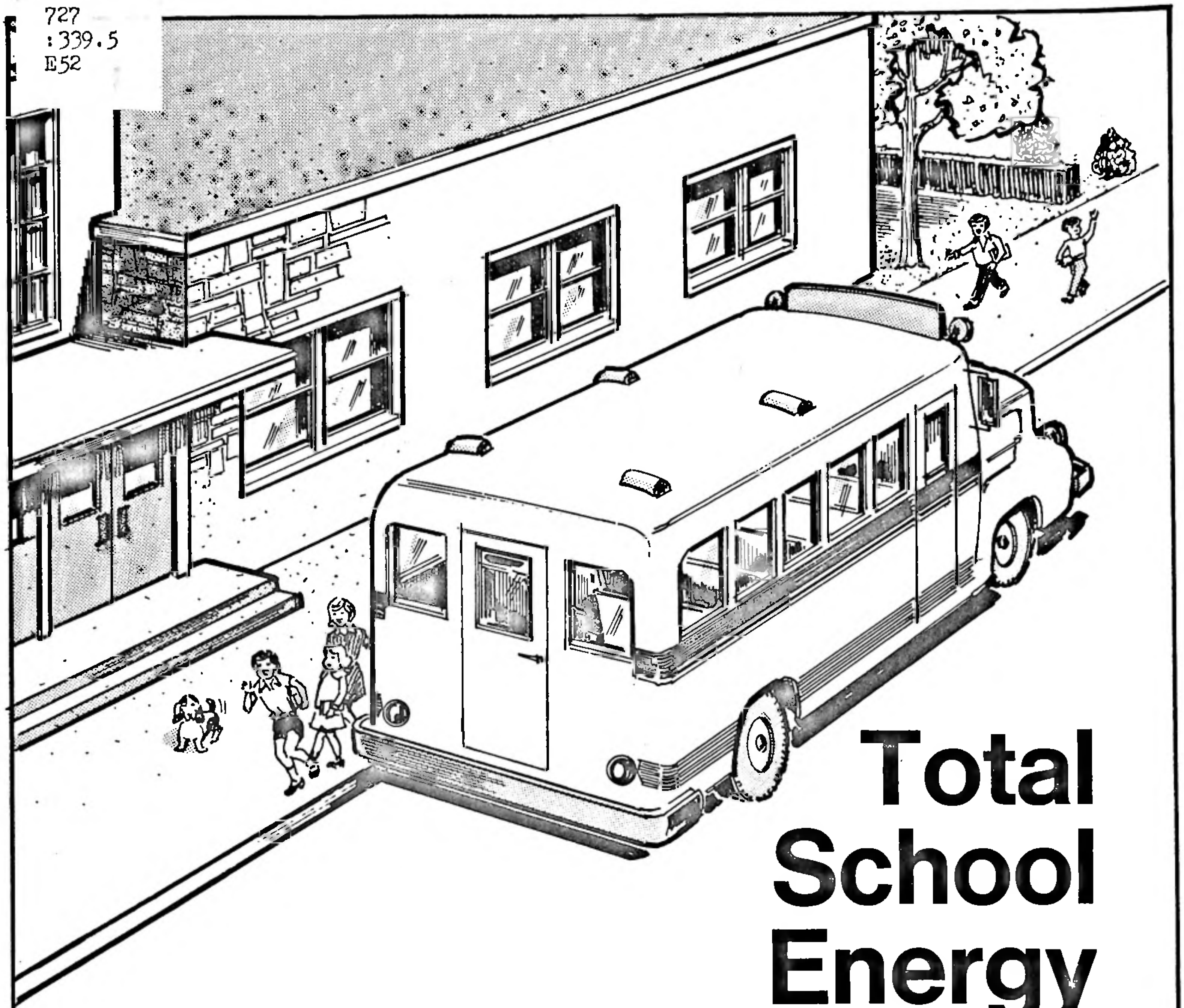

Total School Energy Management Program

DOE/CA/0012-01

March 1980

Prepared for:
U.S. Department of Energy
Office of Consumer Affairs

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Total School Energy Management Program

March 1980

Prepared by:
Energy Education Programs
Woodstock, Illinois
Contract No.EU-R-02-0012

Prepared for:
U.S. Department of Energy
Office of Consumer Affairs
Washington D.C. 20585

Dear Administrator:

Like it or not, massive energy use and the resultant energy bills are a part of our technological world.

The educational specialization, industrialization, and mechanization which has enabled small segments of society to supply goods and services for the rest lead to the necessary use of great amounts of energy in supplanting human labor.

You are confronted with the word "energy" so many times, and in so many ways these days, that as an administrator at any of our institutions of public education you may be tempted to:

(1) Toss this package--you are already well along the road to saving energy in your district.

(2) Toss this package--you are already advising your staff to turn off lights, carpool, and ease up on the use of office coffeepots.

(3) Toss this package--you are offering workshops and courses on energy already and don't want any help.

(4) Toss this package--everybody knows that the energy crisis was a political trick anyway.

And really, no one could blame you. "Energy" awareness, conservation, use, prices and sources are as complex and little understood issues as any that we have faced in the history of our nation. In the long run though, our determination to understand these issues, and to manipulate their relationship to our own best advantage, has brought about our dominance in many areas of world affairs today. But do you, does your district, and the people who contribute the dollars to keep it in operation, really understand how the ability to use and manage energy wisely relates to institutional (or corporate) success?

No question, most industries and many school districts understand this relationship. They have taken the lead in making energy conservation improvements on site.

School administrators can easily understand that money spent unnecessarily on wasted energy means that much less money is available for the real business of education-jobs, materials, and programs. They realize that, unlike any other segment of the economy, public schools cannot simply pass along higher fuel costs to the consumer. Professionalism in managing the business of education means paying attention to energy conservation.

The measures which have been taken-and those yet to be taken-are a long way from token approaches like turning off the coffeepot and keeping the hallways dimly lit. Effective programs are going to require some of the creative, independent "I will" spirit that has made America what it is. If our institutions of public education are going to survive in times to come--survive, that is, in anything resembling the form that we have come to value, it is up to administrators to take a hard, creative look at institutional planning and energy dynamics. Here is a maze of problems that can challenge and stimulate virtually every administrative unit of your district--academic, support, maintenance, students, and alumni. Best of all, you can be sure that virtually <u>any</u> effort will mean payback for the school.

This package is intended to give you some ideas about how to get started. If nothing else, it should make it absolutely clear to you that <u>there is no one "right way"</u> to get going on energy conservation. The creative uses of energy are what have made our "convenience" living possible. Conservation is really a refocusing of that same inventive creativity: how can we make our style of living even <u>more</u> convenient, <u>more</u> enjoyable, while at the same time <u>less</u> expensive? This is really what public education is best equipped to do: study, demonstrate, and develop ideas and tools that will enhance our quality of life. Every institution, of whatever size or status, can contribute to this national effort.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

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INTRODUCTION

What follows is a brief overview of the situation you are faced with and what you can do about it.

Your first job--understanding

As you assume a position of leadership in this important task, one of the first things you must do is understand the problem.

Statistics abound on the "big picture" of energy use in the United States. We needn't go into that here. If you are interested in "boning up" on the millions of Btu's, gallons, therms, etc., used, there are plenty of sources.

What you need to have is a basic understanding of "energy flow" in your own buildings and systems under your supervision-just as you have to have a good understanding of cash flow.

Energy is not as elusive as you think.

Actually, it is easier to understand than money these days; given the confusing world of foreign exchange rates, inflation, etc., it is hard to define what a dollar is. But you can relate to a dollar as a convenient unit of measure and in terms of what it does - i.e., what it buys.

You can look at energy units in the same way-whether you call the units Btu's, gallons, kilowatts, or whatever. A unit of energy will "buy" you a certain result-miles travelled in a car or bus, enough heat to keep a building at 68°, etc.

To get an idea or perspective on how energy units are "spent", consider:

* a school bus will use 2½ gallons or 312,500 Btu's of energy to travel 10 miles.

* a 30 foot by 30 foot classroom built to typical 1950's-early 60's construction standards reguires 23,500 Btu's per hour to keep the indoor temperature at 68° when it is 20° outside, if operating at 75% energy efficiency.

* a six-burner commercial gas range will use about 2.52 therms of gas over a four-hour day in cooking meals in the cafeteria.

* eight hours of fluorescent lighting in a building of ten classrooms will use 144 kilowatt-hours of electricity.

Again, never mind at this point what Btu's, therms, or kilowatts are. It is enough to think of them as money.

Using typical average fuel rates across the United States:

- * one gallon of fuel oil = $.55
- * one therm of natural gas = $.22
- * one kilowatt-hour of electricity = $.04

or

- * one million Btu's supplied by fuel oil = $3.93
- * one million Btu's supplied by natural gas = $2.20
- * one million Btu's supplied by electricity = $11.72

Now that you have equated energy with dollars, what is next?

As a school administrator, you have a unique problem. Unlike manufacturers or retailers, you cannot pass along higher costs to the consumer. You have to perform the basic and critical task of providing a quality education within a limited budget. If the cost of energy rises, the reality is that the amount of dollars available for hiring top teachers, for textbooks, and for equipment, will likely drop. Your challenge as a professional is to handle that situation.

By thinking of energy as you do money, you can apply professional management techniques to energy without being an engineer or technician.

This program is intended to help you apply such techniques to energy-for example; the package is intended to point the way to helping you to:

-Look at what you are doing now and divide it into specific energy tasks.

-See what you are "spending" in these tasks.

-Check out new ways to perform these tasks that require you to "spend" less energy and still get the job done.

-Choose the best way-in terms of money cost, time cost, and energy cost.

-<u>Educate</u> your own personnel in the operations and practices necessary to implement the method chosen.

And, in your unique role as an educator and community leader, you can add:

-<u>Educate</u> the community on energy concepts in general, and publicize your facility as a model of conservation practices.

But hold on!

Don't get discouraged.

This may seem like a difficult process to grasp but it is no more than you are probably already doing when you plan for all the other functions and activities you already manage. The idea is simply to make energy management one of those functions.

It is not necessary for you to become an overnight expert on how heating systems work, what the most efficient ranges are, or how lighting control systems function.

You have operating and maintenance people on your staff to do this for you.

Your next job--commitment

As with any successful program, a most significant step is making a commitment.

If saving money for education by saving energy is important to you . . .

If fulfilling your role as community leader is important to you . . .

You should be able to find the will and desire to commit to an energy management program.

Of course, the depth of a commitment is proportional to the complexity of the task. If you feel like you are getting in over your head, you may not want to make a commitment.

That is why this program has been designed to make it relatively easy for you.

What you can do

Be a better energy manager.

Part of your job is to spend your community's tax dollars wisely for talented personnel, materials, equipment . . . and energy.

To be a better manager, you are going to have to start thinking of energy as you think about money.

Think of "Btu's" as dollars.

In fact, especially with today's fuel costs, energy is money.

Think of how you manage money.

If you use "zero base budgeting", you approach the allocation of money pretty much as follows:

* break down the whole operation into specific tasks
* define carefully each task, deciding if it is necessary or superfluous to your overall goal
* examine different methods (procedures, equipment, and supplies) required to perform the task.
* choose the most cost-efficient method that will get the job done
* set a budget for that method and educate people involved in implementation

You need to think the same way about energy, too.

And you can. True, you can't "see" energy-but you can't "see" money either. Both are numbers on a ledger sheet. And you as a manager can be a professional in managing both.

Be a better community leader.

Like it or not, you are on display.

The actions you take or don't take affect countless others in the educational community as well as in the community at large. People in general look to you for guidance and wisdom-and in most cases trust your judgment.

As an educational leader you are in a unique position to cause significant changes in social attitudes toward energy use.

-Your institution can become a forum for discussion of ideas, concepts, and technologies. This is not revolutionary, just exciting. Better awareness of energy sources and uses on the part of your students not only will lead to their being better informed citizens who can and will make reasonable but effective lifestyle adjustments, but also will filter into the community as a whole.

-Your facilities can become a model of conservation that, through appropriate publicity, the rest of your community can follow.

What effect can you have?

What difference can you make?

To answer that, look at the areas under your control.

Basically, three broad areas of involvement can be defined:

* facilities management
* transportation
* curriculum

Each group can have a significant impact on energy management, throughout the school setting.

And, importantly, each can have a significant impact outside the educational setting.

Each area can be logically subdivided into specific areas or target audiences, too.

So the apparently incomprehensible task can be broken down into easily manageable segments on which you can have an effect.

As with a monetary budget, wise practices in each area can add up to significant impact overall.

The keys are awareness, commitment, and organization.

These materials will help you.

The Energy Management Program

This energy mangagement program is composed of four elements:

(1) First is an Implementation Guide, which provides you with options and step-by-step approaches for marshalling your resources and organizing to get a program off the ground. Covered are answers to questions such as:

-Whose cooperation do I need up and down the line and how do I get it?

-Who on my staff can handle specific responsibilities?

-How can I organize people and assign tasks to best do the job at hand?

-What goals should I set and in what priority?

-What incentive, motivational, and reinforcement techniques can I employ?

-What information do I need and how do I get it?

-How can I publicize the program to achieve wider community awareness?

(2) Second is a Curriculum Review and Development Guide. Since energy awareness is a necessary and important element for the effectiveness of the program, included are general approaches for identifying energy-related concepts and bringing the topic of energy into existing curriculum. There are suggestions for analyzing your current curriculum from an "energy viewpoint" as well as forms to record areas of strengths and weaknesses. Directions are given for selecting energy related educational materials and for introducing energy to your staff so that they will want to become involved.

(3) Third is a guide for Facilities Management which includes technical steps you and your staff can take. These include:

-Determining your history of energy use in order to arrive at a realistic savings goal.

-Conducting a "mini-audit" survey of the school to pinpoint maintenance needs and opportunities for energy savings.

-Evaluating and prioritizing various energy saving opportunities uncovered in your survey.

-Preparing an energy saving action plan.

-Introducing the concept of the maxi-audit. Worksheets and audit forms are included for your convenience.

Suggested steps are organized according to:

-Whether they are "quick-fix", low budget corrective "retrofits", or conversions involving capital expenditures.

-Whether they involve energized systems (mechanical devices), passive systems (building structure), or human systems (operating and maintenance).

(4) Fourth is a complete Transportation Management Guide which provides a similar program outline to save energy in transportation systems.

Materials are organized in such a way and provided in such a format to enable you to exercise maximum flexibility. Nothing is prescribed. You can choose a few, many, or all of the elements outlined to tailor a program to fit your budget, time, responsibilities, and commitment.

(5) Fifth is an appendix which lists a number of DOE publications on energy conservation for school buildings.

GENERAL IMPLEMENTATION GUIDE

ELEMENTARY/SECONDARY LEVEL

General Implementation Guide

By this time you have probably decided whether or not you are going to set up a conservation program.

The task really isn't as formidable as it may appear.

Energy conservation is actually a clear and well-defined challenge . . . in fact, a much better defined challenge than many which you face. The needs are obvious, and the physical or technical solutions are prescribed and tested. The major ingredients, then, are commitment, organization, communication, and motivation . . . typical responsibilities of management. The pieces of the "puzzle" are lying about within easy reach. All you have to do is put them together.

This program is designed so that the "nuts and bolts" details of implementation can be parcelled out among your staff in small, manageable pieces.

Also, you will be able to implement as much or as little of the program as you wish at any one time. Thus you will always have control of the scope and depth of your efforts.

Since anything is easier when broken down into smaller logical steps, the General Implementation Guide gives you some approaches on how to do just that in the way of planning, organizing, and following your program. Regardless of whether you happen to be a district superintendent, business manager, school principal . . . or whoever . . . there are certain steps you can take in your own area of responsibility. This guide should help you identify some of the basic preliminaries you should consider as well as those persons whose cooperation must be sought, (either from an approval or task assignment standpoint). Obviously, as you read this guide, you should superimpose your own situation and position in determining what goals to set and in identifying who must work with you and in what capacity. For those to whom you report, your preliminary work will be to gain approval and/or budget allocation. The degree of necessity for this will vary according to your own local situation and according to how ambitious a program you intend to undertake. For those who report to you, your preliminary work will be used to assign tasks in such a way as to be compatible with their abilities, available time, etc.

You might consider organizing your program into several implementation steps such as:

1) Define your program in general.
2) Identify goals and set timing.
3) Identify those with whom you must work
4) Get Started!

Without futher description then, let us take a closer look at your first step.

Step I: Define Your Program in General

Assuming you are not going to try to do everything at once, consider the program as being divided into phases. Each phase would involve certain tasks or goals, each of which builds on the accomplishments of the previous phase.

Following is a suggested phase breakdown:

A. Phase I
   1. Set up an Energy Management Team.
   2. Plan ways to motivate participants and sustain commitment.
   3. Conduct a Facilities Energy Audit . . . a preliminary or "mini" audit . . . the single most successful technique to use to begin an energy conservation program.
   4. Review and recommend programmatic changes and any changes in operating and maintenance practices in both buildings and transportation.
   5. Accomplish "quick-fix" ideas-the obvious, low cost steps to save energy in school buildings.
   6. Review and audit curriculum for energy-related concepts now in place.

B. Phase II
   1. Review and decide, with your Energy Management Team, what low-cost or capital-outlay steps to take.
   2. Implement programmatic changes.
   3. Examine Phase I results for opportunities to improve.
   4. Organize a proposed energy curriculum based on current content and resources available.

C. Phase III
   1. Implement low-cost or capital-outlay steps chosen.
   2. Develop and implement an energy curriculum.

Most of the activities outlined in this program will concentrate on those activities listed under Phase I above.

Step II: Identify Goals and Set Timing

Once you have organized your program into a rough schedule based on phases such as those above, the next step in breaking it down into manageable pieces is to identify your overall goals and time frame for accomplishing them. This is of course quite subjective, depending upon how ambitious you, your budget, and your colleagues are.

For example, consider and realistically answer for yourself such questions as: When can I start? How long will it take to set up your team and get it into operation? As a safe rule of thumb, you should probably set a time frame of one year to accomplish each of the three phases. This of course is up to you. Set your own pace.

Another part of goal-setting is the amount of energy savings you want the program to realize. For example, realistic energy savings as a result of implementing the "quick-fix" steps in Phase One should amount to 10-20%, in some cases as much as 35%. Fifteen percent might be a good middle ground goal to aim for.

Three case history examples are:

Seattle Washington has instituted a number of energy conservation programs, including one called "Kill-A-Watt." As part of this program the City has succeeded in reducing winter time energy consumption in its downtown office buildings by 42%. The savings were made by reducing unnecessary lighting, lowering thermostat settings, reducing hot water temperatures, and turning space conditioning off completely during unoccupied periods.

The Metropolitan Government of Nashville-Davidson County, Tennessee reported a savings of 18,000,000 kilowatt hours for the 12-month period ending October 15, 1976 as compared with the previous year. These savings were the result of conservation efforts which required no money to implement. The government saved about $400,000, or enough electricity to provide the needs of over 1,000 average Nashville homes for a full year.

Nassau County, New York established a county-wide building energy audit. By correcting conditions uncovered during the audit (primarily unnecessary lighting) the County reduced energy use by 23%, saving $1.5 million dollars in 1975.

Step III: Identify Those With Whom You Must Work

Who will influence the manner in which you implement your program?

What specific controls do they exercise over the program or part of the program?

What do you want from them?

What information will you need in order to make a decision to cooperate?

How will you present the information?

These are the logical steps involved in identifying the various spheres of influence with which you must deal to set up your program. Of course, these will vary somewhat as to identity and degree of influence from district to district. However, there are certainly some common elements to consider:

The School Board or Board of Education

While the Board may not become involved in day-to-day maintenance, transportation, or teaching items (within established policy and budgets), the overall role the Board plays can be vital. If they are wholeheartedly convinced of the worthiness of the program then the first steps you take will be made on firm ground. Also, the Board is a key link between the school system and the community, and can play an important role in enlisting the support of various community groups.

Therefore, it is critical that the Board deliberate and agree to adopt a strong policy statement which gives the superintendent and district at large the needed mandate and direction.

Such a policy statement will serve several functions: provide direction, inform staff and students, alert the community, and psychologically prepare all concerned audiences for involvement in the total program.

A sample policy statement for consideration by your Board might be as follows:

> Whereas the cost of basic energy fuels keeps increasing, and
>
> Whereas the Board of Education bears responsibility to provide for the best use of tax dollars, and
>
> Whereas a basic need exists to make all citizens more aware of energy options, and
>
> Whereas public education can provide leadership in examining lifestyles and developing a realistic energy ethic,
>
> Therefore, the Board of Education of District ____ directs the superintendent and/or his agents to develop short and long range plans to bring about energy conservation strategies in the area of facilities management and transportation as well as develop a curriculum which deals with energy awareness and conservation.

Savings of community tax dollars is of course a prime reason for commitment by the Board to an energy conservation program. There are, in addition, other rationales for Board consideration:

- * A successful program would reduce the impact of a local energy crisis, lessening the possibility of schools being closed in order to save community energy supplies.
- * A successful program could also provide leadership and encourage cooperation among community agencies and groups in an overall energy-savings campaign.
- * Adoption of a program demonstrates conscientious response to national energy-saving policy.

The Board will become involved in specific approvals of such items as curriculum <u>changes</u> or extra-budget outlays for major equipment additions to facilities or transportation systems. These latter measures will sink or swim on their own merits in regard to return on investment, although an energy curriculum is a "now" issue that the Board is likely to view favorably. In any case, initial adoption of a Board policy such as the above will help pave the way.

If you agree that a favorable Board policy is desirable, outline a sample program that might be implemented under such a policy (which is exactly what these materials are designed to help you do), draft a proposed policy (such as that above), and use the appropriate channels to have the policy brought up for the Board's consideration.

Administrative Council

Many districts have an administrative council typically composed of:

Board of Education Representative
Superintendent
Curriculum Director
Business Manager
Building Administrators

The role of this committee varies from district to district, but generally it serves to keep the members informed of policy changes and acts as a coordination point for the entire district. The administrative council also serves as an advisory body to the superintendent and thus to the Board of Education. It may make suggestions or recommendations for policy changes it deems desirable. It can serve as a "go-between" from school to school and is usually one of the few formal avenues of face-to-face communications on a district-wide basis.

District Superintendent

The superintendent, of course, has more latitude (within Board policy) to channel funds to particular projects. As staff manager of the curriculum director, maintenance supervisor, transportation director, and others, his support of a conservation program can effectively mandate district-level cooperation from these influential persons. He is also a likely "point of entry" to reach the School Board with a suggested policy statement or request for approval, as well as with follow-up reports.

A sample administrative policy or directive which could be issued by the superintendent is included at the end of this section.

The superintendent must also be carefully aware of the style and content of his day-to-day support for the program beyond an initial policy statement or oversight of a district-level energy management team.

Some pitfalls:

- * <u>Arbitrary goal setting</u> can kill a program. Far better to trust the judgment and initiative of the staff and building principals to prescribe specific savings targets.
- * <u>Conflicting signals</u>. Consider the energy use implications of all decisions. For example, the superintendent who continues to insist on night time football may be telling his energy management team that his support is mere lip-service.

Curriculum Committee

Curriculum committees are typically composed of:

School Board Representative
Superintendent
Curriculum Director
Subject Area Coordinators or Department Heads (Teachers)
Parent Representative

The role of this committee is to continually review the entire curriculum of the district and to make recommendations for significant changes through the superintendent to the Board of Education. It is involved in providing broad direction instead of dictating the actual specifics taught in the classroom. It can serve as a communications route from the classroom teacher to the Board of Education.

Self-directed Action

Perhaps before you begin "lobbying" with the appropriate persons you should first consider:

What can I do without others' approval?

At any managerial level, building or district, there are certain prerogatives within set policy or budgets that will allow quite a variety of actions.

Insofar as an energy conservation program is concerned, for example, you may well be able to implement on your own those of the following steps which fall under your responsibility.

* Facilities - Changes in operating and maintenance practices, etc., such as light-level reduction, reduction of ventilation to state code levels, shut-down of heating, cooling, or lighting in unoccupied areas or at "off times", and temperature set-back; also effect "quick-fix" measures taken at no or slight cost, involving inexpensive equipment and the time of existing salaried custodial staff.

* Transportation - changes in operating practices, extracurricular activities usage policies, etc.

* Curriculum - voluntary energy-related additions to existing curriculum, outside speaker program scheduling, etc.

Your Staff and Colleagues

Obviously you are going to need the help of co-workers and those on your staff to conduct a successful program. As a manager, you will also recognize the need to organize them into an effective functioning unit. That unit is the Energy Management Team, the organization of which will be the first step as you launch into Phase One.

Step IV: Get Started! Phase I Underway

Now you have got a general idea of what you are going to do, who is going to be involved, and what approvals you will need.

No time like the present to get going!

From the above, or your own additonal experience, choose your first step. Will it be to seek a Board policy statement and district-wide aid and involvement or to begin directly with a limited program under your own recognizance?

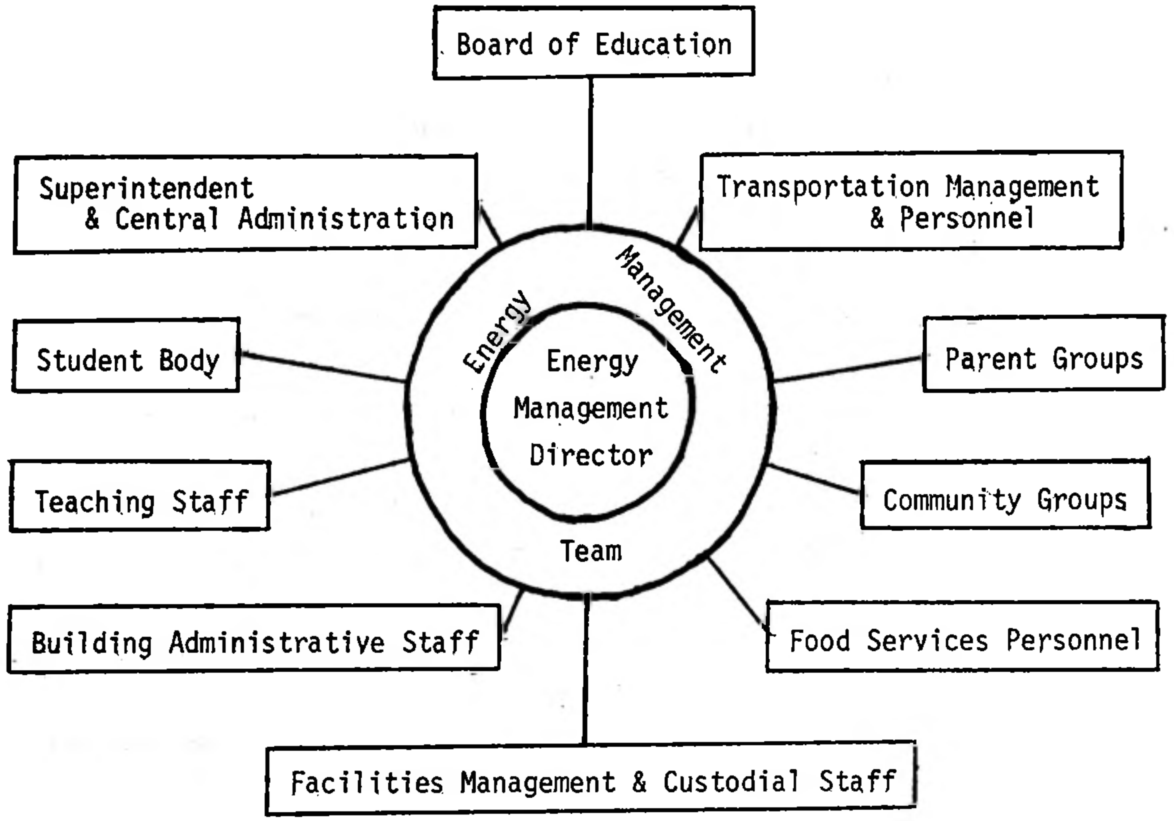
Whichever route you take, you should proceed to outline your steps in more detail and set a general but flexible time frame. Most important is to start now. Resolve to go see the superintendent or a Board member first thing Monday or sit down this afternoon and prepare your list of prospective energy management team members. See-you are already into Phase One hardly before you know it!

The first step in Phase One, you will recall, is to set up an Energy Management Team. This is an important first step so let us consider it in some detail.

The Energy Management Team

One of the most important tasks in making energy conservation a reality will be setting up an effective Energy Management Team. Such teams may be formed at the district level, at each school in the district, or both.

Energy management must be a team effort. All persons in the educational community must have an opportunity to provide input and to participate. Past successful efforts at implementing energy conservation programs indicate that the best approach is to set up a small but strong Energy Management Team. Composed of capable staff persons with the experience and expertise to carry out their portions of the program under your overall management, it is this team that will take on the day-to-day details, and will provide the necessary link-up among areas of concern and expertise so that information, problems, and ideas from each area can be brought to the attention of all others.



Let's now consider a possible make-up for a district-level Energy Management Team or committee.

-District Energy Management Team-

Team Members	Duties
District Superintendent or designee	-preside over team meetings -represent program to the community and to the school board -coordinates collection of audit data from various buildings and from transportation sector -decide on recommendations of maintenance supervisor and transportation director, collect equipment or repair bids as necessary, prepare expense proposals for board approval as necessary -attend seminars, in-service workshops, etc., presented by professionals in order to gain knowledge and remain as informed as appropriate

Team Member	Duties
Maintenance Supervisor	-conduct audit workshops or training sessions as needed for building engineers and maintenance personnel* -collect audits from individual buildings and compile into district-wide audit report* -conduct analysis of audits and make up prioritized list of recommendations* -enlist help of other supervisors, managers, etc., as needed-e.g., district food services supervisor regarding kitchen energy use
Transportation Director	-implement transportation energy management portion of program -submit to business manager any proposals involving new equipment, modifications, extra expenditures, etc., as policy dictates
Curriculum Director	-collect school curriculum reports and recommendations -prepare district-wide program -procure energy educational materials for teacher use -disseminate information to teachers on educational opportunities such as workshops -develop district-wide in-service programs

*these functions may be performed by a professional engineering consulting firm if appropriate.

Team Member	Duties
Community Representative (PTA, civic group member or officer)	-provide input as to community point of view, attitudes, or opportunities to interface with other programs -disseminate program concept, steps, results, etc., to community -act as public relations agent for district team
Student Representative (where applicable, e.g., high school and most secondary level-selected from among student representatives on each of individual school teams)	-advise as to level of student cooperation which could be expected, student attitudes, ideas for student motivation
Consultant	-optional outside professional, technical help retained to peform and/or analyze building energy audits, suggest priorities, etc.
District Energy Director or Energy Coordinator	-appointive office to take over some or all of team duties of business manager and maintenance supervisor A rule of thumb to consider: if you can set up an Energy Director for 10% of the district's fuel budget (including salaries, space cost, etc.), you can't afford not to!

Other possible candidates for inclusion on the district team might be;

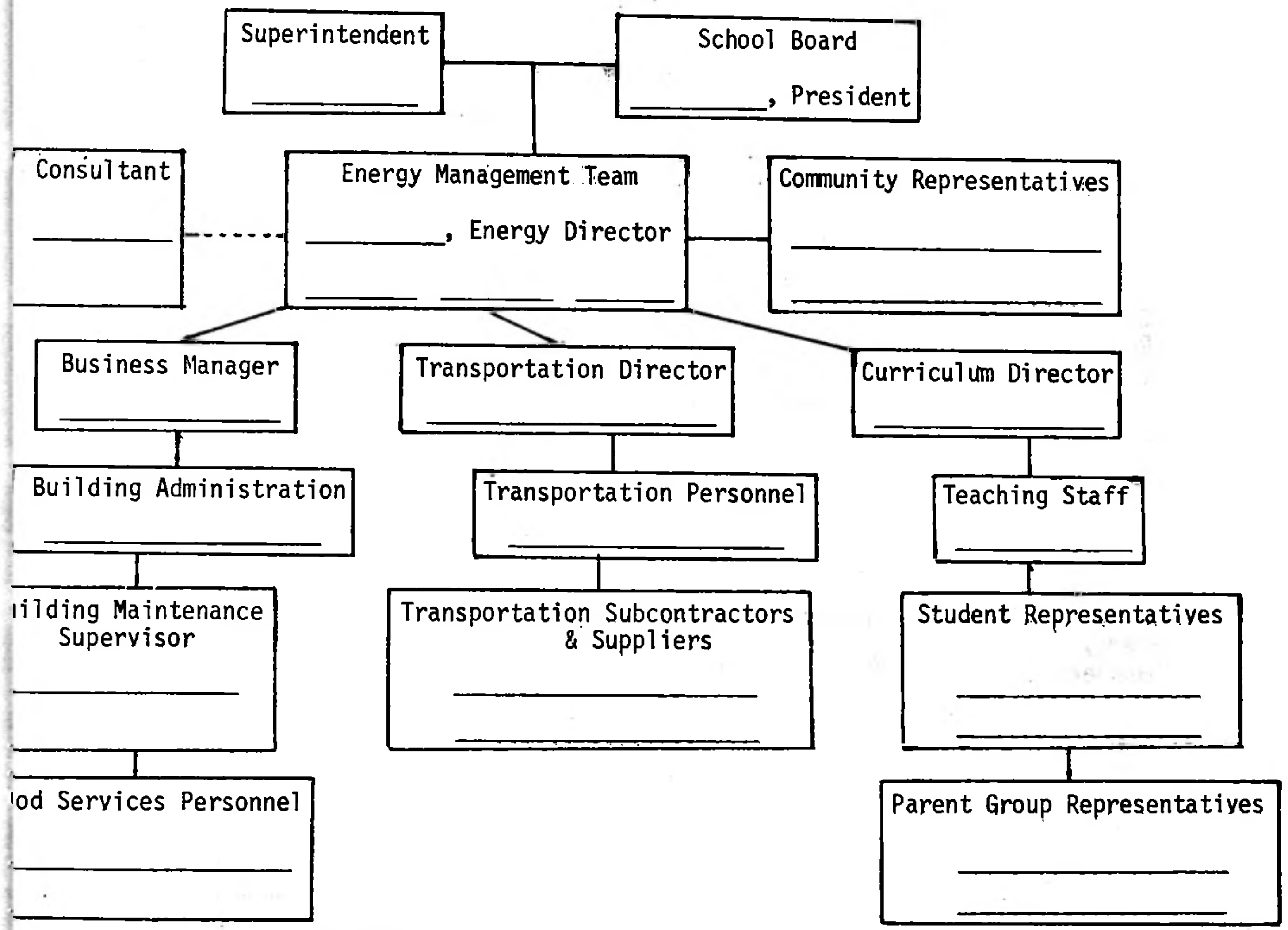
* Utility company representative

* Representative from the board of education

* District Representative (one from/for each school)	-convey building audit results to maintenance supervisor -act as liaison between district and school energy management team -report to curriculum director on results of in-school curriculum audit, recommendations, etc. -represent school team's consensus as to priorities, etc.

Note: Having a representative for each school could become too cumbersome for large districts. If so, the tasks could be handled by one or two persons from various schools who would act as liaisons to all schools in the district.

ENERGY MANAGEMENT TEAM - DISTRICT LEVEL



Let us consider a suggested makeup for an energy management team for an individual school.

-School Energy Management Team-

Team Member	Normal Position	Duties as a Team Member
Team Leader	Dean, Principal, Assistant Pricipal, Business Manager, or Designee	-preside over team meetings -assign tasks within program -represent program to parents, teachers, and the neighborhood as necessary -approve any submittals or recommendations to the district or board
District Representative (Optional)	Could be the Team Leader or a separate designee chosen from staff	-report to team on district activities or recommendations -collect and prepare audits, team recommendations, reports, etc. for district or school board as required
Facilities Energy Manager	Building Engineer or Head Custodian	-conduct or manage building energy use audit (on own or lead entire team through the audit) -prepare a list of operating and maintenance changes or practices which will save energy -prepare a list of "quick fix" energy saving measures (from those suggested in the facilities guide) which he or his custodial staff can do within current budgets -report audit data collected to district representative or team leader who prepares complete report -work as necessary with district maintenance supervisor regarding maintenance or training aspects of the program -make sure entire custodial staff is aware of program and its steps
Food Service Energy Advisor	Head of Food Service, Cafeteria Manager	-provide necessary information on current practices, techniques, equipment, etc. to district representative or team leader, providing energy-saving suggestions as necessary -conduct kitchen-related portion of energy audit (as applicable) in cooperation with facilties energy manager
Faculty Representative (one from each grade)	Subject Coordinators Team Leaders Department Heads Grade Level Leaders	-conduct curriculum audit, getting input from individual teachers as needed -provide input to team as to teacher attitudes, avenues for teacher contribution to program, ideas, etc.

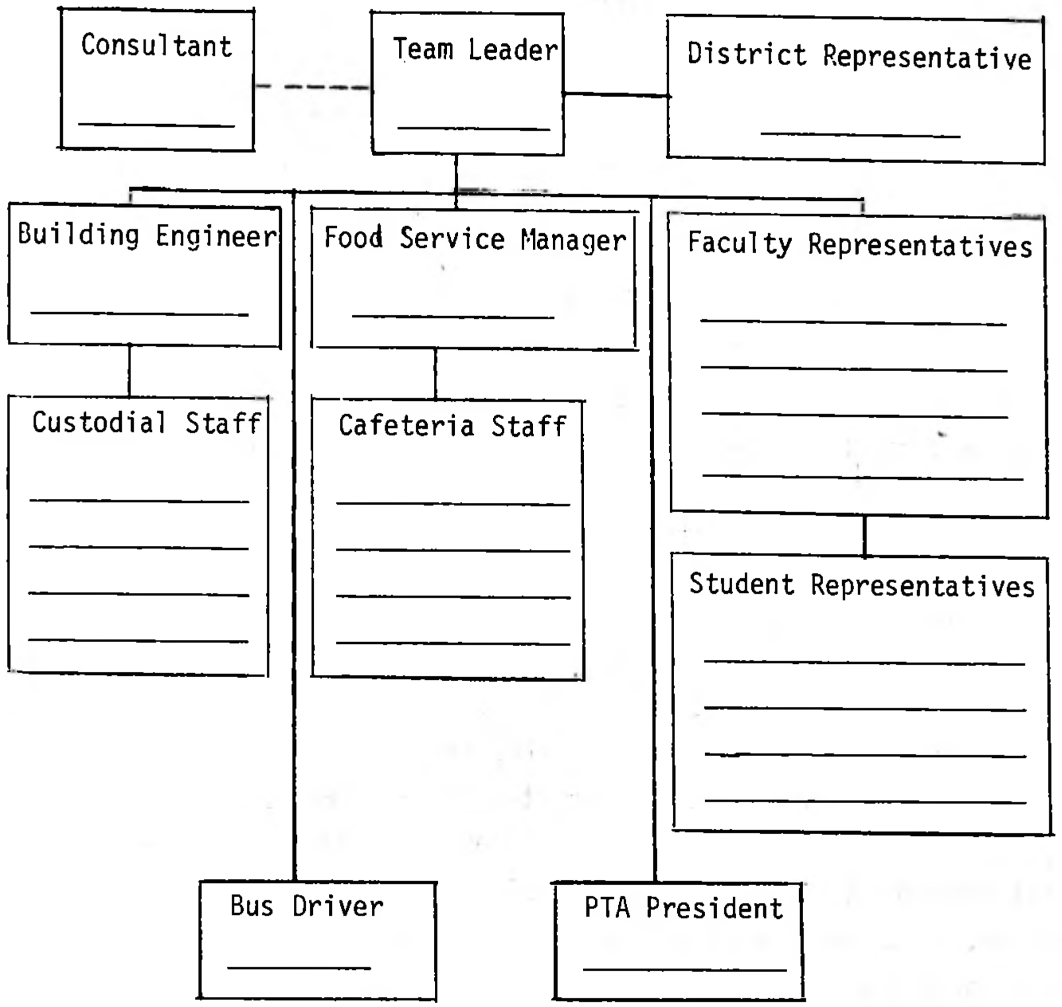
Team Member	Normal Position	Duties as Team Member
		-provide input from teachers as to physical conditions in each room of building as related to energy consumption -help enlist faculty support for team activities -implement faculty motivational concepts -represent team to the faculty
Student Representative	Class Presidents or other officer or outstanding student in vocational or applied sciences	-participate in audits -provide input to student body reactions, ideas for enlisting student cooperation, etc.
Consultant (Optional)	Professional Consulting Engineer or Reputable Energy Audit Firm	-collect audit data, analyze and provide prioritized list of energy-saving measures for team evaluation

Other possible team members who may be effective in helping reduce energy use in their particular areas would be:

Athletic Director or Head of Physical Education
Director of Vocational Education
Director of Dramatics
Band Leader
President of PTA
Transportation Representative - If district owns buses.

You may wish to fill out the following chart with names of appropriate persons on your staff as a reference.

ENERGY MANAGEMENT TEAM - SCHOOL LEVEL



Some Notes About Team Members

The Chairman (Superintendent, Principal, or Designee)

Organization of the team is very important. It must be led by a spark plug . . . a catalyst. The chairman will normally be the superintendent, school principal, or someone who works directly with him. In the case of district teams in larger school districts this person may be the business manager. The business manager is the person who knows about fuel bills and also relates directly to several others on the team. If the business manager, for whatever reason, isn't the person finally selected as chairman, he or she should be on the committee. The important thing is that the chairman be a leader . . . someone who can instill enthusiasm to the committee and subsequently to those who are represented on the committee (students and staff).

Community Representative

Select each of these carefully. They should be leaders--opinion maker types. They may not all be aware of the need to save energy. Some may even be somewhat negative to the concepts. For example, they may feel that the whole energy situation is contrived by the oil interests and that there really isn't a problem at all. Include them too, they will learn the truth--that the problem is real. Secondly, including them will neutralize the opposition, if there is any, and you will have at least partially defused a potential problem.

Teachers and Students

The teachers do not have to be in science or other technical areas. The important thing is that they are interested in the program and show some personal commitment. The student representatives need not be limited to the older ones. Don't hesitate to include those in the lower grades. They are a part of the district, too.

Consultant or Technical Advisor

This person has been mentioned several times--who is it? It is strongly suggested that you include a person with a technical background as a team member and not as a chairman. Your own people should maintain control of the team and set the overall direction. Unless you have talent on your staff over and above that normally found in an educational system you will need input. The person we recommend will probably be an engineer. He or she will be a consulting electrical or mechanical engineer who, hopefully, has prepared energy conservation plans for others. The role this person plays will be explained in detail as we describe what the team does.

Picking the Right Energy Management Coordinator

It is instructive to elaborate for a moment on the post of energy coordinator (or energy management officer), for many successful programs have indicated that one person should be charged with developing and implementing the entire program with the support of the team. This position is thus very important in the process of collecting information, stimulating discussion, establishing goals, providing leadership, and in achieving overall objectives.

Picking the right person is therefore critical.

The position can be part-time or full-time depending on the size of the district, but the appointee must have a manager's responsibility. The appointment should be publicly announced and given both internal and community importance. The indication should be clear that the energy manager is implementing the superintendent's wishes.

The following qualifications should be considered as screening points for each candidate:

1. Interest--Has the candidate demonstrated a sincere interest in the energy issue?
2. Ability--Has the candidate demonstrated ability in organizing committees, accepting and assigning responsibility, or in establishing realistic goals?
3. Time--Can the candidate be freed up to dedicate time to the development of an integrated program?
4. Motivation--Does the candidate possess the necessary inner drive that will sustain the program?
5. Acceptance--Is the candiate currently accepted as a leadership figure in the total community?

Once you have assembled your prospective Energy Management Team, what will you do? What will you tell them at that first organizational meeting?

Before answering this question let us review the question--"Why did we form a team?" The answer is not "because the Board told us to." The team is not a do-nothing, figure head, look-intelligent group. They will assume an active roll in creating the specifics of an energy policy and implementing the policy for the district or individual school. Unless the team members themselves are involved they won't be effective in getting others involved.

The first meeting should therefore acquaint everyone with the overall problem and set a direction for the future. A film that is poignant in making the point of why something must be done is "The Critical Choices Ahead", prepared by the U.S. Department of Commerce. It is a 30 minute film which discusses the subject from the standpoint of natural resources (sources of energy), the various consumers of energy, and why, in order to meet the needs of our society, we must conserve energy NOW! The film is available from the U.S. Department of Energy, Mr. Tim Lankton, Mail Stop: 2H-085 Office of Industrial Programs, Washington, D.C. 20585.

The following are some suggested agenda items that might be explored during the planning and organization meetings of the energy management team:

* Assign responsibilities and tasks to appropriate individuals and/or groups.
* Discuss communication and motivational strategies for involving the entire educational community. (See next section.)
* Plan an energy audit for the district (or for one building).
* Set specific goals and establish a schedule for implementation of the various phases of the program.
* Plan a public information program to inform district personnel and the community about the existence of the project and its goals.
* Discuss the possibility of including outside consultants in the field of building design or energy management.
* Assign individuals the task of reporting back to specific teams at a specific date.

It is suggested that the team be convened on a regular basis. It should be on the same day, the same time each week. Have an agenda and make it specific. Keep the meetings dynamic and be sure they do not dry out.

Another vehicle for encouraging your energy management team is a film entitled The Fourth R which is free by writing to: Modern Talking Picture Services, 2323 New Hyde Park, N.Y., N.Y. 11040. This film was developed in conjunction with SEED (Schoolhouse Energy Efficiency Demonstration), an energy management manual for schools developed by Tenneco. For copies write: SEED, Tenneco Inc., Public Affairs Department, P.O. Box 2511, Houston, Texas 77001.

Following are examples of memos, announcements, building or intra-district correspondence related to implementation of an energy conservation program.

Memo

Date: ____________________

To: District School Principals/Department Heads

From: Superintendent

Subject: Formation of the District Energy Management Team

The need for a total educational energy program has been endorsed by the Board of Education. This policy requires that we strive for a significant reduction in our energy consumption as well as introducing energy concepts into the curriculum at the 4th, 7th and 11th grade levels. I am recommending a first year goal of 20% reduction in overall energy usage.

Our district uses ___ kilowatt hours of electricity, _____ cubic feet of natural gas, and ____ gallons of fuel oil for a total of ____ million Btu's of energy yearly. The monthly cost in dollars averages out to $__________ or $_________ annually. These costs are rising at ___% to ___% per year. The increases since 19___ would have paid for an additional ____ teachers salaries, ____ textbooks, or ____ new chemistry labs. We must initiate an aggressive district-wide energy conservation program at once. I am appointing __________ to the position of district energy coordinator with the responsibility of formulating and conducting the program. ______________ will form a district team which will meet one week from today on _______________ at ________ in room _________ of the _________ building. The total educational energy management approach requires that all the staff be involved. A number of districts have achieved 20% to 30% savings in usage last year by implementing a well planned energy conservation program. They have saved enough money so that they can retain personnel and purchase instructional materials they would not have otherwise been able to purchase.

Your responsibility will be to assist in establishing this program through your staff and to be a communication link between the district team and your building task force.

See you at ____________ on ______________.

Memo

Date: ____________________

To: All District Employees

From: District Superintendent

Subject: Initiation of Energy Awareness and Management Program

Television, radio, and newspapers are filled with reports on the rising cost of energy. The energy problem has a potentially serious impact on our homes and schools, including the operation of this district.

As a result, the Board of Education is initiating a far-reaching Energy Management program to identify and eliminate inefficient and unnecessary uses of energy throughout the district as well as introduce energy as a classroom topic at the 4th, 7th, and 11th grade levels. To accomplish this task, I have appointed __________ to head the Energy Management Team on the district level. This team will formulate a program which will enable us to reduce our energy consumption without altering our educational program. The support and active participation of each employee is essential if we are to achieve our goal of 20% savings in energy use this year.

Since we cannot pass on increased operating costs to the consumer, each increase in fuel costs means that much fewer dollars we have for people, materials and programs. The <u>increases</u> in fuel costs since 19___ would have paid for an additional _________ teachers' salaries or _____ new textbooks.

You will soon be seeing signs that say "Save Energy". This is more than a slogan-it is a reminder that energy will be available at home and at school <u>IF</u> we are careful in the ways we use it. It is no surprise that we are spending more on energy than instructional materials. These signs are a reminder that energy respresents money-and wasted energy is wasted money. Working together we can conserve energy and save for the future.

Plan Ways to Motivate Participants and Sustain Commitment

The human side of your program will need attention if it is to succeed. People need motivation, incentive, and reinforcement if they are to continue to be successful over the long haul. Most professions provide their own incentive and reinforcement in their careers by doing a conscientious job and observing progress. However, progress will be hard to discern. It will thus be crucial to keep them informed of the importance of and progress toward the goals of your program.

One way to provide initial as well as continuous motivation is through professional incentives and awards, aimed at tying the program to their professional activities.

For teachers, in-service credit or board credits can be granted for program participation-e.g., workshops on energy, participation on energy management team, or service as energy coordinator. If salary-related credits are not part of your system, teachers should be assured that their participation will be part of their "resumés" for evaluation.

Cooperative efforts with staff or national teacher organizations or associations can also be a source of professional recognition for teachers. Awards, presentations of papers on the energy management program, etc., can be utilized effectively by such groups.

The continued help and ready cooperation of the critically important staff members involved in facilities management, transportation, and curriculum development can also be spurred with continued long-term reinforcement of an "energy consciousness." Some means of such reinforcement are special events or programs such as:

* Field trips to educational or industrial facilities related to energy production, distribution, or use.

* Industrial arts, home economics and science shows, with energy conservation as the theme.

* Parental "back-to-school" nights - an opportunity to show what the schools are doing to save energy and dollars-and what can be done at home to help.

* In-house communications such as posters, wall sticker-reminders near switches, thermostats, windows and doors, hot water taps, etc.; memos; weekly "energy tips" published in school papers or district newsletters; progress articles in faculty newsletter or school paper, etc.

Everyone involved in the program can receive additional recognition through appropriate union or trade magazines (which may print articles regarding the program), special in-house awards, and favorable publicity (in-school or community publications).

Create some interest--get people excited. Suggest that the entire school become involved in a contest. First could be a "name the effort" contest. Every worthwhile endeavor should have a name. Each student may be asked to submit a name or a slogan for the effort. In one school district where this was tried the winning entry, as judged by the committee, was submitted by a second grader, and the district was K-12. This may be followed by a poster contest-again, active participation by everyone. This may be expanded to include a classroom (or grade) competition, a school winner, and finally a winner for the overall district.

Other educational efforts--and energy from a technical standpoint hasn't even been considered yet--may include buttons, banners, appointment of energy monitors, and of course, solicitation of ideas from <u>everyone</u> as to how to save energy. Properly done, the team will be overwhelmed with ideas, many of them very good.

Obviously, at this point in time, the community is beginning to learn what is happening. The students spread the word to their parents, relatives, etc. Capitalize on it. Soon, the entire community may become aware and begin to save energy. In many parts of our country the school and/or the church is the center of community life. Under this program, the school can be the focal point and lead the way toward providing positive leadership in energy conservation and energy conservation education.

Efforts should be publicized through the local newspapers, radio, and TV. Articles on your program, press releases, public service announcements, and the like can increase the general "esprit de corps" and help assure success of the program. For example, if your Board has issued a policy statement, a press release such as the following example might be in order.

Sample Press Release

> The Board of Education of District _____ has announced plans to develop a district-wide energy conservation ethic in an attempt to curb the ever rising costs of keeping our schools open. ___________, the President of the Board directed the Superintendent to develop "short and long range plans" to save energy dollars and to make curriculum changes so that students will be confronted by facts and issues concerning lifestyles and conservation. All areas of energy use are to be studied including heating, lighting, and transportation. It is the goal of the school board to achieve a minimum of a _____% savings by the end of the first year of the new program.

In addition, contact should be made with civic groups such as Rotary, Kiwanis, Lions, Jaycees, etc., with an eye to providing programs for their meetings on the topic of your energy program and to enlisting their support. Major local employers, unions, and local government officials can be of help in highlighting your program(s).

Community understanding can be further heightened through additional special programs such as energy conservation seminars for homeowners, energy "fairs", and adult continuing education programs on energy, etc.

To review, you should now (using your knowledge of your own situation as well as your creativity) be able to outline your program in terms of:

* Work to be done, in what order, and in what sequence (phases).
* The general goals of your program in terms of time and energy savings.
* The people available on your staff to carry out program details, and how these people will be organized for effectiveness (energy management teams).
* What incentives and motivational reinforcements you will use to help assure long term commitment and success.

Continuing on into Phase I and ultimately other phases will involve detailed examination of energy use in your facilities (buildings) and in your transportation system, as well as getting energy conservation concepts into the curriculum.

Separate sections have been prepared on these areas to facilitate dividing up the program among those of your staff who are best equipped to handle them.

For example, the Facilities section might go to the Business Manager at the district level, or to the Building Engineer at the individual school level. Or, you may be responsible for their implementation yourself. This will depend upon your personnel and time resources.

If you are delegating the Curriculum, Facilities, and Transportation segments, you should read through them first so you will have a feeling for what is to be done.

Let us take a moment to recap.

All of the foregoing has been aimed at helping you get a broad feeling of what is involved organizationally and managerially in setting up an energy management program.

We have reviewed some of the basic steps you will take. By "walking through" these steps mentally and superimposing them upon your own local situation, you should be able to prepare a general outline of key steps and features in your program implementation. Doing so will not only give you a "handle" on the undertaking, but will help you organize your thoughts for presenting your program concepts to those whose approval and/or cooperation must be sought.

The attempt is not to give you a prescription, but a generalized grouping of the sort of things you will likely be considering. There is plenty of latitude, indeed explicit encouragement, for your own ideas!

Some general guidelines to keep in mind as your program unfolds:

* The <u>specific</u> steps you and your Energy Management Team decide to take will depend on your location and climate, the potential savings, the complexity of the building and other systems, technical capability of your staff, time and money available, etc. The specifics outlined are for consideration.
* <u>Continued commitment</u> is crucial. Lip service plus a few memos reminding people to turn off lights or set back thermostats will reap very poor overall results. More than periodic communication is necessary. Liberal use of some of the reinforcements and motivational suggestions previously covered will be of help in addition to your obvious personal involvement.

* Careful planning and coordination, plus well-thought out procedures and guidelines at all phases are important, if desired results are to be achieved. Don't be discouraged if planning efforts seem to consume time, for such efforts will pay dividends.

* Accurate data on energy consumption and cost, plus the cost of changes under consideration and their potential savings will have to be developed in order to establish priorities and monitor performance.

* Evolution, not revolution must be the byword. Obvious inefficiency which can be cheaply and gradually eliminated, is the first target. Following that will be modifications requiring capital outlay, decisions for which will be wiser as more knowledge is gained in earlier phases.

* Conservation, not curtailment. Education remains the primary function of the school or school system. Energy conservation that eliminates needed programs is missing the point...we could all go back to the caves and save a lot of energy. The point is that efficient use, good housekeeping, consolidation, wise scheduling, etc. can allow us to have our cake and eat it, too. We can have conservation and education, without curtailment.

* Constant review and updating of program plans and progress will be necessary to maintain interest and commitment, as well as to identify further conservation opportunities.

CURRICULUM REVIEW AND DEVELOPMENT GUIDE

ELEMENTARY/SECONDARY LEVEL

CURRICULUM REVIEW AND DEVELOPMENT GUIDE

If effective national energy conservation is to become a reality, we must look beyond the immediate saving of dollars and educate society to adopt changes in lifestyle that will lead to continual or lifetime conservation. In short, energy conservation must become a learned habit that replaces current habits which have led to excess consumption.

Since we are concerned with habits, it only seems logical to develop the desired habits early, rather than to let undesirable habits develop which must be changed later. Therefore, it makes sense to develop the strongest energy emphasis among students as early as possible. This will insure that the following grade levels can build on those accepted habits, rather than on those which need to be changed. Otherwise, education becomes only a firefighting process rather than one which addresses itself to prevention. The key to this process is the development of an awareness on the part of students of how energy and energy conservation impacts upon virtually all aspects of our lives.

An energy conservation curriculum can therefore be built from the base of earlier grades, rather than from the top down, as so often happens in curriculum development. An energy curriculum can be started at kindergarten with each successive grade level <u>adding</u> to initial concepts, rather than setting a conceptual "ceiling" at the high school level toward which lower grades must simply provide a circumscribed background. The number of concepts that the kindergarten child can learn are very limited, but those concepts can be expanded upon in first grade and so on, all the way to the post-graduate level.

In developing the energy curriculum, teachers at each grade level can determine what concepts will be dealt with in that grade. These teachers are most familiar with what the students are capable of, how much time they can spend, whether they need an actual energy unit or whether energy concepts can be incorporated into other curricula - in short, they are the experts at that level as are the teachers at every other level.

Since energy is an everyday necessity of life, concepts of energy production, distribution, use and conservation can be incorporated at any or all grade levels. Determining at what grades such concepts will be taught should be the responsibility of each individual school district. Much will depend upon existing curricula as well as the interest of the teachers who will be doing the actual classroom work.

Once the concepts have been identified, decisions can be made on how these concepts will be taught. This may result in the creation of a specific unit on energy or the simple addition of an energy emphasis in a unit that is currently being taught. How the concepts will be taught can vary from one grade level to another depending on each unique set of circumstances.

The final energy conservation curriculum should be developed on a local level because energy consumption patterns are as unique as the geographic location of the district, the economics of the district, the buildings of the district, the size of the district, or the background of the teachers who will implement the curriculum.

This however, does not mean that an energy curriculum committee will be developing everything from scratch, but rather will be able to adopt a program from a wealth of materials currently available. One of the best sources for locating materials is the Energy Education Materials Inventory, volumes I and II. Volume I may be purchased for $5.25 from the U.S. Government Printing Office, Washington, D.C. 20402. Volume II - $8.00.

An energy curriculm which is rigid and inflexible is highly undesirable and would likely result in more problems than it would solve. Such is not one of the goals of this program.

A rigid program cannot address the diversity existing in local energy situations nor inspire much creativity and commitment on the part of the teachers who must use it.

Although the focus of this book is energy conservation, it is important to remember that a comprehensive energy education program is not limited to conservation education. It is far broader, including all that an informed citizen needs to know about energy, energy technologies, policies, socio-economic tradeoffs, energy careers, etc.

However, while no uniform program is intended or desired, some suggestions as to types of concepts to be look for and/or potentially developed are not out of line.

Once the content of the curricular concepts has been established work can begin on selection of activities and personnel to actually teach the unit. These activities should be goal oriented relative to each of the concepts. The establishment of goals and selection of activities might at first glance appear to be rather formidable, but this is only because of the wealth of information available rather than the lack of it. Any number of traditional as well as innovative activities can be assembled for any conceivable goal. The process is one of elimination rather than the creation of new materials. In fact, time spent on developing new materials or activities, at least initially, is a waste of effort. It will simply result in reinventing the wheel, wasting effort which could be channelled to a much more productive use-teaching students.

This guide identifies several steps in assessing existing curricula, identifying energy-related concepts which are or can be involved in that curricula, organizing those energy-related concepts, identifying materials which can be used in the classroom to teach those concepts, and introducing the new approach to teachers through workshops.

The goal is to infuse the entire learning process with those "real world" concepts which can create an awareness in students of the importance of energy and energy conservation in virtually all aspects of our society.

Persuant to this overall goal, the guide breaks the curriculum assessment and development process into five steps:

1) the curriculum audit
2) curriculum evaluation
3) curriculum development
4) selecting materials
5) curriculum in-service

The Curriculum Audit

If energy-related concepts are all-pervasive in virtually all aspects of our lives, then energy-related concepts must be involved in those courses and subjects being taught to students. If energy awareness is to be instilled in students, these energy relationships must be identified, and to some degree highlighted as these subjects are taught.

The Curriculum Audit is designed as the first step in the process: that of identifying energy-related concepts existing within currently taught subject matter. By performing such an audit, not only will a strong energy curriculum be developed, but your own mind and those of your staff members will be "trained" to think of energy and its impact.

Sometimes energy-related concepts are obvious. For example, science classes covering the topic of electricity can obviously spend a few minutes on how electricity is generated and used. Coal, as a topic of geology, can easily and obviously be discussed in terms of its importance as a fuel. The study of plants in biology suggests a few minutes discussion on the progression of our society from primarily wood-burning to petroleum through current experiments in biomass conversion as a source of fuel. Geography can include information on world distribution of resources. Social studies can explore the energy base of other countries as well as that of our own or the need for energy in the operation of such basics as police and fire protection and mail delivery. Civics and government classes can discuss the structure and problems of governmental regulation of energy.

In other cases, energy concepts may not be so obvious. Some imagination may be required to identify inherent but hidden energy-related concepts or energy teaching opportunities in some subject matter. This can actually be fun! For example, what has energy got to do with mathematics? Not much, directly . . . but instead of posing arithmetic or algebra problems in terms of rubber balls, apples, percentages of people, etc., how about instilling some familiarity with the numbers involved in energy issues . . . such as barrels of oil, tons of coal, percentages of our needs supplied by various fuels, etc. English classes often assign essays . . . surely the energy crisis is a fertile field for writing! In geography it is often noted that three-fourths of the earth's surface is covered by water. What does this have to do with energy? Consider that:

> Water is needed to make steam to turn turbines which turn generators which produce electricity.
>
> Water is needed to wash coal to remove impurities before the coal is burned.
>
> Water is needed in the process which is used to remove oil from oil shale.
>
> Water, and Archimedes' principle, have allowed us to develop water transportation to the point of using today's super tankers.

> Water from the oceans can supply an inexhaustible source of hydrogen which can be a source of fuel.
>
> Water is the driving force behind hydroelectric power.
>
> Ocean tides can be used to generate electricity.
>
> Water contains deuterium which is the "fuel" needed for fusion.
>
> The difference in temperature between the water on the surface of the ocean and very deep water can be used to generate electricity.
>
> Water is needed to condense the steam in present day electrical plants.
>
> Aquaculture may be the farming technique of the future which will supply us with vast quantities of biomass for use as a fuel.
>
> The hydrologic cycle naturally returns water to our rivers so it can be used to generate electricity.

You get the idea.

As indicated, <u>everyone</u> must begin thinking about energy and its relationship to all that we do as the first step toward instilling an awareness of conservation as an "automatic" reaction or learned set of habits. Educators must lead the rest in this effort . . . and consequently must first train themselves to recognize and involve energy concepts in what they teach youngsters of the world around them. This can be as interesting and fun a process as it is important.

The Curriculum Audit Forms included are designed to help teachers organize their thoughts in identifying energy-related concepts within the subject matter they are teaching. Ideally, each teacher should prepare one form for each subject area he or she teaches. This may mean that elementary teachers will end up filling out several forms each, while junior and senior high teachers might each fill out only one or two forms. However, the latter will necessarily be going into more depth.

Some suggestions:

* Give teachers plenty of time to complete the audit. Nothing like another autocratic paperwork assignment from above to kill interest and imagination. It may even be a semester or year-long project which teachers complete as they go through their normal lesson planning.

- Make it interesting! The process can be either an exciting and challenging mental "game" or a tedious and boring "nuisance" assignment. Encourage "brainstorming" sessions among teachers in informal settings. Teachers may even involve their classes in such brainstorming.

The forms first ask for what amounts to an outline of the subject matter, identifying the key concepts involved in the overall topic as it is taught. Sometimes these may be basic facts which trigger an energy-related concept (such as the geographical fact of three-fourths of the earth's surface being covered by water as mentioned above). You can begin to see why this isn't something that can be done in one sitting, such as by copying the textbook table of contents! It is a process that requires teachers to think of what they are doing in detail.

After identifying these overall course concepts, the next column can be used to fill in the energy-related concepts which are or could be involved in those overall concepts.

The next column can be used to indicate whether the energy concept has a direct relationship to the course material (e.g., electricity generation and use under the overall science class topic of electricity) or an indirect relationship (e.g., world distribution of resources under overall geography class topics).

Finally, the forms ask for the teacher's assessment of which of the listed energy concepts should be regularly included in the curriculum. In doing so, teachers may wish to "try out" the concept with their classes so they go through the audit process itself. This can change as more and more concepts are considered, but will help establish an overview of the entire project.

Form I

ENERGY CURRICULUM AUDIT

Subject Area ____________ Grade Level ____________

Course Concept	Energy Concept	Direct or Indirect Relationship	Possible Inclusion

Curriculum Evaluation

Now that the energy-related concepts are identified, work can begin on organizing the information into an interdisciplinary format. The idea is to present a meaningful picture on energy rather than various "splinter" ideas with no real relationship to each other.

After teachers have completed the initial curriculum audit forms, they should be collected by the Curriculum Coordinator (if done at the district level) or by the Faculty Representative (if done by the individual school Energy Management Team). As noted in the team organization, this can be a subject coordinator, team leader, department head, grade level leader, or a "subcommittee" of such persons.

Once all audit forms are collected, the first step is to reorganize the diverse energy concepts (i.e., those listed in column #2 of the Curriculum Audit Forms) according to whether a particular concept falls into one or more of the following broad energy categories:

A. Energy Resources
B. Energy Production
C. Energy Distribution
D. Energy Conservation
E. Energy Utilization
F. Environmental Impact

It is likely that a single concept will fall into several different categories such as the example of water mentioned earlier.

The individual energy concept worksheets (IIa-IIf) have been provided to ease the task of organizing your data and ideas. The columns can be filled out easily by copying the subject area and grade level from the individual audit forms, as well as the teachers' opinion as to inclusion. Once all the concepts have been categorized they can be entered on the Energy Concept Log.

As the concept overview begins to emerge it will become relatively easy to see what concentrations exist and where work has to be done. It is very important to understand where strengths and weaknesses exist before attempts are made to develop new curricula.

Curriculum Development

Now that these energy concepts have been categorized into broad groupings work can begin on selecting the specific energy concepts to be included in an energy curriculum at each grade level. This should be a building process which requires starting at the lowest grades and working upward.

The following forms provided are designed to help in this process. They will enable you to establish more specific groupings of topics. It is at this point that you and your faculty representatives will actually decide on the scope of the curriculum. You may find that some concepts need not be included and that others will have to be added.

As soon as the concepts to be included have been identified the process of writing objectives can begin. The objectives that each grade level develops should be based on generalizations derived from the concept groupings. Examples of objectives are given to help in this process. Each district's direction will be different and no attempt is being made to establish a uniform program for all schools.

Sample Objectives

Students shall demonstrate:

1. An appreciation for what energy is and its effect on all.
2. A basic understanding of the utilization of energy by the domestic sector, industry, and government.
3. A knowledge of present sources of energy and their implications in regards to availability, application, and potential environmental impact.
4. An understanding of potential sources of energy and their implications in regards to availability, application, and potential environmental impact.
5. A sensitivity for the need to conserve energy as a national priority.
6. An understanding of the many ways individuals can contribute to energy conservation.
7. A responsible attitude toward the use of energy.

Form IIa

ENERGY RESOURCES

This form should be used for each of the energy resources. They are coal, oil, natural gas, nuclear, hydroelectric, tidal, solar, biomass, geothermal, wind, ocean temperature gradients, fusion, hydrogen.

Geographic location or distribution

Present extent of use

Reserves known or estimated

Ease of accessibility

Recovery technology (Where applicable)
  Mining
    Shaft
    Surface
  Drilling
    On land
    Offshore
  Dam Construction
  Sewerage Treatment
  Processing garbage
  Alcohol production
  Electrolysis of water

Concept	Grade Level	Subject Area

Form IIb

ENERGY PRODUCTION

Energy production is actually energy conversion processes which are needed to convert various energy resources into a usable form. These various technologies are necessary for all energy resources.

Combustion Technology
  Coal
  Oil
  Natural gas
  Biomass
  Hydrogen
  Alcohol

Nuclear Technology
  Fission
  Fusion
  Breeder Reactor

Steam cycle-fossil
  Fuel handling
  Boiler design
  Turbines
  Generators
  Cooling spent steam
  Waste handling

Steam cycle-fission
  Reactor
  Primary loop
    Steam Generator
  Secondary loop
    Turbines
    Generators
    Cooling spent steam
    Waste Handling

Steam cycle-new technology
  Geothermal
  Solar
  Fusion
  Biomass
  Hydrogen

Concepts	Grade Level	Subject Area

Form IIb (continued)

	Concept	Grade Level	Subject Area
Hydroelectric technology Rivers Tidal Pumped storage			
Wind Technology			
Ocean Temperature Gradient Technology			
Solar Technology Thermal Low tech High tech Photovoltaic Passive			

Form IIc

ENERGY DISTRIBUTION

	Concepts	Grade Level	Subject Area
Energy can be distributed as fuels in the form of coal, oil, or natural gas or as energy such as electricity or simply used, like solar, because it is available generally.			
Land transportation systems of fuels Rail Truck Pipeline			
Water transportation systems Barges & river systems Tanker, supertankers & freighters-oceans			
Electrical transmission systems			
General local accessibility Solar Wind			

Form IId

ENERGY UTILIZATION

	Concepts	Grade Level	Subject Area
The ways we use energy can be categorized into transportation, homes, factories, and business. Transportation and the home have the most direct affect on our daily lives. Transportation Energy sources or fuels for Airplane Truck Automobile Water routes Efficiency of various systems Dependency of various systems Futuristics Homes Energy sources or fuels for Home heating Water heating Cooking Refrigeration Air conditioning Lighting Other Efficiency of various systems Dependency of various systems Futuristics Factories Energy sources or fuels for Operating machines Maintaining constant temperature of materials Heating raw materials Space heating Other Efficiency of various systems Dependency of various systems Futuristics			

Form IId (continued)

	Concepts	Grade Level	Subject Area
Business (includes stores, offices, schools, hospitals, etc.) Energy sources or fuels for Space heating Air conditioning Water heating Refrigeration Lighting Other Efficiency of various systems Dependency of various systems Futuristics			

Form IIe

ENERGY CONSERVATION

	Concepts	Grade Level	Subject Area
Energy conservation requires innovative thinking and application if it is going to become an "energy resource". It goes far beyond turning off lights and turning down the thermostat. It does not mean going without. It simply means not wasting needlessly. Since transportation is the focal point of our energy problem, it should receive the most attention. Please do not confuse convenience with need.			
Transportation			
Mass transit vs. private transit			
Comparison of various sytems for moving people or goods			
Work schedules which encourage "pooling"			
Priorities for moving goods			
Priorities for moving people			
Scheduling school functions which reduce the need for transportation			
Home			
Insulation to reduce heat loss			
Decreasing infiltration			
Changes in lifestyle			
Using latent heat in water			
Preparing meals			
Use of convenience foods			
Planned shopping trips			
Planned & coordinating family activities			
Others			

Form IIe (continued)

	Concepts	Grade Level	Subject Area
Factories			
Work schedules that encourage energy conservation or use of non-peak demand			
Conversion to energy sources with greater reserves			
Conversion to energy sources which are not used as chemical feed stocks (coal, oil, natural gas)			
Business			
Schedule activities, hours of service, etc. to maximize use of heating or cooling hours			
Establish seasonal schedules to minimize energy requirements			
Conversion to energy sources with greater reserves			
Other conservation considerations			
Use of nuclear energy to conserve fossil fuels			
Use of alternative technologies to conserve fossil fuels			
Development of technologies such as solid state circuits which have resulted in vast energy savings			
Urban planning			

Form IIf

ENVIRONMENTAL IMPACT

	Concepts	Grade Level	Subject Area
Every energy source has or will have an environmental impact. It is important to weigh these impacts against economic factors, social factors, and all other kinds of issues. Air pollution All energy sources Water Pollution All energy sources Noise Pollution All energy sources Special topics Waste disposal Thermal effect Land disturbance or use Population Energy intensive agriculture			

Selecting Materials

The process of selecting specific classroom materials can now begin. It isn't necessary to select all the information for each level; rather, give suggestions or various alternatives that each teacher can use or supplement with his/her own preferred sources.

In selecting possible materials for inclusion, it will become apparent in a very short time that there is a tremendous amount available from a wide range of sources. What is considered for inclusion will depend on the time available and the initiative of each individual teacher, as well as the appropriateness and cost of the materials.

To facilitate the selection of materials and activities, consult the Energy Education Materials Inventory mentioned earlier (page). In no way does it represent everything available on each topic. It represents a place to begin. A wide variety of information is available from the federal government, utilities and energy-related industries, a host of periodicals, special interest groups and other sources.

In the process of material review, the guidelines on the following page might help categorize available materials into broad groupings so that interested teachers will not have to go through the tedious steps of analysis every time they need something for their special project.

MATERIAL REVIEW GUIDE

Material Title____

Source______________________________ Cost:____________

Intended Grade Level Use______________________________

To which content area(s) does it relate?

Energy Resource(s)		
Energy Production		
Energy Distribution		
Energy Conservation		
Energy Use		
Environmental Impact		

Are the materials designed for: Background Information Hands-on Classroom Use

Additional areas of concern should be:
YES or NO

_____1.Adaptable; Can it be easily used in a variety of settings?

_____2.Appeal; Will the intended audience accept the format?

_____3.Adequate; Does it accomplish the stated objectives?

_____4.Appropriate; Do learning modes meet the needs of the target audience?

_____5.Accurate; Does it represent a biased or objective point of view?

Curriculum In-Service

The ultimate success of an energy curriculum will depend on the extent to which teachers are motivated to become involved and actively implement the curriculum. Many teachers will feel that their knowledge of energy is inadequate and therefore will not want to get involved with the topic in the classroom.

These fears can be overcome if workshops are conducted by competent people in the field of energy. These people can be found within the local districts, in various government agencies, in colleges and universities, and in local utilities or energy-related industries. The U.S. Department of Energy sponsors a number of faculty development workshops for this purpose through various colleges and universities.

The National Science Teachers Association has prepared a book entitled Energy Education Workshop Handbook which should be a valuable asset in developing your own in-house workshops. It can be obtained at no cost from U.S. Department of Energy, Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

The initial workshop could consist of a general overview of the energy situation which exists today in the United States and the world. This will provide the teacher with a least a reason to become involved. This session should be positive and should consider present resources and technologies as well as the prospects for future energy alternatives.

A second workshop may then be presented which deals with the curriculum itself. It can be conducted by the people who were actually involved in developing the finished product as well as possible resource people. Details of the curriculum can be explained with suggestions or recommendations for specific methods or activities. If this session is carefully prepared and is as dynamic as possible, it can almost guarantee acceptance of the curriculum by the classroom teachers-especially since teachers will have been involved in the process of creating the curriculum.

Subsequent sessions can then be scheduled to consider questions or difficulties which the teachers have encountered in implementing the curriculum. Incentives can be provided to improve the energy program by encouraging the teachers to develop their own unique energy unit within the framework of the curriculum.

FACILITIES MANAGEMENT GUIDE

ELEMENTARY/SECONDARY LEVEL

Facilities Management Guide

School districts, like all other entities, are experiencing unprecedented increases in operating costs. These costs are not only straining an already sensitive tax base, but siphon off scarce dollars from the real "business" of education in the form of facilities, materials, and top personnel.

Since these operating cost increases are primarily due to rapid increases in the cost of energy, it is imperative that energy be saved. Not only will saving energy stretch the taxpayer's dollars further, but it will help preserve finite natural energy resources for the future.

Business managers, directors of buildings and grounds, principals, superintendents, board members, and other school district personnel have been inundated with books, pamphlets, film strips, stage shows, and a whole host of experts on how they can save energy. Each one has probably attended more than one seminar or conference on energy conservation. Book shelves and drawers are probably filled with material.

The fact remains--few people are doing anything other than talking. A few, a precious few, have rolled up their sleeves in a "hands-on" approach and taken direct action.

Reasons for lack of action are legion. Most excuses fall into the categories of not having enough time, other "more important" items to address first, "I'll get to it soon," etc., etc.

The truth is, energy conservation is a new field. It is unfamiliar ground. Therefore, although those of us in education, on all levels, have been told "WHAT," have been told "WHY," and all know "WHERE," it is still human nature to work with the more comfortably familiar day-to-day chores. Thus, what we generally need to be told in order to begin an energy conservation program is "HOW TO."

In the following few pages we hope to address the question "HOW TO"--implement an energy conservation program for YOUR district, for YOUR school building, for YOUR campus and even some information for YOUR classroom if this is YOUR problem.

The Language of Facilities Energy Management

Maxi audit? Mini-audit? Type A, B, or C audit? Payback? Life cycle analysis?--What on earth are you talking about? "I am an educator! Talk to me in language that I understand," has been the cry of thousands faced with the new task of instituting energy conservation action. Let us begin by defining in less technical language some of the terms used in energy conservation work.

Audit	- Development of historical energy use records and inspection of the building and , equipment to identify ways to conserve energy PEA (Preliminary Energy Audit) - a compilation of building characteristics and historical energy usage data. EA (Energy Audit)-roughly equivalent to a "mini audit". (See below)
Btu	- British thermal unit. A measure of heat energy often used to quantify heat energy given off by equipment or to quantify the energy used by equipment
Capital Conversion	- A major change or replacement of materials or equipment with more efficient materials or equipment, usually involving significant outlay of funds.
Degree Day	- An index relating climate to energy use for heating and cooling. 1) Heating Degree Day-one heating degree day is counted for each degree below 65° reached by the daily average winter temperature. Example: If on a given winter day the high is 40° and the low is 20° , the average is thus 30° . This is 35° below the base of 65° - so, on that day you would have gone through 35 degree days. Over a winter season, your locality may rack up several thousand degree days. 2) Cooling Degree Day- one cooling degree day is counted for each degree <u>above</u> 65° that the daily average temperature reaches in summer.

Electrical Systems	- Lighting, power distribution to panels, motors, and other equipment
Energized Systems	- Equipment requiring an input of energy to do its job, e.g., furnaces, boilers, water heaters, stoves, lighting, machinery, etc.
Envelope	- The shell of the building, including roof, walls, floors, windows, etc.
Footcandle	- A measure of light intensity
Human systems	- Typically the collection of procedures, practices, or habits by which people operate or use energy... e.g., maintenance practices, habits relating to open doors or windows, etc.
HVAC	- Heating, ventilating and air conditioning systems (sometimes simply refered to as "mechanicals".)
Investment	- Capital commitment of money (dollars) required to implement an energy action.
Life Cycle Analysis	- An analysis of an energy-related investment over its entire life relative to all the costs and savings associated with it. This includes energy costs and savings, maintenance costs and savings, depreciation costs and savings, etc.
Maxi audit	- A <u>major in-depth</u> survey of all systems and components of the systems. This would include fans, boosters, pumps, heat exchangers, lighting fixtures, motors, etc. Usually conducted by technical personnel such as engineers (mechanical and electrical).
Mini audit	- A superficial, or "quickie" or "walk through" type of survey. Most attention during a mini audit is given to operation and maintenance activities and historical records of energy use. Frequently conducted by non-technical personnel.
O & M	- Operating and maintenance
Passive Systems (non-energized systems)	- Equipment or material which does not require energy to do its work, but which helps energized equipment perform more efficiently or helps eliminate waste-e.g., insulation, storm windows, weatherstripping, etc.

Payback	- The time required for an investment to pay for itself in savings--of energy and/or maintenance costs.
Quick-fix	- An adjustment or change in operating practice or equipment at relatively little cost in order to improve energy efficiency.
Retrofit	- A modification or addition to existing equipment to improve its efficiency, performance, etc., usually at moderate cost.

Getting Started

There is really nothing magic about saving energy. It is not necessary to grab a lantern and start searching for an "honest man" who can magically point the way. The "outside experts" are not magicians either. They are simply more familiar with mechancial and electrical equipment than the average school administrator, and know how to operate, adjust, or modify that equipment so its uses less energy. These outside experts or engineering consultants can, indeed, be your friends. They should be included in your plans to develop a plan to save energy. However, there are a number of things you can and should do YOURSELF before you hire one.

What you need to do is develop a PLAN OF ACTION. A plan of action will identify in step-by-step fashion those steps you must take to save energy and dollars. Each action will be quantified by identifying the capital required (if any) to implement the action, how much energy will be saved, how many dollars will be saved, and how long it will take to recover the investment payback.

What did you say? "I thought this was going to be a simple 'how to' approach." Yes it is. The plan of action is what we want to end up with. There may be a need for some outside help in putting it in its final form. However, there is a great deal you can do--NOW!, to prepare for the development of the plan and to save energy. You as an administrator, can do a great deal yourself to achieve these ends-----start by conducting a "mini" audit.

The Mini Audit

In a typical school, that is, one built before energy conservation became a major factor in building design, it is possible to save some 15% or more of energy costs through common sense actions and without any significant expense.

Identifying the opportunities and targets for these common sense actions is the purpose of a mini audit, that is, to readily pinpoint those obvious energy wasting features or practices which are immediately amenable to a "quick fix" approach, while providing basic data which may later lead to retrofit or conversion.

In conducting a mini audit, you will simply be involved in assembling a few records and a quick "walk through" survey of the energy-related systems in your building. No complex instruments or special equipment are needed, only the simple tools of eyes, ears, and the sense of touch. One small exception might be a simple light meter. Answers will be sought for such basic questions as, "Where are we using energy?", "What are we using energy for?", and "How effectively are we using energy?"

Help is available through a computer program known as the Public School Energy Conservaton Service (PSECS). The program was developed by and is available through:

Academy for Educational Development
EFL Division
680 Fifth Avenue
New York, New York 10019

This may also be available from your state energy office.

You may also want to obtain copies of the following:

Energy Audit Workbook for Schools
DOE, 1978. 77 pages $2.75
Stock No. 061-000-00157-3
Obtained from: Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

The program takes easily gathered building data from your building and compares it to an existing data base from similar structures, identifying whether the building needs an audit to help bring it into guidelines. For a nominal fee, EFL will provide a basic data form to fill out and send back for them to process.

There will be certain audit tasks which can be performed by the students and faculty, while others must be performed by maintenance personnel, or a building energy management team. The audit procedure laid out in this booklet includes specific suggestions for actions which may be taken by these different groups. The greater and broader the involvement, the better will be the commitment and the results.

The audit consists of the following steps:

1) Develop an "historical base" record of your energy use
2) Survey your building
3) Compile and evaluate the data
4) Set up and implement an action plan

You will note that the "historical base" portion of the mini audit, which involves assembling records on the buildings' energy use, is virtually the same as the "Preliminary Energy Audit" (PEA) outlined under the Department of Energy's Schools and Hospitals Energy Measures and Energy Audits Grants Program (NEPCA, Title III).

The National Energy Conservation Policy Act of 1978, (P.L. 95-619), contains major grants programs to promote energy conservation in four sectors of public and private non-profit buildings constructed prior to April 20, 1977. The Grants Programs for Schools and Hospitals and for Buildings Owned by Units of Local Government and Public Care Institutions (Title III, Parts 1 and 2 of the law) are voluntary activities which provide 50% matching Federal grant funds for programs to be administered by energy offices in each of the 50 States, Puerto Rico, the Virgin Islands, the District of Columbia, Guam, and American Samoa.

Energy will be saved and an ongoing energy "awareness" will be encouraged through four activities which comprise the two major phases of these programs.

The first activity of Phase 1, the preliminary energy audit (PEA), will be a data gathering activity to determine basic information about the number of buildings in each category, number of square feet, primary fuel sources, etc. The second activity, the energy audit (EA), consists of a site visit which confirms and expands on information gathered in the PEA and provides further information to establish a "building profile". The energy audit examines hours of operation, uses of various areas of the building, past energy use patterns and costs, types of windows, etc. This information is used to indicate possible areas for more efficient operation of the building (improved operations and maintenance procedures) and may suggest areas which may benefit from the installation of energy conservation devices.

The first activity of Phase 2 is the technical assistance (TA) audit. This audit consists of a detailed engineering analysis performed by a registered professional, and reports specific costs, payback periods, and projected energy savings resulting from the purchase and installation of various energy saving devices or systems, examples of which would be storm windows, insulation, solar energy systems, automatic setback devices, and so forth.

The TA is the last activity for which local government and public care buildings are eligible for DOE grants.

The final activity, the energy conservation project (ECP) provides for the purchase and installation of energy measures recommended as a result of the TA audit.

The authorized funding for these programs provides money for schools and hospitals, and for local government and public care buildings.

In Phase I, the Department of Energy (DOE) will make grants available to each State to conduct a State-wide program of PEA's in all four categories of eligible buildings, and to States or units of local government and public care institutions or both for conducting EA's. In both Phases the State will be responsible for the overall planning and administration of the grants.

In Phase II, grants will be awarded to eligible institutions in accordance with State-wide plans developed by each State energy office and approved by DOE. Grant applications will be submitted annually to DOE through the State energy offices, who will approve and prioritize them for funding and then forward the applications to DOE for final approval and grant award.

Institutions will be able to use in-kind contributions (such as salaries of personnel and building materials on hand, etc.) to make up all or part of their 50% matching funds. New construction is not included in these grant programs.

-- Under the law, schools would receive a minimum of 30% of the State allocation and hospitals also would receive at least 30% of the allocated monies. The remaining 40% would be available to schools and hospitals based upon recommendations of each State energy office.

-- No State may receive more than 10% of funds or less than 0.5%.

-- Funds granted to a State or individual facility must be matched 50/50 from non-Federal funds.

-- Funds may not be used to repay money expended for any energy conservation project commenced prior to the effective date of NECPA.

-- For schools and hospitals, in cases of hardship (based on financial, severe climate, and fuel availability criteria), 10% of a State's grant allocation will be reserved to pay up to 90% Federal share.

-- Up to 100% Federal share grants may be made to States to conduct PEA's/EA's for schools and hospitals.

In order to make the funds under these programs available as soon as possible, the law requires DOE to publish, within 60 days of enactment, final regulations in the <u>Federal Register</u> for Phase I. Phase II final regulations will be published 90 days after enactment.

For further information on these grant programs, contact:

Institutional Buildings Grants Programs Division
U.S. Department of Energy
Mail Stop: 2H-027
Washington, D.C. 20585

Attn: Audit Grants - NECPA

Even though you may not be planning to participate in this program, the "Preliminary Energy Audit Data" form (Appendix, p. 3.66) provides a handy reference sheet for recording general building characteristics required under the PEA.

The "walk through" portion of a mini audit will generate the same type of data required for "Energy Audits" (EA) under the Grants Program.

Historical Base

Several times we have referred to a percentage savings in energy. What is this a percentage of? Last year's bill from the local utility or utilities? Not quite. Last year's winter may have been unusually cold, leading to a larger fuel consumption for heat. This year may be unusually warm. We might find that our energy consumption for heating is 10% to 18% less this year because it is warmer. Thus we would show a savings in energy without having done anything. Or, we may save energy and end up spending the same or more money since energy rates are escalating. The same type of problem occurs if you have warm summers and the buildings are used year round, requiring air conditioning.

What is needed in order to weed out these misleading factors and give some hard evidence to work with, is to develop an historical base of energy consumption. To do this you need to know the amount of energy used for each of the last three years or more, and compare this to the "need" for energy as determined by climatic conditions.

Simply refer to your file of utility bills paid over the last three years as a starting place. These bills show the total amount of fuel units used (Kwh, gallons of oil, therms or cubic feet of gas) in addition to what you paid. Although monthly determinations are interesting and can be helpful later on, it will be more convenient and useful for most mini audit purposes to figure the total of the bills year-by-year. While you are doing this, you might consider matching your list to your annual budget year, which may be July-June rather than January-December.

Since a large portion of energy use in a building is due to heating or air conditioning, we are going to zero in on our heating fuel to get an idea of "typical" usage, and then do the same for air conditioning. (If your building isn't air conditioned you can obviously skip the air conditioning part.)

Let us begin with the energy used for heating.

Use Chart #1 to record your results. Add up the total energy used for heating (electricity, natural gas, or fuel oil. Obviously, if your building does not use electric heat or fuel oil, skip that portion of the chart.) The figures you are interested in are total Kwh of electricity (kilowatt-hours); total gallons of fuel oil or total "therms" (or cubic feet) of gas used for each 12 month period. (Note: If your building is electrically heated, you probably have a separate electric meter for the heating unit. Use the Kwh consumption figures taken from that meter. Your electric company representative can probably help you arrive at the correct number. If your building is heated with oil, your oil bills will probably show a total delivery rather than specific monthly usage. If you do not have monthly measurements of use, taken directly from your storage tank, you will have to consider the heating season as a whole.) Record the monthly numbers on a separate sheet, add them up, and transfer the totals to the chart.

The first three columns of Chart #1 should now be filled out. Let us do some simple figuring.

Multiply column #3 by the constant shown in the column headings in the chart to convert the unit of fuel into Btu's (column #4).

Divide column #4 by 1,000,000 to get millions of Btu's (abbreviated MM Btu) in column #5.

But you still haven't finished figuring your historical base.

Let us say your building is heated with gas and you have figured the following on your chart:

YEAR	THERMS	MM Btu
1. June - July	68850	6885
2. June - July	72760	7276
3. June - July	58930	5893

To get a realistic idea of typical energy use for heating, and thus have something to base your savings activities on, it isn't enough just to determine the average of the energy used. You also should know how cold it was during each year and factor this into your figures.

For this purpose, you will need to know the total number of heating degree days for the year in question. The map below gives average heating degree day figures for various U.S. locations. The local weather bureau, utility, or library will have a precise record of degree days for your area. However, be cautioned that these records are usually based on January-December years, and you may be working with July-June years. The solution is to get the degree day records on a month-by-month basis and add up the total for the July-June years yourself. Enter the totals on Chart #2, column #3.

Let us say you have done this and your heating day totals look like the following:

YEAR	TOTAL HEATING DEGREE DAYS
1. July - June	6660
2. July - June	6748
3. July - June	5880

CHART #1: HISTORICAL HEATING ENERGY USE CHART

YEAR	DATES	Kwh	Btu (Kwh X 3413)	MM Btu (Btu ÷ 1,000,000)
1				
2				
3				
YEAR	DATES	THERMS OR THOUSANDS OF CUBIC FEET	Btu (Therms X 100,000) or Btu (Cubic Feet X 1,000)	MM Btu (Btu ÷ 1,000,000)
1				
2				
3				
YEAR	DATES	GALLONS	Btu (Gallons X "K")	MM Btu (Btu ÷ 1,000,000)
1				
2				
3				
①	②	③	④	⑤

Note: "k" above = 139,000 for #2 fuel oil or 150,000 for #4, 5, or 6 fuel oil

MM Btu = one million Btu's

HEATING DEGREE DAYS

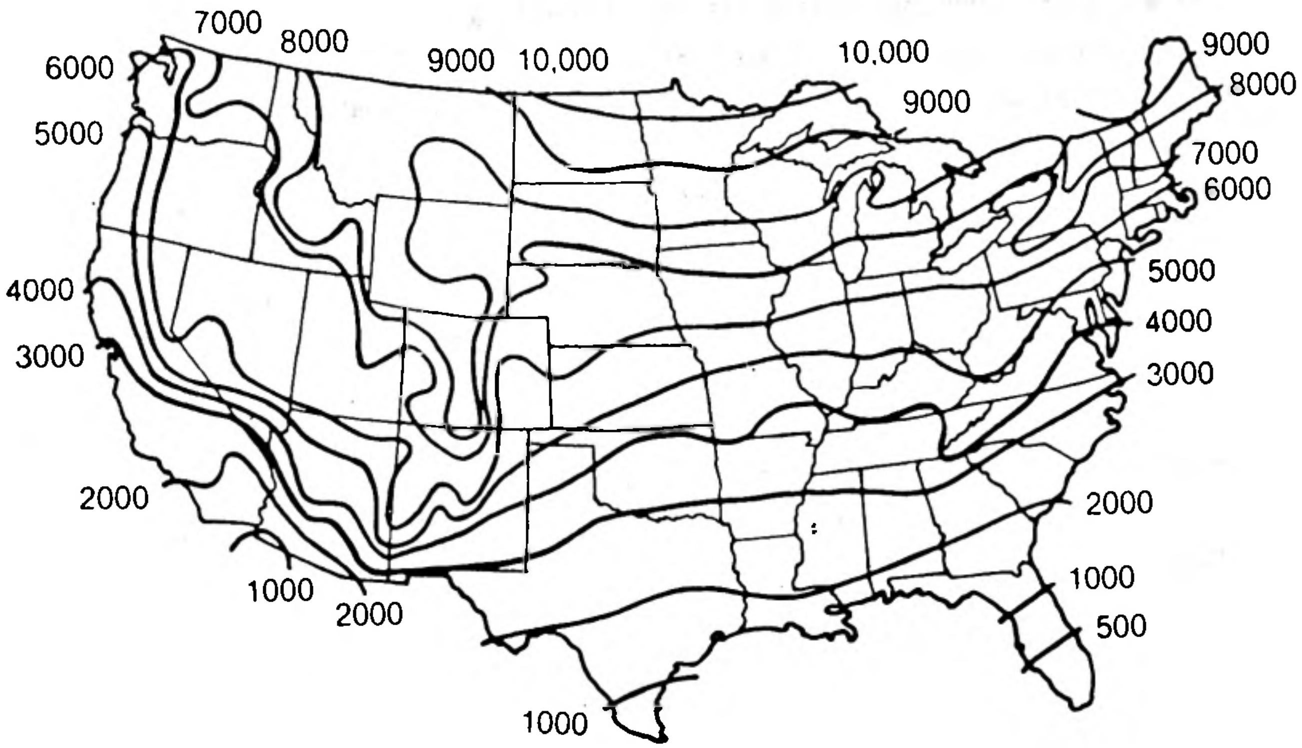


CHART #2: HEATING ENERGY USE HISTORICAL BASE

① Year	② Dates	③ Heating Degree Days	④ MM Btu (Heating Fuel)	⑤ Adjusted MM Btu
1				
2				
3				
				Total ______ ÷ 3
Historical Average Annual HDD: ______			Average Annual Energy Use	______
Building area in sq. ft: __________			Average Annual Energy Use per Square Foot for Heating	______

Note: MM Btu = one million Btu
HDD = Heating Degree Days
Average Annual Energy Use = Historical Base

To find out whether any of these years was colder than normal, you will have to ask the weather bureau or utility what the average number of annual heating degree days has been since they began to keep records. The preceding map provides good "ball park" averages for this purpose.

Let us say, for our example, the average is 6320 heating degree days.

Now we can see that the heating season in years one and two were colder than normal (more degree days) while year three was warmer (fewer degree days).

We can now use these numbers to figure how much energy would have been consumed each year if the heating season had been average.

Back to Chart #2.

Copy the total MM Btu numbers from column #5 in Chart #1 (for your heating fuel) into column #4 on Chart #2.

Now we are going to figure the "adjusted" heating energy used in a typical year, according to the formula.

$$\text{Actual Energy Used X } \frac{(\text{Average Degree Days})}{(\text{Actual Degree Days})} = \text{Adjusted heating energy used in a typical year}$$

Thus for Year 1:

$$6885 \text{ X } \frac{(6320)}{(6660)} = 6534$$

Year 2:

$$7276 \text{ X } \frac{(6320)}{(6748)} = 6814$$

Year 3:

$$5893 \text{ X } \frac{(6320)}{(5880)} = 6334$$

If, for example, year one had been average we would have used 6534 MM Btu of natural gas.

To do this on Chart #2, multiply column #4 by the historical average of heating degree days, then divide by column #3, entering the results in column #5.

The fact that there is some variance in the resulting numbers can be explained by one of several parameters. Some may be differences in equipment efficiencies, breakdown, snow days, differing numbers of days which the school was occupied (or unoccupied), extra activities like basketball tournaments, etc.

Finally, we may find the average of the adjusted number, and that is our historical base.

YEAR	ADJUSTED ENERGY USAGE (MM Btu)
1. July - June	6534
2. July - June	6814
3. July - June	6334
	Total: 19682

$$\frac{19682}{3} = 6560$$ Our heating historical base is 6560 MM Btu/year.

If the goal, as established by the energy management team is to save 10% of the energy used for heating per year, this is:

$$6560 \text{ X } .10 = 656 \text{ MM Btu/year}$$

If we had compared year three with year two, for example--without adjusting the energy used we would have exceeded our goal--without saving any energy.

Finally, you can find out your building's average annual energy use per square foot by dividing your historical base just determined by the total number of square feet in the building.

Why do this?

If you are dealing with several buildings, you should figure your historical base for each building. The average energy use per square foot will then give you a measure of which buildings are least energy efficient on a square foot by square foot basis. Obviously, you would want to concentrate your energy-saving efforts on these buildings first.

If you use a lot of energy for air conditioning (cooling) you can follow the same procedure to arrive at a historical base using "cooling degree days."

Of course, you need to know the amount of electricity used for cooling apart from that used by lighting and other electrical equipment. If your air conditioning unit is <u>not</u> separately metered, this will require some estimating.

Here is how to arrive at a good estimate of Kwh usage for cooling.

If your building is <u>not</u> electrically heated, chances are the January electricity usage is a good representation of your electricity load without air conditioning. So if you subtract your January Kwh usage from your Kwh consumption in each month of the "cooling season", you should have a good idea of the electricity used for cooling.

Referring to the following chart, follow these steps:

1) Look up your March through October monthly Kwh consumption figures for your three historical base period years and enter them on lines 1, 2, and 3 respectively.

2) Look up your January Kwh consumption figures for each of the three years and enter them in the blanks on line 4, 5, and 6.

3) Subtract the January numbers from each of the March through October numbers for each year, entering the results (one column at a time) on lines 7, 8, and 9. (Note: If you are essentially shut down during summer vacation or if March and October are cool or mild months in your climate, you may end up with negative numbers here. If so, simply enter zero for such months.)

4) Add across lines 7, 8, and 9 entering the results in blanks 10, 11 and 12, respectively. These numbers represent your estimated total annual Kwh consumption for cooling.

CHART #3: COOLING ENERGY USE CHART

YEAR		MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	
1	1									
	4	JANUARY Kwh: ____								
	7									Total:
2	2									
	5	JANUARY Kwh: ____								
	8									Total:
3	3									
	6	JANUARY Kwh: ____								
	9									Total:

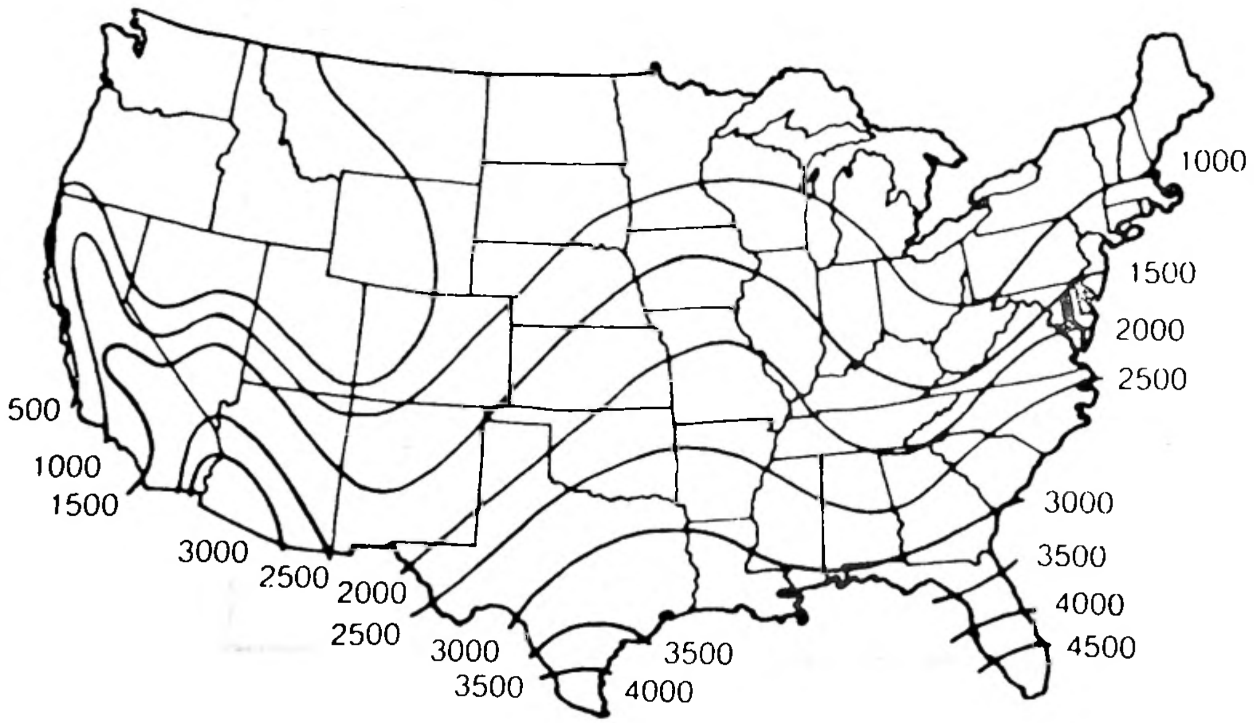
You will now use these figures along with "cooling degree days" to figure your cooling historical base just as we did for heating, using Chart #4.

Chart #4: COOLING ENERGY HISTORICAL BASE

YEAR	DATES	COOLING DEGREE DAYS	KWH CONSUMPTION FOR COOLING	MM Btu	ADJUSTED MM Btu
1					
2					
3					
Historical average CDD: ______				Total	
				Average*	

* Historical base

COOLING DEGREE DAYS



First, find the total number of cooling degree days for each base period year and enter them in column #3.

Next, find your historical average cooling degree days (from weather bureau or utility records, or using the preceding map) and enter it in the blank provided.

Then, enter the estimated annual Kwh consumption for cooling you just figured (items 10,11, and 12 in Chart #3) in column #4.

Now, multiply each number in column #4 by 3413, divide the answer by 1,000,000 and enter the result in column #5.

You are now ready to figure your adjusted annual Btu consumption for cooling.

Multiply each figure in column #5 by the historical average cooling degree days and divide the result by column #3. Enter the final answer in column #6.

If you now total the three numbers in column #6 and divide by 3, you will have your historical base energy consumption for cooling.

You can now add your heating historical base to your cooling historical base to arrive at a total typical annual energy use for heating and cooling.

______________ + ______________ = ______________ MM Btu

Heating Historical Base
Cooling Historical Base
Annual base energy use for heating & cooling

As you did with heating alone, you can divide the number by the total square footage of the building in question to arrive at the typical annual heating and cooling energy use per square foot as a guideline for setting priorities.

The mini audit then will probably show you where you can save enough energy through operation and maintenance activities to achieve a goal of 10% energy savings. And that is without spending any capital money.

Survey Your Buildings

Now that you have some facts and figures to work with regarding your energy use, the time has come to get out there into the buildings and see how that energy is being used. This will involve a survey, or "walk through" . . . the most visible (and interesting) part of your energy audit.

The survey enables you to understand your building in terms of how it is built and how it operates, and to determine which conservation methods are likely to be most effective. It will involve a brief examination of the entire facility to observe, at first hand, what is going on.

Typically, you can divide responsibility for parts of the survey among those involved in the audit efforts or among those on your energy management team roughly along these lines.

For example, faculty and students can do most, if not all, of the survey as it applies to human systems as well as many of the check-outs of the passive systems. Operating and maintenance personnel will probably have to take on the energized systems plus some of the passive systems. There may be some exceptions for both groups.

Several survey forms are included in this manual, covering different areas and systems of the buildings. These are organized so they can be copied and parceled out to different groups or teams. Again, these forms include operating and maintenance items which you will have had to catalog for participation in the D.O.E. Energy Audits Grant Program.

Those which can be entrusted to faculty-student groups are:

- Classrooms
- Enclosed hallways and lobbies
- Bathrooms and gym dressing rooms

Those which should probably be done by experienced operating and maintenance personnel are:

- Offices and administrative areas
- Kitchen
- Large areas
- Equipment

These forms are in simple terms which can hopefully be readily understood by students. The information you sought is both qualitative and quantitative, but relates to that part of the building or equipment the students and teachers come in contact with everyday. In using the forms, they will simply be reporting what they see.

Completing these forms can either be a chore or an interesting experience. It depends on attitude. Are you a task master or a team player?

Refer to some of the motivational ideas in the Implementation Guide for some ways to make your survey an exciting and productive event.

CLASSROOM ENERGY USE AUDIT

Date ________

Building ____________ Room ________ # ________

Auditors ____________________ Outside temperature _____°F

Room size _____ X _____ Ceiling height: ________
length width

Lighting

1. Number of fixtures ________
   Fluorescent tubes? Yes ___ No ___ Number of tubes _______
   Incandescent bulbs? Yes ___ No ___ Number of bulbs _______
2. Total wattage ________
3. Are all lights lit? Yes ___ No ___
4. Is there enough light? Yes ___ No ___
   If lightmeter used, what is reading? __________ foot-candles
5. Does there seem to be too much light? Yes ___ No ___
   Can light levels be reduced and still be comfortable? Yes ___ No ___
6. Is there a problem with light glare? Yes ___ No ___
7. Can you control the lights? Yes ___ No ___
   Number of switches ______
   Number of fixtures per switch _______

Windows, Doors & Skylights

1. Total window area: _____ X _____ X __________ = _____ total sq. ft.
   height width no. of windows
2. Type of windows: Crank-out ___ Sash ___ Fixed ___
   Other (describe) __________________
3. Kind of glass: Single pane ___ Double pane ___
4. Condition
   a. Is glazing putty flaking or loose? _______
   b. Are sashes or panels loose in frame? _______
   c. Do windows close and latch tightly? _______
   d. Is there weatherstripping? _____ Is it in good condition? _______
   e. Is glass cracked or broken? _______

5. Number of exterior doors ______

6. Total door area: ______ X ______ X __________ = _______ total sq. ft.
height width no. of doors

7. Are doors solid? _________ Have glass panes? _______ size? ______

8. Skylights or hatches in ceiling? Yes ___ No ___

9. Number of skylights or hatches? _________

10. Window shading: Venetian blinds ______ Curtains _____
Shades _______ Operating condition ____________

11. Are desks positioned to utilize natural daylighting (without glare or shadows? Yes ___ No ___

Walls and Ceilings

1. Total area of exterior wall: (______ X ______) - __________ = ______ total wall area
length height window & exterior door area

2. Signs of moisture? Yes ___ No ___

3. Walls feel cold or drafty? Yes ___ No ___

4. Color of walls __________

5. Color of ceilings __________

Heating or Cooling Equipment

1. Type of heaters: Radiators _______ Floor registers _______
Wall or ceiling registers _______ Electric baseboard _______

2. Do the heaters work? Yes ___ No ___

3. Is the room too cold? Yes ___ No ___

4. Can you control the temperature in your room (thermostat)? Yes ___ No ___

5. Temperature of room: _____ ° F. Is room comfortable? Yes ___ No ___

6. Thermostat setting (if applicable): ______ ° F

7. Condition

Radiators: Shut off valve works? _____
Any leaks? _______
Clean? ______

Registers: Clean? ______
Open all the way? ______
Obstructed by furniture or equipment? _______

Electric: Clean? ________
Obstructed? _______

8. Are any portable electric heaters ever used? Yes ___ No ___

9. Are windows ever opened to control too warm or too cool conditions? _______

Other Energy Using Devices in Room

1. Motors: (saws, blowers, grinders, mixers, etc.)
List motor-driven equipment in use: ____________________

2. Total motor horsepower: ____________

3. What periods of day are these usually in use? ______________

4. Welders? Yes ___ No ___

5. Kiln? Yes ___ No ___

6. Stoves? Yes ___ No ___ describe ________________

7. Refrigerator? Yes ___ No ___

8. Dishwasher? Yes ___ No ___

9. Other? describe ____________________

Plumbing

1. Sinks? Yes ___ No ___

2. Condition: Leaky hot water faucets? Yes ___ No ___

Locate the following using symbols:
D = Door W = Window H = Heater T = Thermostat
Indicate direction - N = North

Sketch the room

Human Systems

1. Occupancy/use; no. of persons normally in room

8AM-9AM: _____ Noon-1:00: _____
9AM-10AM: _____ 1:00-2:00: _____
10AM-11AM: _____ 3:00-4:00: _____
4:00-5:00: _____

2. Is equipment turned off when not in use? Yes ___ No ___

3. Are windows opened when heat is on? Yes ___ No ___

ENCLOSED HALLWAY & LOBBY ENERGY USE AUDIT

Building ____________________ Date ____________

Wing or location ______________ Outside temperature ____________°F

Auditors ________________________

1. Length of area: _________ Width: __________

2. Rooms opening onto area: Classrooms (no.): ________
   Other: _________

Lighting

1. Number of fixtures __________
   Fluorescent tubes? Yes ___ No ___ Number of tubes _________
   Incandescent bulbs? Yes ___ No ___ Number of bulbs _________

2. Total wattage ___________

3. Are all lights lit? Yes ___ No ___

4. Is there enough light? Yes ___ No ___

5. Is there too much light? Yes ___ No ___
   Can light levels be reduced and still be comfortable? Yes ___ No ___

6. Is there a problem with light glare? Yes ___ No ___

7. Can you control the lights? Yes ___ No ___

Windows, Doors & Glass Area

1. Total exterior glass area: _____ X _____ = _________total sq. ft.
   height width

2. Type of glass: Single pane _____ Double pane _____

3. Exterior entries: #________
   Double door vestibule? ______
   vestibules heated? ______

Heating or Cooling Equipment

1. Type of heaters: Radiators _______ Floor registers _________
   Wall or ceiling registers _______ Electric baseboard _____

2. Do the heaters work? Yes ___ No ___

3. Is the room too cold? Yes ___ No ___

4. Can you control the temperature in the area (thermostat)? Yes ___ No ___

5. Temperature of area: ___° F. Is area comfortable? Yes ___ No ___

6. Thermostat setting (if applicable): ____° F

7. Condition
   Radiators: Shut off valve works? _____
   Any leaks? _____
   Clean? _____
   Registers: Clean? ______
   Open all the way? _____
   Obstructed by furniture or equipment? _____
   Electric: Clean? _____
   Obstructed? _____

Plumbing

Drinking fountains: Total # _____
chilled ______

OFFICES & ADMINISTRATIVE AREAS ENERGY USE AUDIT

Building ____________ Date ____________

Room(s) ________ Outside temperature ________ °F

Auditors ____________________

Room size: ______ X ______ ____________
length width ceiling height

Lighting

1. Number of fixtures ________
   Fluorescent tubes? Yes ___ No ___ Number of tubes ______
   Incandescent bulbs? Yes ___ No ___ Number of bulbs ______
2. Total wattage ________
3. Are all lights lit? Yes ___ No ___
4. Is there enough light? Yes ___ No ___
5. Is there too much light? Yes ___ No ___
   Can light levels be reduced and still be comfortable? Yes ___ No ___
6. Is there a problem with light glare? Yes ___ No ___
7. Can you control the lights? Yes ___ No ___
   Number of switches ______
   Number of fixtures per switch ______

Windows, Doors & Skylights

1. Total window area: _____ X _____ X __________ = ______ total sq. ft.
   height width no. of windows
2. Type of windows: Crank-out ________ Sash ______ Fixed ______
   Other (describe) ________________
3. Kind of glass: Single pane _____ Double pane ______
4. Condition
   a. Is glazing putty flaking or loose? ______
   b. Are sashes or panels loose in frame? ______
   c. Do windows close and latch tightly? ______
   d. Is there weatherstripping? ________ Is it in good condition? _____
   e. Is glass cracked or broken? ________

5. Number of exterior doors ______
6. Total door area: _____ X _____ X __________ = ______ total sq. ft.
   height width no. of doors
7. Are doors solid? ________ Have glass panes? _____ size? ______
8. Skylights or hatches in ceiling? Yes ___ No ___
9. Number of skylights or hatches? ______
10. Window shading: Venetian blinds ______ Curtains ________
    Shades _______ Operating condition _________

Walls & Ceilings

1. Total area of exterior wall: (_____ X _____) - _______ = _____ total wall area
   length height windows & exterior door area
2. Signs of moisture? Yes ___ No ___
3. Walls feel cold or drafty? Yes ___ No ___
4. Color of walls ________
5. Color of ceiling _______

Heating or Cooling Equipment

1. Type of heaters: Radiators _______ Floor registers _________
   Wall or ceiling registers _______ Electric baseboard _____
2. Do the heaters work? Yes ___ No ___
3. Is the room too cold? Yes ___ No ___
4. Can you control the temperature in the room (thermostat)? Yes ___ No ___
5. Temperature of room: ____ °F. Is room comfortable? Yes ___ No ___
6. Thermostat setting (if applicable): _____ °F
7. Condition
   Radiators: Shut off valve works? _____
   Any leaks? _____
   Clean? ______
   Registers: Clean? _______
   Open all the way? ______
   Obstructed by furniture or equipment? ________

Electric: Clean? ________
Obstructed? ________

Other Energy-Using Devices in Room

Copying machine or mimeograph ____________
Typewriters (#) ________
Other (describe) ____

Are business machines turned off at end of work day? Yes ___ No ___
Resistance heating device used (space heaters, coffee pots, hot plates)?
Yes ___ No ___

BATHROOM & GYM DRESSING ROOM ENERGY USE AUDIT

Building ____________________ Room ____________ Location __________
Date __________________ Outside Temperature _____°F Auditor ___________

Bathroom

1. Number of sinks ________
2. Leaks from hot water faucets? Yes ___ No ___ #____
3. Hot water temperature (use lab thermometer) ______
4. Exhaust fans running? Yes ___ No ___
Tied to light switches? Yes ___ No ___
5. Lighting:
   a. Number of fixtures ____________
   b. Fluorescent tubes? Yes ___ No ___ Number of tubes _________
   c. Incandescent bulbs? Yes ___ No ___ Number of bulbs ________
   d. Total wattage ____________
6. Room temperature ____________°F
7. Windows, doors & skylights
   a. Total window area: _____ height X _____ width X ______ no. of windows = _________ total sq. ft.
   b. Type of windows: Crank-out ______ Sash _______ Fixed _____
   Other (describe) __________________________
   c. Kind of glass: Single pane ____ Double pane ____
   d. Condition;
      1) Is glazing putty flaking or loose? _______
      2) Are sashes or panels loose in frame? _______
      3) Do windows close and latch tightly? ________
      4) Is there weatherstripping? _______ Is it in good condition? ______
      5) Is glass cracked or broken? ________
   e. Number of exterior doors _______
   f. Total door area: ______ height X _____ width X ___________ no. of doors = _______ total sq. ft.
   g. Area doors solid? ________ Have glass panes? _______ Size? ______
   h. Skylights or hatches? ___________

Dressing Rooms

1. Number of sinks ________
2. Number of shower heads ________
3. Flow restrictors on showers? Yes ____ No ____
4. Leaks from hot water faucets? Yes ____ No ____ # _________
5. Leaks from shower heads? Yes ____ No ____ # ______
6. Cold water detergents used for towel or uniform washing? Yes ____ No ____
7. Exhaust fans? Yes ____ No ____
8. Lighting
   a. Number of fixtures _________
   b. Fluorescent tubes? Yes ____ No ____ Number of tubes ________
   c. Incandescent bulbs? Yes ____ No ____ Number of bulbs ________
   d. Total wattage _________
9. Shower use schedule (note peak use hours): ______________________________

____

KITCHEN ENERGY USE AUDIT

Building __________________________ Room ______________________

Date ________________________ Outside temperature ________°F

Auditor _____________________________________

Cooking equipment

1. Gas or electric? ___________________
2. Number of burners ______________
3. Number of ovens ____________
4. Infrared warmers? Yes ___ No ___ #_________
5. Toasters: Yes ___ No ___ #_______
6. Other: ___________________________
7. Are ovens used to thaw or cook food while preheating? Yes ___ No ___
8. Is equipment turned off when not in use? Yes ___ No ___
9. Are lids used on cooking equipment? Yes ___ No ___
10. Are exhaust hoods used only while cooking? Yes ___ No ___

Refrigeration

1. Number of units ___________
2. Total capacity: _________ cubic feet
3. Can fewer units be used? Yes ___ No ___
4. Condenser coils clean? Yes ___ No ___
5. Defrosted? Yes ___ No ___ - - - on regular basis? Yes ___ No ___

Heating/Cooling

1. Temperature of kitchen: When cooking ________°F Other times ________°F
2. Thermostat setting __________°F

Lighting

1. Number of fixtures ________
   Fluorescent tubes? Yes ___ No ___ Number of tubes ___________
   Incandescent bulbs? Yes ___ No ___ Number of bulbs ___________
2. Total wattage ____________

LARGE AREA ENERGY USE AUDIT

(GYMNASIUM, CAFETERIA, AUDITORIUM, ETC.)

Building ____________ Date __________

Room ________________ Outside temperature ________°F

Auditor ____________________

Lighting

1. Number of fixtures ________
   Fluorescent tubes? Yes __ No __ Number of tubes _____
   Incandescent bulbs? Yes __ No __ Number of bulbs _____
2. Total wattage ______
3. Are all lights lit? Yes __ No __
4. Is there enough light? Yes __ No __
5. Is there too much light? Yes __ No __
   Can light levels be reduced and still be comfortable? Yes __ No __
6. Can you control the lights? Yes __ No __
   Number of switches _____
   Number of fixtures per switch ______

Windows, Doors & Skylights

1. Total window area: ____ X ____ X ________ = ____ total sq. ft.
   height width no. of windows
2. Type of windows: Crank-out ____ Sash _____ Fixed _____
   Other (describe) ____________________
3. Kind of glass: Single pane _____ Double pane ______
4. Condition
   a. Is glazing putty flaking or loose? _____
   b. Are sashes or panels loose in frame? _____
   c. Do windows close and latch tightly? _____
   d. Is there weatherstripping? ______ Is it in good condition? _____
   e. Is glass cracked or broken? ______
5. Number of exterior doors _____
6. Total door area: ____ X ____ X ________ = ______ total sq. ft.
   height width no. of doors

7. Are doors solid? ______ Have glass panes? ______ size? ______
8. Skylights or hatches in ceiling? Yes __ No __
9. Number of skylights or hatches _____

Heating/Cooling

1. Temperature of room: ______°F
2. Thermostat setting: ______°F

EQUIPMENT ENERGY USE AUDIT

Building ____________________ Date ______________

Auditor ____________________

Heating Maintenance Checklist

a. Fans
- Operating correctly? ______
- Blades clean? ______
- Bearings lubricated? ______
- Drive belts in good condition? ______
- Motors aligned? ______
- Motors operating properly? ______
- Inlet screens clean? ______

b. Burners
- Couplings adjusted? ______
- Heat exchanger surfaces clean? ______
- Air-to-fuel ratio okay?(check stack for smoke) ______
- Burners clean? ______
- Stack temperature okay? ______
- Solenoid valves okay?(check if fire cuts off immediately when unit shuts down) ______
- Burners firing properly? ______
- Gas pilot on during summer? ______

c. Steam Systems
- Check applicable items under "burners" above.
- Steam traps okay? ______
- Shut-off valves working? ______
- Scale deposits or sediment in boiler? ______
- Adequate combustion air in boiler room? ______

d. Electric
- Elements clean? ______
- Working properly? ______

Cooling Maintenance Checklist

a. Fans
- Check applicable items under "fans" above.

b. Compressors & pumps
- Chillers clean? ______
- Condenser coil faces clean? ______
- Compressor valves okay? ______
- Refrigerant level okay? ______

Heating & Cooling Operation

1. Is ventilating and/or cooling system shut down at night and on weekends? ______
2. Are unused areas heated or cooled? ______ Are storerooms, garages, or platforms heated? ______
3. Can exhaust air quantities be reduced? ____________________
4. Is building normally preheated on winter mornings? ______ How long before opening? ______
5. How long after end of day is system turned off or set back? ____________________
6. Does air conditioning ever come on when it is as cool as 50°-55° outside? ______
7. Can heating and air conditioning operate simultaneously? ______

Air Handling System

1. Outside air dampers in good repair? ______
2. Position indicators correct? ______
3. Filters dirty? ______ Replaced on regular schedule? ______
4. Leaks in ductwork? ______
5. Obstructions or loose items in ductwork? ______
6. Ductwork insulated? ______ ______%

Compiling and Evaluating

Let us assume your survey "event" is concluded and you now have a stack of audit forms staring you in the face.

How can you compile these into some meaningful information and then turn this information into some definite "quick-fix" energy saving steps?

Keep in mind the purpose of this mini audit.

You want to learn where the most severe problems are. Or in other words, where energy is being misused or used inefficiently. This may be drafty windows, thermostats which don't control unit ventilators (heaters), insulation missing or damaged, and exposed piping, or perhaps classrooms inadequately illuminated with too many incandescent lamps. If you are dealing with several school buildings, you will want to pinpoint those which are the most inefficient energy users in order to concentrate your efforts on those buildings first. The "Btu's per square foot" figures developed for each building will give you a good idea of where to start.

It will be seen that there are literally dozens of items in this category if the audit has been objective. The sum total of energy saved from this action will be significant.

The first thing to do is summarize audit results for similar systems and equipment throughout the building.

For example, look first at lighting.

Do the auditors tend to report light levels that can be reduced? What about light levels in hallways? Aside from the obvious move of turning off lights when not in use, you may be able to eliminate some of the lighting by simply removing some of the light bulbs or tubes. There is a chance for some energy savings.

Eliminating extra lighting can be a subjective "common sense" approach. For example, is there too much lighting in corners or hallways where people aren't working? Approach it by thinking in terms of how much lighting is necessary for the task. You don't want to cause eyestrain, but many buildings are "over lit" today.

Of course, if you want to be exacting about it, you can obtain a light meter and check foot-candle levels in various areas. You can probably borrow one from a high school physics lab or your local electric company. They are inexpensive and easy to operate. Comparing these to the "Recommended Lighting Levels Chart" in the Appendix p. 3.58) will tell you if you can reduce lighting. (Note: This chart is prepared by the Illuminating Engineers Society and is referenced by many state codes. However, you may want to double check your particular state's lighting code.)

What about the windows? Do reports indicate a trend of loose, leaky windows? New weatherstripping might be in order.

Information gained on room temperatures may indicate the need to lower thermostats. (They should be set at 65° to 68° in winter, 78° in summer.

Comparing your reports to the long list of energy-saving tips included in the Appendix ("Facilities Quick-fix Conservation Tips," p 3.59) will give you some good clues as to where to direct your efforts. Your average annual Btu per square foot figures for each building (Chart #2, p. 3.13) will tell you which buildings to start with.

The audit reports will also pinpoint obvious operating and maintenance tasks which should be done. As you check over each report, keep a master list of specifics, such as leaky radiators, broken windows, leaky hot water faucets, etc. These are items you will want to get to right away.

Also, check out occupany, room, and equipment use schedules. You may want to adjust schedules so certain energy-consuming devices aren't used all at once (e.g., kilns in art class and power tools in shop). Are there some rooms used only at certain times of the day or week for current programs? If so, they may be able to be closed and heating turned down at "off" times without curtailing your educational program.

The idea, then, is to be both an accountant and a detective when compiling your audit reports. Take useful notes of the specific maintenance items that need fixing, as well as be on the lookout for broad trends.

It is these latter, broad trends, that can save you real energy dollars.

Let us say that your examinations have uncovered some general factors that may lead to energy savings-such as those noted earlier-leaky windows, opportunities to set back thermostats, a chance to reduce lighting, etc. How can you tell whether direct action is warranted in terms of energy-saving potential? What actions would have more priority?

Obviously, "common sense" maintenance items which have little or no extra cost and which require little staff time or effort should be done right away. Things like leaky hot water faucets, dirty air registers, rescheduling to make most efficient use of heated space, etc., are generally good housekeeping items that help to save energy. It would be difficult to quantify potential energy savings from such items-and really unnecessary. You know they will save some energy and will help you toward your goal. They are generally a good idea, anyhow. Review your "master list" of maintenance tasks gleaned from the audit reports, consider the "Quick-fix" energy saving tips list included in the Appendix (p. 3.59) and prepare for your school or district a tasks list of maintenance jobs necessary to get everything ship-shape.

Other actions suggested by the audits may take some closer evaluation. They may cost a significant amount of money, take up a comparatively large fraction of staff time or tend to disrupt routines or cause a certain amount of discomfort (at least at first). Several such actions may present themselves for consideration, all of which might not be a good idea to do all at once for reasons of budget or human relations.

When you have to pick and choose among such alternatives, you should obviously arrange them in order of which ones will save the most energy. Obviously, those with the highest potential savings should be done first.

One piece of information you will need in order to evaluate candidate energy-saving actions is to find out how much energy each action will save. This requires making some calculations.

These calculations will in general take into account all energy-using aspects of the system you are considering changing or upgrading (lighting, weatherstripping, etc.). This energy use is converted into Btu's-both for "before" and "after" situations. The difference between "before" and "after" Btu use is the estimated energy savings-which in turn can be used to estimate cost savings.

To arrive at a cost savings estimate, you will of course need to know what you have been paying for energy on a Btu-by-Btu basis.

The following simple formula will give you the answer you need. You will have to use the formula separately for each type of fuel you use.

Refer to your records and enter the total fuel bill paid for the most recent year (Year #3 as used in developing Chart #1). Enter this total in blank #1 of the formula.

1 ____________ ÷ 2 ____________ = ____________

Year #3 total fuel bill — Year #3 total MM Btu used — Average $ per MM Btu

Average fuel cost per MM Btu	
Electricity	
Oil	
Gas	

Refer to Chart #1 (p. 3.12) and enter the total MM Btu used for year #3 (not the average figure) in blank #2 of the formula.

Divide blank #1 by blank #2 and enter this result in blank #3.

Do this for each fuel you use, and enter the result from blank #3 in the chart. How do these numbers compare to the national averages given in the General Introduction (page IX)?

You can now use these cost savings along with your "before" and "after" Btu use estimates to get an idea of what sort of cost savings each energy conservation measure might mean.

You may need some technical assistance in making such calculations.

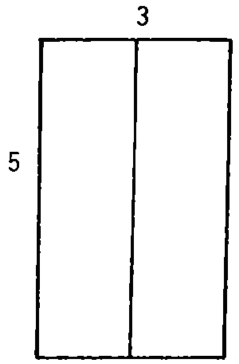
Several example evaluations of candidate energy-saving measures are presented here, of dozens that could be used. Of course, you can use the formulas and procedures in the examples in your own evaluations if you are considering the same energy-saving measure.

Example No. 1: Weatherstripping

Whenever windows leak air from the outside, energy must be expended in heating this air up to room temperature. If you can reduce the amount of air leakage, or "infiltration" as it is called, you can save energy. The quickest, easiest and least expensive way to do this is by adding weatherstripping. This is an action that can probably be done by your own maintenance people at little extra cost-often for material cost alone. Of course, you can hire an outside contractor to do the job, but that will cost more. Regardless, the cost may still be worth it. The key is in how much energy your weatherstripping project will save.

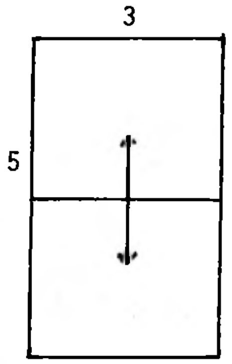
An exacting analysis of potential savings will require some outside technical help-but you can make your own estimate based on the following procedure. This procedure is based on the typical amount of air infiltration experienced by windows of different types. All you have to do is pick which category your windows fall under and count the number of windows in your building.

Let us say for example, you have 100 windows in your building, and that they are type "A" windows from the chart below.



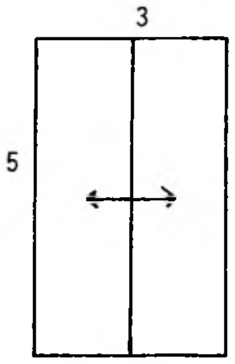
A

Steel or
Aluminum
Casement



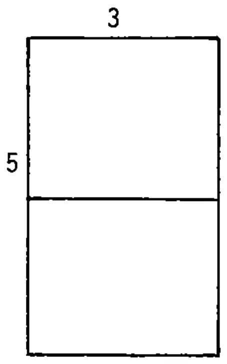
B

Steel or
Aluminum
Double Hung



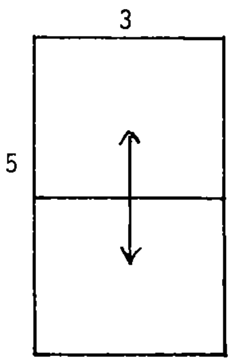
C

Steel or
Aluminum
Sliding



D

Steel or
Aluminum
Pivoted or
In-swinging

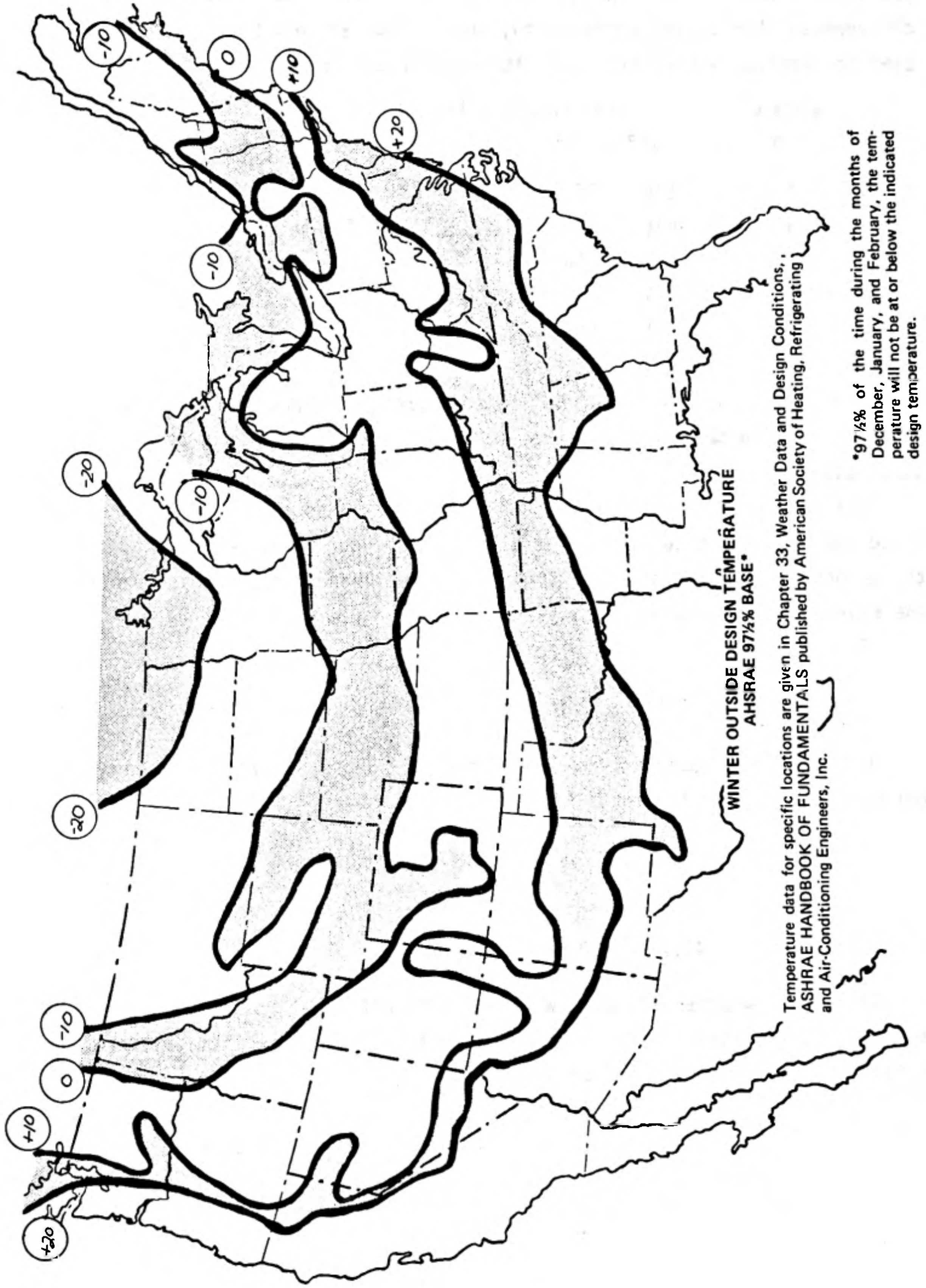


E

Wood Double
Hung

(Note: Estimates on this example are based on an average 3' X 5' window.)

The amount of energy spent in heating infiltrated outside air of course depends on your climate. From the map following, choose the winter temperature for your area.



WINTER OUTSIDE DESIGN TEMPERATURE
AHSRAE 97½% BASE*

Temperature data for specific locations are given in Chapter 33, Weather Data and Design Conditions, ASHRAE HANDBOOK OF FUNDAMENTALS published by American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

*97½% of the time during the months of December, January, and February, the temperature will not be at or below the indicated design temperature.

Got it? Then subtract this from your indoor temperature to arrive at you temperature difference. (Example: 65° indoors - 15° outdoors = 50° difference) Now to the chart below, which gives you Btu per hour of energy used for various window types and temperature differences.

WINDOW TYPE	TEMPERATURE DIFFERENCE 60°	50°	40°	30°	10°
A	846	705	546	423	141
B	618	515	412	309	206
C	1025	854	684	513	342
D	219	183	146	110	73
E	618	515	412	309	206

For window type "A" and a 50° temperature difference, each window requires 705 Btu per hour of energy to heat the incoming air to room temperature.

But hold on! The wind must be blowing at a window for it to leak air. Since the wind can't be blowing at all sides of your building at once, divide the number of windows in your building by two. Then multiply this number by the Btu-per-hour-per-window you just found.

For example:

100 windows ÷ 2 X 705 Btu/hour = 35,250 Btu/hours

Let's say your building is heated for 1400 hours per year. The energy you stand to save is the total Btu/hour X total hours. In the example:

35,250 Btu/hour X 1400 hours = 49,728,000 Btu

Or

49.7 MM Btu

Of course, weatherstripping won't be 100% efficient in stopping air leakage. Let us say it is 50% efficient. Then you can realistically expect to save half the amount or, from our example:

24.9 MM Btu

If you are heating with gas at an average cost of $2.53 per MM Btu, you stand to save $63 over the heating season. Remember, this example is for a relatively small building with only 100 windows.

Example No. 2: Thermostat setback

As another example, let us say that audits of room temperatures and thermostat settings indicate there is room to turn heating thermostats back to the nationally recommended 65°.

How much energy is saved? You can figure your potential savings by using the historical base (Chart #2) and your average outside temperature (from the map in the previous example) in the following simple formulas:

$$\text{Energy consumed at new setting (MM Btu)} = \text{Historical base X } \frac{(\text{Setback temp. - Outside temp.})}{(\text{Current temp. - Outside temp.})}$$

Energy saved (MM Btu) = Historical base - New energy use

$$6560 \text{ X } \frac{(65^\circ - 15^\circ)}{(72^\circ - 15^\circ)} = 5753 \text{ MM Btu}$$

Savings would be: 6560 - 5753 = 807 MM Btu

Gas heat at $2.53 per MM Btu gives a significant annual saving of $2041.71

See why everyone keeps telling us to "dial down"!

Example No. 3: Reduce lighting level

Suppose lighting levels are too high as determined by your survey (with or without a light meter), and you can remove or disconnect several unnecessary lamps or fixtures. (Note: Do not remove fluorescent lamps without disconnecting the ballasts.)

Let's say you feel you can remove a total of 50 bulbs from hallways or classrooms.

If the bulbs are 75 watts and are typically on for 10 hours per day, the energy saved will be:

50 bulbs X 75 watts/bulb X 10 hrs/day = 37,500 watt-hr/day

37,500 watt-hr/day X 260 days/year ÷ 1000 watt-hr/Kwh = 9750 Kwh/year savings

From your historical base chart, let's say your average cost of electricity per KWh is $0.04.

Your annual dollar savings is thus:

9750 KWh/yr saved X $0.04/KWh = $390/year savings

Let's say your average annual total KWh use is 97,500. That means your action is predicted to save 10% of the electric energy . . . and dollars.

Example No. 4: Use more efficient lighting

Gymnasiums and other such large areas require a lot of light to keep them bright enough for activities such as sports events, physical education classes, assemblies, etc. Replacing conventional bulbs with more efficient ones can give you enough light while you save energy.

For example, let's say your gymnasium is lighted with 24 - 1000 watt incandescent lights, or a total of 24,000 watts. Let's also say you figure the lights are in use 3000 hours a year (including weekends and evenings).

Suppose you replace these lights with 12 - 400 watt metal halide lamps (which will provide the same lighting level). Including an allowance for energy consumed by the lamp ballast, the metal halide total wattage is 5760 watts.

The savings in required wattage is:

24,000 - 5760 = 18,240 watts or 18.24 kilowatts (KW)

Multiplied by the 3000 hours of annual use, we arrive at an annual electric energy savings of:

18.24 KW X 3000 Hours = 54, 720 KWh

At a cost of electric energy of $0.04 per Kwh, the annual savings is: $2,189

This would definitely be an energy measure to consider!

Example No. 5: Hot water temperature setback

At what temperature is your hot water set? 160°? 180°? For most purposes, 105° is warm enough except for dishwashing. How much energy can you save by turning back your hot water thermostat?

National daily hot water consumption averages per student are:

* 0.6 gallons/student/day for elementary schools
* 1.8 gallons/student/day for junior and senior high schools

Let's say your school is a senior high with 1000 students.

Let's say you use gas to heat water to 160°, at an average energy cost of $2.53 per MM Btu.

The annual hot water consumption is:

1.8 gallons/student/day X 1000 students X 180 class days/year = 32,400 gallons/year

The energy savings at 110° F:

32,400 gallons/year X (160° - 110° = 50°) temperature difference X 8.34 (constant) ÷ 1,000,000 = 13.5 MM Btu/year savings

Cost savings are then:

13.5 MM Btu/year X $2.53 MM Btu = $34.16 saved per year

You get the idea. The steps in analyzing the savings potential of a particular action are:

1) Determine, using energy use and conversion factors, the amount of energy saving per year.
2) Convert this to a cost savings.

Some handy conversion factors are included in the Appendix (p. 3.56).

The Concept of Payback

Now that you have some candidate energy conservations steps analyzed as to their savings potential, how do you order them in some priority?

Do you place as first priority the one measure that gives the highest dollar savings? Perhaps, but not necessarily. You must first consider the initial cost of the action. It might be that it will take too long to recoup from savings the "first cost".

Enter the concept of "payback".

Simple payback analysis puts in perspective the savings versus cost. As noted, those measures with little or no cost don't need such careful analysis-you can do them now and begin reaping the benefits immediately. Higher cost items need some scrutiny.

Obviously, you will need to know the cost of your candidate action-from bids, estimates, etc.

Your annual dollar savings is thus:

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Obviously, you will need to know the cost of your candidate action-from bids, estimates, etc.

The basic formula for determining simple payback period is:

$$\frac{\text{Total initial cost of the change (\$)}}{\text{Annual cost savings (\$/year)}} = \text{Payback years}$$

Using this formula, what is the payback for our four examples above?

Example No. 1: Weatherstripping

Say the cost in labor and materials is $500. The payback period is:

$$\frac{\$500 \text{ cost}}{\$63 \text{ annual savings}} = 7.9 \text{ years}$$

Example No. 2: Thermostat setback

Labor cost is effectively zero, so the payback period is zero-or immediate.

Example No. 3: Lighting reduction

Say the cost of labor (10 hours X $6/hr) is $60. The payback is:

$$\frac{\$60 \text{ cost}}{\$390 \text{ annnual savings}} = 0.15 \text{ years (just under two months)}$$

(Note: If the "labor cost" of an item is that of your own staff, consider that the staff is on a regular salary regardless of exactly what they are doing. That is, would they be paid for the time they spend in, say, removing extra light bulbs, regardless? Your business manager can tell you whether it is a standard practice to charge portions of existing salaried labor to a particular job or not.)

Example No. 4: More efficient lighting

Say the cost in labor and materials is $500. The payback is:

$$\frac{\$500 \text{ cost}}{\$2189 \text{ savings}} = 0.23 \text{ year (a little under 3 months)}$$

Example No. 5: Hot water temperature setback

Cost is effectively zero, so payback is immediate here as well.

Obviously, items two and five are of higher priority than the others. Following them would be (in order of priority), items 3, 4, and 1.

It should be apparent that the concept of payback becomes more important when analyzing certain "phase two" measures involving retrofitting or capital conversion . . . items like upgrading insulation, adding storm windows, installing new and more efficient furnaces, etc. Items such as these are typically examined in more detail when performing "maxi" audits which examine equipment in more detail.

The basic payback formula given above is admittedly very simplified. It does not take into account interest costs on borrowed money, inflation, increasing fuel rates, etc. However, it is a useful method for ranking proposed conservation alternatives in order of priority.

A more reliable method is "life cycle costing", which allows you to examine costs over a period of time, taking into account inflation, changing utility rates, and other factors.

Analysis of retrofit or capital conversion actions would use such methods, and may require the assistance of an accountant.

Suffice it to say the simple payback method shown will suit your purposes quite well for weighing those conservation measures uncovered during the mini audit.

Prepare Your Action Plan

Assuming that at this point you have compiled a list of alternative conservation actions composed of low cost maintenance-type actions, plus those requiring a relatively modest dollar outlay and have computed their payback periods . . . what is next?

Step 1. Immediately implement very low-cost actions or changes after due consultation with those employees who will be directly affected by any changes. Remember discussions and negotiations with building occupants is appropriate.

It is suggested that you keep a log patterned after the example on the following page. The log should show:

* the task to be done
* the targeted schedule for completion
* the person whose responsibility it is to accomplish the task (designee or volunteer from the Energy Management Team)
* the estimated cost of the task
* the actual cost
* the estimated energy and dollar savings per year (based on your evaluation figures where applicable)
* payback period (if applicable)
* the actual date of completion

Such a log will give you an up-to-the-minute record of your program from which to report progress and audit your schedule.

CONSERVATION ACTION LOG

Task	Completion Target Date	Responsibility	Estimated Cost	Actual Cost	Estimated Savings		Payback Period	Completion Date	Comments
					Energy Units	$			

Step 2. Choose those conservation measures requiring investment in materials or equipment which appear most suited to your educational program and building and rank them according to their payback times.

Enter these in the log after those covered in step one and implement each one according to available funds and management policies.

You will note that at some point the cumulative cost and scope of your measures will perhaps exceed the budget dollars and jurisdiction over which you have sole discretion. Further expenditures will likely require board or district approval. (Some of these measures may be entered into the log as a result of a subsequent maxi audit.)

If so, your log will give you the basis to prepare a proposal for the board or district, which would include the measures proposed, the cost, the expected energy and dollar savings, and the estimated payback period.

Step 3. Periodically review and update changes and lists in light of reduced operating costs and changes which have been made, new budget years, etc.

Along these lines, you should continue to annually update your historical base chart to see if you are saving energy as a result of your action.

Such reviews provide the basic information for progress reports, awards, incentives, etc., as noted in the Implementation Guide.

Step 4. Report periodically to the district or board on what has been done and the results.

This report might take the following form:

1. Introduction - Why the energy management team was formed.
2. Objectives - To establish an energy conservation plan-of-action.
3. Findings - Education Objectives
   Technical Objectives
   Energy Actions (list each and the approximate energy to be saved from each)
   Total energy to be saved. Express as a percent of the historical base.

4. Conclusion & Recommendations - It can be done! Accomplishments to this point should be significant, both educationally and technically. The team can and should continue to function. As a minimum, the team needs to monitor the results of the actions which have been implemented. Where for example, the decision was made to turn the thermostats down the team needs the cooperation of the students, staff, and parents to achieve success. Therefore, an educational campaign is necessary, and it must be on-going to continually make people aware of the need to save energy. The "Preliminary Energy Audit Data" form (Appendix, p. 3.66) may be useful in preparing your report by giving an overall view of each buildings characteristics.

The Maxi Audit

The mini audit has defined obvious energy actions-those that a layman can see and understand. There is more that can and should be done. When the mini audit actions have been accomplished you are now ready to begin a maxi audit. For this you probably will need to call upon outside help. This usually will include any technical advisor you may have been working with already. Additional technical help should also include mechanical and electrical engineers, and in some cases an architect. Since approximately 75 - 90% of the work is engineering, the engineers will probably become the prime consultants.

The consultant you choose should be an engineer with experience in doing this type of work.

To locate such a person or firm:

1) Check other districts, colleagues, or local, regional, or state school administrators associations for recommendations.

2) Your local electric or gas company may be willing to provide you with a list of those in your area who offer reliable energy auditing services (though they will likely not be in a position to give you a specific referral of one firm over another).

3) There is always the Yellow Pages. Interview several and ask for cost estimates for their services as well as a list of references . . don't be bashful about checking those references!

It will be the consultants' job to perform a system analysis of the building(s). Since you will not be doing this work yourself, and since the consultants hopefully know what they are doing and have had some experience, it is not necessary to discuss in detail how and why they do what they do. It is worthwhile, however, to provide an outline of this activity. After all, you will write the contract with them and need to know what you are hiring them to do.

The consultants will be able to build upon the basic work of your committee. They will make use of the historical base and the mini audit. (This should save them time--and reduce your costs.) They will charge you based upon total time required to perform the work. Anything you can do to help them will help you. Be prepared to provide plans of existing buildings to the consultants. These do contain very valuable information. Without them a great deal of additional time may be required on behalf of the engineers and this means a higher cost to you.

With the plans, the consultants will be able to determine the building heating and cooling (if any) requirements as the building is being used NOW. This recognizes that frequently buildings are used differently than that contemplated during design. Classrooms change: they may be made into offices; chemistry rooms become English rooms; gymnasiums become classrooms; etc. This data, along with actual information gathered on the building, the various systems within the building, and equipment will enable the consultants to determine if the equipment is sized properly (undersized or oversized), and operating properly.

Plans will be requested at the basic interview. At this time the consultants will determine by talking to you and/or your committee some very important things about your facilities. These include:

* Type and source of fuel used
  - existing rate schedules
  - size and qualifications of maintenance staff (if any)
  - how maintenance is conducted (frequently, preventive program, etc.)
  - operation of building--hours, by the day (including weekends), who is responsible for controls, operation of temperatures
  - policy of operation of gymnasiums, kitchens, auditoriums, and similar public space
  - general areas of activities in the school, noting specialized areas such as labs, shops, kitchens, etc.

- General types of systems
  - heating
  - air conditioning (if any)
  - temperature controls
  - plumbing
  - electrical
- Historical operating data if it hasn't been developed by the committee.
- History of the development of the building. Who built, when, etc.
- History of operating problems (if any) such as leaking pipes, major boiler work, electrical blowouts, etc.
- History of energy conservation steps already taken and results.

At this time or shortly thereafter the consultants may take a water sample for analysis and if a gas or oil fired boiler, a flue gas test (Orsat analysis).

An Orsat analysis tells you whether your furnace or boiler is using fuel as efficiently as possible by analyzing the chemical composition of the flue gas. For example, too much carbon monoxide (CO) in the flue gas versus carbon dioxide (CO_2) means inefficent fuel use. An Orsat test kit can usually be purchased for $300 to $400. Or, your consultant may have one. Or, you may be able to borrow one from your local gas company or oil supplier . . . they may even provide an Orsat analysis service. Such an analysis should be performed at least once a year, preferably two or three times a year.

From the water it can be determined if the water or steam in the heating system (non-electric resistance system) is or is likely to cause corrosion of piping and heat transfer surfaces.

The maxi audit is a complete systems analysis. A system is defined as:

Mechanical Systems
Plumbing system
Heating system
Cooling (if any) system
Electrical systems (lighting, power distribution)

Architectural Systems
Windows/fenestration (arrangement of windows in a building)
Walls including insulation
Roofs including insulation

Note, a system cannot be completely analyzed by itself. Each interrelates with other systems. For example, if the lighting is reduced you may need more heating due to less waste heat from the light fixtures-but for the same reason, cooling requirements would be reduced. It is something like poking a balloon with your finger. Pressure at one spot affects other locations. Understanding of this is partly why you need experienced, knowledgeable consultants. From each of these activities the committee will derive a list of actions. These are items that will save energy and dollars. Because the committee has identified in the mini audit all or most of the O & M (operation and maintenance) items, most of those specified by the consultants will include capital dollars to implement.

Each action must be analyzed on the basis of payback to determine the wisdom of proceeding with it. Obviously, if it takes 20 years to recover a given investment and two years to recover the same amount of dollars invested for another alternative, the board of education will probably opt for the latter alternative and consider foregoing the first opportunity.

Other factors may be involved as well. For example, if the building is to be re-roofed, the timing may be right to put in new or additional ceiling insulation at the same time-independently of what payback analysis says about the priority of insulating. The educational program may dictate work schedule priorities also not to mention budget conditions, etc.

Keep in mind that some items may have a higher priority simply because the money to get them done may be available through state or federal energy conservation grants programs. Be sure to stay up to date on what is available in this area. Contact your state energy office.

Each action should be evaluated this way. Then each should be given a priority based upon the payback. Example:

Item	Action	Capital Dollars Required	Energy Saved (MM Btu)	Dollars Saved	Payback[1]
1.	Replace ceiling insulation	$4,000.00	2000	$5000.00	0.8 yrs
2.	Replace insulation on combustion pipe	$1,500.00	375	$750.00	2 yrs
3.	Replace leaky windows with new double glazed windows	$29,000.00	500	$1250.00	29 yrs

The federal government (Department of Energy) is suggesting that such an evaluation be on the basis of simple payback. Further they suggest a maximum of 15 years recovery.

Following that analysis, all those actions which have a payback of 15 years or less can be totalled and the overall energy savings determined. If your gross (historical base) size is 65,000 therms per year and these items total 23,000 therms, then you will probably save:

23,000/65,000 X 100% = 35.4% of the energy consumed

The same is done for electrical (lighting and power) energy and a percentage determined for it.

Note, you will save the same percentage in dollars too, if the rate were to remain constant. However, since the rate has increased in the meantime--and will probably continue to increase for the immediate future, the percentage savings in dollars will probably be less.

Note also that dollar savings for each action do not always add up directly to a total dollar savings. Different measures interact with one another so savings will be interactive, too, not additive.

The final steps then are obvious. All this data should be presented to the committee, the administration, and the board of education in report form.

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[1] Example shows simple payback

The format is quite similar to the format of the mini audit report, with, of course, more detail and summaries. For unusual recommendations you may provide sketches or drawings for clarification.

Sound easy. We certainly hope so. It really isn't difficult. As we stated in the beginning, there are no mysteries. YOU can do it, perhaps with some help, but it can be done.

Armed now with the comprehensive plan-of-action you have the tool to accomplish significant savings of energy (dollars) in a step-by-step process and a specific period of time.

After the plan has been accepted by the Board of Education and funding secured, it should be implemented. You will probably want to hire one consulting firm for all three major jobs of preparing a plan and specifications of those action items accepted, going to the street for prices from contractors, and advising you of the contractual process for getting the work done.

The construction phase follows. Details are not included here, except that you would find it in your interest to hire the consultants to observe certain phases of the installation, at least of major equipment and components.

How well did you do? Good question. Monitor the results. Measure the success. Did you, in fact, save 35.4%? Why not? If not, there may have been changes in operation, etc., which precluded it. However, you will quickly find that you may have exceeded it.

You have now accomplished what only a handful of people in the society have done. You should be proud. But don't stop. Continue to provide for your posterity and your prosperity--by saving energy.

FACILITIES MANAGEMENT GUIDE

ELEMENTARY/SECONDARY LEVEL

SOME ENERGY UNITS & CONVERSION

UNITS OF ENERGY

1 kilocalorie (kcal) warms 1 kilogram (2.2 lb) of water 1° C (1.8° F)

1 British thermal unit (Btu) warms 1 lb of water 1° F

1 foot-pound (ft-lb) lifts 1 pound 1 foot

1 joule (J) lifts 1 kilogram 10.2 centimeters (4 in)

UNITS OF POWER

1 watt (W) = 1 joule/second

1 kilowatt (kW) = 1000 watts

1 megawatt (MW) = 1000 kW

1 horsepower (hp) = 33,000 ft-lb/minute

CONVERSION FACTORS

1 kilowatt-hour (kWh) = 860 kcal = 3413 Btu = 3,600,000 J

1 kcal = 4184 J = 3.97 Btu = 3080 ft-lb (a food calorie is a kcal)

1 Q (Quad) = 10^{15} Btu

1 hp = 746 watts; 1 kW = 1.34 hp

2500 kcal/day = 121 watts = 1 average American food diet

12,000 watts = 1 average American nonfood energy diet

ENERGY CONTENT OF FUELS

1 lb TNT = 478 kcal

1 lb bread = 1300 kcal = 5150 Btu

1 lb wood = 1800 kcal = 7150 Btu

1 lb Eastern coal = 3300 kcal = 13,100 Btu

1 lb crude oil (0.14 gal) = 4800 kcal

1 barrel (bbl) = 42 gal

1 lb gasoline (0.18 gal) = 5700 kcal = 22,000 Btu

1 lb natural gas (25 ft^3) = 6600 kcal

1 therm = 100,000 Btu = 25,200 kcal

1 lb uranium 235 = 8.6 billion kcal (note: in nature you find 140 lb U^{238} to 1 lb U^{235})

1 ton Eastern coal = 26 million Btu

1 barrel crude oil (42 gallons) = 5.8 million Btu

1000 cubic feet natural gas = 1,000,000 Btu

There are about seven barrels of crude oil to a ton. Often all energy is expressed in metric ton coal equivalents (about 28 million Btu) or barrels of oil equivalent (BOE).

Source: Energy Management: A Program of Energy Conservation for the Community College Facility, Lawrence Berkeley Laboratory

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ABBREVIATIONS USED

Term	Abbreviation	Equivalent
kilowatt	kWe	10^3 watts electrical
megawatt	mWe	10^6 watts electrical
gigawatt	GWe	10^9 watts electrical
kilowatt-hour	kWh	10^3 watthours electrical
million BPD	MBPD	10^6 barrels per day oil
million TPY	MTPY	10^4 tons per year solids
billion CFD	BCFD	10^9 cubic feet per day
trillion CFY	TCFY	10^{12} cubic feet per year

The following conversion factors can be used to obtain the oil equivalent expressed in million barrels per day (MBPD).

To Obtain	Divide	By
MBPD Oil Equivalent	Btu per year	2.12 X 10^{15}
	mQ's	2.12
	MTPY of Eastern coal	86.8
	MTPY of Western coal	125
	BCFD of natural gas	5.63
	TCFY of natural gas	2.06
	10^{12} joules per year	2.23

Source: Energy Management: A Program of Energy Conservation for the Community College Facility, Lawrence Berkeley Laboratory

RECOMMENDED LIGHT LEVELS

The Illuminating Engineering Society recommends the following lighting levels for various uses and occupancies:

ILLUMINATION LEVELS

	Minimum Foot Candles
Libraries	
Reading rooms and carrels	70
Stacks	30
Book repair and Bindings	70
Check in & out, catalogs, card files	50
Offices	
Designing, detailed drafting	110
Accounting, bookkeeping and business machines	85
Regular office work, reading, transcribing, active filing and mail sorting	70
Corridors and stairways	20
Washroom	20
Classroom Space	
Regular classroom work	50
Chalk boards	100
Drafting rooms	100

	Minimum Foot Candles
Laboratories	
General work	50
Close work	100
Lecture Rooms	
General	50
Special/demonstration/exhibit	100
Dormitory Rooms	
Concentrated and prolonged study	50
Lounge/lobbies	10
Kitchen	30
Auditorium	
Assembly only	20
Study hall	50
Exterior	
Parking areas	5
Roadways	5

The variations in intensity measured in lumens/watt for different lamp types are as follows:

Lamp Type	Intensity
Incandescent	16-20 lumens/watt
Fluorescent	60 lumens/watt
Mercury	60 lumens/watt
Metal Additive	43 lumens/watt
Hi Pressure Sodium	95 lumens/watt

Translated into gallons of fuel oil per year these intensity ratings used the following in a typical laboratory of 100,000 s.f. operating 3,000 hours/year:

Lamp Type	Fuel Oil Consumption per year
Incandescent	100,000 gallons
Mercury	46,000 gallons
Metal Additive	34,000 gallons
Fluorescent	30,000 gallons
Hi Pressure Sodium	22,000 gallons

Source: Energy Management: A Program of Energy Conservation for the Community College Facility, Lawrence Berkeley Laboratory

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FACILITIES "QUICK-FIX" CONSERVATION TIPS

Low or no-cost items to save energy now.

Lighting

1. Usage Patterns
   - a. Schedule cleaning to overlap normal working hours or other hours when daylight is sufficient for the task.
   - b. If daylight is not available, have custodial staff use lights only one room at a time, and only those lights in a given room needed for the task.
   - c. Schedule extra-curricular activities for maximum use of daylight.
   - d. Use only 50-75% of gym lights for classes and meetings.
   - e. Place desks perpendicular to windows to minimize glare, thus enabling better use of daylight during classes (north windows provide the best light). Translucent curtains or shades may be used to cut glare. (Each linear sill foot of window area can save 100 Kwh of lighting per year.)
   - f. Reduce outdoor, decorative, and display lighting.
   - g. Turn off parking area lights unless needed for security.
   - h. Modify visual tasks to need less light-e.g., a #2 pencil on manila needs 50 times the light of a felt tip on matte white.
2. Equipment Modifications
   - a. Reduce overall lighting by using lower wattage bulbs or by disconnecting some of the fixtures or bulbs. Check the current foot-candle lighting standards and reduce to minimum for specific tasks.
   - b. Adjust sensitivity of photoelectric controls for outdoor lights.
   - c. Consider using energy-efficient mercury or sodium vapor lamps outside or in gym.
   - d. Provide teachers with fluorescent desk lamps so they will not have to use all lights in the room when working.
   - e. Use table lamps in offices, lounges, and waiting rooms.
3. Maintenance
   - a. Clean fixtures on a regular schedule.
   - b. Replace old bulbs which are darkened and inefficient.

Heating, Cooling, & Air Handling

1. Usage Patterns
    a. Close off and seal unused areas.
    b. Reduce heating and cooling in infrequently used or storage areas.
    c. Cut heating and cooling to garages or loading platforms.
    d. Heat to no more than 65-68° in winter (5° reduction = 8% savings).
    e. Set heating back to 55° at night and on weekends and holidays.
    f. Cool to no less than 78-80° in summer.
    g. Shut off cooling and ventilating systems at end of school day and on weekends and holidays.
    h. Preheat building in winter only enough to reach 65° by the time occupants arrive.
    i. Turn off cooling or set back heating 30 minutes before end of occupied period.
    j. Review room schedules to see if some can be left vacant during first or last part of the day-cut heating or cooling to those areas during that time.
    k. Consolidate classes and extra-curricular activities into fewer buildings or rooms which can be separately heated or cooled by zone.
    l. Does air conditioning come on when its 50-55° outside?
    m. If possible, cycle ventilation equipment off for 15 minutes every hour.
    n. Eliminate "hot stand-by" of heating in mild weather.
    o. Close outdoor air dampers during first and last hours of occupancy.
    p. Reduce exhaust air quantities when practical.
    q. Limit outdoor air intake to minimum required to balance exhaust or to that specified by state code.
    r. Operate one boiler, chiller, or compressor at 90% capacity instead of two at 45% capacity.
    s. Maintain relatively cool kitchen and cafeteria temperatures (i.e., at "unoccupied" levels if not used for classes).
2. Equipment Modifications
    a. Turn off boiler or heating natural gas pilots in summer.
    b. Adjust controls to prevent simultaneous operation of heating and cooling.
    c. Make sure ductwork is insulated properly.
    d. If you are producing hot water for showers, lavatories, kitchens, etc. with a boiler normally used for space heating, consider installing an independent hot water generator.

3. Maintenance
    a. Keep the following clean and unobstructed.
        1) Filters-replace on regular schedule
        2) Room air inlets and outlets
        3) Fan blades
        4) Fan motors
        5) Chillers
        6) Condenser coil faces
        7) Strainers
        8) Heat exchanger surfaces
        9) Burners
        10) Electric heating elements
        11) Ductwork-free from obstruction
        12) Humidifiers
    b. Check the following and repair, adjust, or maintain as necessary on a regular basis.
        1) Outside air dampers
        2) Bearings and linkages (lubrication)
        3) Fan drive belt alignment
        4) Motor bearing and packing, drive belt wear*
        5) Fan or compressor motor (alignment, vibration, proper voltage, overheating)*
        6) Compressor valves*
        7) Gas leaks*
        8) Fuel-to-air ratio (check stack for tell-tale smoking or perform Orsat analysis)
        9) Burner couplings and linkages
        10) Burner stack temperature*
        11) Solenoid valves (check to see if heating element cuts off immediately when unit shuts down)
        12) Calibration of pressure controls on dual-duct systems (to obtain less leakage and minimize static pressure at low demand)
        13) Burner firing controls
        14) Level of refrigerant (check sight glass)
        15) Coal stokers and grates
        16) Fuel oil temperature (affects viscosity which in turn affects efficiency of combustion)

* likely to require outside technical assistance

17) Adequate combustion air in equipment room (Orsat analysis)*

18) Keep daily log of pressure and temperature, as these are good indicators of the need for tube and nozzle cleaning, pressure, or linkage adjustments, etc.

For example:

Oil pressure drop:	Indicates plugged strainer, faulty regulator valve, or suction line air leakage
Oil temperature drop:	Indicates temperature control malfunction or fouled heating element
Gas pressure drop:	Indicates lower supply line pressure or malfunctioning regulator

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* likely to require outside technical assistance

Hot Water, Steam, & Plumbing Systems

1. Usage Patterns
   - a. For steam heat, observe same usage pattern tips as possible under "Heating, Cooling, and Air Handling" above.
   - b. Reduce hot water temperature to 110°F. (May require local "boosting" at kitchen depending on health codes.)
   - c. If hot water is distributed through continuous circulation, turn off pump when building is unoccupied.
   - d. Turn off refrigeration on cold drinking fountains during "off" hours-disconnect refrigeration entirely if the staff agrees.
   - e. Limit or reschedule gym shower use.
   - f. For electric hot water heating, limit duty cycle to avoid operation during peak demand periods (usually mid-afternoon in summer, late afternoon in winter).
2. Equipment Modifications
   - a. Consider adding flow resistors and/or timers to all lavatories and shower heads.
   - b. Insulate hot water pipes, steam pipes, and storage tanks.
   - c. Install spring-activated hot water taps.
   - d. If you are producing hot water for showers, lavatories, kitchens, etc., with a boiler normally used for space heating, consider installing an independent hot water generator.
3. Maintenance
   - a. Check steam piping automatic temperature controls to be sure the system is being regulated according to building needs.
   - b. Are radiator shut off valves operable? Leaking?
   - c. Inspect steam traps.
   - d. Check condensate pumps and tank vents.
   - e. Flush system twice a year.
   - f. Repair tap and shower head leaks.

Doors, Windows & Exterior Walls

1. Usage Patterns
    - a. Close draperies and shades each evening in winter and during day in summer (especially on south-facing windows).
    - b. Open drapes and shades each evening in summer and during day in winter (especially on south-facing windows).
    - c. Limit number of entrances and exits in morning and evening.
    - d. Keep classroom doors closed.
    - e. Do not open windows to adjust indoor temperature when heating or cooling is on-adjust system instead.
    - f. Use windows instead of heating or cooling system in mild weather.
2. Equipment Modification
    - a. Add automatic door closers to outside doors.
    - b. Provide covers for window air conditioning units during winter.
    - c. Use opaque insulating material to block and seal unused windows.
    - d. Consider a double entry (vestibule).
3. Maintenance
    - a. Repair broken or cracked window panes.
    - b. Replace worn weatherstripping.
    - c. Replace missing putty or caulking around frames.
    - d. Seal around window air conditioners.
    - e. Replace or adjust latches on windows and doors which do not close tightly.
    - f. Adjust uneven doors.
    - g. Seal exterior joints, such as foundation-to-wall.
    - h. Seal openings in walls for piping, electrical conduits, thru-wall units, etc.

Kitchen and Cafeteria Equipment

1. Usage Patterns
    - a. Take advantage of oven pre-heating to defrost food.
    - b. Use only the minimum necessary refrigeration.
    - c. Limit use of exhaust hood to only when cooking.
    - d. Run dishwasher only when full if practicable and consistent with health codes.
    - e. Turn off infrared warmers when no food is being warmed.
    - f. Reduce temperatures or turn off frying tables and coffee urns during off-peak periods.
2. Equipment Modifications
    - a. Install timers on exhaust hoods.
    - b. Consider using microwave ovens for defrosting or heating prepared foods.
3. Maintenance
    - a. Stove and oven burners firing properly?
    - b. Refrigeration condensers clean?
    - c. Refrigeration condensers receiving adequate air circulation?
    - d. Refrigeration coils defrosted regularly?
    - e. Consider at least an annual service call for accomplishing preventive maintenance.

Miscellaneous Equipment

1. Encourage use of stairs instead of elevators.
2. Curtail use of resistive heating devices-e.g., coffee pots, portable heaters, hot plates, etc.
3. Connect bathroom exhaust fans to light switches if permitted by health codes.
4. Don't schedule use of equipment consuming large amounts of electricity during peak load periods-e.g., shop tools, art class kilns, home economics facilities, etc.
5. Turn off office machinery when not in use.

PRELIMINARY ENERGY AUDIT DATA

GENERAL:

(1) Project ______________________ Date ______________

____

(2) Utility Data:

Name and address of utility companies

Gas Company ______________________________

Electric Company ______________________________

Oil Company ______________________________

Energy (fuel) Cost

Electricity/Kwh ______________

Oil/Gallon ______________

Gas/Therm or Gas/Thousand Cubic Feet ______________

LPG/Gallon ______________

Annual Utility Consumption Data

Year 1: (19__-19__) __________KW/HRS __________ THERMS __________ GAL

Year 2: (19__-19__) __________KW/HRS __________ THERMS __________ GAL

Year 3: (19__-19__) __________KW/HRS __________ THERMS __________ GAL

(3) Location ______________________________

(4) Type of Building ______________________________

(5) Size of Building __________ Floors (5a) __________ Sq. Ft./Floors (6) __________

Ft/Floor (7) __________ Cu. Ft.

(8) Type of Construction-Walls ______________ (9) ______________ Insulation

(10) Type of Construction-Roof ______________ (11) ______________ Insulation

(12) Type of Construction-Glass ______________

(13) Hours of Usage: Sunday ______________

Monday-Friday ______________

Saturday ______________

(14) Average Number of People in Building ______________

(15) Special Requirements ______________________________

(16) Maintenance Staff ______________ People

(17) Maintenance Staff - Qualifications ______________________________

HEATING SYSTEM:

(18) Type of Fuel: ______ Gas ______ Oil ______ Electric ______ Coal

______ Other ______________________________

(19) Type of Heating Source: ______ Hydronic ______ Steam ______ Air

______ Electric Resistance

TRANSPORTATION MANAGEMENT IMPLEMENTATION GUIDE

ELEMENTARY/SECONDARY LEVEL

I. INTRODUCTION

Rising energy costs have no prejudice, they affect everyone. From farm workers, to blue collar workers, to nurses, to corporate executives, regardless of race, religion, or natural origin, everyone is faced daily with the prospect of rising prices. It is not uncommon to hear young married couples discussing the option of purchasing a home or having a baby. It is becoming inreasingly difficult to accomplish both in a world characterized by rising food and clothing costs, mounting interest rates, and soaring real estate prices. The populace is becoming increasingly aware of taxes, the inflation rate, the cost of living index, and economic trends in general as they wage battle with rising prices that consistently seem to outdistance wage and salary increases.

Rising energy costs are giving birth to a genuine crisis in education. School districts are experiencing constant losses of revenue while costs continue to escalate rapidly. Declining enrollment and the nationwide taxpayer rebellion do little to support increasing teacher payrolls and rising physical plant operating costs. Thus, the educational administrator must look to controlling the costs of the physical plant and its operating expenses.

Transportation costs have also been affected by new educational concepts. Open enrollment and the increasing number of special education programs, combined with increased requirements for busing may be extremely expensive without the proper analysis of the impact on transportation service. By adding inflation and rising energy prices to new educational concepts it is not surprising that the average annual cost of transporting a student to and from school has more than tripled since 1940. From 1970 to 1974 alone, the annual per pupil cost rose from $66.96 to $87.04, an increase of 30%.

a study of school times and the interrelationships of the routes between schools.

Thus, effective transportation management is a mixture of many variables: the minimization of all related costs, fuel economy, and efficient routing. Efficient routing must be based on student demand with further improvements possible via time analysis. Because every school district is different in size, geography, and population, different approaches may be necessary to accomplish an efficient transportation system. This material will aid educational administrators and transportation managers in applying various cost-reducing techniques to their unique districts. The material will move through planning, designing, and implementation stages with suggestions for various areas of investment to achieve technical, operational and economic improvements in transportation.

II. COMMUNITY AWARENESS AND INVOLVEMENT

The first step in developing an efficient transportation program is to create awareness of your campaign to examine transportation in your school system. By motivating participants to share your ideas, a great amount of momentum is generated. This first step is relatively inexpensive and could be to the district's advantage. Influential school system employees and community leaders can contribute to a transportation program. These people should be highly respected and inspirational in character. They can not only offer valuable advice but will also help spread the word in your community. Principals, teachers, parent-teacher associations, administrators, school board officials, and community groups are good sources of inspirational promoters. Fighting inflationary costs and fuel conservation are popular contemporary causes that will help generate interest. If this material does not provide sufficient background material, a wealth of information is available at any public library. Additional sources include both public and private concerns and will be listed later.

A good public relations campaign is important. The community will want to be informed of what the transportation manager is trying to accomplish and why. Explain the rising costs of transportation and indicate that the community can lend a hand in the campaign by expressing their interest to the school board. The streamlining of a transportation system may bring complaints from uninformed students and parents. However, these complaints are often generated by the minor changing of familiar habits. A successful public relations campaign will promote additional conservation activity as well as consoling unhappy taxpayers who believe they are receiving less and less for their tax dollar.

There is a good film available for purchase or rental which can help create an awareness in drivers that they have the ability to conserve fuel while operating a school bus. It will provide the drivers with many techniques for reducing fuel consumption and motivate them to use these methods. The film is entitled, "Who Cares?" Information can be obtained from:

Visucom Production, Inc.
P.O. Box 5472
Redwood City, CA 94063
Telephone: 415-364-5566

If you have a local film library that provides free loan films to schools (perhaps at the county level), you might want to make them aware of this film for inclusion in their catalogue. This can make it accessible to more drivers.

TRENDS IN BUS MILEAGE AND FUEL CONSUMPTION
1940-1974

YEAR	AVERAGE ANNUAL MILEAGE	AVERAGE ANNUAL FUEL USE (gallons)	AVERAGE MILES PER GALLON
1940	8,011	775	10.3
1950	7,775	748	10.4
1960	7,556	1,066	7.1
1970	7,274	1,039	7.0
1974	6,867	933	7.4

Source: U.S. Department of Transportation, Federal Highway Administration, Highway Statistics, 1976.

A good starting point in fuel efficiency analysis is comparing fleet and individual driver fuel consumption with the current national average. Recent surveys indicate that the national average for bus fuel consumption is 7.4 miles per gallon. This serves as a basic guide and does not mean efficiency cannot be accrued in those districts below the national average. It should be noted that these figures can vary considerably depending on fleet composition.

Drivers can keep accurate records of both mileage and fuel consumption for effective analysis. In many districts maintenance personnel are available to record this data and in general, will be more precise. Record fuel use to the nearest tenth if possible. Attempt to make all fuel fill-ups with the bus resting in the same positon. Try to have individual buses fuel at approximately the same time from day to day. Fuel consumption should be recorded daily. However, because air pockets in the gas tanks may vary actual fuel usage, miles per gallon computations should be based on a weekly or biweekly average. This analysis may also be applied to oil usage, but would require a longer sample period.

SAMPLE

FUEL CONSUMPTION DATA COLLECTION FORM

DRIVER ______________________ PERIOD ENDING ____________

BUS # ______________________

FUEL CONSUMPTION

DATE	GALLONS
10/6	18.1
10/7	17.5
10/8	22.3
10/10	23.2
10/11	16.8
/	.
/	.
/	.
TOTAL	97.9

ENDING MILEAGE	12885.6
START MILEAGE	12376.5
TOTAL MILEAGE	509.1

$$\frac{\text{TOTAL MILEAGE}}{\text{TOTAL FUEL CONSUMPTION}} = \frac{509.1 \text{ MILES}}{97.9 \text{ GALLONS}}$$

MPG = 5.2

FUEL CONSUMPTION DATA COLLECTION FORM

DRIVER ______________________ PERIOD ENDING ____________

BUS # ______________________

FUEL CONSUMPTION

DATE	GALLONS
____	______
____	______
____	______
____	______
____	______
____	______
____	______
____	______
TOTAL	______

ENDING MILEAGE ____________

START MILEAGE ____________

TOTAL MILEAGE ____________

$$\frac{\text{TOTAL MILEAGE}}{\text{TOTAL FUEL CONSUMPTION}} =$$

MPG =

Once a miles per gallon figure is established for each driver, publish the results. Create friendly competition among the drivers to improve efficiency. Give the drivers fuel economy material. Instill a desire to improve their driving habits. Transportation savings can mean more funds for educational purposes.

There are many ways to improve driver efficiency. The basic principle is to drive the bus smoothly. Start the engine and move out as soon as possible (even in cold weather) at a slow pace, speeding up as the engine heats up. Go through the gears smoothly.

IMPORTANT DRIVING TIPS

- No courtesy stops.
- Avoid jackrabbit starts.
- Do not let engine idle over one minute. Shut-off and restart engine. (Diesel manuals should be followed)
- Anticipate traffic flow.
- Avoid high traffic areas.
- Drive main roads - lights are more likely to be in your favor.
- Observe speed limits.

Remind the drivers that fuel consumption is based upon the energy needed to power the engine. Any time the bus brakes and loses momentum, additional energy will be needed to regain that momentum. Thus, it is much wiser to operate the bus at such a speed, depending upon traffic, that constant braking/acceleration may be avoided. Ideally, a steady foot on the gas pedal will give best results. These driving tips and the ones to follow should be covered at a driver seminar arranged by the transportation manager.

AND MORE DRIVING TIPS

- Do not ride the brake or clutch.
- Minimize warm-up periods. Drive slowly until engine is warm.
- Avoid fuel spillage while refueling.
- Maintain patience, courtesy, and common sense.
- Drive scheduled route - no special routing unless approved by transportation manager.
- Change lanes smoothly.
- Do not pump gas pedal.

Acknowledge drivers that improve their driving habits. This will supply further incentive for improvement for those that did not fare as well. Biweekly meetings should be held to discuss results and ideas for additional improvements. Many of your drivers may surprise you given a chance.

MAINTENANCE

In the previous section it was discovered that by monitoring bus mileage and fuel consumption the transportation manager is able to identify existing areas of inefficient driving habits. Poor fuel consumption figures may also be a result of the poor mechanical operation of the bus fleet. The solution to this dilemma is preventive maintenance.

Preventive maintenance can be provided by effective scheduling or investing in additional manpower and garage equipment. The return, or profit, is identified through more efficient vehicles that experience fewer breakdowns, achieve better fuel economy, and have a longer life on the road.

The maintenance department should plan regular check-ups for every vehicle in the fleet. An example of this effort is the Austin Independent

School District.[1] Every 2,000 miles buses go through a general test - cooling system, fan belts, tire tread wear, brakes, oil, ball joints, and king pins. At 6,000 miles more tests are conducted: drive shafts, U-bolts, wiring, plugs, points, and timing. At 12,000 miles an even more vigorous check-up is conducted. This testing includes all the previously mentioned inspections plus additional tests on PCV valves, torque on head, rocker manifold, carburetor, alternator, regulator, thermostat, engine mounts, transmission oil, and the replacement of plugs, condenser, points, distributor cap, and wires if necessary. Preventive maintenance in Austin, Texas resulted in lower operating costs, and reduced down-time expenses beyond the costs of the preventive maintenance program. Most importantly, it resulted in significant reductions in fuel consumption.

Along the same line, the transportation manager should consider the purchase of engine analyzers and other modern tools as well as in-service training programs and workshops to keep the maintenance department operating at maximum efficiency. Contact the bus manufacturers about in-service maintenance training programs.

EQUIPMENT

In order to insure wise decisions, before considering equipment purchase and improvements, the transportation manager must know and be able to utilize evaluation tools. Two simple ways of analyzing benefits versus costs are the payback period and return on investment.

Payback period simply stated is the period of time, in years, required to recover investment costs by means of annual savings.

$$\text{Payback period} = \frac{\text{Initial Cost - Salvage Value (if any)}}{\text{Annual Savings}}$$

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[1] Bobit Publishing Company, School Bus Fleet, April-May, 1978

Return on investment is a percentage figure which takes into account not only initial costs and annual savings, but also utilizes annual depreciation costs.

$$\text{Annual Depreciation Costs} = \frac{\text{Initial Cost - Salvage Value (if any)}}{\text{Expected Life}}$$

Once annual depreciation costs have been calculated, return on investment may be computed as follows:

$$\text{Return On Investment} = \frac{\text{Annual Savings - Annual Depreciation Costs}}{\text{Initial Cost - Salvage Value (if any)}}$$

Although neither of these computations takes into account school district cash flow or the time value of money, they do offer a good base for analysis. Consult the district business or finance director or a business instructor for more advanced analysis.

PURCHASES

Purchase the smallest or most efficient vehicle at the best price available that will effectively serve the purpose for which the purchase was made. Simply stated - do not overbuy and shop around for the best price. Carefully investigate all aspects of the vehicle annual operating expense, expected life, maintenance history, and comparisons to similar equipment.

Know your district. Are there a lot of steep grades that will demand powerful engines, or can the district get by with economical low-horsepower engines? Important considerations include the number of pupils to be transported, physical size and condition of the pupils, fuel consumption, maintenance costs, power requirements, travel speed, temperature and weather conditions, and distances to be travelled.

Another important consideration is the experience and the expected employment period of the driver. To the experienced driver, manual transmissions generally give better mileage than automatic transmissions. However, maintenance costs can be very high if many drivers are inexperienced. This tends to be amplified if there is a high turnover rate in the driver corps. An automatic transmission will generally yield savings in districts where drivers are inexperienced and generally short term in nature.

Diesel engines are more expensive than conventional gasoline engines. However, these initial higher costs must be compared to more economical fuel and maintenance costs. Not only do diesel engines experience better mileage, but diesel fuel has proven to be less expensive than gasoline. Depending on temperature conditions in an area, districts should consider the diesel to increase efficiency.

There are many other equipment investments that can be made to improve fleet efficiency and lower operating costs. An example of these are:

- Use of radial tires,
- Temperature controlled fans,
- Correct thermostat application,
- Governors,
- Turbo chargers (used primarily on deisel engines),
- 2-way radios, etc.

The transportation managers involvement in state and national associations provides the opportunity to meet counterparts and share knowledge and experience. The National Association of Pupil Transportation (NAPT) conducts an annual convention which includes a seminar setting for discussion of various topics including presentations from vehicle manufacturers exhibiting advancement in design technology.

Recording devices are available to monitor vehicle use. Although these devices do not save fuel themselves, recording equipment provides the effective transportation manager with more engine performance data for subsequent analysis. Instrumentation is being developed that will warn drivers that they are performing inefficiently. This is an improvement to the tachograph and will record engine speed, sudden braking, engine bugging, and engine idling over various time periods. This equipment can prove to be an invaluable tool in the information (charts are read and analyzed regularly).

A final point for consideration in either original investment or refurbishing of existing equipment is the standardization of equipment. Equipment standardization will produce savings in two ways. First, a smaller parts inventory will be necessary because the number of different parts will be limited. Secondly, the training of personnel will be easier due to the fact that, again, differences in operation and repair procedures will be limited.

IV. TRANSPORTATION SYSTEM PLANNING

The transportation manager has two basic objectives: 1) minimize the number of buses as well as mileage for the lowest cost; and 2) ensure that the safety and transportation policies of the school board are met.

Based on a given set of operating parameters, the transportation manager will determine, based on whatever methodology, the number of buses required and therefore the overall cost of providing transportation. Typically, routes are developed between the close of the school year and the beginning of the new. Assuming all of this time is applied toward new routing, this would represent a small percentage of the managers time for determining the number of buses to be used for the entire new school year. This problem is compounded by a lack of summer updates in enrollment.

Annual operating costs for an individual bus normally range between $12,000 to $18,000 including maintenance, fuel, depreciation, and other associated costs. Thus, if the transportation manager is able to eliminate one bus and driver from the daily operating fleet using techniques to assist in route development, the annual savings will be approximately $15,000. Actual dollar figures will vary with each district and may even fall outside these ranges, but in most cases, these figures will hold true. Thus, by streamlining the transportation system, tremendous amounts of savings are possible.

SAVINGS

NUMBER OF BUSES ELIMINATED	ESTIMATED MINIMUM (Annual Operating)	ESTIMATED MAXIMUM (Annual Operating)
1	$ 12,000	$ 18,000
2	24,000	36,000
3	36,000	54,000
4	48,000	72,000
5	60,000	90,000
6	72,000	108,000
7	84,000	126,000
8	96,000	144,000
9	108,000	162,000
10	120,000	180,000

It should be pointed out at this time that proven computer technology has entered the world of school transportation systems. The high speed and accuracy of a computer allows for quicker and more indepth analysis for route design. Larger districts are more likely to benefit from the speed of a computer editing a large number of data sources. School districts with less than approximately 1500 transported students should make a very detailed analysis before considering this type of service.

The larger districts with 20 vehicles or more should consider computer services due to economies of scale. It is much easier and less costly for a computer to edit the great amounts of information needed for efficient route design and it is virtually impossible to manually calculate the most efficient route paths and bus assignments. (example: with eight stops there are 40,320 possible routes) Furthermore, consultants of experienced computer firms may be able to make beneficial suggestions from their past experiences.

An example of how computer routing can benefit a district can be seen in the examples below:

° Clovis, New Mexico - computerization brought about a fleet reduction from 64 to 55 buses in the first year. State officials hope to implement the system in other New Mexico school districts.

- Milwaukee, Wisconsin - Over 100,000 total students with a voluntary desegration assignment plan, and up to 40,000 students transported, presented significant challenges. Administrators now have excellent system documentation. Principals were overjoyed with their transportation packets-information which eased handling of parent inquiries and disciplinary problems. The district credits the computer system with over two million dollars in savings the first year.
- Stockton, California - With the passing of Proposition 13 in California this district was forced to cut its transportation budget while keeping their desegregation plan intact. The system initially reduced vehicle requirements from 73 to 43 buses. However, in early August, the district requested that the bus coordination be reanalyzed with additional school time restrictions to resolve a teacher contract dispute. Within 5 hours, the computer service advised Stockton that a 54 bus solution had been designed that helped speed arbitration. Although some vehicle savings were lost, the business manager indicated an additional savings of hundreds of thousands of dollars in teacher salaries.

TRANSPORTATION POLICIES AND THE SCHOOL BOARD

The initial step in developing an efficient transportation system is to determine a set of district guidelines within state guidelines concerning transportation. Guidelines would include rules concerning walk zones, walk-to-stop distances, maximum ride times, maximum number of students at a stop, earliest arrival time, latest departure time, streets deemed unacceptable for school vehicle use, and the unique treatment of kindergarten and special education students. Obviously, there are many more variables in a transportation program and they will vary with every school district. The point is, however, that the transportation manager must determine the guidelines or parameters under which the transportation system will exist.

Once these parameters have been documented, they should be reviewed with the school board and the administration. Explain the guidelines and get their backing. To impress upon them the importance of the documentation, request that the board members and administration commit themselves to the parameters. This will ensure that the transportation manager will be able to enforce these guidelines. It will enable the school district to make uniform and consistent decisions, therefore avoiding controversy. Special situations requiring exceptional treatment should also be documented.

ELIGIBILITY - ATTENDANCE BOUNDARIES AND WALK ZONES

An important item to include in the documentation of transportation system guidelines concerns the eligibility of students to be transported. An efficient transportation system needs the support of the administrators and school board for definition of attendance areas and walk zones for transportation. Failure to obtain policies of this type causes two basic problems.

First, once an exception is granted in either situation, another student will request the exception, then another, and another, and so on. This can eventually create an increase in the number of transported students great enough to demand another bus for the district fleet (i.e. additional costs). Attendance boundary exceptions, secondly, will further complicate the problem as these students will be spread throughout the district. This will increase bus mileage, fuel consumption, driver time, and vehicle wear.

Strict enforcement of these zones is imperative. The school board and the administration cannot be totally inflexible but they should realize the consequences in making exceptions.

Large districts may benefit from the use of computers to determine rider eligibility. A computer will compare the student census to a map of the district that has designated school attendance zones and their respective walk zones. Unlike some bus drivers and teachers, the computer will not get emotional in determining eligibility. It will assign eligibility with the district guidelines without exception. Reports can be generated that indicate for a given address whether the student walks or where he or she should catch the bus. Since students advance through the grades annually, many that were eligible for transportation to primary school may not be eligible for the secondary level.

STOP AND ROUTE ASSIGNMENT

Walk-to-stop distance will vary from district to district as well as within a district. In suburban areas, the distance may be very large while in a very rural district it may be door-to-door service. However, door-to-door service is the most inefficient in terms of cost and should be avoided in all cases except when safety is the overriding factor.

With all students, the most important factor is safety. Without impairing the safety of every eligible student, stops should be designated in areas that are easily accessible for buses as well as the student.

Avoid stops that make it necessary for the bus to turn around at the end of a dead end road. Assign stops where the greatest density of students exists. Attempt to keep stops on paved roads (a bus requires more fuel to maintain momentum on rough or unpaved roads) away from busy intersections.

Special considerations such as one-side pick-ups as well as resident stop streets should be documented in the transportation department guidelines.

Secondary students unlike elementary students are easier to assign to stops, but more difficult to route since load factors vary greatly. Secondary students are older, and can walk further to stops. Avoid stops on dead-end streets as well as those in developments. Make the students walk out to a main road or easily accessible corner whenever possible. The computer can help a district assign stops with unemotional but fair and consistent treatment of walk-to-stop policies.

Routing must be based on student demand. Attempt to load every bus to capacity. In the case of elementary students, a very high percentage (90% or greater) of eligible students will ride. Buses should be loaded with this in mind. Growing districts might even leave a few seats empty at the beginning of the school year to avoid mid-year rerouting.

The loading of secondary students is difficult due to the difference between actual and eligible students. The number of eligible students will be greater than actual ridership because of those students who use other means of transportation. This includes students who drive, catch a ride with parents enroute to work, or ride with a friend. If public transportation is available, encourage its use by secondary students as this means of transportation is usually much cheaper even if the district must cover student costs.

For the secondary level, loading the bus based on eligibility factors alone will cause a large fluctuation in the actual on-the-road load. This can be minimized by comparing, geographically, the eligibility factors against actual load counts from the previous year. Determine the percentage of actual riders as compared to eligible riders for the geographic areas. Rural areas will have higher rider participation rates while upper middle class and urban areas generally will have lower participation. Take periodic rider counts to remain aware of the loading factors. Use these loading factors to load the bus close to capacity for the expected actual ridership allowing a given margin of error. Careful monitoring of rider counts will enhance the managers knowledge of participation in different geographic areas causing the margin of error to become smaller and smaller. A loading lighter than listed capacity may be desirable because bus seats are designed to allow thirteen inches per student which although realistic for elementary students can become somewhat tight for secondary students. If the ride time is very short however, a heavier load could exist as long as the safety of the students and driver are not impaired. Routes should be designed to avoid dangerous roads and intersections. Otherwise, base the routing upon full utilization of every seat on the bus.

Again, the computer has demonstrated success in the design of efficient routes while adhering to district policy for safety and service. The computer can provide the routing and scheduling and reporting required for an efficient bus system fully communicable to the administrative staff and district residence. The three reports that follow represent a driver summary of a route, a detail of assigned students by stop on the route, and a route stop assignment report. The first two route reports should be self explanatory. The Route/Stop Assignment report allows the manager to quickly reference stop and time information while responding to parent inquiries (i.e. child resides at 915 Blackhawk Street and should attend Muddy Creek Elementary School. Since the report is alphabetized by street name, look up Blackhawk and the school to the right. The last entry in the first group is address range 911 to 919. The child, reading across will be picked up on Bus 1, route 14, the 11th stop on the route at 8:08 AM at the corner of Blackhawk & Sullivan).

P R E L I M I N A R Y

8/28/75 ROUTE 8 ---- ROUTE SUMMARY REPORT ---- PAGE 2

PROGRESS LOCAL SCHOOL DISTRICT PROGRESS JUNIOR HIGH BUS CODE = 2

STOP SEQ.	STOP NUMBER	STOP LOCATION OR DESCRIPTION	NUMBER OF STUDENTS	DEPARTURE FROM STOP	ELAPSED ROUTE RUNNING TIME
1	1001-J	CRNR BURNHAM & GREENBRIAR	1	7:34	0.1
2	1029-J	729 BURNHAM	1	7:35	0.8
3	1005-J	CRNR BLACKHAWK & SANDRA	5	7:39	5.6
4	1002-J	CRNR UNION & CIRCLE	4	7:42	7.8
5	1003-J	CRNR CIRCLE & BARBARA LN	7	7:44	9.9
6	1012-J	CRNR HICKOK & SAMSON DR	3	7:48	14.0
7	1011-J	CRNR HICKOK & MILDRED	2	7:49	14.7
8	1009-J	CRNR IRVING & NATHAN	7	7:51	17.3
9	-----	---- MAIN SCHOOL	0	7:53	19.2

TOTAL STOPS = 8. BUS CAPACITY = 30. TOTAL STUDENTS = 30. RUNNING TIME = 19.2

```
8/28/75              -- PICKUP --              --- TRANSPORTATION CENSUS ---               ROUTE NUMBER  8                        PAGE 1
PROGRESS LOCAL SCHOOL DISTRICT                           ECOTRAN, INC.
                                                                                                PROGRESS JUNIOR HIGH
                                        --------------------------  ---------------------  -----  ----------  ----------------------------
                                        STUDENT NAME                HOME ADDRESS           GRADE  HOME PHONE  SCHOOL NAME
***** STOP 1.  TIME...7:34    PLACE...CRNR BURNHAM & GREENBRIAR
                                        --------------------------  ---------------------  -----  ----------  ----------------------------
                                        POIRRIER DEBORAH A           853 BURNHAM             9    492-4185    PROGRESS JUNIOR HIGH

***** STOP 2.  TIME...7:35    PLACE...729 BURNHAM

                                        FETHER TAMMY LYNN            721 BURNHAM             1    492-8748    OUR LADY OF PEACE

***** STOP 3.  TIME...7:39    PLACE...CRNR BLACKHAWK & SANDRA

                                        ANTONELLI TINA               802 BLACKHAWK           9    499-8085    PROGRESS JUNIOR HIGH
                                        ATWOOD DONALD M              731 BLACKHAWK           9                PROGRESS JUNIOR HIGH
                                        BROOKS JIM G                 731 BLACKHAWK           7    492-2440    PROGRESS JUNIOR HIGH
                                        DAVID JOSEPH A               729 BLACKHAWK           8    499-2372    PROGRESS JUNIOR HIGH
                                        HAUMSCHILT LISA A            729 BLACKHAWK           9    453-8953    PROGRESS JUNIOR HIGH

***** STOP 4.  TIME...7:42    PLACE...CRNR UNION & CIRCLE

                                        ABBUHL MARK D                533 CIRCLE              5                OUR LADY OF PEACE
                                        AMAN RONALD V                529 CIRCLE              9    456-9663    PROGRESS JUNIOR HIGH
                                        ANSTADT ANDREA               718 CIRCLE              7    492-7196    PROGRESS JUNIOR HIGH
                                        BEGERT CHRISTINE             531 CIRCLE              8    499-3204    PROGRESS JUNIOR HIGH

***** STOP 5.  TIME...7:44    PLACE...CRNR CIRCLE & BARBARA LN

                                        CHOMA MARY E                 511 CIRCLE              8    494-1291    PROGRESS JUNIOR HIGH
                                        CLARK MICHAEL A              509 CIRCLE              7    492-4330    PROGRESS JUNIOR HIGH
                                        CLARK STEVEN S               509 CIRCLE              8    454-3889    PROGRESS JUNIOR HIGH
                                        COLEMAN JAMES                505 BARBARA CT          7    452-6911    PROGRESS JUNIOR HIGH
                                        FERGUSON KAREN M             508 CIRCLE              7    494-2913    PROGRESS JUNIOR HIGH
                                        HALTER DARLENE M             508 CIRCLE              9    492-7522    PROGRESS JUNIOR HIGH
                                        MOORE SANDRA VIRGINIA        514 CIRCLE              9    452-2539    PROGRESS JUNIOR HIGH

***** STOP 6.  TIME...7:48    PLACE...CRNR HICKOK & SAMSON DR

                                        BARR MICHAEL                 507 HICKOK              9    492-5089    PROGRESS JUNIOR HIGH
                                        BOWEN DOUGLASS              1006 SAMSON CT           8    492-4066    PROGRESS JUNIOR HIGH
                                        HUFFMAN CHARLOTTE L         1006 SAMSON DR           7    454-6542    PROGRESS JUNIOR HIGH

***** STOP 7.  TIME...7:49    PLACE...CRNR HICKOK & MILDRED

                                        BARTLETT SHERRY             1013 MILDRED             7    452-0945    PROGRESS JUNIOR HIGH
                                        ELLIS TAMI J                 523 HICKOK              9    494-1936    PROGRESS JUNIOR HIGH
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8/28/75        PROGRESS LOCAL SCHOOL DISTRICT                                 * ROUTE/STOP ASSIGNMENT REPORT *                          PAGE 2

          ADDRESSES
SIDE     FROM    TO     STREET-NAME       GROUP/SCHOOLS SERVICED       BUS   ROUTE   STOP   STOP   STOP-LOCATION
----     ----   ----    ---------------   --------------------------   NBR    NBR    SEQ.   TIME   ----------------------------------------
                                                                       ---   -----   ----   ----
BOTH      704    740    BLACKHAWK         MUDDY CREEK ELEMENTARY                                   NON-TRANSPORTED STUDENTS.
BOTH      795    811    BLACKHAWK         MUDDY CREEK ELEMENTARY        1      14     10    8:03   CRNR BLACKHAWK & SANDRA
BOTH      813    909    BLACKHAWK         MUDDY CREEK ELEMENTARY        1      14      9    8:03   CRNR BLACKHAWK & ANN
BOTH      911    919    BLACKHAWK         MUDDY CREEK ELEMENTARY        1      14     11    8:08   CRNR BLACKHAWK & SULLIVAN

BOTH     1021   1048    BLACKHAWK         SAMPLE ELEMENTARY                                        NON-TRANSPORTED STUDENTS.
BOTH     1050   1101    BLACKHAWK         SAMPLE ELEMENTARY             2      11     10    8:13   CRNR BLACKHAWK & AMHERST

BOTH      813    909    BLACKHAWK         MUDDY CREEK P. M. K'S         3      16      4   11:44   CRNR BLACKHAWK & ANN
BOTH      911    919    BLACKHAWK         MUDDY CREEK P. M. K'S         3      16      5   11:48   CRNR BLACKHAWK & SULLIVAN

BOTH      721    803    BLACKHAWK         EAST PROGRESS SENIOR HIGH     2       4      3    7:11   CRNR BLACKHAWK & SANDRA
BOTH      815    909    BLACKHAWK         EAST PROGRESS SENIOR HIGH     2       4      4    7:12   CRNR BLACKHAWK & ANN
BOTH      914    919    BLACKHAWK         EAST PROGRESS SENIOR HIGH     2       4      7    7:19   CRNR BLACKHAWK & HICKOK

BOTH     1021   1048    BLACKHAWK         HARVEY SENIOR HIGH                                       NON-TRANSPORTED STUDENTS.
BOTH     1050   1101    BLACKHAWK         HARVEY SENIOR HIGH            1       1      4    7:32   CRNR BLACKHAWK & ABBOT

BOTH      729    802    BLACKHAWK         PROGRESS JUNIOR HIGH          2       8      3    7:39   CRNR BLACKHAWK & SANDRA
BOTH      903    909    BLACKHAWK         PROGRESS JUNIOR HIGH          4       9      4    7:42   CRNR BLACKHAWK & ANN
BOTH      915    927    BLACKHAWK         PROGRESS JUNIOR HIGH          4       9      6    7:49   CRNR BLACKHAWK & HICKOK
BOTH     1021   1048    BLACKHAWK         PROGRESS JUNIOR HIGH                                     NON-TRANSPORTED STUDENTS.

BOTH      706    712    BLACKHAWK         SWAMPY BOG JR/SR HIGH         1       5      6    7:05   CRNR BLACKHAWK & GORDON
BOTH      718    728    BLACKHAWK         SWAMPY BOG JR/SR HIGH         1       5      7    7:06   CRNR BLACKHAWK & MUDDY CREEK ELEM

BOTH     1030   1040    BRADFORD          SAMPLE ELEMENTARY             4      10      6    8:07   CRNR ABBOT & BRADFORD

BOTH     1030   1036    BRADFORD          HARVEY SENIOR HIGH            1       1      3    7:24   CRNR ABBOT & BROCKHURST

BOTH     1020   1035    BRADFORD          PROGRESS JUNIOR HIGH          3       7      6    7:47   CRNR ABBOT & BROCKHURST

BOTH     1030   1042    BROCKHURST        SAMPLE ELEMENTARY             4      10      7    8:07   CRNR ABBOT & BROCKHURST

BOTH     1039   1041    BROCKHURST        HARVEY SENIOR HIGH            1       1      3    7:24   CRNR ABBOT & BROCKHURST

BOTH     1030   1041    BROCKHURST        PROGRESS JUNIOR HIGH          3       7      6    7:47   CRNR ABBOT & BROCKHURST

BOTH      500    524    BUCKLEY           SAMPLE ELEMENTARY             4      10      8    8:08   CRNR ABBOT & BUCKLEY

BOTH      705    723    BURNHAM           MUDDY CREEK ELEMENTARY        1      14      2    7:44   CRNR BURNHAM & MANTECA
BOTH      726    743    BURNHAM           MUDDY CREEK ELEMENTARY        1      14      4    7:52   CRNR BURNHAM & SWAMPY BOG SHS

BOTH      853    863    BURNHAM           EAST PROGRESS SENIOR HIGH     2       4      2    7:00   CRNR BURNHAM & CORDOBA

BOTH      710    740    BURNHAM           PROGRESS JUNIOR HIGH          2       8      2    7:35   729 BURNHAM
BOTH      840    853    BURNHAM           PROGRESS JUNIOR HIGH          2       8      1    7:34   CRNR BURNHAM & GREENBRIAR

BOTH      710    750    BURNHAM           SWAMPY BOG JR/SR HIGH                                    NON-TRANSPORTED STUDENTS.

BOTH      780    759    BURR OAK          MUDDY CREEK ELEMENTARY        3      15      3    8:07   CRNR EXCHANGE & BURR OAK
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Perhaps the most powerful tools in improving the efficiency of a transportation system are school time analysis and the coordination of the bus fleet. By effectively analyzing and adjusting school times and efficiently coordinating bus use between schools and/or routes, a transportation manager can generate significant savings for the school district.

For instance, let us construct a sample school district that is excessively inefficient from a transportation standpoint.

SCHOOL	TIME	ROUTES
Washington	8:30-3:00	3
Lincoln	8:30-3:00	3
Wilson	8:30-3:00	3
Kennedy	8:30-3:00	3
Eisenhower	8:30-3:00	3
Roosevelt	8:30-3:00	3
TOTAL		18

Assuming that each school has the same number of routes and that each bus may execute only one route because students must arrive no earlier than five minutes before school starts and must depart no later than five minutes after school ends. Thus, the bus fleet consists of eighteen buses that execute one route each in the morning and in the afternoon.

However, given reasonable route length and geography, and a change in school times, the size of the bus fleet can be cut in half yielding a savings of nine buses.

SCHOOL	TIME	ROUTES
Washington	8:00-2:30	3
Lincoln	8:00-2:30	3
Wilson	8:00-2:30	3
Kennedy	9:00-3:30	3
Eisenhower	9:00-3:30	3
Roosevelt	9:00-3:30	3

Under this set of school times, each bus is able to execute two

routes in both the morning and in the afternoon. Using the bus dollar savings chart shown earlier in this section, dollar savings would range from $108,000 to $162,000. By further easing the restrictions on school arrivals and departures, i.e. the creation of "windows", thereby allowing double-tripping, even more savings are possible. Double-tripping is usually feasible in high density population areas where route times are very short.

Although this is a very simple example that does not account for numerous variables, it does make a point. By adjusting school times and considering the drive time between individual schools, each bus may execute more routes. The transportation manager must look beyond the gas pump. In some cases, more fuel is consumed because of greater distances travelled. However, this increase in fuel expense may be only a small fraction of the cost of an unnecessary bus and driver.

In essence, get as much out of every bus as possible. Limit idle time; a bus that runs one route then waits an hour before another route is being wasted. Find a route that will fit between the two routes, changing school times if necessary. Educational needs are, of course, paramount. Scheduling should not adversely affect learning conditions. If school times cannot be changed, try adjusting arrival times. Explain adjustments to the board, administration, teachers, and a PTA meeting if possible. School time changes can be very controversial if not promoted correctly.

Computer aided analyses and simulations can be most effective in this area of endeavor. Not only are they a tremendous technical tool to be used in locating coordination inefficiencies, but their results are also more accepted in promoting change due to the objective and unemotional nature of the computer and/or outside services firm. Utilizing the speed of a computer, many different sets of school times with variable arrival and departure times may be tested in a very short time span; then more intelligent decisions can be made by school administrators. This can then be presented to the school board for consideration.

The computer report that follows provides the transportation manager with an analysis of the activities of each bus and the connection of routes that make up a driver assignment. The report describes the number of stops on each route, route start/end time, idle or available time, dead-head time (the traversing of streets with no students on board), and the school serviced and its start time.

Use of this type report as a simulation tool is perhaps the most powerful resource available as far as transportation planning is concerned. The effects of decisions regarding school time changes, waiting periods before and after school, and any of the other policies established can readily be seen in terms of the number of vehicles required. Alteration of these input factors can be made repeatedly and the report reproduced - thus answering the many "what if?" questions.

EVALUATION

Now that the transportation manager has purchased new buses, or replaced all old tires with new radials, or hired a computer firm for bus scheduling, there is one last step to effective transportation management. This is the evaluation process. Did we accomplish what we originally planned?

Obviously, some returns may be difficult to assign monetary values. For instance, better routing techniques have improved service to many students. It is difficult to realistically give a dollar value to better service. Yet, the better service may help to pass a school levy in the near future and thus, it does have value.

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8/22/75    PROGRESS LOCAL SCHOOL DISTRICT            *** BUS CO-ORDINATION REPORT ***                                                PAGE 5.

BUS   ROUTE    ADJ    TOTAL    NBR     ROUTE    START   RUN    END    AVAIL   DEAD                                          SCHOOL
NBR    NBR     CAP    LOAD     STOPS   TYPE     TIME    TIME   TIME   TIME    HEAD   SCHOOL NAME                                 TIME
---   -----    ---    -----    -----   ----     -----   ----   ----   -----   ----   ------------------------------------------  ------

26     138     66      62       13     SCHOOL    6:33   21.5   6:55     0      12    GLENOAK EAST                                 7:15
       123     66      59        7     SCHOOL    7:07   16.2   7:23     1      10    GLENOAK WEST                                 7:35
       510     66      60       13     SCHOOL    7:34   23.2   7:57     0       5    OUR LADY OF PEACE                            8:15
       521     66      21       13     SCHOOL    8:02   36.8   8:39     0      18    HERITAGE CHRISTIAN                           9:00
       213     66      54        6     SCHOOL    8:57   10.1   9:07     0       7    DAY ELEMENTARY                               9:10
       208     66      56       10     SCHOOL    9:14   25.7   9:40    IDLE   ----   AVONDALE ELEMENTARY                          9:45
                                                                                     /// RETURN TO GARAGE ///
       130     66      62        9     -HOME-    2:05   19.8   2:25     0       9    GLENOAK EAST                                 2:00
       121     66      42       13     -HOME-    2:34   38.7   3:13     2       5    GLENOAK WEST                                 2:20
       321     66      63        9     -HOME-    3:20   14.6   3:35     0       5    TAFT                                         3:15
       518     66      51       29     -HOME-    3:40   71.6   4:52     0     ----   CANTON COUNTRY DAY                           3:30

BUS TOTAL:   10 ROUTES,    122 STOPS,     530 STUDENTS,    278 RUN-TIME,    3 MINS AVAIL,    71 DEAD-HEAD
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35     116     66      61       13     SCHOOL    6:49   25.7   7:15     0      11    GLENOAK WEST                                 7:35
       501     66      56       15     SCHOOL    7:26   30.3   7:56     1       4    ST MICHAEL ELEM                              8:15
       320     66      31       12     SCHOOL    8:01   23.8   8:25    19      13    TAFT                                         8:30
       268     66      66        7     SCHOOL    8:57   13.3   9:10    IDLE   ----   BARR ELEMENTARY                              9:30
                                                                                     /// RETURN TO GARAGE ///
       111     66      61       11     -HOME-    2:25   25.8   2:51     0       8    GLENOAK WEST                                 2:20
       238     66      56       13     -HOME-    2:59   15.6   3:15     1      14    PLAIN CENTER ELEMENTARY                      2:50
       211     66      64       12     -HOME-    3:30   16.8   3:47     0      10    DAY ELEMENTARY                               3:25
       271     66      56        8     -HOME-    3:57   15.0   4:12     0     ----   BARR ELEMENTARY                              3:45

BUS TOTAL:    8 ROUTES,     91 STOPS,     451 STUDENTS,    166 RUN-TIME,   21 MINS AVAIL,    60 DEAD-HEAD
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49     136     72      71        8     SCHOOL    6:38   17.0   6:55     0      14    GLENOAK EAST                                 7:15
       110     72      61        9     SCHOOL    7:09   20.9   7:30     0       6    GLENOAK WEST                                 7:35
       529     72      47       11     SCHOOL    7:36   27.2   8:03    28      14    ST THOMAS AQUINAS                            8:20
       259     72      54       10     SCHOOL    8:45   20.1   9:05    IDLE   ----   WARSTLER ELEMENTARY                          9:25
                                                                                     /// RETURN TO GARAGE ///
       122     72      62        6     -HOME-    2:25   13.9   2:39     0      14    GLENOAK WEST                                 2:20
       313     72      70       17     -HOME-    2:53   27.5   3:21     0      12    MIDDLEBRANCH                                 2:45
       214     72      58        9     -HOME-    3:33   16.1   3:49     0       8    DAY ELEMENTARY                               3:25
       269     72      71        5     -HOME-    3:57   13.7   4:11     0     ----   BARR ELEMENTARY                              3:45

BUS TOTAL:    8 ROUTES,     75 STOPS,     494 STUDENTS,    156 RUN-TIME,   28 MINS AVAIL,    68 DEAD-HEAD
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However, when a decision to purchase or to implement is made, it is important to list goals to be attained. After the purchase has been made or procedure implemented, evaluate your achievements. What else could have been accomplished? Is there still room for improvement?

Utilize the payback period and return on investment formula. Compare expected or projected figures with actual figures. Analysis will help with future considerations. One must be willing to learn from his experiences (especially mistakes), in order to achieve higher levels of efficient transportation management.

Communicate with neighboring school districts. Your school district may benefit from experiments they have successfully undertaken. Or on the other hand, your school district can avoid unneeded expenses that are most likely doomed to failure. Compare statistics with other districts.

By utilizing after-the-fact analysis, the transportation manager can decide whether the new practice is better than the old practice. It is important to closely document all phases of transportation system development for the final evaluation. Documentation provides many historical facts while also laying the groundwork for future considerations.

On the following page is an example of a questionnaire for evaluation of a transportation system whether done by a manual or computer application.

LAST YEARS RIDER ELIGIBILITY ______________

CURRENT RIDER ELIGIBILITY ________________

NUMBER OF BUSES REDUCED/ADDED ± ________________ BUSES

DRIVER TIME REDUCED/ADDED ± ____________________ HOURS

DRIVER PAY REDUCED/ADDED ± _____________________ TOTAL DOLLARS

LEVEL OF SERVICE:

STOPS - GREATER WALK TO STOP DISTANCES

- LESS WALK TO STOP DISTANCE
- MORE STOP LOCATIONS
- FEWER STOP LOCATIONS

ROUTES - AVERAGE INCREASE/DECREASE IN ROUTE TIMES __________ MIN.

- AVERAGE NUMBER OF ROUTES PER BUS _______________ ROUTES
- IS THERE AN INCREASE/DECREASE IN NUMBER OF ROUTES PER BUS AS COMPARED TO LAST YEAR? ________________
- AVERAGE BUS LOAD: ______________ ELEM.

______________ JHS

______________ HS

STATE REIMBURSEMENT

HAS STATE AID BEEN INCREASED/DECREASED DUE TO RE-ROUTING? ______

V. CONCLUSION

The transportation manager must first make the public aware that there exists a need for transportation and fuel economy. Then, utilizing prominent figures, motivate people to aid in reaching projected goals.

The transportation manager must also motivate his drivers and mechanics to achieve efficiency. Offer incentives for improved driving habits and mileage figures for the drivers. Challenge mechanics that they can have 20% less breakdowns than last year.

Effective transportation management is a continuous utilization of analysis. There is the planning stage, cost versus benefits analysis, the controlling phase while in operation, and finally, the "looking-back" or evaluation analysis. The transportation manager must continuously record the daily operations of the system in order to have sufficient background material with which analysis may be performed.

School time analysis and coordination studies can result in substantial savings for a given school district. Computer assisted plans may provide both savings and the information needed for effective management. Weigh benefits and costs to find if a project will bring a positive return on investment.

Utilize other district personnel where experience is lacking. Finance or business directors will be beneficial to the projecting of costs and benefits and their effects on the school district budget.

Transportation management is a daily challenge. There is always room for improvement. Closely study and document all activities. Continuously search for system weaknesses. Make every attempt to remain objective.

Every school district is searching for savings. Start the energy conservation program in your district. Develop a low-cost efficient transportation system. The school board will be pleased. The taxpayers will be happy. Teachers and students will want to get involved. But most important of all, the transportation manager will be pleased with a smoothly operating, efficient transportation system.

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APPENDIX

DOE PUBLICATIONS ON ENERGY CONSERVATION FOR SCHOOLS

A SELECTED LIST OF
DEPARTMENT OF ENERGY PUBLICATIONS ON
ENERGY CONSERVATION FOR SCHOOLS

ADOPTION OF ENERGY CONSERVATION TECHNOLOGY BY THE SYRACUSE AND ROCHESTER CITY SCHOOL DISTRICTS (Dec 1977)

Shea, P.E., Syracuse Research Corp., New York. Available from: National Technical Information Service, Springfield, Virginia 22151, Report SRC-TR-77-595-6, 110 p., Price: $6.50

Data are presented on energy consumption for the heating and lighting of public schools in Rochester and Syracuse, N.Y., and the methods considered for conserving energy in these schools. These methods included school closings, financial incentives to individual schools for decreasing energy usage, improved boiler maintenance, retrofitting windows, retrofitting boilers, and use of heat recovery equipment. The role of school personnel, board of education, city council and utility companies in implementing energy conservation options and the legal aspects of such implementation are discussed.

ASSESSMENT OF ENERGY CONSERVATION MEASURES APPLIED TO OIL HEATED BUILDINGS (Feb 1977)

Hittman Associates, Inc., Columbia, Maryland. Available from: National Technical Information Service, Springfield, Virginia 22151, Report HIT-687, 32 p.

The energy conservation potential of retrofit measures for conserving heating oil in hospitals, schools, public housing and public buildings are assessed; the cost effectiveness of retrofit measures are compared; and payback periods for such retrofitting are estimated. The retrofit measures include means for improving thermal insulation: preventing heat losses; use of set-back thermostats; and improved efficiency of space and water heating equipment. Tabulated data for the calculated energy savings in each type of building in various geographic areas are presented.

BUILDING STANDARDS AND ENERGY CONSERVATION IN PUBLIC SCHOOL BUILDINGS. AN OVERVIEW OF THREE STATES: COLORADO, RHODE ISLAND, VIRGINIA (Apr 1977)

Friedman, C.F., American Association of School Administrators, Arlington, Virginia. Available from: National Technical Information Service, Springfield, Virginia 22151, Report TID-27629-P3, 98 p., Price: $6.00

The results are presented of a survey conducted in 3 States to determine how issues, individuals, and agencies involved in setting building standards affect energy consumption and conservation in public school buildings.

THE CHICAGO PROJECT: EVALUATION AND TESTING OF THREE TYPES OF ENERGY AUDIT PROCESSES FOR SCHOOL BUILDINGS (Feb 1976)

Minnesota Energy Agency, St. Paul. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-255321, 280 p., Price: $9.25

This report discusses techniques for identifying and alleviating excessive and unnecessary energy use in public schools. Three methods for accomplishing these goals are analyzed. (1) A computer simulation model (PSECS) developed by Educational Facilities Laboratories; (2) the mini-audit system developed by the Minnesota Energy Agency; (3) extensive energy use audits (maxi-audit) that can be performed by qualified engineering firms.

ENERGY AND EDUCATIONAL FACILITIES: COSTS AND CONSERVATION (Apr 1977)

Educational Facilities Labs., Inc., New York. Available from: National Technical Information Service, Springfield, Virginia 22151, Report TID-27629-P2, 49 p., Price: $4.50

Data are presented on energy consumption and costs for U.S. primary, secondary, and university-level educational facilities. Opportunities for energy conservation in such facilities are discussed. Since schools consume 5% of all space-conditioning energy used in the USA or 1.5% of the total national energy consumption, reduced energy consumption could contribute significantly to the Nation's 1985 energy conservation goal.

ENERGY AUDIT WORKBOOK FOR SCHOOLS (Sep 1978)

Department of Energy, Washington, D.C. Available from: Government Printing Office, Washington, D.C. 20401, Stock No. 061-000-00157-3, 84 p., Price: $2.75

This workbook describes some simple methods by which the administrator, maintenance manager, or operator of a school can analyze energy uses, determine areas in which energy savings can be made, and estimate the magnitude of cost savings in accordance with U.S. Department of Energy procedures described as Class C information audits. It provides a do-it-yourself, fill-in-the-blanks approach to an energy-conservation program for schools that do not have full-time engineering personnel. Of necessity, it is a generalized approach which cannot be as detailed as an energy audit conducted by an engineering team. Although this workbook emphasizes the energy-intensive processes and some of the recognized areas of energy waste in schools, it should be used selectively because each building has its unique energy use patterns.

ENERGY CONSERVATION IN NEW BUILDING DESIGN. AN IMPACT ASSESSMENT OF ASHRAE STANDARD 90—75 (Mar 1976)

Little, (Arthur D.), Inc., Cambridge, Massachusetts. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-252639, 273 p., Price: $9.00

This report assesses the energy, economic, and institutional impacts that may result from the broad voluntary adoption of Ashrae Standard 90-75 by individual building regulatory authorities. This standard is the first major voluntary consensus standard dealing with energy use in new buildings and is available for optional acceptance by state and local governments. With strict use of the standard, annual energy consumption would be reduced in all building types and locations. This report contains many findings, observations, and recommendations concerning the effects of Ashrae 90-75 on building energy consumption, its influences on physical changes in the buildings, its implications on the owning and operating costs of buildings, its potential impact on the Nation's energy consumption in construction, its possible economic impact on several selected markets and participants within the construction sector, and its impact on building habitability.

ENERGY CONSERVATION ON CAMPUS. VOLUME I. GUIDELINES (Dec 1976)

Association of Physical Plant Administrators of Universities and Colleges, Washington, D.C. Available from: Government Printing Office, Washington, D.C. 20401, Stock No. 041-018-00125-5, 38 p., Price: $.90

The Federal Government has developed a variety of programs through the Federal Energy Administration to foster large energy savings in the areas of building construction, maintenance, and operation. This publication has been prepared to assist colleges and universities and other nonprofit institutions to mount and sustain effective energy management programs. The guidelines presented are the result of an extensive analysis of existing energy management programs augmented by administrative and technical expertise drawn from numerous resources. Information is included on the development of a campus energy conservation program and its implementation by minor and/or extensive changes in the design and operation of energy consuming equipment on campuses.

ENERGY CONSERVATION ON CAMPUS. VOLUME I. GUIDELINES (Dec 1976)

Association of Physical Plant Administrators of Universities and Colleges, Washington, D.C. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-266211, 42 p., Price: $4.50

The development of a campus energy management program including policy elements, formation of an energy management committee, appointment of an energy management officer, and measuring and evaluating the energy use of campus buildings is discussed. Various areas in which reductions in energy consumption are possible are noted. Checklists of specific energy conservation actions to be taken in the major areas are presented along with samples of various energy information and survey forms.

ENERGY CONSERVATION ON CAMPUS. VOLUME II. CASE STUDIES (Dec 1976)

Association of Physical Plant Administrators of Universities and Colleges, Washington, D.C. Available from: Government Printing Office, Washington, D.C. 20401, Stock No. 041-018-00126-3, 35 p., Price: $.80

This report contains 19 case studies covering examples of various energy conservation actions taken on college and university campuses across the country and in Canada along with the resulting costs savings.

ENERGY MANAGEMENT: A PROGRAM OF ENERGY CONSERVATION FOR THE COMMUNITY COLLEGE FACILITY (1978)

California University, Berkeley; Lawrence Berkeley Lab. Available from: National Technical Information Service, Springfield, Virginia 22151, Report LBL-7813, 101 p., Price: $6.50

This handbook develops helps for assessing and improving the energy efficiency of the community college facility. The TEEM approach (Total Educational Energy Management) is a labor-intensive approach which requires the commitment and participation of all segments of the college community. The TEEM program presented here defines a series of tasks selected, ordered, and implemented in such a way as to achieve two basic objectives: (1) reducing campus energy requirements, and (2) meeting those reduced energy requirements more efficiently without adversely affecting the quality of educational programs. This guide to large-scale energy conservation on college campuses includes step-by-step procedures for establishing a program task force, defining specific tasks, and assigning responsibilities. Action plans are developed, energy consumption monitored, goals set, and conservation measures implemented. A series of appendices provides more detailed information, charts, and worksheets related to all aspects of energy use. The TEEM program provides the basic structure for achieving a significant reduction in campus energy costs.

ESTABLISHMENT OF AN ENERGY CONSERVATION MANAGEMENT PROGRAM IN ILLINOIS SCHOOLS (June 1977)

Tuma, S.L.; Dunwoody, J.E.; Illinois Department of Business and Economic Development, Division of Energy, Springfield. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-271730, 66 p., Price: $5.25

This energy conservation manual was written to help local and district school administrators in justifying, organizing, and implementing an effective energy management program within state schools. It discusses energy costs and operating expenses over the life of the facility and gives examples of energy-saving tips together with the forms necessary to make a walk-through school audit.

EVALUATION OF VENTILATION REQUIREMENTS AND ENERGY CONSUMPTION IN EXISTING NEW YORK CITY SCHOOL BUILDINGS. BUILDING SCIENCE SERIES (FINAL) (Apr. 1977)

Liu, S.T.; Hunt, C.M.; Powell, F.J.; National Bureau of Standards, Center for Building Technology, Washington, D.C. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-266069, 73 p., Price: $5.25

A detailed computer thermal analysis of a selected school was made to determine the breakdown of its energy usage with respect to lighting, heating, ventilation, and equipment operation. The report also gives the results of a one-week ventilation test conducted in a typical urban classroom in New York City to determine the effect of reduced ventilation on the interior environment, including the concentrations of carbon dioxide and oxygen, the change in dry-bulb temperature, the variation of relative humidity and the activity and response of the students.

FEASIBILITY STUDY ON THE IMPACT OF AGENCIES AND CODES ON UNIVERSITY AND COLLEGE ENERGY USE. VOLUME I. EXECUTIVE SUMMARY (Mar 1977)

Association of Physical Plant Administrators of Universities and Colleges, Energy Project Office, Washington, D.C. Available from: National Technical Information Service, Springfield, Virginia 22151, Report TID-27629-P1P1, 31 p., Price: $4.50

A study was conducted to determine the impact on energy use in colleges and universities of agencies and organizations which review and apply building standards affecting school construction in the U.S. Sixteen institutions in four states having widely varying climates were questioned. It was concluded from the responses that the architect/engineer, public building inspectors, physical plant supervisor, source of building funds, and building standards all have an impact on energy use and conservation in educational buildings, while the impact of the building planning process and the academic community is undetermined.

FEASIBILITY STUDY ON THE IMPACT OF AGENCIES AND CODES ON UNIVERSITY AND COLLEGE ENERGY USE. VOLUME II. SOURCE DATA (Mar 1977)

Association of Physical Plant Administrators of Universities and Colleges, Energy Project Office, Washington, D.C. Available from: National Technical Information Service, Springfield, Virginia 22151, Report TID-27629-P1P2, 162 p., Price: $8.00

The Association of Physical Plant Administrators of Universities and Colleges assisted the Energy Research and Development Administration in a feasibility study to determine the impact of agencies and organizations that review and apply codes and standards to new construction and major renovation projects affecting colleges' and universities' ability to use and conserve energy. A questionnaire was prepared, setting forth two theoretical models, major building exceeding $2,000,000, and a major renovation exceeding $100,000, and used as a basis for information gathering. The program involved a survey of four representative States: (1) California, moderate climate, West Coast; (2) Maryland, moderate climate, East Coast; (3) Michigan, cold climate/heating region, North; and (4) Texas, warm climate/cooling region, South. Within each State, four institutions were analyzed, one from each of the following types: (1) two-year public community or junior college; (2) four-year public college; (3) public university; (4) four-year private college/university. The recommendations and conclusions of the survey are contained in the Executive Summary, Volume I. The source data are set forth in Volume II.

LOW ENERGY UTILIZATION SCHOOL, ENERGY CONSERVATION OPERATION MANUAL, PHASE 2: REPORT

Stein, R.G.; Stein, C.; Nathan, D.B.; Stein and Partners, New York. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-268555, 85 p., $6.00

This manual consolidates maintenance and operational steps which will result in the lowest energy use consistent with a schools' educational program. It covers guidelines for maintenance and operating procedures for energy efficiency in the plant, a revised set of standards based on extensive research, and methods of scheduling and controlling the use of the equipment to provide services only when the spaces are occupied and only to the extent required by physical conditions and types of activity. Mainly, the discussion concerns procedures that are the custodian's responsibility.

REPORT ON THE DEVELOPMENT OF A MODEL ENERGY CONSERVATION PROGRAM FOR NEW YORK STATE SCHOOLS. REPORT ON PHASE I, JANUARY—JULY 77 (23 Nov 1977)

Green, A.C.; Boice, J.R.; Burns, J.A.; Bedford, S.; Educational Facilities Labs., Inc., New York. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-274285, 94 p., Price: $6.00

All school buildings (158) in twenty-two of New York State's seven hundred thirty school districts were analyzed in terms of energy use and conservation potential. This was done first with GAP2 (Guideline Analysis Program) adjusted to New York State standards, and then with CIP2 (Capital Improvements Program).

REPORT TO IOWA ENERGY POLICY COUNCIL ON ENERGY AUDIT TOUR OF INDIANOLA JR. AND SR. HIGH SCHOOLS, INDIANOLA, IOWA (20 Apr 1976)

Flanagan, R.W.; Environmental Engineers, Inc., Des Moines, Iowa. Available from: U.S. DOE Technical Information Center, P.O. Bpx 62, Oak Ridge, Tennessee 37830, Report NP-21321, 21 p.

Junior and senior high schools in Indianola, Iowa, were subjected to an energy audit to determine areas of potential energy savings. A lack of monitoring equipment in the schools make the findings subjective. Faulty equipment, such as variable thermometers, also hampered the study. Previous practices of building engineers allowed only enough comfort to forestall complaints. Lighting and temperature control were found to vary widely within the buildings. A 20 percent reduction of energy use is projected if temperature and lighting management is changed and equipment improved. Estimates for capital expenses are $7,500 to replace control instruments. No formal energy conservation program is proposed. The study covers usage of buildings by teachers, students, adults, and custodians. Charts list current policy, applicability to the building, and capital cost of specific energy-reducing items.

RESEARCH DESIGN, CONSTRUCTION AND EVALUATION OF A LOW ENERGY UTILIZATION SCHOOL, PHASE 2 (31 Mar 1977)

Stein, R.G.; Stein, C.; Deibert, P.F.; Stein and Associates, Architects, New York. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-269407, 196 p., Price: $9.00

This report discusses the development of a lighting program which includes the evaluations of high-efficiency commercially available light fixtures and design, construction, and testing of fluorescent adaptors for buildings presently lighted with incandescent fixtures; modifications to ventilation systems; and the design of a filmstrip to involve the teachers and students in the school buildings in an energy conservation program.

SOLAR ENERGY AND CONSERVATION AT ST. MARK'S SCHOOL. FINAL REPORT MAR 76-FEB 77 (Feb 1977)

Jones, W.J.; Meyer, J.W.; Massachusetts Institute of Technology, Cambridge, Energy Lab. Available from: National Technical Information Service, Springfield, Virginia 22151, Report PB-265982, 181 p., Price: $9.00

This report investigates the possibility of employing solar energy at a residential secondary school. The approach was to explore this possibility in the context of a more general survey of opportunities to conserve energy (in particular, fuel) at the school and illustrate how to go about an appraisal of conservation opportunities plus implementation and evaluation of the most productive conservation measures.

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