWh)						
Nat Gas Impacts (metric tons/GJoule)						
Oil Impacts (metric tons/GJoule)						

Figure 9. 'Avoided Costs' worksheet: emissions coefficients

Emissions factors can be selected that apply only to the direct combustion of fossil fuel (which applies indirectly to electric savings depending on the generation source), or which include estimated emissions due to the “upstream” production and refinement of each fuel. For example, direct complete combustion of gasoline generates 19.6 lbs CO₂/gallon, but is estimated to generate 36.0 lbs CO₂/gallon if you take into account the full fuel cycle³. Whichever method is chosen, the coefficients should be consistent for electric energy and fossil fuels.

3.4. 'Program Data' Worksheet

The data entered on this sheet is used throughout the tool to reference the programs. In particular the 'Report' sheet subtotals the results by Sector, Program Type, and Program Name. Sector and Program Type are chosen from drop-down boxes. These boxes refer to the lists to the right of the Program Data section. The Sector list and data is entered in the 'Avoided Costs' sheet.

Use a mnemonic abbreviation for the Program Code, as this will be used for various inputs and outputs.

If the PST is configured to use multiple zones (see “Enable Multiple Zones?” for the 'Screening Info Worksheet, page 18), then the 'Program Data' worksheet will also display input areas for defining zones and allocating programs across zones, as shown in the figure below.

³ Federal Highway Administration, 1999, Summary of Travel Trends, 1995 Nationwide Personal Transportation Survey.

Init. #	Sector	Initiative Type	Initiative Name	Zone Allocations			
				Total %	North	Central	
1	All Sectors	Lost Opportunity	Retail Products	100%	50%	20%	30%
2	Residential	Lost Opportunity	Residential New Construction	100%	50%	20%	30%
3	Residential	Retrofit	Existing Homes	100%	50%	20%	30%
4	Com/Ind	Lost Opportunity	Commercial / Industrial - North	100%	100%		
5	Com/Ind	Lost Opportunity	Commercial / Industrial - Central	100%		100%	
6	Com/Ind	Lost Opportunity	Commercial / Industrial - South	100%			100%
7				0%			
8				0%			
9				0%			
10				0%			
11				0%			
12				0%			
13				0%			
14				0%			
15				0%			

Zone	Zone Code	Zone Description
1	North	Northern area
2	Central	Central area
3	South	Southern area
4		

Figure 10. 'Program Data' sheet - Zone definition and allocation by program

Zone Code

Enter a zone code that will be displayed under the zone allocations and on the 'Avoided Costs' worksheet.

Zone Description

Enter a description for each zone so that the area covered by the zone is clear (not used elsewhere).

Zone Allocations

For each program, the avoided costs can be assigned a percent allocation for each zone (the total allocation should be 100%). For each measure, the avoided costs will be determined by a weighted average using the allocations by zone specified for the program to which the measure belongs.

3.5. 'Load Shapes' Worksheet

The load shapes distribute the electric savings among the different costing periods shown in the 'Avoided Cost' sheet. The load shapes for all of the types of measures screened need to be entered in this sheet. Different measures may share the same load shape. For example, the same commercial indoor lighting load shape may be used for T8 fixtures and compact fluorescent fixtures. The load shapes entered in this sheet can be selected from a drop-down selector for each measure in the 'Meas Cost & Save Yr1' sheet.

Energy Distribution

Annual energy savings (kWh) will be divided between the cost periods according to the percentage inputs. The sum of these inputs must equal 100%. If the summation does not equal 100%, then the kWh check column will alert the user by turning red.

Capacity Coincidence Factors

Enter the seasonal capacity reductions as a percent of the maximum load reduction. Generation capacity savings are computed for normal seasonal peak conditions (e.g., cold weather in the winter and hot weather in the summer).

The peak reduction is the average reduction across the peak hours on a seasonal-peak day. In general, a measure's peak contribution in one winter (or summer) day will be very similar to its contributions in other days of that season. Peak conditions that may occur in one winter day can also occur in other winter days, and peak conditions in one summer day can occur in other summer days. In this case, winter generating capacity savings will be driven by the average savings in the listed hours on a typical winter-peak day.

Weather related measures will typically have usage patterns that coincide with the seasonal peaks. For these measures, the coincident factors should be based on the equipment usage in the actual peak hour, rather than average usage across the defined peak hours and month.

Transmission and distribution peak capacity times are utility specific. For a winter-peaking utility, if utility-specific data is unavailable, then winter coincident factors may serve as an approximation of the transmission and distribution coincident factors.

3.6. 'Meas Cost & Save Yr1' Worksheet

This sheet provides for more than 30 inputs that characterize each measure:

- timing
- costs
- electricity savings
- fuel type and use
- existing equipment the measure would replace
- other resource and non-resource savings
- program incentives.

The inputs on this sheet are for the first year of portfolio activities. Many of the inputs can have different values in subsequent years, as provided for in the 'Meas Cost & Save Changes' worksheet described later.

All measure costs must be input in the year's real dollars set in the 'Screening Info' sheet, regardless of when the expenditure is made.

Measure Name

Identify the measure with a brief but clear description.

Prgm Code

Assign a program code from the 'Program Data' sheet to each measure.

Include in Calc's (Include in Calculations)

Use one of the following values to indicate how each measure should be included in, or excluded from, the PST's calculations:

- Blank = Not included in any calculations or outputs.
- M = Include in measure-level outputs, but not program- or portfolio-level outputs.
- P = Include in program- and portfolio-level outputs.

If a measure has no name or program code, it will not be included regardless of this value. If the “Include in Calc’s” values are updated, you must re-run the calculations as for any change to the PST inputs.

“Update ‘Include in Calc’s” Button

This button can be used to automatically exclude measures from program-level analysis when they are not cost-effective based on one of the cost-effectiveness tests. The cost-effectiveness test to be used is set by the *Cost-effectiveness Test* input (p. 17) on the ‘Screening Info’ sheet.

When the button is clicked, the user is guided through several dialog windows that explain the “Include in Calc’s” values and how to use the button. The dialogs also enable the user to enter the range of measure numbers to be processed by the routine (e.g., to process commercial measures without affecting a separate block of residential measures, for which the “Include in Calc’s” values may be manually set).

See also the *Depends On* and *Links With* inputs (p. 29), also on this worksheet, which are used by the “Update ‘Include in Calc’s” button to handle dependant and linked measures.

Measure ID1-ID3

The first 3 measure IDs are not inputs but are determined by the Program #. The sector, program type and program name for each program number are defined in the Program Data sheet.

Measure ID4-ID6

These measure IDs are optional. The user may use this input to assign a short alphanumeric code or category to the measure. This may be an abbreviation of the measure name with numbers designating variations among similar measures (e.g., CFL1, CFL2).

Measure Life

Measure life usually refers to the expected useful life of the equipment, once installed. If an analysis period longer than the measure life is chosen, then all parts requiring replacement over the analysis period need to be input into the Maintenance and Component Costs section.

If a measure consists of two components with different useful lives (e.g., a gas furnace and ductwork), then one may input the useful life of the longer-lived component as the measure life. Inputs concerning timing and costs of replacing the shorter-lived components are addressed in the Operation and Maintenance Costs section of the ‘Meas Non-Resource’ sheet.

Measure Life can be any positive integer, such that:

$$\text{Measure Life} + (\text{Year Installed} - \text{First Year of Analysis}) \leq 50.$$

Incremental Installed Cost (Full Cost for Retrofit)

The costs of measure equipment, installation labor, and incidental costs. Depending on how savings are input, these costs should be expressed as either total costs or incremental costs above the costs of baseline equipment.

In general, for natural replacement and new construction measures, installed cost should be set at the efficiency premium, calculated as the cost of the efficient measure less the cost of new baseline equipment (“incremental cost”). However, if the efficient and baseline equipment have different measure lives, installed cost should be set at the full cost of the efficient measure, and the baseline measure should be characterized using the optional inputs for early-retirement retrofit measures.⁴ The PST will then calculate the effective premium, accounting for the difference in measure lives.

For early-retirement retrofit measures (efficient equipment replacing functioning existing equipment or add-on equipment such as controls), installed cost should be set at full efficient measure cost, and existing equipment should be characterized using the optional retrofit inputs.⁵

Utility Customer Incentives

Enter the per-measure incentive paid to the customer. These inputs will be used to calculate the total customer incentives shown in the ‘Program Budgets’ sheet.

The accounting for the customer incentive must be consistent with the accounting for incremental installed costs (or full cost for early-retirement retrofit) to reflect the customer’s cost:

$$\text{Cost}_{\text{Customer}} = \text{Cost}_{\text{Incremental}} - \text{Incentive}$$

For example, for a low income retrofit program where efficiency upgrades are performed by a contractor at no cost to the end customer, both the incentive and the incremental cost should be set to the full cost of the efficient equipment plus the contractor’s labor costs.

Annual kWh Saved

Enter the first-year customer electric savings from the measure. Measure savings should be input consistent with measure costs – incremental to the baseline equipment that the efficient equipment replaces. For early-retirement retrofit measures, the kWh savings are relative to the equipment being replaced; kWh savings after the remaining life of existing equipment are handled in the section below on Data Only for Early-retirement Retrofit *Measures*.

Load Shape

Choose the load shape that characterizes each measure from the drop-down selector. If the desired load shape does not appear in the drop-down selector, it needs to be added to the list of load shapes in the ‘Load Shapes’ sheet. The chosen load shape percentages appear immediately to the right of the menu choice in the “% of Annual Energy Savings” and “Coincidence Factors” columns.

⁴Other approaches are possible, but should be carefully evaluated for consistency with the rest of the tool’s analysis before proceeding.

⁵For “pure” retrofits (i.e., the addition of a new piece of equipment rather than early retirement, such as a variable speed drive or the installation of additional insulation), the early-retirement retrofit inputs should be left blank.

Maximum Load Reduction or Generated

Enter the first year customer electric kW savings from the measure. This would typically be the connected load reduction or the kW savings when the equipment is running. The kW savings for the capacity periods will be the product of this input and the coincident factors of the chosen load shape. If a diversified kW savings is entered, then the coincident factor needs to account for the reduction already applied to the kW.

Data Only for Early-retirement Retrofit Measures

The PST uses the inputs in this section to calculate a credit to measure costs associated with the deferral of future replacements of existing equipment. These inputs also handle what is referred to as a “baseline shift,” since the baseline energy usage is expected to change in the future when the existing equipment would naturally be replaced (if that occurs within the lifetime of the efficient equipment).

For example, replacing a standard water heater with 10 years of remaining life with an efficient model having a 15-year life will avoid the cost of replacing the existing equipment in 10 years, and permanently shift the natural replacement cycle by 5 years (i.e., rather than replacing in years 10, 25, 40..., replacements will now occur in years 15, 30, 45...). The PST uses the installed cost of new baseline equipment and the remaining life of existing equipment to capture the benefits of permanently shifting the replacement cycle (the “early replacement deferral credit”).

Further, these inputs are used to reflect changes in the level of savings over the life of an early-retirement retrofit measure (the “baseline shift”). The existing inefficient equipment that is replaced by a retrofit measure is likely to be less efficient than new standard efficiency (baseline) equipment. In the short term, savings are determined based on the difference between the energy use of the existing inefficient equipment and the newly installed efficient equipment. In the long term, savings drop to the difference between new baseline efficiency equipment and the newly installed efficient equipment. As a result, measure savings shift over time. In the above example, savings in the first 10 years of the measure’s life might be higher than in the final five years. The *baseline shift* input reflects the percentage of first year savings that will result after the remaining life of the measure.

Note that for retrofit measures full costs rather than incremental costs of efficient equipment should be used.

Existing Equipment Life

Enter the life of the existing equipment if it were new, in whole or partial years. The useful lifetime of the existing equipment may or may not be the same as the lifetime of the efficient equipment. Even if it is the same, if this section is being used, this data should also be input so that a blank is not interpreted as a zero.

If the Existing Equipment Life is zero or blank, the inputs for the "Data Only for Early-retirement Retrofit Measures" section will be ignored by the screening calculations.

Existing Equipment Age

Input the age of the existing equipment, in whole or partial years. This will be used with the existing equipment life to calculate the remaining years of service that the existing equipment can provide. For planning “on average,” users will often assume the average age of existing equipment is one half of the existing equipment life.

New Baseline Installation Cost

The installation cost of the new baseline equipment (the hypothetical new baseline equipment that would be installed when the existing equipment would be naturally replaced) should be the full installed cost of the new equipment.

Savings Adjustments (Electric and Fossil Fuel)

Enter the ratio of:

- (a) the savings from the efficient equipment that would follow the natural replacement of the existing equipment (i.e., savings relative to new baseline equipment) to
- (b) the savings from the efficient equipment in the first year following the retrofit (i.e., the savings relative to the existing equipment).

This value should be a percentage between 0% and 100%.

For example, if the new baseline equipment is expected to have the same efficiency as the existing equipment, then this input will be 100%, and no savings shift would occur at the end of the remaining life of the existing equipment. If the new baseline equipment is expected to have the same efficiency as the retrofit efficient equipment, then this input will be 0%, and savings would only result until the end of the remaining life of the existing equipment. In most situations, the efficiency of new efficient equipment is higher than new baseline equipment. In this case, the baseline shift value will vary between 0% and 100%. For example, if the savings of the new efficient equipment compared to new baseline equipment is 800 kWh and the savings of the new efficient equipment compared to the existing equipment is 1000 kWh, then the “Electric Savings Adjustment” input is 80% (800/1000).

Both the annual kWh savings and fossil fuel savings may change in subsequent years, as input in the ‘Meas Cost & Save Changes’ sheet. If this is the case for a measure, the savings adjustments should be evaluated carefully so that they apply appropriately to the changing savings in subsequent years.

Note that the Electric Savings Adjustment is applied to both energy and demand (kWh and kW) savings. Also, the Fossil Fuel Savings Adjustment is applied to all fossil fuels (Fuel 1, Fuel 2 and/or Fuel 3) in the case where there are multiple types of fossil fuel impacts (described below).

Fossil Fuel Impacts

Use these inputs if the measure either decreases or increases the usage of natural gas or other fossil fuels (e.g., insulating an oil-heated home). The inputs allow for each measure to impact up to three fuel types, selected from up to 16 fuel types that can be defined in the ‘Avoided Costs’ sheet.

Fossil Fuel Type

Select the fuel type from the drop-down selector corresponding to the type of fuel expected to be saved or increased in usage. The available fuel types are those entered on the ‘Avoided Costs’ sheet (see *End Use Fuel Costs*, page 20).

Fossil Fuel Savings (or Increased Usage)

The change in annual fuel consumption by the new equipment should be expressed in the energy units defined on the 'Screening Info' sheet. Fossil fuel savings are entered as a positive number and increased usage is entered as a negative number.

Water

Enter the annual quantity of water saved by the measure. Savings are based on the avoided costs entered for water in the 'Avoided Costs' sheet.

Wood

Enter the annual cords of wood saved by the measure. Savings are based on the avoided costs entered for wood in the 'Avoided Costs' sheet.

Other

Enter the annual quantity saved of the additional, user-defined 'other resource'. Savings are based on the avoided costs entered for "Other" in the 'Avoided Costs' sheet.

Non-Resource Benefits

These columns summarize the inputs from the 'Meas Non-Resource' sheet – the next sheet to the right.

Depends On

This input is only needed when using the "Update 'Include in Calc's'" Button (p. 25) to automatically determine which measures are not cost-effective and thus should be excluded from program-level outputs.

Some measures are tiered, such as High Efficiency Air Conditioning Tier 1 and Tier 2. The higher-tier measure is a higher level of efficiency that can only be achieved if the lower-tier measure is installed. In other words, the higher-tier measure *depends on* the lower-tier measure to be cost-effective. If the lower-tier measure is not cost-effective, then the higher-tier measure cannot be installed.

For each higher-tier measure, enter the row offset (number of rows) to the measure that it depends on. If the "depends on" measure fails, then this measure will also fail. The "depends on" value must be a negative number. If this measure depends on another and is also linked with another, then both of the linked measures must have the "depends on" value filled in.

Links With

This input is only needed when using the "Update 'Include in Calc's'" Button (p. 25), as for the "Depends On" input (above).

A single efficiency measure may impact more than one end use. For example, Duct Sealing affects cooling and ventilation. In such cases, a separate measure may be used in the PST for each end use in order to separate the savings attributed to each end use (which apply to different load shapes). For example:

- Duct Sealing - Cooling
- Duct Sealing - Ventilation.

The cost of the Duct Sealing measure would typically be assigned to one or the other, but the benefits are separated out between the end uses.

Such measures are “linked” since they pass or fail cost-effectiveness as a unit. They pass if their combined net benefits are greater than or equal to 0.

If a measure is linked to another, enter the row offset (number of rows) to the measure that is linked to this measure. If 2 measures are linked, they must reference each other (a positive number for one, a negative for the other). If 3 measures are linked, all three must be linked (A to B, B to C, C to A). You can't link more than 3 measures.

3.7. 'Meas Non-Resource' Worksheet

This sheet characterizes the non-resource costs or savings of installing the efficient measures not captured in the previous sheet. Three forms of non-resource benefit inputs appear on this sheet (described below). To quickly move to the desired input section, click on one of three buttons at the upper left corner of the sheet.

Operation and Maintenance Costs

Use these inputs to account for recurring costs over the life of the measure. These costs could be for replacing a component or for maintenance. Up to two shorter-lived separate components can be modeled. These inputs are only necessary if there is a difference between the operation and maintenance costs of the efficient and baseline equipment.

For some efficiency measures the baseline equipment would have been replaced multiple times over the life of the efficient equipment. For example, a compact fluorescent lamp (CFL) might have a measure life of 6 years, whereas the incandescent bulb being replaced has a life of 1 year. In this case, replacement of the entire baseline unit can be considered a component replacement in order to account for savings due to not having to replace the baseline equipment each year.

Efficient Equipment Components/Maintenance are those shorter-lived components or maintenance visits associated with the efficient equipment that is being screened for cost-effectiveness.

Baseline Equipment Components/Maintenance are those shorter-lived components or maintenance visits associated with the baseline equipment that would have been installed if the efficient equipment were not.

The inputs under *Efficient Equipment Components/Maintenance* will result in additional measure costs. The inputs under *Baseline Equipment Components/Maintenance* will result in a reduction in the net measure costs.

Component Life

Input the life of the component that will need to be replaced or the time between required maintenance visits before the end of the full measure life. The component life should be a positive number less than the Measure Life.

Component Replacement Cost

Input the cost of the shorter-lived equipment component or the cost for the scheduled maintenance visit. Note that the original measure cost should be the entire measure cost (incorporating both the cost of the short- and long-lived components).

One Time Only Non-Resource Benefits per Measure

Use these inputs if there is a benefit from installing the measure that only occurs once and is not recurring over the life of the measure. Input the description of the benefit in the header row (just above the measure rows), replacing the “Benefit #n Description” text. For each measure having this benefit, enter the dollar benefit in the measure row. The total program benefit for each type of non-resource benefit is calculated in row 6, just above the benefit description.

Include / Exclude

Above the benefit description there is a drop-down selector for “Include” / “Exclude”. By default all non-resource benefits are included in the outputs. However, individual non-resource benefits can be excluded from the analysis, in which case they do not appear in any of the output totals.

If any non-resource benefits are excluded, the following warning:

" At least one non-resource benefit was excluded from the calculations."

is displayed at the top of the following output worksheets:

'MeasReview', 'MeasScrn', 'MeasSaveYr', 'Program Cost-Effect', 'BenefitsCosts Review', 'Net Benefits', 'Benefits Summary', 'Economic Benefits'.

Input cells have yellow background		<i>(Scroll to the right in Excel to see these columns)</i>									
Non-Resource Benefits		Annual Non-Resource Benefits Per Measure (2006\$)									
O&M Costs		Benefit #19	Benefit #20	Benefit #1A	Benefit #2A	Benefit #3A	Benefit #4A	Benefit #5A	Benefit #6A	Benefit #7A	Benefit #8A
Non-Resource One Time Only		0	0	0	0	0	0	0	0	0	0
Non-Resource Annual		Include	Include	Include	Include	Include	Include	Include	Include	Include	Include
Measure Name		Benefit #19 Description	Benefit #20 Description	Benefit #1A Description	Benefit #2A Description	Benefit #3A Description	Benefit #4A Description	Benefit #5A Description	Benefit #6A Description	Benefit #7A Description	Benefit #8A Description
Clothes Washer (E-Star)											
Dishwasher (E-Star)											
Refrigerator (E-Star)											
Freezer (E-Star)											

Figure 11. 'Meas Non-Resource' worksheet, annual non-resource benefits

Annual Non-Resource Benefits per Measure

For non-resource benefits occurring each year, enter inputs into this section. Input the description of the benefit in the header row, as for the one-time non-resource benefits, and the dollar benefit in all applicable measure rows. The total program benefit for each type of non-resource benefit is calculated in row 6, just above the benefit description.

As for the one-time, non-resource benefits, individual annual non-resource benefits can be excluded from the analysis (see the description above for one-time, non-resource benefits).

3.8. 'Meas Cost and Save Changes' Worksheet

This sheet provides inputs for varying some of the measure characteristics for measures installed after the first year of the analysis.⁶ The measure characteristics for each subsequent year default to the values for the previous year, but these defaults may be changed in this sheet.

By default, each yellow input cell contains a formula that refers to the value for the previous year (the cell to the left). If you enter a new value in one of the input cells and overwrite the default formula, subsequent years to the right will display that new value. If you later wish to remove the entered (hard-coded) value, you can copy the original formula from any other cell in that block of the worksheet into that cell.

Use the buttons in the upper-left corner of the screen for quick navigation to each section of the worksheet.

Installation Cost

Indicate a decrease or increase in the real cost of installing the efficient measure with this input.

Annual kWh Saved

Indicate a decrease or increase in the kWh savings of the efficient measure installed in different years with this input. The difference in savings could be the result of an efficiency change in either the efficient or baseline equipment energy consumption. Any change in the energy savings should be consistent with the installation cost assumption change, if any.

Fossil Fuel Savings

Indicate a decrease or increase in the fossil fuel savings of the efficient measure installed in different years with these inputs.

Incentives

Indicate a decrease or increase in the electric or gas utility incentives offered for the efficient measure in different years. It is not necessary to set the incentives to zero for years following the program years. The penetrations in the 'In Program' sheet will indicate for which years the measure will be offered in a program. In years without an 'In Program' penetration, incentives will not be counted.

3.9. Penetrations: No Program, With Program, In Program

Three measure penetration input sheets work together to determine the penetration rates for each measure:

'No Program': measures installed if there were no efficiency program

'With Program': measures installed if there is an efficiency program

'In Program': measures installed in the program (i.e., for which an incentive is paid)

⁶ Cost changes due to inflation should not be considered as a change for purposes of analysis using this model. All costs must be entered in the same year's dollars.

Several concepts are key to understanding how penetration rates are used by the model:

Free Riders: Those who participate in an efficiency program and collect an incentive (“In Program”), but would have done it even without the incentive (“No Program”).

Spillover: Measures installed outside of the program (i.e., no incentive is paid) that would not have been installed absent the program. In other words, the program inspires some individuals to install the measure although, due to their particular circumstances, they are unable or choose not to take the incentive (e.g., they do not send in a rebate form).

Net Penetration: The number of measures installed that can be attributed to having an efficiency program (i.e. for which savings can be claimed).

The figure below shows the relationship between no-program, with-program and in-program penetration rates.

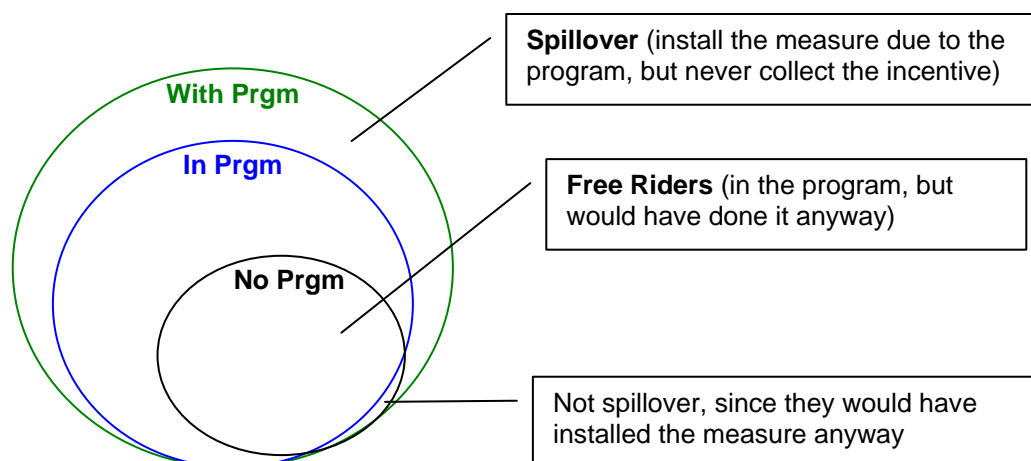


Figure 12. No Program, With Program, In Program Penetrations

An example further illustrates the calculation of the net penetration of measures installed as a result of running an energy efficiency program. Suppose a program results in having 100 measures installed. The following scenario illustrates possible penetration rates due to the program.

- 44 Installed if **No Program**
- 100 Installed **With Program**
 - 60 Used the incentive (**In Program**)
 - 54 Installed due to the incentive
 - 6 Would have installed anyway, without the program (**Free Riders**)
 - 40 Did not use the incentive
 - 38 Would have installed without the program
 - 2 Installed due to the program, but didn't get the incentive (**Spillovers**)

Therefore, as a result of the program:

- 56 **Net measures (penetration)** installed due to the program (100 - 44)
- 10% **Free Rider rate** = Free Riders / In Program (6 / 60)
- 5% **Spillover rate** = Spillovers / # in "With Program" who did not get the incentive (2 / 40)

For each measure, the PST model allows either of two methods for entering penetration data and calculating the net penetration of measures installed as a result of running an energy efficiency program:

Method 1: No / With / In Program

The first method requires penetration inputs with 'No Program' 'With Program', and 'In Program'.

Method 2: In Program with free rider / spillover rates

The second method applies free rider and spillover rates to the 'In Program' penetrations (program participants) to arrive at the net measure penetrations.

The 'In Program' penetrations are required regardless of the method used. If using the first method, free rider and spillover rates are not needed and, in fact, should not be entered (in the 'In Program' sheet) because they would override this method. If using the second method, the 'No Program' and 'With Program' inputs are not needed and will be ignored.

The penetration inputs may be in terms of number of widgets (e.g., the number of CFLs) or as a percentage of market share. For residential analysis, penetrations are typically expressed as the number of widgets installed, due to the conformity in the residential market that enables estimating penetrations on a "per household" basis (which is then multiplied by the number of households). In contrast, the commercial and industrial (C&I) markets have very little conformity across businesses and establishments, so that measures typically represent a market share and penetrations are expressed as a percentage thereof.

If the inputs for measure savings represent total potential savings, the penetration input may be used to represent the percentage of the potential savings installed in that year.

3.10. 'No Program' Worksheet

For each measure using the 'No / With / In Program' method (described above), provide the number of efficient measures that would have been installed without a program for the total number of installation years included in the analysis. For measures that will have free rider and spillover rates entered in the 'In Program' sheet, the 'No Program' penetrations should be left blank.

3.11. 'With Program' Worksheet

For each measure using the "No / With / In Program" method (described above), provide the total number of efficient measures that are expected to be installed with a program for the total number of installation years included in the analysis. The penetrations should include measures installed after the program period. The 'No Program' penetrations are a subset of the 'With Program' penetrations, unless one thinks that by running the program fewer of the measures will be installed. For measures that will have free rider and spillover rates entered in the 'In Program' sheet, the 'No Program' penetrations should be left blank.

3.12. 'In Program' Worksheet

For each measure and program year, enter the number of measures installed in the program (i.e., for which an incentive is paid). If using the "In Program with free rider / spillover rates"

method (described in Section 3.9), enter the free rider and spillover rates. If using the “No/With/In Program” method, leave the free rider and spillover rates blank.

Note: If you enter the optional free-rider or spillover rate for a measure, the “In Program with free rider / spillover rates” method will be used for determining penetration rates, and the ‘No Program’ and ‘With Program’ penetration values will be ignored.

Penetration Profile

If penetration profiles (curves) are entered in the ‘Pen Profiles’ sheet, these can be selected here. If a penetration profile is selected, that measure’s penetrations will be automatically filled in when the calculations are run.

Free Rider Rates

Enter the percentage of program participants that would have installed the measure on their own without a program. Using this input will override any ‘No Program’ and ‘With Program’ inputs.

Spillover Rates

Enter the percentage of measures installed outside of the program (i.e., no incentive is paid) that would not have been installed absent the program. Using this input will override any ‘No Program’ and ‘With Program’ inputs.

Number of measures installed with programs and participated in program

These are the inputs referred to as ‘In Program’ penetrations. The total program incentive budget calculations rely on these inputs, along with the per-measure incentives. If free rider and spillover rates are entered, this input is also used in calculating the net measure penetration.

3.13. ‘Penetration Profiles’ Worksheet

As an alternative to entering individual penetration values for each year, penetration profiles (or curves) can be entered in this sheet. The profile for a measure can then be selected in the ‘In Program’ sheet, in which case that measure’s penetration values will be copied to the ‘In Program’ sheet when the calculations are run.

When penetration profiles are used, the free rider and spillover factors should also be filled in on the ‘In Program’ sheet, as there are no profiles for the ‘No Program’ or ‘With Program’ penetrations (when the free rider and spillover factors are entered, the ‘No Program’ and ‘With Program’ penetrations are ignored).

3.14. ‘Elec Budgets’ Worksheet

This sheet provides a template for entering non-measure (non-incentive) electric utility budget costs at the program level. Each program on this sheet has rows for:

- incentive costs, calculated in the light-green cells, and
- non-incentive costs by line-item categories, which can be entered in the light-yellow input cells.

The program incentives are calculated from on the incentives and “In Program” penetrations for the individual measures in each program (and only for measures included in program-level calculations – see the *Include in Calc’s (Include in Calculations)* input on p. 24). These cells are protected and should not be overwritten.

The line-item labels for non-incentive costs can be entered under the “Totals” section near the top of the sheet. The same line items are used for all programs.

The individual line-item values are only used for calculating the total non-incentive budgets for each year of each program, which are used for determining program cost-effectiveness. The totals are also output in the ‘Cost Summary’ sheet.

3.15. ‘Gas Budgets’ Worksheet

The ‘Gas Budgets’ sheet is used for entering natural gas program budgets, and has the same layout and inputs as the ‘Elec Budgets’ sheet (above). A single program can have non-incentive budgets for both the electric utility and natural gas utility, if those expenses are shared between the utilities. The totals are also output in the ‘Cost Summary’ sheet.

3.16. ‘Non-Utility Budgets’ Worksheet

This sheet provides for non-measure (i.e., non-incentive), non-utility budget costs at the program level, following the same layout as the ‘Elec Budgets’ sheet. The non-utility for which budgets are entered is the first non-utility contributor configured in the ‘Screening Info’ sheet (see *Non-utility Contributors*, p. 18). The non-measure budget information entered here is included in the societal or total resource costs for each program, and is **not** included in the electric or natural gas systems tests. The totals are also output in the ‘Cost Summary’ sheet.

4. Portfolio Screening Tool Output Sheets

The worksheets at the right side of the workbook, starting with the 'Penetrations' sheet, display the outputs from the cost-effectiveness screening model.

The outputs are generated by running the calculations with the "Run" button on the Screening toolbar. As described in Section 2.4 (p. 11), the outputs must be manually refreshed after any changes to the inputs. As well, intermediate calculations (e.g., shown in the 'MeasReview' sheet) do not persist when the PST (or Excel) is closed; thus the calculations must be refreshed to view these outputs.

The output sheets display various details at several levels of aggregation:

- Measure-level outputs
- Program-level outputs
- Sector-level outputs
- Portfolio-level outputs

The details of each output sheet are described below. These are best reviewed with the PST open for viewing each worksheet.

4.1. 'Penetrations' Worksheet

This sheet calculates the net program effect on measure penetration, determines the net-to-gross ratio, and provides a graphical representation of the penetration inputs. One measure at a time may be viewed by entering the measure number in the input cell at the top-left of the sheet.

4.2. 'Budgets Summary' Worksheet

Level of Output Detail: Program and Portfolio

A summary of the utility and non-utility budgets is shown, based on budgets entered in the 'Elec Budgets', 'Gas Budgets' and 'Non-Utility Budgets' sheets. All values are in the base year's dollars, as configured in the 'Screening Info' sheet. Both discounted and non-discounted values are shown (discounted values are discounted to the base year using the Real Discount Rate).

4.3. 'MeasReview' Worksheet

Level of Output Detail: Measure

Intermediate Calculations: This sheet displays intermediate calculations that do not persist when the PST is closed. Run the calculations to refresh.

The 'MeasReview' sheet provides various energy impacts and cost-effectiveness program results by measure and year. A drop-down selector in the upper left hand corner allows one to pick the particular details to view.

The following measure results are available for viewing:

Drop-down Selection	Outputs Displayed
Net Measures	Number of Net Measures by Year
Net to Gross	Measure Net to Gross Ratios by Year
Net Incremental MWh	Incremental Annual MWh Savings (Net of free riders, at meter)
Net Incremental Summer MW	Incremental Summer MW Savings (Net of free riders, at meter)
Net Incremental Winter MW	Incremental Winter MW Savings (Net of free riders, at meter)
Net Incremental Fuel	Incremental Fuel Btu Savings (Net of free riders)
Net Incremental NGas	Incremental NGas Btu Savings (Net of free riders)
Net Incremental NGas Peak Day	Incremental NGas Peak Day Btu Savings (Net of free riders)
Net Incremental Oil	Incremental Oil Btu Savings (Net of free riders)
In Prgm Incremental MWh	Incremental Annual MWh Savings (in prgm w/ free riders, at meter)
In Prgm Incremental Summer MW	Incremental Summer MW Savings (in prgm w/ free riders, at meter)
In Prgm Incremental Winter MW	Incremental Winter MW Savings (in prgm w/ free riders, at meter)
In Prgm Incremental Fuel	Incremental Fuel Btu Savings (in prgm w/ free riders)
In Prgm Incremental NGas	Incremental NGas Btu Savings (in prgm w/ free riders)
In Prgm Incremental Oil	Incremental Oil Btu Savings (in prgm w/ free riders)
Net Incremental MWh at gen	Incremental Annual MWh Savings (Net of free riders, at gen)
Net Incremental Summer MW at gen	Incremental Summer MW Savings (Net of free riders, at gen)
Net Incremental Winter MW at gen	Incremental Winter MW Savings (Net of free riders, at gen)
Net Cumulative MWh at gen	Cumulative Annual MWh Savings (Net of free riders, at gen)
Net Cumulative Summer MW at gen	Cumulative Summer MW Savings (Net of free riders, at gen)
Net Cumulative Winter MW at gen	Cumulative Winter MW Savings (Net of free riders, at gen)
Societal Benefits	Societal Benefits (2008\$, Present Value)
Societal Costs	Societal Costs (2008\$, Present Value)
Electric Benefits	Electric Benefits (2008\$, Present Value)
Electric Costs	Electric Costs (2008\$, Present Value)
Fuel Benefits	Fuel Benefits (2008\$, Present Value)
Fuel Costs	Fuel Costs Including Nat Gas Incentive (2008\$, Present Value)
Nat Gas Benefits	Nat Gas Benefits (2008\$, Present Value)
Nat Gas Costs	Nat Gas Costs Including Incentive (2008\$, Present Value)
Electric & Nat Gas Benefits	Electric & Nat Gas Benefits (2008\$, Present Value)
Electric & Nat Gas Costs	Electric & Nat Gas Costs (2008\$, Present Value)
Electric Retail Benefits	Electric Retail Benefits (2008\$, Present Value)
NGas Retail Benefits	NGas Retail Benefits (2008\$, Present Value)
NGas Retail Costs	NGas Retail Costs (2008\$, Present Value)
Participant Benefits	Participant Benefits (2008\$, Present Value)
Participant Costs	Participant Costs (2008\$, Present Value)
Prgm Efficiency Benefits	Prgm Efficiency Benefits (2008\$, Present Value)
Prgm Efficiency Costs	Prgm Efficiency Costs (2008\$, Present Value)
Weighted Average Line Losses	Weighted Average Line Losses by Measure

4.4. 'MeasScrn' Worksheet

Level of Output Detail: Measure

Intermediate Calculations: This sheet displays intermediate calculations that do not persist when the PST is closed. Run the calculations to refresh.

This sheet shows the single-measure present value cost-effectiveness results for measures installed in each year. The year is chosen with the drop-down box in the upper left corner of the sheet. The following results are shown:

- Societal/Total Resource Benefits, Costs, Net benefits and Benefit to Cost Ratio (BCR) (Present Worth)
- Electric Utility Benefits, Costs, Net benefits and BCR (Present Worth)
- Natural Gas Utility Benefits, Costs, Net benefits and BCR (Present Worth)
- Electric & Natural Gas Utility Benefits, Costs, Net benefits and BCR (Present Worth)
- Fossil Fuel Benefits, Costs (Present Worth)
- Ratepayer Impact Measure (RIM) Benefits, Costs, Net benefits and BCR (Present Worth).

4.5. 'MeasSaveYr' Worksheet

Level of Output Detail: Measure

Intermediate Calculations: This sheet displays intermediate calculations that do not persist when the PST is closed. Run the calculations to refresh.

This sheet shows the total annual electricity and fuel savings by measure for each installation year. Only the savings from the installation year chosen from the drop-down box are shown. The outputs include the savings in later years attributable to installations in the selected year. Electricity savings are at the customer meter.

The type of electricity or fuel savings to view is selected in the other drop-down box in the upper left corner of the sheet. The choices are as follows:

Drop-down Selection	Outputs Displayed
Ann_MWh	Program Annual MWh Savings by Install Year, at Meter
Win_MW	Program Winter MW Savings by Install Year, at Meter
Sum_MW	Program Summer MW Savings by Install Year, at Meter
Fuel1 (units)	Program Annual Fuel1 (units) Savings by Install Year
Fuel2 (units)	Program Annual Fuel2 (units) Savings by Install Year
Gas (units)	Program Annual Natural Gas (units) Savings by Install Year
Oil (units)	Program Annual Oil (units) Savings by Install Year

4.6. 'Program Cost-Effect' Worksheet

Level of Output Detail: Program and Portfolio

This sheet summarizes the cost-effectiveness results by program and the total portfolio of programs. The present value of benefits, costs, net benefits, and benefit-cost ratio are shown under the following cost-effectiveness tests:

- Societal or Total Resource (depending on if externalities are included, as configured on the 'Screening Info' sheet)
- Electric System
- Gas System
- Combined Electric and Gas System
- Ratepayer Impact Measure (RIM).

Non-measure and measure costs are shown separately for each program.

4.7. 'BenefitsCosts Review' Worksheet

Level of Output Detail: Program

Intermediate Calculations: This sheet displays intermediate calculations that do not persist when the PST is closed. Run the calculations to refresh.

This sheet shows the incremental annual and cumulative annual present value benefits and costs results by program for each installation year. The particular benefit or cost to view is selected from the drop-down box.

4.8. 'Net Benefits' Worksheet

Level of Output Detail: Program and Portfolio, or Electric/Gas

Intermediate Calculations: This sheet displays intermediate calculations that do not persist when the PST is closed. Run the calculations to refresh.

This sheet shows the incremental and cumulative present value of societal or total resource benefits, costs, net benefits, and benefit-cost ratio results by program for each installation year. The electric and gas system benefits, costs, net benefits, and benefit-cost ratio results for the total portfolio of programs may also be viewed, in which case the results are summarized by Electric and Gas rather than by program.

Select the results to be displayed with the drop-down box.

4.9. 'Costs Summary' Worksheet

Level of Output Detail: Program and Portfolio

The 'Costs Summary' sheet provides a breakdown of costs by program, with portfolio totals. Costs are shown for the total measure, incentive contributions, and non-measure (non-incentive) costs from utility and non-utility budgets.

4.10. 'Benefits Summary' Worksheet

Level of Output Detail: Program and Portfolio

This sheet shows the breakdown of benefits by program, with portfolio totals. The following categories of benefits are shown:

- Summer capacity
- Winter capacity
- Transmission capacity
- Distribution capacity
- Electric energy by costing period
- Natural gas
- Other fossil fuels
- Water
- Other resource savings
- Non-resource savings

4.11. 'Energy Summary' Worksheet

Level of Output Detail: Program and Portfolio

This sheet shows the electricity, natural gas, and total fossil fuel (including natural gas) energy savings by program and year, with Portfolio totals. The program aggregate net to gross ratio is shown (Net MWh / In program MWh). This sheet also shows emissions reductions.

The savings are expressed in the following forms and units:

- Incremental Annual MWh Saved (Net of free riders and spillover)
- Incremental Annual MWh Saved (In program)
- Incremental Annual MWh Saved at generation (Net)
- Incremental Annual Summer MW Saved at generation (Net)
- Incremental Annual Winter MW Saved at generation (Net)
- Cumulative Annual MWh Saved at generation (Net)
- Cumulative Annual Summer MW Saved at generation (Net)
- Cumulative Annual Winter MW Saved at generation (Net)
- Incremental Natural Gas TJoule Saved (Net)
- Incremental Natural Gas TJoule Saved (In program)
- Cumulative Natural Gas TJoule Saved (Net)
- Incremental Fossil Fuel TJoule Saved (Net)
- Incremental Fossil Fuel TJoule Saved (In program)
- Cumulative Fossil Fuel TJoule Saved (Net)
- Cumulative Annual CO₂ reductions (metric tons) from electricity and fossil fuel savings
- Cumulative Annual SO₂ reductions (metric tons) from electricity and fossil fuel savings
- Cumulative Annual NO_x reductions (metric tons) from electricity and fossil fuel savings

4.12. 'Electricity Savings' Worksheet

Level of Output Detail: Program and Portfolio

A summary of the energy and peak electricity savings by program by year is shown on this sheet. In addition to the incremental and cumulative annual savings, lifetime GWh savings are shown. A weighted average lifetime for each program is calculated that reflects the possible reduction in savings for early-retirement retrofit measures that may have smaller savings after the time of natural replacement of the equipment with more efficient baseline equipment.

4.13. 'Elec Utility Costs' Worksheet

Level of Output Detail: Program and Portfolio

The electric utility costs are repeated in this sheet. These are the same as the costs on the 'Program Budgets' sheet, but do not show the subcategories of program costs.

4.14. 'Elec Utility Cost per kWh' Worksheet

Level of Output Detail: Program and Portfolio

These outputs are levelized electric utility costs per kWh, where both the costs and kWh savings are discounted based on the timing of when they occur. The utility costs include the incentives and non-incentive program costs.

Two sets of levelized cost per kWh are shown. The top portion shows “gross” levelized costs based on the electric utility costs (incentives plus the non-incentive budgets). The bottom portion shows net levelized costs, for which the capacity benefits have been subtracted from the electric utility costs.

The gross levelized costs are more commonly seen in the industry and are often compared with the avoided cost of energy, although this is not a good comparison since the gross levelized costs do not reflect the capacity benefits. For example, a measure with high capacity benefits and relatively few kWh savings might appear to cost \$0.30/kWh (relatively expensive), but still be cost-effective due to the capacity benefits. The net levelized costs subtract the capacity benefits from the utility costs, and are thus a better indicator of cost-effectiveness.

4.15. ‘Economic Cost per kWh’ Worksheet

Level of Output Detail: Program and Portfolio

These outputs are levelized societal (or total resource) costs per kWh, where both the costs and kWh savings are discounted based on the timing of when they occur. The societal (or total resource) costs include the incentives and non-incentive program costs. The configuration to “include externalities” in the ‘Screening Info’ sheet (described on p. 17) determines whether societal or total resource costs are used.

Two sets of levelized cost per kWh are shown. The top portion shows “gross” levelized costs based on the societal (or total resource) costs (the relevant costs are described for the cost-effectiveness tests in section 1.3, p. 4). The bottom portion shows net levelized costs, for which all non-electric energy benefits have been subtracted from the societal (or total resource) costs. The gross levelized costs are more commonly seen in the industry and are often compared with the avoided cost of energy, although this is not a good comparison since the gross levelized costs do not reflect the non-energy benefits. For example, a measure with high capacity benefits and relatively few kWh savings might appear to cost \$0.30/kWh (relatively expensive), but still be cost-effective due to the non-energy benefits. The net levelized costs subtract the non-energy benefits from the societal (or total resource) costs, and are thus a better indicator of cost-effectiveness.

The non-energy benefits for calculating the net levelized costs include: electric capacity benefits, fossil fuel benefits, operation and maintenance benefits, deferred replacement credit benefits, water benefits, and other non-resource benefits from the ‘Non-Resource Benefits’ sheet. These are discounted based on when they occur, just as for the costs and energy benefits.

4.16. ‘Elec Utility Benefits’ Worksheet

Level of Output Detail: Program and Portfolio

This sheet is a summary of the electric utility net benefits and benefit/cost ratios for each program. The net benefits are cumulative, meaning they include the previous years’ net benefits.

4.17. 'Economic Benefits' Worksheet

Level of Output Detail: Program and Portfolio

This sheet is a summary of the societal net benefits and benefit/cost ratios for each program. The net benefits are cumulative.

4.18. 'Report' Worksheet

Level of Output Detail: Sector, Program, and Portfolio

A three-page summary report is produced in the 'Report' sheet. The report includes societal or total resource cost-effectiveness results, a breakdown of costs, a breakdown of benefits, and kW and MWh savings. If any changes are made to the inputs, this report needs to be updated by clicking on the 'Refresh Report' button in the upper left corner of the sheet. The report is printed by clicking on the "Print Report" button. Below is an example of the report.

4.19. 'Emissions' Worksheet

Level of Output Detail: Program and Portfolio

The emissions sheet shows annual and lifetime emissions reductions for the electricity savings, based on the emissions factors entered in the avoided costs sheet. The value for the CO₂ reductions may be calculated by entering the dollar value per metric ton at the bottom of this sheet.

4.20. 'Elec Rate Impact' Worksheet

Level of Output Detail: Electric rate projections by year.

This sheet is used to project the impact of energy savings due to the efficiency portfolio on average electric rates. The inputs of annual revenue requirements and native (retail) sales are entered in the 'Avoided Costs' sheet (see *RIM Inputs*, page 21). Average prices (rates) are calculated for the base case and for the case of having an efficiency portfolio. The Net Savings at Meter are also shown, which are used to project the Portfolio Revenue Loss (not present value).

The calculated Base Case Average Price for each year is also used in the Ratepayer Impact Measure (RIM) cost-effectiveness test. The Base Case Average Price for each year is used to calculate the revenue loss for the energy savings through the life of each measure. For the RIM test, the revenue loss is considered a measure cost along with the electric incentive costs.

5. Portfolio Screening Tool Support

Some users of the PST may have a support agreement providing them with phone or on-site support for use of the tool. In those cases, the support agreement provides specifics as to the support process and the level of support provided.

Authorized users of the PST⁷ with no support agreement are expected to be, for the most part, self-reliant with use of the tool. However, while the PST has been developed to trap many potential errors, not all user actions can be anticipated. This section describes some of the steps that can be taken should an error occur, including when a request for support may be advisable.

Excel formula errors may occur due to invalid inputs. For example, a cell may display a value of “#DIV/0!” (division by 0) or “#VALUE!” (displayed when the formula includes an argument or operand of the wrong type). In such cases, you can follow the formula references to determine the invalid input value. Or, if the error occurs for a specific measure, you can look for the invalid input value among the inputs for that measure.

The use of Visual Basic for Applications (VBA) code is described in section 2.5 (p. 11). If an error is encountered by the VBA code when running the calculations, an error report dialog will be displayed to the user. Where possible, the context of the error is provided, such as the measure or program number. If there were recent updates made to the tool inputs (e.g., for specific measures), those should be reviewed for any invalid values (which may appear as the Excel cell errors described in the previous paragraph, or may be extremely large, etc.). If you are unable to determine the source of the error, you should follow the instructions of the error report and contact Optimal Energy, Inc., for support as described below.

Contacting Optimal Energy Support

If you encounter an error that you cannot resolve, and which you believe may be a processing error in the PST application, you can contact Support as follows:

Call Optimal Energy, Inc., in the United States at (802) 453-5100, x14
or,
Email a detailed description of the issue to: support@optenergy.com

⁷ The PST is covered by applicable copyright law. Unauthorized duplication or distribution is prohibited.

Appendix A: Glossary of Terms

Achievable Analysis: Efficiency portfolio analyses can be broadly characterized as follows:

- **Technical Analysis:** Identifies savings that can be attained using all available efficiency measures without regard to cost-effectiveness or budget constraints.
- **Economic Analysis:** Identifies savings that can be attained due to all efficiency measures that are cost-effective (generally from a societal standpoint), with no budget or other constraints.
- **Achievable Analysis (sometimes called “Program Scenario” or “Market Potential”):** Identifies savings that can be attained due to efficiency measures that are cost-effective, and that are constrained by funding or other practical factors.

At "Generation": Describes the energy (kWh) or demand (kW) used at generation, or at the point of power purchase. This corresponds to utility "requirements".

At Meter: Describes the energy (kWh) or demand (kW) used at the customer meter. This corresponds to utility "sales". The difference between "at generation" and "at meter" is due to line losses.

AvCos: See Avoided Costs

Avoided Costs: The marginal (or “incremental”) costs of generating and delivering electric power that will not have to be incurred if efficiency or another alternative resource is added to a utility’s resource mix. Avoided costs are typically determined for several energy periods (summer peak, summer off-peak, etc.), for peak demand (summer and/or winter), and for transmission and/or distribution (though these are sometimes included in the other avoided costs). Avoided costs (“AvCos”) can also be provided for fossil fuels, water, and other resources, though these are the customer’s avoided costs (except in the case of a natural gas screening, in which case the natural gas AvCos are for the gas utility).

Baseline Penetration: See “No Program Penetration” in section Penetrations: No Program, With Program, In Program, p. 32.

Baseline Shift: For retrofit measures, this is a change in energy savings at the time when the existing equipment would have been replaced. For example, if a home refrigerator is replaced when it is 12 years old, with a remaining life of 5 years, then it would have been replaced in 5 years with a more efficient refrigerator anyway. So after 5 years the annual energy savings might shift, for example, from 100 kWh to 60 kWh (a shift of 60%).

Coincidence Factor: For an efficiency measure, the percentage of the demand reduction that will occur during the demand peak hour.

Cost-effectiveness Test: A test used to determine cost-effectiveness of an efficiency measure or program from the point-of-view. See the table at the end of this document.

Cumulative Annual Savings: Energy and/or demand savings for a given year resulting from all program activity since program inception. For example, for a program started in 2001, cumulative annual savings for 2004 would be the total savings attained in 2004 due to all program activities (i.e., all installed efficiency measures) from 2001 through 2004.

Cumulative Cumulative Savings: Energy and/or demand savings from program inception through a given year, due to all program activity since inception. For example, for a program started in 2001, cumulative cumulative savings through 2004 would be the sum of all savings attained in all years (2001, 2002, 2003 and 2004).

Deferred Replacement Credit: For a retrofit measure, a credit for deferring the replacement cycle of the existing equipment (due to early replacement).

Economic Analysis: See Achievable Analysis.

Externalities: Monetized dollar values for emissions or other impacts external to the Total Resource Cost/Benefit analysis.

Free Rider: See section Penetrations: No Program, With Program, In Program, p. 32.

Gross: See “Net”.

Incremental Annual Savings: Energy and/or demand savings for a given year resulting from measure installations in that year. For example, for a program started in 2001, incremental annual savings for 2004 would be the total savings attained in 2004 due to measures installed in 2004 (i.e., the savings attained during the first year of each measure’s life).

Initiative: Synonym with “program”.

Line Loss Factors: A loss of energy or capacity between the point of generation (or power purchase) and the customer meter. There may be separate line loss factors for each energy period, for peak demand reductions, and for transmission/distribution. The PST calculates the line loss factor as a percent of usage at the customer meter, so

$$\text{At_Generation} = \text{At_Meter} * (1 + \text{LineLossFactor})$$

Some utilities calculate line losses as a percent of generation, so we should always be aware of how they relate to generation vs. the customer meter

Levelized Costs: Levelized costs are a way to readily compare electric (or gas) efficiency energy savings with electric (or gas) energy production in the same terms. These are calculated by amortizing program expenditures over the life of the efficiency measure and then dividing that by the annual energy savings of the same measure. Another method is to divide the amortized expenditures by the energy savings discounted back to the same year.

Load Factor: The ratio of actual kWh usage to usage at the peak demand rate. For example, if a business uses 500,000 kWh/year, and has a peak demand of 200 kW, then:

$$\text{Load Factor} = 500,000 \text{ kWh} / (200 \text{ kW} * 8760 \text{ hr/yr}) = 28.5\%$$

Therefore, annual kWh/kW ratio = Load Factor * 8760. However, keep in mind that the business’s peak demand may not coincide with the system peak.

Lost Opportunity: Describes efficiency measures that become available at the time new equipment would have been installed anyway, due to burn-out or new construction/renovation. Contrast with “Retrofit”.

LRAC: Long Run Avoided Costs, the term used by NY regulators for Avoided Costs. See Avoided Costs.

Market: For screening analyses, this is generally the market to which efficiency measures are applied, for example (for commercial measures):

- Retrofit
- New Construction (NC)
- Renovation (RENO), which applies when overhauling at least 2 systems (e.g., lighting and AC)
- Replacement (REPL) – Natural replacement-on-burnout, or due to remodeling. This market has also been referred to as Replacement/Remodel (RR), but “replacement” is now preferred.

Market Driven: Describes markets that reflect time-dependent opportunities for efficiency and are driven by natural market events. For Optimal Energy this generally includes 3 markets: new construction (NC), renovation (Reno), and natural equipment replacement/remodeling (Repl). The fourth market is Retrofit.

Market Effect: “A change in the structure or functioning of a market or the behavior of participants in a market that is reflective of an increase in the adoption of Energy-Efficient products, services, or practices and is causally related to Market Interventions.” (from [CA PUC Glossary](#)). In the PST we define “program years” with program spending, followed by post-program “market effect years” in which we quantify market effects (through no-program and with-program measure penetrations).

Net: Net penetrations or savings include free rider/spillover effects. “Gross” penetrations or savings are based on those participating in the program (i.e., those who receive an incentive), thus gross values do not include free rider/spillover effects. See section Penetrations: No Program, With Program, In Program, p. 32.

Non-Resource Cost / Benefit: Generally refers to externalities, or benefits or costs not directly related to energy usage, operation and maintenance, or program incentives and budgets. For example, non-resource benefits might include worker job satisfaction, productivity or product quality improvements.

Penetration: The portion of the market, or the number of people, who install an efficiency measure. See section Penetrations: No Program, With Program, In Program, p. 32.

Portfolio: Collection of efficiency programs (or "initiatives"). The overall portfolio of programs may have its own administrative costs, which should be spread across the programs (e.g., based on program spending) when evaluating overall portfolio performance or cost-effectiveness.

Price Effect: The effect of efficiency on electric (or natural gas) prices. Efficiency may reduce a utility’s marginal costs of generation without reducing fixed costs, thus electricity savings may result in increased prices per kWh (or therm).

Program: Collection of energy efficiency (and/or renewable energy) measures, administered and marketed collectively under a separate administrative budget. The equivalent term “initiative” is sometimes used.

Retrofit: Describes the market for efficiency measures installed when the existing equipment was still functional, thus the new equipment installation is discretionary and mainly for the efficiency benefits (aka “early-replacement” retrofit). Also includes measures that add onto existing equipment, such as “HVAC tune-up” or an Energy Mgmt System (EMS). See Market Driven.

Screening: Refers to cost-effectiveness screening: does it pass cost-effectiveness? Includes the analysis of all monetized costs and benefits, including electric savings, associated with efficiency measures or programs.

Societal Cost-effectiveness Test: Includes costs and benefits to society as a whole, including externalities. See section Cost-effectiveness Tests, p. 4. Note that an efficiency incentive does not affect societal costs/benefits because it is simply a transfer between parties.

Spillover: See section Penetrations: No Program, With Program, In Program, p. 32.

Technical Analysis: See Achievable Analysis.

Total Resource Cost Test: As relates to the “Total Resource Cost” (TRC) cost-effectiveness test: includes the monetized benefits and costs of all resources (electricity, fossil fuels, water, etc.) for an efficiency measure, program or portfolio. See section Cost-effectiveness Tests, p. 4. The TRC test includes costs & benefits from society’s

perspective, but generally does not including externalities (which are included in the Societal test). Note that operation & maintenance benefits are considered “non-resource”, but they are included in the TRC test.

Utility Cost-effectiveness Test: Costs and benefits from the electric or gas utility's perspective. In general, costs include incentives plus non-incentive program costs, while benefits are from the avoided costs of electricity and capacity savings. See section Cost-effectiveness Tests, p. 4.