

Cost-Benefit Analysis Tool Instructions

Turn-Key Industrial Lighting Web Site

Overview

The Cost-Benefit Analysis Tool (tool) allows users to determine the cost effectiveness of implementing a lighting demand-side management (DSM) program. The tool enables users to enter a variety of parameters that describe a utility's energy-demand and supply characteristics. These parameters will be compared with the costs and benefits associated with operating a lighting DSM program. When a user is finished entering data, he or she will be able to make a go/no-go decision about starting a DSM program and set an appropriate budget and energy-savings goals.

Layout

The tool is arranged in a way that leads users through the process of entering pertinent parameters for making go/no-go decisions about starting DSM programs. This layout includes four tabs where users will enter utility and DSM program parameters. Brief descriptions of the four tabs are provided below. A more in-depth description of each tab and its functionality are provided in later sections of this document.

1. **Energy Demand** – The energy demand tab allows users to enter information about energy demand across specified rate classes. This tab provides data that characterizes a utility's demand characteristics and energy revenue.
2. **Energy Supply** – The energy supply tab allows users to enter information about energy supply across specified supply resources. This tab provides data that characterizes a utility's supply characteristics and energy costs.
3. **DSM Details** – The DSM details tab allows users to enter information about the DSM program's energy-savings goals, as well as the times when energy savings will occur. This tab provides data that will impact a utility's current operational characteristics.
4. **Financial Details** – The financial details tab allows users to enter DSM program budget details and other financial information. This tab also provides output information on program performance, which will lead a utility to make a go/no-go decision.

STEP 1: Energy Demand Tab

The **Energy Demand** tab allows users to enter information about energy demand across specified rate classes. This tab provides data that characterizes a utility's demand characteristics and energy revenue. Information entered in this tab will be compiled for analysis. The steps for entering this information are described below.

Editing the Daily and Monthly Demand Profiles

For this version of the tool, there are three rate classes available: **Industrial**, **Commercial**, and **Residential**. The tool does not require users to input information for all three rate classes in order to function properly. Utilities with more than three rate classes should combine the characteristics of rate classes in order to represent them in the three rate classes provided. Future versions of the tool will likely allow users to create more than three rate classes.

For each rate class, users will enter the *average* daily demand for each hour in a typical day. The measurement unit for hourly demand is megawatts (MW). Additionally, for each rate class, users will enter the *maximum* monthly demand for each month in a typical year. The measurement unit for maximum monthly demand is also MW. Users can edit the daily and monthly demand profiles by selecting the demand profile type under a given rate class. Once the rate class is selected, click the **Edit Rate/Profile** button to make changes. See Exhibit 1 for an illustrated example.

Exhibit 1: Energy Demand Tab 1

The screenshot displays the 'Energy Demand' tab interface. It features a sidebar with 'Demand Profiles' categorized by rate class: Residential, Commercial, and Industrial. Under the Industrial category, 'Industrial Avg Daily Demand' and 'Industrial Avg Monthly Demand' are listed. The 'Industrial Avg Daily Demand' profile is selected, and its details are shown in the main panel. The details include: Profile Name (Industrial Avg Daily Demand), Rate Class (Industrial), Energy Rate (\$/kWh) (0.065), Demand Rate (\$/kW-month) (12), and Annual Load Growth Rate (%) (0.005). A callout box points to the 'Industrial Avg Daily Demand' profile with the text 'Select the desired profile under a rate class'. Another callout box points to the 'Edit Rate/Profile' button with the text 'Click the Edit Rate/Profile button to modify the profile'. The main panel also contains a graph showing demand over 24 hours, with a blue area representing the demand profile.

Once the **Edit Rate/Profile** button is clicked, a new screen will appear. This screen allows users to edit the profile by using sliders in the middle of the screen or by entering numerical values across the top of the screen. Modifying the slider position will automatically update the fields across the top of the screen and vice-versa. The chart scale can be set by selecting the **Maximum Load** for the load profile, which is located at the bottom of the screen. Once the appropriate values have been entered, use the **Save** button to update the profile. Use the **Cancel** button to discard all changes. Both the daily and monthly demand profiles operate in the same way. All units are in MW. See Exhibit 2 for an illustrated example.

The next step is to enter information about the revenue received from each rate class, along with information about annual load growth. For each rate class, **Energy** and **Demand Rates** must be entered. The **Energy Rate** is entered in dollars per kilowatt hour (kWh); **Demand Rate** is entered in dollars per kW-month. This information will be used to determine energy revenue. The **Load Growth Rate** may also be entered if the growth is known. Load growth information will be used to analyze demand and related supply characteristics over a number of years. Values can be entered as decimal values or as values with percentage signs. For example, 2.5 percent can be entered as “0.025” or “2.5%.” Once this information is entered, click the **Save Changes** button. See Exhibit 3 for an illustrated example.

Once the desired load profiles are entered and saved, you can view them on the graphical output within the Energy Demand tab. Each profile can be viewed by selecting the profile name from the Demand Profiles area. You can view profiles individually or aggregately by selecting the appropriate radio button above the demand profile graph. Aggregate demand profiles can be switched between daily and monthly profiles by selecting a daily or monthly profile name under any rate class. See Exhibit 4 for an illustrated example.

Exhibit 2: Load Profile Input Box

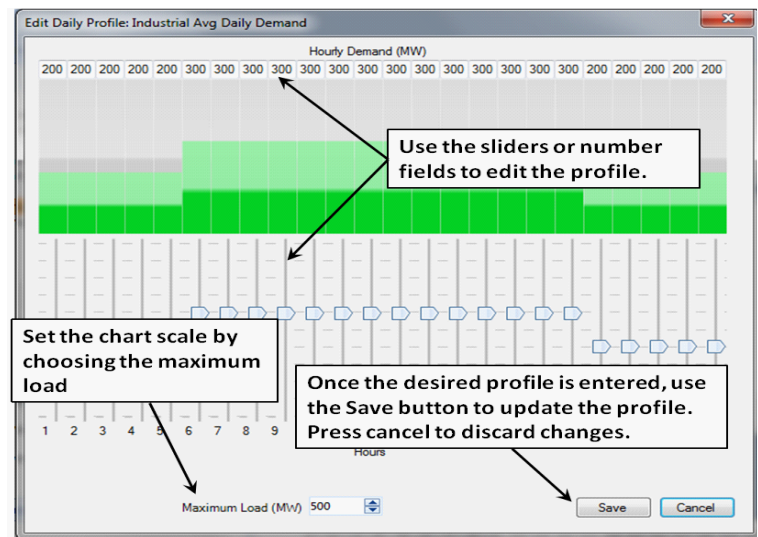


Exhibit 3: Energy Demand Tab 2

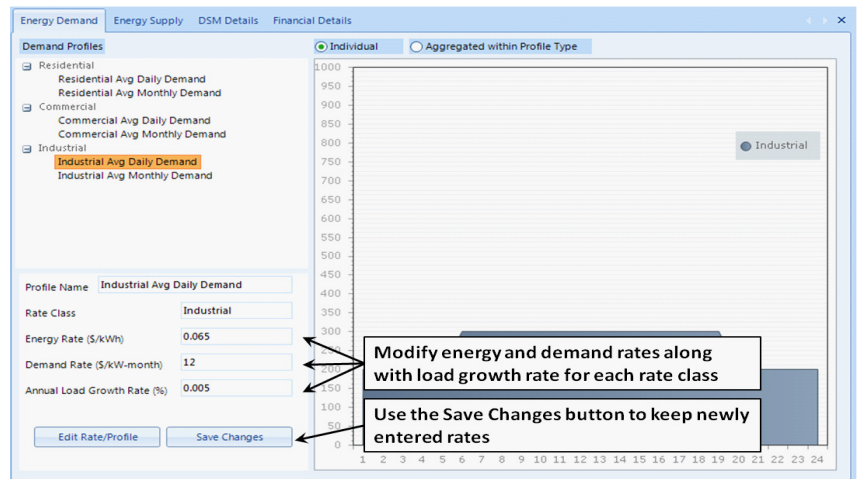
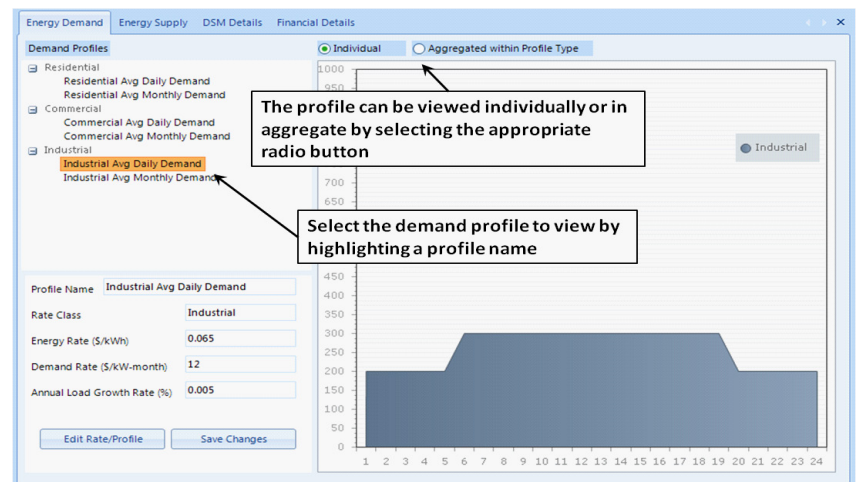


Exhibit 4: Energy Demand Tab 3



STEP 2: Energy Supply Tab

The **Energy Supply** tab allows users to enter information about energy supply across specified supply resources. This tab provides data that characterizes a utility's supply characteristics and energy costs. Information entered in this tab will be compiled for analysis. The steps for entering this information are described below.

Editing the Supply Resources

Supply resources can be created and edited in the **Energy Supply** tab. To create a new resource, click the **New** button in the **Energy Supply Resources** area. New and existing resources can be edited by selecting the desired resource and changing its parameters. Parameters include the following: specifying whether the resource is **Generated** or **Purchased** power; **Resource Name**; **Unit** or **Tier** number; **Operational Capacity** or **Capacity Ceiling**; **Energy Cost**; and **Monthly Capacity Cost**. Capacity units are MW; energy cost units are dollars per MWh; and demand cost units are dollars per MW. Once the desired information is entered for the supply resource, it must be saved by clicking the **Update** button. Resources can also be deleted by selecting a resource and clicking the **Delete** button. See Exhibit 5 for an illustrated example.

In addition to being able to directly enter the energy and capacity costs for a generated power resource, users can also use a calculator to determine these costs. This function is intended to be used for units where the energy and supply costs are not known, but the components of the costs are. The calculator can be opened within any generated supply resource by clicking the calculator icon to the right of the **Monthly Capacity Cost** field. Once the calculator is opened, users can determine energy and capacity costs by entering information about **Fuel Type**, **Fuel Cost**, **Heat Rate**, **Variable** and **Fixed Maintenance Costs**, and **Monthly Debt Burden**. Provided below are calculator instructions. For an illustrated example, see Exhibit 6.

1. Select the appropriate **Fuel Type** from the drop-down menu.
2. Enter the **Fuel Cost** in units (units depend on the **Fuel Type** selected). For example, all coal fuels have **Fuel Cost** units of dollars per short ton. Users must ensure that the **Fuel Cost** matches the units specified within the **Fuel Cost** field.
3. Enter the **Heat Rate** (indicating efficiency) in units of British thermal units (Btu) per kWh. For reference, 1 kWh is equal to 3,412 Btu at 100% efficiency.
4. **Variable** and **Fixed Maintenance Costs** are entered next. **Variable Maintenance Costs** have units of dollars per MWh and **Fixed Maintenance Costs** have units of dollars per MW-month.
5. **Debt Burden** is entered last with units of dollars per MW-month.
6. Once information has been entered into every field, click the **Calculate** button to determine energy and capacity costs.
7. These costs can be imported into the **Supply** tab by clicking the **Apply** button. The values can be discarded by clicking the **Cancel** button.

Exhibit 5: Energy Supply Tab 1

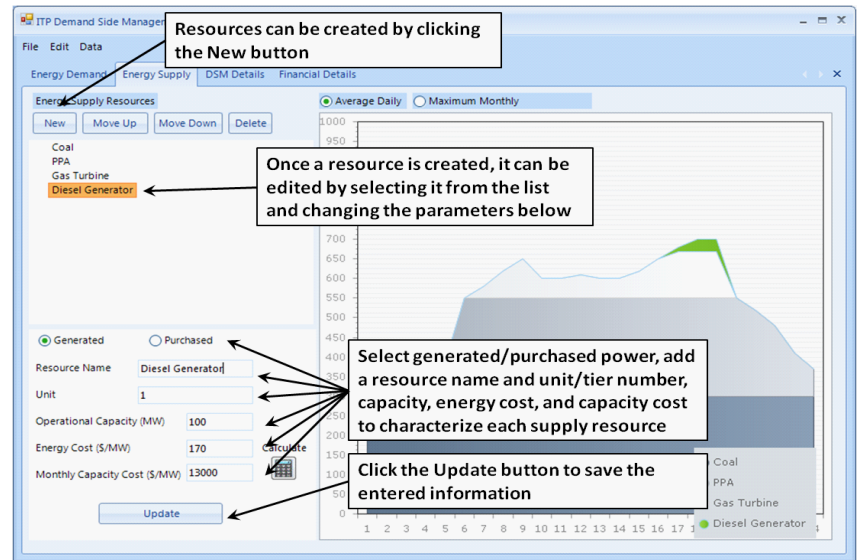
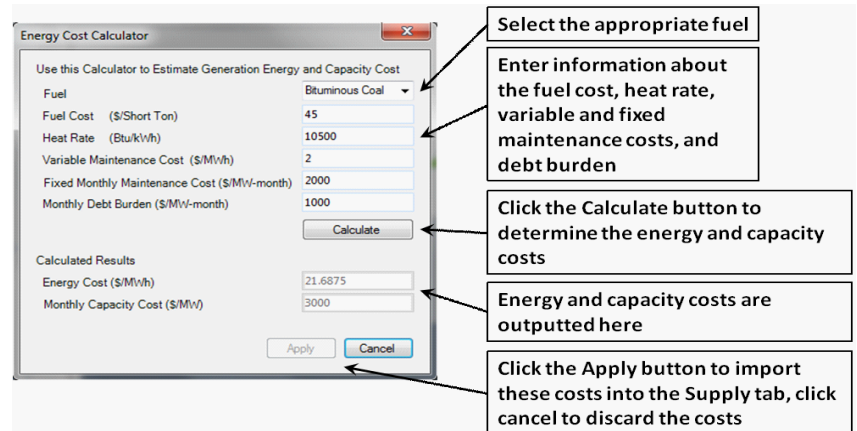


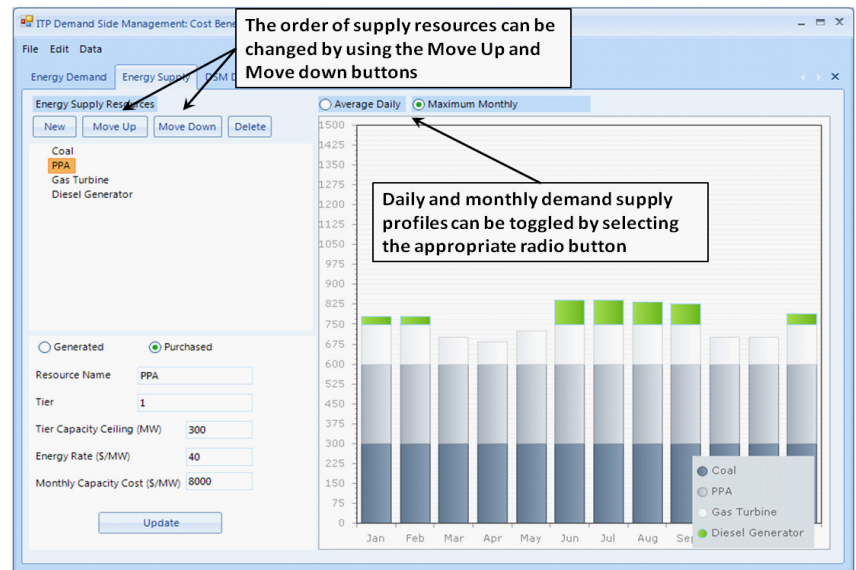
Exhibit 6: Generated Energy Cost Calculator



The supply resources entered in the **Energy Supply** tab are used to fill in the aggregate demand profile specified in the **Energy Demand** tab. The order in which supply resources appear depends on the order in which they are entered. In Exhibit 7 below, the first resource is coal, the second is PPA, and so on. The order is very important because it will impact the effectiveness of a DSM program's ability to reduce energy-supply costs from more expensive supply resources. You can change the order in which the supply resources appear by selecting a resource and using the **Move Up** and **Move Down** buttons. This allows users to locate each resource in the proper order in which it comes online to meet demand.

The order of resources can be verified by looking at the graph. The first resources that come online to meet demand will be located at the bottom of the graph; the last resources that come online will be located at the top of the graph. Users can check both daily and monthly profiles by selecting the appropriate radio button, located above the graph. See Exhibit 7 for an illustrated example.

Exhibit 7: Energy Supply Tab 2



STEP 3: DSM Details Tab

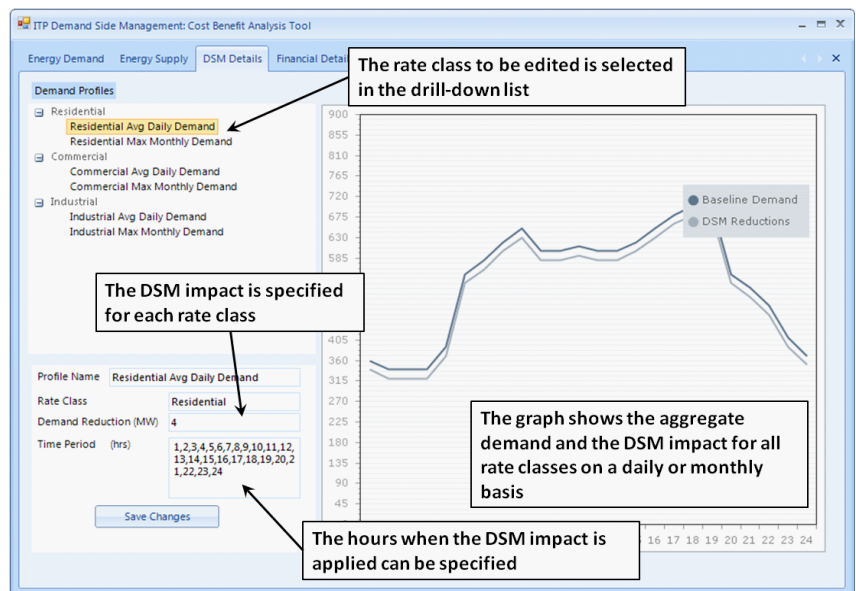
The **DSM Details** tab allows users to enter information about the DSM program's energy-savings goals, as well as the times when energy savings will occur. This tab provides data that will impact a utility's current operational characteristics. Information entered in this tab will be compiled for analysis. The steps for entering information are described below.

Editing the DSM Details

For each rate class, users can enter the target **Demand Reduction** on either the daily or monthly drill-down menu item. The **Demand Reduction** entered in either item will be applied to both daily and monthly profiles. Under the daily profile, users must select the **Time Period**, or times of the day, when the **Demand Reduction** will be applied for each rate class. Times of day must be entered for each hour when the **Demand Reduction** will be applied. Entered hours must be separated by a comma. This **Demand Reduction** will be applied equally to all months of the year.

The daily and monthly demand reductions are shown in the graph. Regardless of which rate class a user selects, the graph will show the aggregate daily or monthly demand before and after the **Demand Reduction** impact is applied. Graphically, this impact is only applied to the demand entered by a user, not the future values that are reflected in the **Financial Details** tab. See Exhibit 8 for an illustrated example.

Exhibit 8: DSM Details Tab



STEP 4: Financial Details Tab

The **Financial Details** tab allows users to enter DSM program budget details and other financial information. This tab also provides output information on program performance, which will lead a utility to make a go/no-go decision. Information entered in this tab will be compiled for analysis. The output of this analysis is also displayed in this tab. The steps for entering this information are described below.

Editing the Financial Details Tab

The **DSM Program Costs**, **Energy Consumption Penalty**, and **Time-Based Details** can be edited in this tab, within their respective areas.

First, enter information about **DSM Program Costs**. These costs include **Unit Rebate Amount**, **Energy Service Manager**, **Equipment**, **Marketing**, and **Other Costs**. The **Unit Rebate** amount is used in conjunction with the DSM **Demand Reduction** targets entered in the **DSM Details** tab. Units for the **Unit Rebate** amount are dollars per kW. All other units in this area are dollars per year. Once all of these values are entered, the **Total DSM Program Cost** is determined.

The **Energy Consumption Penalty** area can be used by utilities that face a mandatory, annual energy reduction with a penalty. Penalty analysis is based on an **Annual Reduction Goal**. This goal is a percentage applied to the total energy sales determined by the values a user enters in the **Energy Demand** tab. The **Avg Penalty** field allows users to specify the unit penalty for energy sales that did not meet the goal. **Avg Penalty** is in dollars per MWh. The **Energy Consumption Penalty** can be applied over a given number of years which the user specifies. This functionality will apply a penalty for not meeting the mandated goal from year one through the specified year.

Time-Based Details help users determine the true cost or benefit of the program over time. Users must first enter an appropriate **Discount Rate** to determine the present value (PV) of the DSM program. This is required to accurately compare future net energy-supply revenue to current net energy-supply revenue. An **Inflation Rate** may also be entered. This rate is applied to all **DSM Program Costs**, except the **Rebate Cost**. Both discount and inflation rates have units of annual percentage rates. Values can be entered as decimal values or as values with percentage signs. For example, 2.5 percent could be entered as “0.025” or “2.5%.”

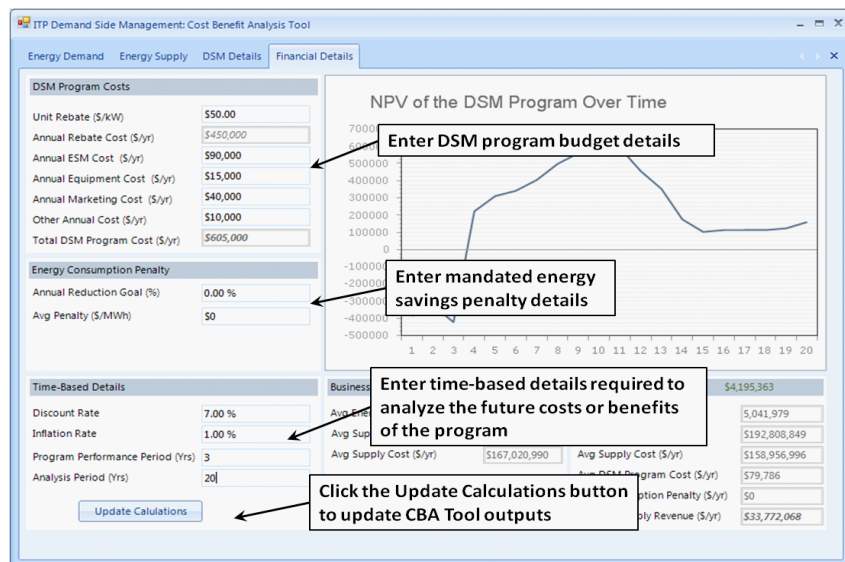
Two other important time-based features of the analysis are **Program Performance Period** and **Analysis Period**. The **Program Performance Period** is the amount of time the DSM program will be in service and will require a utility to pay the associated program costs. The **Analysis Period** is the amount of time the program costs or benefits will be analyzed over. For example, if the DSM program is supposed to run for three years, but the benefits need to occur over five years, the **Program Performance Period** would be three and the **Analysis Period** would be five. The **Analysis Period** must be greater than or equal to the **Program Performance Period**.

Once all of the desired fields are filled in, users must click the **Update Calculations** button at the bottom of the screen to perform the analysis and output the values. This button must be clicked again whenever any changes are made to the inputs because the model does not update automatically. See Exhibit 9 for an illustrated example.

Using the Financial Details Tab to Provide Analysis

After the **Update Calculations** button is clicked, a number of results appear in the two areas located in the bottom right-hand corner of the **Financial Details** tab. The two areas include **Business as Usual** and **DSM Impact**. The **Business as Usual** area displays the financial results of a utility’s current trajectory without a DSM program. The **DSM**

Exhibit 9: Financial Details Tab 1



Impact area displays the financial results of a utility that implements the DSM program (for the specified **Program Performance Period**). Both the **Business as Usual** and **DSM Impact** areas show results averaged over the specified analysis period. They have the following metrics:

- **Average Energy Sales** – Annual energy sales in MWh
- **Average Supply Revenue** – The amount of revenue earned by supplying customers with electricity
- **Average Supply Cost** – The cost of supplying electricity through purchased and generated power sources
- **Average DSM Program Cost (DSM Only)** – The annual cost of running the DSM program during the period of performance
- **Average Penalty** – The penalty incurred by not meeting mandated energy reductions
- **Average Net Supply Revenue** – The revenue of energy sales minus supply, DSM, and penalty costs.

There is a possibility that an error will occur once the **Update Calculations** button is clicked. This error will appear if a user has entered insufficient supply resources to cover the demand in the present or the future. The error will display how much of a deficit a user needs to overcome by increasing the contribution from existing supply resources or by adding additional supply resources. See Exhibit 10 for an illustrated example.

Please note, meeting future demands is important in comparing the business-as-usual and DSM scenarios, based on load growth. If anticipating future supply resources is difficult, the load growth rates can be set to 0% for all rate classes to simplify the use of the tool.

The **NPV of the DSM Program Over Time** graph is also updated when the **Update Calculations** button is clicked. This graph shows the difference in net supply revenue between the business-as-usual and DSM scenarios. All future values are discounted to the present value. This graph shows the DSM program's net cost or benefit, year-by-year.

The full net present value of the DSM program is displayed in the **DSM Impact** area heading. If the value displayed is green, then the proposed DSM program is beneficial. If the value displayed is red, then the DSM program, as designed, will not provide a net benefit. See Exhibit 11 for an illustrated example.

Exhibit 10: Financial Details Tab 2

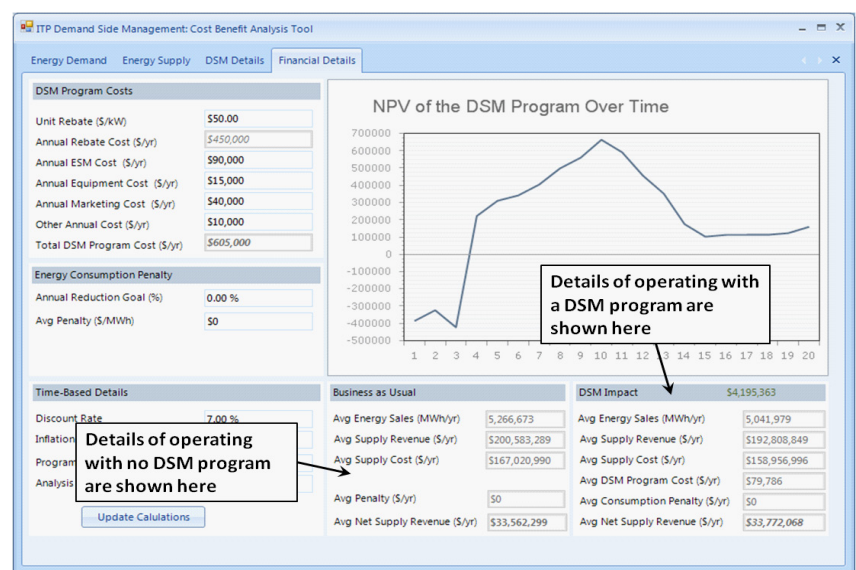
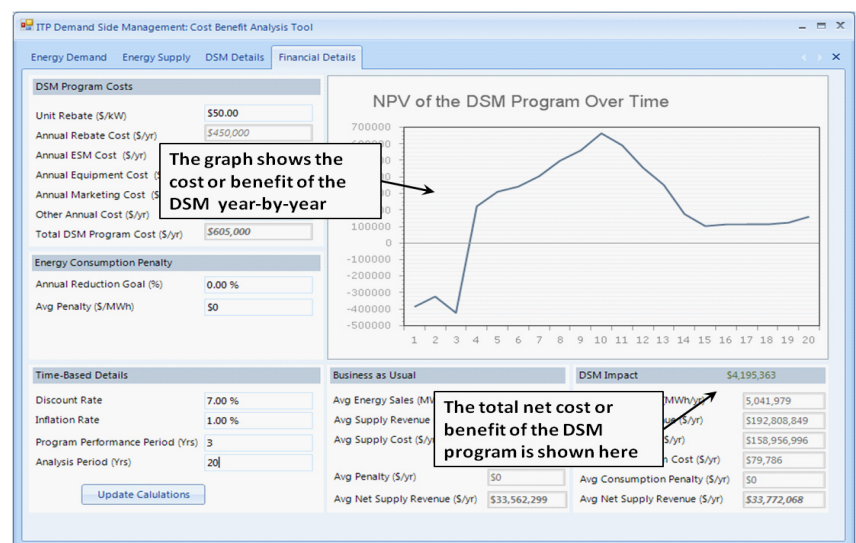


Exhibit 11: Financial Details Tab 3



Direct Support

If you have any questions or comments about the tool, please contact Ryan Harry at rharry@bcs-hq.com.