Abstract

Marshall Independent School District has documented more than a half million dollars in actual energy savings during the past four years, while increasing total building area by 61,190 square feet.

This paper will describe the many strategies implemented to achieve an effective energy management program from 1984-1988. Although the MISD program is comprehensive in nature it hopefully is described simply enough so that management personnel in any school district shall be able to replicate a similar aspect of the program with equally rewarding results.

Background and Policy Development

Marshall is an East Texas community with a population of approximately 25,000. Marshall ISD has a student population of approximately 6,750. The facilities in MISD consist of 10 schools, 4 support facilities, and 4 lighted outside athletic facilities.

In July of 1984 Marshall ISD began development and implementation of a plan for energy management and conservation. Practices and facility conditions existed at that time that made the potential for energy savings in Marshall ISD very significant.

During the first four years of operation the energy management savings amounted to $610,000.

In order to provide an understanding of the base from which our development started it is important to share the extant facility conditions and management practices related to energy conservation.

The existing conditions and practices are briefly described as follows:

1. Approximately 640,000 sq. ft. was cooled with various types of air conditioning. This consisted of 100,000 sq. ft. cooled with absorption chillers and the balance with central reciprocating and roof top units.

2. Approximately 690,000 sq. ft. was heated with various types of furnaces and boilers, supplemented at a few locations with strip heat.

3. No HVAC controls existed other than simple manual on/off thermostats.

4. Incandescent and quartz lighting was in common use for approximately 25% of the lighting applications.

5. All fluorescent lighting was 40 watt with no energy savings ballasts in use.

6. It was not uncommon for HVAC units to run at normal levels 24 hours a day, seven days a week, including summer months.

7. Pilot lights normally burned 12 months out of the year.

8. In some locations large blocks of rooms operated on one thermostat.

Strategies for Energy Management

During initial planning several interrelated strategies emerged which were used to address our energy management concerns. These strategies are as follows:

- ESL-HH-89-10-14
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Administrative Strategies

Energy Cost Review

A review of energy costs was made for recent school years. This review of annual fiscal audits indicated that since 1978 there had been a consistent and significant increase in both gas and electricity costs. These increases were attributable to rate increases, addition of floor space, addition of air conditioning in unconditioned space, addition of various types of equipment as well as inefficient use of energy.

Policy Development

The review of energy costs of recent years made it clearly evident that a policy was necessary to address the rapidly expanding energy expenses. The policy that emerged was one of Board and Administration working in support of one another on the many energy management concerns. Both board of trustees and superintendent provided the necessary support needed to initiate and carry through with the projects needed. Time was provided in board meeting agendas for reports and updates on the progress of energy management efforts. Subsequent appropriate funding was provided.

Rate Structure Examination

Another of the initial administrative strategies was review of our utility rate structures. In consultation with utility suppliers the rate structure for each facility was evaluated. In many cases the rate structure was changed to one of greater advantage to the school system.

Appropriate school maintenance staff were instructed in the fundamentals of utility rate structures. Using this knowledge designated maintenance personnel was given the responsibility of reviewing utility statements each month before sending the bill to the business office for payment. This administrative strategy accomplished two important functions. It not only provided a review for possible errors in billing, but more importantly the monthly review made maintenance staff instantly aware of the energy usage in each facility and their responsibility in assisting in the minimization of energy usage. Review of rate structures are now done at least once a year.

Tracking

Using the data from monthly statements maintenance staff began manually tracking the use of energy for all facilities.

This initial manual tracking began to provide sound data for evaluation and decision making.

Building Energy Audits

Another fruitful administrative strategy was to conduct building energy audits on a more comprehensive basis than just our initial review of building energy usage. To accomplish this task the Energy Resource Center was enlisted to provide their building energy auditing service. The reports compiled by the ERC team provided important data and recommendations for decision making on many important phases of our energy management program. Also, local staff have learned many energy auditing skills that are being subsequently used in-house.

No-cost/low-cost Strategies

A large percentage of the energy dollars that have been saved has been through no-cost/low-cost strategies. These savings resulted from administrative directives and have amounted to approximately 30-40% of the cost reduction realized. These simple, readily implemented strategies are listed below.

A. Simple cut-off procedures
1. Summer air conditioning- cut off all areas not used for instructional and administrative purposes
2. Night, weekend and holiday cutbacks of heat and air conditioning.
3. Cut off all pilot lights in early April and re-light late in October/November.
4. Cut off refrigerators, freezers, ice machines, hot water tanks, etc. as soon as school is out for the summer.
5. All necessary lights off when not in use.
6. Relamping
   a. Replace 40 watt fluorescent with 34 watt and energy efficient ballasts.
7. Relamping over-lighted areas.
8. Weatherstripping and caulking of doors and windows
9. Insulation of freon, hotwater and chill water lines
11. Optimization of water temperatures for all HVAC equipment and domestic hot water.
12. Review and approval of monthly utility bills by Energy Management Staff.
13. Review billing structure with local utility companies for optimum rates.
14. Survey energy usage on each campus with building principal.
15. Optimize locations of summer and evening programs.
16. Consider value of maintenance contracts.

The savings that were realized in the first year of energy savings efforts were achieved primarily as a result of our no-cost/low-cost strategies. Only after the first year were any energy savings installations or retrofits made.

The documentation that comes later in this report shows natural gas usage was reduced drastically the first year. Since no sophisticated controls had been installed at this time, most of this savings was attributable to simply shutting off pilot lights during the months when heating was not needed.

During the first year the electrical savings were not as significant as the gas, but at least the upward trend in electrical energy usage was reversed. This initial downward turn in electricity cost resulted from summer, weekend and holiday cut-backs. Since our electricity provider has a demand charge in the rate structure the kilowatt hours saved does not show a direct relationship to dollars saved.

Another smaller, but significant contribution to the electrical savings the first year came in lighting changes.

Our retrofit and high technology strategies are separate in some respects, but are very interrelated. These changes were implemented after detailed energy audits were accomplished by the ERC. Our audits identified inefficient systems that needed modification or replacing and gave direction to more efficient operation of systems that were still viable.

Retrofits

According to our initial audits our most wasteful equipment consisted of three gas fired absorption chillers units, one in each of the two middle schools and one in the junior high. In accordance with DOE guidelines technical assistance studies were performed for each of these facilities. Data collected in these studies indicated the payback time for replacing these units with efficient systems was projected for 3 to 4 years. Based on this

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data Marshall ISD applied to the DOE Energy Grant Program for 50/50 matching funds to replace the absorption units on these three campuses. The grants were approved and the school district realized 50% savings with the new electrical central units.

Other significant retrofits related to gas savings include changeout of old inefficient boilers on the campuses listed above with non-condensing high efficiency water boiler.

Lighting retrofits have also contributed greatly to electrical savings. These changes fall into two general categories- (1) change out of incandescent lighting to metal halide, sodium, and fluorescent and (2) change out of 40 watt fluorescent to 34 watt energy efficient fluorescent. All outside playing fields, parking lots and security areas are now lit with efficient applications. Incandescent lighting now consists of less than 1% of the total lighting in MISD where 4 years ago it amounted to 20-25%.

High Tech Applications
One of the most significant changes that has impacted our energy savings has been the installation of sophisticated computerized controls. After investigating several options we selected and installed on each campus a computerized control panel that is capable of optimum start-up, load shedding, demand control, night and holiday shut-back, instantaneous monitoring and information storage. All building units are tied to a central computer which can on command monitor energy usage in each building in Marshall ISD. Our computerized control system has been installed both by contractors during construction projects and also by our staff. The system is maintained completely by our staff.

We are now using a software program to track energy usage in each facility. This information is used to identify inefficient usage of energy, set realistic demand controls and project energy usage.

Teaming Strategies
Last, but certainly not least in strategies used to achieve energy savings, has been teaming. Every member of our maintenance staff that has anything significant to do with energy consumption is included on the energy management team. This team includes assistant superintendent, maintenance supervisor, maintenance foreman, all electricians, and HVAC servicemen. This team meets once a month to receive reports and to share energy management experiences and ideas. An agenda is planned for each meeting and each member of the team is given an opportunity some time during the year to make a presentation regarding his specialization and energy management concerns. Giving everyone an opportunity to share makes everyone feel a part and truly makes our energy management a joint effort.

Documentation
As a result of concerted efforts on many fronts Marshall ISD has been very effective in saving energy dollars as the following documentation illustrates. It is practically impossible to be specific in the identification of how each strategy has contributed to the savings. However, in the four years the cost of natural gas has been cut 59% and the cost of electricity has been cut 18%. These reductions are calculated on the 1984 base when our energy management program was initiated. The following charts will demonstrate the amounts of the reductions for each year.

Although no cost avoidance is listed in any of our documentation it is clearly evident that if the cost information is extrapolated the cost avoidance may be as much as the actual dollar savings.
### COSTS AND FUNDING 1984-1988

#### A. RETROFITS

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost 1984</th>
<th>Cost 1985</th>
<th>Cost 1986</th>
<th>Cost 1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>MJH (HVAC)</td>
<td>$60,000</td>
<td>$50,000</td>
<td>$100,000</td>
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<tr>
<td>PTY~SH (HVAC)</td>
<td>$140,000</td>
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<td>Maverick Field (Lighting)</td>
<td>$13,000</td>
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<tr>
<td>3 Gym (Lighting)</td>
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<td>$5,000</td>
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<tr>
<td>Cafeteria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hallways (Lighting)</td>
<td>$6,000</td>
<td></td>
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</tr>
<tr>
<td>Security (Lighting)</td>
<td></td>
<td></td>
<td>$5,000</td>
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</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>$219,600</strong></td>
<td><strong>$120,000</strong></td>
<td><strong>$339,600</strong></td>
<td><strong>$339,600</strong></td>
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</tbody>
</table>

#### B. COMPUTERIZED CONTROLS

- **Cost 1985**: $14,000
- **Total Cost**: $337,000

### DOLLAR SAVINGS 1984 - 1988

<table>
<thead>
<tr>
<th>Year</th>
<th>Gas 1984</th>
<th>Gas 1985</th>
<th>Gas 1986</th>
<th>Gas 1987</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984-85</td>
<td>61,764</td>
<td>61,231</td>
<td>85,817</td>
<td>124,206</td>
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<tr>
<td>1985-86</td>
<td>90,237</td>
<td>91,599</td>
<td>102,146</td>
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<tr>
<td>1986-87</td>
<td>148,065</td>
<td>146,065</td>
<td>160,145</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>395,648</strong></td>
<td><strong>350,227</strong></td>
<td><strong>387,502</strong></td>
<td><strong>227,087</strong></td>
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### INCREASING IN BUILDING AREA SERVED 1984-88

<table>
<thead>
<tr>
<th>Building Name</th>
<th>Square Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>JH Moore</td>
<td>12,953</td>
</tr>
<tr>
<td>South Marshall Addition</td>
<td>7,907</td>
</tr>
<tr>
<td>We Travis Addition</td>
<td>6,215</td>
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<tr>
<td>David Crockett Addition</td>
<td>19,625</td>
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<tr>
<td>Lee Addition</td>
<td>11,190</td>
</tr>
<tr>
<td>Sam Houston/PT Young</td>
<td>3,800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>61,190</strong></td>
</tr>
</tbody>
</table>

### MARSHALL ISD ENERGY EXPENSES

#### GAS

- 1979-80: $120,000
- 1980-81: $125,000
- 1981-82: $185,000
- 1982-83: $155,000
- 1983-84: $156,000
- 1984-85: $170,000
- 1985-86: $203,000
- 1986-87: $227,000
- **Total**: $910,000

#### ELECTRICITY

- 1979-80: $441,000
- 1980-81: $433,000
- 1981-82: $559,000
- 1982-83: $521,776
- 1983-84: $403,877
- 1984-85: $227,300
- 1985-86: $260,584
- **Total**: $24,167,000

- (Energy Management initiated)

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