



# Pre Design Energy Analysis

An Online Continuing Education Course for Engineers

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# Pre-Design Energy Analysis

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## Introduction

When contemplating the design of a new facility, the future energy consumption of the facility should be considered in the early stages of the design. One way to do this is with a pre-design energy analysis.

A pre-design energy analysis uses general information about a building and site to estimate energy performance, characterize energy uses, and identify potential energy savings opportunities for a new building. The objective is to use results to develop design concepts that minimize energy loads and costs from the outset. Results also provide important guidance for setting energy performance goals. At this early stage in the design process, the building siting, orientation, zoning, internal organization, massing, and appearance of the facade can be manipulated to maximize performance without adding significant cost.

The energy performance of a building depends on complex interactions between the outdoor environment, indoor conditions, building envelope, and mechanical systems, so computer simulation programs are the best tool to perform building energy analyses. A whole-building computer simulation tool that calculates hourly or sub-hourly loads for the building is critical for all high-performance projects.

In most cases, a professional energy consultant should be hired to perform a pre-design energy analysis based on information provided by the owners, architects, and engineers. The consultant will perform most of the simulation work in advance. The energy consultant must be given sufficient time to prepare and execute the required simulations. The lead time for the analysis depends greatly on the magnitude of the project and the desired level of analysis.

Energy cost is also closely related to energy performance. Energy cost savings form the basis for earning LEED points under the Energy and Atmosphere credit. A comprehensive pre-design energy analysis provides a head start for the simulation work required to calculate LEED points throughout the design process.

This course is intended to help you know what type of information to give the energy consultant and what results to expect. The types of pre-design energy analyses are described and tips for presenting results are also discussed. Chapter one begins with a look at the different types of pre-design energy analysis procedures.

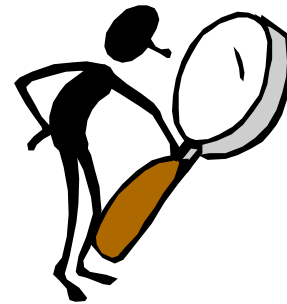
## Chapter 1

### Pre-design Energy Analysis

This chapter discusses the various types of pre-design energy analyses that may be used in a building design. This chapter includes the types of information to supply to an energy consultant, questions for the energy consultant, and how to set performance goals for a new facility.

Pre-design energy analyses can be divided into one of these five basic types:

1. Baseline analysis
2. Load elimination parametric analysis
3. Sensitivity analysis
4. Energy conservation measure analysis
5. Utility bill analysis (if applicable)



The first four types of analyses can be performed for any building project. The fifth type, utility bill analysis is mainly applicable to renovation projects or projects that will build a new version of an existing building. The following sections introduce the intent and application of each type of analysis. Examples of analysis results and ways to present them are shown later. Remember in all cases that a pre-design energy model is a simplified sketch of a potential building. Results are best used to compare and explore alternatives and will not necessarily be representative of the actual performance of the final design.

Determine with the energy consultant which specific analyses are most appropriate for the budget, and available time. At the very least a baseline analysis is recommended. Chapter Two describes the methods and procedures for each type of analysis in detail.

#### 1. Baseline Analysis

*Baseline analysis* (also known as base case analysis or base building analysis) characterizes the energy uses and costs that would be expected if the building were built to code with no high-performance features. In the pre-design stage, the architecture and geometry have not yet been decided. The baseline building is therefore merely a box that meets all the owner's program

requirements. The performance of building materials and mechanical equipment is dictated by the applicable minimum energy code requirements for the site. The most common energy code for commercial buildings is Standard 90.1 of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The applicable year of the Standard can vary by state and municipality. California has its own energy code called Title 24.

The baseline analysis yields several results that are relevant for the design team. Estimated total annual energy use, total annual energy cost, and peak demand are based on the magnitude and profile of the anticipated loads. The results are compared to benchmarks against which the building is being designed. The breakdown of energy use by end use, equipment (plug loads, lighting, etc.), or seasonal variations, or energy storage, etc., is also provided.

Understand the goals and objectives of the baseline analysis and the energy code requirements.

2. Load Identification and Modeling

Load identification and modeling involves identifying the energy gain and loss through walls, windows, doors, and plug loads, and modeling each load in a separate manner.

The results of the energy analysis are used to determine the relative importance of each end use and equipment in the building. The contribution of each end use and equipment to the total energy use and lighting power densities. Careful examination of the energy analysis results can also reveal coupling between different types of loads. For example, reducing the electric lighting load decreases the cooling load, but also increases the heating load.

