BUILDING ENERGY SIMULATION FROM THE MANUFACTURER'S PERSPECTIVE

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Trane has been involved in the ongoing development of energy analysis methods since the early 1970's. Current development work includes not only new system simulations, but also new financial reports. This paper highlights an alternative method for presenting financial information to a building developer.

Manufacturers can choose to take an active or passive role in regard to the use of energy simulation programs. Obviously, Trane has chosen an active role in developing and providing ongoing enhancements to TRACE, Trane Air Conditioning Economics. With TRACE, the building designer can create a computer model of a building, simulate the operation of the building over an entire year, calculate utility costs, and then project the life cycle costs of the building.

Our involvement in energy simulations dates back to the early 1970's. The Trane Company's equipment development strategy has been based on providing environmental systems with higher efficiency and more reliability than alternative systems. While it is not correct to conclude that this objective always translates to a higher purchase price for the system, there are many cases where there is a price premium associated with obtaining increased efficiency.

Use of computer models seemed to be a possible answer to quantifying the value added by an additional first cost premium. The first attempts to use computer models were moderate failures. Trane developed specific purpose programs to estimate the savings of one system over another. The problem with the estimates was that they lacked credibility with the system designer. While Trane felt that the estimates were honest attempts to quantify savings, designers in general were very skeptical. They felt that computer models could only be used to justify price premiums if the designer was confident that the program properly modeled the building and the environmental system.

For emphasis, I would like to restate what I just said in different terms. The designers told Trane that they would not use the results of a computer simulation as the basis to write a specification, unless the designer was convinced that the computer program accurately modeled the building. This objective formed the basis for the development of TRACE.

TRACE was announced in 1973. Since that time, the program has been used to analyze tens of thousands of buildings. It is important to understand that TRACE is a generic modeling tool. Our development goal is to create the most accurate computer models possible. These models are questioned and tested by designers every day. The result is that when a specific system demonstrates operating efficiencies, the benefits can be quantified and justified.

We are actively developing simulations for new systems being considered by designers today. For example, new TRACE models for ice and chilled water storage have recently been developed. These models let the designer use storage systems to shift loads to off peak times in order to reduce utility bills. By being involved in the evaluation of these new systems, Trane is in an excellent position to learn what products the market needs.

In addition to work on new simulations, we are also investigating the methods used to present the financial data generated by the program. Most of our emphasis has been on the development of new simulation techniques. Relatively little emphasis has been placed on methods used to present the results of the model to the ultimate customer, the building owner. The real value of energy simulation is helping the building owner decide how much money to spend on the environmental system. We are researching the needs of several owner types including government, industrials, and developers to see how they justify purchases. From this effort, we hope to create new reports that better meet their needs. As an example, let me show you an alternative method of presenting energy results to a developer that could be more meaningful than the Internal rate of return and present value that TRACE prints out today.

Developers are more interested in energy costs today than they were ten years ago for two reasons: they are holding buildings for a longer period of time, and energy costs are now a much more significant part of the building cash flow. Speculative offices that were once sold before completion or within the first few years of service, are now being held and operated for between 5 and 7 years before sale. At the same time energy costs have dramatically increased as a percentage of building operating expense. In fact, today energy cost is the single largest expense that the building operator sees after debt service. Utility costs have increased as a percentage of building operating expense from the 12-15 percent range in the early 70's to over 32 percent by 1984. Since developers are now operating buildings, there is a much greater incentive to consider operating costs. Reducing utility expense provides the best opportunity for the building operator to improve cash flow.

The increase in utility cost as a percentage of operating cost makes sense when viewed from an historic prospective. Over the last 10 years with the associated rapid inflation, utility costs increased at an average of 13.6 percent annually. What about today? The inflation rate as measured by the Consumer Price Index for 1983 was 3.6 percent, but utility rates jumped by 12.8 percent in that same year. Utility rates are expected to continue to increase at over 10 percent annually, slightly over twice the anticipated inflation rate. This trend will continue to increase the impact that utility costs have on building cash flow.

The trend of increased importance of utility costs is a real problem for some developers caught in the cost spiral, and a real opportunity for those who can take advantage of the trend by building energy efficient new buildings.

Another trend which is important is the divergence in operating cost between the best and worst environmental systems. It used to be that the spread between the worst and best systems was approximately 10 percent. New technologies have emerged that have created choices that are up to 40 percent better than the worst systems. Many inefficient systems are still in use. So the spread on utility cost from best to worst is now up to 40 percent.

The opportunity available to all developers is to differentiate their buildings through the choice of environmental systems. There are many highly efficient, cost justified systems to choose from. Let's examine the opportunity to install a more efficient system using the developers' view of the purchase decision.

Utility cost savings present two profit making opportunities to the developer. While the developer holds the building, the lower utility costs will improve his cash flow. Since it is not unusual to hold a building for 6 years in today's building market, this component is substantial. But another very important source of profit occurs when the building is sold. The selling price is based on a capitalization rate, or cap rate. Selling price is determined by dividing the most recent year's building cash flow by the cap rate.

To illustrate, let's examine a 25 cent idea. Every designer can come up with an idea that could save 25 cents per square foot in utility cost on a typical design. Let's examine the annual cash flow, showing future value using 15 percent inflation rate on utilities. Let me also use a 15 percent discount rate to bring the savings back to present value. The following savings in utility cost would be generated by the idea.

YEAR	FUTURE VALUE	PRESENT VALUE
1	$ .250	$ .25
2	.286	.25
3	.331	.25
4	.380	.25
5	.437	.25
6	.503	.25
TOTAL	$2.19	$1.50

Rather than considering the future value, I will view the entire transaction in today's dollars. The first benefit is a savings of $1.50 per square foot over the 6 years generated from utility cost savings. This is simply the summation of the 25 cent per year savings for 6 years.

Now consider the sale of the building. A cap rate of 10 percent is not uncommon and also keeps the arithmetic simpler. The final year savings of 25 cents is divided by the 10 percent cap rate to yield a $2.50 per square foot profit on the sale of the building as a result of our idea.

$$\text{SELLING PRICE} = \frac{\text{FINAL YEAR CASH FLOW}}{\text{CAP RATE}} = \frac{.25}{.10} = \$2.50$$

The total revenue associated with our idea is $1.50 per square foot in energy savings plus $2.50 per square foot on the sale or a total of $4.00 per square foot. For a 100,000 square foot building, the 25 cent idea will generate an additional $400,000 over the project life.

How much is the developer willing to pay for the idea that will save him up to $4.00 per square foot in today's dollars? If he pays $4.00 per square foot, it is a break even deal. Let's generate a pro forma to look at the decision. Two additional items must be known to generate the pro forma: the additional first cost for this idea, and the debt service to finance the cost. For discussion's sake, let's say that the idea cost 50 cents per square foot. Financing can often be arranged at terms like 10 percent interest only, with a balloon on the sale of the building. This means that no principle is paid until the building is sold. At that time the entire principle plus any unpaid interest must be paid. This is the pro forma for the building.

BUILDING BUILDINGS, INC.
PRO FORMA

YEAR	1	2	3	4	5	6	TOTAL
ENERGY SAVINGS	.25	.25	.25	.25	.25	.25	1.50
DEBT SERVICE	(.05)	(.05)	(.05)	(.05)	(.05)	(.55)	(.80)
SELL BUILDING	-	-	-	-	-	2.50	2.50
CASH FLOW	.20	.20	.20	.20	.20	2.20	3.20

Energy savings generates $1.50 per square foot in revenue from the energy savings. Debt service will cost 5 cents per square foot each year for interest only on 50 cents per square foot. The final year debt service includes retirement of the 50 cent per square foot first cost. Sale of the building generates $2.50 per square foot. The bottom line cash flow for the developer is $3.20 per square foot.

Looks very attractive. The building owner could generate additional profits of $3.20 per square foot in present value. For a 100,000 square foot building that means a gain of $320,000. What is the maximum amount that he would be willing to pay for this energy savings idea? With his current terms, he could afford to pay up to $2.50 per square foot for the idea that is returning 25 cents per square foot in utility savings.

The point of this presentation is that there is a benefit on the sale of the building that can easily be greater than the savings associated with annual reduction in utility cost. How many energy programs include a sale of the building scenario as part of the economic analysis? Since the sale of the building can be an integral part of the decision making process for a developer, doesn't it make sense to present this information as part of the energy analysis.

The financial information presented to not only the developer, but all sectors, needs to be scrutinized and modified to make it more valuable to the decision maker. Understandable financial information can be much more effective in promoting energy conservation than adding the simulation of a new system. This area deserves everyone's attention.