

PC Screening Tools for Commercial Building Technologies

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ABSTRACT

The Customer Systems Division at the Electric Power Research Institute (EPRI) is developing materials to enhance the adoption of advanced electric technologies. Among in these materials are a number of software programs. COMTECH and CooLAiD are two of these programs, which allow technical and non-technical analysts to answer questions about advanced end-use technologies, energy impacts, and utility bills for individual customers.

These programs require information about customer energy-use patterns, utility rates, equipment cost and performance and operating strategy. They provide estimates of utility bills, energy use, peak demand and equipment costs.

The strengths of these programs are summarized as follows. They have all the features we have come to expect from good PC software. They are visual and interactive. Graphics are available throughout the program to illustrate input data and calculation results. Finally, they execute quickly, which allows users to conduct what-if analyses easily.

This paper describes the features and uses of these programs.

INTRODUCTION

With an increasing emphasis on equipment efficiency and energy conservation, advanced end-use technologies are being more widely used in the marketplace. These advanced technologies have the following characteristics:

- These technologies often serve more than one end use. Examples include heat recovery cooling systems and heat pump water heaters.
- These technologies alter end-use load shapes, which implies they have both energy consumption and peak demand impacts. Cool storage and cogeneration systems provide examples.
- These technologies may be controlled according to utility rate schedules, that is, by time of day. Examples include dual-fuel heat pumps and cool storage systems.

In practice, these characteristics come together with specific customer characteristics and by utility rates. The resulting interaction among all of these factors can be quite complicated, which makes economic evaluation of equipment options a difficult task.

To address this problem, the Electric Power Software Center (EPRI) has developed COOLAID and COMTECH, which are PC analysis tools for commercial building technologies. The focus of these programs is to provide consulting engineers and utility analysts and engineers with a method for understanding the economic impacts of alternative technologies on equipment costs and utility bills, and for conveying these impacts to decision makers. They provide a flexible, yet easy-to-use method for evaluating technology options.

These programs serve as first-level screening tools, and they provide the basis for more detailed feasibility studies or for hour-by-hour building simulation. They are designed to be used by both technical and non-technical analysts.

COOLAID deals explicitly with cool storage. It is being used around the world for evaluation and marketing of cool storage systems. It allows direct comparison of a variety of cool storage equipment options and operating strategies with conventional electric cooling systems under a broad range of utility rates.

COMTECH allows evaluation of a variety of electric technologies, as well as gas-based alternatives. The list of technologies includes:

- Conventional cooling and heating plant options
- High-efficiency cooling and heating plant options
- Heat pumps, including dual fuel and water loop
- Cool storage systems
- Heat recovery cooling systems
- Heat pump water heaters
- Gas cooling plant options
- Cogeneration systems with and without absorption cooling.

In the remainder of this paper, the features and uses of these programs are discussed.

ANALYSIS FRAMEWORK

The logic of these programs is straightforward: the user provides a compact set of information, which is used to perform simplified sizing calculations and to determine equipment and operating costs. Input data include:

- Building end-use load shapes
- Electric and gas/fuel rate structures
- Equipment efficiencies
- Equipment costs

- Equipment sizes
- Operating strategies.

COOLAID and COMTECH combine these inputs to provide estimates of equipment costs, monthly utility bills and operating costs for each technology option. Detailed results are available for each individual technology, and comparisons can be made between technologies. The results may be reviewed interactively within the programs and they may be printed in formal customer reports.

INPUT DATA

There are four major types of inputs in both COOLAID and COMTECH. These are described below.

Energy Use. COMTECH and COOLAID are screening tools. They are not building simulation models. They require load shapes for four daytypes in each month. These daytypes include a typical weekday, a typical weekend, a hot day and a cold day. At a minimum, load shapes must be provided for cooling, space heating, water heating, and other electric loads.

Load shapes can be developed using building simulation models or using customer data for a specific site. Also, the programs come with a prototype database of buildings, which serve as a starting point for analysis of different technologies and rate structures. EPRI has linked its building simulation, microAXCESS 10.0, directly to COOLAID and COMTECH. Micro-AXCESS can be used to develop end-use load shapes.

Rates. COMTECH and COOLAID contain the most comprehensive rate framework available in the industry today. Users enter their own rates, which may contain time-of-use periods by season, fixed and load-factor blocks, energy charges, demand charges and ratchets. The user has complete control over the rate structure and price levels, and may change these whenever necessary.

Technology Description. Equipment information includes cost data and performance data. Only a handful of powerful parameters are included for each specific technology. These data are easily obtained from equipment vendors. In addition, COMTECH and COOLAID come with a technology data base that contains default cost and performance parameters for each type of equipment.

Sizing and Operating Strategy. This module is the heart of these programs. Not only do COOLAID and COMTECH allow the user to select equipment sizes, they allow the user to describe how the equipment performs. Given the operating strategy, the user can then view performance, in the form of load shapes, interactively on the screen. Further, these graphs can be printed for review at a later date or for inclusion in a customer report. An example is provided in Figure 1.

COMTECH and COOLAID provide the flexibility to vary the operating strategy by month. This degree of flexibility is not available in any other program, and it is particularly important for technologies that change load shapes, such as cool storage. For example, a cool storage system may be sized as a partial storage system in the summer, but can run as a full storage system in the winter or swing months.

RESULTS

Given these inputs, COOLAID and COMTECH calculate end-use load shapes, monthly demand, monthly energy use, utility bills and

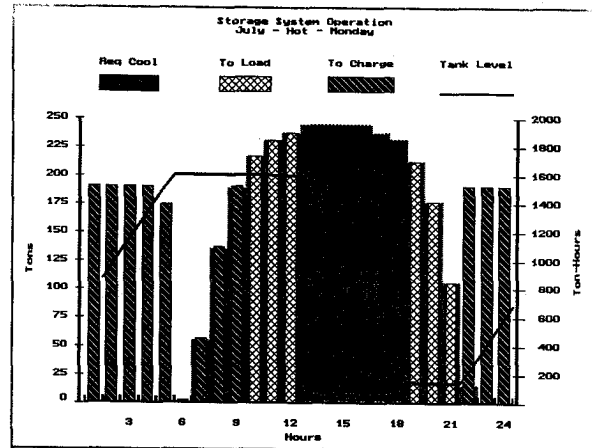


Figure 1

equipment costs for any technology. Execution time is very brief. In addition, users may assign different utility rates to different technology options or to individual end uses. Detailed results for each technology option are available for review in the programs or in printed tables and graphs.

Once results for two or more individual technologies are calculated, the technologies can be compared. Users may also perform in incremental discounted cash flow analysis of the options. Results may be viewed interactively in the programs as illustrated in Figure 2. They may also be printed in formal customer reports that can include a cover letter, a table of contents and the tables and graphs selected by the user.

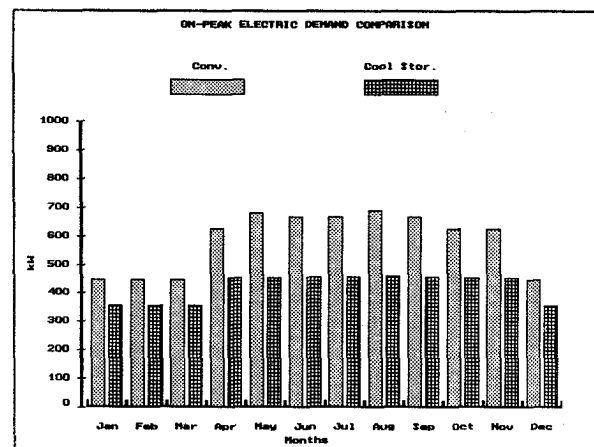


Figure 2

EXAMPLE

Let's consider two technology options in an office building: a conventional centrifugal chiller and an ice storage system. The relevant input data are:

- Energy-use patterns consist of cooling and other electric loads.
- Electric prices average \$.07/kwh and there is a demand charge of \$10/kW during the six-hour on-peak period.

The ice storage system is sized as a full-storage system, so that the chiller is shut off during the on-peak period. The ice storage chiller runs to meet the building cooling load during the occupied hours of the building. During the ten unoccupied hours, it makes ice. This is illustrated in Figure 1.

Both COOLAID and COMTECH can be used to evaluate and compare these options. In our example here, the simple payback is about 3 years.

USES

Four primary uses have been identified for the COOLAID and COMTECH programs:

- **Training.** COMTECH and COOLAID can be used to learn about the various technologies. The analysis framework allows users to evaluate a particular technology to understand how it works and what it means for specific customers.
- **Market Analysis.** COOLAID and COMTECH can be used to estimate how different technologies impact individual customers, as well as aggregate customer segments. Both energy consumption and peak demand can be evaluated.
- **Direct Marketing.** COMTECH and COOLAID can be used by consulting engineers and utility analysts to inform customers about specific technologies.
- **Rate Design.** COOLAID and COMTECH can be used to analyze rates, develop alternative rates and to develop incentive or rebate programs.

CONCLUSION

EPRI has developed these screening tools to meet the analysis needs of utility marketing analysts and engineers and the engineering community. These analysts must provide information about specific technology options to their customers in a timely fashion. COMTECH and COOLAID allow analysts to develop this information quickly and to present it in a visual form that can be easily understood by the customer.