Getting Started

System Analyzer™

Simplified HVAC Energy and Economic Analysis

Version 6

TRANE®

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System Analyzer™, whether used by itself or in combination with other software, is intended as a tool for estimating the energy and economic performance of HVAC systems based on specific building properties, operating and environmental conditions, and financial factors. Program accuracy is highly dependent on user-supplied data. It is the user's responsibility to understand how the data entered affects program output, and to understand that any predefined libraries are to be used only as guidelines for entering that data. The calculation results and reports from this program are meant to aid the building designer and are not a substitute for design services, judgment, or experience.

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Chapter **12** Graphs

1 A Brief Introduction

System Analyzer™ is a comparative analysis tool for preliminary evaluations of HVAC systems based on energy and economic performance. Use it to compare virtually any combination of air distribution system(s) and cooling/heating equipment for a specific building type and weather location. Then use the program's professional-looking reports and graphs to help weigh the benefits of prospective system designs.

If you're new to the program, you'll discover that the straightforward, logically organized entries and built-in templates can help even an HVAC novice create a complete analysis in as little as 10 minutes. Experienced users can model more complex HVAC scenarios by customizing the templates and libraries.

Package contents and system requirements

The System Analyzer program includes these components:

■ TRACE™ Family CD-ROM with executable files, online Help— everything you need to install and run the program

■ System Analyzer *Getting Started* manual

Refer to the ReadMe file on the CD-ROM for details about the operating system and hardware that are required to run the program.

What's new

We completely redesigned System Analyzer to integrate it into the TRACE family of HVAC design and analysis tools. The program now uses the same calculation engine as that of our tried-and-true TRACE 700 building load and energy analysis program. This

approach provides two important benefits: Now you can easily import your preliminary System Analyzer evaluations of prospective HVAC designs into TRACE 700 for further refinement and comprehensive analysis. Also, integrating the two programs makes it easier for us to add new features—which means that you can expect more frequent upgrades.

But more importantly, System Analyzer version 6 was developed to better meet your HVAC evaluation needs. Here are a few highlights:

- **Smooth, stable operation.** We changed the programming language to make System Analyzer compatible with the latest Windows operating systems.

- **Streamlined entries.** The redesigned work area and built-in templates make it easy to quickly define a building, weather location, and HVAC systems with as much or as little detail as you want. Collapsible lists in the new "project navigation" pane replace menus, providing instant access to every aspect of the project.

- **Expanded modeling capabilities.** With System Analyzer version 6, you now can model makeup-air units, heating-only airside systems, and a building with *five* (rather than two) thermal zones.

- **Simplified file-sharing.** It's no longer necessary to export information from System Analyzer libraries when sharing your project files with others. Each .sa file contains *all* of the details for a project.

Installing (and uninstalling) System Analyzer

The System Analyzer program must be installed on your hard disk or a LAN drive; you cannot run the program from the CD-ROM. The ReadMe file on the CD-ROM provides step-by-step installation instructions.

Uninstalling the program

If you ever need to remove the System Analyzer program from your computer, use Add or Remove Programs in the Windows

Control Panel. This utility will delete all System Analyzer files—except for those shared by other applications and those that you created (project files and custom definitions of equipment and/or utility companies).

Starting System Analyzer

Start the System Analyzer program just as you would any other Windows program, by doing *one* of the following:

- Double-click the **System Analyzer** icon on the desktop.

- On the **Start** menu, point to **Programs** and **C.D.S. Applications**; then click **System Analyzer 6**.

Learning to use System Analyzer

The System Analyzer program was specifically designed so that anyone with a basic knowledge of HVAC systems can easily prepare a design analysis or comparison.

This manual

The *Getting Started* manual will acquaint you with:

- How the program works (Chapter 2)

- The *System Analyzer* workspace (Chapter 3)

- How to create an analysis, step by step (Chapters 4–10)

- The reports and graphs of the analysis results (Chapters 11–12)

Read the manual from cover to cover, or skip directly to Chapter 4 to begin using the program by recreating the sample analysis project.

Tips like this one appear throughout the manual to provide helpful hints and additional insight into how the program works.

Online Help

System Analyzer's online Help describes how to perform basic tasks. It also provides detailed information about each program entry. To open online Help, do one of the following:

■ On the **Help** menu, click **Contents**.

■ Press F1 for the Help topics related to the currently displayed screen.

■ Click the **Help** button on the toolbar.

Web resources

Additional sources of information and help are available in the Software area of the Trane Web site. Visit www.tranecds.com for access to our online knowledge base, download center, and training opportunities, and to subscribe for notifications about program updates.

Technical support

Your license agreement (renewed annually) entitles you to continued use of the program, free program upgrades, and the latest documentation. As a Trane C.D.S. customer, you're also eligible for free technical assistance from the experienced HVAC engineers and software specialists in our support center.

Support center hours are 8:00 a.m. to 5:30 p.m. (central time), Monday through Thursday; and 8:00 a.m. to 5:00 p.m., Friday.

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	La Crosse, WI 54601-7599

Comments?

We are committed to continually improving our HVAC design and analysis tools. As you use System Analyzer and discover opportunities to improve its usability, or if you encounter difficulties, please take a moment to let us know by e-mail, fax, or phone.

2 How System Analyzer Works

Key concepts

Alternatives

An **alternative** represents a particular combination of building and/or HVAC system characteristics. System Analyzer lets you define and compare up to four alternatives within the same project.

Systems and plants

Airside system represents the arrangement of air paths that carry air to and from the building zones. The program can model 17 types of airside systems in three categories: constant volume, variable volume, and heating only.

Plant refers to the mechanical equipment that conditions (heats, cools), filters, and/or moves air, usually to keep occupants comfortable. Examples include packaged air conditioners, air handlers, chillers, boilers, and auxiliary equipment, such as pumps and cooling towers.

Libraries and templates

Libraries provide the attributes of commonly used construction materials, equipment, base utilities, weather, and scheduling—all of which the System Analyzer program uses to calculate building loads and equipment energy consumption. Much of the information in these libraries reflects the design parameters published in the *ASHRAE Handbook–Fundamentals* and similar industry references.

Note: The program includes a separate Library/Template Editors utility that helps you customize the libraries of building schedules, utility rates, and cooling, heating, and thermal storage equipment. See online Help for more information.

Each *building type, airside system type,* and *plant type* serves as a **template** that provides nearly all of the information necessary to complete a preliminary performance analysis. You can rely on the default values in the template or change them to more closely match a prospective or existing design.

What the program does

System Analyzer automates four sets of calculations, which simulate building and equipment cooling and heating loads to predict the energy consumption and life-cycle costs of the HVAC system.

- ■ Building cooling and heating loads based on local weather
- ■ Equipment cooling and heating loads
- ■ Energy consumed by the HVAC system
- ■ Costs of owning and operating the HVAC system

To complete these calculations, the program uses information about the building, its location (weather), and the HVAC systems under consideration. Most of this information is provided automatically when you identify the geographic location, building type, and system type.

Here's a brief explanation of the program's methodology.

Weather

System Analyzer predicts the effect of typical weather on building loads by simulating the operation of the building and its services for a "reduced" year. In other words, for each month of a year, the program calculates the "actual" energy consumption during three 24-hour day types—Weekday, Saturday, and Sunday—and then

multiplies each result by the number of occurrences of that day type (Figure 2-1).

Figure 2-1 Basis for calculating monthly energy consumption

MARCH						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
			1 Weekday	2 Weekday	3 Weekday	4 Saturday
5 Sunday	6 Weekday	7 Weekday	8 Weekday	9 Weekday	10 Weekday	11 Saturday
12 Sunday	13 Weekday	14 Weekday	15 Weekday	16 Weekday	17 Weekday	18 Saturday
19 Sunday	20 Weekday	21 Weekday	22 Weekday	23 Weekday	24 Weekday	25 Saturday
26 Sunday	27 Weekday	28 Weekday	29 Weekday	30 Weekday	31 Weekday	

Example:
March energy consumption = (Weekday × 23) + (Saturday × 4) + (Sunday × 4)

The program's "weather" library contains weather profiles (Figure 2-2) for many geographic locations. Each weather profile includes dry-bulb and wet-bulb temperatures, enthalpies, air pressures, solar radiation, and cloud cover for the seasons in that location. System Analyzer uses:

■ "Typical" weather (historical temperatures) to calculate the Weekday, Saturday, and Sunday *energy consumption* for each month

Figure 2-2 July temperature profile for San Francisco
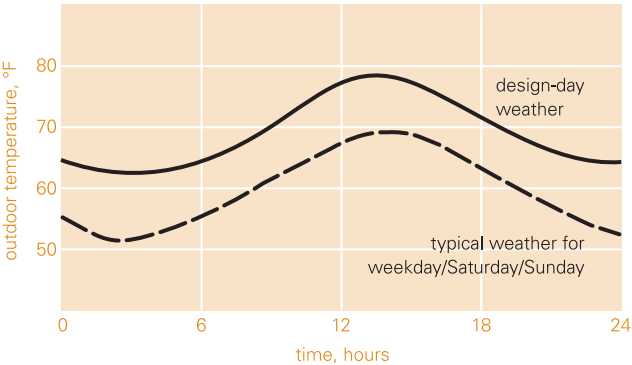
■ "Design" weather (ASHRAE 2.5%, worst-case temperatures)—along with a cooling design day type—to calculate each month's peak *energy demand*

Building loads

Because it's a comparative analysis tool for *preliminary* evaluations, the System Analyzer program generalizes the load characteristics of a building. It treats all buildings, regardless of type or size, as rectangular and divided into five thermal zones—four along the perimeter and one in the interior (Figure 2-3). The depth of each perimeter zone equals the distance between the exterior wall and the interior zone.

Figure 2-3 Typical building in System Analyzer (plan view)

System Analyzer divides each building into five thermal zones
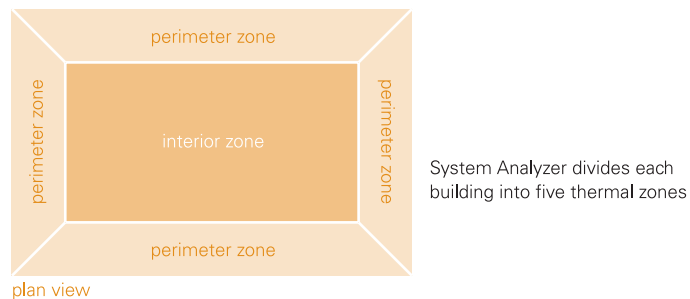
Calculations performed during this simulation define the building cooling and heating loads at design conditions based on the weather location and the description of the building. This description includes the type of building, its layout and construction, and the utilization schedules for occupancy, lights, and miscellaneous loads. (Much of this information is provided when you select a building type. See Chapter 5 or online Help for more information.)

Loads in each zone are calculated independently and without thermal interaction between zones. It's also assumed that all internal loads and ventilation are evenly distributed throughout the building.

Airside systems

To simulate operation of the airside systems in the building, the program performs calculations that determine the equipment loads for air-moving, cooling, and heating based on the heat gains and losses determined during the building load simulation.

System Analyzer then combines the resulting 24-hour building load profiles for each month with coil and fan capacities to determine the effect on the HVAC system and to calculate required airflows.

Cooling and heating plants

The objective of the plant simulation is to predict how much energy the cooling, heating, and air-handling equipment will consume each month of the year. To accomplish this, the program relies on the "equipment" library for performance information (full-load consumption rates, percentage of power consumed, and curves for unloading and ambient relief) about each piece of equipment in the system. The building load profiles generated during the airside system simulation provide the hourly demands for cooling, heating, and airflows.

The program also adjusts equipment performance based on the ambient wet-bulb and dry-bulb temperatures in the weather profile.

Economic performance

System Analyzer's economic simulation automates life-cycle cost calculations to enable decision-making based on financial criteria, such as simple payback period, yearly net present value of cash flows, internal rate of return, and summation of discounted cash flows.

Monthly utility costs are calculated by applying the utility rates (that you define) to the energy consumption and demand values that were calculated during the "plant" simulation. Installed cost, maintenance expense, and other economic factors are applied to project the life-cycle cost for the proposed design.

3 Work Area Basics

Layout

The System Analyzer work area (Figure 3-1) is divided into two main areas or panes: a "project navigation" pane and a "project details" pane.

Project navigation pane

After you open a file, three collapsible lists in the "project navigation" pane on the left side of the screen provide quick access to information about the project:

- The **File name** list, *mytutorial* in this case, shares the same name as the current file. Use it to create or switch between

Figure 3-1 System Analyzer work area

*menu bar
*toolbar

Identifies the current alternative and worksheet (or report)

Use these collapsible lists to display details about the project

"project navigation" pane → ← → "project details" pane

links to "previous" and "next" worksheets

*See online Help to learn more about specific menu commands, toolbar buttons, or other elements in the work area
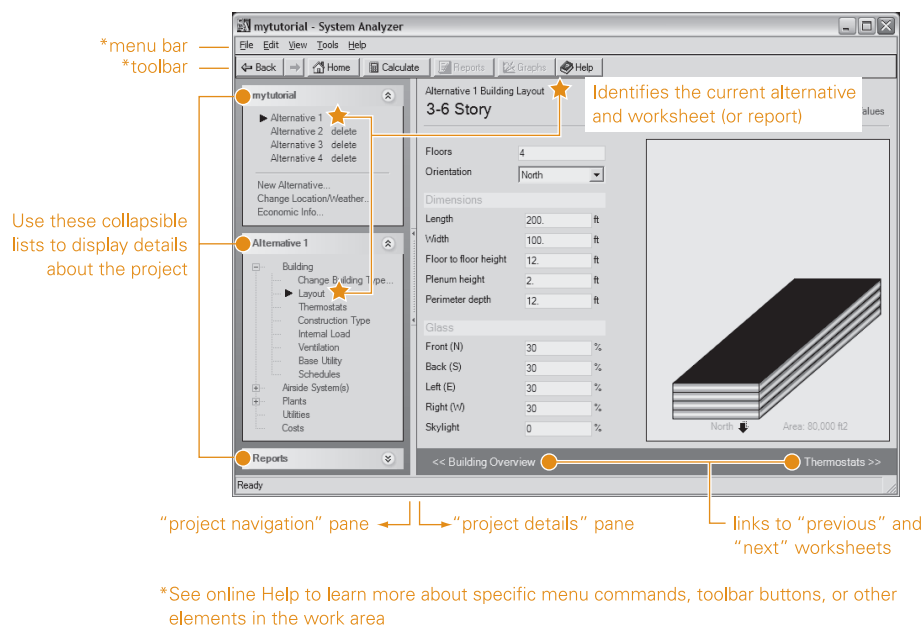
alternatives, and to change information that's common to all alternatives (weather location and economic parameters). A ▶ points to the current alternative.

*Note: System Analyzer displays a list of recently opened files when you start the program. Click a listed file to open it, or use the **File** menu to locate some other existing project or to create a new one.*

■ The **Alternative** list helps you move between "worksheets" to provide details about the building, airside systems, cooling and heating plants, utilities, and HVAC costs for a particular alternative. Clicking an item in this list displays the corresponding worksheet in the adjacent pane. A ▶ points to the worksheet that's currently displayed.

■ The **Reports** list provides links to the input and output reports for the project. (Some reports only become available after the program completes the analysis calculations.) "Input" reports summarize the data that were used to complete the calculations. "Output" reports show the results of those calculations. A ▶ points to the report that's currently displayed in the adjacent window.

Project details pane

The "project details" pane on the right side of the screen displays the details for the current alternative, worksheet, or report. Default values are provided for most worksheet entries, based on the type of building, airside system, or plant that was selected. Most entries can be edited.

Links at the bottom of this pane let you move to the next worksheet (or report) or return to the previous one.

Menus and toolbar

Menus across the top of the main System Analyzer window organize the commands that help you manage and work with your analysis projects. A **toolbar** directly below the menus provides one-click access to the most commonly used commands. (See Figure 3-1, p. 3–1.)

Color cues

As you work with System Analyzer, you'll notice that some worksheet entries appear in a pale yellow box (Figure 3-2). The values displayed in these entries come from one of the program's libraries of predefined equipment, construction materials, utilities, weather, and schedules. In some cases, you can change the displayed value. A "restore library values" link lets you reset the entry to the original default value.

Blue text identifies commands and hyperlinks. (An underline appears under the text when you point to it.)

Aqua bars with headings divide worksheets into groups of related entries.

Dimmed entries cannot be edited.

Figure 3-2 Colors identify links and library values

Blue text flags commands and hyperlinks

Aqua bars divide a worksheet into groups of related entries

Yellow shading identifies information from a System Analyzer library

Restore Library Values becomes available if you edit a value that came from a library

Dimmed entries are not available for the selected building, airside system, or plant
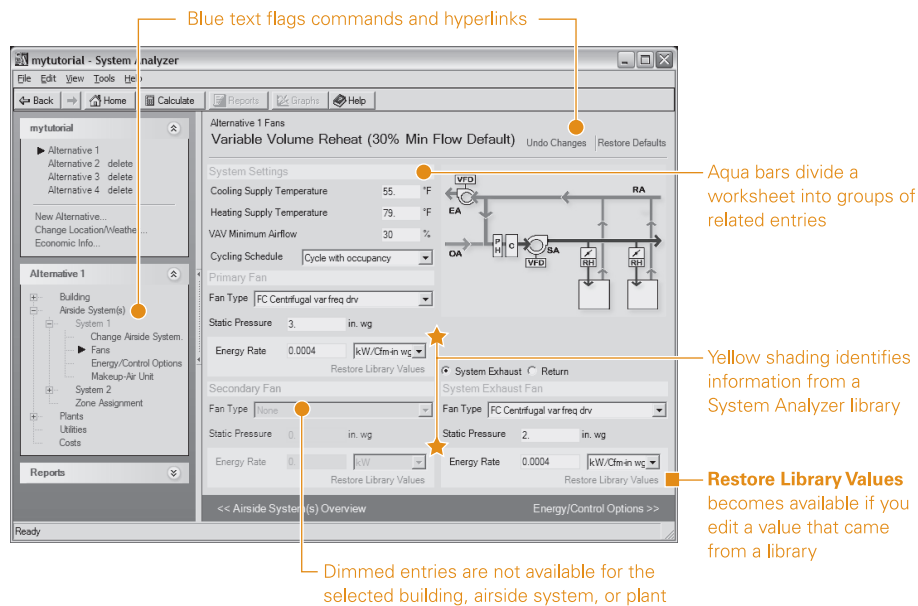
Setting preferences

Preferences are options that let you "tell" the program how you want it to work. Your choices remain in effect until you change them. In the case of System Analyzer (Figure 3-3), you can choose English I-P or metric SI units of measure, a default city for weather, and file locations for projects and libraries.

To review and/or change your preferences, open the **Tools** menu and click **Preferences**.

Figure 3-3 Preferences dialog box

If you typically use metric units, select them here

Click **Change** to choose a different default folder for your project files or library additions

If most of your projects represent buildings in one location, use the map tabs, region options, and **Default City** list to make it your default
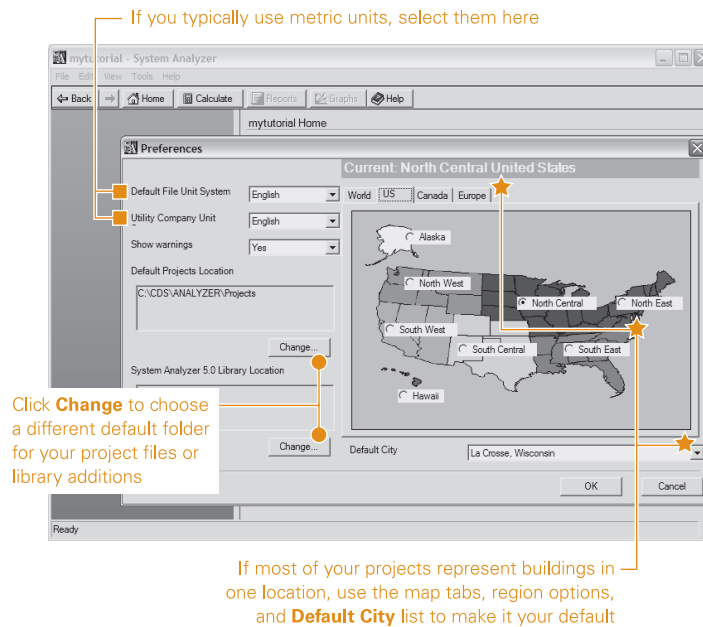
Values selected in the **Preferences** dialog box become the defaults for all new System Analyzer project files, and will remain in effect until you change them. (You can change this information for an individual project when you create a new file or edit an existing one. See online Help for more information.)

Tutorial

Setting up an analysis

The best way to learn how to use the System Analyzer™ program is to try it. Chapters 4–10 will guide you through the steps and most basic entries needed to perform an analysis. Along the way, you'll find out how to choose a weather location, select and define equipment, add options, and create alternatives.

Analysis Steps

- [ ] Create a new project
- [ ] Choose a building type
- [ ] Choose airside system(s)
- [ ] Choose clg/htg plant(s)
- [ ] Define utility rates
- [ ] Define HVAC costs
- [ ] Add alternative(s)
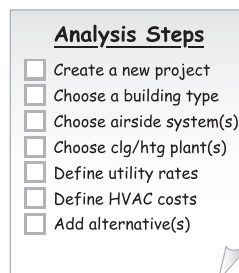
Note: To complete this tutorial, you must successfully install System Analyzer on your computer and possess a working knowledge of the Windows® operating system. The instructions and accompanying illustrations are based on the Windows XP operating system.

◆4 Step 1— Create a New Project

Scenario

Analysis Steps

☐ Create a new project
☐ Choose a building type
☐ Choose airside system(s)
☐ Choose clg/htg plant(s)
☐ Define utility rates
☐ Define HVAC costs
☐ Add alternative(s)

You and the design engineer are engaged in the planning stage for a new office building. The building owner isn't sure what type of HVAC system to install, so the design engineer wants to provide a preliminary comparison of two candidate systems: a small chilled water system with variable-volume air distribution (Alternative 1) and a high-efficiency water-source heat pump system (Alternative 2).

Although the building design is far from complete, you know that:

■ The building will be located in Tampa, Florida.

■ Most of the space will be used as offices.

■ The building will have four floors and will occupy approximately 80,000 square feet.

Note: The main objective of this tutorial is to quickly familiarize you with the "look and feel" of System Analyzer so that you can comfortably explore the program's functionality on your own. For that reason, the tutorial relies on the default values for the selected building, system, and plant types. If you're puzzled about a particular entry, press F1 to check online Help for an explanation.

Starting a new file

For this tutorial, you'll create a new project. To do so:

1 Start the System Analyzer program.

2 Click the **Start a new file** link on the right side of the screen (Figure 4-1). Or, if you prefer, open the **File** menu and click **New**.

The program will open a New File worksheet that prompts you for general information about the project.

Figure 4-1 Starting a new System Analyzer project
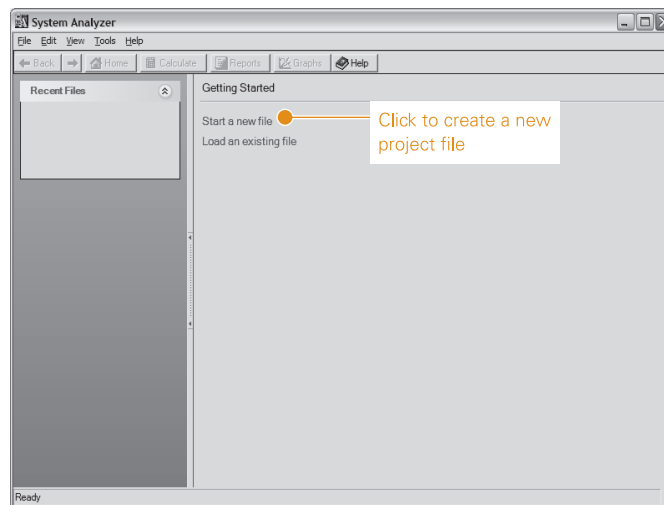
Providing overview information

Whenever you start a new analysis, it's important to assign a file name. On the New File worksheet (Figure 4-2):

1 Type **mytutorial** in the **File Name** text box. (Do not use punctuation marks or special characters.) The program will give the file a .sa extension and save it in the Projects folder unless you choose a different location.

*Note: The program regularly saves your entries as you add details about the project, which is why **File Name** is a required entry. System Analyzer will not let you continue until you name the file.*

2 If desired, provide additional background information about the project in the boxes provided.

The New File worksheet prompts you to describe the building, its owner, and the person performing the analysis. These entries are optional, but can be useful for distinguishing one project from another because the information you provide will appear on reports.

3 When finished, click **Next**.

> **TIP**
>
> If you wish, you can add background information later. Simply click the **Home** button in the toolbar. Then, click **Edit** or ⓘ in the General heading bar.

Figure 4-2 Name your project and provide additional information, if desired

required entry

You can add or change this information at any point in your analysis

The program displays the **project name** in the heading —and the **file name** and **application user** in the footer —of each report

Selecting a weather location

Having named the project file, the next task is to identify the geographic location of the project (Figure 4-3). Recall that the office building will be built in Tampa,Florida.

1 Click the appropriate tab to display the desired map (the **US** in this case).

2 Select the desired region by clicking its option button (**South East** in this case). Then click the **Next** button at the bottom of the screen to continue.

3 From the list provided, select the city that is geographically closes to the location of the project (**Tampa, Florida** in this case). The program displays the typical summer and winter design conditions for your selection. You can replace the values shown by typing new ones that more closely match the design conditions for the project.

4 Click **Finish** to continue.

Figure 4-3 Name your project and provide additional information, if desired

Click a tab to display a different map

Select the appropriate region on the map and click **Next**

Then select a city from the list and click **Finish**

To use a different design value, simply type it in the appropriate box. If you change your mind, click **Restore Library Values** to bring back the default(s).
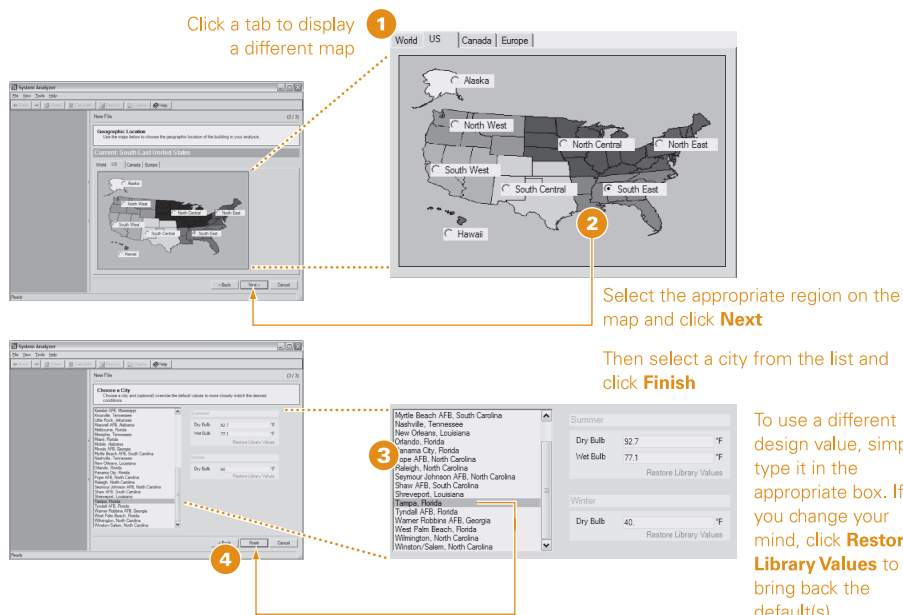
5 Step 2—Choose a Building Type

In the previous chapter, you created and named a new project file and then chose a geographic location with the appropriate weather profile. In this chapter, you'll define the four-story office building in our tutorial.

Describing the building

Analysis Steps

- ☑ Create a new project
- ☐ Choose a building type
- ☐ Choose airside system(s)
- ☐ Choose clg/htg plant(s)
- ☐ Define utility rates
- ☐ Define HVAC costs
- ☐ Add alternative(s)

TIP

Refer to online Help to find out more about the default values in each "building type" template.
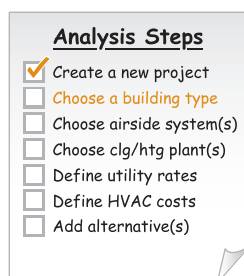
1 In the "project navigation" pane on the Choose Building Type screen (Figure 5-1, p. 5–2), expand the Office Buildings section of the list and click **3–6 Story**. Then click **OK**.

In System Analyzer, each building type is a template that provides default values describing the building's size, construction, internal loads, and utilization schedules (that is, when and for how long internal loads and system events occur).

Most entries can be edited to more closely match the design details of the project. In some cases, such as this tutorial, the defaults may be accurate enough for a preliminary analysis.

2 Review the template defaults for 3-to-6-story office buildings. These defaults are organized on the series of worksheets represented by the items under Building in the Alternative 1 list (Figure 5-1). To move between worksheets, do *one* of the following:

- Click a link at the bottom of the "project details" pane to move to the previous or next worksheet.

- Select the desired building worksheet from the Alternative list in "project navigation" pane.

When you're ready to continue, open the Schedules worksheet and proceed to the next section.

Figure 5-1 Choosing a building type opens a template of completed-but-editable worksheets

Choosing a building type
type opens a series of
worksheets that are already
filled out with the default
values in that template

Select a
worksheet to
display it

Use these links to view the
"previous" or "next" worksheet
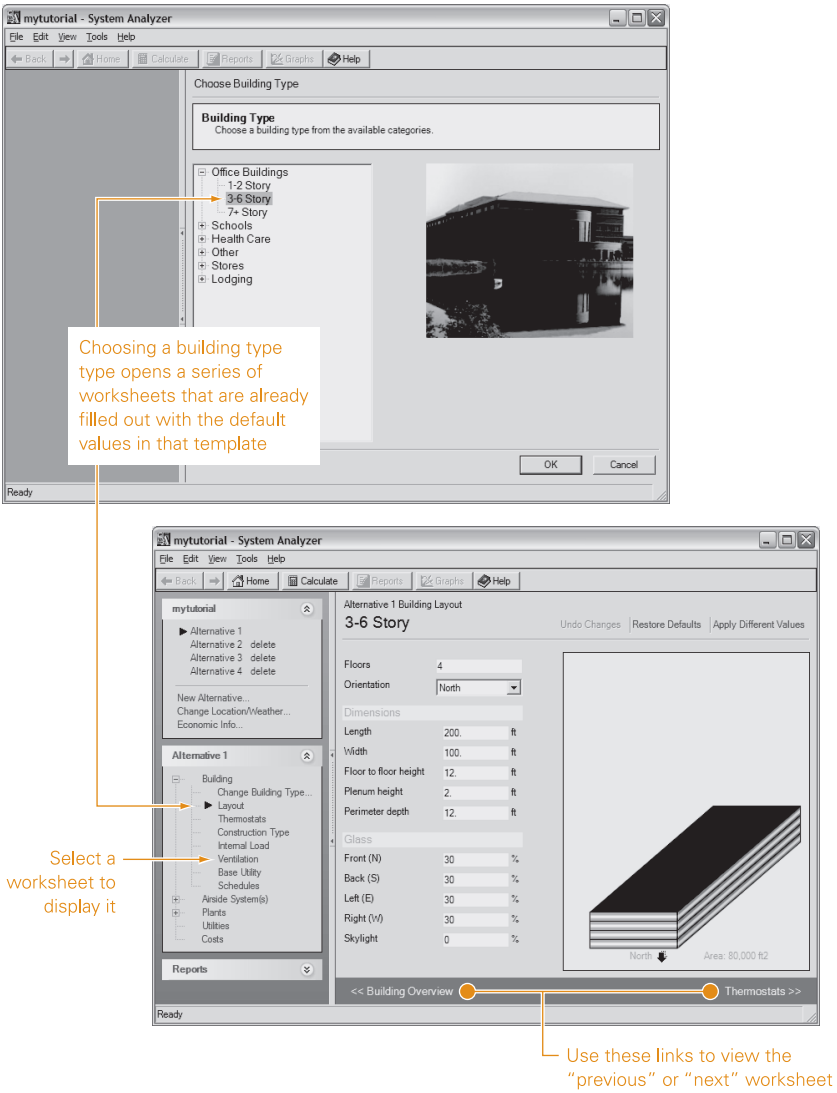
Working with building utilization schedules

Utilization schedules play an important role in determining a building's load profiles and energy consumption: They define when and for how long internal loads and system events occur. Both affect energy use.

The System Analyzer program provides seven customizable building load schedules (Figure 5-2): people/occupancy, lights, miscellaneous equipment (computers and photocopiers, for example), infiltration, ventilation, base utilities, and domestic hot water. There's also a "summary" schedule, which provides a helpful overview.

To view a specific schedule, do *one* of the following:

■ Click one of the tabs (**Lights**, for example) near the top of the screen.

Figure 5-2 System Analyzer provides seven customizable building utilization schedules

To display a different building utilization schedule, click its tab …

… Or click **Edit** next to the appropriate graph
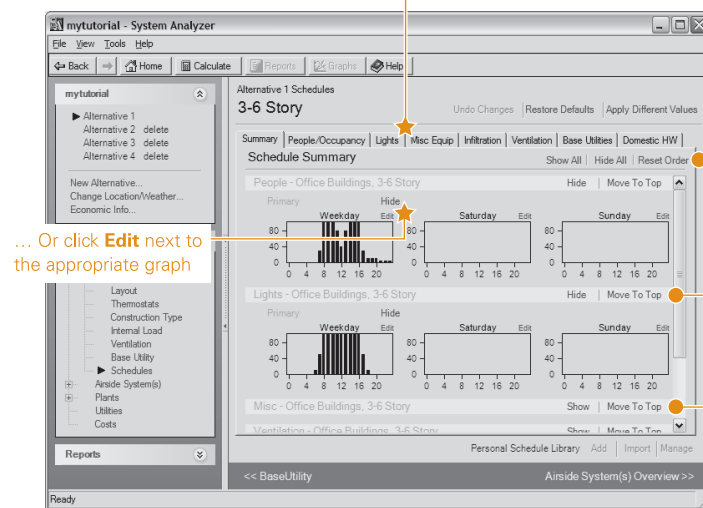
Use these commands to rearrange the schedule summary or to hide/show any or all individual schedules

■ On the **Summary** tab, scroll to the desired schedule type and click **Edit** next to the Weekday, Saturday, or Sunday graph.

Figure 5-3 summarizes how to modify and save a schedule so that it's available for other projects. But for the office building in this tutorial, we'll use the default schedules in the "3–6 Story Office Building" template.

Figure 5-3 Edit an existing schedule and save it for use in other projects

To model seasonal use of a building (a school, for example), select this check box and define primary and secondary schedules

Move the slider or type a different value to change the percent-of-full-load value for a particular hour

Import a different schedule, either from another building type or from your library of custom schedules

See online Help for more information about working with schedules

To make the revised schedule available to other projects, click **Add** and give it a name

6 Step 3 — Choose Airside System(s)
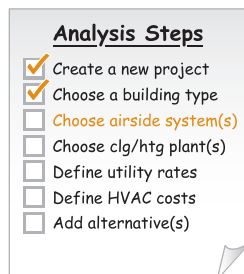
The next step is to describe how conditioned air will be delivered to (and removed from) the occupied space. There are a few things to keep in mind:

- You must choose at least one airside system (System 1).

- You can pick a *second* airside system (System 2) if a different system will serve any of the building's five thermal zones.

- Each zone can only be served by *one* airside system.

Describing the method of air distribution

For the office building in our tutorial, the first alternative under consideration consists of a **variable-air-volume system with reheat** (System 1 in this case) to serve the interior zone and a **parallel-fan-powered VAV system** (System 2) to serve the perimeter zones. Makeup-air units will serve both airside systems.

TIP

Don't forget that you can use the hyperlinks at the bottom of the "project details" pane to "page" through worksheets until you reach the one you want.

1 Open the Airside System #1 worksheet (Figure 6-1, p. 6–2). To do so, expand the Airside System(s) portion of the Alternative 1 list and click **Choose airside system** under System 1.

2 Expand the Variable Volume section of the list of airside system types and select **Variable Volume Reheat (30% Min Flow Default)**. Then click **OK**.

Like building types, each airside system type is a template that provides default details about airside operating conditions, fan types, and various airside options (exhaust-air energy recovery and optimum start/stop, for example).

Refer to online Help to find out more about the default values in each "airside system type" template.

3 Review the template defaults on the Fans and Energy/Control Options worksheets. Most entries can be changed to better

Figure 6-1 Choosing the air distribution method for an airside system

Click either of these links …

… To select from the list of airside system types available
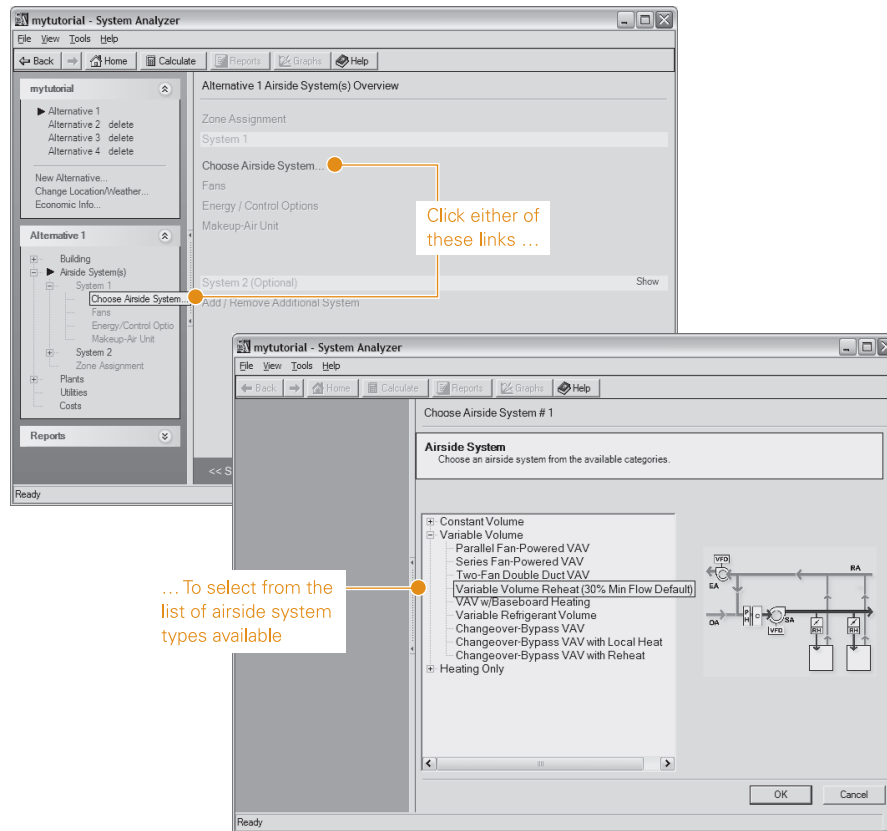
match the design details of the project, but the default values are acceptable for the preliminary analysis in this tutorial.

4 To add makeup air to our VAV system (System 1), open the Makeup-Air Unit worksheet (Figure 6-2) and select the **Use Makeup-Air Unit** check box. We'll keep the default values, so let's turn our attention to System 2.

5 Click **Add/Remove Additional System >>** at the bottom of the Makeup-Air Unit worksheet. Then select the **Use System 2 in this alternative** check box (Figure 6-3) and click **Choose Airside System…>>**.

6 Expand the Variable Volume section of the list of airside system types, select **Parallel Fan-Powered VAV**, and click **OK**.

Figure 6-2 Adding makeup air to an airside system
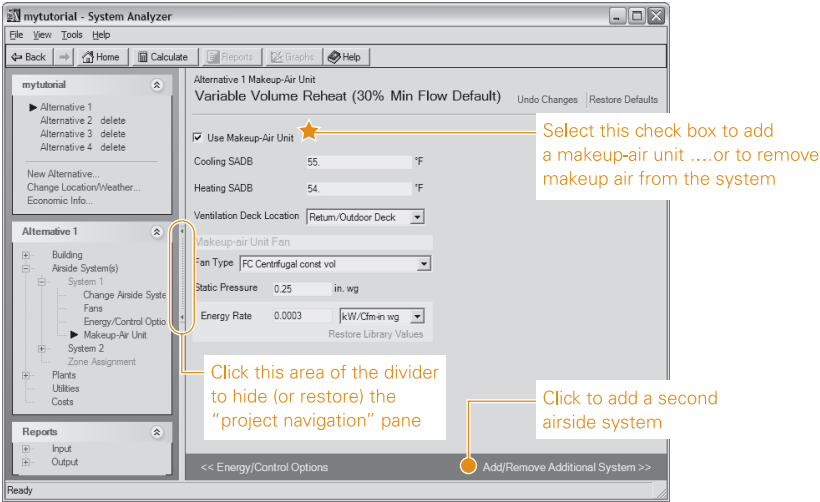
Figure 6-3 Adding a second airside system (System 2)
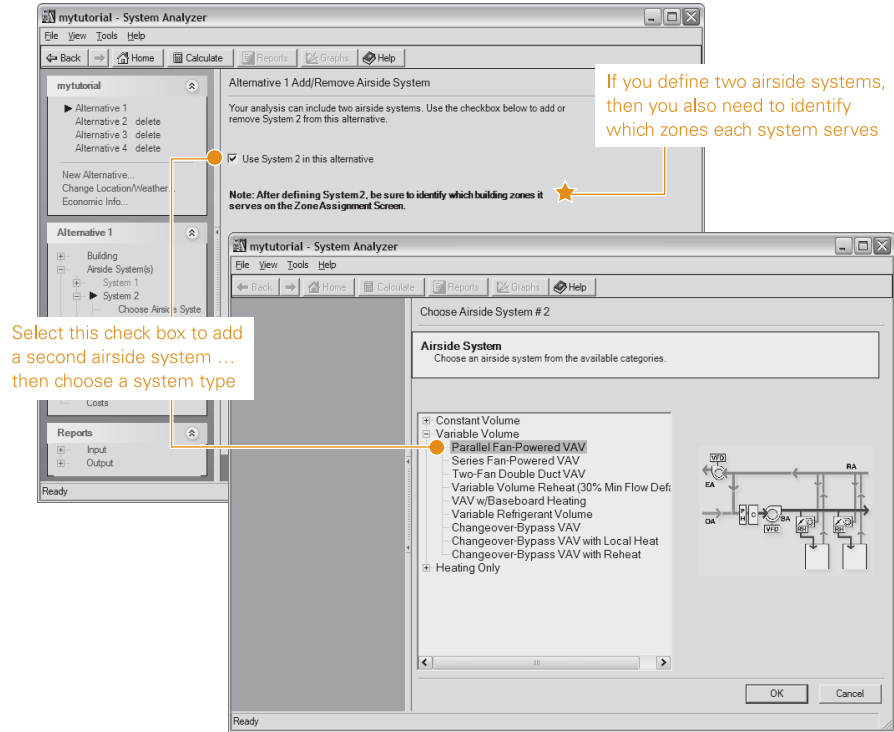
We'll use the default values in the template, but if you wish, review the information on the Fans and Energy/Control Options worksheets for System 2.

7 To add makeup air to System 2, open the Makeup-Air Unit worksheet and select the **Use Makeup-Air Unit** check box. As in System 1, we'll use the default values.

Assigning zones to an airside system

Recall from Chapter 2 that a building in System Analyzer is divided into five thermal zones (see p. 2–4). By default, the program assigns all five zones to System 1, regardless of whether you add a second system.

To assign one or more zones to System 2:

1 Open the Zone Assignment worksheet.

Notice that all five zones in the building plan view under the System 1 schematic are solid-colored dark blue, which indicates that they're currently assigned to System 1.

2 To reassign one or more of these zones to System 2, click the desired zone in the building plan view under the System 2 schematic.

For this tutorial, assign the four perimeter zones to System 2. When finished, your screen should match Figure 6-4.

Ready to continue? Click the **Plants Overview** link and go to the next chapter.

Figure 6-4 Zone assignments for the office building in this tutorial
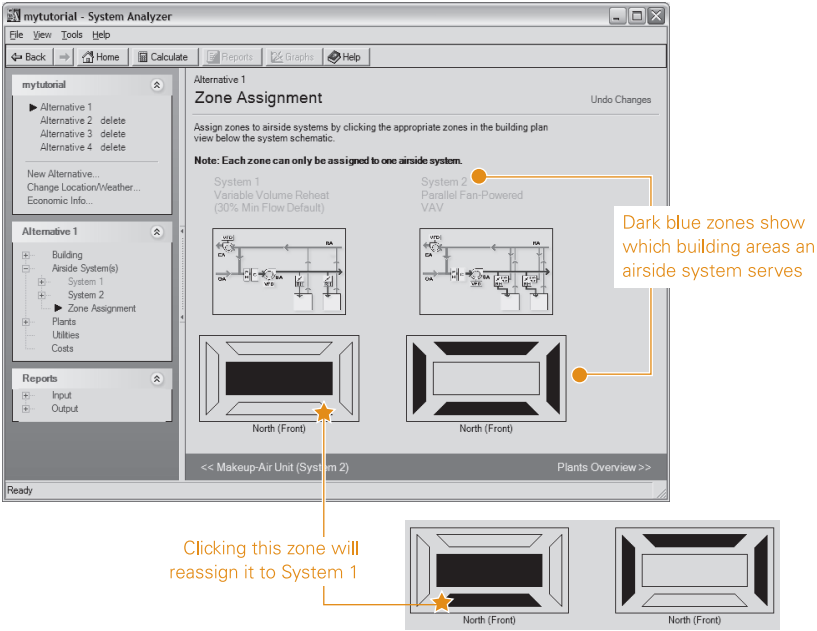
◆7 Step 4 — Choose Cooling and Heating Plant(s)

Analysis Steps

☑ Create a new project
☑ Choose a building type
☑ Choose airside system(s)
☐ Choose clg/htg plant(s)
☐ Define utility rates
☐ Define HVAC costs
☐ Add alternative(s)
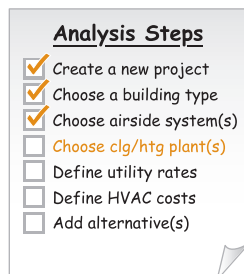
Next, we'll choose the cooling and/or heating "plants"—that is, the equipment that either directly or indirectly cools, heats, or otherwise conditions the air that's delivered to the zones.

Once again, there are a few things to keep in mind:

■ You must choose at least one piece of cooling or heating equipment (Plant 1).

■ You can choose a second piece of equipment (Plant 2) if you defined two *airside* systems.

 Use this approach if each airside system will be served by *different* cooling/heating equipment.

 Note: Adding Plant 2 also can be useful for separating the energy consumption of each airside system when both are served by the same cooling/heating equipment. In this case, choose identical equipment for Plant 1 and Plant 2.

■ Plant 3 is reserved for makeup-air equipment, even if Plant 2 is undefined. Use it when an airside system includes makeup air that's provided by a dedicated unit, which is separate from the cooling/heating equipment.

Describing cooling and heating equipment

From the scenario outlined in Chapter 4 (p. 4–1), you know that the VAV systems in Alternative 1 are served by a small chilled water system. You'll need these details to define the cooling/heating plant: a **water-cooled helical-rotary chiller** will provide chilled water for cooling, a **gas-fired boiler** will provide hot water for heating, and a **rooftop air conditioner** with gas heat will provide conditioned makeup air.

1 With the Alternative 1 Plants Overview worksheet displayed, click **Choose cooling equipment …**.

Figure 7-1 Choosing the cooling equipment in a plant

To model a chilled water plant, first select a plant configuration …

Then select a specific chiller based on condenser type, compressor type, and approximate capacity

Use the **Condenser Type** (air-cooled or water-cooled) and **Chiller Type** (absorption, centrifugal, engine-driven, helical-rotary, or reciprocating) lists as filters, so that the **Chillers** list only displays the units that match the condenser and chiller types you select

2 Expand the Chiller Plant section of the Choose/Change Equipment list, select **1 Chiller at ARI** and click **Next**.

On the Equipment Type worksheet (Figure 7-1), you'll see that your choice defaults to a helical-rotary chiller with a water-cooled condenser and a cooling capacity that exceeds 130 tons.

3 Click **Finish** at the bottom of the Equipment Type worksheet to complete your choice.

Like building types and airside systems types, each equipment type is a template that provides default details about capacity, efficiency, control strategies, equipment options, and auxiliary equipment, such as pumps.

4 Review the template defaults on the Equipment Controls/ Details and Miscellaneous Clg Accessories worksheets (Figure 7-2). Most entries can be changed to better match the design details for a specific project, but in this case, we'll use the default values for the chiller and its pumps (which the program added automatically).

Figure 7-2 Review cooling equipment defaults and edit if necessary
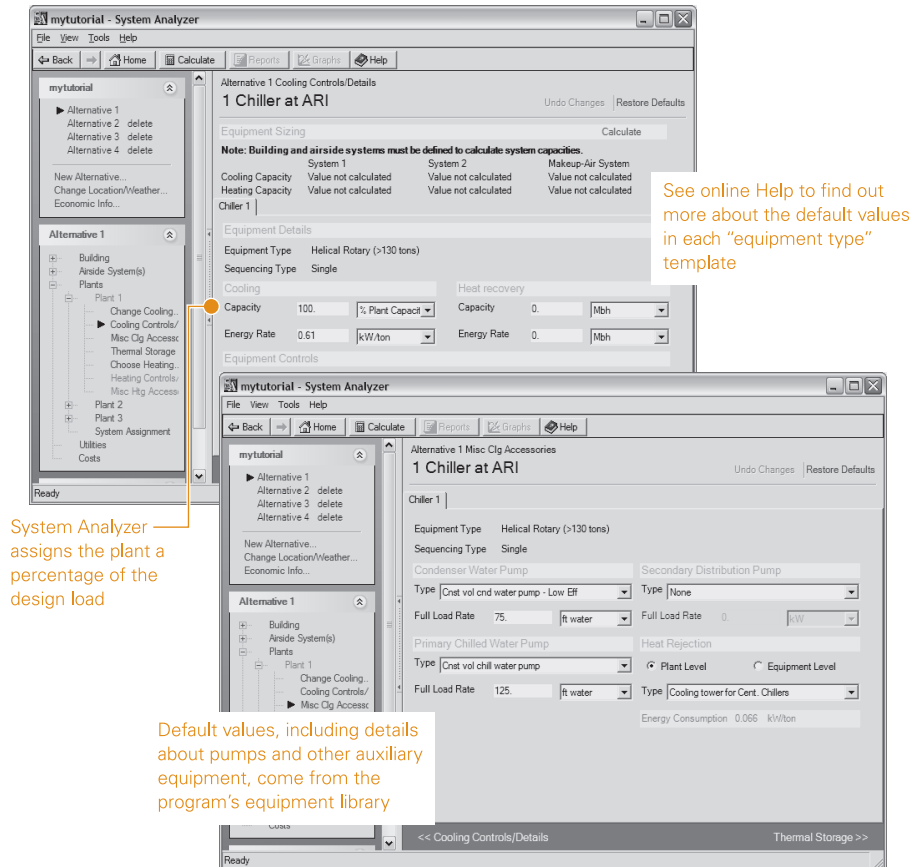
*If you want to change the assigned loads, click the **Calculate** button at the top of the screen. The program will provide a breakdown of the cooling, heating, and makeup-air loads for each airside system, enabling you to redistribute these loads between equipment and plants.*

5 Adding the boiler to Plant 1 involves the same basic steps that you used to add the chiller: Select an equipment category (**Boiler**) and pick a specific equipment type (**Gas Fired Hot Water Boiler**), as shown in Figure 7-3.

Then review the default values for heating equipment controls/details and miscellaneous accessories, and make any changes needed, such as sizing the hot water pump. In this case, we'll use the defaults.

Figure 7-3 Adding heating equipment to a plant
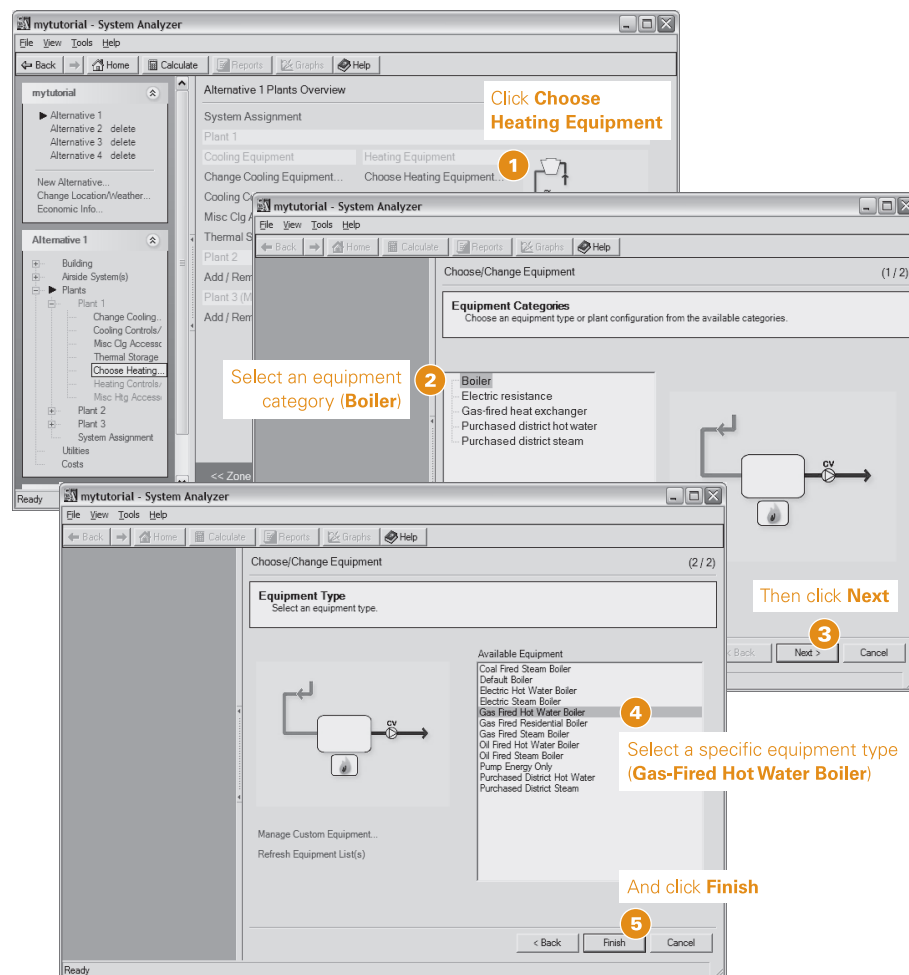
Now that you've defined the cooling and heating equipment in Plant 1, let's turn our attention to the rooftop air conditioner that will provide our office building with makeup air.

Adding makeup-air equipment

Remember that both of the airside systems that we defined in Chapter 6 include makeup air. In this case, outdoor air brought into the building will be preconditioned by a rooftop air conditioner with gas heat. Also recall that System Analyzer reserves Plant 3 for makeup-air equipment, even if Plant 2 is undefined.

To model makeup-air equipment:

1 On the Plants Overview worksheet, click **Add/Remove Plant 3**. Then select the **Use a makeup-air unit plant for this alternative** check box on the Add/Remove Makeup Air Plant worksheet (Figure 7-4, p. 7–6).

2 Define the cooling equipment for Plant 3. For our example, select **Air-Cooled Unitary** as the equipment category and **Industrial Rooftop IPAK 20+ Ton Scroll** as the equipment type (Figure 7-5, p. 7–7). Then click **Finish** to save your selection.

3 *Not shown:* In the same manner, define the heating equipment for Plant 3. To represent the gas furnace in the rooftop air conditioner, select **Gas-Fired Heat Exchanger** as the equipment category and then pick **Rooftop Gas Heat** as the equipment type. Click **Finish** to save your selection.

Note: Although we omitted this step for the tutorial, it's good practice to review the details on the cooling and heating equipment worksheets to make sure that the default values are acceptable for your analysis.

Figure 7-4 Adding Plant 3 to model makeup-air equipment
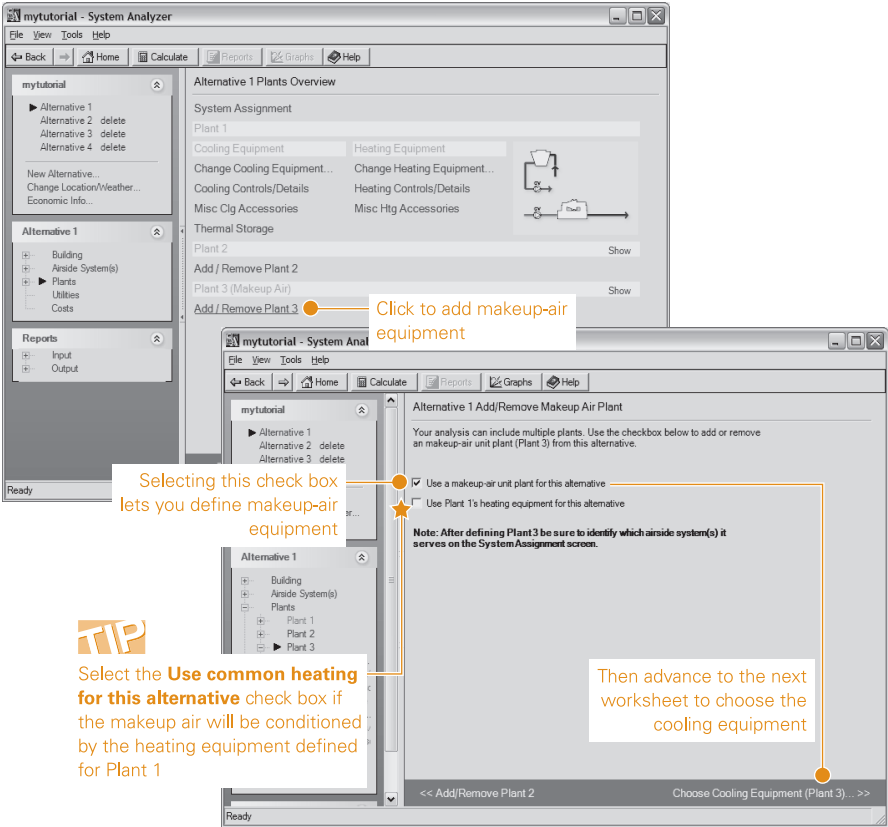
Figure 7-5 Adding cooling equipment to the makeup-air plant
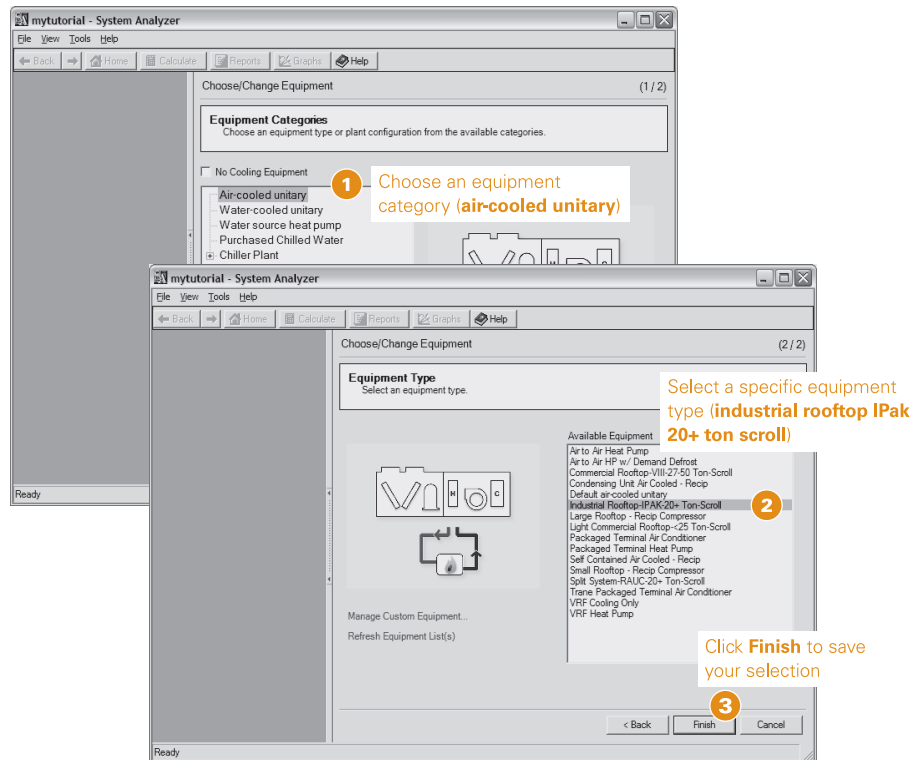
Assigning an airside system to a plant

Just as the program initially assigns all building zones to Airside System 1, it assigns all airside systems (including makeup air) to the equipment in Plant 1. When you define more than one plant, you need to identify which airside systems the other plants serve.

To reassign the makeup-air systems to Plant 3:

1 Open the System Assignments worksheet.

Notice that both airside systems, as well as the makeup air for each of these systems, are currently assigned to Plant 1.

2 Under Plant 3, click **Airside System 1 Makeup-Air Unit** and **Airside System 2 Makeup-Air Unit** to reassign them to Plant 3 (Figure 7-6).

Figure 7-6 System assignments for the plants in this tutorial

Plant 3 is reserved exclusively for makeup air—you can't assign the primary airside systems to it

Use the option buttons to identify which airside systems each plant serves
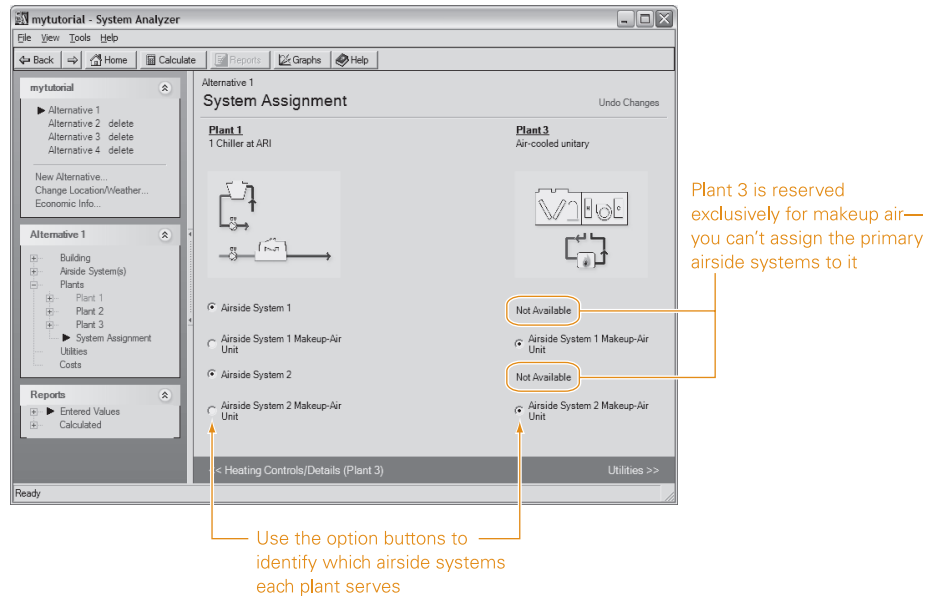
◆8 Step 5 — Define Utility Rates

Analysis Steps

☑ Create a new project
☑ Choose a building type
☑ Choose airside system(s)
☑ Choose clg/htg plant(s)
☐ Define utility rates
☐ Define HVAC costs
☐ Add alternative(s)
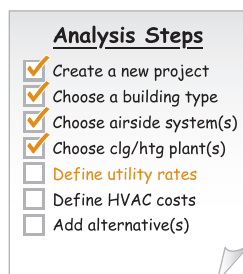
So far, the information you provided about the office building and the HVAC system in Alternative 1 enables System Analyzer to estimate the monthly energy consumption. But to estimate the cost of this energy, you'll need to provide the program with information about the utility rates. This information will be archived, by utility company, in the "utility rates" library so that you can reuse it in other analysis projects.

In this chapter, you'll find out how to create a utility company, describe the utility rates, and define rate schedules.

Adding a utility company

When you first install System Analyzer, the "utility rates" library contains only one sample utiliy. It's up to you to provide the relevant information about the utility companies that will serve the buildings you analyze.

Our fictitious office building in Tampa, Florida will use Southeast Power for electricity and gas service. To add Southeast Power to the library:

1 On the Utilities worksheet, click **Manage Utility Companies**.

2 In the **Manage Utility Companies** dialog box, click **Add …**.

3 In the **Add Utility Company** dialog box, type **Southeast Power** in the **Name** box.

4 Next, identify what types of utility service the company provides. For Southeast Power, select **Electric Consumption**, **Electric Demand**, and **Gas**. Each selection adds a tab that will be used to define the utility rates for that service (Figure 8-1, p. 8–2). See "Defining utility rates" on p. 8–3.

5 The building owner will be charged **$115.50** each month, regardless of energy usage, so type this value in the **Customer Charge** box.

Figure 8-1 Adding a utility company to the System Analyzer library

Give the utility company a name (required) and, if, desired, add a further description in the **Comments** box

If the utility company bills a monthly administration or service fee in addition to energy usage charges, enter that value as the **Customer Charge**

Then use the check boxes to select at least one type of utility service

Each selected utility type displays a tab prompting you for rate details

Defining utility rates

Table 8-1 summarizes the information that you'll use to define Southeast Power's rates for electricity and gas. Notice that the electric rates are seasonal and subject to the time of day.

Table 8-1   Utility rates for Southeast Power[1]

| Utility type | Rate type | Energy charge | | Rate period | |
		Value	Unit	Begins	Ends
Electric consumption	On peak[2]	$ 0.1396	kWh	May 1	Oct 31
	Off peak	$ 0.0325	kWh		
	On peak[2]	$ 0.1155	kWh	Nov 1	Apr 30
	Off peak	$ 0.0214	kWh		
Electric demand	On peak[2]	$ 10.55	kW	Jan 1	Dec 31
	Off peak	$ 7.50	kW		
Gas	Stepped	$ 0.4845	therm	Jan 1	Dec 31
Customer charge for all services		**$ 115.50**	month		

[1] The data shown here is provided to help illustrate how to define utility rates in System Analyzer. It is only valid within the context of this tutorial.

[2] On-peak hours are 9 a.m. to 9 p.m. Monday through Friday. All other hours and days are off peak.

With the **Add Utility Company** dialog box displayed:

1 Click the **Electric Consumption** tab to bring it to the foreground and select **Time of Day** as the rate type.

2 Southeast Power's energy charges for electricity are seasonal. To add a second set of rates, select the **Use Secondary Season** check box and use the **From** and **To** lists to define its duration. For this tutorial, we used **November** through **April** as the secondary season.

3 Type the on-peak and off-peak rates (from Table 8-1) in the appropriate text boxes.

Figure 8-2 Defining seasonal time-of-day rates for electric consumption

Make sure that the values you enter as secondary rates ($/kWh) pertain to the period that you defined as the secondary season

Click **Manage Company Schedules** to add or edit a time-of-day schedule
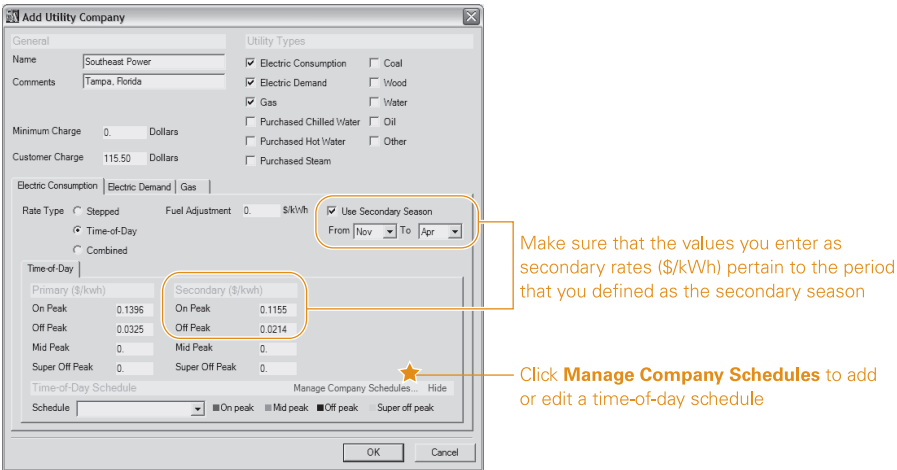
Make sure that the rates you enter under Secondary ($/kWh) coincide with the range of months that you defined as the secondary season (Figure 8-2).

We'll also need to create a time-of-day schedule (see p. 8–6) and assign it to these rates; but for this tutorial, let's first enter the electric demand and gas rates on the appropriate tabs.

4 Click the Electric Demand tab, and enter **10.55** as the on-peak rate and **7.50** as the off-peak rate (Figure 8-3). These rates apply year-round, so there's no need to define a secondary

Figure 8-3 Electric demand entries for this tutorial

Schedule is a required entry for time-of-day rates … See "Creating a time-of-day schedule" for more information
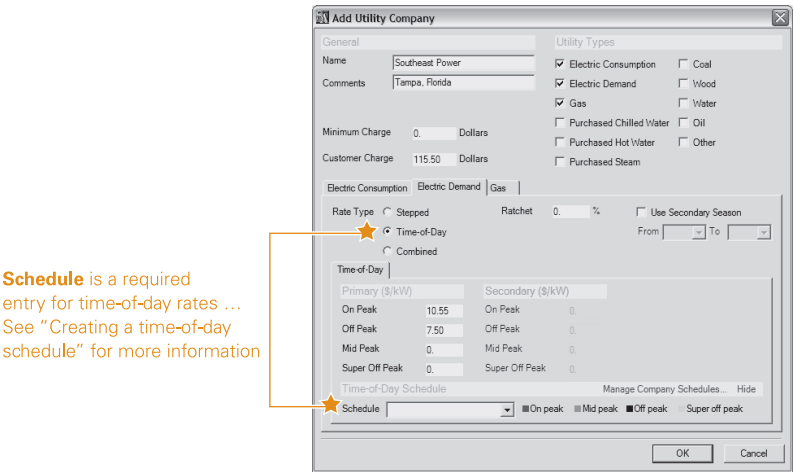
Figure 8-4 Adding a gas rate
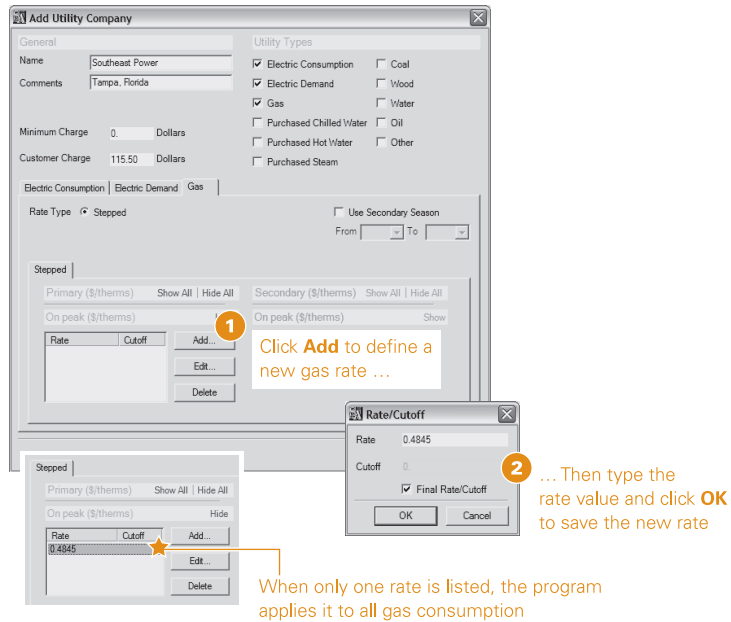
season. We'll come back to this tab in a moment to assign a time-of-day schedule.

5 Southeast Power charges one stepped rate of $0.4845 per therm for gas. To provide System Analyzer with this information, click the Gas tab and click the **Add ...** button next to the **Rate** list box (Figure 8-4).

6 Type **0.4845** in the **Rate** box and select the **Final Rate/Cutoff** check box to indicate that it's the only gas rate that Southeast Power charges (Figure 8-4). Click **OK**.

All that's left to complete the description of Southeast Power is to create and assign the time-of-day schedule for the electric consumption and demand rates.

Creating a time-of-day schedule

A time-of-day (TOD) schedule "tells" System Analyzer when to apply on-peak and off-peak utility rates. To create the time-of-day schedule for Southeast Power:

1 With the **Add Utility Company** dialog box still open, click the Electric Consumption tab to bring it to the foreground.

2 Click **Manage Company Schedules …** and then click **Add …** in the **Manage Company Schedules** dialog box.

3 In the **Add/Edit Time-of-Day Schedule** dialog box, type **Southeast Power TOD** in the **Name** box.

The remaining entries let you define on-peak and off-peak hours for three types of days: Weekday, Saturday, and Sunday (Figure 8-5). By default, Saturday and Sunday are entirely off peak, while on-peak hours for a weekday begin at 8 a.m. and end at 5 p.m. You also can define a second season if the on/off-peak schedule is in effect for only part of the year.

4 Southeast Power's year-round TOD schedule designates 9 a.m. to 9 p.m. on weekdays as on peak; all other hours are off peak,

Figure 8-5 Defining on-peak and off-peak hours in a time-of-day schedule
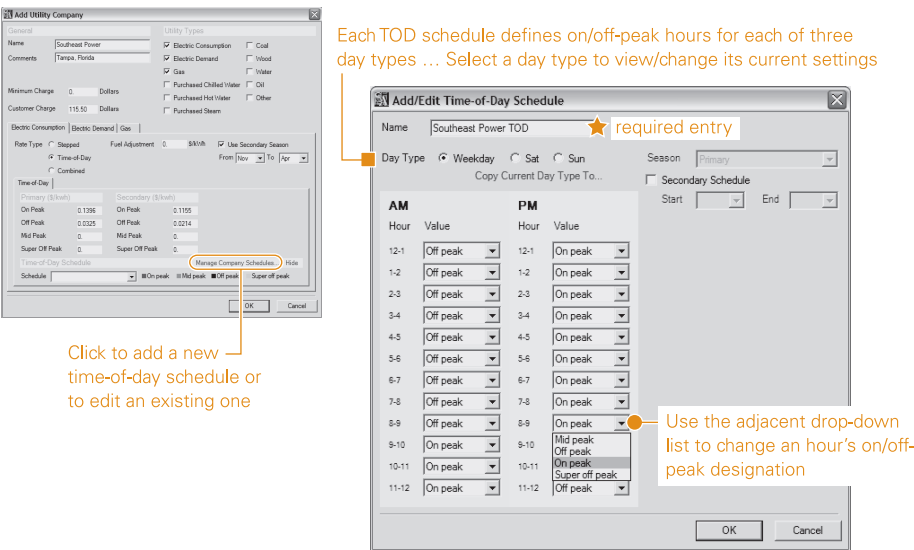
as are Saturdays and Sundays. With Weekday selected as the day type:

- Change AM Hour 8–9 to **Off peak**.

- Change PM Hours 5–6,6–7, 7–8, and 8–9 to **On peak**.

- Click **OK** to save your changes and close the **Manage Company Schedules** dialog box.

5 To assign the newly created TOD schedule to consumption charges for electricity, select **Southeast Power TOD** from the **Schedule** list (Figure 8-6).

6 The TOD schedule also applies to demand charges, so click the Electric Demand tab and select **Southeast Power TOD** as the schedule.

7 This completes our definition of Southeast Power, so click **OK** to close the **Add Utility Company** dialog box. Then click **Close** to return to the Utility Rates worksheet.

Remember that each utility company you define is stored in a separate library so that it's available to any of your System Analyzer projects.

Figure 8-6 Assigning a TOD schedule to a utility type

Assign a TOD schedule to the utility rates

Scroll down to display graphs of on-peak and off-peak hours for each day type

Assigning utility companies to utilities

Drop-down lists on the Utility Rates worksheet make it easy to assign a utility company to each type of utility in a project. For this tutorial, use the adjacent **Company** list to select **Southeast Power** as the utility company for electric consumption, electric demand, and gas (Figure 8-7).

*Note: Each **Company** list displays only the utility companies whose definitions include the selected utility type. For example, the **Company** list adjacent to the gas utility type will only show the utility companies with defined gas rates.*

Figure 8-7 Assigning a utility company to a utility type

Assign a company to each utility type that will serve the HVAC equipment in this alternative

At a glance, see which energy rates are based on a time-of-day schedule
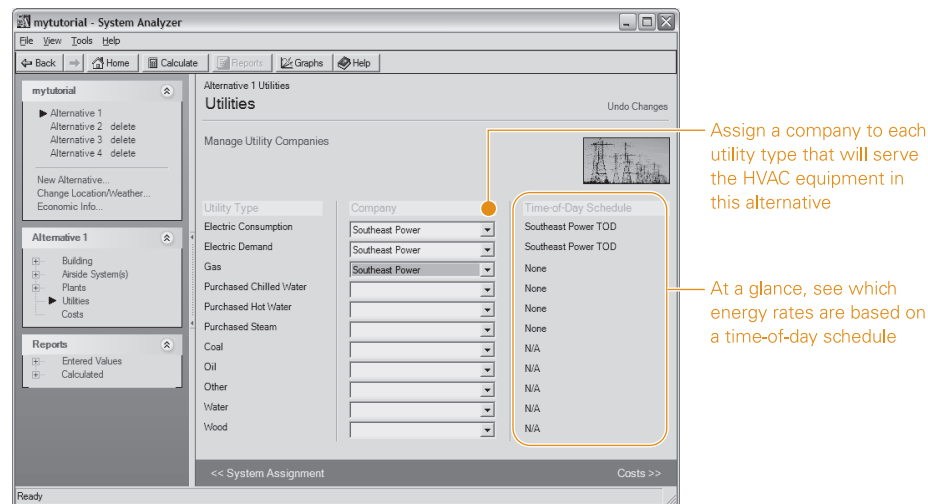
9 Step 6 — Define HVAC Costs

Analysis Steps
- ☑ Create a new project
- ☑ Choose a building type
- ☑ Choose airside system(s)
- ☑ Choose clg/htg plant(s)
- ☑ Define utility rates
- ☐ Define HVAC costs
- ☐ Add alternative(s)
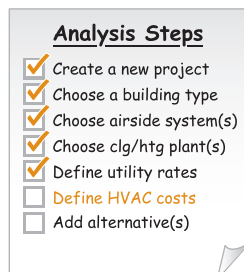
Operating costs for energy are only one element in a life-cycle cost comparison of prospective HVAC systems. It's also important to consider the costs of purchasing, installing, and maintaining the system over its service life.

The Costs worksheet prompts you for details about equipment cost and recurring or additional depreciable costs. It also shows the program's default values for economic factors, such as depreciation life, cost of capital, replacement cost, and mortgage interest rate. The more information you provide about the costs related to a prospective system, the more realistic the resulting life-cycle cost comparison will be.

Let's complete the description of Alternative 1 by providing the HVAC costs for the chilled water/VAV system.

1 The design engineer estimates that it will cost **$9/sq ft** to purchase and install the equipment. Enter this information as the **Equipment Installed Cost** on the Costs worksheet.

2 Similarly, the design engineer estimates the annual maintenance cost as **$50/ton**. Enter this information as the **Yearly Maintenance Expense**.

When finished, your Costs worksheet should match the one in Figure 9-1 (p. 9–2).

At this point, you could click the **Calculate** button (at the top of the screen) and System Analyzer would compute the design cooling and heating loads, coil capacities, airflows, as well as the monthly energy consumption and utility costs for the chilled water/VAV system in Alternative 1.

But our ultimate objective is to provide the owner of our fictitious office building with a life-cycle cost comparison of two prospective systems. In the next chapter, you'll learn how to add an alternative to your project.

Figure 9-1 Adding cost information to an alternative

Estimated equipment costs for our
fictitious chilled water/VAV system

Inflation rates and other economic
data apply to the entire project—
not just to the current alternative

Provide as many cost details for the
equipment in an alternative as you can
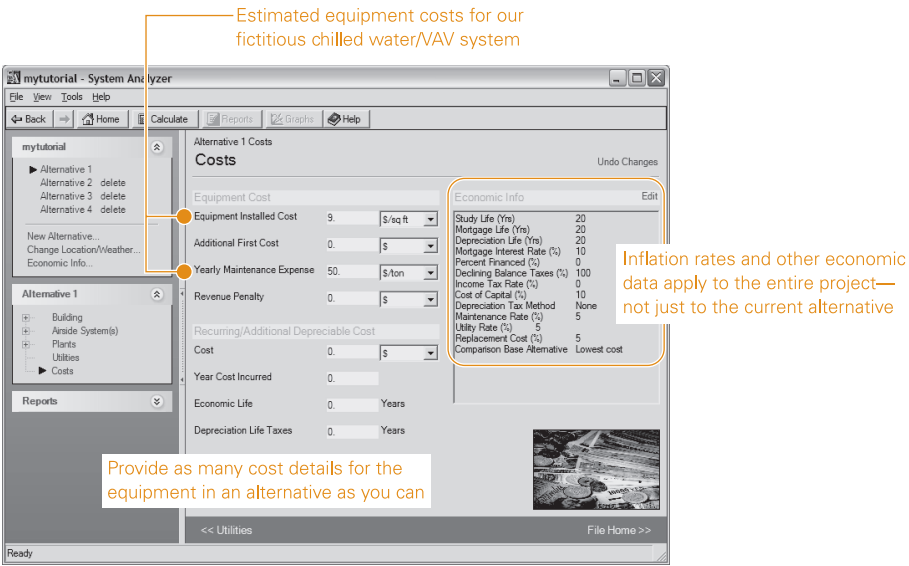
◆10 Step 7 — Add an Alternative
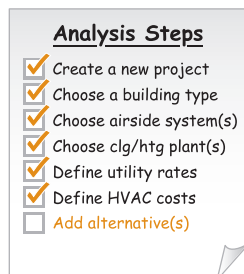
Remember that our scenario (p. 4–1) identified two alternatives for the HVAC system in our four-story office building: a small chilled water/VAV system, which we defined as Alternative 1; and a high-efficiency water-source heat pump, which we will define as Alternative 2.

To include the water-source heat pump system in the project analysis, we must define another alternative. Here's how:

1 Click the **Home** button at the top of the screen to display an overview of the project (Figure 10-1). Then click **Create a new alternative …**.

2 On the Create New Alternative worksheet (Figure 10-2, p. 10–2), provide a brief description of the new alternative in the box provided.

Note: Providing a description for each alternative is optional … But doing so will help you distinguish between alternatives when viewing output reports.

Figure 10-1 Adding an alternative from the project Home view
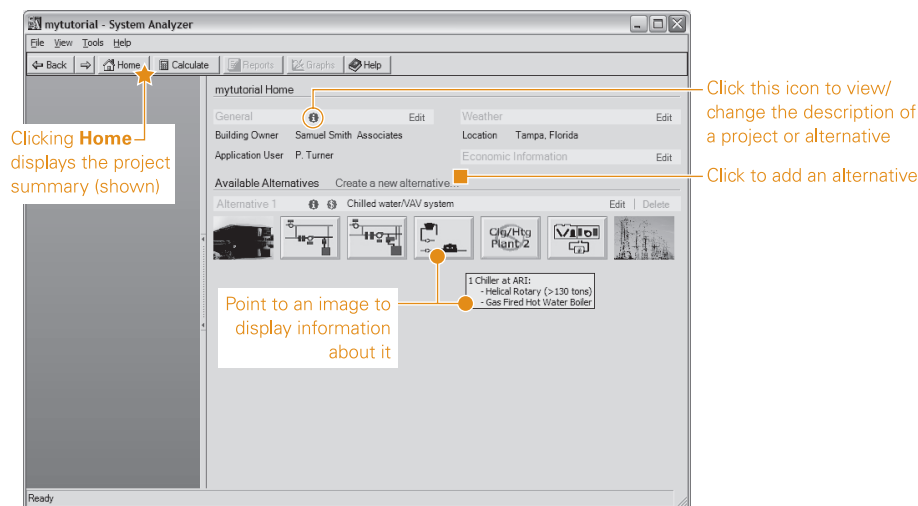
Figure 10-2 Creating a new alternative and identifying its relationship to an existing alternative

Descriptions make it easier to distinguish between alternatives when viewing reports

If you pick **Use** or **Base On**, select an existing alternative as the "source"

New	Define from scratch
Use	Link to an existing alternative (uneditable)
Base On	Copy from an existing alternative (editable)
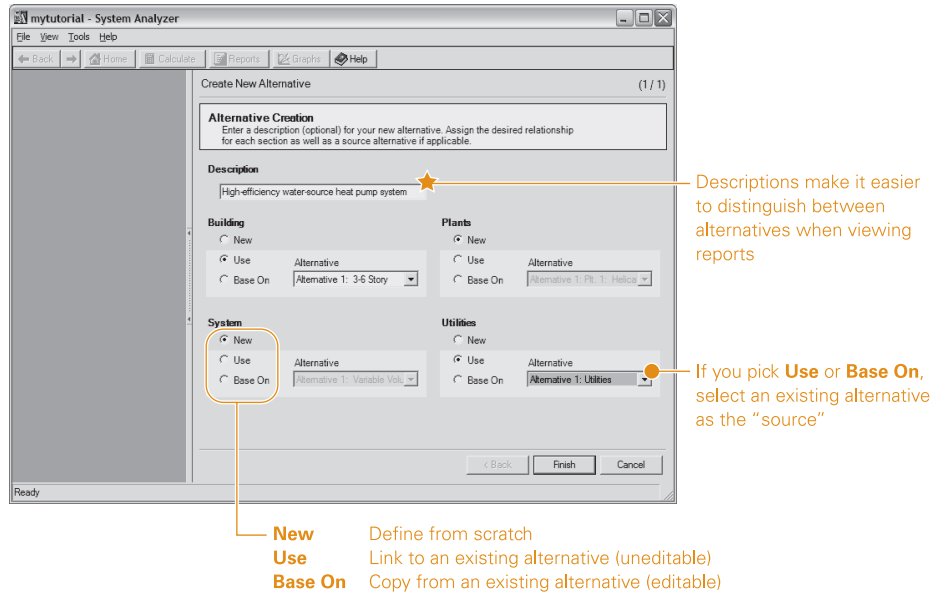
The Create New Alternative worksheet provides several options to help you quickly define the building, airside system(s), plant(s), and utilities for the new alternative using information that you already provided for an existing alternative. The options for each section are as follows:

- **New.** Choosing this option gives you a blank worksheet to complete from scratch. Select "New" for a section if the new alternative differs completely from the alternatives that you already created.

- **Use.** Select this option to mirror all of the information from the same section of another alternative, which you select from the adjacent list. You will be able to view the mirrored information in the new alternative, but you won't be able to edit it. Any changes made to the mirrored section of the "source" alternative will be reflected in the new alternative.

- **Base On.** Picking this option copies the information from the "source" alternative (selected from the adjacent list) and pastes it into the new one, allowing you to edit it. Choose this option if the new alternative will be similar, but not identical, to an existing alternative.

3 For our tutorial, the **System** and **Plant** sections of the second alternative are entirely different than Alternative 1, so select **New** in each of those sections.

For the **Building** and **Utilities** sections, select **Use** to mirror the information in Alternative 1. (If our project contained more than one alternative, you would also use the **Alternative** list to identify which of the existing alternatives you want to mirror.)

At this point, your screen should match ours (Figure 10-2).

4 Click **Finish** to return to the Home screen (Figure 10-3). The overview of our project now shows two alternatives. From the pictorial summary of Alternative 2, we can see that the building and utilities sections use the information in Alternative 1, while the airside systems and cooling/heating plants haven't been defined yet.

5 Let's start with the airside system for our second alternative. On the Home screen, click the box labeled **No Airside System 1** to display the airside system(s) overview for Alternative 2.

6 Click **Choose Airside System …** and then select **Water Source Heat Pump** from the Constant Volume category in the list of system types.

Figure 10-3 Interpreting the pictorial summary of an alternative

System Analyzer displays a picture for each section of an alternative that you define … a "no" symbol, ⊘, identifies undefined sections

The number means that this section "uses" information from Alternative 1

Click to define Airside System 1
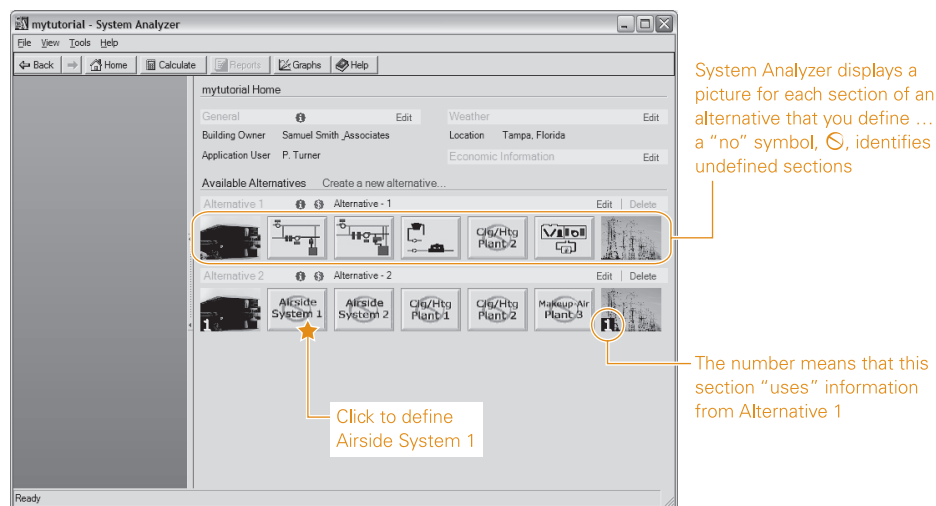
This system will not include makeup air and it will serve the entire office building, so use the "project navigation" pane to skip to the Plants Overview worksheet for Alternative 2 (Figure 10-4).

7 Click **Choose cooling equipment …**. Select **Water source heat pump** from the equipment categories list and click **Next**.

Figure 10-4 Selecting the airside system for Alternative 2
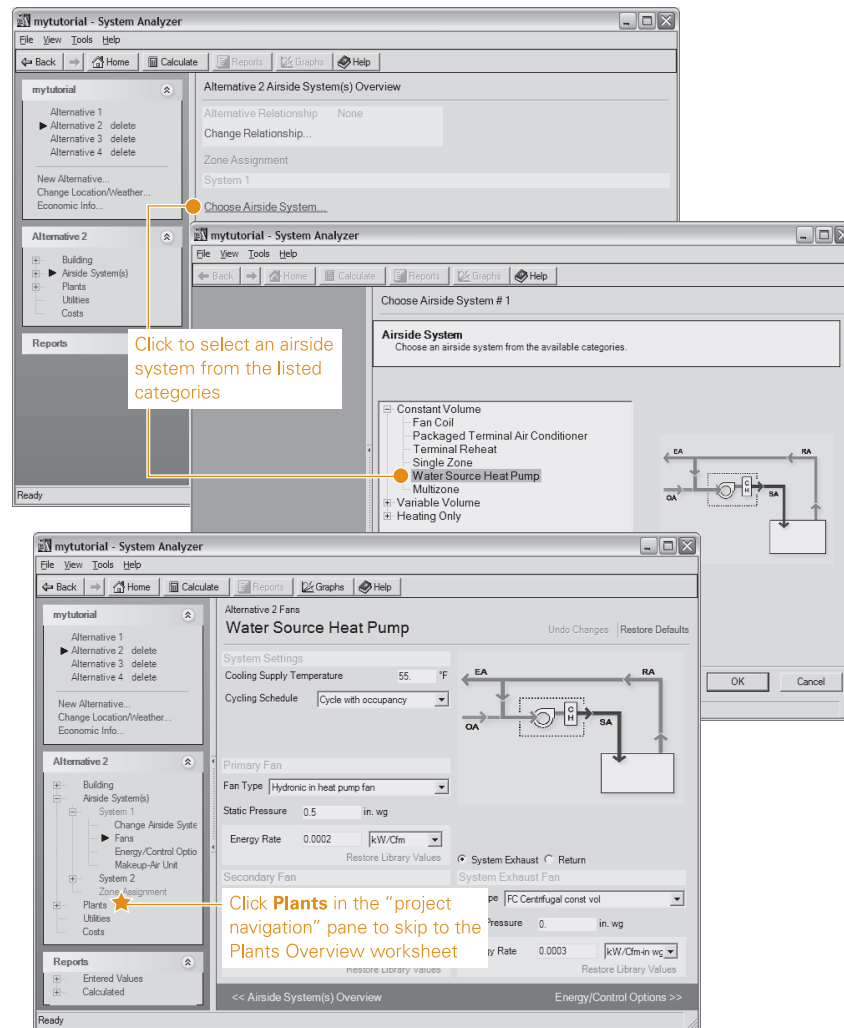
Then select **Water Source–High Eff** from the equipment types list and click **Finish** (Figure 10-5).

8 To define the heating equipment for this alternative, click **Choose heating …** under Plant 1 in the project navigation pane. Then select **Boiler** as the equipment category and **Gas-Fired Hot Water Boiler** as the equipment type (Figure 10-6, p. 10–6). Click **Finish**.

Figure 10-5 Selecting the cooling equipment for Alternative 2–Plant 1
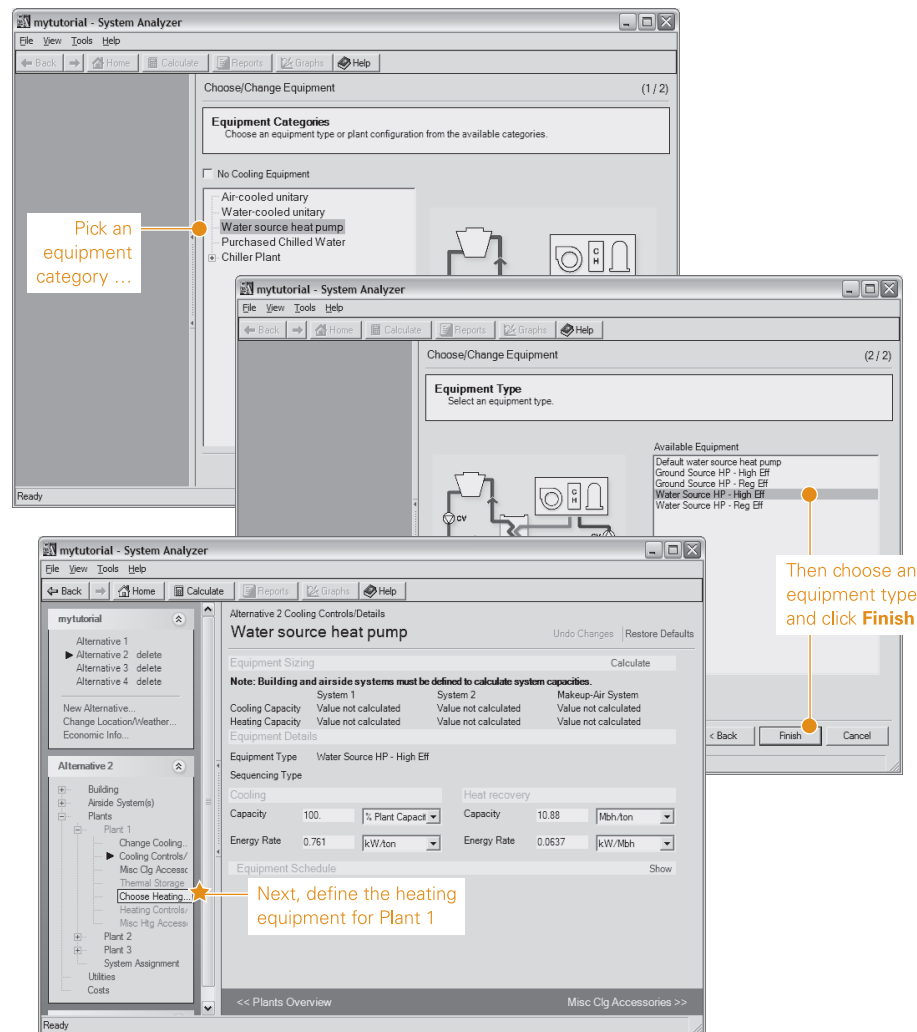
Figure 10-6 Selecting the heating equipment for Alternative 2–Plant 1
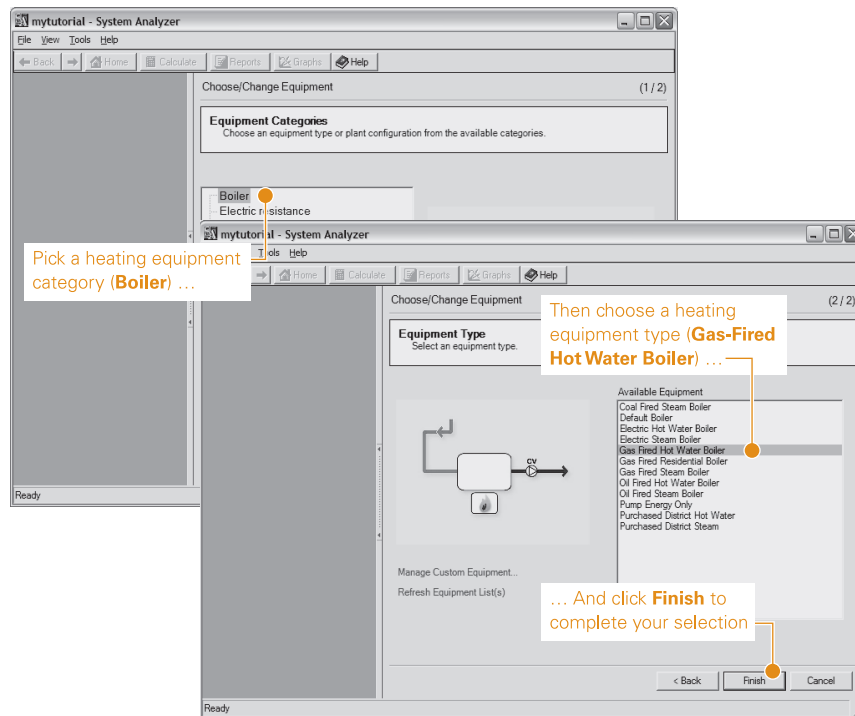
9 Use the navigation link in the lower right corner of the screen to page forward to the Utility Rates worksheet (Figure 10-7). "Alternative Relationship: Use Alternative 1," displayed near the top of this worksheet, reminds us that this section uses the information from Alternative 1. As a result, none of the entries can be edited.

Note: To revise any of these entries, you must first choose a different option ("new" or "based on") using the **Change Relationship** *command.*

10 All that remains is to define the costs for this alternative. On the Costs worksheet, enter **$4/sq ft** as the installed cost and **$72/ton** as the yearly maintenance cost (Figure 10-8).

Figure 10-7 Utility Rates worksheet that results from the Use Alternative 1 option

Dimmed entries remind us that this alternative mirrors Alternative 1

Use this command (and pick **New** or **Base On**) if you want to change one or more of the entries for this alternative
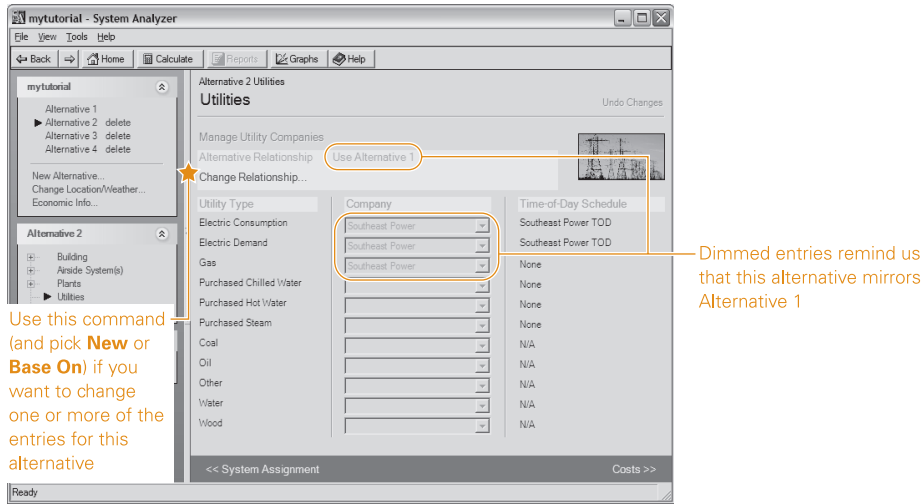
Figure 10-8 Defining costs for Alternative 2

Enter these values for the WSHP system in our tutorial

This icon provides a shortcut to the Costs worksheet, making it easy to review, edit, or add details about the costs of an alternative
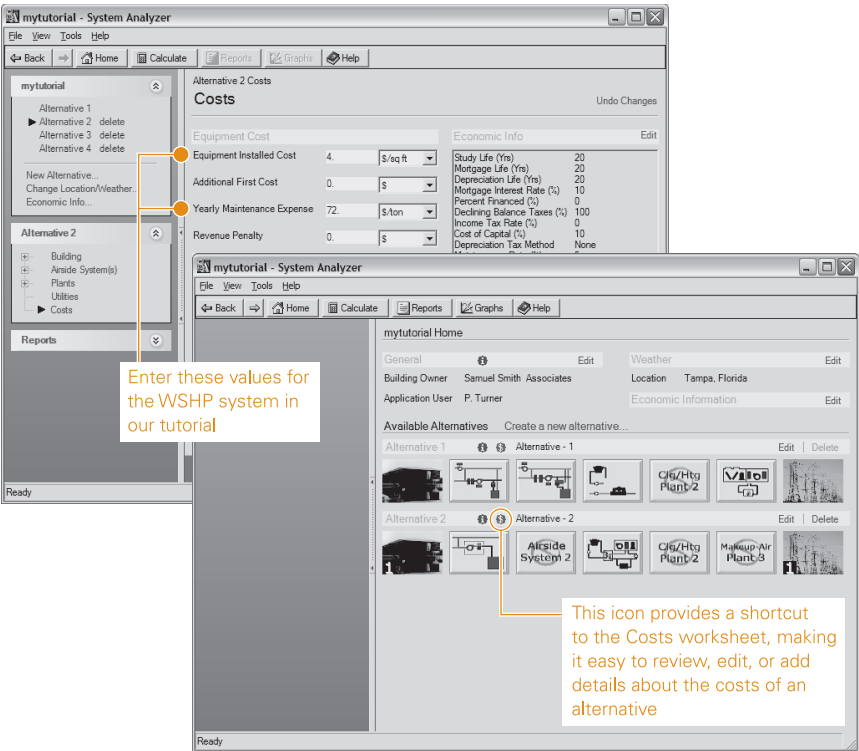
Figure 10-9 Summary of the completed project

After providing as much information as you can about each alternative, click **Calculate**

… to start the simulations that will yield a life-cycle cost comparison
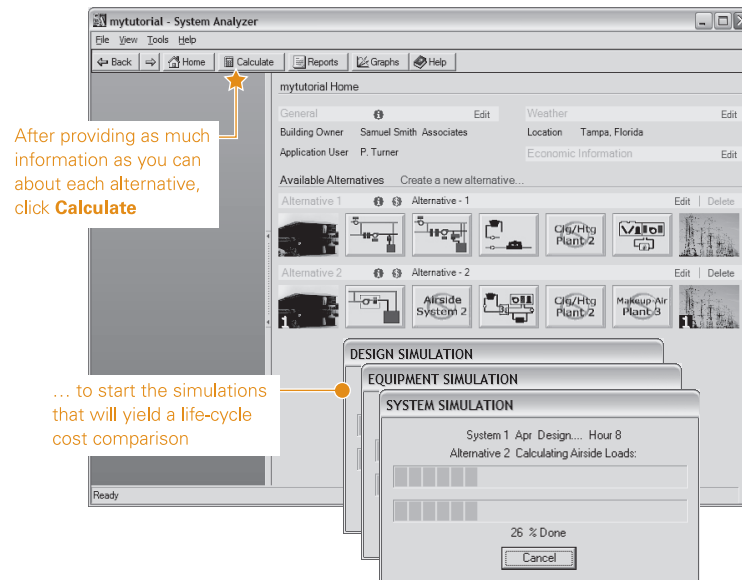
Now that the definition of the second alternative is complete, click the **Calculate** button at the top of the screen (Figure 10-9). System Analyzer will perform the simulations that will ultimately yield a life-cycle cost comparison.

In the next chapter, we'll review the reports that result from a System Analyzer analysis.

Tutorial

Analysis results

System Analyzer™ makes it easy to evaluate different HVAC systems based on energy and economic comparisons. Of course, a comparative analysis is only helpful if the results are presented in a way that's readily understood by everyone on the project team.

Chapters 11–12 provide examples of the reports and graphs that are available when you complete a System Analyzer analysis. Be sure to familiarize yourself with these documents so that you can use them to best advantage when sharing analysis results.

Note: The example reports and graphs in this section result from the fictitious analysis project that was described in Chapters 4–10.

11 Tabular Reports

The most difficult aspect of choosing the right HVAC system for a particular application isn't entering the data into an analysis program: It's interpreting the analysis results and evaluating them based on project goals and constraints. Well-constructed reports that quantify the energy and economic performance of prospective system designs can ease the decision-making process.

At the end of Chapter 10, System Analyzer performed the calculations necessary to compare the two candidate systems for our fictitious, four-story office building: a chilled water system with variable-volume air distribution (Alternative 1) and a high-efficiency water-source heat pump system (Alternative 2). In this chapter, you'll see how the program organizes the calculation results into a series of tabular reports.

Viewing or printing reports

After completing its calculations, System Analyzer displays a Reports screen that lists the available reports (Figure 11-1, p. 11–2) and organizes them into two categories:

■ *Calculated reports,* which document the results of the program's computations (outputs); and,

■ *Entered values reports,* which document the data that the program used to perform these computations (inputs).

The Reports screen makes it easy to preview or print several reports at once. Simply select the check box next to the report title, and then click the appropriate button.

When you preview reports in this manner, they're displayed in a separate "tabbed reports" window (Figure 11-2, p. 11–2). Clicking one of the tabs near the top of the window brings the corresponding report to the foreground. You can also open an individual report by selecting it from the Reports list in the

TIP

You can export the results of your analysis in several formats: Microsoft Word .doc, rich text format .rtf, Microsoft Excel .xls, Adobe Acrobat .pdf, Crystal Reports .rpt, or GLHEPRO heat exchanger design .gt#. To export the current report, while previewing it, click 📥 in the "reports" toolbar.

Figure 11-1 Use the Reports screen to select the results you want to preview or print

These buttons only activate after calculating results … Use them to display existing reports and graphs without recalculating the file

To display or print a report, select its check box

Select or unselect all reports with a single click

Display all of the selected reports in a "tabbed" window

Send all of the selected reports to the printer you designate

Figure 11-2 Reports are displayed in a "tabbed reports" window or in the "project details" pane

Use the "reports" toolbar to print, refresh, export, zoom, or search text in the current report

If you open several reports at the same time, click the appropriate tab to bring a particular report to the foreground

To view an individual report in the main System Analyzer window, click the appropriate link in the Reports list

"project navigation" pane. In both cases, a special "reports" toolbar lets you print the current report, refresh or search its content, or export it for use elsewhere.

The rest of this chapter introduces you to System Analyzer's reports using the results from our tutorial analysis.

Calculated reports

Title/summary

As its name implies, this report (Figure 11-3, p. 11–4) provides a high-level summary of the project. It recaps the selections in each alternative, shows the total energy use and energy costs for the building, and states the life-cycle payback on investment.

The Title/Summary report also indicates the environmental impact of each alternative and conveniently summarizes the data needed to use the ENERGY STAR® benchmarking tool (www.energystar.gov) for building performance—information which some states require for compliance with their building codes.

Design load summary

Review the Design Load Summary report for a detailed breakdown of the building loads on the *main* cooling and heating coils. The report from our tutorial (Figure 11-4, p. 11–5) allows us to make two important observations:

- Despite their identical building details, the cooling and heating loads of the two alternatives differ. That's because *the load calculation method is determined by the type of airside system*. Building loads are always calculated as block loads for VAV systems (Alternative 1) and as peak loads for water-source heat pump systems (Alternative 2).

  Note: **Block load** *equals the largest* simultaneous *load that's "seen" by all cooling coils.* **Peak load** *equals the sum of the highest loads "seen" by each of the cooling coils regardless of when they occur. Check online Help to discover which load calculation methodology is preassigned to a particular airside system.*

■ The dedicated makeup-air unit in Alternative 1 lowers the
ventilation load on the main coils by preconditioning the
entering outdoor air. This effect is represented by the negative

Figure 11-3 Title/Summary report provides a convenient overview of analysis results

Title / Summary Report
One River Place

Location: Tampa, Florida

	Alternative - 1	Alternative - 2
Alternative Description	Alternative - 1	High-efficiency water-source heat pump system
Building Template	3-6 Story	3-6 Story
Building Floor Area	80,000 ft²	80,000 ft²
System #1	Variable Volume Reheat (30% Min Flow Default)	Water Source Heat Pump
Max Clg Load	53.4 ton	208.8 ton
Max Htg Load	208.5 MBh	735.8 MBh
System #2	Parallel Fan-Powered VAV	
Max Clg Load	79.9 ton	
Max Htg Load	532.7 MBh	
Opt Ventilation Clg Load	75.7 ton	
Opt Ventilation Htg Load	174.6 MBh	
Total Building Clg Load	209.0 ton	208.8 ton
Total Building Htg Load	915.8 MBh	735.8 MBh
Plant #1		
Clg Equipment Type #1	Helical Rotary (>130 tons)	Water Source HP - High Eff
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type	Gas Fired Hot Water Boiler	Gas Fired Hot Water Boiler
Plant #2		
Clg Equipment Type #1		
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type		
MAU Plant #3		
Clg Equipment Type #1	Industrial Rooftop-IPAK-20+ Ton-Scroll	
Clg Equipment Type #2		
Clg Equipment Type #3		
Htg Equipment Type	Rooftop Gas Heat	
Building Clg Coil Load	391,009 ton·hrs/year	355,862 ton·hrs/year
Building Htg Coil Load	-34,267 kBtu/year	-13,759 kBtu/year
Building Energy Usage	43,814 Btu/ft²·year	39,683 Btu/ft²·year
Building Energy Cost	2.563 $/ft²·year	2.494 $/ft²·year

The top section of the report summarizes your system and cooling/heating equipment selections (shaded here) for each alternative

Estimations of annual energy use and its cost

Life Cycle Payback on Investment

	Alt 1 vs 2
Internal Rate of Return	0.0 %
Life Cycle Cost Difference	-$411,096
Net Present Value of Cash Flow	-$411,096
Life Cycle Payback on Invest.	Does not pay back
Simple Payback on Invest.	Does not pay back

Environmental Impact Analysis ★

	Alt 1	Alt 2
CO2 Impact *	4,343,181 lbm/year	3,964,120 lbm/year
SO2 Impact *	18,470 gm/year	16,858 gm/year
NOX Impact *	10,287 gm/year	9,389 gm/year

* Negative Denotes Reduction

Some states require this data to help demonstrate compliance with their local building codes

Energy Star Building Label Benchmarking Tool ★

	Alt - 1	Alt - 2
Building Floor Area	80,000 ft²	80,000 ft²
Weekly Operating Hours	68 hrs	68 hrs
Number of Occupants	559 People	559 People
Annual Electric Consumption	1,014,863 kWh	930,169 kWh
Annual Gas Consumption	414 therms	0 therms
Annual Oil Consumption	0 therms	0 therms
Annual Steam Consumption	0 therms	0 therms

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Dataset Name: mytutorial

System Analyzer <version number> calculated on 5/17/2006 10:18:59AM
Title Summary Report Page 1 of 1

ventilation load values for cooling and heating design and is
identified by the "Includes the impact of optional ventilation"
note at the end of the report.

Figure 11-4 Design Load Summary report provides a detailed breakdown of cooling and heating loads

Design Load Summary Report
One River Place

Location: Tampa, Florida
Summer Design DB: 92.7 °F
Summer Design WB: 77.1 °F
Winter Design DB: 40.0 °F

	Alternative - 1				Alternative - 2			
	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)	Cooling Design Btu/h	Percent Of Total (%)	Heating Design Btu/h	Percent Of Total (%)
Envelope Loads								
Skylight Solar	0	0.0	0	0.0	0	0.0	0	0.0
Skylight Conduction	0	0.0	0	0.0	0	0.0	0	0.0
Roof Conduction	193,485	12.1	-116,966	12.8	157,933	6.3	-122,370	16.6
Glass Solar	465,996	29.1	0	0.0	733,972	29.3	0	0.0
Glass Conduction	72,338	4.5	-167,139	18.3	48,461	1.9	-167,139	22.7
Wall Conduction	47,004	2.9	-63,209	6.9	34,963	1.4	-63,491	8.6
Infiltration	0	0.0	0	0.0	0	0.0	0	0.0
Sub Total:	**778,823**	**48.7**	**-347,314**	**38.03**	**975,329**	**38.9**	**-353,001**	**47.97**
Internal Loads								
Lights	566,238	35.4	0	0.0	546,608	21.8	0	0.0
People	243,399	15.2	0	0.0	240,934	9.6	0	0.0
Miscellaneous	131,140	8.2	0	0.0	129,232	5.2	0	0.0
Sub Total:	**940,776**	**58.8**	**0**	**0.0**	**916,774**	**36.6**	**0**	**0.0**
Ventilation Load **	-183,441	-11.5	-224,506	24.6	624,781	24.9	-399,121	54.2
Exhaust Heat	-47,256	-3.0	33,209	-3.6	-32,782	-1.3	16,303	-2.2
Reheat	0	0.0	0	0.0	0	0.0	0	0.0
Fan Heat	110,570	6.9	0	0.0	21,123	0.8	0	0.0
User Oversizing	0	0.0	0	0.0	20	0.0	0	0.0
Grand Total:	**1,599,472**	**100.0**	**-913,310**	**100.0**	**2,505,245**	**100.0**	**-735,819**	**100.0**
Main Coil Capacities:	**133.3 tons**		**-913 MBh**		**208.8 tons**		**-736 MBh**	
MAU Capacity:	**75.7 tons**		**-175 MBh**		**N/A**		**N/A**	

** Includes the impact of optional ventilation

Building loads are calculated
as block loads for the VAV
system in Alternative 1 ... and
as peak loads for the WSHP
system in Alternative 2

The makeup-air unit in
Alternative 1 preconditions
the entering outdoor air
before it reaches the main
airside cooling coils ... which
reduces the ventilation load
on the main airside system(s)

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Dataset Name: mytutorial

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Design Load Summary Report Page 1 of 1

System summary

The first page (Figure 11-5) of this multiple-page report provides a side-by-side comparison of the monthly coil loads for each alternative, as well as the outdoor, cooling, and heating supply airflows for each system.

Each succeeding page (Figure 11-6) in the report details the operation of each system in each alternative, showing how many hours the system operates at various percentages of the design load. This profile results from the combination of building utilization schedules, airside system selections, and control strategies (energy-saving economizers or fan cycling, for example).

Closely examining these detailed profiles can help you determine whether the airside systems are operating as you expect.

Figure 11-5 Find a monthly coil load profile and airflow summary on the first page of the System report

System Report
One River Place

Monthly Coil Loads

	Alternative - 1		Alternative - 2	
	Cooling Coil Load ton-hrs	Heating Coil Load kBtu	Cooling Coil Load ton-hrs	Heating Coil Load kBtu
January	15,996	-17,217	11,935	-6,906
February	13,876	-10,576	11,101	-4,663
March	29,814	0	27,079	0
April	33,040	0	30,725	0
May	40,279	0	37,620	0
June	47,686	0	45,026	0
July	45,131	0	42,429	0
August	50,943	0	47,567	0
September	41,325	0	38,316	0
October	30,599	0	27,876	0
November	24,686	-251	21,925	-125
December	17,634	-6,224	14,262	-2,065
Total:	**391,009**	**-34,267**	**355,862**	**-13,759**

System Airflows

	Alternative - 1	Alternative - 2
System #1		
System Type	Variable Volume Reheat (30% Min Flow Default)	Water Source Heat Pump
Outside Airflow	7,483 cfm	11,189 cfm
Cooling Supply Airflow	25,239 cfm	71,290 cfm
Heating Supply Airflow	7,572 cfm	71,290 cfm
System #2		
System Type	Parallel Fan-Powered VAV	
Outside Airflow	3,706 cfm	
Cooling Supply Airflow	36,957 cfm	
Heating Supply Airflow	3,926 cfm	
Optional Ventilation Unit		
Cooling Supply Airflow	11,189 cfm	
Heating Supply Airflow		

The first page of the System report summarizes the building's coil load and airflow profiles by alternative

Figure 11-6 Detailed operating profiles for each airside system also appear in the System report

System Report
One River Place

Alternative - 1 System # 1 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Hrs (%)	Hrs	Heating Load Capacity (Btuh)	Hrs (%)	Hrs	Cooling Airflow Capacity (cfm)	Hrs (%)	Hrs	Heating Airflow Capacity (cfm)	Hrs (%)	Hrs
0 - 5	5.2	3	113	-16,264	36	38	1,262	0	0			
5 - 10	10.4	1	41	-32,528	15	16	2,524	0	0			
10 - 15	15.6	2	72	-48,792	15	16	3,786	0	0			
15 - 20	20.8	13	445	-65,056	0	0	5,048					
20 - 25	26.0	5	174	-81,321	0	0	6,310					
25 - 30	31.2	5	184	-97,585	0	0	7,572					
30 - 35	36.4	4	152	-113,849	0	0	8,834					
35 - 40	41.6	4	124	-130,113	3	3	10,096					
40 - 45	46.8	5	167	-146,377	0	0	11,357					
45 - 50	52.0	6	210	-162,641	0	0	12,619					
50 - 55	57.2	6	203	-178,905	0	0	13,881					
55 - 60	62.4	5	189	-195,169	20	21	15,143					
60 - 65	67.6	6	221	-211,434	7	7	16,405					
65 - 70	72.8	5	171	-227,698	3	3	17,667					
70 - 75	78.0	4	142	-243,962	3	3	18,929					
75 - 80	83.2	7	247	-260,226	0	0	20,191					
80 - 85	88.4	6	227	-276,490	0	0	21,453					
85 - 90	93.6	3	114	-292,754	0	0	22,715	4	155			
90 - 95	98.8	3	122	-309,018	0	0	23,977	10	348			
95 - 100	104.0	6	224	-325,282	0	0	25,239	27	958			
Hours Off	0.0	0	5,218	0	0	8,653	0	0	5,218	No heating fan for selected system		

Subsequent pages of the System report provide a detailed load profile that reflects the anticipated performance for each alternative's combination of utilization schedules, airside system selections, and control strategies

Alternative - 1 System # 2 Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Hrs (%)	Hrs	Heating Load Capacity (Btuh)	Hrs (%)	Hrs	Cooling Airflow Capacity (cfm)	Hrs (%)	Hrs	Heating Airflow Capacity (cfm)	Hrs (%)	Hrs
0 - 5	5.2	7	317	-29,524	34	140	1,848	11	475	196	14	57
5 - 10	10.5	4	163	-59,048	33	136	3,696	5	231	393	12	50
10 - 15	15.7	3	130	-88,573	13	53	5,544	3	118	589	14	57
15 - 20	21.0	5	208	-118,097	7	27	7,391	2	81	785	23	94
20 - 25	26.2	6	251	-147,621	3	13	9,239	0	4	981	13	54
25 - 30	31.5	11	466	-177,145	5	19	11,087	0	0	1,178	6	23
30 - 35	36.7	11	492	-206,670	0	0	12,935	0	0	1,374	3	14
35 - 40	42.0	6	248	-236,194	4	17	14,783	16	694	1,570	3	13
40 - 45	47.2	6	267	-265,718	0	0	16,631	10	449	1,767	6	23
45 - 50	52.5	7	299	-295,242	0	0	18,478	7	320	1,963	5	20
50 - 55	57.7	2	103	-324,767	1	4	20,326	7	333	2,159	0	0
55 - 60	63.0	4	174	-354,291	0	0	22,174	8	365	2,355	0	0
60 - 65	68.2	5	204	-383,815	0	0	24,022	6	275	2,552	0	0
65 - 70	73.5	4	194	-413,339	0	0	25,870	5	224	2,748	0	0
70 - 75	78.7	2	101	-442,864	1	4	27,718	3	151	2,944	0	0
75 - 80	84.0	4	155	-472,388	0	0	29,565	4	174	3,140	1	4
80 - 85	89.2	5	231	-501,912	0	0	31,413	1	45	3,337	1	4
85 - 90	94.5	3	140	-531,436	0	0	33,261	2	81	3,533	0	0
90 - 95	99.7	3	139	-560,961	0	0	35,109	1	28	3,729	0	0
95 - 100	105.0	2	95	-590,485	0	0	36,957	9	403	3,926	0	0
Hours Off	0.0	0	4,383	0	0	8,347	0	0	4,309	0	0	8,347

Alternative - 1 Building Load Profile

Percent of Design Load	Cooling Load Capacity (Tons)	Hrs (%)	Hrs	Heating Load Capacity (Btuh)	Hrs (%)	Hrs	Cooling Airflow Capacity (cfm)	Hrs (%)	Hrs	Heating Airflow Capacity (cfm)	Hrs (%)	Hrs
0 - 5	10.4	11	480	-45,788	57	235	3,110	14	629	196	14	57
5 - 10	20.9	6	269	-91,577	22	91	6,220	6	247	393	12	50
10 - 15	31.3	4	192	-137,365	4	17	9,329	1	33	589	14	57
15 - 20	41.8	2	78	-183,153	0	0	12,439	0	0	785	23	94
20 - 25	52.2	9	395	-228,942	4	16	15,549	0	0	981	13	54
25 - 30	62.7	8	356	-274,730	6	23	18,659	0	0	1,178	6	23
30 - 35	73.1	6	246	-320,519	2	10	21,769	7	294	1,374	3	14
35 - 40	83.6	5	238	-366,307	2	10	24,878	7	324	1,570	3	13
40 - 45	94.0	5	225	-412,095	1	3	27,988	4	177	1,767	6	23
45 - 50	104.5	4	194	-457,884	0	0	31,098	4	166	1,963	5	20
50 - 55	114.9	4	188	-503,672	1	4	34,208	7	325	2,159	0	0
55 - 60	125.4	3	151	-549,460	0	0	37,317	3	120	2,355	0	0
60 - 65	135.8	5	201	-595,249	0	0	40,427	9	388	2,552	0	0
65 - 70	146.3	3	146	-641,037	1	4	43,537	10	447	2,748	0	0
70 - 75	156.7	5	231	-686,825	0	0	46,647	6	247	2,944	0	0
75 - 80	167.2	3	147	-732,614	0	0	49,757	4	171	3,140	1	4
80 - 85	177.6	5	228	-778,402	0	0	52,866	5	222	3,337	1	4
85 - 90	188.1	4	165	-824,190	0	0	55,976	4	198	3,533	0	0
90 - 95	198.5	4	160	-869,979	0	0	59,086	2	76	3,729	0	0
95 - 100	209.0	2	87	-915,767	0	0	62,196	9	387	3,926	0	0
Hours Off	0.0	0	4,383	0	0	8,347	0	0	4,309	0	0	8,347

Built By: P. Turner
Dataset Name: mytutorial

System Analyzer <version number> calculated on 5/17/2006 10:18:59AM
System Report Page 2 of 3

Equipment energy consumption

Consult the Equipment Energy Consumption report for an itemized breakdown, month by month, of the energy used by the cooling, heating, and air-moving equipment (including accessories, such as pumps) in each alternative. This report also summarizes energy consumption and demand by utility type and time of day (that is, on-peak versus off-peak).

Use this report to identify which equipment is contributing most (or least) to the overall energy consumption of each alternative. For example, when we compare the gas consumption of the two alternatives in our tutorial, we find that Alternative 2 did not consume any gas because the water-source heat pump loop satisfies the entire heating load (Figure 11-7).

The Equipment Energy Consumption report also can help you discover whether control strategies, such as economizing and setpoint reset, are delivering the expected energy savings.

Cash flow summary

The three remaining calculated reports document the economic results of the analysis, providing financial evidence to support your determination of the best alternative.

The Cash Flow Summary report is exactly that: a summary of the expenses (and savings) attributable to an alternative for each year of the analysis period. At minimum, the report shows the yearly utility and maintenance costs, cash flow effect, and net present value (Figure 11-8, p. 11–10).

Economic comparison

You'll find this report to be invaluable for cost-based comparisons of alternatives. It shows the installed cost, first- and final-year utility costs, first- and final-year maintenance costs, and life-cycle cost for each alternative. It also compares Alternative 1 to each additional alternative in the project. The comparison reports the differences in first cost and life-cycle cost, as well as the simple payback period, net present value, life-cycle payback, and internal rate of return.

Figure 11-9 (p. 11–11) shows the economic comparison of the alternatives for our fictitious office building: the chilled water plant in Alternative 1 versus the water-source heat pump system in Alternative 2. Both simple and life-cycle payback values show that

Equipment Energy Consumption Report
One River Place

See how much energy individual equipment will consume each month

Alternative 1

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lights	Elec(kWh)	38,556	34,884	42,228	36,720	40,392	40,392	36,720	42,228	36,720	40,392	38,556	36,720	464,508
MISC LD	Elec(kWh)	7,644	6,916	8,372	7,280	8,008	8,008	7,280	8,372	7,280	8,008	7,644	7,280	92,092

Fans:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Makeup-air unit	Elec(kWh)	206	186	225	196	215	215	196	225	196	215	206	196	2,477
System 1	Elec(kWh)	2,602	2,504	3,811	4,539	5,508	6,362	6,032	6,453	4,897	3,640	3,116	2,744	52,209
System 2	Elec(kWh)	1,074	973	2,229	3,569	4,536	6,093	5,760	5,944	4,294	2,467	1,415	1,041	39,395

Cooling:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P1 Helical Rotary (>130 tons)	Elec(kWh)	6,258	5,530	10,716	13,366	16,568	20,289	19,709	21,134	16,566	11,714	9,264	6,977	158,093
Cooling tower for Cent. Chillers	Elec(kWh)	2,232	1,796	3,371	3,700	4,240	4,460	4,573	4,480	3,851	3,826	3,479	2,696	42,703
Cooling accessories	Elec(kWh)	5,044	4,564	5,731	6,160	7,052	7,412	7,601	7,447	6,400	6,417	5,954	5,319	75,101
P3 Industrial Rooftop-IPAK<20+	Elec(kWh)	1,222	738	4,210	5,092	7,146	11,538	11,376	14,033	11,045	4,617	3,713	1,675	76,403
Consenser fan for MZ rooftop	Elec(kWh)	231	141	687	757	1,012	1,444	1,417	1,734	1,409	730	611	300	10,473
Cooling accessories	Elec(kWh)	24	19	32	28	30	30	28	32	28	30	29	25	333

Heating:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P1 Gas Fired Hot Water Boiler	Gas(thm)	201	106	0	0	0	0	0	0	0	0	3	74	384
Heating accessories	Elec(kWh)	438	305	0	0	0	0	0	0	0	0	21	313	1,076
P3 Rooftop Gas Heat	Gas(thm)	6	22	0	0	0	0	0	0	0	0	0	1	29

Utility Summary:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electrical Consumption	Peak(kWh)	56,142	50,088	69,371	65,474	74,962	84,061	77,796	88,503	73,000	68,033	61,726	55,228	824,382
	Off Peak(kWh)	9,388	8,469	12,239	15,933	19,746	22,184	22,896	23,579	19,685	14,024	12,280	10,058	190,481
Electrical Demand	Peak (kW)	340	342	398	422	434	486	485	484	470	409	383	349	486
	Off Peak (kW)	276	274	341	402	413	438	449	454	454	341	307	284	454
Gas Consumption	Peak(thm)	207	129	0	0	0	0	0	0	0	0	3	75	414
Gas Demand	Peak (thm/hr)	8	5	1	0	0	0	0	0	0	0	1	4	8
Water Consumption	(kgals)	49	45	83	94	112	127	119	129	104	85	68	53	1,066

Alternative 2

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lights	Elec(kWh)	38,556	34,884	42,228	36,720	40,392	40,392	36,720	42,228	36,720	40,392	38,556	36,720	464,508
MISC LD	Elec(kWh)	7,644	6,916	8,372	7,280	8,008	8,008	7,280	8,372	7,280	8,008	7,644	7,280	92,092

Fans:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
System 1	Elec(kWh)	5,519	4,994	6,046				77	6,129	5,319	5,800	5,535	5,263	67,027

Cooling:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P1 Water Source HP - High Eff	Elec(kWh)	9,423	8,687	20,607					36,199	29,158	21,214	16,692	10,963	271,507
WSHP - Cooling tower	Elec(kWh)	1,081	930	1,681					3,231	2,513	1,895	1,651	1,336	24,746
Cooling accessories	Elec(kWh)	698	632	784					1,031	862	867	803	722	10,289

Heating:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
P1 Gas Fired Hot Water Boiler	Gas(thm)	0	0	0					0	0	0	0	0	0
Heating accessories	Elec(kWh)	0	0	0					0	0	0	0	0	0

The shaded sections of the report show energy consumption and demand by utility type

Utility Summary:

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electrical Consumption	Peak(kWh)	54,351	49,473	68,264	62,737	70,927	75,597	69,196	79,399	67,131	66,420	60,701	53,775	777,971
	Off Peak(kWh)	8,571	7,570	11,454	12,780	15,298	16,973	16,595	17,791	14,721	11,756	10,180	8,510	152,198
Electrical Demand	Peak (kW)	405	405	406	407	408	410	410	410	410	407	406	406	410
	Off Peak (kW)	403	404	405	407	407	408	409	409	409	405	405	404	409
Gas Demand	Peak (thm/hr)	5	0	0	0	0	0	0	0	0	0	0	5	5
Water Consumption	(kgals)	45	42	105	120	146	175	165	185	149	109	85	55	1,382

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Dataset Name: mytutorial

System Analyzer <version number> calculated on 5/17/2006 10:18:59AM
Equipment Energy Consumption Report Page 1 of 1

Figure 11-8 Cash Flow Summary report documents yearly cash flow for each alternative
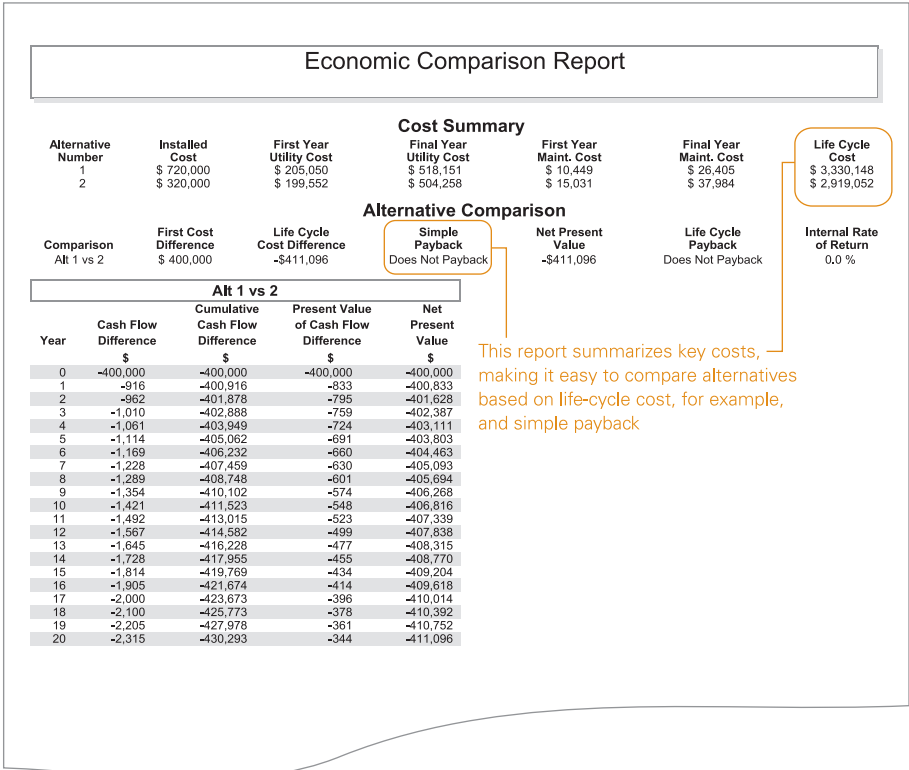
Cash Flow Summary Report

Yearly Cash Flow By Alternative

Alternative - 1

Year	Utility Cost	Maintenance Cost	Interest Cost	Principal Cost	Property Tax	Insurance Cost	Revenue Penalty	Replace Expenses	Deprec. Tax	Cash Flow Effect	Present Value
0	0	0	0	720,000	0	0	0	0	0	720,000	720,000
1	205,050	10,449	0	0	0	0	0	0	0	215,500	195,909
2	215,303	10,972	0	0	0	0	0	0	0	226,275	187,004
3	226,068	11,520	0	0	0	0	0	0	0	237,588	178,504
4	237,371	12,096	0	0	0	0	0	0	0	249,468	170,390
5	249,240	12,701	0	0	0	0	0	0	0	261,941	162,645
6	261,702	13,336	0	0	0	0	0	0	0	275,038	155,252
7	274,787	14,003	0	0	0	0	0	0	0	288,790	148,195
8	288,526	14,703	0	0	0	0	0	0	0	303,229	141,459
9	302,952	15,439	0	0	0	0	0	0	0	318,391	135,029
10	318,100	16,210	0	0	0	0	0	0	0	334,311	128,891
11	334,005	17,021	0	0	0	0	0	0	0	351,026	123,033
12	350,705	17,872	0					0	0	368,577	117,440
13	368,241	18,766	0					0	0	387,006	112,102
14	386,653	19,704	0					0	0	406,356	107,006
15	405,985	20,689	0					0	0	426,674	102,142
16	426,284	21,724	0					0	0	448,008	97,500
17	447,599	22,810	0					0	0	470,408	93,068
18	469,979	23,950	0					0	0	493,929	88,837
19	493,478	25,148	0	0	0	0	0	0	0	518,625	84,799
20	518,151	26,405	0	0	0	0	0	0	0	544,557	80,945

This report shows the expenses associated with each alternative for each year of the analysis—in this case, a 20-year period

Alternative - 2

Year	Utility Cost	Maintenance Cost	Interest Cost	Principal Cost	Property Tax	Insurance Cost	Revenue Penalty	Replace Expenses	Deprec. Tax	Cash Flow Effect	Present Value
0	0	0	0	320,000	0	0	0	0	0	320,000	320,000
1	199,552	15,031	0	0	0	0	0	0	0	214,583	195,076
2	209,530	15,783	0	0	0	0	0	0	0	225,313	186,209
3	220,006	16,572	0	0	0	0	0	0	0	236,578	177,745
4	231,006	17,401	0	0	0	0	0	0	0	248,407	169,665
5	242,557	18,271	0	0	0	0	0	0	0	260,827	161,953
6	254,684	19,184	0	0	0	0	0	0	0	273,869	154,592
7	267,419	20,144	0	0	0	0	0	0	0	287,562	147,565
8	280,790	21,151	0	0	0	0	0	0	0	301,940	140,857
9	294,829	22,208	0	0	0	0	0	0	0	317,037	134,455
10	309,571	23,319	0	0	0	0	0	0	0	332,889	128,343
11	325,049	24,485	0	0	0	0	0	0	0	349,534	122,509
12	341,302	25,709	0	0	0	0	0	0	0	367,010	116,941
13	358,367	26,994	0	0	0	0	0	0	0	385,361	111,625
14	376,285	28,344	0	0	0	0	0	0	0	404,629	106,552
15	395,099	29,761	0	0	0	0	0	0	0	424,860	101,708
16	414,854	31,249	0	0	0	0	0	0	0	446,103	97,085
17	435,597	32,812	0	0	0	0	0	0	0	468,409	92,672
18	457,377	34,452	0	0	0	0	0	0	0	491,829	88,460
19	480,245	36,175	0	0	0	0	0	0	0	516,420	84,439
20	504,258	37,984	0	0	0	0	0	0	0	542,241	80,601

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Dataset Name: mytutorial

System Analyzer <version number> calculated on 5/17/2006 10:18:59AM
Cash Flow Summary Report Page 1 of 1

Economic Comparison Report

Cost Summary

Alternative Number	Installed Cost	First Year Utility Cost	Final Year Utility Cost	First Year Maint. Cost	Final Year Maint. Cost	Life Cycle Cost
1	$ 720,000	$ 205,050	$ 518,151	$ 10,449	$ 26,405	$ 3,330,148
2	$ 320,000	$ 199,552	$ 504,258	$ 15,031	$ 37,984	$ 2,919,052

Alternative Comparison

Comparison	First Cost Difference	Life Cycle Cost Difference	Simple Payback	Net Present Value	Life Cycle Payback	Internal Rate of Return
Alt 1 vs 2	$ 400,000	-$411,096	Does Not Payback	-$411,096	Does Not Payback	0.0 %

Alt 1 vs 2

Year	Cash Flow Difference $	Cumulative Cash Flow Difference $	Present Value of Cash Flow Difference $	Net Present Value $
0	-400,000	-400,000	-400,000	-400,000
1	-916	-400,916	-833	-400,833
2	-962	-401,878	-795	-401,628
3	-1,010	-402,888	-759	-402,387
4	-1,061	-403,949	-724	-403,111
5	-1,114	-405,062	-691	-403,803
6	-1,169	-406,232	-660	-404,463
7	-1,228	-407,459	-630	-405,093
8	-1,289	-408,748	-601	-405,694
9	-1,354	-410,102	-574	-406,268
10	-1,421	-411,523	-548	-406,816
11	-1,492	-413,015	-523	-407,339
12	-1,567	-414,582	-499	-407,838
13	-1,645	-416,228	-477	-408,315
14	-1,728	-417,955	-455	-408,770
15	-1,814	-419,769	-434	-409,204
16	-1,905	-421,674	-414	-409,618
17	-2,000	-423,673	-396	-410,014
18	-2,100	-425,773	-378	-410,392
19	-2,205	-427,978	-361	-410,752
20	-2,315	-430,293	-344	-411,096

This report summarizes key costs, making it easy to compare alternatives based on life-cycle cost, for example, and simple payback

the chilled water plant in Alternative 1 does not yield a satisfactory return on investment when compared to the WSHP system in Alternative 2. The report also confirms that the WSHP system has the lowest life-cycle cost. Overall, it appears that Alternative 2 is the best choice for this scenario.

Utility summary

The last of System Analyzer's calculated reports, the Utility Cost Summary (Figure 11-10, p. 11–12), shows the monthly energy costs for the first year of operation. The costs are categorized by utility type and alternative.

Figure 11-10 Check the Utility Cost Summary report for monthly energy costs by utility type

Utility Cost Summary Report

Monthly Utility Costs

Alternative - 1

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	6,484	5,785	8,012	7,562	10,465	11,735	10,860	12,355	10,191	9,497	7,129	6,379	106,455
	Off Pk ($)	316	297	377	456	642	721	744	766	640	456	263	215	5,884
	Sub Total($)	6,801	6,082	8,390	8,019	11,107	12,456	11,604	13,121	10,831	9,953	7,392	6,594	112,349
Electric Demand	On Pk ($)	3,582	3,609	4,201	4,449	4,581	5,125	5,121	5,110	4,963	4,315	4,043	3,686	52,785
	Off Pk ($)	2,066	2,058	2,558	3,014	3,096	3,287	3,365	3,403	3,408	2,557	2,306	2,129	33,248
	Sub Total($)	5,649	5,666	6,759	7,463	7,677	8,412	8,486	8,514	8,372	6,872	6,349	5,816	86,033
Gas	On Pk ($)	100	62	0	0	0	0	0	0	0	0	1	36	200
	Sub Total($)	100	62	0	0	0	0	0	0	0	0	1	36	200
Monthly Total ($)		12,550	11,811	15,149	15,482	18,783	20,868	20,090	21,635	19,202	16,825	13,742	12,446	198,582

Alternative - 2

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Electric Consumption	On Pk ($)	6,278	5,714	7,884	7,246	9,901	10,553	9,660	11,084	9,371	9,272	7,011	6,211	100,187
	Off Pk ($)	299	277	361	389	497	552	539	578	478	382	218	182	4,753
	Sub Total($)	6,576	5,992	8,245	7,635	10,399	11,105	10,199	11,662	9,850	9,654	7,229	6,393	104,939
Electric Demand	On Pk ($)	4,276	4,274	4,286	4,295	4,300	4,324	4,327	4,327	4,320	4,290	4,285	4,279	51,585
	Off Pk ($)	3,026	3,027	3,039	3,049	3,054	3,060	3,064	3,068	3,070	3,040	3,034	3,029	36,559
	Sub Total($)	7,302	7,301	7,325	7,344	7,354	7,384	7,391	7,395	7,391	7,331	7,319	7,309	88,144
Monthly Total ($)		13,878	13,292	15,570	14,979	17,753	18,489	17,590	19,057	17,240	16,985	14,548	13,702	193,084

This report lets you compare the monthly energy costs, by utility type, for each alternative during the first year of operation

Built By: P. Turner
Dataset Name: mytutorial

System Analyzer <version number> calculated on 5/24/2006 10:14:25AM
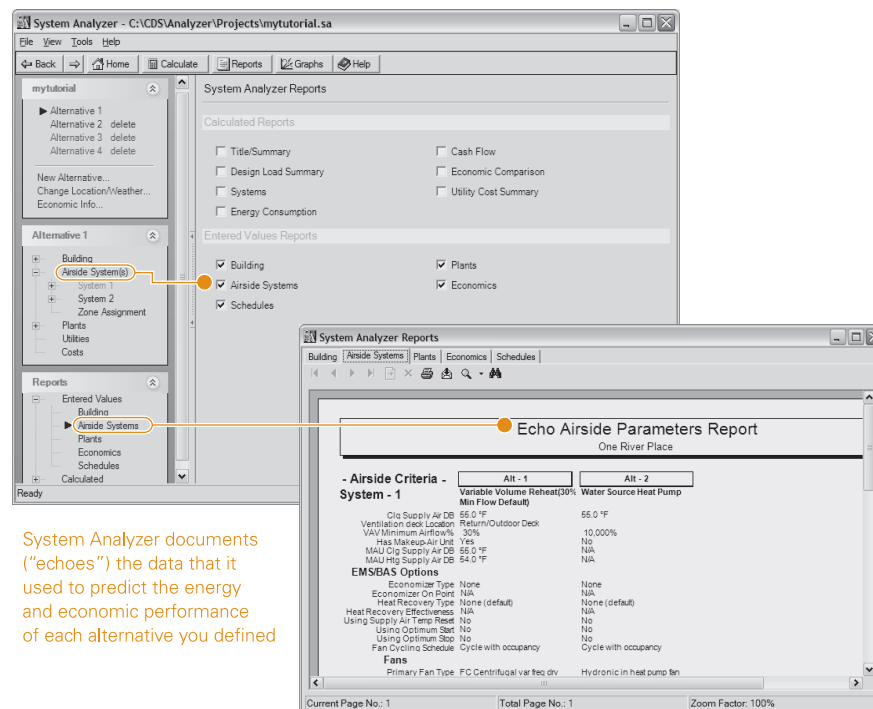Utility Cost Summary Report Page 1 of 1

Entered values reports

In addition to documenting calculation results, System Analyzer reports the data that it used to perform the calculations. The data consists of the values you provided as well as information from the appropriate templates.

There's an "entered values" report for each section of the alternative (Figure 11-11), with the Economics report recording both the utility rate definitions and the economic parameters that were used to determine the costs related to each alternative. A separate Schedules report details the building utilization and control schedules that were applied to simulate energy use.

Printing these reports can make it easier to point out the differences between alternatives and to identify refinements to the design. These reports also can be useful for determining the reason for unexpected results.

Figure 11-11 Use the "entered values" reports to help refine your designs

System Analyzer documents ("echoes") the data that it used to predict the energy and economic performance of each alternative you defined

12 Graphs

The underlying truth to the adage that "a picture's worth a thousand words" also applies to columns of numbers. Graphing the results of a comparative analysis can make it easier to interpret and evaluate the performance of each alternative.

System Analyzer includes a Graphs utility to help you present the analysis results as clearly and effectively as possible. The utility includes five 2D default graphs (Figure 12-1, p. 12–2):

■ Building electric demand/consumption cost comparison

■ Building electric monthly demand costs by equipment

■ Building electric monthly energy costs by equipment

■ Building energy cost comparison by utility type

■ Monthly HVAC energy

You can customize a predefined graph or create a new one from scratch. In either case, you also have the option of saving the custom graph for use in other System Analyzer projects.

Opening the Graphs utility

TIP

The Graphs utility is only available after you provide enough information for System Analyzer to generate analysis results when you click the **Calculate** button.

To open the Graphs utility, click the **Graphs** button in the toolbar at the top of the main System Analyzer window (Figure 12-2, p. 12–3). By default, the utility displays a graphical comparison of the building's demand and consumption costs for electricity.

**Figure 12-1 Default graphs for analysis results**
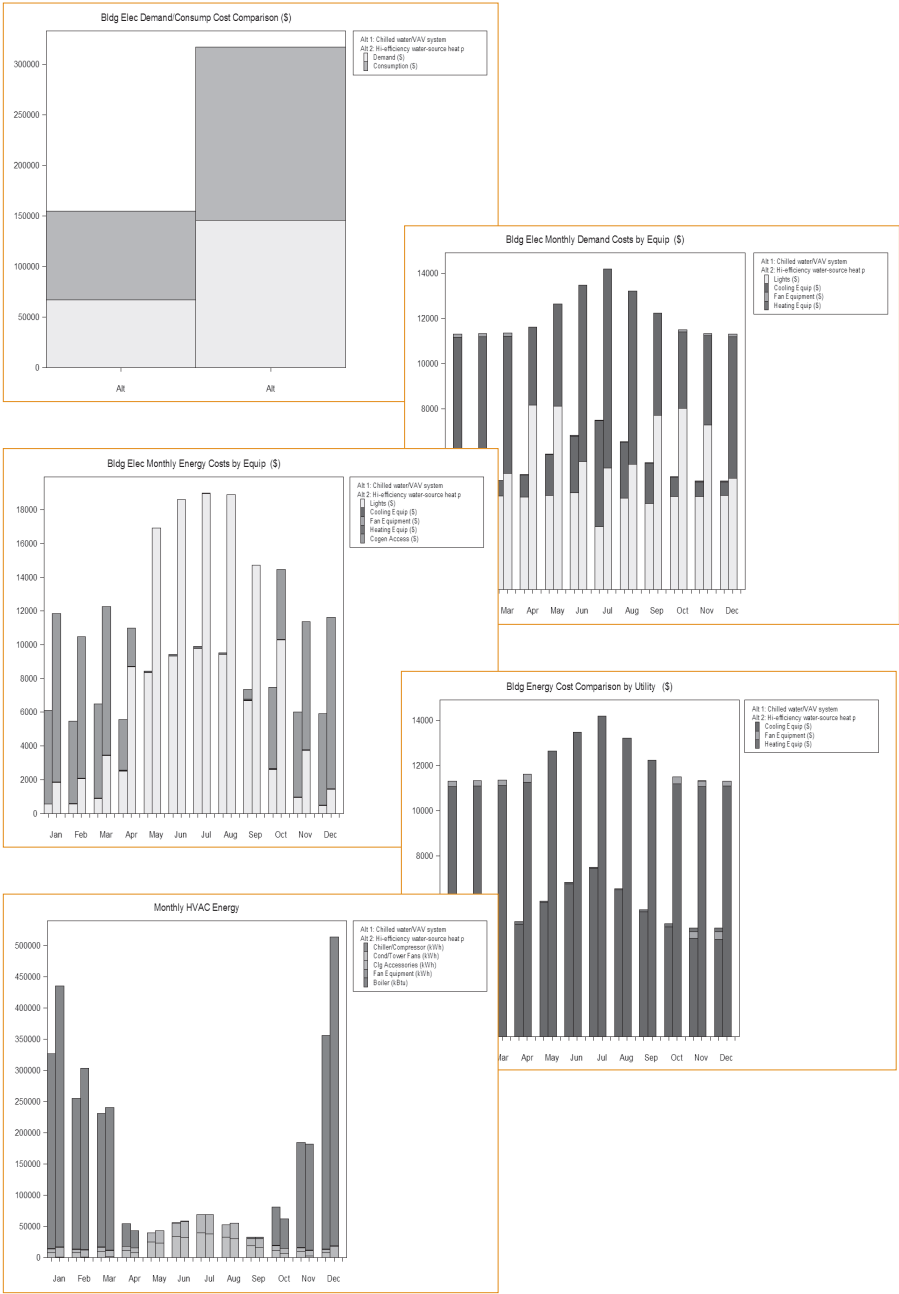
Displaying a predefined graph

To display a different predefined graph, select it from the drop-down list at the bottom of the window (Figure 12-2); then click **Draw**. The list includes the five default graphs (listed on p. 12–1), plus any customized graphs that you create and save.

**Figure 12-2 Opening the Graphs utility in System Analyzer**
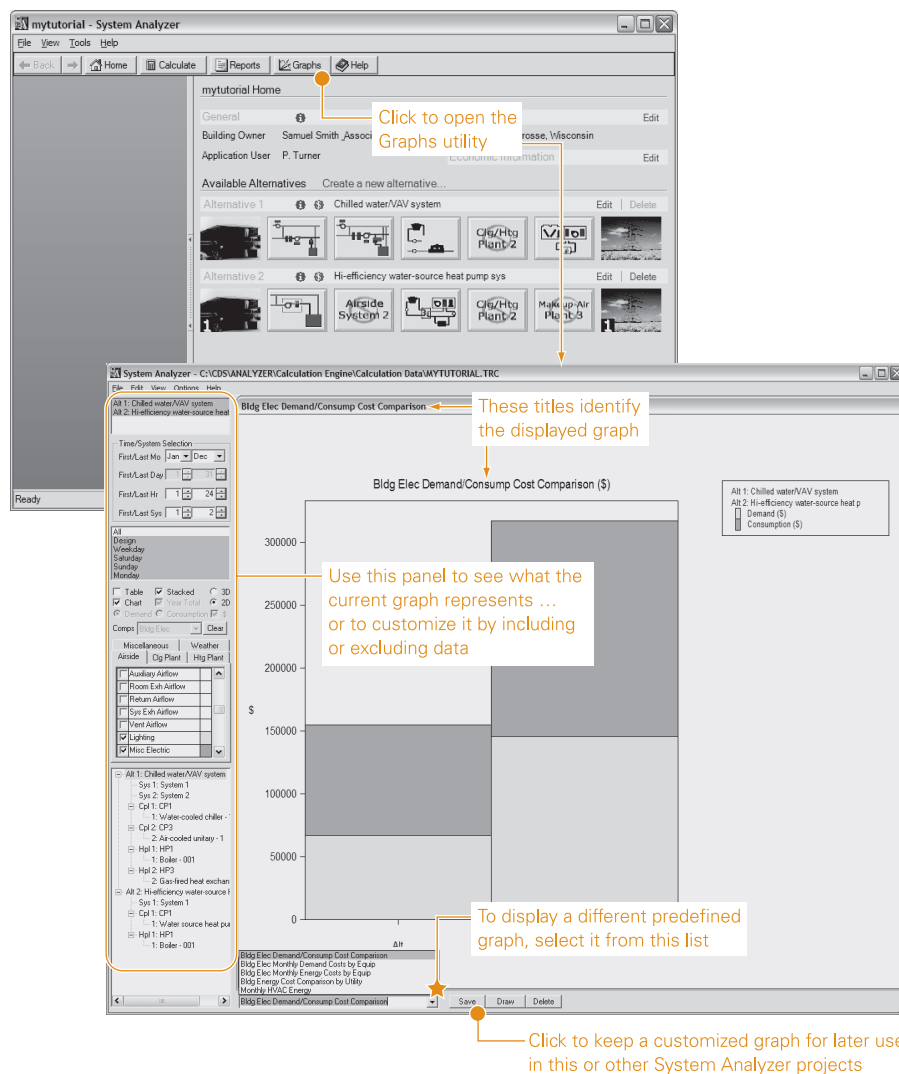
Printing or exporting graphs

To print one or more of the saved graphs, or to export them as bitmap images:

1 With the Graphs screen displayed, open the **File** menu and click **Print saved graphs**.

2 Select the desired graphs from the list on the left side of the **Print** dialog box (Figure 12-3).

3 Select the **Print graphs to hardcopy** check box for printouts of the graph(s) you chose. (Or, clear this check box if you only want to export each selected graph.)

4 To export each selected graph as Windows bitmap (.bmp) and/or portable network graphics (.png) file, select the appropriate check box(es).

Figure 12-3 Printing graphs or exporting them as bitmapped images
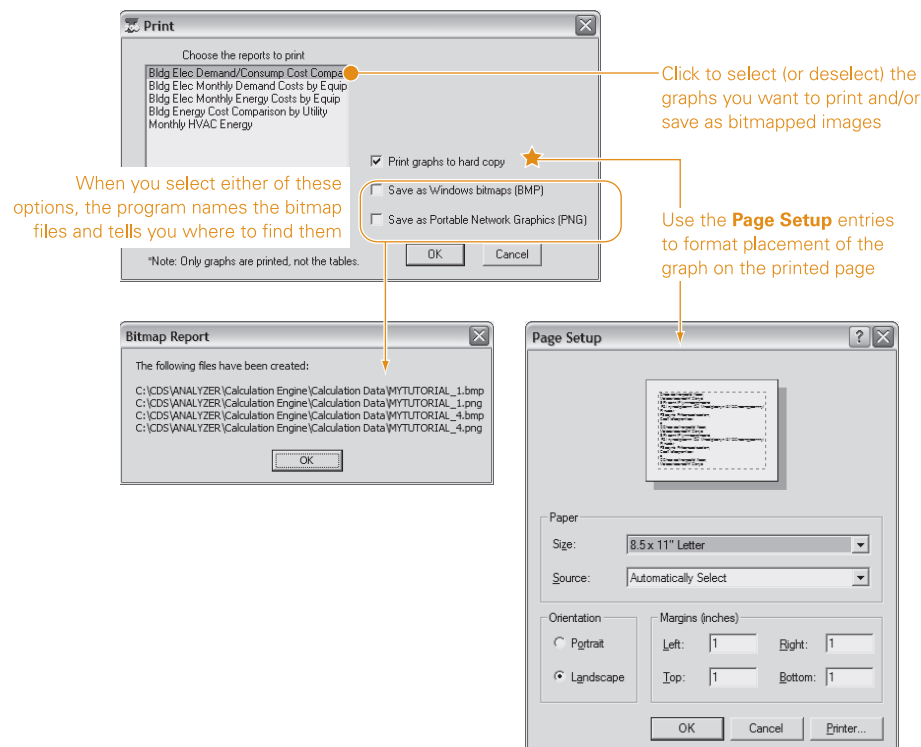
5 Click **OK** to complete your selection.

If you chose to make printed copies of the graphs, a **Page Setup** dialog box opens so that you can reposition the graph on the page and/or choose a different printer.

When you save (export) graphs as bitmapped images, the program uses the name of the System Analyzer project to identify the files and reports their location (Figure 12-3).

Note: Although you can display the graphed data as a table, you can't print the table. As a work-around, transfer the table contents to the worksheet of a spreadsheet program, such as Microsoft Excel. Use keyboard shortcuts to copy (CTRL+C) your selection and paste (CTRL+V) it into the worksheet.

Customizing a graph

TIP

If the settings aren't displayed when you start the Graphs utility, open the **View** menu and select **Settings**.

The settings on the left side of the Graphs screen show you what the current graph represents. But perhaps more importantly, you can alter these settings to change the graph's appearance (unstacking the bars, making them 3D, or showing a table of the plotted data) or scope (showing a single alternative or including/excluding specific equipment).

Figure 12-4 (p. 12–6) briefly explains the purpose of each of the Graphs utility settings. For more information, consult online Help.

*Note: To repaint the graph based on your changes, click the **Draw** button at the bottom of the Graphs utility screen … or open the **View** menu and select **Auto Refresh** to automatically update the graph with each change.*

Once you customize a default graph, you can add it to the list of available graphs. Simply click the **Save** button at the bottom of screen and give the new graph a name when prompted. (The program prevents you from overwriting the default graphs.)

Figure 12-4 Use the Graph utility settings to customize any default graph

Each highlighted alternative appears on the graph … Click an alternative to exclude (or include) it

Use these entries to redefine the time period …

Or to show more or fewer airside systems

Choose which day types to include in the graph … the Monday day type represents pull-down/up loads

Display a table, 2D (or 3D) bar chart, or both … Stack the bars for each alternative on top of each other or display them side by side

Click to deselect all of the items in the tabbed list

Each selected item is represented by a color-coded bar on the graph … Click an item to add (or remove) it from the graph

A collapsible list, organized by by alternative, helps you keep track of the airside system and cooling/heating plant components represented in the graph