ABSTRACT

Like many school districts in the southeast, the Arlington Independent School District (AISD) felt a need to upgrade their schools to maximize their value for the gas and electricity being used. They felt they needed to make sure that energy was not being wasted and that any energy conservation measures implemented would provide good payback for the investment made by the school district.

After conducting an extensive search to determine the best way to identify and implement energy conservation strategies, the school district contacted Johnson Controls, Inc. as the company felt they could best help them achieve the goals that they had set. AISD also requested help in identifying the best way for the school district to finance the measures taken and for the tracking of the measures to make sure the desired energy conservation goals were met. Finally, the school district requested, a guarantee that expected savings goal be attained by an agreement that the contractor pay for any "shortfall" in savings that might occur.

The contractor was initially assigned the ten schools which seemed to be the most wasteful within the school district. With their personnel, loads and energy users within the schools were identified and quantified. From this information, areas where energy was being wasted were identified and ways of eliminating waste were examined. If a reasonable payback and a means to measure the payback were identified, then it was included in the list of measures to be examined. Finally, the information gathered, they were presented to the school board for consideration; if payback was reasonable, then it was included in the list of measures to be examined. After all energy conservation measure ideas were gathered, they were presented to the school board with a suggested method of payment, so the best return on investment for the district could be achieved. Also, a written guarantee was made available, so the school district could feel certain that whatever conservation measures selected, desired results would be achieved.

During the construction phase, special attention was given to ensure measures would be implemented as little as possible and the work would be completed on schedule.

After construction, the contractor monitored savings results and has shown that this project, which represented an investment of well over a million dollars, will provide payback on time, or in advance, of the original estimate.

INTRODUCTION

The Arlington Independent School District (AISD), as does many Texas school districts, has been faced with the ongoing problem of maintaining satisfactory comfort levels and high levels of equipment maintenance, while also seeing that budget items such as utility costs, preventative maintenance costs, and repair costs were kept at a minimum. This paper addresses the way in which that school district chose to take a very active role in controlling the direction in which their school district moved in order to reach their goals, both short term and long term. Readers should be able to gain a basic insight into a source of action that will enable parties responsible for goals similar to those of the AISD to meet their needs and to allow them to bring about the necessary actions needed to put the measures into practice.

IDENTIFYING ENERGY SAVINGS

How does a school district, or anyone else, determine the optimal way in which to identify and make needed changes to their building or buildings? How can an efficient, cost-effective program be implemented so that the owner is sure that when energy conservation measures are identified they can be installed at a reasonable cost with minimal disruption to school personnel free from needing that any or not be readily available? And very importantly, how does the owner go about ensuring that the energy conservation measures actually do what they were intended to do? Has the owner got a guarantee that money actually will be saved if they go ahead with the measures?

The AISD had experienced mixed results in the past whenever they had put new equipment into their buildings to save energy. Sometimes they were able to see that they had achieved desired results with what they did. At other times it appeared the conservation measures actually did not achieve desired results. And at times, it was difficult to see what effect had been brought about. Everything seemed to go slow and hazardous course in trying to reach conservation goals.

No matter what conservation steps were taken, one thing remained constant: whether the conservation measure worked or not, AISD paid for everything. There was no guarantee from anyone that when everything was installed that the desired results would occur. This, coupled with the fact that AISD was in the education business, not the energy conservation business, made for a slow and hazardous course in trying to reach their conservation goals.

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The schools which were surveyed were either primary or secondary educational facilities. All of the schools were either one or two story buildings with a single or multistory construction, and included educational facilities. The age of the buildings varied from five years old to thirty years old. The HVAC systems in these schools were typical of those found in educational facilities, except that one school had a direct digital control system. In general, these buildings were constructed before the energy crisis and were not designed to keep all areas of the building cool simultaneously. These changes affected the original air distribution design of these buildings and were causing many comfort problems.

During the development of the computer models, it became clear that the sizes of the original heating and cooling plants did not match the existing building heating and cooling loads. In almost all cases, it was found that the heating plants in the schools were too large and the cooling plants were not designed to cool all areas of the building. In some instances, these changes proved very useful in achieving savings. It was discovered that during the previous three years, a comprehensive maintenance and repair program had been implemented in the buildings. However, during the past three years, a comprehensive maintenance and repair program had been implemented in the buildings. However, the performance of this equipment had also led to the need for additional equipment and new equipment was very critical. The performance of this equipment had also led to the need for additional equipment and new equipment was very critical. The performance of this equipment had also led to the need for additional equipment and new equipment was very critical. The performance of this equipment had also led to the need for additional equipment and new equipment was very critical. The performance of this equipment had also led to the need for additional equipment and new equipment was very critical.

The energy consumption in each of the ten buildings was at a minimum and the performance of the buildings was at a minimum. The energy consumption in each of the ten buildings was at a minimum and the performance of the buildings was at a minimum. The energy consumption in each of the ten buildings was at a minimum and the performance of the buildings was at a minimum. The energy consumption in each of the ten buildings was at a minimum and the performance of the buildings was at a minimum.
1. Many of the school facilities contained several long-roofed portable buildings in addition to the main school building. These building could be used for many after school, weekend, and summer activities. Although the temporary buildings themselves are energy inefficient, less energy would be used operating these buildings, rather than large areas of the main school, building which requires large areas to be air conditioned.

2. Numerous activities, such as faculty training, night classes, community services, etc., are scattered throughout the school district in various facilities. These buildings were under-utilized. Significant energy conservation could be achieved if many of these activities were consolidated into fewer facilities.

3. Each school did not have energy at the same rate, the same efficiency, or at the same cost. For this reason, consideration was given to building activities in the most efficient facility whenever this option was available.

4. All schools were partially occupied for beyond normal operating hours to allow additional space to clean the buildings. These were worked until midnight on weekdays and throughout the summer during daytime hours. This use of the facilities caused additional energy consumption. Although this consumption was much lower than full occupancy, it was not insignificant. A reduction in the time required to accomplish these activities provided tangible energy savings.

5. Often times, when more than one after hours activity occurred in the same facility, they were scattered such that most or all of the buildings' systems were forced to operate. This was extremely inefficient as large areas of the building had to be heated or cooled whereas the activity was at a very low level. If these events were consolidated into one building, then the remaining areas could be shut down. Significant energy of these activities could then be saved.

The response time to operate sidewalks and entry doors was frequently influenced by the school administration as an urgent problem. Obviously, this caused frustration among those responsible for operating a school. Additionally, when integrating mechanical breakdowns caused comfort discomfort and unnecessary energy usage.

The energy conservation study included a review of building walls and roofs. A common denominator in nearly all of the school facilities was inadequate insulation and a high degree of infiltration in most of the exterior surfaces. This increased both the heating and cooling losses in these facilities which led to increased energy consumption. Our study was unable to discover any economical measures to improve this condition due to high retrofit costs. However, if any structural or roofing improvements were planned, or in the case of any new construction, improvement in wall and roof insulation quality should be seriously considered. (Also at the time of exterior surface erection would make these changes cost effective.)

As stated earlier in this paper, many buildings and their mechanical systems had been in place for relatively long periods of time. Much of this equipment was nearing or has passed the end of its normal life expectancy. This caused increased maintenance costs and energy consumption due to mechanical wear and the lower efficiencies of older equipment. It was recommended that program be undertaken to replace this aging equipment as it failed, rather than engage in continued expensive repairs and maintenance. More modern and efficient equipment would be considered in all cases. The improved energy efficiency and lower maintenance would pay for much of, if not all, the cost of replacing these systems.

After the buildings surveys, the computerized model was designed for each school and simulated the utility consumption with an accuracy of +/- five percent. Specific energy conservation measures were then defined and those most likely to provide the highest savings were entered into the data base. These measures were then evaluated to determine which gave the highest return on investment and which provided the highest return for the same provided investment criteria.

To complete the study, costs were firmly established for the cost of installation measures. Comparing these costs with the dollar savings generated in the engineering model, payback terms were established and applied to both individual and composite energy conservation measures. Projects were then selected on the basis of those which gave the highest return on investment and which satisfied the owner most.

The total savings of all energy conservation measures elected for use by the owner had projected savings of about $26,000 per year. These savings were then evaluated to determine which measures implemented were $87,000. Though this investment equipment, the first step, it has a single payback of 1.45 years.

A financial package was put together and structured so that the district was able to gain a very strong increase in present cash flow from the money that they no longer would be paying to the utility companies. This was because the yearly installment payments for the new equipment and improvements was less than their guaranteed savings.

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At the end of this paper there can be found several charts that show both "before" and "after" examples of utility consumption and also how this consumption relates to dollars saved. (Fig. #1, p. and #2) Figure #4 shows the description of work done at each of the schools.

The AISD has been the beneficiary of its good planning because they were willing to try new ideas. They used innovation to secure savings and new equipment that was needed.