820242

ENERGY

PLANNING GUIDE FOR MINNESOTA COMMUNITIES

820242

ENERGY
GUIDE BOOK

This document is made available electronically by the Minnesota Legislative Reference Library
as part of an ongoing digital archiving project. http://www.leg.state.mn.us/lrl/lrl.asp

ACKNOWLEDGEMENTS:

This publication was prepared by the Minnesota Department of Economic Development in conjunction with the Minnesota Energy Agency, with acknowledgements to the Association of Minnesota Counties, International City Managers Association, League of Minnesota Cities, Minnesota Association of Regional Commissions, the Metropolitan Council, Minnesota Planning Association, Minnesota Department of Transportation, and the Minnesota Rural Electric Association.

The preparation of this publication was aided through a federal grant to the State Planning Agency under the Urban Planning Assistance Program authorized by Section 701 of the Housing Act of 1954, as amended.

Note: The 1981 Minnesota State Legislature established the Minnesota Department of Energy, Planning and Development, which combined the existing Department of Economic Development, the State Planning Agency, the Minnesota Energy Agency, and the Minnesota Crime Control Board. The completion of the merger of the agencies requires additional action by the 1982 Legislature; therefore, as this publication was printed prior to the completion of the merger, the aforementioned agencies are referred to by their former names.

Portion of printing cost paid for by
Northern States Power Company

**Consulting services provided by
Peat, Marwick, Mitchell and Company,
Washington, D.C.**

**Graphic design by Destiny 2, Inc.,
Saint Paul, Minnesota.**

ENERGY

PLANNING GUIDE FOR MINNESOTA COMMUNITIES

Table of Contents

1. INTRODUCTION 1
   - Why Do Energy Planning 1
   - What Is Energy Planning 3
   - How to Use the Guidebook 4
   - Self-Assessment 5

2. ORGANIZING 9
   - Commitment 10
   - Publicity 10
   - Program Organization 11
   - Public Participation 15
   - Intergovernmental Coordination 16
   - Example 17

3. DEFINING ENERGY PROBLEMS 21
   - Data Collection 22
   - Organizing Energy Data 28
   - Evaluating Energy Data 29
   - Data Forecasts 34
   - Identifying Problems 34
   - Example 36

4. DEFINING ENERGY RESOURCES 39
   - Conservation 40
   - Renewables 46
   - Planning Applications 53
   - Example 54

5. SETTING ENERGY GOALS 57
   - Resource/Problem Matching 58
   - Cost Screening 60
   - Goal Screening 61
   - Decision Process 63
   - Energy Policy Statement 64
   - Example 64

6. DEVELOPING THE ENERGY PLAN 67
   - The Land Use Plan 68
   - The Public Facilities Plan 70
   - Implementation Program 72
   - New Energy Programs 74
   - Coordination 76
   - Example 77

7. IMPLEMENTATION 81
   - Local Government Operations 82
   - Example 88
   - Utilities 89
   - Example 93
   - Financing 93
   - Example 96

GLOSSARY 99

Foreword

The use of energy pervades our lives; this is especially true for local governments and their communities. Zoning decisions and other actions by the planning commission have energy implications for future generations. Purchasing decisions by the city clerk will affect energy use in buildings and equipment for years to come. The capital budget before the council also embodies major energy decisions for the future. Adequate consideration of the energy cost implications of these decisions is vital to controlling community energy costs and to building a more secure energy future.

The economic health of many communities is threatened by a continuing failure to control energy costs and find reliable local sources of energy. The bulk of every dollar spent on conventional fuels like oil and gas leaves the community. Spending this money on more community-based energy options like conservation projects, renewable energy sources, local power generation, or district heating can help reverse this economic drain. Energy can be a new frontier for economic revitalization: it can create local jobs, building the local tax base, and attract new residents and businesses with reliable, affordable sources of energy.

This guidebook is designed to provide a basic energy planning process for local officials, planners, and citizens to use in developing a comprehensive energy plan for their communities. Recognizing the limited resources of many local governments, the guidebook is designed in two parts: the comprehensive planning process, contained in the text chapters; and the Energy Planning Tools Library, which describes options and techniques for increasing energy efficiency and the use of renewable resources. Communities that choose not to take the comprehensive approach can use individual tools as their needs dictate. Communities opting to do comprehensive energy planning can use the tools to support parts of the planning effort.

Energy is likely to remain one of the most serious problems facing local governments for the foreseeable future. It will require a serious effort in response. This involves manpower, materials, budget support, and possibly capital outlays. However, energy also presents major opportunities — for unifying the community in a common cause, for reducing the local "balance of payments" problem, and generating local jobs and local economic growth. Meeting the energy challenge does not have to mean cutting back and doing less; it can mean new economic opportunities, a stronger sense of community cohesion, and a strengthening of the traditional values of self-reliance and enterprise that have sustained our communities in the past.

1

2

3

4

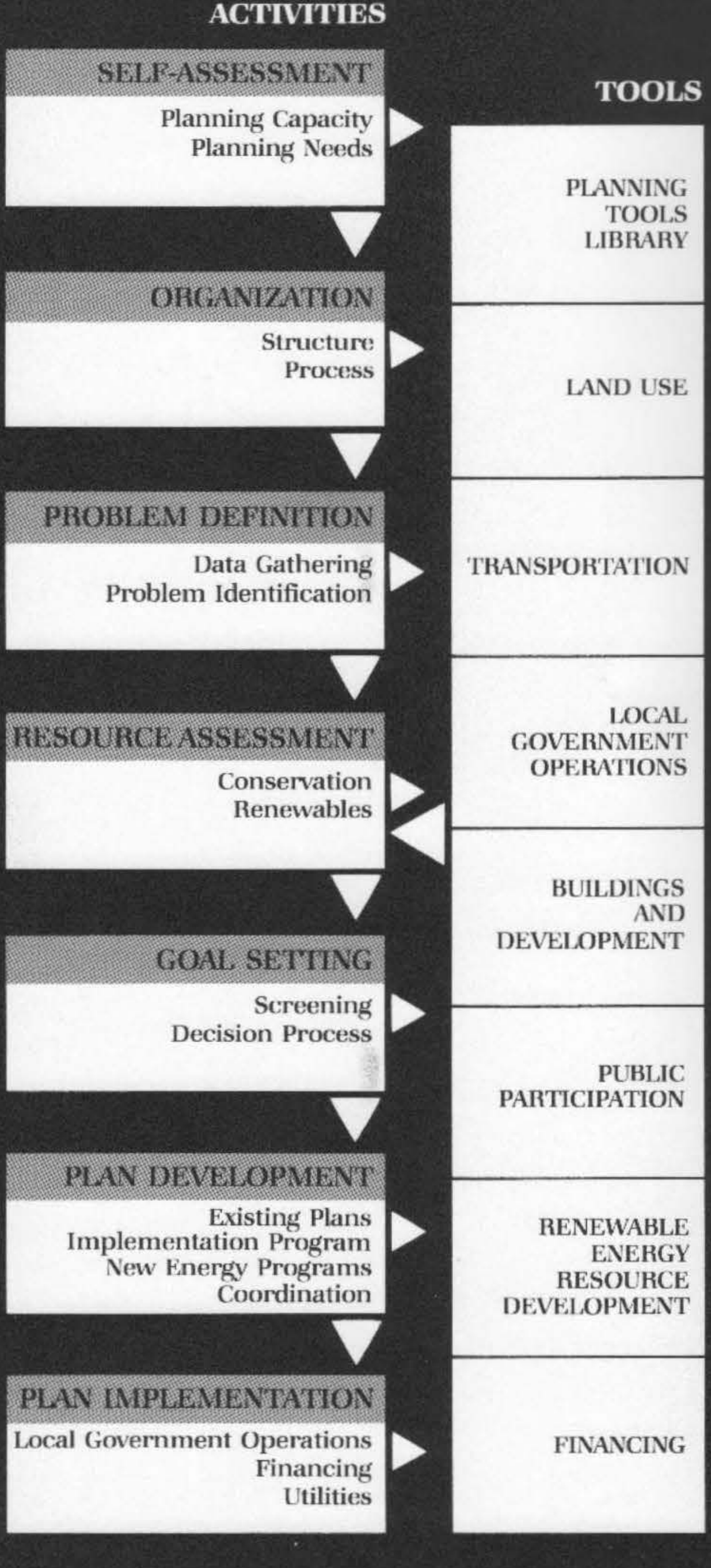
5

6

7

INTRODUCTION

THE ENERGY PLANNING PROCESS



INTRODUCTION

WHY DO ENERGY PLANNING?

Most Americans now accept the fact that the energy problem is real, serious, and here to stay. Although fewer people agree on how to solve the problem, there is growing consensus that energy conservation and "renewable" energy sources like solar are an important part of the solution. The purpose of this Guidebook is to assist communities in assessing their energy problems and in beginning the challenging work of planning for energy conservation and renewable energy development.

Why should our energy problems be of special concern to local governments? A look at the history of our energy situation shows that many of the difficulties now facing us are the result of a movement away from local control of our energy production systems.

Originally, all human settlements were energy self-sufficient. They had to be, because the technology to extract, transport, convert and distribute energy on a large scale did not exist. Energy for these settlements came from locally available materials; in the United States wood was the dominant energy source until the mid-1800's.

The shift to fossil fuels began in the mid-19th century, when coal began to take the place of wood fuel in railroads, industries, and in home stoves. The first gas utilities, which used gasified coal, appeared in the 1870's. After Thomas Edison harnessed electricity in 1879, electric utilities began to appear in eastern cities. These were all local enterprises; economics and limited technology confined them to a local scale with service areas as small as a few blocks.

The founding of John D. Rockefeller's oil empire in the 1860's marked the establishment of the first national energy system. With the invention of the automobile and other changes in American life, oil became an indispensable energy source. Rapid technical advances in electric generation and distribution and in gas pipelines, combined with the invention of numerous gas and electrical appliances, led to the creation of regional and national electric and gas utility systems by World War II.

These technical advances resulted in very cheap energy. In fact, the real (non-inflated) price of energy actually declined for much of this century. Cheaper and cheaper energy from larger and more complicated energy systems created an irresistible pressure for local governments to get out of the energy business. In Minnesota, this trend led to the abandonment of more than half of the state's district heating systems.

As our confidence in the reliability and economy of centralized energy systems grew during the post-war decades, little need was seen for federal, state, or local energy policies. Since the oil embargo in 1973, however, the situation has changed. The limits of conventional fuel sources and energy delivery systems are being reached. The trend of declining energy prices has dramatically reversed, with prices increasing fourfold in less than a decade. This energy price explosion has shown us how serious our habit of importing nearly half of our nation's oil has become. Most communities import nearly 100% of their energy. The cost of these imports creates a serious balance of payments problem as well as dangerous vulnerability to external events that can cut off energy supplies vital to the life of the community.

At the state level, Minnesota is particularly vulnerable because we import virtually all of our traditional energy sources — oil, natural gas, and coal. The supply of these fuels is not expected to keep up with the state's growing demand, even at a very low growth rate. Energy demand could begin to exceed available supplies by the mid- to late 1980's. Fuel prices have risen rapidly and will continue to rise at a rate exceeding the rate of inflation. In addition, energy expenditures for these conventional fuels create economic benefits outside of the state; in 1980, most of the $6.5 billion spent for energy by Minnesotans left the state. The economic effects of these energy supply and cost constraints are significant. For example, by the year 2000, without substantial conservation and new energy resource development, energy-related unemployment in Minnesota could reach 11.1%.

What can be done to reverse these trends? Conservation measures, which could be encouraged and carried out through the energy planning process and projects described in the Guidebook and accompanying tools library, could significantly lower state and local demand for energy by the year 2000. The potential for renewable energy resource development in Minnesota is also great. Energy Agency projections indicate that renewable energy resources could supply 40% of gross end-use demand by 2000.

The active leadership of local governments is essential to meet the challenge of these energy problems and opportunities. Just as energy self-sufficiency in the past came from reliance on local energy sources, fulfillment of the opportunities suggested by state projections of conservation and renewable energy development potentials will depend primarily upon careful planning and implementation at the local level. Conservation projects and renewable energy development consist primarily of small-scale technologies which are most effectively promoted at the local level. Weatherization programs, earth sheltered, passive solar school construction, development of municipal wind machines, changes in land-use patterns to reduce transportation energy consumption, and cogeneration in a new industrial park are all projects that a local government can carry out or encourage. These projects can produce net economic benefits at more than two dollars for each dollar invested. They can have a positive impact on a community— by creating local jobs, improving the tax base, reducing municipal fiscal strains, and helping to protect the community from economic disruptions. This basic economic development issue is one of the strongest arguments for developing an effective community energy plan.

Although our comunities may never be completely reliant on local energy resources again, decreased dependence on centralized energy supply and distribution systems will give them greater control over their energy future. This Guidebook outlines a process for energy planning at the local level which can be used by Minnesota communities in determining that future.

WHAT IS ENERGY PLANNING?

For some communities, the first question to ask is "What is energy planning, and how does it relate to other planning?" Many smaller communities do not have professional planners or comprehensive plans, though most have planning commissions which meet to review various development issues and proposals. Defining planning is difficult, because it means different things to different people:

- to the neighborhood group, planning is a process whereby it can gain some control over its future;
- to a developer, planning defines and limits the type, location, and character of what he can build in the community;
- to an environmentalist, planning is a way to protect natural resources from irreversible consumption; and
- to a professional land use planner, planning is a complex comprehensive process matching community goals with physical, economic, and social resources.

In *Local and Regional Planning in Minnesota*, Gunnar Isberg defines planning broadly as:

> "an ongoing attempt to guide future development or redevelopment of a neighborhood, community or region in order to create and maintain a desirable environment, and to promote the public health, safety, welfare, and convenience; as such, the comprehensive planning process should reflect the aims, goals, and ambitions of the citizens of the community or region."

How does energy fit into this definition? In several ways:

Communities are realizing that energy is a vital component of every aspect of life — home, working environment, transportation, shopping, schools, and recreation — all these activities require energy.

Communities are realizing that aspects of community life are threatened by energy problems resulting from continuing price increases and supply uncertainties of traditional energy sources.

Energy problems are producing energy efficiency and new energy resource opportunities involving the form and function of the entire community — its land use patterns, its buildings, its transportation means, its service functions.

Many of these opportunities require planning — a comprehensive review of the community's future — so that individuals and institutions are encouraged to act on these opportunities, and are also discouraged from decisions that will impede or block these opportunities.

Some energy opportunities may not need comprehensive planning — homeowners can weatherize their homes, government buildings can be better controlled and weatherized, and more fuel efficient vehicles can be purchased. Though comprehensive planning is not essential, these activities can benefit from planning, which provides needed information and resources and provides a broader basis for acting on these opportunities.

Other energy initiatives require planning:

- a new subdivision built to make best use of solar energy;
- a shopping mall built near housing and transit to reduce driving;
- higher density allowances in certain areas to reduce sprawl;
- a district heating system to integrate downtown energy use;
- bicycle paths to provide alternatives to motor vehicles.

Energy planning is an element of comprehensive planning. It affects the land use plan, the public facilities plan, the transportation plan, and the recreation plan. It also affects regulations: zoning, subdivision rules, building codes, and other mechanisms which are used to implement and enforce plans.

Energy planning can take two main forms: the comprehensive approach involving the full spectrum of energy use and supply areas; and the project approach which focuses on a particular project, energy type, or user group. They are not mutually exclusive: comprehensive plans usually spawn a number of specific projects; but a comprehensive plan is not essential to moving ahead on a project which is justified on its own terms.

In Minnesota's local governments, energy planning has taken several different forms. Some cities, including Minneapolis and St. Paul, have developed comprehensive energy plans involving all sectors of the community (residential, commercial, industrial, transportation, and governmental), an analysis of energy supply and demand trends, and specific program goals for supply and demand in each user sector. Some of these goals and programs have been implemented. Other cities, including Moorhead, Red Wing, New Hope, Richfield, and Hopkins, have focused on more specialized and immediate goals, such as housing weatherization programs, ridesharing programs, street lighting studies, district heating and solid waste projects.

HOW TO USE THE GUIDEBOOK

This Guidebook is intended for use by local government (city and county) administrators, planners, elected officials, and volunteer energy committees — in other words, a very diverse audience. It is also designed to be used by local governments of varying sizes and resources.

To meet the widely varying needs of these users, the Guidebook was developed in two separate though related parts. The first part contains a planning process which takes the user through several phases, from organization to plan implementation. The second part is designed as a "planning tools library" — a set of specific tools for developing energy efficiency and renewable resources in such areas as land use, transportation, buildings, municipal operations, etc.

The ideal approach is to use both parts of the Guidebook — a comprehensive planning process aided by specific tools to develop parts of the plan. Realistically, however, not all local governments have the resources or inclination to do comprehensive energy planning. These users can employ the planning tools library to focus on specific areas such as ridesharing projects, energy audit programs, energy fairs, or solar access.

An outline of the overall organization of the workbook, the energy planning process, and the energy planning tools library is presented in the Planning Process Chart. The guidebook chapters develop the phases of the planning process and are cross-referenced with the planning tools.

SELF-ASSESSMENT

The first planning activity shown in the Planning Process Chart is called "self-assessment". Because energy planning is such a broad field, and intended users of the Guidebook vary widely in their perspectives, skills, needs, and resources, each user should undertake a self-assessment of energy planning needs. While the planning process is designed to be adaptable to different levels of needs, some communities may choose to focus on a few specific areas, for planning or for implementing projects.

The basic criteria for a self-assessment of energy planning needs are:

SIZE
Larger communities are more likely to need and may be more capable of conducting full-scale planning efforts.

GROWTH
Communities likely to experience a lot of new growth may have more planning — related energy opportunites than communities that don't expect to grow significantly.

PLANNING CAPACITY
Communities that have professional planning staff (or access to professional planning through regional or county commissions) are more equipped to do comprehensive energy planning than those without paid staff (this issue is discussed further in Chapter 2).

RESOURCE POTENTIALS
Communities that have known resources like district heating systems, hydroelectric sites, or another energy sources have a stronger motivation to plan than others. Unfortunately, detailed resource assessment is sometimes needed to determine if such resource potentials exist (see Chapter 4 for more information on resource assessment). If a community does know it has a special resource potential, planning is all the more crucial for its best use.

Communities which decide that comprehensive energy planning is needed should use the basic process described in the text. Communities that opt not to do full-scale planning can use various planning tools from the planning tools library as they deem appropriate. They can use parts of the planning process — data collection, resource assessment, goal-setting— as needed, and concentrate on specific projects or programs.

2

3

4

5

6

7

ORGANIZING

ORGANIZING THE ENERGY PROGRAM

ACTIVITIES

COMMITMENT

Official Resolution

PUBLICITY

Official Proclamation
Media Campaign
Kickoff Event

PROGRAM STRUCTURE

Elected Officials
Planning Department
Energy Coordinator
Advisory Group

PUBLIC PARTICIPATION

Key Issues
Advisory Structure

INTERGOVERNMENTAL COORDINATION

County
Regional Agencies
State Agencies
Federal Agencies

ORGANIZING

COMMITMENT
Prepare a formal resolution by the governing body, endorsed by the chief executive official, enabling the creation of the necessary institutional structure and giving it a basic mission and role.

PUBLICITY
Make all parts of the community aware of the effort and why it is important, to generate interest and participation.

PROGRAM STRUCTURE
Establish an energy office, energy commission or other focal point.

PUBLIC PARTICIPATION
Establish the public participation structure of the energy program.

INTERGOVERNMENTAL COORDINATION
Establish contacts with other communities, and county, regional, state and federal agencies that may affect the community's energy program.

This chapter describes the process of getting organized for energy planning. The basic steps to follow are outlined in the chart at left and discussed in the text.

At the end of the chapter is an example of a community going through the organizing process.

COMMITMENT

No major community effort will be effective or lasting without political support. The mayor, the city council, or other key decision-makers must support and actively promote the community's energy program. If the program is initiated by an elected official, demonstrating this support is the first step. If the initiative comes from staff professionals or community interest groups, obtaining this support must be the initial goal. One of the best ways to formalize this commitment is to obtain a formal resolution or proclamation of the chief executive official and/or governing body. This document should:

- establish the need for the energy program;
- outline the organizational structure of the program and its decision-making body;
- state the mission of the decision-making body in the program; and
- state the actions needed by other community agencies to support the effort.

A sample resolution establishing an energy commission appears in Section 8 of the tools library.

Before drafting and issuing a resolution, however, it is important that the individual or group taking the initiative contact and develop support from as many sectors of the community as possible. This is perhaps best done on an informal basis at this stage, prior to the more formal process of organizing an advisory group, task force, etc.

Some communities may decide to organize their program more fully before developing an official resolution, so that the resolution will both reflect broad community support and contain more substantive policy statements. In this sense the organizing phase is more a unified process than a fixed series of steps. The resolution, publicity campaign, program structuring, public participation, and intergovernmental coordination activities can be carried out concurrently to an extent.

PUBLICITY

Equally important as official support is broad-based community interest. Several forms of publicity can be used to create public awareness and interest: issue a news release, mount a media campaign, hold an energy fair, or use direct mail. The publicity effort should not only announce the energy planning effort, but should also:

- show homeowners, businessmen, and other community members why the effort is important to them;
- tell them how to participate — come to meetings, serve on task forces, help with surveys; names and numbers of whom to call should be included; and
- present goals and a basic schedule for the effort — at the least, the time and place for the next meeting or event.

An Energy Fair or other public event can be an effective way to launch the energy program. See Tool 5.2 in the planning tools library for more information.

PROGRAM ORGANIZATION STRUCTURE

An effective energy program needs a clearly defined organizational structure, even if the program is modest in scope and must draw on existing resources. This structure may include representation from the following parts of the community:

- elected officials;
- local government staff, including planners (if they exist) and department heads;
- public interest groups such as neighborhood organizations, League of Women Voters, Jaycees, Minnesota Solar Resource Advisory Panel;
- energy suppliers: utilities, fuel dealers, solar equipment dealers;
- business groups: bankers, chambers of commerce, retailers, major employers;
- education institutions: school districts, colleges, AVTI's, universities; and
- professionals: engineers, architects, contractors, builders and other members of the community with technical skills and resources to help the energy effort.

Figures 1 and 2 show how the various elements of the community could fit into organization structures. Figure 1 is oriented to larger cities, and Figure 2 to smaller cities. The principal difference between the organization recommended for larger and smaller cities is the nature and location of the advisory body. In larger cities (Figure 1) the advisory body is a committee supported by the professional staff of the planning commission or department. In smaller cities (Figure 2) the advisory body is a commission associated with the planning commission; because no regular professional staff are available, it has commission status to signify a potentially greater decision-making role.

Staff support would be provided by planning department staff in larger cities. In smaller cities, administrative support would be more limited; it could come from the city administrator's office, or could be supplemented by "donated" time from professionals. In both cases, volunteer efforts will be important; they will be more critical in small cities without professional staff. Staffing issues are discussed more fully below in the energy coordinator section.

Decision-making would be somewhat different in the organization structures for larger and smaller cities. The advisory committee in larger cities would rely on professional staff for some of the data gathering and analysis tasks. It would review staff analyses, and make recommendations on energy policies and programs. In smaller cities, the energy commission would have greater responsibilities for data collection and analysis as well as developing policy recommendations. Commission status would give greater weight to its recommendations than those of a committee. However, in all cities final decision about energy policies and programs would be made by the governing body, unless it specifically delegated authority.

The organization structures shown in Figures 1 and 2 and discussed above are only suggested approaches. Each community should follow its customary procedures and organizational lines. The important point is to integrate the energy planning effort into the community's decision-making and administrative structure, so that its activities and decisions are both adequately supported and effectively used.

ENERGY PROGRAM ORGANIZATION

(for larger cities)

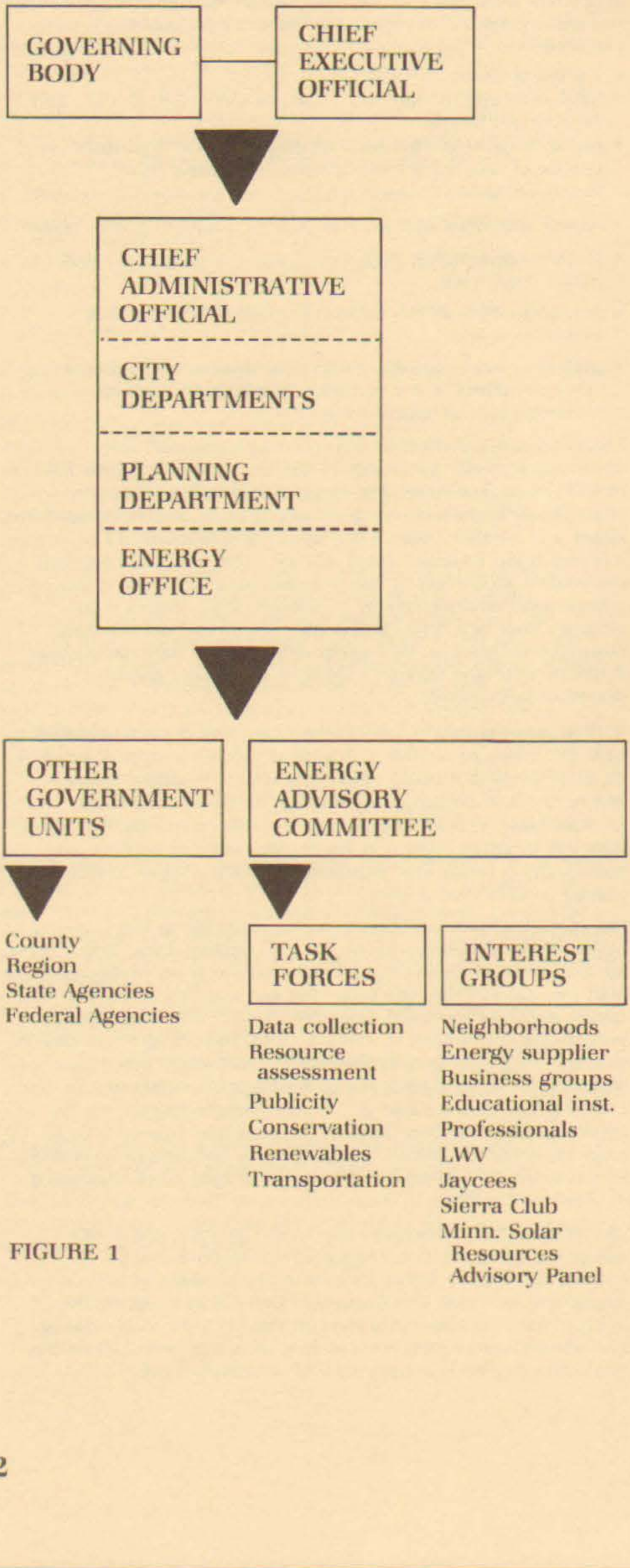


FIGURE 1

ENERGY PROGRAM ORGANIZATION

(for smaller cities)

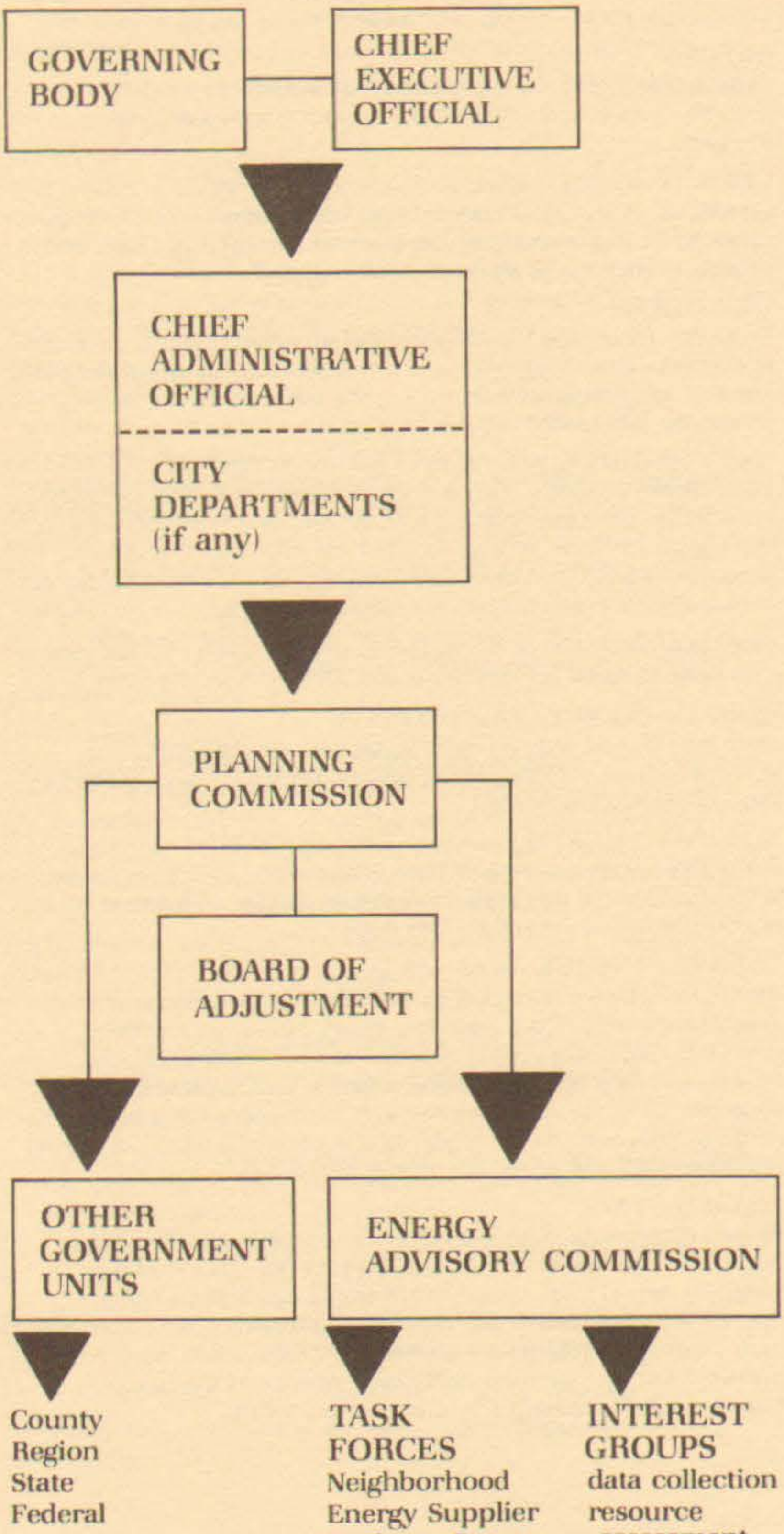


FIGURE 2

THE ENERGY PLANNING COORDINATOR

A critical issue for most local governments starting an energy planning effort is finding the people needed to carry the effort to completion. The energy planning coordinator must perform several key functions vital to the success of the program:

MOMENTUM
Scheduling meetings, supporting task forces, developing documentation and other data — making sure things keep happening;

COORDINATION
Coordinating with local government departments, task forces, other units of government, consultants, energy suppliers, and others — keeping all the cogs meshing; and

DIRECTION
Providing focus and impetus for the program; making sure data is accurate and assumptions reasonable, that the program goals are not conflicting, and that the program's products are politically acceptable.

Such a demanding role requires both technical and administrative ability. The energy coordinator should be visible, both in the local government's administrative structure and in the community. He or she should have access to the chief executive official or a designate, and should have direct lines of communication to community interest groups.

Finding a person to perform these functions can be challenging. The basic options for acquiring this kind of staff resource are:

HIRE AN ENERGY COORDINATOR
This option may only be open to larger units of local government — only two cities outside the Metro area currently have full-time energy staff.

USE EXISTING STAFF
If the local government has planning, administrative, or other staff qualified for this role, their duties can be reallocated to reflect the added energy-related duties.

USE VOLUNTEERS
Interested citizens, working in task forces, can often complete substantial parts of the planning effort. Some commitment from the city is important — at the least, a designated staff liaison, meeting space, supplies, copying and mailing services, recordkeeping, etc. In some cases, private companies or professionals will donate a part of the time of an individual for public service and good community relations;

SHARED STAFF
Several Minnesota cities currently "share" city administrators under the provisions of the Joint Powers Act (Minnesota Statutes, Sec. 471.59). Local governments can also investigate limited technical assistance through the county government, or their regional development commission (RDC). RDC staff have provided energy planning staff assistance, as in the case of Elmore, which got help from the Region 9 RDC.

PUBLIC PARTICIPATION

Involving all interested parties in the energy planning process is critical to its success. Many projects in recent years failed to involve key groups who later successfully opposed them. Energy planning can be a controversial activity, and requires public participation in all stages of the planning process.

Some of the important issues to consider in setting up a public participation program include:

LEGITIMACY

The planning effort must be seen as a legitimate activity, endorsed by the governing body, elected officials, and other opinion leaders. This can be achieved through media publicity, by using official local government procedures such as council resolutions and mayoral proclamations, and by giving all interested parties a voice in the process.

DECISION PROCESS

The particular decision-making process in the energy program must be seen as credible. If enough people believe the energy commission is merely a "rubber stamp" for a special interest, its decision will be hard to implement. The decision-making process should be open, should allow voting representation of affected parties, and should allow sufficient time and opportunity for review and comment on proposals.

CONSENSUS

The decisions, policies, and other outputs of the energy planning process should reflect some degree of compromise among divergent views.

REPRESENTATION

No group which feels itself significantly affected by the planning program should be denied representation through a public participation structure. Since the advisory body cannot physically represent all interests, mechanisms such as comment periods, public hearings, forums, and open meetings should be used to include as many interests as possible.

Most of these issues will be resolved in the makeup and operation of the advisory group. The advisory committee or commission should be structured to:

- ensure that affected interests have a forum in which to be heard;
- create and maintain active interest in participating;
- have a clearly defined role:
- type of power should be clarified, e.g. advisory (non-decision-making), commission powers (some decision-making and/or regulatory powers);
- available administrative resources should be confirmed (whether through city or other sources);
- mission statement should be stated generally in enabling action, and elaborated in the group's initial meetings;
- by-laws should be adopted in initial meetings; and
- schedule and products should be established in the initial meetings.

INTERGOVERNMENTAL COORDINATION

Many communities have made significant steps in their energy programs, acting on their own initiative and resources. The opportunities for community energy planning expand, however, when local governments work together and with other units of government. The City of Elmore worked with Region 9 RDC staff to develop a comprehensive energy plan; several cities have used a variety of federal grants for energy programs; others have made use of the resources of the Minnesota Energy Agency, and the Minnesota Housing Finance Agency. The 1980 law authorizing energy planning grants (Minn. Stat. Sec. 116H.089) has not yet received appropriations, but does create authority for energy planning.

The energy coordinator or the chairman of the advisory body should make contact with neighboring cities, the county government and planning commission, the regional development commission (or Metropolitan Council in the Twin Cities area) and state agencies to inform them of local goals and activities, and solicit information and potential forms of assistance. These agencies include:

- Minnesota Department of Economic Development
- Minnesota Department of Transportation
- Minnesota Housing Finance Agency
- Minnesota Department of Natural Resources
- Minnesota Public Utilities Commission
- Minnesota Energy Agency

At a minimum, the local government should get on the proper mailing list for receiving information about energy activities in the state. Federal agencies such as:

- Agricultural Extension Service (usually in the county seat)
- HUD (area office, Minneapolis)
- Farmers Home Administration (St. Paul)

should also be contacted to get on the appropriate mailing list.

At the organizational stage, it is important to make these intergovernmental contacts to establish a network of information and referral. More specific program references to agency sources occur throughout the rest of the Guidebook.

EXAMPLE

Community X, a city of 12,000, decides to create an energy plan, based on the mayor's attendance at a state conference where energy planning concepts were presented. The basic sequence of events for Community X is:

1. The mayor introduces a resolution in city council calling for the establishment of a volunteer Energy Commission whose mission will be to develop a comprehensive energy plan for the city. The resolution passes with one dissenting vote. The new Commission is to be an advisory commission to the planning commission. It is to receive administrative support (meeting room, supplies, recordkeeping, copying services) from the city administrator's office.

2. A mailing is sent out to all concerned organizations in the community. It includes a copy of the council resolution and a flyer announcing the initial meeting of the Commission, and summarizes its mission. The mailing is accompanied by radio spots and newspaper stories announcing the program and inviting participation on the advisory commission. Interested citizens are invited to submit their names to the Mayor's Office for committee membership consideration.

3. The Mayor and city council appoint committee members from the names that they have received.

4. At the organizational meeting, which is convened by the mayor, a representative of the League of Minnesota Municipalities is on hand to speak about the potential for local energy planning. The city administrator from a small Metro area city also speaks, describing his city's energy planning process, what it has done so far, its problems, and how Community X can learn from his experience.

After the speakers, nomination and election of officers is held, and the new officers are asked to the next meeting. The chairman is a local high school science teacher who has been active in teaching energy curriculum, and has built his own energy efficient home.

At the close of business, a small reception is held around exhibits placed by the local utility, the State Energy Agency, and some energy consultants.

5. At its next meeting, the Commission adopts by-laws. The Chairman presented an initial schedule and work plan, which is reviewed, revised, and adopted. Task forces are created to work in specific areas, including:

data collection
resource assessment
land use and transportation
energy conservation
municipal operations

It also develops proposed procedures with regard to coordination with the Planning Commission, the mayor, the city administrator, the task forces, the county planning commission, the State Energy Agency, and others. The chairman negotiates these procedures with the affected organizations.

6. The task forces begin their work on collecting energy data, defining alternative energy resources, investigating conservation programs, land use and transportation issues, and municipal operations.

DEFINING ENERGY PROBLEMS

DEFINING ENERGY PROBLEMS

ACTIVITIES

DATA COLLECTION

sources
methods

DATA ORGANIZATION

default methods
tabulations
conversions

DATA EVALUATION

statistics
graphics

DATA FORECASTS

usage
prices
sources
methods

PROBLEM IDENTIFICATION

criteria
framework
method

DEFINING ENERGY PROBLEMS

DATA COLLECTION
why collect it, where to get it, how to estimate it, how much and what kind of data is needed, how to collect it;

DATA ORGANIZATION
filling data gaps, using tables, converting to BTUs;

DATA EVALUATION
creating statistics, using graphics;

DATA FORECASTS
projecting usage, projecting prices, where to get forecasting data, basic forecasting methods; and

PROBLEM IDENTIFICATION
criteria for what makes a problem, a framework for comparison, a method for defining problems, limitation of the method.

Once a community has completed the organizational process as described in Chapter 2, it is ready to move to the first technical stage of the energy planning process: defining energy problems through the collection and analysis of data. This technical stage and others that follow need not be overwhelming. If the community has carefully selected the members of its advisory group, representatives from technical and non-technical fields should be available to provide and evaluate the data necessary for the community's planning process.

At the end of the chapter a "sample" community is taken through the problem definition process for an example.

DATA COLLECTION

WHY COLLECT DATA AND HOW MUCH?

Some energy programs have gotten inundated with too much energy data. It is important for a community to realize why it needs energy data, how it will be used, and how much is enough.

Energy data — that is, information on how much energy the community has been using, in what forms, for what purposes, and how much is paid for it — is a necessary foundation for energy planning. It is useful for such purposes as:

PROVIDING A COMMON BASIS FOR MAKING DECISIONS
A base year energy profile and projections provide benchmarks for planning.

TARGETING NEEDS FOR ENERGY PROGRAMS
Knowing how much energy is used by different sectors helps show where needs are greatest.

DEMONSTRATING THE NATURE AND DEGREE OF ENERGY PROBLEMS
Comparing cost and usage data between sectors, and with other communities, helps point out potential problems.

EVALUATING PLANS AND PROGRAMS
The base year data can become a reference for monitoring progress as plans and programs are put into action.

We all know energy is expensive, and sometimes scarce. But how much more expensive is one source than the other, now and in 2000? How much of each type do we use? Which sources may be more scarce in 2000? Which will be most expensive? Answers to these kinds of questions require some amount of information on energy usage and costs, now and in the future.

How much data is needed? That depends on three factors: the depth and complexity of the planning effort, the staff resource limitations of the local government, and the availability of energy data. If the community is anticipating a full-scale comprehensive planning effort impacting all sectors of the community, more data is needed than for a limited effort targeting a few sectors. Without full or part-time staff assistance, a major data effort may be difficult to accomplish. Lastly, if data sources are too numerous and laborious to research, the effort required to collect the data may be unwarranted.

This section presents basic data collection, analysis and display methods that local governments can use as a guide. The factors described above — the complexity of the planning effort, limitations in staff resources, and availability of data sources — will serve as constraints for individual planning efforts.

An issue related to the amount of energy data needed is the methods used to collect it. Two principal methods are available:

- public survey, similar to St. Paul's three-day Energy Mobilization, which has the advantage of creating widespread public awareness, but requires extensive staff time and logistical support; and
- research in existing records such as utility data, fuel dealer sales, census data, planning data, etc., which can yield good results on a broad level but may lose accuracy focusing on smaller areas.

The method used in this chapter assumes the second approach is used. It is more cost-effective for an initial effort, but does not exclude surveys, which can be used to fill data gaps or for specific project purposes. An energy data survey requires designing a survey instrument (such as a questionnaire), training a field crew to administer the survey, following up by phone and visit, compiling returns, validating data, and tabulating and analyzing results. Such surveys should be designed individually to meet the needs and fit within the resources of the individual community. Contact the St. Paul Energy Office (612/292-6730) for more details on surveys.

COMMUNITY PROFILE

To understand the meaning of energy data and projections, and to use them for planning in a community-wide context, an overall profile of the community is useful. This profile need not be elaborate, and should be based on data which are readily available. Information that should be included in the profile includes:

POPULATION

Population data to be gathered may include:

- current population
- population estimates for the years 1985, 1990 and 2000
- number of households
- income by household

These data may be used to determine the number of current dwelling units and the number of persons per dwelling unit, the number of dwelling units needed in the future and the future number of persons per dwelling unit. These data will also help to calculate the number of vehicles required, the number and type of daily trips generated and the need for special services; e.g. public transit for senior citizens and school children, financial assistance for payment of energy bills and for weatherization of housing units.

BUILDINGS

Knowledge of the characteristics of local buildings is very useful in identifying where conservation efforts might be most effectively targeted. The type of data which will be of use include:

- age of buildings
- type of materials used in construction
- type of heating and cooling systems used

An analysis of the preceding data will form a foundation upon which decisions can be made regarding how much investment should be made in energy conservation programs and where that effort can yield the greatest benefit.

ECONOMIC PROFILE

The following economic data are useful in determining the relationship between energy production, consumption and jobs within the community. These data should include an analysis of the:

- number of persons employed in each sector
- travel patterns of employees
- existing and alternative production methods

This analysis will provide an indication of where employment gains are possible with the implementation of new technologies. A detailed analysis will also provide information which is needed to determine the potential for using district heating, cogeneration and various transportation technologies.

TRANSPORTATION

Compilation and analysis of transportation data will be useful in addressing a variety of issues directly and indirectly related to transportation and land use patterns. The data collected should include:

- current number of registered vehicles
- age of vehicles
- type of vehicles (personal or commercial)
- traffic control systems and devices
- public transportation systems
- commuting patterns
- annual vehicle miles travelled
- home to work trips
- home to shopping trips
- non-home based trips
- average number of passengers per vehicle

These data can be used to determine practical energy saving opportunities with respect to van and car pooling, parking, traffic control changes, mass transit, potential for increased vehicle efficiency and transportation alternatives.

LAND USE PATTERNS

The following information may be collected:

- total area of planning unit
- breakdown of area by use districts
- present or anticipated annexation
- percentage vacant/undeveloped land
- areas presently served by municipal services (fire and police protection, sewer, water, etc.)

This information will be used to measure the density of land uses, to indicate where in-fill development can occur, to determine where services are currently provided and additional development should be encouraged, and to evaluate solar access, and zoning concerns related to earth sheltered construction and the construction of wind machines.

ENERGY PROFILE

An energy profile providing accurate information about local energy capabilities should be developed. This profile might include:

- identification of local energy suppliers
- identification of local energy production and supply facilities
- existing energy-related programs, such as weatherization, home energy audit and fuel assistance payments programs
- conservation programs undertaken in the past

This type of information will be used to determine what local facilities and programs are available, who is being served by them, and how they can best be utilized.

In developing the community profile a major effort to develop new data is not called for — the intent is to create a useful picture of the community which will provide a context for the energy data collection and planning efforts. Once available data have been compiled, be sure to consider the relationships between the various community profile categories and their relevance to the community's energy situation.

The following agencies can generally supply data which will be useful in developing the community profile:

City, County and Regional Planning Offices
Minnesota State Demographer
612/296-2557

Minnesota Department of Economic Security
Research and Statistical Services
612/296-6546

Minnesota Department of Economic Development
Research Division
612/296-0581

Minnesota Analysis and Planning Systems — MAPS
612/376-7003

Minnesota Department of Transportation
Minesota Energy Agency
U.S. Department of Commerce
Field Office Library
612/725-2134

U.S. Bureau of the Census (publications)
title and publication number:
General Population Characteristics PC-1-B25
General Social and Economic Characteristics PC-1-C25
County Business Patterns CBP-78-25

U.S. Department of Housing and Urban Development

ENERGY DATA SOURCES

The best source of energy data can be local energy suppliers, especially electric and gas utilities. If, as suggested in Chapter 2, suppliers are made part of the advisory group, the data effort may be made easier. In the Twin Cities area, the Metropolitan Council is developing community energy data files, available through its Local Planning Assistance program (call 612/291-6415). Out-state cities can contact the State Energy Agency's Information Center at 800/652-9747, which may be able to refer individual requests to the proper source.

In general, the most likely data sources, listed below by energy type, are:

ELECTRICITY

Every community is served by an electric utility; either investor-owned (such as Northern States Power or Minnesota Power and Light), municipally-owned (about 130 in Minnesota), or cooperative (principally in rural areas). All have records of power sales; however, this data is usually only available in bulk form, by customer class and geographic area, to protect individual user's privacy. The data collection task force should be aware that, except in the case of municipally-owned utilities, sales records may not conform to the geographic boundaries or energy-use sectors needed for the local energy effort. In these instances, a formula such as that presented on page 28 may be used to estimate the community's use of a particular energy resource. Utilities vary in the number and definition of customer classes in their service areas. The most common classes are residential, commercial (often called "general service"), and municipal with special rates applying to various customers in each class.

The class definitions should be examined carefully to see how they correspond to desired end-use categories. A utility's general commercial service customer class, for example, may include local government buildings, retail merchants, small industries, and waste treatment plants. Separating the data into these categories would require considerable analysis. For this reason the method recommended in this Guidebook uses a minimum of energy end-use sectors (see tool 8.3), and the end-use sectors in the table can be changed to fit available data categories.

If electrical energy suppliers serve on the commission, they can provide valuable assistance in collecting pertinent energy use data. Work with them to develop a list of data needs and secure the data from the utilities which they represent. If energy suppliers are not represented on the commission, develop a list of specific data needs and then contact the manager or public relations person at each utility serving the community. Data needs may include (depending on the objectives of the commission);

- annual sales of electricity for the community (in both kilowatt-hours and dollars) for the selected base year, broken down by customer class. If the utility cannot provide community-specific sales figures, obtain available information for the area which most closely approximates community boundaries and solicit the utility's help in deriving estimates of community usage (see page 28).
- seasonal and annual electrical energy usage trends for the area
- utility supply and demand forecasts for the area.

When your specific questions have been answered, invite the utility representative to offer other information or assistance which may serve the purposes of the commission. He or she may be able to supply other types of information which can expedite the data collection process.

An additional source of information is the Metropolitan Council in Saint Paul, which is developing energy data for communities in the Twin Cities metropolitan area. If your community is in the Metro area, call the Metropolitan Council's Local Planning Assistance Program at 612/291-6415.

NATURAL GAS

Gas utilities operate in somewhat the same way as electric utiities, and in general maintain the same kind of sales records. Like electric utilities, they normally protect individual customer's privacy, but can release bulk data by customer class and geographic area.

The questions and data collection suggestions outlined above for electrical energy use data may be modified for use in obtaining natural gas data. In this case, however, sales will be expressed in therms (1 therm = 100,000 BTU) or, more commonly, in MCF (thousand cubic feet). (All future references to natural gas data in the Guidebook will be expressed in MCF. Natural gas data for Metro area communities may also be available from the Metropolitan Council's Local Planning Assistance Program (612/291-6415).

HEATING OIL

Heating oil is usually sold by local dealers, who buy from wholesalers or "jobbers". However, they may not be able to provide the needed data on a community basis. It may be easier to use estimating methods such as those below.

Estimating heating oil consumption in the community requires determining the number of households using fuel oil. Two ways of doing this are:

- obtaining the number of households using electricity or gas from utilities; the remainder will be using oil (except for those using propane or wood — normally a small percentage);
- obtaining census data, from a library, from county authorities, or from the State Department of Economic Development; the census data will report households heated by oil on a county-by-county basis; the number of households heated by oil in the community can then be derived by multiplying the ratio of community to county population by the number of oil-heated households in the county.

When the number of oil heated households in the community has been estimated, calculate heating oil consumption by using an average consumption factor of 1100 gallons per household per year.

GASOLINE

Gasoline dealers are so small and numerous that they are usually impractical as a source of gasoline data. An easier method may be to use the Minnesota Department of Transportation (MnDOT)'s data on vehicle miles travelled (VMT) by area. This data is available through MnDOT; call the Roadway Information System office at 612/296-1262. As a "fallback" estimate, MnDOT estimates that in cities of 5,000 and up travel is about 11 VMT per capita per day. Divide VMT by a mileage figure (14.5 is a current, conservative figure) to derive gallons of gasoline consumed.

Alternate gasoline estimating methods are:

- Obtain local vehicle registrations from the state motor vehicle department, and multiply by estimated mileage and travel data; a suggested formula is:

_____	×	10,000	÷	14.5	=	_____
VEHICLE REGISTRATION		MILES PER YEAR		MILES PER GALLON		LOCAL GASOLINE USE (GALLONS)

- Obtain statewide gasoline sales from the state department of revenue and proportion them by population; thus:

_____	÷	_____	×	_____	=	_____
LOCAL POPULATION		STATE POPULATION		STATE GASOLINE SALES		LOCAL GASOLINE SALES (GALLONS)

(Note on diesel fuel: Approximately 94% of the transportation fuel consumed in Minnesota is gasoline, and 6% is diesel fuel. Given that diesel is a relatively minor portion of total transportation fuel use, local data collection efforts can usually proceed safely by calculating transportation energy use as if it were 100% gasoline, using one of the methods suggested above.)

OTHER

Coal, bottled gas (propane), and other sources (including renewable sources such as wood or solar) usually provide a minor fraction of energy used in the community. Local dealers are the best sources for this kind of data. Otherwise, surveys involving "chimney counts" or similar techniques can be undertaken. Each community should try to determine whether these minor sources are significant enough to warrant a special data collection effort.

ORGANIZING ENERGY DATA

Once raw data has been obtained, it has to be compiled, analyzed, and interpreted. The raw data collected may not be in the most convenient form. If the data that have been gathered do not conform to community boundaries or the desired end-use categories, set up the basic energy data format and then "massage" the data into the desired categories. A basic energy data summary format is shown in Tool 8.3. Within this format, the energy types (columns) and energy-use sectors (rows) can be expanded or reduced in accord with local needs and data availability. A sample completed energy data table is shown in Tool 8.3.

When the available data does not fit desired categories, use the following estimating methods:

ELECTRICITY

If available data is not broken down by community, it can be estimated by using zip codes or meter districts. Obtain the zip code or meter district map and draw a rough correspondence to community boundaries. A proportioning method can also be used, such as the following:

electricity sold in community =

$$\frac{\#\text{ customers in community}}{\#\text{ customers in service area}} \times \text{total electricity sold in service area}$$

This procedure can be followed for each customer class (i.e., residential, commercial, etc.). Problems may arise in using this method to estimate local industrial energy use, however, since the energy requirements (or energy intensities) of different types of industries vary considerably. Your utilities may be able to assist in the process of estimating the share of total sales which go to industries in the community. Another option for assessing industrial energy usage is to conduct a survey of the community's industries. (A greater response is likely if the respondents are permitted to remain anonymous and if only aggregated data are presented in the survey results.) Industry-specific usage information may be obtained if the respondents provide their two-digit SIC (Standard Industrial Classification) code number, which identifies the general industrial category to which they belong.

NATURAL GAS

The same procedures apply for natural gas as for electricity.

Using the above methods, complete a basic energy data summary, similar to the one shown in Tool 8.3, or a variant based on local objectives and data availability. This will create a baseline profile of the community's energy usage and costs, against which to evaluate future usage and cost figures.

COMMUNITY ENERGY DATA SUMMARY

YEAR 1980

COMMUNITY SECTOR	ENERGY TYPE	HEATING OIL (*2) (GALLONS)	NATURAL GAS (THERMS)	ELECTRICITY (KILOWATT-HOURS) (See Note 1)	GASOLINE (GALLONS)	OTHER	TOTAL
RESIDENTIAL	UNITS	900,000		32,800,000			
	MMBTU*	124,000		112,000			236,000
	COST	$801,000		$1,314,000			$2,115,000
COMMERCIAL/ INDUSTRIAL	UNITS						
	MMBTU						
	COST						
LOCAL GOVERNMENT	UNITS	12,000		1,500,000	8276		
	MMBTU	1,656		5119	1068		7843
	COST	$ 10,680		$60,000	$10,760		$81,440
TRANSPORTATION	UNITS				1,379,000		
	MMBTU				178,000		178,000
	COST				$1,793,000		$1,793,000
TOTAL	MMBTU	125,656		117,119	179,068		421,843
	COST	$811,680		$1,374,000	$1,803,760		$3,989,440

BTU CONVERSIONS

HEATING OIL (*2)	NATURAL GAS	ELECTRICITY	GASOLINE	COAL	WOOD
Gallons	Therms	KWH	Gallons	Tons	Cords
x	x	x	x	x	x
0.138	0.1	0.003413	0.129	22	30
=	=	=	=	=	=
MMBTU	MMBTU	MMBTU	MMBTU	MMBTU	MMBTU

*MMBTU = MILLION BTU

TOOL 8.3
Also see Planning Tools Library, Section 8, Forms & Samples.

EVALUATING ENERGY DATA

When the basic energy data has been collected, how do you make sense of it? What do you compare it to? How do you display it?

Several concepts are important to understanding and using energy data:

USAGE VS. COST

Because of regulatory policies going back as much as 40 years, different energy sources vary in price. Hence a traditionally "cheap" energy source (such as natural gas) might appear to be less of a problem than a costly source (such as electricity) if one compares only dollars spent. But because a customer might be paying only one-third as much for gas as for electricity (on a BTU equivalent basis), he might be using a lot more gas than the relative cost figures show. Hence it is important to compare "apples and apples" which means comparing energy sources on a usage basis as well as a cost basis. This also means converting all sources from basic units (gallons, therms, kilowatt hours) to BTU (British Thermal Units) using the conversions shown in the table in Tool 8.3.

NORMS

In order to place the amount of energy used by the community in a meaningful context, it is helpful to express energy use and cost numbers in terms of something known — a normalizing factor — like total population, number of households, square feet of space (where available), or degree days (to capture weather effects). This points to the value of an overall community profile (as described in the Data Collection section) to use as a basis for this kind of evaluation.

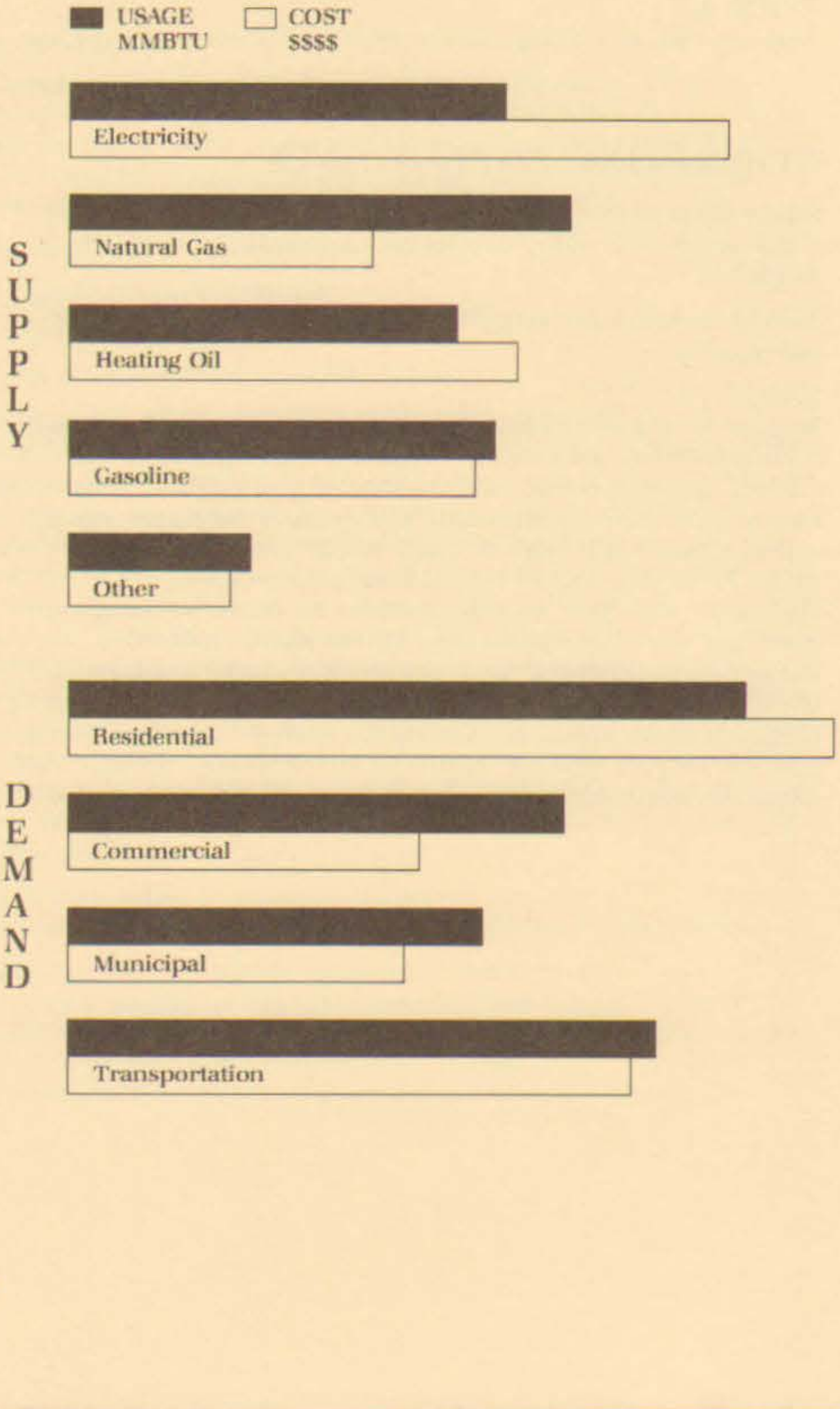
GRAPHICS

Energy data can often be conveyed more clearly through good graphics than they can be in a written report. Figures 3 through 5 represent a selection of graphic concepts that can be used to display energy data in a meaningful way.

Deriving statistics in terms of per capita, per square foot, or per degree day figures can help the community compare its situation to others, and can create "benchmarks" to serve as reference points as the community and its energy program develop and change. A few of the simplest "normalized" statistics include:

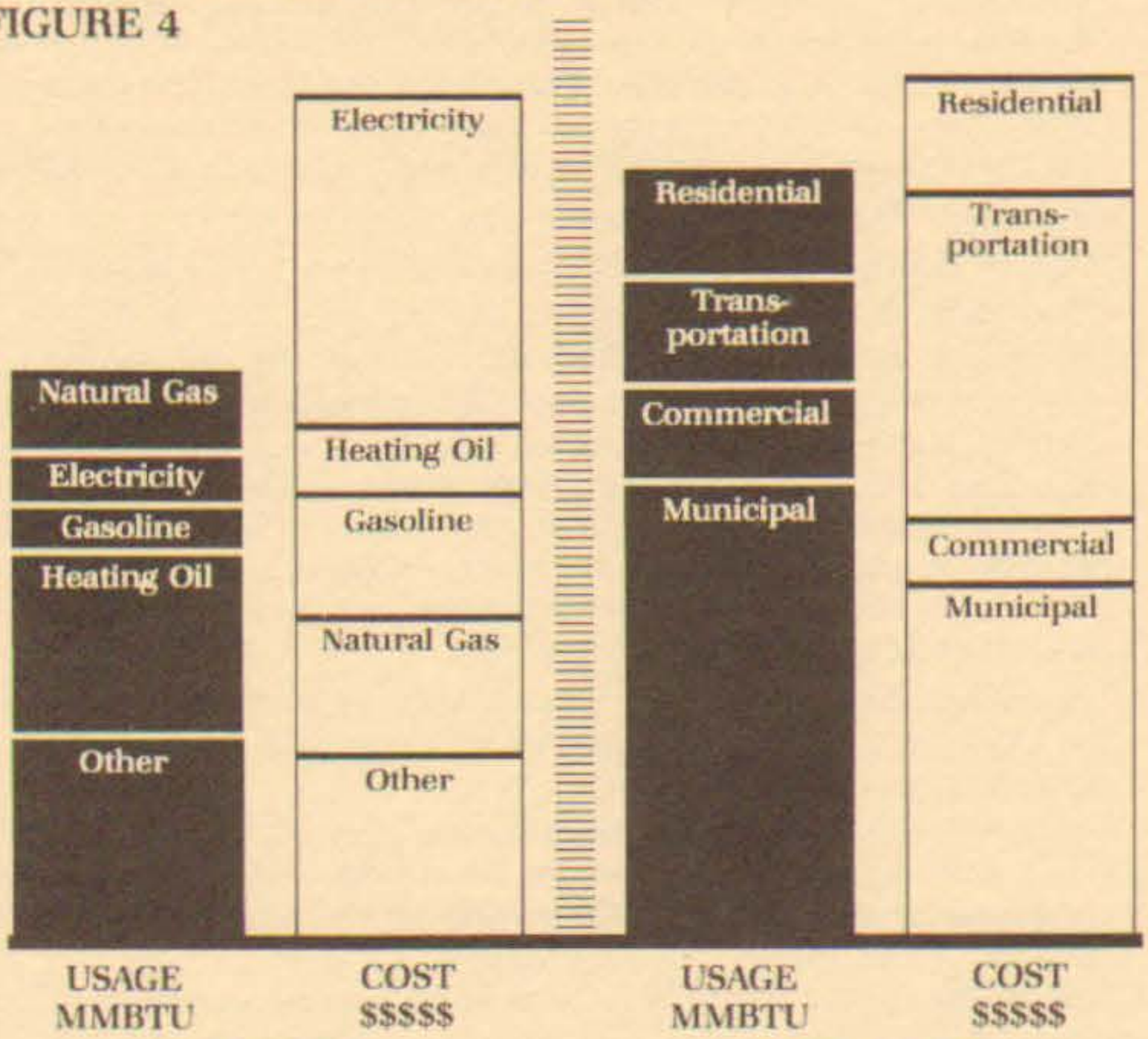
SAMPLE ENERGY GRAPHICS
BAR CHART

FIGURE 3



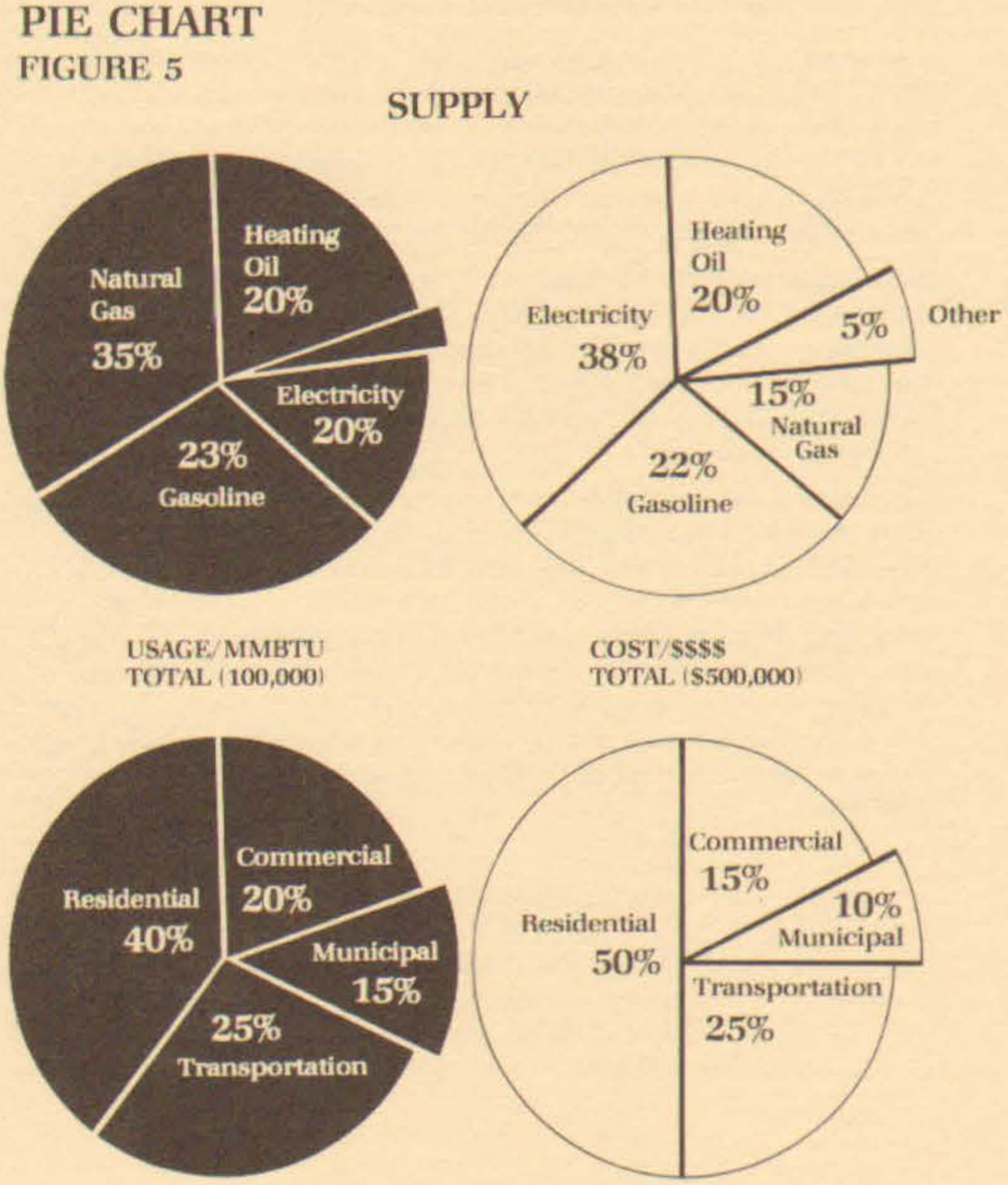
COMBINED BAR CHART

FIGURE 4



PIE CHART

FIGURE 5



RESIDENTIAL USE AND COST PER CAPITA

Total all energy sources, usage and cost figures and divide by the total population, total households, or total square footage of residential space, if available. This allows the individual citizen to see how much energy they actually use; it also brings the numbers down to a comprehensible level, where their meaning can be better grasped.

USE PER SQUARE FOOT (LOCAL GOVERNMENT FACILITIES)

Floor area data is usually hard to develop except in facilities owned by the local unit of government. However, energy use and cost per square foot are data that tell a lot about a building's energy efficiency. Basic office buildings that use less than 100-150,000 BTU/square foot/year are fairly efficient; 50,000 BTU/square foot/year is very efficient. These figures vary by climate conditions — see degree day discussion below. These figures can be used to set targets and track progress year by year.

DEGREE DAYS (DEGREE DAYS ARE THE DIFFERENCE BETWEEN THE MEAN DAILY TEMPERATURE AND 65°F — SEE GLOSSARY)

In Minnesota, with up to 10,000 heating degree days in a year, as compared with southern areas with 2-3,000 or mid-atlantic areas with 4-5,000 degree days annually, climate clearly affects energy use. The National Weather Service maintains degree day data on a monthly and annual basis. Using degree days as a comparative factor allows the community to see how "weather-tight" it is. It might use less energy in a given year, but that may have been due to a mild winter. Dividing consumption (BTUs) by degree days at year's end tells you how well the community did.

For example, if the community used 200,000 million BTU in year X and 220,000 million BTU in year Y, use degree day records to compare performance. If degree days were 9,000 in year X and 10,000 in year Y, BTU per degree day would be 22 million for both years. The apparent increase in year Y could then be at least partly explained by weather variations.

Looking at weather variation can be important, in that improving "BTU-per-degree-day" performance can help avoid shortages. It also provides an ongoing performance measure to see whether the community's energy performance is improving. (Figure 6 shows average degree day totals for various Minnesota locations.)

Limitations on the detail or accuracy of energy data need not be a roadblock to the energy planning program. Sooner or later, however, as the community gets more serious about energy, it will want to use some of these data tools to keep track of progress, set new goals, and identify new problems. A natural extension of the data gathering effort is the establishment of an ongoing monitoring system. A one time energy profile is good, but a regular "annual energy report" is better, because it keeps the community aware of both progress and continuing problems.

MINNESOTA ANNUAL HEATING AND COOLING DEGREE DAY NORMALS

STATION	ANNUAL HDD	ANNUAL CDD	STATION	ANNUAL HDD	ANNUAL CDD
Ada	9223	483	Maple Plain	8145	579
Albert Lea	7769	650	Marshall	8032	656
Alexandria FAA Airport	9235	418	Meadowlands	9745	212
Angus 4 E	8952	340	Milaca	8704	426
Argyle 4 E	10205	329	Milan	8429	539
Artichoke Lake	8402	577	Minneapolis-St. Paul WSO	8159	523
Austin 3 S	7907	556	Montevideo 1 SW	8303	557
Babbitt 2 SE	9846	235	Moose Lake 1 SSE	9265	257
Baudette	10098	254	Mora	8684	449
Beardsley	8356	586	Morris W C School	8815	490
Bemidji Airport	10203	241	New London	8360	614
Big Falls	9913	244	New Ulm 2 SE	7864	704
Bird Island	8051	635	Park Rapids	9707	324
Brainerd Ranger Station	9163	374	Pine River Dam	9274	305
Cambridge State Hospital	8764	415	Pipestone	8477	549
Campbell	9253	421	Pokegama Dam	9564	253
Canby	7917	713	Red Lake Falls	9694	350
Chaska 1 NE	8039	648	Red Lake Indian Agency	10112	277
Cloquet	9567	187	Rochester WSO	8227	474
Crookston NE Exp Station	9567	394	Roseau 1 E	10359	254
Detroit Lakes NNE	9770	328	St. Cloud WSO	8868	425
Duluth WSO	9757	175	St. Peter 2 SW	7748	710
Fairmont	7831	684	Sandy Lake Dam Libby	9298	265
Faribault	7911	677	Springfield 1 NW	7858	678
Farmington 3 NW	7937	584	Tracy	7900	722
Fergus Falls	8790	524	Two Harbors	9180	152
Fosston	9439	387	Virginia	9694	278
Grand Marais	9678	81	Wadena 3 S	9102	399
Grand Meadow	8306	467	Walker Ah Gwah Ching	9365	305
Grand Rapids NC School	9586	229	Warroad	10264	260
Gull Lake Dam	8925	397	Waseca Exp Station	8053	588
Hallock	10287	363	Wheaton	8197	689
Hinckley	8975	384	Willmar State Hospital	8332	588
International Falls WSO	10547	175	Windom	7755	698
Itasca State Park Sch	9799	251	Winnebago	8208	588
Leech Lake Dam	9358	292	Winnibigoshish Dam	9551	306
Litchfield	8237	612	Winona	7511	745
Little Falls In	8730	458	Worthington	8275	561
Long Prairie	8997	425	Zumbrota	7924	580
Madison Sewage Plant	8005	673			

Source: Climatological Data of Minnesota
National Oceanic and Atmospheric Administration
National Climatic Center, Asheville, North Carolina

FIGURE 6

Such a system could be as simple as filling out a new energy data form like the one in Tool 8.3. It could involve a cooperative effort by energy suppliers to revise their accounting systems to produce needed data as a regular feature, eliminating the need for a costly annual exercise. More details on developing an energy information system appear in Chapter 7 and Tool 3.8.

DATA FORECASTS

Because energy planning is future-oriented it implies some prediction of where energy usage and cost will be five, ten or twenty years from now. Forecasting is an inexact science; the best way to approach it is to make reasonable assumptions and create descriptions of alternative futures, or "scenarios," based on different assumptions. The most basic forecasting method is the "trend extrapolation" method: this assumes that prices and usage continue to increase as they have in recent years. This results in a "base-case" scenario. Then assumptions about prices and usage can be altered to create alternative scenarios. At this stage in the planning process, it is sufficient to make a "base case" projection: that is, how much energy will be used, and how much will it cost, assuming that energy sources and usage practices do not change, and that prices increase according to current trends. A simple method for doing this is:

1. Calculate energy used per capita or per household for the base year, by fuel type for each sector, i.e. gallons of residential fuel oil per capita, commercial kilowatt hours per capita, etc. Use the following formula:

Base year fuel units/sector ÷ base year population or households = per capita or household use/fuel/sector

2. Use population projections for the year 2000 to calculate energy usage by fuel type and sector in the year 2000 (other target years, such as 1990, 1985, etc. can be used based on available data, existing planning projections, etc.). Use the following formula:

Per capita use/fuel/sector × projection year population (2000) = projeted use/sector

3. Use current price projections for each energy source (dollars per gallon of oil; cents per kilowatt hour, etc.) to project costs in the year 2000 or other planning period for each energy source and each sector. Contact the State Energy Agency for price projection estimates.

4. Add up usage and cost projections, convert energy sources to BTUs, and develop a summary table similar to that in Tool 8.3. Use energy graphics parallel to these suggested in Figures 3 through 5.

This base case forecast can be displayed alongside the base year energy data as a means of assessing what the impact on the community will be of energy use and costs in 2000, if nothing is done to change current sources and usage patterns. As conservation and renewable resource potentials are evaluated, they can be used to alter the base case forecast.

IDENTIFYING PROBLEMS

In one sense, energy problems are simple: gasoline shortages, heating oil prices, electricity costs, and so on. In that sense you don't need a "problem definition process" as much as direct action. But to plan effectively, to look at the whole community, and at the future as well as the present, it helps to use a logical method to lay out the scope and the relative urgency of local energy problems. The basic steps are as follows:

DEFINE CRITERIA

What constitutes a problem? The planning process can use factors such as:

- cost
- usage
- vulnerability of supply
- importance of activity served

These factors interrelate: for example, electricity may cost a lot, but its actual volume in BTU units or the functions it serves

may not be as critical as natural gas; nor is it as likely to be interrupted. So cost alone is not the only way to define a problem. As a counter example, if electricity has been relatively inexpensive in an area, causing people to use it extensively for heat and other vital uses, and if the utility's rates begin to increase rapidly, then the cost of electricity would be a greater problem. Supply predictions depend mainly on external events; contact the State Energy Agency for supply forecast data.

This problem definition process uses the four factors above as basic criteria, and weighs them in a balanced fashion such as that discussed in the example below.

LAY OUT A FRAMEWORK

It is useful to set up a problem definition chart or "matrix" that covers the potential problem areas. A simple way to do this is to use the same table format as in the basic energy data form in Tool 8.3. This allows you to use the data base directly. An example of a "problem definition table" is shown in Tool 8.4.

USE A CONSISTENT METHOD

A logical "first cut" would be to look at each cell in the problem definition table in Figure 13 and weigh it according to the four factors. Use a simple weighting method for each factor such as:

1. not very important 2. important 3. very important

Going through this weighting process for each cell of the table produces total relative rankings for each sector and each fuel type. Follow the instruction accompanying the table. This need not be a complex procedure; it is best done as a group exercise, as part of the advisory committee's role. It should be recognized that this will be a political as well as a mathematical process; people will use their values as well as raw data to define problems. This is perfectly appropriate, and in fact is important to a successful program. People will support something they believe is important more strongly than they will support a reasonable analysis that doesn't get them interested. This method has its limits. It is meant as a framework to help spur discussion and thought, and should be used flexibly in a spirit of exploration.

COMMUNITY ENERGY PROBLEM DEFINITION TABLE

COMMUNITY SECTOR / ENERGY TYPE		HEATING OIL	NATURAL GAS	ELECTRICITY	GASOLINE	OTHER
RESIDENTIAL	FACTORS	A B C D		A B C D		
	WEIGHTS	2 2 3 3		2 2 1 3		
	TOTAL WT	10		8		
COMMERCIAL/ INDUSTRIAL	FACTORS					
	WEIGHTS					
	TOTAL WT					
LOCAL GOVERNMENT	FACTORS	A B C D		A B C D	A B C D	
	WEIGHTS	1 2 3 2		1 2 1 2	2 3 3 2	
	TOTAL WT	8		6	10	
TRANSPORTATION	FACTORS				A B C D	
	WEIGHTS				3 3 3 3	
	TOTAL WT				12	
AVERAGE WEIGHT		9		7	11	
TOTAL RANK		2		3	1	

Potential Problems
(ranked in order of total weights in cells of the table)

1. GASOLINE (PRIVATE CARS)
2. RESIDENTIAL HEATING OIL
3. MUNICIPAL VEHICLE GASOLINE
4. RESIDENTIAL ELECTRICITY
5. MUNICIPAL HEATING OIL
6. MUNICIPAL ELECTRICITY
7.
8.
9.
10.

TOOL 8.4

Also see Planning Tools Library, Section 8, Forms & Samples.

EXAMPLE

Community X, in going through the energy problem definition process, follows these basic steps:

1. The Energy Data Task Force of the Energy Commission contacts local energy suppliers. One volunteer contacts the electric utility; another develops heating oil estimates from census data. A third contacts the Department of Transportation to obtain vehicle miles travelled and confirms an estimate of average gasoline mileage.

2. Working cooperatively with the suppliers, the task force is able to develop reasonable estimates of 1980 consumption and cost data for electricity, heating oil, and gasoline in the residential, municipal, and transportation sectors. The group fills out a basic energy data summary similar to that shown in Tool 8.3.

3. The task force obtains population data and weather data, and creates a graphic presentation of 1980 energy costs and usage using concepts like those in Figures 4-6, with some simple statistics like total BTUs and dollars per capita, and per household, and heating oil BTUs per degree day.

4. Based on predicted growth in population, and on predicted energy prices for the year 2000, the task force creates a "base case" scenario which indicates slight growth in energy usage but manyfold increases in energy costs. A summary table and graphics are prepared, comparable to the base year data analysis.

5. The task force presents the base year and "base case" forecast data to an open meeting of the commission. After explanation and discussion of the data, the group goes through an exercise of filling out an energy problem table similar to that in Tool 8.4. In the meeting, each cell's weight and raking was filled out by simple voice vote after brief discussion. After the whole table was filled out, the consensus was reached that Community X's most pressing problems were in the areas of residential heating oil, residential gasoline, and municipal electricity.

6. The consensus reached on basic energy problems was summarized in a report including the basic energy data summaries and graphics. The report included an overall profile of the community — its population, growth projection, and economic activity in a general statement of potential problem areas.

DEFINING ENERGY RESOURCES

4

5

6

7

RESOURCE ASSESSMENT

ACTIVITIES

CONSERVATION

residential
commercial
local government
transportation

RENEWABLES

solar
wind
hydro
biomass crops and residues
wood
manure
special energy crops
district heating

PLANNING APPLICATIONS

energy potential
cost issues
local government role

DEFINING ENERGY RESOURCES

This chapter is a guide to defining the conservation options and alternative energy resources available to the community for replacing conventional energy sources. Assessing the potential for conservation and renewable resources is a vital link in the energy planning process; it provides a basis for setting goals and devising specific plan elements and programs to respond to the problems identified in the previous phase of the planning process (Chapter 3). The chart at left outlines the resource assessment process contained in this chapter.

Resource assessment can be as complex as the community's needs, resources, and initiative want to make it. One very simple approach to resource assessment is to use problems as guides; for example, if the community's largest problem appears to be in residential space heating, currently dependent on heating oil, then the resource assessment process would be based on finding alternatives to heating oil used in homes. A more complex, comprehensive method involves identifying all potential alternatives, and then matching them to specific needs.

Each community should decide how much resource assessment it needs for its planning effort. "Self-assessment" methods for this are included in each resource section. These sections provide basic descriptions of and self-assessment methods for conservation and renewable resource potentials. Detailed resource assessment formulas are found in the tools library and are referenced in the text as needed.

To provide a frame of reference on a statewide basis, Figure 7 shows the estimated potentials of renewable resources for replacing various conventional fuels. These potentials will not be available in the same proportions in each community, but the table does provide an overview of the ultimate potential. The "bottom line" of the table is particularly interesting; it shows that renewable resources could potentially replace 40% of conventional fuel use by the year 2000. The applicability of these resources will vary in different communities; the sections that follow help the reader decide whether a resource may be worth investigating.

Tool 8.5 is a resource inventory format suggested as a summary table for the results of the assessment methods described in this chapter. It is designed to be used with the energy data summary produced in Chapter 3. The conservation and renewable potentials can be applied against projected year 2000 energy demands (the "base case" scenario). If projections were not made, base year energy use data can be used as an alternate frame of reference. Tool 8.5 includes a sample completed resource inventory.

Tool 8.6, designed to be used with Tool 8.5, is a guide to identifying the conventional energy types that different conservation and renewable resource potentials could replace.

In conducting the resource assessment, use Tool 8.5 as a summary format. Develop conservation and renewable resource estimates using the methods referred to in the sections of this chapter, enter the data in Tool 8.5, and compare it to the base year and forecast energy use data to assess the potential for replacing conventional energy sources.

CONSERVATION

Energy conservation, or better stated, energy efficiency, is the one energy resource common to all users. It is also the least expensive and the most immediately available. Energy efficiency is limited more by economics than by technology; rising energy prices are already encouraging substantial reductions in energy use, and continuing increases will further reduce energy used per unit of activity while allowing economic growth and comfortable lifestyles.

Conservation appears first on the resource list because it affects planning for all other energy sources. Setting targets for conservation gives the community an idea of how much energy will really be needed. If projected energy use is reduced, supply requirements can be reduced as well. The 1970s were an example of energy suppliers (mainly electric utilities) building supply capacity based on projected demand that was too high. Prices and shortages reduced actual demand growth, and many suppliers were left with excess capacity and substantial debt burdens, which were passed on to consumers in higher prices. Hence projecting conservation potential is important to planning for both conventional and alternative energy sources.

Estimating the exact amount of conservation achievable is difficult, because several factors come into play.

COST
Many conservation measures are low-or-no-cost items, and so tend to be achieved faster and more widely; some of the larger potential require substantial expenditures, and so happen more slowly;

BUILDING STOCK
New buildings can be (and in some cases already are) built much more energy-efficient than existing buildings; existing buildings can be "retro-fit" to a limited extent;

USER DIVERSITY
Commercial buildings, schools, transportation and other energy-use sectors are different in the physical means by which conservation is achieved, and in the motivations, constraints and regulations they operate in.

Estimating conservation potentials can be performed in a consistent framework, by referring to the basic energy data summary table in Tool 8.5, which is organized by energy type and end-use sector. In this framework rough conservation potentials can be estimated for each end-use sector, using the estimation procedures that follow

RESIDENTIAL

Projecting conservation potential in homes involves using the community profile data developed in Chapter 3 to determine how many homes will be replaced by a given date (2000 is used in this guidebook). Use the following guidelines for estimating conservation potential:

- 25% for existing homes;
- 36% for new homes meeting current state building energy code;
- 65% for new designs using super-insulation, earth-sheltering, and passive solar concepts.

Energy usage can be reduced by the above percentages in the target year projection.

POTENTIAL REPLACEMENT OF CONVENTIONAL FUELS BY ALTERNATIVES, YEAR 2000

(Trillion BTU)

	CONVENTIONAL FUEL TYPES[1]							
Resource	Natural Gas	LPG	Thermal[2] Fuel Oils	Transportation[3] Fuel Oils	Gasoline	Electricity[4]	Thermal Coal	Total
Solar[5]	41.5	6.5	24.2	0	0	9.3	0	81.5
Wind[6]	0	0	0	0	0	20.6	0	20.6
Hydro[7]	0	0	0	0	0	4.2	0	4.2
Biomass								
Conventional Crops[7]	0	0	0	0	0	0	0	0
Crop Residues[8]	20.3	3.2	11.8	7.1	11.6	8.2	0	62.2
Animal Waste[9]	3.1	0	0	0	0	0	0	3.1
Wood[7]	0	0	0	0	0	0	0	0
Special Crops (+Peat)[8]	55.1	8.7	32.1	20.0	32.5	22.3	0	170.7
Urban Waste[10]	.4	0	3.4	0	0	0	0	3.3
Cogeneration District Heating[12]	25.6	0	15.0	0	0	0	0	40.6
Total	146.0	18.4	86.5	27.1	44.1	64.6	0	386.7
Projected Fuel Demand[11]	212.0	33.3	123.6	90.3	146.8	164.5	185.7	956.2
% of Projected Demand Replaced	68.9	55.3	70.0	30.0	30.0	39.3	0	40.4

NOTES:
1) Thermal use coal assumed not replaced; coal and nuclear for electric production replaced in electricity column.
2) Includes distillate and residual fuel oils for heat.
3) Includes jet fuel and distillate fuel oil used for transporation and agriculture.
4) Metered electricity includes both thermal and nonthermal; excludes industry self generated.
5) Assumes natural gas, LPG, thermal fuel oils, and thermal electricity use replaced in proportion to their year 2000 demand in the d[4] forecast.
6) Assumes wind and hydro generated electricity replaces nonthermal electricity.
7) Assumes wood and conventional crop energy contribution insignificant by year 2000.
8) Crop residues and special crops (+peat) assumed to replace natural gas, propane, thermal fuel oils, and thermally-used electricity in proportion to each resource's d[4] thermal end-use demand; transportation fuels in proportion to each resource's year 2000 transportation and use demand; and nonthermal electricity to the extent each resource is needed.
9) Assumes all animal waste used to replace natural gas.
10) Assumes solid waste portion used to replace thermal fuel oils (industrially burned). Assumes sewage portion used to replace natural gas.
11) Energy used to generate and transport electricity not included.
12) Assumes natural gas and thermal fuel oils replaced in proportion to their year 2000 demand in the d[4] forecast.

Source: Minnesota Energy Agency. *1980 Biennial Report.*

FIGURE 7

To estimate overall residential conservation potential, use the following formula:

a) Estimate number of existing residential buildings likely to be in use in 2000 (use 40 years as an average building life).

b) Estimate new residential buildings to be constructed by 2000; assume all will meet state code.

c) Estimate number of new residential buildings that will be built on "state-of-the-art" energy principles by 2000 (use 20% of total new buildings as a rule of thumb).

d) Obtain projected energy use per household for the year 2000 from the data forecasts described in Chapter 3; use this per-household factor in steps e, f, and g.

e) Take the number of households from c and multiply by the projected per-household factor; then multiply the result by .35.

f) Take the number of households from b and multiply by the projected per-household factor; then multiply the result by .64.

g) Take the number of households from a and multiply the projected per-household factor; then multiply the result by .75.

h) Add the results from e, f, and g to produce a revised projection for residential energy demand in the year 2000.

i) Take the projected year 2000 residential usage (the "base-case" scenario) from the forecasting exercise described in Chapter 3. Subtract the total usage derived in step h to obtain energy savings potential from conservation for the residential sector in MMBTU.

j) Divide energy savings potential by residential 2000 base case total to yield a percentage residential energy savings. Apply this percentage to each recorded fuel type (MMBTU) to yield the potential MMBTU savings for each fuel in the residential sector.

ENERGY RESOURCE INVENTORY

DISPLACED ENERGY TYPE	HEATING OIL		NATURAL GAS		ELECTRICITY		GASOLINE		OTHER		TOTAL	
ENERGY SOURCE	MMBTU*	%**	MMBTU	%	MMBTU	%	MMBTU	%	MMBTU	%	MMBTU	%***
CONSERVATION												
Residential	31,000	25%			28,000	25%					59,000	14%
Commercial/Industrial												
Local Government	1,143	69%			3,587	69%	427	40%			5,157	1%
Transportation							71,000	40%			71,000	17%
SUBTOTAL	32,143	26%			31,587	27%	71,427	40%			135,000	32%
RENEWABLES												
Solar	45,500	36%			45,500	39%					91,000	22%
Wind					1,200	1%					1,200	0.2%
Hydro					4,400	4%					4,400	1%
Biomass	6,670	5%			6,670	6%	6,670	4%			20,010	5%
crops												
animal waste												
wood												
special crops												
SUBTOTAL	52,170	42%			57,770	49%	6,670	4%			116,610	28%
DISTRICT HEATING												
TOTAL	84,313	67%			89,357	76%	78,097	44%			251,767	60%

* MMBTU = Million BTU
** (%)= Percent of projected 2000 usage for the individual sector, (e.g., residential heating oil)
*** Total % - based on total community energy use hence percentages will be lower than for individual columns.

TOOL 8.5

Also see Planning Tools Library, Section 8, Forms & Samples.

This formula ignores the differences between building types, e.g. single vs. multi-family, townhouses, high-rises, etc. It is keyed to single family residences; the continuing trend to smaller homes and multi-unit buildings such as townhouses, condominiums, and apartments will tend to reduce per-household energy use. However, separating these units statistically and making specific projections for each type is difficult unless the community has very detailed planning capabilities and data files.

Energy Resource Substitution Table

ENERGY SOURCE / DISPLACED ENERGY TYPE	HEATING OIL	NATURAL GAS	ELECTRICITY	GASOLINE
CONSERVATION				
Residential				
Commercial/Industrial				
Local Government				
Transportation				
Subtotal				
RENEWABLES				
Solar				
Wind				
Hydro				
Biomass				
crops				
animal waste				
wood				
special crops				
DISTRICT HEATING				

TOOL 8.6

Also see Planning Tools Library, Section 8, Forms & Samples.

COMMERCIAL

This sector includes office buildings, retail stores, institutional buildings, etc. Conservation potentials vary with the age, equipment, usage and ownership of the building. Projecting commercial energy use requires some estimate of the floor-space or similar measure. If possible, energy use per square foot should be calculated for the base year; then project square footage for the year 2000.

Use the following general formula for estimating commercial conservation potential as described in the next section on industrial conservation estimates. This procedure can be used to develop a combined gross estimate of conservation potential in the commercial and industrial sectors.

a) Estimate square footage of commercial space for the base year, either from the community profile described in Chapter 3, or by dividing the total commercial energy in BTUs from the Energy Data Summary Table by 224,000 (an average BTU/square foot figure).

b) Project commercial floor space (square feet) for the year 2000 using available planning or economic development data, in three categories:

1. currently existing buildings
2. new buildings meeting the state building energy code
3. new buildings meeting "state-of-the-art" standards.

c) Multiply square footage in category b.1 by 180,000 to reflect conservation in existing buildings (assumes 20% conservation potential).

d) Multiply square footage in category b.2 by 141,000 to reflect conservation potential in new buildings (assumes 37% conservation potential)

e) Multiply square footage in category b.3 by 70,000 to reflect "state-of-the-art" conservation potential in new buildings (assumes 69% conservation potential).

f) Add results from c, d, and e to yield total energy demand in commercial buildings in 2000.

g) Multiply total projected 2000 floor space projection by 224,000; subtract result from f to yield potential energy savings from conservation

INDUSTRIAL

Because industries vary substantially in energy conservation potential, a single estimating formula cannot be used. The methodology for commercial conservation can be used to develop a combined gross estimate of conservation potential in the commercial and industrial sectors, as described also in the commercial section. Figure 8 shows some federally-published targets for major industries. Since many industries are already active in conservation, an alternative method is to survey plant managers and ask them what their conservation goals are.

Whether or not industrial energy conservation projections are feasible to make, local governments can assist local industry in energy conservation through programs such as:

- government-sponsored seminars, co-sponsored by the Chamber of Commerce, utilities, or other local business groups, to present information on conservation techniques;
- government-sponsored financing programs, such as revolving loan funds through industrial development commissions or other non-profit corporations;
- industrial park projects such as Red Wing's Energy Park, which uses an efficient low-cost energy source for several plants;
- energy-efficient design criteria for industrial parks.

Industrial energy use is important because it affects the economic health and development potential of the community. Helping to increase energy efficiency and providing reasonable-cost, stable energy supplies can help save and create jobs and maintain or build the tax base.

LOCAL GOVERNMENT

This sector includes government buildings, utilities like water, solid waste, and sewer, and vehicles. Local government buildings' conservation potential should be estimated on the same basis as commercial buildings (page 43) using 20% as a target for existing buildings and 37% as a target for new

buildings. Public buildings, however, can be built to be perhaps more energy-efficient than private buildings, given a strong policy mandate for energy efficiency and fewer "market" constraints. Local governments that want to experiment with super-insulation, earth sheltering, and solar can reduce their buildings' energy demands to or beyond the 69% target.

Efficient management of solid waste and sewage sludge is another means of energy conservation in the municipal sector. Such methods as waste recycling and composting can yield significant energy savings. See Tools 3.4, 3.5, and 3.6 for further information.

In local government vehicle fleets, mileage for new cars can more than double based on Federal 1985 mileage standards; increasing occupancy, improving maintenance, reducing unneeded trips, and other measures can add to fuel use reductions.

A conservative estimate would be a 40% reduction in fuel use by the year 2000. An upper limit target would be a 60% fuel demand reduction per vehicle.

To estimate local government transportation energy conservation potential, use this formula:

- Obtain the base figure for local government motor fuel consumption from the Energy Data Summary Table. Divide it by the number of vehicles in the fleet to obtain per-vehicle consumption.
- Project vehicle fleet size for 2000; multiply by the per-vehicle factor to yield total consumption in 2000.
- If only vehicle mileage improvements are anticipated, multiply the 2000 total consumption figure by .40 to yield conservation potential.
- If additional fleet management methods are planned, multiply the 2000 total consumption figure by .60 to yield conservation potential.

INDUSTRIAL ENERGY EFFICIENCY IMPROVEMENT PROGRAM

Type of Industry	Improvement Targets (%)
Food & Kindred Products	12%
Paper & Allied Products	20%
Petroleum & Coal	12%
Primary Metals	9%
Stone, Clay, Glass, Concrete	16%
Nonelectrical Machinery	15%
Fabricated Metal Products	24%
Chemicals	14%
Transportation Equipment	16%
Textiles	22%
Weighted Average	14.7%

Source: *Industrial Energy Efficiency Improvement Program, Annual Report Support Document Volume II*, U.S. Department of Energy, DOE/CS-0033/2, June 1978.

FIGURE 8

TRANSPORTATION

As mentioned above, federal mileage standards will increase vehicle fuel efficiency; and the market is already producing cars beyond the required performance levels. In addition, higher occupancy, more use of bus and rail, reduced travel needs through land use strategies (review community profile developed in Chapter 3, pages 23 and 24 in Chapter 6, and the Land Use and Transportation Tools), and other factors can reduce the demand for motor fuels. A 40% reduction in motor fuel demand per mile travelled by the year 2000 serves as a lower estimate, with 60% as an upper estimate. Use the formula in 4 above to calculate conservation potential.

As conservation potentials are estimated, record them in the resource inventory table in Tool 8.5, in terms of million BTU. The percentages used in the formulas in this section are conservative; they can be exceeded if a strong policy commitment is made, and if rising energy costs increase investments in conservation measures faster than expected. The best yardstick for conservation potential is a financial one: how fast the cost of the measure will be recovered in energy cost savings. Some measures show very fast paybacks, less than a year in many cases: these are usually "housekeeping" measures like controlling temperatures, reducing use of lights and air handling systems, caulking and weatherstripping, etc. More expensive measures like replacing windows, adding insulation, or refitting heating and cooling systems tend to pay back more slowly, in 3 years or more. Each measure must be looked at individually. The Tools Library contains numerous conservation techniques for various sectors of the community.

When conservation potentials are recorded in the resource inventory table, add them up to produce a total energy conservation potential for the year 2000. If a "base-case" scenario was developed in the problem identification process presented in Chapter 3, subtract the estimated conservation potential from the "base-case" projection, in terms of both individual sectors (e.g. residential gasoline, municipal electricity) and the community total. This reduced projection then becomes a "conservation" scenario, which can be used as basis for energy supply planning involving conventional or alternative sources, or both.

If "base-case" projections were not made, or if significant growth in the community is not expected, apply the conservation potentials to the base year energy data in the Energy Data Summary Table described in Chapter 3.

RENEWABLES

Renewable energy resources replenish themselves within a year or a few years. All communities need not evaluate all renewable potentials, because they differ in their resource base and needs, and smaller communities may have fewer opportunities to exploit resources than larger cities. Each community should use the self assessment rules in the section that follows to target its renewable resource assessment. Tool 8.5 suggests a resource inventory format that can be used to compile and summarize assessment results. For each resource investigated, enter the energy potential in million BTU, in the appropriate row (e.g. wind, hydro, etc.) and column (e.g. displacing electricity, gas etc.). Use Tool 8.6 to help identify which conventional energy

sources can be replaced by a given renewable resource. If the displaced energy type cannot be specified, enter the result in the "total" column only. Calculate the percentage of conventional energy sources renewable resource can displace, in terms of either the "conservation scenario" developed in the previous section, year 2000 projected demand from the "base case" scenario, or the base year data summary. The year 2000 and base year data are developed in the problem definition process described in Chapter 3.

District heating and cogeneration are included in this section because they represent energy strategies particularly attractive in Minnesota. They may or may not use renewable resources; district heat systems and cogeneration can be fueled by coal, oil, wood, other biomass, even solar energy. District heating and cogeneration are unique approaches to local energy supply, and so are treated in a separate section. However, they do have implications for other resource strategies; if a city decides to pursue district heating several considerations arise, which are discussed in the district heating section.

SOLAR

Active and passive solar thermal energy, including industrial uses, could meet up to 10% of the state energy needs, as shown in Figure 7. For local governments, the two most practical uses are active thermal and passive thermal units. Active thermal uses include water heating, space heating, and some industrial uses like grain drying. Passive thermal uses are basically building siting and design features, such as southern windows, thermal storage, etc., that maximize absorption and retention of solar radiation without the mechanical use of a heat transfer fluid.

With currently available technologies, solar energy systems for residential uses can supply energy in roughly the following volumes (on an annual basis):

- 10 million BTU/yr. for new and retrofit domestic hot water system;
- 30 million BTU/yr. for new and retrofit active space heating;
- 30 million BTU/yr. for new passive space heating;
- 6 million BTU/yr. for retrofit passive space heating.

Industrial and commercial systems are harder to estimate averages for because of the wide variety of type and size. The most common feasible uses are for hot water, low-temperature steam, and drying of grain, coatings, etc. Individual facility managers should be contacted to help estimate the types and amounts of energy uses that solar could replace. Solar can be used in some form in almost every community. To assess the potential amount of energy that solar could contribute, use the formula found in Tool 6.1.

WIND

Wind can be converted to electricity or heat with current technology. The Energy Agency estimates that wind could replace about 3% of the state's current conventional energy use by the year 2000. There are several technologies for wind energy conversion. Currently, larger wind systems (40 kilowatts capacity or larger) are most cost-competitive with conventional sources but smaller wind systems (2-10 kilowatts) will become competitive as conventional energy prices rise.

Wind system placement is limited by several factors:

AVERAGE WIND SPEED
Must be high enough to justify the cost of the machine. Typically average wind speeds of 11 mph or more are required for economic operation of wind machines. Wind speeds vary greatly with altitude, topography, and vegetation;

SPACING
Wind machines should be sited to avoid wind interference from vegetation, buildings, and other wind machines.

NOISE
Some systems make sufficient noise to be objectionable to nearby residents;

INTERFERENCE
Some systems may cause radio and TV interference;

AESTHETICS
Larger systems are quite visible and may be objectionable to local residents;

ZONING
Height restrictions, safety, and nuisance regulations may restrict wind systems in some more densely settled areas.

Sites must be identified based on each community's topography, land use patterns, regulations, wind conditions, etc. Two system sizes are used in the estimating method in Tool 6.2; a 4-kilowatt system for single household use and a 10-kilowatt system for wider use (thermal systems are not considered). These are reasonable current technologies in engineering and cost terms.

To obtain wind data, first contact nearby airports and weather stations. The federal government also maintains weather data in its Climatological Data Service in Asheville, North Carolina. However, the most accurate and useful data is obtained by long-term monitoring (i.e. a year or more at potential sites), using an instrument called a recording anemometer. It should also be noted that at about 150 feet above the ground, wind speeds may average 15 mph or more, so tall towers can help improve system performance. And larger machines can often function on lower average wind speeds, so lower recorded wind data need not be discouraging. A basic method for estimating wind potential is found in Tool 6.2.

HYDRO

Water power was the earliest industrial energy source in this country, and since 1900 has provided electric power as well. Many hydroelectric sites have been abandoned since World War II because of cheap fossil fuel sources for electricity. Recent price increases have turned people back to hydro sites as cost-effective power sources. The U.S. Army Corps of Engineers has identified significant potential for hydro at existing dams; in Minnesota the estimated total potential for hydro at existing dams is 6.7 trillion (10^{12}) BTU per year, which is 0.8% of 1980 total energy demand and 6.0% of electricity demand. Hence, the overall resource potential is small.

However, a community with an existing dammed stream may be able to profit from hydro power. If an existing dam is within community borders or accessible on a regional basis, a resource assessment such as that found in Tool 6.3 should be performed. If no existing dam is within reach, the resource potential for hydro should be left at zero.

BIOMASS

Biomass energy is the energy trapped by photosynthesis in the plant ecosystem; it also includes animal and human wastes. It comes in several forms, including:

- crops: corn, other grains, potatoes, etc.
- crop residues
- animal wastes
- wood
- special energy crops and peat
- urban solid waste
- sewage

The State Energy Agency in its *1980 Biennial Report* projects that these biomass sources could supply as much as 28% of the state's energy needs in the year 2000.

As the substitution table in Tool 8.6 shows, many biomass sources can be converted to gas (through gasification), or liquid (through liquefaction). Hence, biomass sources are generally flexible in terms of the conventional energy sources they can replace.

The subsections that follow present basic rules for assessing whether biomass sources should be investigated. In developing its resource strategies, the community should try to determine what to do with biomass potentials: what conversion technology to use, the role of the local government, private industry and entrepreneurs, and how the energy product will be used. These issues are discussed further under each biomass subsection.

Several general issues raised in pursuing biomass energy strategies should be noted:

LAND USE

There may be conflicting demands for strategies that involve large land areas, like wood and crop residues; biomass may be more highly valued as food or raw material than for energy uses.

ENVIRONMENT

Intensive use of biomass in a given area can alter nutrient balances, deplete soil quality, or create other ecological impacts.

CONVENTIONAL CROPS

Agricultural crops grown for human and animal food contain a great deal of energy. However, it is questionable whether substantial crop volumes will be available for energy users, because of increasing competition from food and animal feed uses.

For conventional crops to be considered realistic potential energy sources, the following issues should be investigated:

- the presence of cropland within reach of the community, so that transportation costs are not excessive;
- interest from landowners in investigating energy uses for crops;
- there should also be some consideration of conversion technologies, ownership, and use of the fuel produced.

If favorable conditions cannot be foreseen, crops should not be pursued further as an energy strategy.

The six principal crops available, with their average energy content (at 15% moisture levels), are:

- corn (#2) — 371,000 BTU/Bushel
- soybeans — 398,000 BTU/Bushel
- oats — 212,000 BTU/Bushel
- wheat — 398,000 BTU/Bushel
- barley — 318,000 BTU/Bushel
- hay — 14 million BTU/Ton

A basic formula for estimating conventional crop energy potentials is found in Tool 6.4.

CROP RESIDUES

Stalks, cobs, wheat straw, etc. could potentially supply up to 8% of the state's energy needs in 2000, according to the State Energy Agency's *Biennial Report*. However, in parts of the state with organic carbon deficiencies in the soil, diversion of crop residues away from the soil and into energy production may be unadvisable.

The same conditions as those stated above for conventional crops should exist for residues to be feasible. There should be farmland within a reasonable distance, and landowners willing to participate in a residue harvesting program. Also, thought should be given to conversion technologies, ownership, and use of the fuel produced.

A basic method for assessing crop residue potential is found in Tool 6.4.

ANIMAL WASTES

Manure and bedding from farm animals can be digested to gas, usable mostly on-farm. Minnesota Energy Agency calculations indicate that only large cattle feedlot and confined poultry operations produce enough manure to yield economically recoverable surplus gas. However, this gas is unlikely to produce significant distributable quantities except in rare cases; it may be usable for on-farm purposes. Moreover, the manure source must be close to community users, and owners must be willing to investigate the strategy. If gas is found to be available, specific users for it should be identified; it is of little use to plan for a resource when consumers are not equipped to use it.

A formula for calculating animal waste resource potential is found in Tool 6.6.

WOOD

More than 25% of Minnesota's land is potentially productive forest land, and Minnesotans use almost a million cords of firewood a year for home heating. A cord is a volume measure, 4' x 4' x 8', or 79 cubic feet of wood volume on average (allowing for air spaces), containing from 12 to 28 million BTU per cord at 20% moisture content.

The energy yield from woodland depends on factors such as:

- forest management — can improve yields more than double;
- wood type — hardwood and softwoods have different use potentials;
- end use — whether the wood is used in home stoves, central furnaces, large boilers, or converted to gaseous or liquid fuels.

The State Energy Agency, while agreeing that wood energy potential is large, points out that future use of wood for energy may be severely limited or even reduced by strong competition for wood as a raw material, which could drive prices higher than alternatives and limit volumes available.

The conditions for exploring wood potential include:

- substantial acreage of mature forest within reasonable transport range (50 miles or less);
- landowners willing to permit harvesting;
- a nearby logging or milling company that is willing to investigate wood energy strategies with the community.

If these kinds of conditions exist, use the simple formula in Tool 6.5 to estimate wood energy potential.

SPECIAL ENERGY CROPS AND PEAT

Minnesota has significant biomass potential in what are called special energy crops. These crops include alder, cattails, willows, and certain grasses and reeds. Special energy crops are a valuable energy resource because they have little food or raw material value and they are grown in areas that are generally not suitable for other agricultural or forest uses. About 20% of Minnesota's land area falls in this category. Sixty percent of the land in this category is peatland which can be used for special energy crop production. Energy crop data is still very limited; available research indicates potential yields of 15 dry tons per acre per year. At 8000 BTU per dry pound, that yield would contain 240 million BTU per acre per year.

Peat is dead, partially decayed plant material. Unlike special energy crops and other biomass resources peat renews itself at such a slow rate that it is considered a nonrenewable resource. However, the scale of peat production and the economic and land use issues concerning its development are similar to special energy crops.

Few communities have peatland or special energy crop lands suitable for inclusion in local energy planning efforts. This section is included because of the relative importance of these crops to the state, and for those individual communities that have the potential and interest to explore these resources.

Special energy crops and peat, like many biomass resources, require large scale recovery to be economical, which may limit their availability for development by local communities. However, the resource assessment is valuable and can prove useful if small-scale technologies prove economical or if a community enters into energy production as an economic development project, either by itself, with adjacent communities, or as private development ventures.

No specific resource assessment method is presented for special crops and peat. See Tool 6.7 for references.

SOLID WASTE

While solid waste can be used as an alternative source of energy, it must be managed in the most energy and cost effective manner. Often more energy can be conserved by operating waste reduction and material recycling programs than by energy recovery from solid waste (see Tools 3.4 and 3.5). After careful consideration of waste reduction, source separation, and composting programs, it may still benefit the community to recover energy from solid waste. Should this be the case, opportunities for energy recovery should be examined. Solid waste contains approximately 4600 BTUs per pound, which can be recovered either by incineration or by digestion of solid waste and sewage sludge with methane recovery (see Tool 3.6 for further information on energy recovery from solid waste).

SEWAGE SLUDGE

Sewage sludge can also be a source of energy. In most urban areas of Minnesota, almost all sewage is collected for wastewater processing. An estimated 3 million people are served by municipal waste treatment plants. Based on this estimate the sewage sludge produced in these plants could provide .78 trillion BTUs for one year, or about 260,000 BTUs per person per year. This yield of energy can be accomplished by digestion of the sludge with methane recovery. Digestion with methane recovery can take place in conjunction with a sludge land spreading program or composting program in an effort to both recover direct energy and conserve energy through fertilizer displacement (see Tools 3.5 and 3.6 for further information on energy efficient management of sewage sludge resources).

DISTRICT HEATING AND COGENERATION

Minnesota, with its very high heating demand, has significant potential for using district heat and cogeneration systems, which distribute thermal energy through pipes to customers in the nearby area. Cogeneration is the joint production of heat and electricity; many boilers now producing heat (as steam or hot water), and power plants producing electricity, can be retrofit to co-generate both heat and electricity.

Fourteen district heat systems are currently operating in the state, although twelve have been abandoned since 1965. The best potentials are in areas with power plants, because obtaining the waste heat costs less than building a heat-only boiler. However, heat-only systems can be used to develop district heat "islands" which can be converted to cogeneration systems as development progresses. In this sense district heat can be an economic development tool, which builds new development around an efficient, reliable energy system.

The minimal conditions for developing a practical district heating system include one or more of the following:

- an existing power plant within a one-mile radius;
- an existing large incinerator within ½ mile;
- a planned heat source such as the above;
- a planned, densely-settled area or industrial park with high heat demand.

District heating systems typically require substantial capital investment in the heating plant, distribution piping, and conversion of building systems to use the hot water or steam source. These costs are lower when the following factors are present:

- an existing heat source with excess capacity, which reduces plant costs;
- the heating plant can use lower-cost fuels (coal or biomass) which reduces fuel costs;
- customers are located near the plant in a dense pattern, which reduces conversion costs;
- customers are large (buildings over 5000 square feet), which reduces conversion costs;
- some customers have heat requirements beyond heating season (industrial process leads), which improves overall economic return on investment.

District heating requires a very detailed process of feasibility evaluation, planning and design. This process is fairly advanced in some cities, such as the Twin Cities, Moorhead, and Red Wing. Beyond the technical and economic analysis, several issues such as ownership, financing, legal and regulatory considerations must be worked out.

The Minnesota Energy Agency is developing a state district heating plan which will be open to all interested communities. As mentioned above, district heating is a major energy option for many Minnesota communities. Combined with economic development and land use planning, it can be a tool for urban revitalization (such as the St. Paul Energy Park) and new development that can save energy while encouraging well-planned growth. The Minnesota Energy Agency is also developing a district heating manual which will be available in the fall of 1981. For other district heating and cogeneration references, see Tool 6.8.

PLANNING APPLICATIONS

As the basic resource assessment process is conducted, an energy resource inventory such as the table in Tool 8.5 should be filled out; Tool 8.5 includes a sample version of a completed table. This will provide an overview of the gross energy potentials from various alternative sources, and in some cases an indication of the conventional energy sources that could be replaced.

The resource assessment process as described in this chapter can be summarized as follows:

1. Estimate conservation potentials. Use these potentials to create a "conservation scenario" to compare with the "base-case" scenario developed with the methods in Chapter 3.

2. Review renewable resource potentials for their feasibility, potential energy content, and ability to replace current sources.

3. Review potential for district heating/cogeneration as a strategy for integrating energy supply and demand planning.

The resource inventory can be used as a guide to judge the relative importance of different sources in terms of their potential energy contribution and replacement of critical energy sources. However, once the energy potentials are known, other factors govern the method and speed with which they can be developed. The dominant factor is economics; energy potentials are valuable only insofar as they can be used at reasonable cost, or at a cost equal to or below conventional energy costs. The difficulty is that many alternatives are not now competitive with conventional sources, but will be in a few years as conventional prices rise. For this reason, costs were left out of the initial resource assessment.

For each alternative energy source that appears to have significant energy potential, the community should investigate cost and related issues. This implies looking closer at particular conversion technologies. A good summary and reference source for more information about technologies and costs is the Minnesota Energy Agency's *1980 Biennial Report.* Cost issues are discussed further in Chapter 5.

Another consideration beyond the cost issue is developing an action plan for each strategy, which involves institutional arrangements, ownership, financing, markets for energy produced, etc. For each attractive resource potential, try as much as possible to define *how* it could be developed.

Other issues beyond cost include tradeoffs between various resource strategies, relationships between energy planning strategies and other community planning goals, and the appropriate role of local government in resource development. Those issues are different in each community; their consideration is part of the goal-setting process outlined in Chapter 5.

EXAMPLE

Community X's energy commission has a resource assessment task force among its other task forces. The resource assessment task force begins a comprehensive effort, with one person assigned to each resource area. The basic steps they follow are:

1. In their self-assessment, the task force decides that as a small city in a rural community, they will look at conservation, solar, wind, hydro, and biomass. One person is assigned to each resource.

2. The conservation potential is calculated as follows:

RESIDENTIAL
A 25% per household reduction is projected based on low growth projection;

MUNICIPAL
A 69% reduction target is established based on a projection of building a new city administration building on the most energy efficient principles; and

TRANSPORTATION
A 40% per vehicle mile reduction is anticipated from mileage improvements.

A "conservation scenario" for the year 2000 is developed which shows a potential savings of 32% compared to the "base case" year 2000 scenario from Chapter III.

3. The renewable potential is estimated as follows:

SOLAR
estimated at 91,000 million BTU

WIND
estimated at 1,200 million BTU

HYRDO
the existing dam could be refitted to produced 4,400 million BTU/year; and

BIOMASS
As a southwestern Minnesota city, Community X identifies crop residues as the principal biomass potential. Approximately 50,000 bushels of residues at 400,000 BTU/bushel can be recovered each year for a total of 20 billion BTU.

4. The totals from conservation and renewable potentials are entered in the resource inventory table. For each potential, the task force identifies tentative means of achieving the goal, and rough cost estimates. The completed table shows that up to 60% of the community's energy needs could be met by conservation and renewable resource strategies.

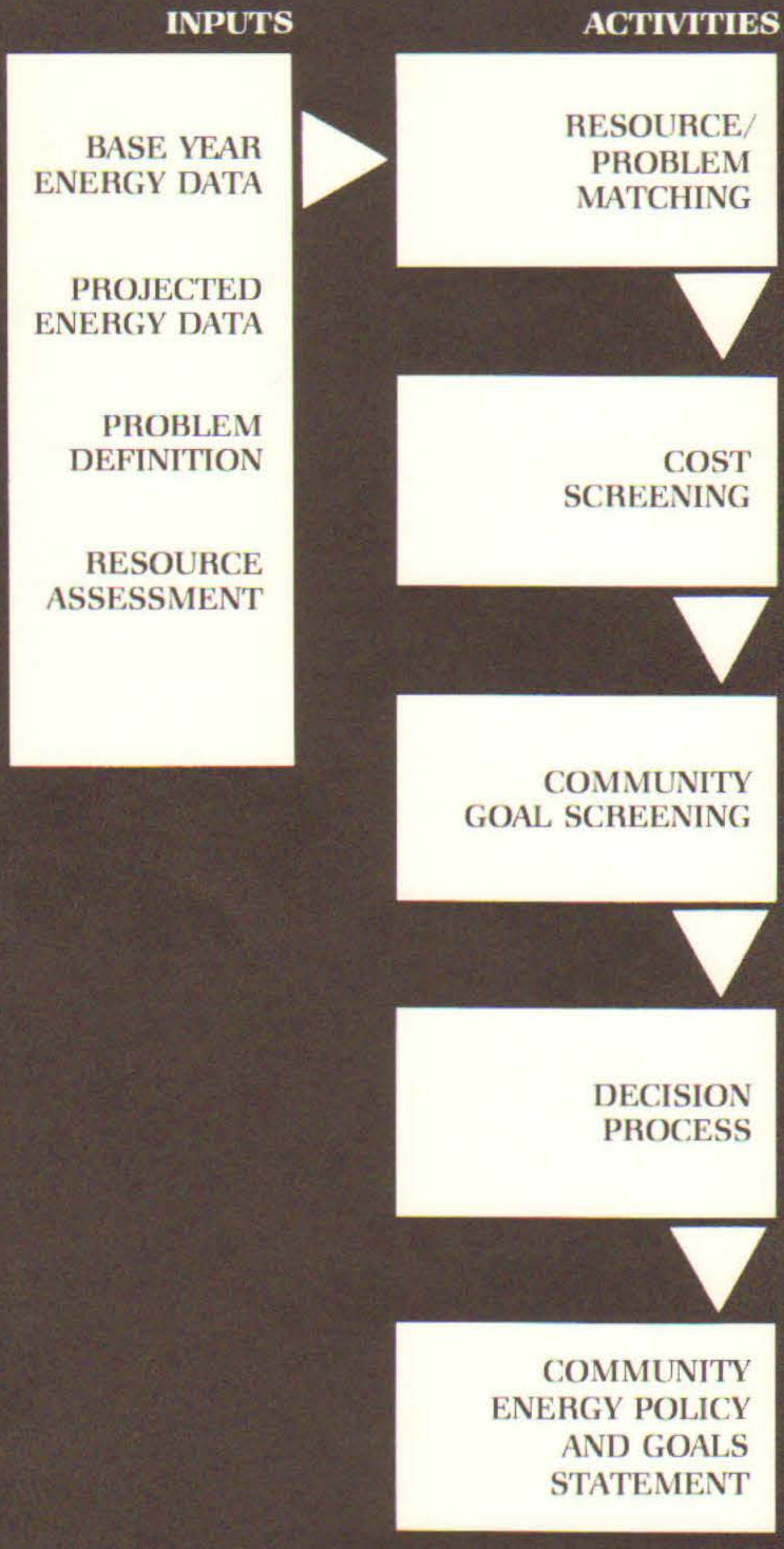
SETTING ENERGY GOALS

5

6

7

ENERGY GOAL-SETTING



SETTING ENERGY GOALS

RESOURCE/PROBLEM MATCHING
identifying which resource potentials can address specific problems;

COST SCREENING
estimating which energy strategy is most cost-effective for a given problem area;

COMMUNITY GOALS
reviewing energy strategies against other community goals;

DECISION PROCESS
a way to reach a consensus on energy goals and strategies; and

POLICY STATEMENT
a summary of goals and strategies for use as an energy planning guide.

At this stage in the planning process, the community should have a working energy planning organization, some base year energy use and cost data, some projections of future use and costs, an outline of energy problems, and some estimates of energy potentials from alternative sources such as conservation, solar, wind, hydro, biomass, and district heating. This chapter deals with the process of goal setting or creating policy directions from the data collected. As the steps in this chapter are closely related to the plan development and implementation process outlined in the next two chapters, Chapters 5, 6, and 7 should be read before beginning the tasks in this chapter. The chart at left outlines the goal setting process.

RESOURCE/PROBLEM MATCHING

A direct approach to developing energy goals and strategies is to match energy resource potentials directly, using data from the energy problem definition table (Tool 8.4) and the energy resource inventory (Tool 8.5). From these data a summary of problems and potential solutions can be created in the form of a goal and strategy statement. Such a statement could be developed in a format such as the following:

PROBLEM:
High cost of energy source X;

GOAL:
Reduce usage of X and create less costly alternatives;

STRATEGY #1:
Encourage conservation of X in homes and commercial buildings to achieve a 25% energy use reduction by year Y;

STRATEGY #2:
Develop biomass resources to substitutes for Y percent of X by year Z.

Tool 8.7 presents a sample format for a strategy statement.

A single sheet or set of sheets could be developed for each problem, so that each problem is clearly identified with a set of potential solutions. Each strategy should be specific, with quantifiable results and target dates stated as clearly as possible.

Energy Strategy Statement

PROBLEM: AGED HOUSING WITH INADEQUATE INSULATION.

GOAL: TO RETROFIT 50% OF THE AGED HOUSING STOCK WITHIN TWO YEARS TO CURRENT EFFICIENCY STANDARDS.

STRATEGIES:

STRATEGY #1 PROVIDE RESIDENTS WITH CONSERVATION INFO AND ASSISTANCE THRU A PROGRAM OF WORKSHOPS, ENERGY FAIRS, AUDITS AND OTHER PUBLICITY MECHANISMS.

Cost Considerations
Capital and Funding Requirements: FUNDS WILL BE REQUIRED FOR THIS NEW INITIATIVE.
Payback:
Cost Per Million BTU:
Potential Conflicts: NONE

STRATEGY #2 PROVIDE RESIDENTS WITH FINANCIAL ASSISTANCE AND INCENTIVES FOR RETROFITTING THEIR HOMES BY: PROMOTING THE MINNESOTA HOUSING FINANCE AGENCY'S HOME IMPROVEMENT LOAN PROGRAM IN COOPERATION WITH X NAT'L BANK AND TWO SAVINGS AND LOANS; INCLUDING FUNDS FOR RETROFITTING IN THE COMMUNITY'S CDBG APPLICATIONS.

Cost Considerations
Capital and Funding Requirements: UTILIZE AVAILABLE FUNDS IN MOST EFFICIENT MANNER.
Payback:
Cost Per Million BTU:
Potential Conflicts: NONE

STRATEGY #3
Cost Considerations
Capital and Funding Requirements:
Payback:
Cost Per Million BTU:
Potential Conflicts:

Energy Strategy Statement

PROBLEM: EXISTING ZONING ORDINANCES INCLUDE X ACRES IN A RESIDENTIAL ZONE IN WHICH LOT SIZES CANNOT BE LESS THAN ONE (1) ACRE, WHICH RESULTS IN HIGH ENERGY USE FOR TRANSPORTATION.

GOAL: TO REDUCE TRANSPORTATION ENERGY USE BY PERMITTING HIGHER DENSITY DEVELOPMENT.

STRATEGIES:

STRATEGY #1 REZONE AREA TO PERMIT PLANNED UNIT DEVELOPMENT.

Cost Considerations

Capital and Funding Requirements NONE

Payback

Cost Per Million BTU

Potential Conflicts: COMMUNITY VALUES MAY PREFER LOW DENSITY DEVELOPMENT.

STRATEGY #2

Cost Considerations

Capital and Funding Requirements

Payback

Cost Per Million BTU

Potential Conflicts:

Energy Strategy Statement

PROBLEM: EARTH SHELTERED HOUSING CANNOT BE CONSTRUCTED BECAUSE IT IS CONSIDERED TO BE BASEMENT HOUSING, MAKING IT IMPOSSIBLE TO UTILIZE THIS ASPECT OF ENERGY-EFFICIENT BUILDING TECHNOLOGY.

GOAL: TO PERMIT ALL ENERGY-EFFICIENT CONSTRUCTION TECHNIQUES IN THE COMMUNITY.

STRATEGIES:

STRATEGY #1 REDEFINE EARTH-SHELTERED HOUSING CLASSIFICATION.

Cost Considerations

Capital and Funding Requirements NONE

Payback

Cost Per Million BTU

Potential Conflicts: NONE

STRATEGY #2 CLARIFY BUILDING PERMIT PROCESS

Cost Considerations

Capital and Funding Requirements NONE

Payback

Cost Per Million BTU

Potential Conflicts: NONE

TOOL 8.7

Also see Planning Tools Library, Section 8, Forms & Samples.

COST SCREENING

In order to quantify strategies on the Energy Strategy Statement form, it is important to conduct a cost-screening process. A major factor in selecting a resource strategy to solve a given problem is cost-effectiveness: that is, cost per unit of resource produced. Most problems will have a set of potential solutions; applying a cost-effectiveness measure can help screen and rank the strategies.

One or more of the following analyses should help to quantify cost considerations:

COST PER MILLION BTUs

Figure 9 contains some rough cost-per-million-BTU estimates for alternative resources, except for conservation. The cost-effectiveness of conservation varies with the measure employed. In this sense there is almost always some level of investment that is cost-effective, be it replacing light bulbs or replacing boilers. To estimate cost-effectiveness for conservation measures, estimate potential BTU savings and dollar costs, and calculate dollars per million BTU. Each case should be looked at separately; each community's circumstances will alter cost considerations for specific resource strategies. Figure 9 is meant primarily as a guideline in the absence of better data. For example, if Communities X and Y want to mount home conservation programs, and X can get material donations, some labor and low-cost financing, its "resource cost" will be less than for Y, which has to absorb all costs directly. Or if X has a nearby grain operation that can provide crop residues at low cost, its cost will be less than Y's, which must rely on longer transportation.

The steps to follow in the cost-screening stage are:

1. Calculate cost-per-million-BTU figures for each proposed alternative.

2. Compare cost-per-million-BTU figures with current energy prices, converted to dollars-per-million-BTU figures.

3. If alternative resources cost less than the energy types they would replace, at either current or projected prices, they are cost-effective.

4. Include cost-effectiveness figures on strategy sheets developed in Section A, and rank strategies by cost-effectiveness.

PAYBACK

Calculating payback can be a complicated procedure, requiring accounting for the future cost of fuel and debt service cost.

A simpler method is to:

- determine the first year energy savings (in dollars)
- determine the implementation cost
- implementation cost divided by first year energy cost

The simple method has limitations and should only be used as an initial screen and for similar investments.

A key issue here is that alternative resources may not be cost-effective at current energy prices, but will be cost-effective in future years as energy prices increase more rapidly than alternatives. One way to allow for this is to use energy price projections from the State Energy Agency for 1985, 1990, or another future year. Then the cost-effectiveness measure could be stated in a time frame, e.g. measure X is not cost-effective in 1981, but will be in 1985.

CAPITAL AND FUNDING REQUIREMENTS

The decision to invest in an energy project, despite its other potential advantages, may come down to the community's ability to pay for it. This step determines how much the project costs and how it could be funded.

Consideration should be given to the following:

- total project cost
- potential finance mechanisms

  operating revenues
  bonds
  loans
  grants

(Additional details on financing can be found in Chapter 7, page 93, and in Part 7 of the Energy Planning Tools Library.

COMMUNITY-SCALE ALTERNATIVE ENERGY ECONOMICS (1981 $/MMBtu)

	THERMAL	TRANSPORTATION	ELECTRIC
Solar, Active Residential	$24.00		
Solar, Passive Residential	3.00		
Wind	14.00		$14.00
Hydro			4.00
Biomass			
Conventional crops	33.00	$ 8.00	
Crop residues	3.00	13.00	
Animal wastes	7.00	8.00	
Wood and Wood			
Wood and wood residue	13.00	7.00	
Special crops/peat	3.00	13.00	
Urban waste	1.00	8.00	

FIGURE 9

GOAL SCREENING

Energy planning and resource strategies must be reviewed in light of other, perhaps more vital community goals. Cities with comprehensive plans normally have a number of development goals as the basis for the plan. These may include such goals as:

- a desired growth rate;
- maintaining a positive residential environment;
- maintaining open space;
- encouraging controlled economic development; and
- maintaining air and water quality.

The community profile developed in Chapter 3 should be used here to help define the community's characteristics.

The potential energy strategies developed so far should each be reviewed for their impacts with regard to these general community development goals. Energy strategies that conflict too strongly may be ruled out; others may help further community goals. Some strategies may have to be altered to reduce conflicts with other goals. For example, a strategy to develop wetlands for energy crops may have to be reduced in acreage to preserve open space and environmental goals. On the other hand, a strategy to use solar energy for space heating can reduce pollution, thus creating a positive impact.

Some energy strategies work better together than others. Wind systems may not be feasible in densely settled areas; hence a strategy to use wind energy means limiting future density, or relying on larger, more remote wind systems. District heating can help promote other density-related strategies in land use and transportation, though it may limit solar access in some cases. Conservation programs generally do not conflict with other strategies. Where conflicts are indicated, an effort can be made to modify the strategy to reduce the conflict.

Steps to follow in the goals screening process are:

1. Assemble strategy sheets and existing documents containing goals statements, such as comprehensive plan texts, etc.

2. Review each strategy for conflict with existing goals; if a conflict is found, consider changes in existing community goals, or alter or reject strategy to conform with existing goals.

3. Review each strategy for conflict with other strategies; if conflicts appear, alter one or more strategies to reduce the conflict.

4. Identify cases in which energy strategies enhance or further existing goals, and highlight these positive effects on the strategy sheets.

DECISION PROCESS

The process of developing energy goals and strategies is initially a technical process of collecting and analyzing data, but eventually becomes a political process involving the community's values and the particular interests of different groups. When the energy planning team, whether it involves professional staff or volunteers, produces its basic data on energy use, forecasts, energy problems and resource potentials, a public procedure is needed to make decisions about the guiding energy goals and strategies for the community. As described in Chapter 2, public participation is an essential element in every phase of the planning process. This stage of the energy planning process is critical, and needs to be done in a manner that gives the results legitimacy, and makes them as specific and reasonable as possible.

A simple decision process could operate as follows:

1. The planning team assembles the results of the process to date, including:

- base year data;
- forecast data;
- problems identified;
- resource potentials; and
- a list of proposed goals and strategies for each problem.

2. A public forum is announced, with a mailing including a summary of results of the planning process to date. The meeting is also advertised by newspaper and other media.

3. At the meeting, a brief presentation summarizes the results of the process to date. Then each problem is presented with a list of potential goals and strategies. A voice vote by committee members is held on the adoption of each strategy after hearing comments from attendees. Strategies that arouse unresolved debate are tabled for review and modification.

4. After the meeting, a list of approved goals and strategies is drafted, reviewed by the energy advisory body, and submitted to the chief executive official and governing body of the city for their review, endorsement, and signature.

ENERGY POLICY STATEMENT

The results of the process described above become the city's official energy policy and planning guide. This document is used to develop specific elements in existing plans as well as new programs or regulations derived from the goals and strategies described in the statement.

EXAMPLE

Community X has completed its data collection, problem definition and resource assessment tasks. It undertakes the goal setting process through the following steps:

1. The results of the previous efforts are assembled at a full meeting of the energy commission. A series of large sheets is posted, one for each problem identified in the problem definition phase.

2. A general goal is established for the solution of each problem, based on group consensus.

3. Using the energy resource inventory, and referring to the planning tools library, the group identifies strategies directed at solving each problem. A list of strategies is developed on each problem sheet.

4. The resource assessment task force supplies rough cost-per-million-BTU estimates for the different resource strategies; this could be done in preparation for the full commission meeting or later, in order for the commission to address specific additional information requests.

5. Referring to the development goals statement in the comprehensive plan, the commission reviews each resource strategy for consistency with development goals. Two strategies are found to conflict and are removed from the lists for further study. The task force also identifies mutual strengths and conflicts between strategies. Three strategies are modified to reduce potential conflicts.

6. A public forum is announced, by a mailing which includes typed copies of the problem/goal/strategies sheets, and a summary of background energy use and resource assessment data. Newspaper ads and radio spots encourage attendance at the meeting.

7. At the meeting, the problem/goal/strategies sheets are presented, with a brief discussion of tradeoffs, costs, and related issues. For each problem sheet, voice votes are taken to approve each strategy. Four strategies arouse sufficient debate that they are tabled for further study.

8. The approved goals are drafted and sent to the mayor and town council for review and signature. The council removes two additional strategies because of the objections of two neighborhood groups. The remaining strategies are approved, and the final document becomes the *Community X Energy Policy and Planning Guide* (see excerpt on pages 58 and 59).

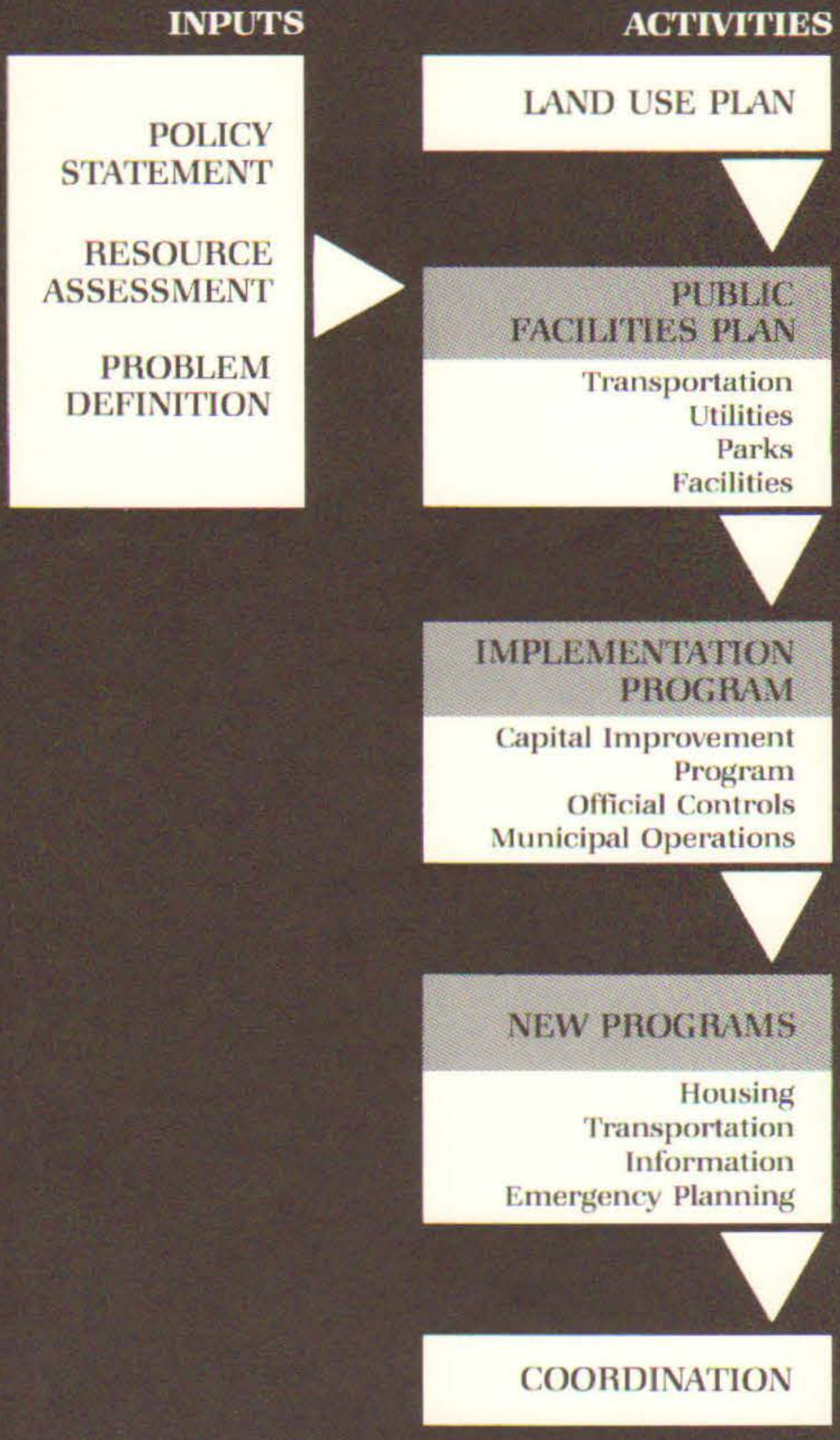
DEVELOPING THE ENERGY PLAN

6

7

GLOSSARY

ENERGY PLAN DEVELOPMENT



DEVELOPING THE ENERGY PLAN

Making energy resource strategies work is perhaps the most complex part of the planning process. This chapter deals with methods for integrating energy policy goals and resource strategies into existing plans, programs, and regulations, planning for specific energy resource projects, and other activities needed to implement energy policies as developed in the goal-setting process.

The chart at left outlines the basic process for integrating energy policies and strategies into the existing framework of the community's planning, regulatory and administrative activities. In this context energy planning becomes part of comprehensive planning; energy becomes a separate element of the land use plan, the public facilities plan, and the implementation program. The "energy element" of each plan should contain:

- a policy statement, derived from the policies developed in the goal-setting phase, but made more specific in terms of the existing plan;
- programs and regulatory mechanisms needed to achieve the policy intent; and
- a means for monitoring and evaluation.

THE LAND USE PLAN

Land use plans usually include maps and a text; the maps identify current uses, zoning, and planned uses for specific areas, and the text defines the various land uses and states various policies regarding land use goals and regulations. Energy considerations can be built into the plan either by changing the future land use maps to reflect goals for greater density, better transportation efficiency, etc., or by changing the text to reflect changes in the definition of permissible uses, or general policies concerning density, solar access, etc. It is usually easier to change the wording than to change the maps; inserting energy policy elements can create the framework in which to make specific map changes as time goes on. Amending the comprehensive plan may require legal proceedings and hearings by the planning commission. Changes in the comprehensive plan should also be reflected by changes in zoning ordinances, subdivision regulations, annexation plans and other appropriate planning and land use control documents.

Some of the basic land use strategies being pursued by local governments include:

INCREASING DENSITY

Rather than allowing new development to be located randomly, some communities are encouraging the "infill" of existing developed areas, using such mechanisms as:

- amending zoning ordinance requirements to permit smaller and odd-shaped lots;
- granting increased density allowances and reduced parking requirements to builders who locate in desired areas

(See Tool 1.1 for more details.)

MIXING LAND USES

Allowing multi-family housing in previously single-family areas, light commercial and industrial facilities in residential areas, and other appropriate and controlled mixes of activities helps increase density and reduces travel needs between activities. (See Tool 1.2 for more information.)

PLANNED UNIT DEVELOPMENTS

For new development areas, PUDs are an increasingly popular way to control density, mix land uses, provide for solar, earth shelter, and other building site options. (See Tool 1.6 for more information.)

REVISING LAND USE CONTROLS

This procedure allows for solar access, earth sheltered construction, and wind machines. (See Tools 1.7, 1.8, and 1.9.)

Some communities do not have a comprehensive land use plan or zoning ordinance. This limits the community's ability to control the energy efficiency of development, but other regulatory powers, such as subdivision review or the location of water and sewer service lines, can be used as well.

The basic steps to follow in building energy goals into the land use plan are:

1. Review the community's energy goals to determine which goals can be pursued through land use policies, within the general planning goals and development guides already established.

2. Review the community's current land use planning process regulations to determine potential energy-conserving tools; refer to the Land Use Planning Tools for assistance. Potential tools include:

- Amending the zoning ordinance to permit smaller lots in selected areas;
- Revising the comprehensive plan, zoning ordinances, subdivision regulations, and other land use controls to permit mixed uses in certain areas, such as shopping and housing;
- Revising the comprehensive plan, zoning ordinances, subdivision regulations, and other land use controls to control development in outlying areas.

3. Develop a set of policies reflecting the community's energy goals, such as:

- New development proposals should be located as close as possible to current developed areas;
- Developers should be encouraged to locate in areas close to existing services, by granting them density allowances or other incentives.

4. Examine land use maps for immediate and future areas for applying tools and policies, such as:

- A planned residential development that could be relocated closer to existing services;
- A single-use residential zone that could accommodate other uses, such as small retail stores;
- An agricultural area which could be protected from development by rezoning and relaxing density limits in other areas;
- An energy-efficient, orderly annexation plan.

5. Follow the local process for inclusion of the energy element in the land use plan, zoning ordinance, or other documents bearing official authority in the community.

THE PUBLIC FACILITIES PLAN

THE TRANSPORTATION PLAN

Few smaller local units of government have official transportation plans, but several Minnesota communities, including Willmar, Edina, and White Bear Lake run small public transportation programs, and more and more communities are looking at ways to reduce dependence on automobiles.

For energy planning purposes, the most important aspect of transportation planning is coordination with land use planning. The major road-building programs in the past sought mainly to reduce travel time between distant points; the result was to encourage spread-out development at those distant points, locking in heavy dependence on long-distance driving among housing, employment, and shopping areas. Fast, high capacity roads allowed rapid development of cheaper land farther from urban centers. In this way transportation planning dictated land use planning; where the roads went, so went the development.

This trend cannot be completely reversed; it has aleady shaped many communities too strongly. But planners need to begin to link land use and transportation planning. This has already begun, but mostly on the basis of avoiding environmental impacts. From an energy point of view, land uses should first be located so as to minimize the need for travel; then transportation should be provided to meet those needs.

If development can be planned in dense clusters or centers, the possibility of using public transportation increases. Small "loop" buses, van limousines or other small systems can be developed on a fairly small scale, as demonstrated by Willmar, White Bear Lake, and Edina.

In between roadway planning and public transportation systems is a vaguely defined but increasingly important transportation strategy called "paratransit". Paratransit is anything that either increases the efficiency of automobile use or assists the use of public transit. Examples range from park-and-ride lots to coordinate individual auto use with buses, carpools, etc., or jitney and shared-taxi services near busy areas or along transit routes.

Tools 2.1-2.5 in the Planning Tools Section contain more information about various energy-saving transportation strategies.

1. Review the land use plan and its energy goals to determine if the current transportation plan will conflict with land use energy goals; for instance, will a planned highway by-pass encourage sprawl, or will planned arterials encourage new development.

2. Develop general policies for transportation planning that are consistent with land use energy goals; for example, new roads should not be constructed unless the growth to be served cannot be absorbed in existing developed areas.

3. Examine planned transportation features that can be altered to be more consistent with energy goals; for example, delay new arterial development and improve roads in existing developed areas. This may require obtaining agreement with county and state transportation planning authorities.

4. Adopt the new transportation planning policies through local official channels and provide a mechanism for regular review of transportation plans and projects to ensure ongoing consistency with overall land use goals.

UTILITIES

Water and sewer piping and electric power lines are the "lifelines" that provide essential services to developed areas. Decisions on the expansion of these systems have potentially great impacts on the growth, shape, and tax burdens in the community. Poorly planned utilities can overextend the service lines at unnecessary expense, raising the tax (or rate) burden to pay for building and operating the systems. In some jurisdictions, developers request water and sewer hookups, electric lines, telephone service, etc., which the local government or public utility would normally provide. In other jurisdictions, larger developers are required to install parts of the utility systems at their own cost. However, this may not really benefit the community if other areas still have unused capacity.

If the local government has a utilities plan, it can use it to further its energy goals in such ways as:

- restricting new service extensions within the limits of legal authority, until unused capacity in certain areas is used;
- planning new service extensions at the lowest possible cost in coordination with density strategies in the land use plan; and
- providing incentives for locating in service areas with unused capacity in coordination with the land use plan.

This kind of policy can save money in energy used to build and operate utility systems and in capital and mainenance costs. Showing how such utility control strategies will keep rates and taxes down can help sell the concept to taxpayers.

The basic steps for using the utilities plan to further energy goals are:

1. Review current facilities plan; assess its capacity, areas of underused capacity, and areas of planned expansion;

2. Coordinate with land use plan to be sure new development is targeted for underused capacity areas, and that expansion areas are planned to minimize utility costs; and

3. Coordinate with land use plan to develop incentives for developing under-capacity areas first and to minimize utility costs in new development areas.

PUBLIC FACILITIES

Most communities that expect growth maintain capital plans for public buildings, schools, fire stations, and other public facilities. Two basic considerations in planning public facilities directly affect energy use:

BUILDING DESIGN

Many local procurement practices require lowest-bidder selection for construction. This can result in energy-inefficient buildings that cost more in the long run.

FACILITY LOCATION

Building schools, libraries, and other facilities within walking distance of housing can save considerable energy; decentralized versus centralized service delivery also helps reduce travel to facilities. On the other hand, building schools, etc., in undeveloped areas encourages growth that might have been absorbed in existing areas.

Methods to build energy efficiency considerations into capital planning include:

1. Changing procurement policies and practices to a life-cycle costing or other basis to capture long-term operating costs;

2. Specifying consideration of certain energy features in architectural services procurements, such as:

- passive solar
- active solar
- earth sheltering
- added insulation
- control of window areas
- conserving mechanical systems

3. Requiring an energy impact analysis for proposed facilities, which includes direct energy requirements, the impact on overall community energy use, and evaluation of alternative design or locations that could be more energy efficient.

The capital plan can become the foundation for long-term energy savings. Shifting dollars from energy bills to the capital budget can thus be a community's best energy investment.

To review the existing capital plan, follow these steps:

1. Identify facilities planned to be built or remodeled.

2. Determine whether energy considerations were employed in the design and location.

3. Examine alternatives in design and location that could improve energy efficiency; for example, make the new library earth-sheltered, or locate the new recreation center closer to developed neighborhoods.

4. Build in energy-efficient features into procurement practices and the capital planning process, using one or more of the three methods listed above.

IMPLEMENTATION PROGRAM

REGULATORY CONTROLS

Most communities have one or more of the following kinds of regulatory powers:

- zoning ordinance;
- subdivision review;
- taxing powers.

Wide use of these powers can strongly affect the energy-using characteristics of the community. The use of zoning has been discussed in the land use plan section. Subdivision controls are also a potentially powerful tool. They can affect:

- the use of slopes and vegetation;
- the orientation of streets and lots;
- the density and types of housing;
- the level of services — roads, street lights, sewer and water pipes, utility lines, etc.

These factors can affect energy use in terms of:

- using southern slopes for solar access and earth sheltering;
- maintaining vegetation for wind protection;
- orienting building lots for solar access;
- encouraging energy-efficient multi-unit structures; and
- reducing energy needed for service delivery.

See Tools 1.6 and 4.1 for more information on subdivision strategies and site planning.

Building codes for energy efficiency are determined by the state energy code; if a local government adopts a code, it must use the State code (see Tool 4.2). Even if the community has no official building code, it can create incentives for builders, such as allowing higher density for a development if a certain percentage of the units have solar designs or other energy features.

Taxes are another potential means of encouraging energy improvements. Several cities outside Minnesota offer tax abatement programs wherein building owners are not assessed at higher market values for their buildings if solar equipment or other features are added (see Tool 7.4). This practice may be limited by state statutes on local government taxing powers, but should be considered on a case-by-case basis.

Real estate transactions can be opportunities for energy efficiency improvements. Portland, Oregon, was the leader in establishing a "time-of-transfer" ordinance wherein a home has to meet energy standards before it can be sold. Minnesota law now requires a home seller to conduct an energy audit, the results of which must be shown to the buyer before the sale. The buyer, however, can waive the energy audit requirement (see Tool 4.3).

To build energy goals into your community's regulatory procedures, you should follow some basic steps:

1. Review local regulatory powers to determine opportunities for encouraging energy efficiency:

- subdivision regulations;
- building code;
- tax powers;
- deed and title transfers;
- signage control.

2. Develop proposals for amending regulations to encourage desired energy measures; review with homeowners and builders via advisory committee and public forum. These could include:

- revision of subdivision rules to allow for southern orientation of building sites, by requiring street grids to be oriented east-west;
- revision of subdivision controls to allow cluster housing and planned unit developments; and
- revision of subdivision controls to encourage use of natural features such as southern slopes, existing vegetation, and earth sheltering.

3. Present proposals to governing body for review and decision.

4. Hold workshops for homeowners, builders, etc., to explain and advertise new regulatory procedures.

CAPITAL IMPROVEMENT PROGRAM

The financial issues related to CIP are discussed in the Cost Screening section as part of the public facilities planning process.

NEW ENERGY PROGRAMS

Perhaps the most far-reaching and open-ended way in which a local government can help develop energy efficiency and renewable resources in the community is through direct assistance programs that offer homeowners, businesses, and other parts of the community information, training, technical services, financial incentives, or materials.

An important principle to maintain when planning outreach and assistance programs is to make use of outside resources, including private sector expertise and financial support, and state and federal programs providing technical information and financial incentives. The key word is "leveraging" - using some local dollars to attract larger investments from the private sector and other government units.

The difficulty in "leveraging" other programs is the fragmented condition of energy programs, which makes it hard to find out what programs exist and how to use them. The best remedy for this is to look at specific program areas and pinpoint as specifically as possible the options open in each area. Accordingly, the rest of this section is focused on specific program areas, with references to specific tools in the planning tools section.

HOUSING

Many communities have become active in weatherizing their homes. Champlin, Mankato, and others have used infrared "flyovers" to show residents how their homes are losing heat (see Tool 4.5). Austin has done home energy audits in over 700 homes (see Tool 4.7). Moorhead and Hopkins have made use of HUD property improvement loans (see Tool 7.3). Moorhead has held home weatherization workshops and offered discounts on materials (see Tool 4.6). The Buildings and Development section of the Planning Tools Library includes these and other options for housing; refer to them for more detail on individual housing program options.

TRANSPORTATION

Local governments are beginning to look more seriously into helping the community find alternatives to our over-reliance on automobiles. Faribault's Never on Tuesday program encouraged drivers to get out of their cars with free transit incentives. Willmar, Edina, and White Bear Lake have worked on small-scale transportation systems (see Tool 2.5), and several cities, especially in the Metro area, have helped encouraging park-and-ride and other paratransit options. Local governments have considerable potential to assist in the transportation area. They may have staff and data processing resources for ridesharing, jurisdictional and financing authority to establish public transit systems, and usually are in a natural position institutionally to coordinate efforts among employers and citizens. Also, with the new emergency fuel management procedures developing at the state level, the local government is the key actor in handling contingency problems. Refer to the Transportation section of the Planning Tools Library for more details on specific program options.

INFORMATION

A chronic lack in the energy conservation and renewable resources field is good information, delivered effectively through the right media. St. Paul's 1980 three day Energy Mobilization made effective use of publicity in carrying out 100,000 energy audits. Austin's energy advisory board has developed a public library energy section, a weekly energy column in the local newspaper, and has used local radio and TV public service spots, talk shows, and news. Ramsey County has used an Energy Hotline for instant information. Other energy information programs include:

ENERGY FAIRS

Energy conservation engineers, utilities, equipment vendors, local agency programs, and outside speakers are pooled to create a major event that attracts large numbers of people, disseminates information in large volumes, and attracts media coverage. (See Tool 5.2.)

WORKSHOPS

Local contractors, engineers, or utilities can be enlisted to help conduct training sessions for home weatherization or other energy measures. This can be combined with incentive programs such as low-interest home improvement loans and discounts on materials purchases. (See Tool 4.6.)

ENERGY LIBRARY

Creating a special energy exhibit at the public library, town hall, post office, or other public places can be an effective information-spreading technique. The Minnesota Energy Agency's Energy Information Center can be a good source for pamphlets and other handouts, as well as telephone referrals. (See Tool 5.2.)

SCHOOL ENERGY PROGRAMS

It is important to build energy awareness into the community at all levels. One of the best ways to do this is to create curricula or special programs in the elementary and secondary schools. The state energy and education agencies can help suggest curriculum materials. (See Tool 5.3.)

PUBLICITY

No energy program works well without publicity. This can take innumerable forms: poster contests, displays of infrared "flyover" results, press conferences, awards programs, demonstration programs like mobile trailers, and others. It is important to use publicity both to generate initial interest and to regularly remind the community of ongoing programs. (See Tool 5.2.)

EMERGENCY PLANNING

In recent years energy shortages have become a reality for the nation, and for many communities. Minnesota's "end-of-the-pipeline" dependence on oil and gas sources outside the state, including uncertain Canadian sources, suggests that, at least in the short run, there will continue to be occasions when natural gas, motor fuel, or other vital energy sources will be in short supply. The local government, working with state authorities, can potentially do a lot to reduce the impact of these shortages. Such measures as:

- emergency storage;
- local allocation procedures;
- specific activity curtailment plans;
- emergency electric generation and load shedding plans;
- ridesharing and other emergency transportation plans;
- coordinating with local suppliers; and
- residential evacuation procedures

can prepare the community to meet short-term shortages without serious disruptions. See Tool 3.7 for more details on emergency planning.

COORDINATION

A chronic problem with energy programs is that they are generated by a small, enthusiastic group, but do not involve a broader spectrum of the community and thus fail to mobilize enough resources to give the program a major impact. It is important for energy planners or local organizing groups to reach out and coordinate efforts with such groups as:

UTILITIES

Electric and gas utilities, as public service organizations, respond to well-presented, constructive ideas for improving their energy services.

PROFESSIONALS

Contractors, plumbers, electricians, engineers, architects, foresters, and farmers each have significant knowledge to devote to working on energy problems, if the energy program leaders can show them how the program is in their interest as well as the interest of the whole community.

BANKS

More and more bankers are seeing that helping customers control energy costs improves the community's fiancial health. Customers are better able to meet mortgage payments if energy bills are under control, and energy improvements can help sell home improvements loans, which helps the bank's own financial picture. (See Tool 7.3.)

One of the greatest tasks for the energy planner is to articulate energy programs in a way that attracts the active support of the basic institutional resources of the community.

Another side of the coordination issue is interprogram coordination. Programs can start spontaneously, and then fade away from lack of follow-up support. The designated energy planner, working with the advisory task force, needs to maintain an overall picture of what individual programs are doing and how they can complement each other. For instance, the Minnesota Housing Finance Agency and local CAP agencies have begun coordinating weatherization grant programs with home improvement loans, which enhances the effectiveness of each program.

Ways to maintain some coordination among different programs include:

- regular program reports to the planning commission or advisory commission;
- keeping a wall chart of all active programs with a master schedule, milestones, and products;
- using the city's annual budget review process as a program review period.

EXAMPLE

Community X, having completed the problem definition, resource assessment, and goal-setting tasks, now endeavors to apply the goals and strategies in the Community X Energy Policy and Planning Guide to the city's existing plans, regulations, and program administration structure. The basic steps taken by the Energy Commission include the following:

1. New task forces are organized to work with:

- the land use plan
- the facilities plan
- regulatory issues
- special programs.

The chairman establishes a coordinating structure, consisting of a wall chart system for listing proposals from each of the four task forces, to ensure that activities are consistent with each other, and to identify options to combine initiatives.

2. The land use task force reviews the land use plan and identifies:

- two central areas where zoning could be modified to allow increased density;
- three areas where zoning could be altered to allow mixed land uses; and
- a better site for the planned unit development currently proposed to be built 8 miles from downtown; the new site would be 2 miles from downtown.

It develops a set of policies including the above specific items but also including concepts for protecting solar access, density increases, height and setback allowances for energy equipment, and others.

3. The facilities task force reviews the transportation, utilities, and public facilities plans, and makes the following recommendations:

- removing the planned road to the planned unit development; the new site can be served by improvements on three existing roads;
- removing the planned sewer extension to the PUD, because under-used capacity in the collection system near the new site can handle the new load;
- removing the planned fire station for the PUD site, since the new site can be served by the existing station; and
- instituting energy review procedures for all proposed capital program additions, including the life-cycle cost analysis, alternatives analysis, and consideration of specific energy features in new buildings.

4. The regulations task force reviews the subdivision rules, the zoning ordinance, permitting procedures, and tax regulations, and the building code. Its findings include:

- the county has rejected the state energy building code; the task force recommends developing incentives for builders who exceed the state code voluntarily, by reducing permit fees and offering density increases;
- the zoning ordinance, reviewed in coordination with the land use task force, is recommended for alterations to allow greater density, mixed land use, and height and setback variances for energy equipment;
- subdivision rules can be altered to increase density in the planned PUD, encourage solar access, vegetation retention, earth-sheltering, and passive solar design; and
- a solar access policy using restrictive convenants is recommended for development in cooperation with the town council and a planner from the RDC.

5. The special programs task force develops a list of energy programs for development, including:

- a home energy audit program with the electric utility;
- a home energy loan program with local banks, using CDBG money and MnHFA's Title I home improvement loan program;
- a small "loop bus" experiment from the town center to the shopping mall;
- a ridesharing program, working with six local employers;
- an energy exhibit at the library with free handout material from the state energy agency and local utilities;
- a school energy program, beginning with a poster contest and developing into a part of the science curriculum; and
- an emergency planning program for allocation of fuels, coordination of transportation, and curtailment of public operations.

6. The task forces report back to the Energy Commission. Findings are reviewed for consistency among themselves, with stated energy goals, and with other community planning and development goals.

7. A draft energy element is prepared for each plan affected, and submitted to the planning commission for review and adoption.

8. Program proposals are prepared and sent to the city administrator, who has been developing the government's internal energy managment program. Utilities, banks, professionals and others are contacted through their energy commission representatives to develop their roles.

9. Annual review and reporting procedures are established for each plan element and program, for the planning commission and city administrator to follow.

IMPLEMENTATION

IMPLEMENTATION

INPUTS

ENERGY PLAN

programs,
projects,
goal

ACTIVITIES

LOCAL GOVERNMENT OPERATIONS

buildings
vehicles
special functions
purchasing
management systems
case example

FINANCING

the budget
bonds
loans
state and
federal programs
case example

UTILITIES

types
utility -
government regulations
regulatory issues
case example

IMPLEMENTATION

MUNICIPAL OPERATIONS
buildings, vehicles, street lights, operating and capital budgets, etc.;

UTILITIES
working with electric and gas utilities to put plans into action;

FINANCING
how to pay for programs and projects.

The most difficult part of most planning efforts is implementation-putting goals, strategies, and potentials into action. Implementation has been covered to an extent in Chapter 6, in terms of amending planning documents, and creating programs.

This chapter addresses the above areas in a practical fashion, identifying the key issues, management methods, and specific tools local governments can use to apply energy concepts on both a daily and long-term basis. The topics covered in the chapter are summarized in the chart at left.

LOCAL GOVERNMENT OPERATIONS

Local government operations relate to energy planning in a number of ways:

DATA COLLECTION
Local government accounting and information systems may contain a great deal of useful information, including:

- energy use in local government buildings;
- planning data such as population, housing, growth projections, etc.;
- physical data such as maps of water, sewer, and utility lines.

These kind of data can be usd in the data collection process described in Chapter 3, as part of the overall community profile.

RESOURCE APPLICATIONS
Local government operations contain opportunities for direct application of conservation and renewable resource strategies. If the community energy planning process sets goals for conservation and renewable resources, government buildings, vehicles, etc., can be used for initial testing and demonstration. For example, solar systems can be tested on government buildings, alcohol fuels can be tested in local government vehicles, etc.

PROGRAM MANAGEMENT
The energy planning process may produce recommendations for various energy programs, such as a phone hotline, an energy audit program, weatherization workshops, etc. Local government agencies may then be called upon to assume ongoing support or coordination for these programs. Moreover, in Chapter 2 it was shown how local governments can support the energy planning process itself in terms of providing space and staff and administrative support for the process.

FINANCING
This chapter discusses some of the options that may be open to local governments to help pay for both internal and community-based energy programs and projects. The local government's taxing powers, capital budgeting process, and tax-exempt financing powers can be critical tools in putting the community energy plan into action.

Local government operations, then, can provide input to the community energy planning process, and can be the focus of ongoing efforts to put the energy plan into action. Independent of the comprehensive community energy plan, however, local government operations contain numerous areas for direct energy savings in the short term, which are elaborated in the sections that follow.

Local government energy use falls in three main areas:

- buildings
- vehicles
- special functions such as:
  - water systems
  - wastewater systems
  - traffic lights
  - street lights.

Other government functions that directly affect energy use include:

- purchasing
- accounting and information systems
- budgeting
- maintenance
- personnel motivation and management.

These areas are discussed in the remaining sections of this chapter.

BUILDINGS

There is a growing industry providing products and services for improving energy efficiency in buildings. Cities like Edina, Willmar, and Hopkins have gone ahead with building energy programs (see Tool 3.3 for references). Many building owners have been approached by equipment salesmen, "energy auditors", or others offering to save energy through devices or methods. But for a local government facility manager, building energy management is a more complex process. The main elements of the energy management process are:

DATA BASE

The building's energy sources, including utility and fuel accounts, must be identified and linked to particular functions, such as heating, cooling, hot water, motors, appliances, lighting, etc. A basic profile of the building's past energy use must be established and a consistent set of performance measures, or Energy Utilization Indices (EUIs), must be developed. EUIs are usually expressed as BTU per square foot per year. (See The Minnesota Energy Agency's *Local Government Accounting Procedures Manual* - call 612/296-8899).

BUILDING SURVEY

A thorough inventory, inspection, and performance testing survey of all major energy-using equipment, and of the building envelope—walls, roof, doors, and windows—must be conducted to identify opportunities for improving energy efficiency. Energy Conservation Measures (ECMs) should be developed for these opportunities.

COST ANALYSIS

ECMs should be categorized as no-cost, low-cost (within current or projected operating budget), or capital cost (requiring individual treatment as a capital improvement). For each ECM, basic cost analysis should be conducted to identify:

- expected energy cost savings (annual)
- expected implementation cost
- simple payback (implementation cost ÷ annual energy cost savings).

Local practices may require additional cost analysis, taking into account the time value of money, such as:

- discounted payback
- discounted cash flow analysis
- cost benefit analysis.

(More information on these methods can be found in *Simplified Energy Design Economics*. NBS Special Publication 544. U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234.)

IMPLEMENTATION PLANNING

Putting ECMs into practice and maintaining their effectiveness can be the hardest part of the program. Implementation methods include:

- training building personnel in revised operating and maintenance procedures
- developing bid specifications for equipment
- reviewing bid proposals
- preparing budget proposals; including a budget set-aside for ECMs.

MONITORING AND REVIEW

It is vital to develop means of checking building performance in future years if ECMs are to remain effective. The basic energy profile and EUIs can be used as a basis for a regular accounting and information system, where data from energy bills are fed each month into a system that analyzes the data in terms of past or targeted performance measures (EUIs). (See the Minnesota Energy Agency's *Local Government Manual* for more information on energy accounting). See Tool 3.3 for more information on building energy audits, including a simple ECM checklist.

VEHICLES

Most local governments own or lease vehicles for police, fire, administration, sanitation, and other services. Since gasoline prices have risen more than fourfold since 1973, and since the mileage of vehicles now on the market varies from less than 15 to more than 50 miles per gallon, many cities as well as citizens are using higher mileage cars and changing their driving habits. Some are even moving to new vehicle types, such as diesel, natural gas, or alcohol-fueled vehicles. New Ulm, Hennepin County, and Edina are among Minnesota local governments who have made attempts at controlling vehicle fuel use.

The options available for controlling vehicle energy use include:

REPLACEMENT

Vehicles can be replaced with more energy efficient models, either on an individual or fleet basis. The key factor here is proper cost evaluation. Life-cycle Costing (LCC) is coming into wider use as a means of accounting for energy and other operating costs, as well as the first cost, in comparing costs for alternative vehicles. Basically, LCC involves adding together first cost and operating costs (including fuel) for the expected life of the vehicle; factors such as fuel cost escalation and discount rates should be included. See Tool 3.9 for cost saving estimates from vehicle replacement. More information on LCC is found in this Chapter.

REDUCTION IN FLEET

A comprehensive review of vehicle use and departmental service needs can sometimes justify reducing the number of vehicles in the fleet. Consolidating functions, combining or eliminating trips, relocating functions to reduce travel needs, and other management strategies can be used to accomplish this objective. To carry out the comprehensive review, a method for recording trip information, such as a vehicle log system, is needed. A trial study can be carried out for a limited period to gather data for a particular department or vehicle.

IMPROVE MAINTENANCE

Performing simple maintenance tasks such as:

- checking tire inflation
- checking oil levels and changing oil regularly
- regular tuneups

can substantially improve vehicle performance. A vehicle fuel/maintenance log system, in which drivers record fuel and service purchases, can include prescribed maintenance procedures at specific mileage intervals so that drivers know what to do, and at what intervals. See Tool 3.2 for estimates of mileage improvements from better maintenance.

IMPROVED OPERATIONS

A lot of gasoline can be wasted through unnecessary idling, rapid acceleration and deceleration, high speeds, and other basic driving practices. A simple dashboard sticker can prescribe operating procedures. The best way to improve driving practices, however, is to create a driver incentive system, in which drivers who consistently use specific vehicles are rewarded for meeting targeted cost-per-mile figures, or for recording the best cost-per-mile performance in a given department or vehicle pool. This kind of program needs a vehicle/driver log system to record operating cost data.

FUEL USE MONITORING

Some larger cities use a computerized fuel dispensing system with "credit cards" that automatically record fuel use. A less expensive approach is a vehicle fuel log system, so that all fuels and servicing purchases are recorded. Since such a system depends on driver compliance, an incentive program or other motivating method should be used to encourage use of the system. (See the Minnesota Energy Agency's *Local Government Energy Accounting Procedures Manual* for more information on vehicle fuel accounting).

Various alternatives to gasoline-powered vehicles are being pursued, including diesel, natural gas, alcohol or gasohol, and electric vehicles. Diesel vehicles are relatively well-proven, and offer improved mileage and lower fuel costs. They have less "pickup" and present some air pollution problems. Natural gas vehicles are used in Los Angeles, by the U.S. Postal Service, and other public bodies, largely for pollution-control reasons. They require special engine adaptation and different maintenance. Gasohol is growing in popularity and offers the main advantage of stretching gasoline supplies. It has caused problems in some engines and under some driving conditions. Pure alcohol fuel is being used in a few cases but requires engine modification, has lower energy content than gasoline, and as yet offers no cost advantage.

See Tool 3.2 for other references on vehicle energy management.

SPECIAL FUNCTIONS

STREET LIGHTING

Almost every local government owns, operates, or leases street lights. Recent improvements in lamp technology have spurred many local governments to replace their current fixtures with more efficient types. Other practices, such as reducing hours of operation and renegotiating utility contracts, can also reduce energy costs in street lighting.

Some examples of cost differentials between lamp types are shown in Tool 3.1. Apart from replacing fixtures, you can also reduce hours of operation through more careful control of timing equipment in different areas. Savings possible from reducing operating hours are also shown in Tool 3.1.

Other issues in considering street lighting energy cost control include:

- Utility Rates: Make sure that the rates are appropriate to your situation. Many rate schedules are based on estimated hours of operation. If you can reduce estimated hours by as little as an hour per day or include a fixture outage factor, savings can be considerable.
- Ownership: Changing from a leasing to an ownership position can in some cases save the local government money if it uses better fixtures and keeps better control over operating hours, maintenance, and replacement.

OTHER FUNCTIONS

Energy savings can be found in other special functions, including:

- Water Supply Systems: Water conservation programs, such as distribution of shower flow restriction, can reduce costs for pumping and treatment; proper scheduling, loading, and maintenance of pumping equipment can also reduce energy costs (see Tool 3.4 for more information);
- Wastewater Systems: Local governments that operate sewage facilities can reduce energy costs through better engineering and management in plant operations (see Tool 3.4 for more information on these practices);
- Solid Waste: Proper routing, driving practices, and maintenance of solid waste collection can be combined with recycling programs to reduce energy used in solid waste operation (see Tool 3.4 for more information).

PURCHASING

The way in which the local government buys vehicles, office equipment, buildings, and other energy-consuming items has a major impact on the government's long-term energy efficiency. Several states, Minnesota being one of the first, have begun to encourage local governments to include life-cycle costing or similar measures in their procurement practices. State support may be needed to overcome the low-bid requirements under which most local governments operate.

Life-cycle costing can be applied to copy machines, air conditioners, water heaters, and other equipment where it is straightforward to estimate purchase price, lifetime, energy consumption, and maintenance costs. Life-cycle costing for new buildings is more difficult, because estimating energy usage from building plans requires sophisticated computer modeling or other complex analytical techniques. Local governments should adopt building evaluation procedures suitable for their internal analytical and data processing capabilities.

More information about life-cycle costing can be found in Tool 3.9.

MANAGEMENT SYSTEMS

Often the least developed, yet one of the most important, elements of an energy program is the management system. In program after program, the energy measures are sound, the economics are attractive, the support is strong; yet after the initial round of planning and activity the program fades from view. When this happens, it is often because of inadequate ongoing management.

What goes into good energy program management?

- An energy accounting and budgeting system;
- An energy performance evaluation method;
- An "accountability" and incentive structure of responsibility that keeps personnel focused on energy goals.

Without these basic features the energy program will suffer after a short time from lack of feedback on progress, lack of information for setting new goals, and lack of motivation to maintain the effort.

The most basic management tool is an energy accounting and information system that produces useful information on energy costs and consumption levels on a regular basis. The Minnesota Energy Agency has produced an *Energy Accounting Procedures Manual for Local Governments and School Districts* to meet the need for a uniform approach to energy accounting (call 612/296-8899 for more information). This manual covers such topics as:

- inventories of energy supply accounts
- monthly recordkeeping forms and procedures
- creating Energy Use Indices (EUIs)
- computerizing the system
- accounting for
  - buildings
  - processes (wastewater treatment, etc.)
  - street lights
  - vehicles
- energy budgeting and cost analysis
- reading utility meters
- energy-saving tips for interior lighting, street lighting, and vehicles.

The particular design of your energy accounting system will depend on the size and complexity of your local government, its manpower, and its current accounting practices. Whatever form the accounting system takes, there are related issues that should be considered:

ACCOUNTABILITY

A well-designed system not only processes data, it also assigns responsibility. There is a need to make individuals responsible for reporting, reviewing, and acting on energy data. Individual personnel, by department or function, must have specific responsibilities assigned to keep the information flowing, and flowing to the right places. The information must get to the individual who can best apply it. For instance, if a central comptroller's office processes the energy data, reports must flow back out to operators in a form that allows them to see how they are performing and tells them where to look for problems if they appear. As another example, energy budget line items must be relatable to specific facilities or operations so that individuals can be made responsible for meeting specific goals.

BILLING REVIEW

The system should contain procedures for positive verification of billings' accuracy through internal meter recordkeeping, through guidelines based on known consumption patterns, or rate classification review.

MOTIVATION

No energy accounting system is effortless. Given the day-to-day pressures on employees, some things, (including energy accounting,) can get deferred. Compliance with energy data reporting requirements can be achieved through either mandatory or incentive methods. Incentives can take the form of awards such as employees suggestion awards or manager-of-the-month awards. For personnel with responsibility for vehicles, buildings, or functions like waste treatment, energy management can be a special criterion in the employee's annual performance review process. A bonus system for meeting or exceeding energy saving targets is another possibility.

These kinds of considerations can make the energy accounting system a very effective management tool for sustaining the initial energy program effort and building energy awareness into the basic operating principles of the local goverment.

EXAMPLE:

Community X had been trying to control its energy costs for several years. Controlling thermostats, turning off lights, installing double windows in the city hall, and replacing full-size municipal automobiles with compacts had already been undertaken. The comprehensive energy planning process, however, generated interest in a wide range of opportunities. As the advisory commission conducted its work, the city administrators and public works director made a comprehensive review of municipal operations. This resulted in an expanded energy management program for government operations. The steps taken in the development of this program included:

1. A comprehensive study of city-owned buildings, including the development of a data base, identification of energy conservation measures, and collection of preliminary cost and savings data for each measure. The survey was conducted by public works staff with help from the city's consulting engineer.

2. From the buildings survey, a list of energy conservation measures, ranked by cost and simple payback, was developed. Measures fundable within the existing maintenance budget were separated from those requiring a capital improvement program submission. These more costly measures were further analyzed, and detailed cost estimates were developed by an architect/engineer firm interested in doing the work. Next the measures were "packaged" for funding the capital improvement program over a five-year period.

3. Vehicle replacement was not considered given the existing practice of buying compact cars. However, a manual log and report system was devised to track mileage and maintenance for each vehicle.

4. The public works director obtained bids from manufacturers for high-pressure sodium light fixtures and recommended gradual replacement of existing mercury vapor fixtures over a five-year period. A capital budget submission was prepared to support the recommendation.

5. The water department issued free shower flow restrictors to all customers in a mailing that included a list of water conservation measures. It also reviewed pumping operations and found that cost savings were available through better regular maintenance and through more careful operating practices to reduce overuse of pumping units.

6. The purchasing department obtained the U.S. Department of Commerce publication on life-cycle costing and revised its procedures to reflect life-cycle costing principles.

7. The comptroller's office instituted a system for tracking energy cost and usage in all buildings and major utilitiy accounts, using the State Energy Agency's *Local Government Energy Accounting Procedures Manual.* The system included a reporting system in which managers with line responsibility for major energy-using facilities and functions were evaluated each year on their unit's energy performance, as part of their regular annual review. This system was combined with an awards program which gave recognition to employees for energy-saving suggestions (through a "suggestion box" program) and for energy saving performance (for line managers).

UTILITIES

An important test of local energy programs is their ability or failure to use all of the resources at their disposal. Electric and gas utilities contain some of the greatest resources available to communities for planning new energy strategies. Utilities have the experience, the manpower, and the financial capacity to make new energy strategies work. For example:

- Northern States Power conducts a customer attic insulation program, internally administered and financed;
- Minnegasco is helping the Minneapolis Housing and Redevelopment Authority implement a low-interest energy conservation loan program;
- Some electric cooperatives are offering energy loans to consumers;
- Some utilities are paying customers **not** to **use** power at critical peak periods, to keep generating costs down for the whole community.

TYPES OF UTILITIES

To better understand who the utilities are and how they can be part of the community's energy strategy, let's look at the three basic kinds of utilities:

INVESTOR-OWNED (IOUS)

THE IOUs, like Northern States Power and Minnegasco, are corporations much like any other, with stockholders, board of directors, etc. Their main difference from other corporations is that they are regulated monopolies — they provide exclusive electric or gas service in a specified service area. Their rates, profits, and operating practices are regulated and monitored closely by the Public Utilities Commission (PUC).

MUNICIPAL UTILITIES

Owned and operated by local governments, these utilities are not PUC-regulated, as they answer to their local political structure. Some municipals generate electricity, some purchase from other utilities, and others both generate and purchase from other utilities. There are also larger public power agencies which generate power for member municipal utilities and share costs of power plants and transmission lines.

COOPERATIVES

Rural electric cooperatives began in the 1930's as part of the New Deal and now serve large sections of rural areas. They were often established where customers were too sparse for an IOU to make a profit and where no town was large enough to support a muncipal utility. Co-ops are literally owned by their customers. They generally buy all their power from a generation and transmission cooperative which is owned by the local cooperatives, which then distribute electricity to customers.

UTILITY-GOVERNMENT RELATIONSHIPS

Utilities, then, vary widely in size, ownership, and method of operation. Local governments can have a variety of relationships with utilities: they can own them directly (in the case of a municipal), buy power from them at retail, or buy power from them at wholesale for distribution within the municipal system. In the conservation and renewable resource area, local governments can work with utilities in several ways:

- The local government can help create financing methods and incentives for energy programs serviced by the utility, as Minneapolis is doing with Minnegasco.
- A major utility residential conservation program began in Minnesota in 1981. The Minnesota Energy Conservation Service (MECS) requires the larger regulated utilities in the state to offer energy audits and related services to all their residential customers in buildings containing four or fewer housing units. The charge to the customer for these audits can be no more than $10. This program offers local governments in those communities served by the program an opportunity to participate in a program with a sizable conservation potential. Local governments may be able to assist with the promotion and conduct of utilities' local MECS efforts. Municipal and cooperative utilities may also be encouraged to participate in the program.
- The utility can use its technical expertise, data processing capability, and manpower to help run local government-sponsored energy fairs, workshops, training sessions, and other programs.

- The utility can work with local energy planners to coordinate local energy goals with the utility's capacity planning, local management, and other programs; this can include such approaches as working out rate agreements and power purchase agreements for local projects such as hydroelectric, waste-to-energy, wind, or other projects.

Communities operating municipally-owned electric and gas utilities have a unique vehicle for managing community energy use and cost. There are over 100 municipally-owned electric and gas utilities in Minnesota. Municipal utilities can influence the use and cost of electricity and gas by the prices charged (rate design) and by load control. Rates can be designed to accomplish the following goals:

- increase or decrease use for space heating;
- increase or decrease overall use;
- shift use from peak periods to off-peak periods; and
- encourage or discourage economic development.

Many of these rate design changes will also significantly affect consumer costs. Reducing the rate of growth in electric demand will likely reduce future cost increases, because inflation in the cost of electrical generating facilities results in new plants costing significantly more than present plants.

Because the amount of generating capacity required is determined by the peak load, programs to shift electrical usage from peak demand to off-peak times will reduce costs. This can be accomplished by load management as well as rate design.

Load management can be controlled either by the utility or the customer. Programs have been conducted by utilities to control hot water heaters and air conditioners. The utility turns customers' appliances off and on based on a predetermined plan as the utility approaches its peak demand. Load control requires an investment in equipment and should be thoroughly costed before implementation. Customers can use the same approach by limiting electrical use to a predetermined peak by rotating electrical uses such as air conditioners.

If local governments and utilities begin exploring their mutual interests in a creative and cooperative manner, other options may be identified.

REGULATORY ISSUES

Until recently the regulated status of investor-owned utilities has limited their flexibility in taking initiatives in the conservation and renewable resource areas. Also, the historical trend from 1930 to 1973 was one of **decreasing** real costs of utility-sold electricity. This trend made conservation and alternative power sources unnecessary and economically unattractive. However, in recognition of the sudden reversal of that declining trend and the need for utilities to explore more flexible options in meeting customers' energy needs, Congress passed the Public Utilities Regulatory Policies Act (PURPA) as part of the 1978 National Energy Act. PURPA is a complex piece of legislation, but two of its key features are:

- PURPA requires state public utility commissions, and thus indirectly many utilities, to consider several new rate-making standards, including:

  lifeline rates
  time-of-use rates
  seasonal rates
  interruptible rates
  load management features

  These standards create more flexibility in pricing electricity according to conservation and load management goals.

- PURPA creates the potential for "small power producers", including small hydro, biomass, wind, cogeneration, or other alternative energy projects, to sell their power to utilities at a cost equivalent to the utility's "avoided cost".

Avoided cost has been defined differently by various utilities and PUCs with resulting differences in prices paid to small power producers. However, the basic principle is that the purchaser pays a price equal to his cost of **not** supplying the last unit of electricity sold.

Each state utility commission and each utility will react to PURPA differently. Many PUCs and utilities are already beyond the minimal PURPA requirements. Others are moving more cautiously. But the overall trend is clear: utilities are not operating under past regulations wherein they simply sold gas or electricity for a reasonable rate of return of their fixed investment. They are becoming more service-oriented, selling a range of energy services as well as a basic commodity. The cost of building new plants, coupled with the fact that **managing** energy use can be cheaper than building new generation capacity, is causing more and more utilities to investigate alternative energy sources and energy management programs.

The upshot of PURPA for local governments is that communities should begin to work closely with utilities, so that their energy goals can support each other and so that the major resources embodied in the utility become part of the community's energy program.

Another regulatory issue has to do with municipal and other publicly-owned utilities. In recent years, public power districts have begun forming joint action agencies, through which they can exercise several energy options, such as:

- building new generating plants;
- buying reduced rate wholesale power for distribution among themselves.

Local governments that own or participate in public power districts can investigate the potential for gaining control over their energy future by:

- forming new public power districts;
- creating joint action agencies among existing districts;
- using the financial and institutional powers of the district or agency to:

  acquire new energy producing facilities,
  purchase wholesale power at reduced rates, and
  create energy conservation service and load management programs.

Local governments can take a more creative role in becoming energy producers as well as consumers. Each community should review its existing utility situation, discuss alternatives with the appropriate utilities and neighboring communities, and develop future strategies for developing local energy sources and energy management programs. Working together, local governments and utilities can form partnerships that will become the basis for long-term solutions to energy problems.

EXAMPLE

Community X is served by a large investor-owned utility. A utility representative serves on the community's energy advisory commission. The utility takes an active role in the process; its activities include:

1. Providing historical consumption and cost data for residential, commercial, and municipal consumers.

2. Working with the city to provide its low-cost energy audit service to homeowners and small businesses.

3. Providing a booth at the energy fair early in the planning process.

4. Helping the community analyze district heating potential from its local power plant.

5. Providing technical personnel for a series of neighborhood home weatherization workshops.

Community Y has a small municipal utility, which purchases and distributes power in the community; it belongs to a municipal power agency, which generates and distributes power to members. The municipal utility takes a very active role in the planning process; its activities include:

1. Providing detailed consumption and cost data on past electric consumption in the community.

2. Providing a part-time staff person to the energy advisory commission for data collection and analysis, and resource assessment.

3. Working closely with the commission in its capacity planning process, especially in looking at opportunities for creating local power generation projects using renewable resources.

4. Operating an energy audit, retrofit, and loan program for homeowners and small businesses, wherein the utility provides all needed services in a package, and charges the customer through the normal billing cycle.

FINANCING

The ultimate roadblock for many well planned energy programs is money. Finding the means to pay for much needed projects can be the energy planner's greatest frustration. Yet local governments are finding ways to create the financing needed for energy conservation and renewable resources. Some examples:

- Minneapolis, through its Housing and Redevelopment Authority, proposes issuance of $3 million in tax exempt bonds to create low-interest conservation loans in association with the Minnegasco gas utility.
- The Minnesota Housing Finance Agency's Title I Home Improvement Loan Program is used for low interest energy conservation loans by local lenders throughout the state.
- Red Wing issued a general obligation bond to build a solid waste plant that will generate steam for the local industry.
- Cities like New Hope have used federal Community Development Block Grant (CDBG) funds for a number of local energy activities. Hutchinson, Kansas, used CDBG funds for a "thermal flyover" aerial energy survey, and Wichita, Kansas, used CDBG money as part of a low interest loan program.

Recent fiscal trends at the federal and state level indicate that local governments should not expect major new financial assistance programs for energy resources. The ingenuity of local governments in packaging financing on their own will be called upon increasingly in the years to come. The remainder of this chapter discusses some of the most promising options local governments can pursue for financing their energy programs.

THE BUDGET

Portland, Oregon, has made a policy of dedicating 1% of its operating budget to energy conservation projects. Many local government fund accounting practices include line items for capital outlays. Since energy costs can be made specific line items in local government budgets, it is also possible to earmark funds for energy conservation expenditures by creating specific line items for energy conservation. This can be done by department, by accounting fund, or city wide. A policy can be developed similar to Portland's, setting aside a certain percentage of operating funds for conservation outlays. Alternatively, a separate fund can be created, especially if a specific energy office or subdepartment is established. See Tool 7.2 for more information.

BONDS

Tax exempt bonds are a potentially effective vehicle for raising energy program funds. Their attractiveness stems from two factors:

LOW INTEREST
Because income from the bonds is tax exempt, investors will buy them at low interest rates to reap the tax advantage.

LONG TERM
Long repayment terms mean that loans made from the bond proceeds can be issued with longer terms than most commercial loans. This means monthly payments will be lower and may be offset by energy cost savings enough that the loan recipient actually sees a net positive cash flow.

Municipal bonds are generally one of two types:

GENERAL OBLIGATION
backed by the issuer's taxing power and his full faith and credit.

REVENUE
backed solely by the funded project's projected revenues without obligating the issuer's full faith and credit.

General obligation (G.O.) bonds are normally easier to issue than revenue bonds if the municipality's bond rating is good, but they usually require a public referendum for approval. Revenue bonds do not necessarily need public approval, but underwriters will require extensive financial projections, technical feasibility studies, negotiated contract terms, letters of intent, and other documentation on the proposed project. Deciding which type of bond to use depends on such factors as:

LOCAL G.O. BOND RATING
A low rating may require using revenue bonds or may raise required interest rates.
SIZE OF THE ISSUE
Large issues may need a revenue stream to support them.

CURRENT G.O. DEBT BURDEN
The current ratio of bonded debt to local personal income, other public revenue figures, and related factors should be considered; heavy debt burdens will be reflected in the bond rating and in public reaction.

NATURE OF THE PROJECT
For a revenue bond, the project must be able to generate a documentable revenue stream sufficient to cover the debt service by a minimum ratio; this usually means selling energy generated by the project or receiving loan payments in a sufficient volume. See Tool 7.6 for more information.

LOANS

Government loans to private parties are the best known and (until recent interest rate surges) most popular financing mechanisms for a wide variety of public and private projects. Loans can be issued either directly (by the local government itself or through agencies) or indirectly (by subsidizing the interest or principal or by guaranteeing or insuring the loan). Loan funds can be created in a number of ways: from bonds, from public programs (such as CDBG), or from internal funds. Minneapolis is proposing to use bond proceeds for a loan fund; Wichita, Kansas, used CDBG monies for its home insulation loan fund.

In Minnesota, perhaps the most widely used loan program is the Minnesota Housing Finance Agency property improvement loan program, which is supported by bond proceeds and state subsidies, and marketed by participating local banks and housing agencies. Northern States Power Company offers its customers an attic insulation program, financed by the company and amortized through its billing system.

A number of communities have used Community Development Block Grant funds for energy conservation loans, such as the Wichita home insulation loan program mentioned above. In Wichita, the CDBG money is used to create a revolving loan fund, so that new loans are issued as old loans are repaid. The key is to work out payment and interest schedules so that enough money flows in from repayment that new loans can be issued to meet the demand. See Tool 7.3 for more information.

Another approach to loan financing is through non-profit corporations such as Industrial Development Corporations or other institutions created to encourage economic and community development. These organizations can use revolving loan funds created from tax-exempt financing or other sources to offer fiancial assistance to business and to consumers. This kind of program can enhance overall economic development programs.

STATE AND FEDERAL PROGRAMS

The state and federal financial assistance programs described above can help local governments finance energy programs. These and a few others that can be used are summarized below:

MINNESOTA HOUSING AND FINANCE AGENCY (MnHFA)
Local lenders provide reduced rate loans to homeowners based on MnHFA bond proceeds and loan repurchase. Contact local participating banks, housing agencies, or MnHFA, 612/296-8844.

COMMUNITY DEVELOPMENT BLOCK GRANTS (CDBG)
CDBG funds can be used directly for energy programs and can be used to subsidize loan programs through local banks. Contact HUD area office in Minneapolis, 612/349-3019.

See Section 7 of the Tools Library (Financing) for more information on financing mechanisms.

EXAMPLE

Community X's energy plan contains a number of programs and projects that need financing. The city administrator, after reviewing the plan produced by the energy advisory commission, works with the finance director to identify mechanisms for funding parts of the plan. The mechanisms include:

1. A line item is created in the city administrator's budget to support ongoing management and coordination activities.

2. A line item is created in public works budget for energy management in city facilities.

3. Capital improvement program submissions are developed for major retrofits to city buildings. In addition, the CIP submission form is revised to include energy impact analysis of all proposed projects on a life-cycle cost basis with consideration of alternatives.

4. A revolving loan fund for home energy improvements is created, using community development block grant funds. This program is coordinated with two local banks which were already involved in the Minnesota Housing Finance Agency's (MnHFA) energy loan program. The revolving fund loans are made available to those ineligible for the MnHFA program. The banks service the loans, and the local government coordinates publicity and provision of energy audits and retrofit services through local architects, engineers, and contractors.

GLOSSARY

GLOSSARY

Active Solar
Equipment designed to absorb the sun's energy and to use this energy for heat by use of mechanically forced energy transfer such as fans or pumps.

Biomass
Plant matter; for energy purposes, the energy bound in the plant and animal food chain by plant photosynthesis; biomass energy may be converted to numerous other forms.

BTU
British Thermal Unit; the amount of energy required to raise one pound of water one degree Fahrenheit; used as a standard measure of energy.

Conventional Crops
Corn, wheat, soybeans, and other agricultural crops which are suitable for conversion to liquid or gaseous fuels.

Cord
A traditional volume measure of firewood, with dimensions of 4' x 4' x 8'; normally contains 79 cubic feet of wood, allowing for air spaces; contains from 8 to 28 million BTU.

Degree Days
In a single 24-hour period, degree days are the difference between the mean (average) temperature and 65°F. If the mean temperature is above 65°, the difference is expressed as cooling degree days. If the mean is below 65°, the difference is expressed as heating degree days. These daily degree day totals can be added to derive monthly, seasonal, and annual totals.

Demand Charge
An item on an electric utility bill reflecting charges for the customer's peak usage rate during the billing period; as distinguished from the energy charge, which reflects charges for total energy used during the billing period.

District Heating/Cogeneration
District heating is the central generation of heat as steam or hot water, which is distributed through pipes to multiple customers in a nearby area. Cogeneration is the joint production of heat and electricity; district heating is most effective with a cogenerating central plant. District heating can use rejected heat from an electric power plant, or a district heating boiler can generate electricity.

Earth-sheltering
The use of earth in building construction to reduce exposure to wind and temperature extremes. Buildings can be built into south-facing slopes, sheltering the north wall, or can use artificial banks (berms) to protect north walls and other exposed surfaces; often combined with southern exposure to solar radiation to retain solar heat (see passive solar).

Easement
A limited right to a parcel of land that leaves title to the land to the owner while granting rights to an individual(s) for a specific use; for example, an individual may have an access easement to be able to cross a parcel owned by someone else. A solar access easement prevents the owner from erecting or allowing any structure, tree, etc., to reduce solar radiation on the property of the easement holder.

Energy Audit
An evaluation of a facility to assess its current energy using equipment and practices and to identify measures to improve energy efficiency.

Gasification
The chemical processing of a solid or liquid material to convert it to gaseous form.

Jobber
A heating oil or gasoline wholesale dealer.

Kilowatt
A unit measuring the instantaneous rate of electric energy usage, as opposed to the amount of energy used; also refers to the capacity of an electric generating unit, as distinguished from the energy produced from the generating unit (see Demand Charge).

Kilowatt-hour
A unit measuring the amount of electric energy consumed, as distinguished from the rate of consumption (see kilowatt); equivalent to 3413 BTU.

Life-Cycle Costing
A method of analysis of an item which has both initial costs and ongoing operating costs; it takes into account the initial cost, the operating costs over the life of the item, and the effect of inflation.

Liquefaction
Chemical conversion of a material to liquid form.

Mixed-Use Zoning
Provision in a local zoning ordinance for different land use classifications (e.g., residential, commercial) to locate in the same zone.

Paratransit
A term for a number of transportation strategies and programs that provide alternatives to using private cars and/or increase the effectiveness of public transporation systems.

Passive Solar
Design features in a building which encourage the absorption and retention of solar radiation, without the use of a mechanically-circulated heat transfer fluid.

Peat
Partially-decayed plant matter occuring in shallow bogs; used as fuel in Ireland and the Soviet Union; occuring in large volumes in northern Minnesota.

PUD
Planned Unit Development; a development concept in which a parcel of land is developed under a single plan and developer; planning includes streets, services, natural features, site design, building configuration, and other features.

Renewable Resource
An energy resource which for practical purposes is not depleted over a period of time but is renewed through natural cycles; examples are solar, wind, hydro, and some biomass forms; distinguished from non-renewable resources such as oil, gas, and coal.

Retrofit
Alteration of an existing building or piece of equipment; in energy conservation programs, the alteration of building walls, roofs, doors, windows, and energy systems to increase energy efficiency.

Sewage Sludge
Sewage sludge is residue that remains after sewage is treated in wastewater treatment plants. Sludge results from settling of sewage during treatment. Sewage typically enters a treatment facility with a water content of 95 to 98%. Sewage sludge is usually comprised of 70 to 88% water with the remaining 20 to 30% made up primarily of human and food waste.

Small Hydro
Also called "low-head" hydro; refers to hydroelectric power projects in dams with less than 20 meters of head or change in water level from the upstream to downstream side.

Solar Access
The ability of a building or land parcel to receive natural sunlight; used in reference to avoiding obstacles such as tall buildings or trees which would reduce the amount of sunlight the building would otherwise receive.

Special Energy Crops
Cattails, reeds, alder and other plant species with little food or raw material value that can be grown expressly to be agriculture or development.

Therm
A unit of natural gas usage; 100 cubic feet, normally containing 100,000 BTUs.

Trombe Wall
A passive solar device, involving a heat-retaining wall covered by a transparent material, with an enclosed air space in between; exposed to the sun, the wall stores solar heat which is used inside the building.

820242

ENERGY

PLANNING TOOLS LIBRARY

Index

LAND USE PLANNING TOOLS
1.1 Encourage Higher Densities
1.2 Encourage Mixed Land Uses
1.3 Discourage Sprawl Development
1.4 Encourage Downtown Development
1.5 Energy Performance Zoning
1.6 Energy-Efficient Subdivision
1.7 Protecting Solar Access
1.8 Wind Machines and Zoning Concerns
1.9 Earth Sheltered Construction and Zoning

TRANSPORTATION TOOLS
2.1 Ridesharing
2.2 Paratransit
2.3 Discourage Downtown Auto Use
2.4 Reduce Transportation Needs
2.5 Small Scale Transit

LOCAL GOVERNMENT OPERATIONS TOOLS
3.1 Street Lighting Retrofit
3.2 Fleet Management
3.3 Building Energy Audits
3.4 Energy Conservation through Water and Waste Reduction
3.5 Energy Conservation through Recycling and Composting
3.6 Energy Recovery from Solid Waste and Sewage Sludge
3.7 Contingency Planning
3.8 Energy Accounting
3.9 Energy-Efficient Procurement

BUILDINGS AND DEVELOPMENT TOOLS
4.1 Site Planning
4.2 Energy Codes for Buildings
4.3 Energy Considerations in Real Estate Transactions
4.4 Energy-Efficient Building Design and Construction
4.5 Thermal Flyovers
4.6 Energy Training Programs
4.7 Energy Audits
4.8 Energy Conservation Services

PUBLIC PARTICIPATION TOOLS
5.1 Citizen Energy Committees
5.2 Energy Information Programs
5.3 Energy Education Programs

RENEWABLE ENERGY RESOURCE DEVELOPMENT TOOLS
6.1 Solar Energy
6.2 Wind Energy
6.3 Small Scale Hydroelectric
6.4 Crops and Crop Residues
6.5 Wood
6.6 Animal Wastes
6.7 Special Energy Crops and Peat
6.8 District Heating and Cogeneration

FINANCING TOOLS
7.1 Capital Improvement Project Review
7.2 Operating Budget Set-Asides
7.3 Loan Financing
7.4 Tax Incentives
7.5 Federal Assistance Program
7.6 Tax-Exempt Bonds

FORMS AND SAMPLES
8.1 Sample Resolution Establishing an Energy Commission
8.2 County Energy Program Organization
8.3 Community Energy Data Summary
8.4 Community Energy Problem Definition Table
8.5 Energy Resource Inventory Table
8.6 Energy Resource Substitution Table
8.7 Energy Strategy Statement
8.8 Sample Zoning Ordinances

LEGISLATIVE REFERENCE LIBRARY
STATE OF M A

2 copies

1 LAND USE

The Land Use Planning Tools presented in this section are inter-related because land use planning is a comprehensive process in which different strategies and methods affect each other. If your committee has gone through the planning process outlined in the Guidebook, it may be useful to review the community profile developed in Chapter 3 before reading the Land Use Planning Tools. The references listed here provide examples of the energy impacts of different land use patterns and of land use and energy planning efforts in other communities. Tools 1.1, 1.2, 1.3, and 1.4 should be part of an overall land use plan, because they have overlapping goals and involve the development patterns of the whole community. Tools 1.5 through 1.9 are directed towards incorporating energy conservation and alternative energy options in new and existing developments.

REFERENCES

Energy-Conserving Development Regulations: Current Practice
by Duncan Erley and David Mosena
Planning Advisory Service Report No. 352
American Planning Association

"Energy and Land Use" in
Environmental Comment, September, 1974
Urban Land Use Institute
Washington, D.C. 1975

The Costs of Sprawl
Real Estate Research Corporation
and the Council on Environmental Quality
Washington, D.C., 1974

Methodology for the Preparation of Regional Development Plan Alternatives
Capital District Regional Planning Commission
Albany, New York

The Planner's Energy Workbook
T. Owen Carrol, et al
Institute for Energy Research
State University of New York
Stony Brook, New York 11790
and
Brookhaven National Laboratory
Energy Systems Center
Policy Analysis Division
Upton, New York 11973

Encourage Higher Densities

Increasing density is a collection of land use strategies with the purpose of reducing energy used in transportation, in public services, and in buildings.

KEY ISSUES

Increasing density can take a lot of different forms, which are described below. In devising a strategy of this type, planners should keep in mind several factors:

SIZE
Increasing density is an effective strategy mainly in communities that expect growth and that have some centralized development. For small, rural communities with scattered housing, increasing density may not be relevant.

THE EFFECT OF INCREASED DENSITY ON SERVICES
Water and sewer lines, streets, and parking must be able to bear the increased demand. In unsewered areas, density is limited by on-lot disposal needs; on the other hand, in areas with excess service capacity, more density can be a fiscal benefit.

PUBLIC PARTICIPATION
Neighborhoods must have a role in decisions affecting their future.

STEPS

The mechanisms for increasing density include:

1. ZONING FOR SMALLER LOTS
This mechanism can be used in selected areas to increase density near transportation, commercial and employment areas. This can help reduce automobile use, and combined with proper siting and building practices, can encourage more energy efficient buildings.

Smaller lots can also increase the efficiency of sewer, water, gas, electric, sanitary, and other services if the added density provides more users in the same service areas. Sprawl-type development can result in high service costs because new equipment must be installed in each new tract development. Using smaller lot sizes to encourage the "infill" of existing developed areas can greatly reduce capital and energy costs for public services.

Permitting smaller lots can be achieved either by relaxing the area requirements in specified zones, or by allowing variances on a case-by-case basis.

2. ZONE FOR MORE MULTI-FAMILY HOUSING
Like smaller lot sizes, encouraging multi-family dwellings near to transportation, shopping, and employment can help increase density, thus reducing energy used in driving, in buildings, and in providing services. Building multi-family housing in previously single-family neighborhoods can create conflicts; planners, developers, and neighborhood organizations must work together to locate the right kind of development in the right areas, based on local values and good design and planning.

Encouraging multi-family use can be achieved by changing the zoning designation of target areas or by permitting rental units in large single-family structures. Changes of this kind must take into consideration neighborhood character, parking problems, and service capacity.

3. ENCOURAGE CLUSTER HOUSING AND PLANNED UNIT DEVELOPMENT
With increasing costs of land, construction and services, these types of developments have become more common. Cluster housing (that is, single or multi-family units in common structures) can reduce building costs because of its shared foundations and walls, and saves service costs in terms of roads, piping, telephone and power lines. Planned unit developments (PUD's) can combine several features:

- cluster housing
- mixed land uses
- site planning for energy efficiency
- efficient service planning

Cluster housing and planned unit developments are more appropriate to new development areas than existing neighborhoods. This makes it easier to plan for energy efficiency from a "clean slate." But it is still important for planners, developers, and citizens to work cooperatively in shaping new developments so that they fit within the overall picture of the community's goals. (See Tool 1.6 for more PUD information.)

LEGISLATIVE REFERENCE LIBRARY
STATE OF MINNESOTA

REFERENCES

Text—Chapter 6

Portland, Oregon. Bureau of Planning

Richmond, Indiana. CCEMP Project

Clinton County, Michigan Energy Office

Davis, California. Community Development Department

Minnesota Energy Agency
612/296-5120

City of Cottage Grove
612/458-2824

City of Brooklyn Park
612/425-4502

City of Edina
612/927-8861

City of Apple Valley
612/432-0750

Encourage Mixed Land Uses

Mixed land strategies involve allowing compatible activities to occur close to each other, to reduce travel needs, public service costs, and energy used in buildings (especially multiple-use buildings).

KEY ISSUES

Zoning laws were originally established to separate incompatible activities, such as heavy industry and housing. However, several land uses can be mixed with housing without disturbing the harmony of neighborhoods. These uses include:

LIGHT COMMERCIAL
Convenience stores, offices, laundries, restaurants, etc. Conditional use permits and other regulations can control size, setbacks, signage, parking and other features.

LIGHT INDUSTRIAL
Low polluting and small scale industries, such as electronics, research, etc. Permit controls can restrict size, parking, setbacks, landscaping, and other features to make the development harmonious.

RECREATION
Small parks, art centers, and other facilities can be planned on a neighborhood scale.

MIXED USE DEVELOPMENT (MUD'S)
A variant of planned unit developments, MUD's are designed to be more self-contained in terms of employment, shopping, housing and services. These mixed uses can be encouraged by:

- rezoning specified residential or commercial areas to permit specified new uses; or
- granting conditional or special use permits for controlled development of desired land uses; these should be used sparingly, so as not to defeat the purpose of zoning; their advantage is that they give the local government more control over each permitted use; and
- working cooperatively with commercial developers and employers to locate new developments in "energy-efficient areas" close to residences and public transportation.

Mixed land use strategies are more workable in well developed areas with existing zoning ordinances. Like higher density strategies, they are not very useful to small towns without zoning or concentrated development. However, some smaller towns are undergoing substantial new development, and local governments can encourage energy efficient development in these cases.

STEPS

Developing a mixed use strategy involves the following basic steps:

1. Identify residential areas that need and can absorb commercial and light industrial development; a special task force involving potential developers and neighborhood groups would be a good way to start.

2. Choose selected kinds of developments to be allowed, using the same task force as in Step 1.

3. Select method of allowing new uses:

- rezoning of specified areas;
- creation of "floating zones" for desired uses; that is, zones not tied to a specific area that allow certain uses without requiring variances;
- offering special use permits for desired uses, with conditions designed to maintain the desired neighborhood character.

4. Develop mixed use strategies combined with incentives to encourage the desired mix of residential, commercial, facilities, and employers. Incentives can include:

- density allowances;
- permit fee reductions;
- parking requirement reductions for development located in desired areas.

5. Use a public participation process for review and approval, as well as existing legal and administrative procedures.

REFERENCES

Text—Chapter 6

City of Cottage Grove
612/458-2824

City of Brooklyn Park
612/425-4502

City of Edina
612/927-8861

City of Apple Valley
612/432-0750

Discourage "Sprawl Development"

Many cities (even moderate-sized communities) are already well aware of urban sprawl. Sprawl is the development of an area without regard to the overall effect on the environment, energy use, and demands on local services. Sprawl results partly from basic real estate economics—land is usually cheaper further away from existing developments than closer—and partly from inadequate planning. This produces "leapfrog" and "strip" developments that reach out into rural area, consuming farmland, straining local services, and increasing the use of automobiles. Managing growth in this context has become a major issue for many communities; energy considerations create an added need for growth management.

KEY ISSUES

Sprawl can be controlled in a number of ways:

DOWN-ZONING
Reducing the density allowance, or changing the zoning of an area to a less intensive use (e.g. commercial to residential), can help control the rate and location of development. Zoning an area for agriculture can create a "holding zone" which can be used to stage growth or direct its location.

LIMIT COMMERCIAL ZONES TO CONCENTRATED AREAS
This tends to produce malls and shopping centers, but if located near population centers and public transportation it can reduce travel, reduce energy in commercial buildings by encouraging shared structures, and reduce service costs.

LIMIT SERVICES TO DESIRED AREAS
Sewer and water hookups are the main means of control; if there is a public sewer and water system, it can be planned to encourage new development in existing service areas. This can improve the economics of the service system as well as controlling sprawl.

ACQUIRE LAND OR EASEMENTS
A local government can exert long-term control over the rate and location of development by buying land outright or by gaining easements on parcels of land. Easements are limited rights over land owned by others; examples are scenic easements, wetland easements, access easements. They protect rights of people other than the landowner without taking the land outright. This is usually an expensive and sometimes a controversial option, but may be workable as part of an overall parks and recreation plan.

STEPS

Controlling sprawl development must be a part of an overall growth management and land use planning effort. A comprehensive plan and zoning ordinance are important elements in limiting sprawl; in communities without these tools, the local government will have a harder time shaping future land use patterns. For communities with a comprehensive plan and ordinance, the basic steps in a sprawl control effort are:

1. Identify undeveloped areas on the fringe of the community, especially prime agricultural land.

2. Identify areas preferred for development based on

- closeness to employment;
- closeness to commercial areas;
- access to existing services;
- potential for renewable resource use.

3. Identify potentials for discouraging development in preferred areas through

- down-zoning areas to be protected;
- limiting service extension to protected areas;
- acquiring title or easements to protected land;
- creating incentives for development in preferred areas, such as:

  allowing higher densities for individual developments on a conditional use basis

  reducing permit fees on a conditional basis

  rezoning preferred areas for higher densities

  providing services to preferred areas

  offering tax incentives to developers in preferred areas (reduced or deferred assessments)

4. Investigate options for preserving agricultural land. Check with the State Department of Agriculture or the Metropolitan Council in the Twin Cities Metropolitan area.

5. Modify the comprehensive plan and/or zoning ordinance to reflect new policies, following the existing public participation process and the appropriate official procedures.

REFERENCES

State Department of Economic Development, Office of Local and Urban Affairs; *Growth Management Handbook.*

Text—Chapter 6

State Department of Agriculture, Planning Division (612) 297-2200

Metropolitan Council (612) 291-6411

Forsyth County, North Carolina, City-County Planning Board, Winston-Salem, North Carolina

Clinton County Energy Office, Clinton County, Michigan

League of Minnesota Municipalities. *Local and Regional Planning in Minnesota.* St. Paul, 1975.

Portland, Oregon. Bureau of Planning

City of Cottage Grove
612/458-2824

City of Brooklyn Park
612/425-4502

City of Edina
612/927-8861

City of Apple Valley
612/432-0750

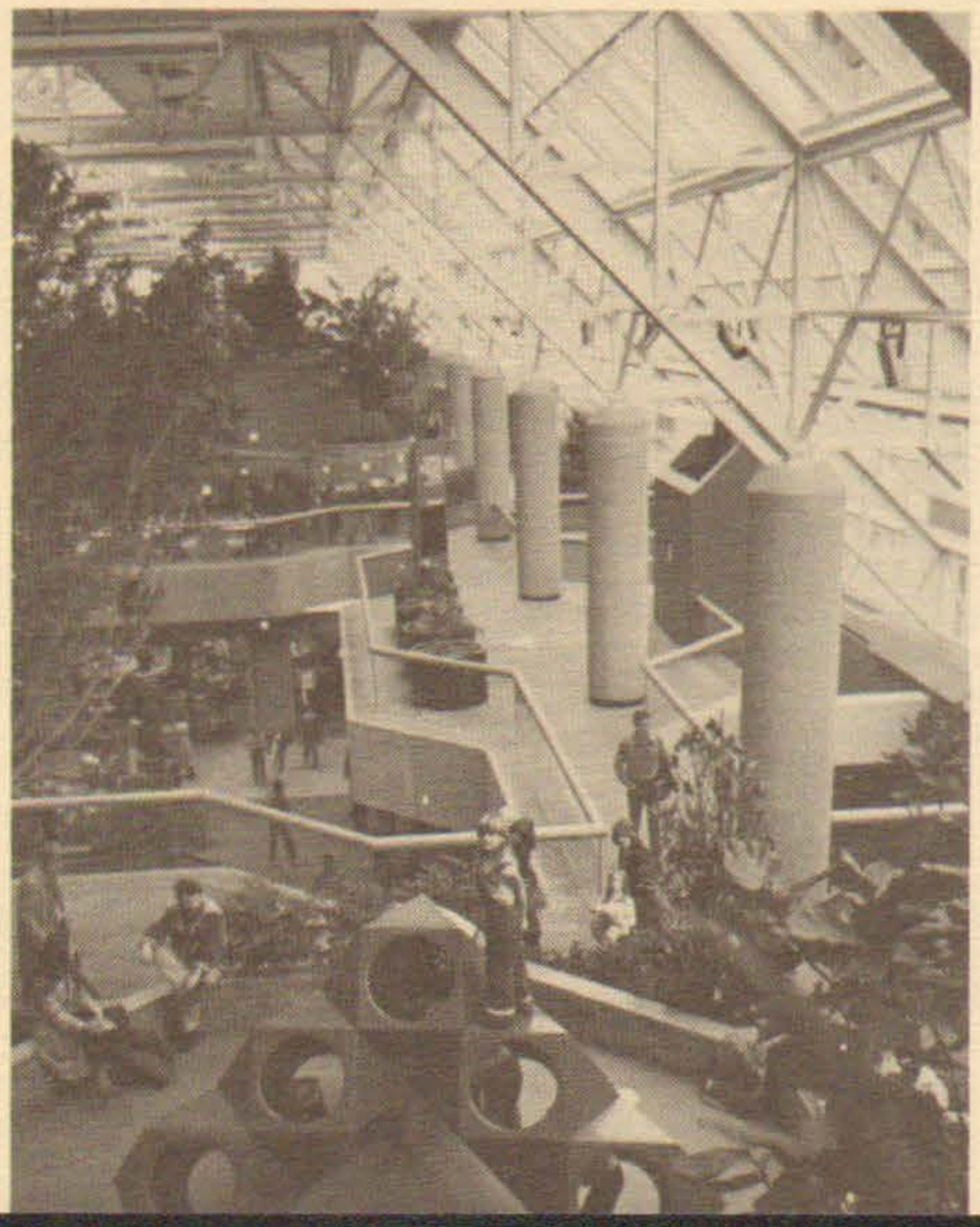
Encourage Downtown Industry and Commercial Development

A number of older cities have begun revitalizing their downtown areas by encouraging industrial and commercial development. This applies mostly to larger cities, but even in smaller towns highway bypasses have attracted business out of the town center, causing more travel, downtown economic decline, and a strain on services. Focusing shopping and employment at a central location saves energy by:

- reducing needs for new service equipment;
- creating better potential for district heating;
- making ridesharing and public transportation more feasible;
- reducing overall transportation needs; and
- allowing possible reuse of existing buildings, saving energy in new construction.

KEY ISSUES

St. Paul's new Town Square Mall, Mankato's downtown renewal, and Red Wing's Energy Park, are examples of this kind of downtown development. Smaller cities can in some cases use this kind of strategy on a smaller scale. There are some problems with this strategy, of course; potential pollution, the high cost of urban land, the desire of some businesses and industries for one story buildings, large parking requirements, etc. But these obstacles can often be overcome if the project clearly benefits the community as a whole.



Indoor park in St. Paul's Town Square Mall
Source: St. Paul Area Chamber of Commerce

STEPS

The basic steps in attracting development downtown are:

1. Identify the need and potential for downtown revitalization, by looking at:

- abandonment rates for buildings;
- tax base decline; and
- shift of businesses and institutions to fringe areas.

2. Actively seek businesses and institutions that are considering relocating.

3. Identify potential incentives to attract businesses and institutions to downtown, such as:

- tax abatements
- providing services and site improvements (possibly using industrial development revenue bonds).

Negotiate with interested organizations; examine negative impacts and means to handle them.

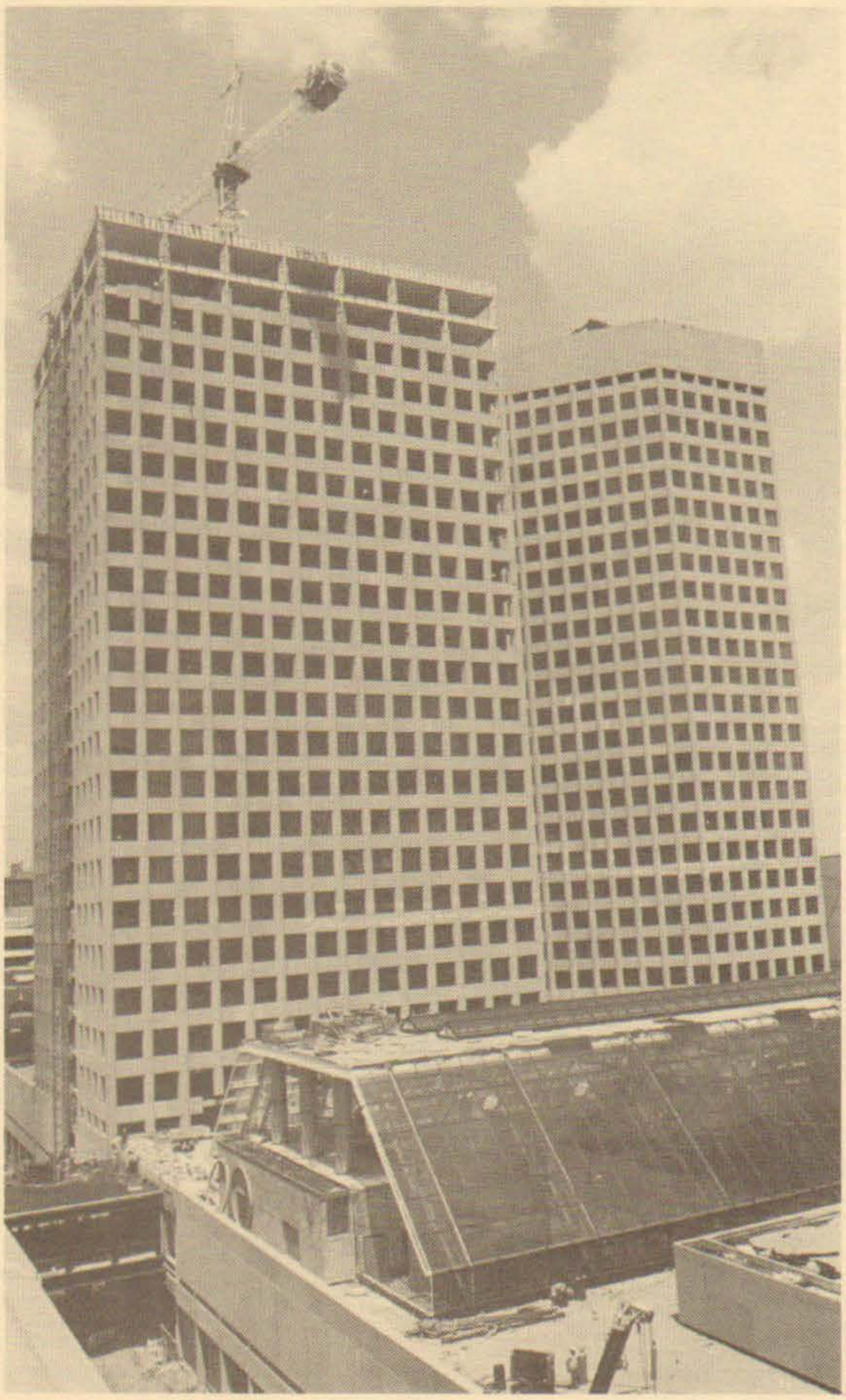
REFERENCES

Minnesota Energy Agency, St. Paul
612/296-5120

City of St. Paul, Mayor's Office
612/298-4323

City of Red Wing

City of Mankato, Planning Department
507/625-3161



Town Square Mall and Towers
Source: St. Paul Area Chamber of Commerce

Energy Performance Zoning

Performance zoning is a relatively new approach to land use control, spurred largely by environmental concerns. Rather than specifying exactly what may or may not be done in a given zone or subdivision, performance standards set goals related to the impacts of the land use activity. This approach differs from the usual subdivision control approach, which tends to prescribe more specific features. For example, a performance standard could limit the percentage of natural tree cover removal, or the total BTUs required per acre (averaged over an entire area to permit flexibility in siting). Subdivision controls can include performance standards, but usually also include detailed prescriptions for some features (see Tool 1.6).

KEY ISSUES

One use of performance zoning is to encourage use of solar devices, passive solar, wind systems, and earth-sheltered construction by making setback and other lot-related rules more flexible. The same objective can be met by granting variances for specified energy features that could violate current zoning, granting special use permits (which can provide more control over the types and configurations of energy systems), or by creating a "floating zone" (which amounts to creating a special use without requiring a permit or variance) for energy systems and energy efficient construction. For example, if earth-sheltered and passive solar designs were desired, zoning ordinances could be used to allow natural features, such as southern slopes and decidious trees, to be included in the site and building design.

Special use permits could be granted for the same purposes, and would provide more control over the specific features of a given use.

STEPS

To use performance zoning and related tools the planner should follow some basic steps.

1. Examine current zoning rules for potential conflicts with desired energy features, such as:

- height limits (solar and wind systems);
- setback (solar, wind, earth-sheltered);
- steep slopes (passive solar, earth shelter).

2. Review community physical features via topographical maps, aerial photos, etc., to identify natural features that can help reduce energy needs, such as:

- vegetation - evergreen (for wind cover) and hardwoods (for summer shade, winter solar access);
- southern slopes;
- natural "wind tunnels" or ridges, etc.

3. Revise zoning rules in desired areas to encourage the use of natural features. This can apply to both developed and undeveloped areas. Subsequently, new development proposals would be reviewed for compliance with the performance standards.

REFERENCES

Text—Chapter 6

Overcoming Land Use Barriers to Solar Access
Central Naugatuck Valley Regional Planning Commission
20 E. Main Street
Waterbury, Connecticut 06702

Planning for Solar Access Protection
Metropolitan Council, St. Paul

Solar Access Law
Gail Bayer Hayes
Ballinger Publishing Co.

Minnesota Energy Agency
Solar Access Workbook

Minnesota Energy Agency
Earth Shelter Construction and Zoning Issues

Energy Efficient Subdivisions

Subdivisions have been a major means of new residential development in recent decades. The controls exercised by local governments can significantly influence energy consumption in the subdivision.

KEY ISSUES

While zoning controls the land uses allowable in specified districts and limits building practices on individual lots, subdivision controls can affect the total design of a land parcel when it is subdivided into multiple lots. Features that can be included in subdivision controls include:

- streets
- water supply
- sewage disposal
- vegetation
- open space
- gas and electric supply
- lot size and orientation
- slopes, soils, floodplains and other natural features

Subdivision controls can be used to help save energy in several ways:

STREET ORIENTATION

To the extent that streets in the subdivision can be oriented to run east-west, the lots in the subdivision will be able to use a north-south orientation to allow for solar energy use. Reducing street widths, and coordinating streets with bike or pedestrian paths can also save energy.

SLOPES

Requiring maximum use of southern and eastern slopes will permit use of natural solar exposure, will provide shelter from cold winds, and will also encourage earth-sheltered designs. Such requirements must be balanced with steep slope restrictions to prevent erosion and sewage disposal problems.

VEGETATION

Requiring maximum retention of natural tree cover, as well as landscaping with shrubbery, can create natural shelter from cold winds, and shade in summer; cold wind protection is, in Minnesota, more critical than summer shade.

BUILDING ENERGY USE

Allowing cluster housing, mixing of single and multi-family units, and higher density can reduce the energy needed in each housing unit.

SERVICES

Proper planning can reduce the need for streets, street lights, water and sewer mains, and other services which consume energy in construction and operation.

PLANNED UNIT DEVELOPMENTS (PUDS)

PUDs have become popular with many developers and local governments as a way to keep costs down while providing attractive and efficient uses of the land to be developed. PUDs often use two basic principles:

DENSITY TRANSFER

Using units per acre for the overall development, rather than rigid lot size requirements, to control density, PUDs permit flexible clustering of housing units.

DISTRICT INTEGRATION

By combining single-family and multi-family housing with commercial and recreational uses, the PUD allows land uses to be more accessible to each other.

PUDs can be encouraged either through conditional use permits without rezoning, or by rezoning the tract to a PUD designation. Local governments vary widely in the complexity and nature of the PUD review procedures they use; the energy planner should follow the laws and practices prevailing in the community. The key point is that a PUD almost always requires a detailed review by local officials. By encouraging PUD-type development, local energy planners can take a comprehensive look at the total energy picture before the development is in place. In several communities, early cooperation between developers and local officials has resulted in creative and effective PUDs and other development packages.

STEPS

Basic steps involved in a PUD or other subdivision review process include:

1. Review current zoning and subdivision rules and practices.

2. Revise current rules to include generic guidelines for energy efficiency, such as:

- east-west street and lot orientation;
- use of southern and eastern slopes;
- retention of tree cover;
- allowance/incentives for efficient structural types (i.e. townhouses vs. detached, earth-sheltered vs. exposed).

3. Meet with developers in pre-application conference to hear their basic concepts and convey energy and other guidelines.

4. Developer prepares preliminary plat.

5. Review preliminary plat for inclusion of desired features.

6. Developer prepares final plat.

7. Review final plat.

8. Final plat submitted for approval by local or county planning commission or other body.

REFERENCES

Text—Chapter 6

LEGISLATION
State Platting Act (M.S. 505.01-505.1792)

Municipal Planning Act (M.S. 462.358)

County Planning Act (M.S. 394.25)

PUBLICATIONS
Local and Regional Planning in Minnesota, League of Minnesota Municipalities, St. Paul

PUD: A Special Tool for Special Situations. State Planning Agency, Office of Local and Urban Affairs, St. Paul

CITIES
City of Cottage Grove
612/458-2824

City of Brooklyn Park
612/425-4502

City of Edina
612/927-8861

City of Apple Valley
612/432-0750

Protecting Solar Access

Solar access protection means protecting southerly roofs, walls, and yards (depending on the desired level of protection) of new and existing buildings from shading by adjacent buildings and trees. Protecting solar access is essential for effective use of solar radiation by active and passive solar systems.

KEY ISSUES

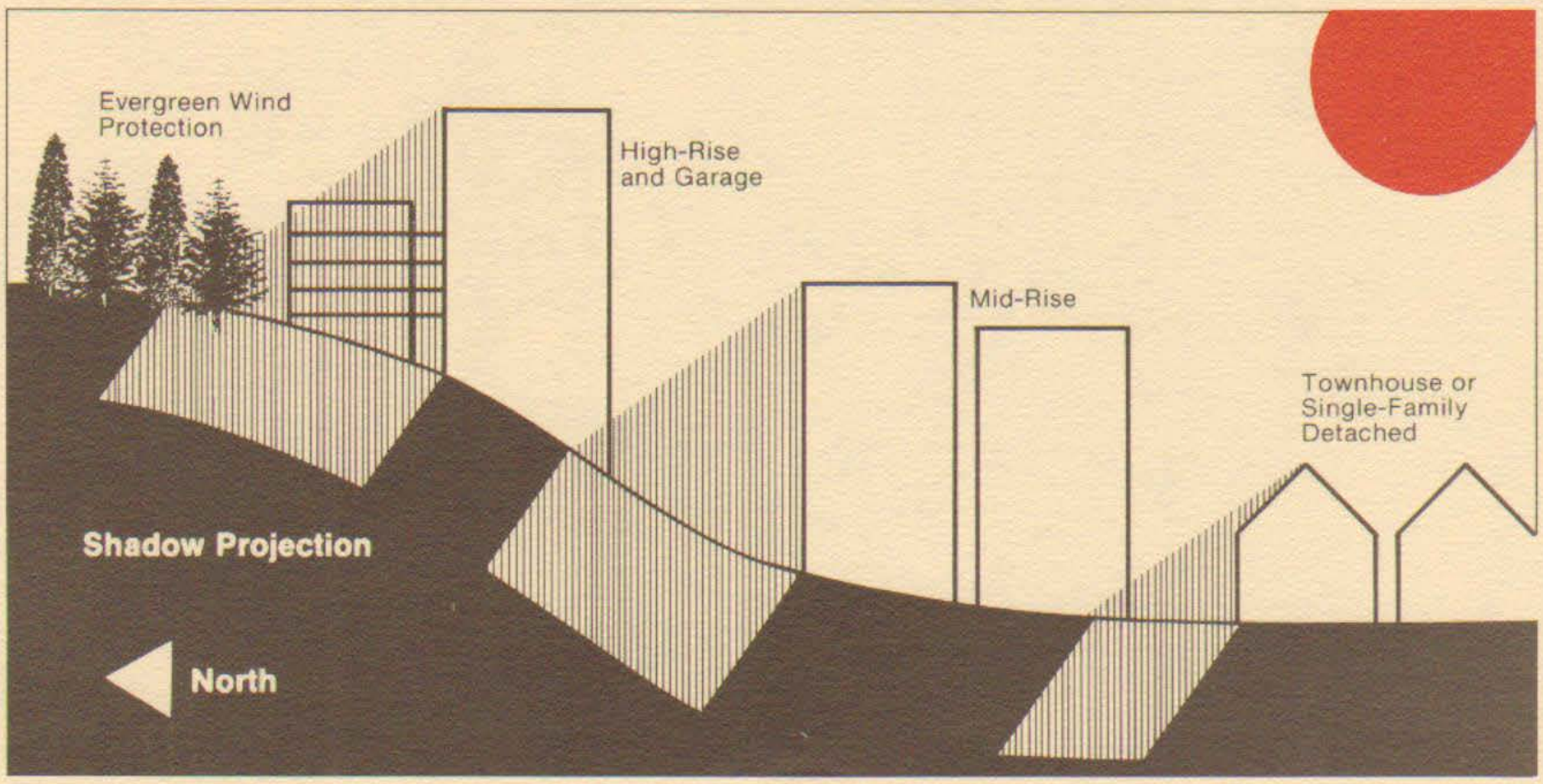
Solar access is an increasingly important issue because the expanding use of solar energy has resulted in cases where development on nearby property shades a solar facility. There is some precedent for using zoning tools to protect solar access. Early zoning laws were often motivated by the concern that development would block light and air flow to adjacent properties. Amendments to the Municipal and County Planning Acts clearly indicate that solar access protection is a valid zoning function in Minnesota. The Metropolitan Land Use Planning Act (applicable in the Twin Cities Metropolitan area) includes a requirement that comprehensive plans include a solar access element. Other legislation outlines how to obtain a solar access easement.

The concept of solar access protection is quite straightforward but writing effective solar access protection provisions that complement other community goals and are not an excessive burden on adjacent development is difficult. Some of the mechanisms that can be used to protect solar access include:

- Removing barriers to the use of solar energy and solar access in existing zoning ordinances and subdivision regulations.
- Modify existing land use control language to provide for solar orientation, changes in height limits, staggered setback requirements, and other solar access protection provisions.
- Incorporate solar access concerns in the site plan review process.
- Encourage citizens to obtain solar easements. A solar easement gives an owner of a solar system limited rights over nearby property. For example, the City of Moorhead engineering department provides assistance with preliminary surveying necessary to obtain a solar easement.
- Encourage solar access protection covenants in new developments.
- Incorporate a solar access permitting process; Minneapolis has a solar access permit ordinance (Minneapolis Zoning Code, Title 20, Ch. 545).

See tool 8.8 for examples of solar access provisions in the City of Moorhead's zoning ordinance and subdivision regulations.

Denser Development is Appropriate for South Slopes



STEPS

Communities interested in solar access protection should take some basic steps:

1. Review pertinent legislation concerning solar access.

MUNICIPAL PLANNING ACT
Zoning authority (M.S. 462.357, Subd. 1)
Zoning variances (M.S. 462.357, Subd. 6)
Subdivision rules (M.S. 462.358, Subd. 2a)
Appeals and Adjustments (M.S. 462.358, Subd. 6)

METROPOLITAN LAND USE PLANNING ACT (Metro Area)
Planning Authority (M.S. 473.05, Subd. 1)
Plan requirement (M.S. 473.859, Subd. 2)

COUNTY PLANNING ACT
Zoning authority (M.S. 394.25, Subd. 2)
Board of Adjustment (M.S. 394.27, Subd. 7)

REGIONAL DEVELOPMENT ACT
Planning authority (M.S. 462.39, Subd. 3)

SOLAR EASEMENTS
(M.S.500.30, Subd. 1-5) - creates authority and guidelines for solar easements

2. Make a general assessment of the feasibility of solar energy use in your community. How many solar systems are currently in place? Check with current and potential solar system owners and local solar dealers to get their views on solar energy potential and on solar access problems.

3. Make a general assessment of potential solar access problems. Consider street orientation and width, height and density limits in zoning ordinances, type and height of tree growth, topography and other natural features in your community.

4. Develop solar energy use and solar access policies and plan.

5. Review current zoning ordinance and remove barriers to solar energy use and solar access.

6. Develop, as necessary, more detailed solar access protection provisions that are appropriate to your community's interest in solar energy and administrative structure using the techniques outlined in the discussion of key issues.

REFERENCES

Solar Access Workbook
Minnesota Energy Agency
Saint Paul, MN
612/296-5120

Planning for Solar Access Protection
Metropolitan Council
Saint Paul, MN

Protecting Solar Access for Residential Development
M. Jaffe and D. Erley
The American Planning Association
1313 E. 60th Street
Chicago, IL 60637

City of Cottage Grove
612/458-2824

City of Brooklyn Park
612/425-4502

City of Edina
612/927-8861

City of Apple Valley
612/432-0750

Wind Machines And Zoning Concerns

Wind energy conversion systems (WECS) convert the motion of the wind into mechanical energy, which can then be converted to electricity, heat or energy that is stored in batteries. Wind machines are commercially available in many sizes and types. Backyard do-it-yourselfers may also build wind machines. Zoning regulations may inhibit or exclude the possibility of constructing wind machines especially in towns and other urban settings.

KEY ISSUES

- Height regulations and wind machines
- Safety and durability of the wind machines
- Noise and other nuisance concerns
- Aesthetics of wind machines
- Use designation of wind machines. Will WECS be considered a permitted use or a conditional use?
- The need for wind speed monitoring and careful site analysis
- Community policy issues about wind machines include desired density of machines, and the possibility of a community encouraging larger, municipally operated WECS instead of residential scale wind machines.

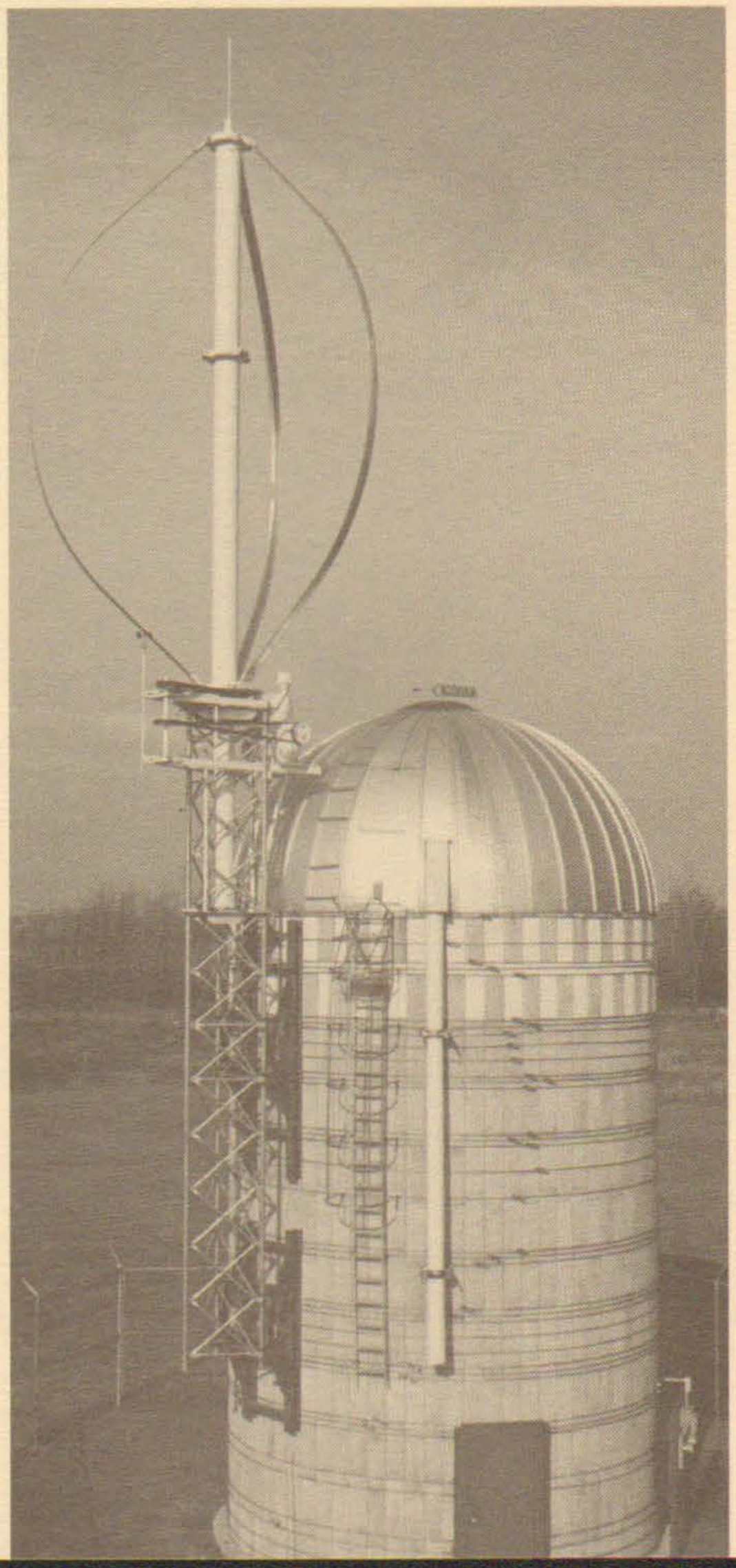
STEPS

1. Become familiar with the basic characteristics of wind machines, horizontal and vertical axis machines, typical sizes and capacities of machines, different designs, etc.

2. Review any available wind speed data (check with local airports, weather bureau, and the Minnesota Energy Agency) and assess the potential for economical operation of wind machines and/or the need for additional wind speed monitoring in your community.

3. Develop a community policy on wind speed monitoring and on any particular size of wind machine that the community wants to encourage.

4. Review existing zoning ordinance and add language, as appropriate, to facilitate safe and efficient wind machine construction.



REFERENCES

Tool 6.2 on Wind Energy

Minnesota Energy Agency, *Wind Machines and Zoning* (Handbook to be completed in Fall, 1981) 612/296-5120

MEA, *Wind Siting Manual* (to be completed Fall 1981)

Earth Sheltered Construction and Zoning

Earth sheltered construction involves using the earth in some aspect of building design. State land use enabling legislation defines earth sheltered as:

...constructed so that more than 50% of the exterior surface area of the buildings, excluding garages and other accessory buildings, is covered with earth and the building code standards, promulgated pursuant to section 16.85, are satisfied. Partially completed buildings shall not be considered earth sheltered.

Zoning and other land use regulations may inhibit construction of earth sheltered buildings. Financing and problems with meeting building codes may also inhibit earth sheltering. The role that a local government can play with regard to zoning concerns is the focus of this tool.

KEY ISSUES

- Basement ordinances and definitions of basements and cellars may exclude earth sheltered construction;
- Interpretation of setback requirements, minimum floor area and lot size requirements, and maximum lot coverage requirements may inhibit earth sheltered construction;
- Earth sheltered construction is a type of construction and not a use. This fact must be kept in mind when revising zoning ordinances.

STEPS

1. Review amendments concerning earth sheltered construction in the Municipal and County Planning Acts.

M.S. 462.357 subdivision 1
M.S. 462.357 subdivision 6
M.S. 394.25 subdivision 3
M.S. 394.27 subdivision 7

2. Assess physical barriers to earth sheltered construction in your community and develop a policy on earth sheltering for inclusion into the comprehensive plan.

3. Review your community's existing zoning ordinance and remove barriers to earth sheltered construction. Add language, as necessary, to insure appropriate control of earth sheltered construction.

REFERENCES

Minnesota Energy Agency, *Earth Sheltered Construction and Zoning Issues* (to be completed in fall 1981)
612/296-5120

Transportation is one of the largest users of energy, and one of the most vulnerable to shortages. Unfortunately, many smaller local government units have little direct control over transportation to the extent that it occurs in private vehicles. These smaller cities can make best use of Tools 2.1, Ridesharing, 2.4, Reduce Transportation Needs, and possibly 2.5, Small Scale Transit. Larger cities can look into Tools 2.2, Paratransit and 2.3, Discourage Downtown Auto Use. All local governments can investigate emergency planning, which is described in Tool 3.7, Contingency Planning, in the Local Government Operations section.

Ridesharing

Ridesharing means increasing the occupancy and hence the efficiency of motor vehicles. Its principal forms are car pooling and van pooling.

KEY ISSUES

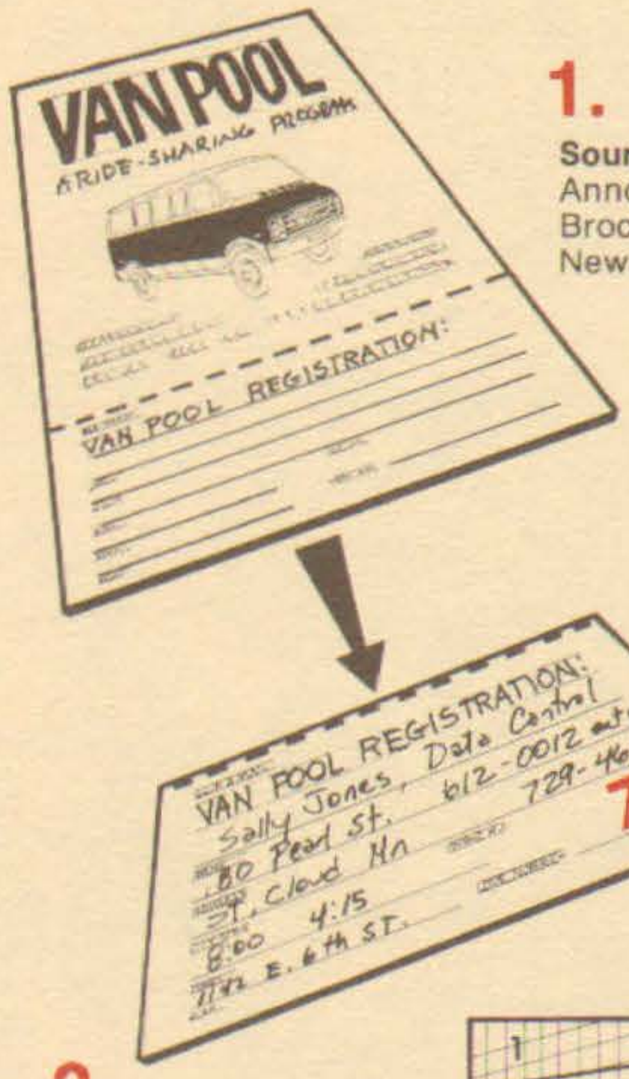
People have been car pooling on an unplanned basis for years. Since the 1973 energy crisis, more and more public and private employers have been providing computer matching services, "ride boards", preferential parking, and other incentives for car pooling.

Van pooling is a newer form of ridesharing in which a separate vehicle, owned by the employer, an employee, or a third party, is used primarily for home to work commuting. Although van pools involve more initial expense and more administrative work, they can carry up to 12 people and save thousands of gallons of gasoline each year. They can be cost effective, too; while each rider pays a share of the costs, it is most often less than what the rider would pay to operate an individual car.

STEPS

Local governments can work with employers, starting with themselves, to help set up car pooling and van pooling programs by:

1. Contacting the Minnesota Rideshare Program for free assistance in setting up matching programs of employees and work places using computers;
2. Advertising and promoting the matching program;
3. Helping to coordinate riders and drivers at key locations, or by setting up special "park'n'ride" lots that combine bus service and ridesharing;
4. Offering free or discounted parking for car poolers and van poolers;
5. Improving parking benefits for van ridesharers; and
6. Setting up restricted traffic lanes for car pools, van pools and buses.



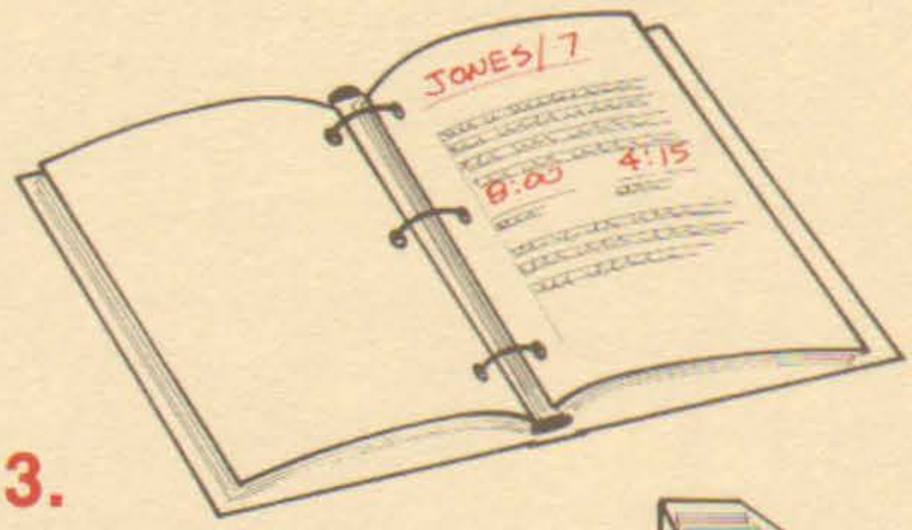
1.

Source Document
Announcement
Brochure
Newspaper Ad

2.

Interest Slip/Coupon
Map Segment Number
Assigned to Vanpool

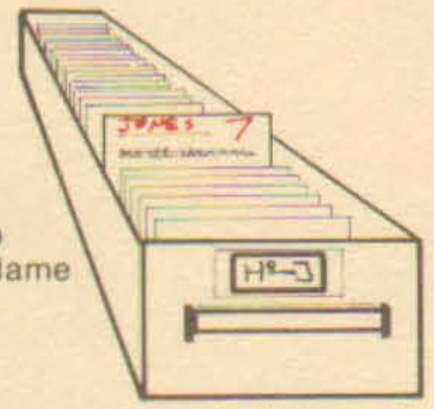




3.

Vanpool Lists
Includes name of geographic area, map segment number, and starting or departure time of vanpool.

Interest Slip
Employee Name
Alpha File



Cross Reference File



4.

Vanpool Formed

Flow Chart, Manual Matching Method

Source: *How Ridesharing Can Help Your Community*
U.S. Department of Transportation, May 1979

REFERENCES

Getting Your Employees to and from Work
July 1980
Available from Minnesota Business Partnership
2406 IDS Center
Minneapolis, MN 55402

Minnesota Rideshare Program
Transportation Building, Room B-23
Saint Paul, Minnesota
612/297-2068

Paratransit

"Paratransit" means anything designed to assist or augment the use of public transportation. Ridesharing is one of the most important forms of paratransit, but other varieties include:

- preferential lanes for buses, car pools and van pools;
- preferential parking for ridesharers; and
- fringe parking coordinated with bus, transit, ridesharing.

KEY ISSUES

These kinds of measures are applicable mainly in larger cities, and those with public transportation systems. Smaller jurisdictions are more suited to basic ridesharing and small scale transit programs.

STEPS

Developing paratransit programs involves the following basic steps:

1. Review existing bus, rail or other public transit systems for opportunities for creating or increasing parking at route terminals.

2. Review road use data from the State Department of Transportation, or use local surveys to determine congested commuter routes; consider preferential bus, car pool, or van pool lanes on these routes.

3. Review existing city-owned or city-regulated parking facilities to asess the feasibility of preferential rates or spaces for car pools and van pools.

4. Encourage local employers to provide parking incentives.

REFERENCES

Cities that have developed paratransit strategies include:

MINNEAPOLIS
The Grant St. Car Pool Ramp allows car pools and buses to use a special freeway ramp during rush hours.

Downtown Dime Zone Bases (for information, contact the Metropolitan Council, Transportation Planning Division 612/291-6308.)

ST. PAUL
Fringe parking near freeways with bus service to downtown (for imformation, contact the City of St. Paul, Downtown Operation Section, Department of Planning and Economic Development 612/292-6258).

FARIBAULT
Never on Tuesday program - "carless" days combined with free transit (for information, contact the Faribault Chamber of Commerce 507/334-4381).

Discourage Downtown Auto Use

Discouraging downtown auto use is a collection of strategies designed to reduce gasoline use, often combined with economic revitalization and environmental protection programs.

KEY ISSUES

Many cities, mostly larger metro cities but also smaller towns, have been upgrading their downtown areas with a combination of commercial redevelopment and street redesign to encourage pedestrian and public transit and limit private cars. Nicollet Mall in Minneapolis is an example of an auto free area designed to enhance the aesthetics and economics of the city center. Discouraging downtown auto traffic can only be economically successful if there is sufficient density of people or commercial establishments to attract people without direct auto accessibility. Mobility, however, can be provided by means of buses, trains, or other forms of mass transit. Other methods of reducing downtown auto use include:

PARKING RESTRICTIONS

Reducing or eliminating parking both on-street and off-street helps keep autos away; this strategy is best combined with a fringe parking/bus service program or other alternatives to encourage people to come downtown without their cars. Increasing parking fees, and structuring parking fees to favor car pools, is another part of this strategy.

SKYWAYS

Minneapolis and St. Paul's skyways are energy savers as well as frostbite protectors. However, they require a downtown density prevalent only in metropolitan areas. Nonetheless, skyways represent a positive commitment to pedestrians, which can also take other forms. Pedestrian malls, small parks, covered bus shelters and other small stops encourage walking instead of driving.

STEPS

The potential for reducing downtown auto use can be investigated by:

1. Inventory public and publicly-regulated parking facilities in the downtown area; survey price structures and (if available) usage patterns.

2. Review local powers to regulate parking practices and rates.

3. Develop a plan to dedicate spaces and/or provide reduced rates for car pools and van pools.

4. Explore strategies for establishing pedestrian malls and auto-less commercial areas.

5. Evaluate principal downtown commercial zones for vehicle restriction potentials:

- survey merchants in potential areas;
- review traffic congestion in potential areas;
- review transit options to compensate for vehicle restrictions;
- develop paratransit and other options to compensate for vehicle restrictions such as fringe parking, special loop buses, etc.

REFERENCES

City of Minneapolis
Planning Department
612/348-2597

City of Saint Paul
Mayor's Office
612/298-4323

City of Saint Cloud
Planning Department
612/251-5541

City of Mankato
Planning Department
507/625-3161

Reduce Transportation Needs

This planning tool is directly related to the land use planning tools (see Tools 1.1 - 1.6) such as discouraging urban sprawl, increasing densities, encouraging mixed land uses and planned unit developments.

KEY ISSUES

Reducing transportation needs should be a part of an overall land use strategy to reduce energy demands, which includes energy used in buildings and in public service networks as well as energy used in transportation. Among the mechanisms that can be used for this purpose are:

"INFILL" STRATEGIES
Using variances or rezoning to relax area requirements for building lots, so that vacant land or small or odd-shaped lots can be used within developed areas;

MIXED USE STRATEGIES
Permitting some kinds of small commercial uses in residential area; this can be achieved through conditional use permits or rezoning; however, parking should be limited on sites so as not to defeat the purpose of reducing car use;

PLANNED UNIT DEVELOPMENT
For new development, encourage a full mix of housing, shopping, schools, and other uses to reduce outside travel needs; encourage on-site employment, or car pools to major employers from the PUD; and

DEVELOPMENT NEAR PUBLIC TRANSIT
Some cities have allowed developers density increases of up to 20% for building near commercial areas or public transportation; also, lot coverage rules and off-street parking requirements were relaxed.

STEPS

Developing strategies for reducing needs for transportation parallels the steps used in Tools 1.1 - 1.6. Review the procedures recommended in these tools, as part of an overall transportation and land use planning approach.

2.4
TRANSPORTATION

REFERENCES

Review Chapter 6 of the text.

See Tools 1.1 - 1.6

Small Scale Transit

Small scale transit is energy efficient mass transportation in areas too small for full scale public transportation systems.

KEY ISSUES

Most cities and towns cannot support a public transportation system; more and more small and medium-sized municipalities have tried out limited transportation programs, such as:

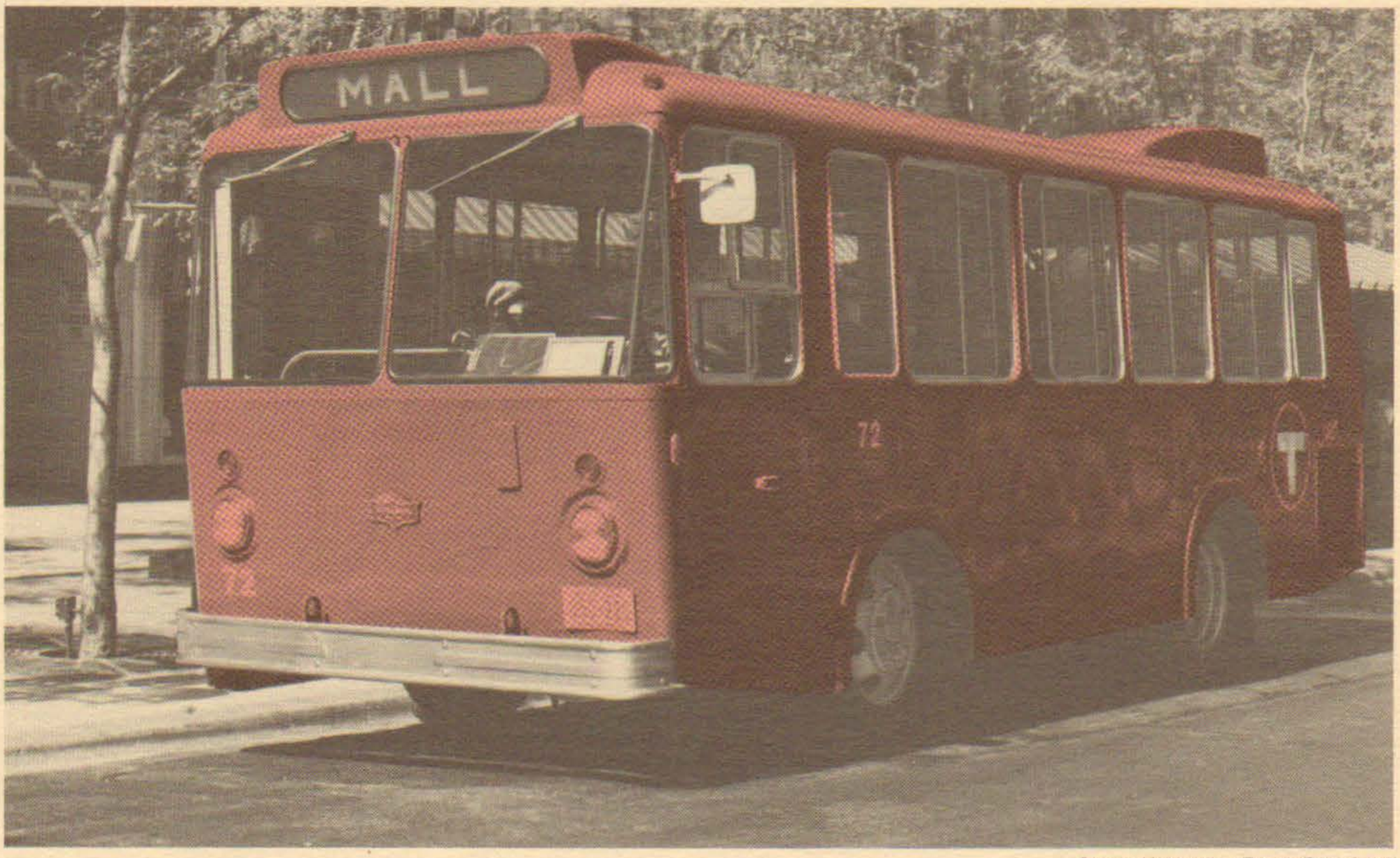
SUBSCRIPTION BUSES
Prepaid, prearranged routing and scheduling, somewhat like van pooling;

JITNEYS
Private cars or taxis that follow transit routes or advertise certain destinations on their visors; operates like a "floating" car pool;

TAXI RIDESHARING
Encouraging taxi stands at busy spots, with ridesharing incentives in the fare structure;

"LOOP" BUSES OR VANS
A few small vehicles traveling frequently on fixed routes can work even in small areas; and

"SPECIALS"
Shoppers or sports specials to major commercial areas, airports, sports or cultural events.



Source: Metropolitan Transit Commission

2.5
TRANSPORTATION

STEPS

To assess a community's potential for small-scale transit, follow these basic steps:

1. Determine whether a public transportation authority exists in the municipality, county, or region.

2. If an authority does exist, contact it to determine the level of service currently provided to the community:

- routes
- frequency
- ridership on routes serving community
- financial status of routes serving community
- long-range plans for service increase/decrease, or route changes

3. Work with the State Department of Transportation, Area Planning Organization, Regional Development Commission, and other planning bodies to assess where present and future travel demands are greatest, such as:

- planned new developments
- current downtown area and future growth areas
- major cities within a regional radius

4. Survey consumer attitudes and interest toward transit, on such variables as:

- age and socioeconomic status of interviewees
- preferred destinations
- preferred type of service
- preferred schedule and frequency
- acceptable fares

5. Based on most heavily traveled routes and on consumer survey, project potential transit service needs, in terms of:

- routes
- type of service
- schedule
- fares

6. If an authority exists, work with it to develop the types of service identified above. If an authority does not exist, investigate the potential for a local or regional authority; also, investigate the potential for private services, by contacting nearby taxi and limousine companies.

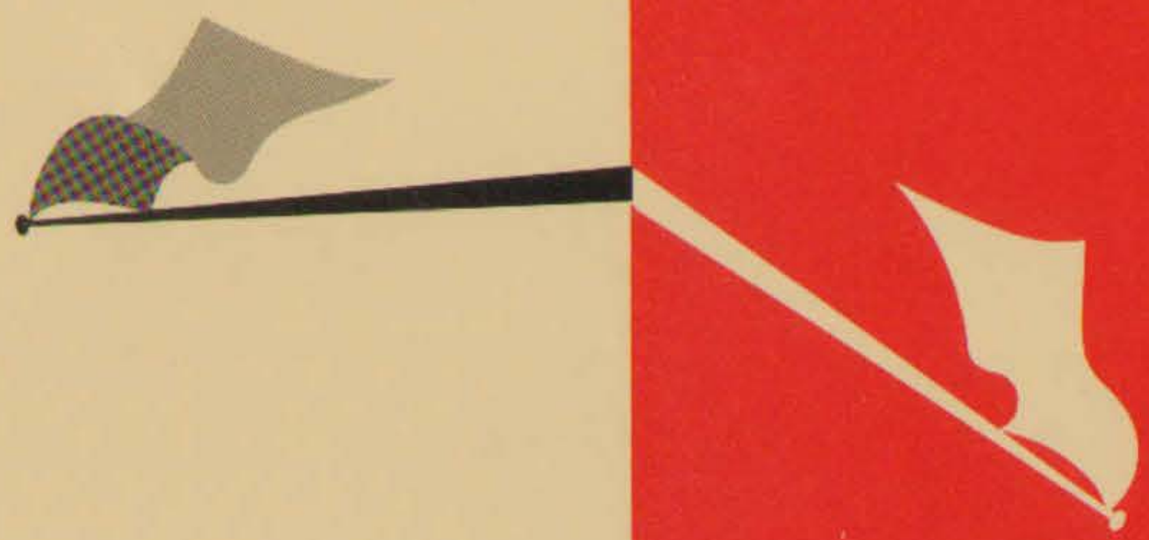
REFERENCES

City of New Ulm
507/359-8233

City of White Bear Lake (for information, contact the Metropolitan Transit Commission 612/221-0939).

City of Faribault
507/334-2222

For general information, contact the Metropolitan Transit Commission
612/221-0939



Many local governments have already made substantial changes in their internal operations, resulting in marked decreases in energy consumption. The tools in this section, while they do not go into great detail, outline the basic techniques which have been used successfully, they also list references to publications and local governments which have more detailed information on specific topics.

The tools deal with areas such as street lights (3.1), fleet management (3.2), buildings (3.3), and water, sewer and solid waste management (3.4, 3.5 and 3.6). They also address contingency planning (3.7), energy accounting (3.8), and purchasing (3.9).

Street Lighting Retrofit

Many cities have sizeable public lighting systems, on streets, in parks, public parking lots, and other non-enclosed spaces. In many cases the city leases its lighting system from a utility which owns and operates it. Newer types of lighting fixtures use 30 to 60% less electricity than conventional mercury vapor lamps. Recent studies project annual cash flow savings of up to 33% from changing to the more efficient fixtures; however, each local government must make an analysis based on its own situation.

KEY ISSUES

The key considerations in street lighting retrofit are:

CAPITAL AVAILABILITY
Tight budget and debt limits may make major investments hard to justify.

CHOICE OF EQUIPMENT
High pressure sodium and low pressure sodium fixtures are the most common alternatives. Low pressure sodium fixtures consume less energy but produce lower quality light. Both fixtures cost more per unit and have shorter lives than mercury lamps — but these costs are more than offset by energy savings. See Figure 10 for a comparison of lamp performance and costs.

UTILITY RELATIONS
Negotiations may be needed whether the system is to be purchased from the utility or some other arrangement is to be made. Annual hours of operation, credits for lamp outages, rate structure, and other issues should be worked out to arrive at an equitable agreement.

STEPS

Undertaking a street lighting retrofit program entails these basic steps:

1. Inventory existing system equipment.
2. Calculate annual costs for energy, maintenance, debt, etc.
3. Evaluate options for eliminating unneeded fixtures. The evaluation should take into account illumination levels as they related to traffic safety.
4. Evaluate alternative fixture types for initial costs, performance, energy costs, and lifetime. Manufacturers/distributors will provide this data.
5. Compare alternatives with current system costs, both capital and operating costs.
6. Examine utility arrangements — rates, lease terms, etc.
7. If a retrofit program looks favorable, prepare a capital budget item proposal.

REFERENCES

Energy Conservation Office, Clearwater, Florida

City of Edina
612/927-8861

Hennepin County
612/935-3381

City of Richfield
612/869-7521

Energy Accounting Procedures Manual for Local Governments and School Districts.
Minnesota Energy Agency, 1981
612/296-8899

For information on traffic safety and illumination standards, contact the Minnesota Department of Transportation, Office of Traffic Engineering
612/296-6164

FIGURE 10

COMPARISON
ANNUAL COST OF BUYING AND OPERATING 25 STREET LAMPS

	Incandescent	Metal Halide	Mercury Vapor	High Pressure Sodium
Cost of Buying and Operating 25 Lamps for a Year	$3100	$1233	$1025	$811
Light Output (Lumens)	15,000	15,000	12,000 (20% less)	16,000 (6% more)
Lamp Life (Hours)	3,000	7,500	24,000	24,000
Watts	750W	175W	250W	150W
Est. Lamp Purchase Cost	$12	$48	$30	$64
ANNUAL COST PER LAMP:				
Electricity	$107.62	$25.11	$35.87	$21.53
Lamp Replacement	$16.40	$25.24	$5.13	$10.93
Total Cost/Lamp/Year	$124.02	$51.35	$41.00	$32.46

Assumptions:

1. Replacement lamp purchase cost based on a manufacturer's 1980 price catalog. A city or utility company probably can purchase lamps in quantity on bid at a lower cost.
2. Electricity price 3.5¢/kwts
3. One year = 4100 operating hours
4. Lamp replacement cost over one year = $\frac{\text{purchase cost}}{\text{lamp life in hours}} \times 4100 \text{ hrs}$

Source: *Energy Accounting Procedures Manual for Local Governments and School Districts*, Minnesota Energy Agency, 1981.

Fleet Management

Fleet management encompasses a number of practices designed to reduce motor fuel use and overall fleet operating costs.

KEY ISSUES

There are several ways to save energy used by vehicles owned by the local unit of government. These include:

PURCHASE ENERGY EFFICIENT VEHICLES

Using life cycle costing analysis, alternatives to current vehicle models can be evaluated. See Figure 11 for a comparison of costs with different vehicle mileages.

INCREASE FLEET OPERATING EFFICIENCY

Several relatively simple principles can be used to increase the overall efficiency of the fleet:

- improve regular maintenance procedures (see Figure 12 for cost impacts);
- reduce unnecessary idling time;
- eliminate or consolidate unnecessary trips;
- reduce the total number of vehicles by consolidating activities or rescheduling.
- promote efficient driving habits

IMPROVE FUEL ALLOCATION PROCEDURES

Some cities have implemented "credit card" or manual systems for controlling motor fuel dispensing. This kind of system can be used to reduce unnecessary fuel use and to make and monitor fuel use budgets.

ALTERNATIVE VEHICLE FUELS

Several alternative fuels are being experimented with. In summary, some of their key features are:

- diesel — available now, lower cost, higher mileage, less acceleration, worse emission problems;
- gasohol — rapidly growing, slightly higher cost, lower energy content, some problems with separation and condensation;
- natural gas — used by General Services Administration, clean, relatively cheap, lower performance, requires special equipment, fuel storage and handling, can use gas from sewage plants;
- electric vehicles — several successful prototypes, limited in range, more assured fuel supply. Minnesota Department of Transportation currently uses an electric van for some deliveries within the Metropolitan area.

FIGURE 11

ESTIMATED ENERGY COST SAVINGS OVER 10,000 MILES

(Switching to a More Efficient Vehicle)

MPG of New Vehicle	MPG of Vehicle Being Replaced			
	10	12	14	16
18	$533	$333	$190	$ 83
20	$600	$400	$257	$150
22	$655	$454	$311	$204
24	$700	$500	$357	$250
26	$738	$538	$395	$288
28	$771	$571	$428	$321
30	$800	$600	$457	$350

Assumptions: unleaded gasoline @ $1.20/gallon

Source: *Energy Accounting Procedures Manual for Local Governments and School Districts*, Minnesota Energy Agency, 1981.

FIGURE 12

ENERGY COST SAVINGS WITH PROPER VEHICLE MAINTENANCE

Original	Gasoline Mileage		
	24	20	16
Poorly tuned engine (spark plug misfiring, bad timing, carburetor dirty) 20%	19.2	16.0	12.8
Wheels need alignment 0.3 mpg	18.9	15.7	12.5
Tires underinflated causing high rolling resistance 1 mpg	17.9	14.7	11.5
Energy Savings Over 10,000 Miles With Proper Maintenance	$170	$216	$293

Assumptions: Gasoline at $1.20/gallon

Source: *Energy Accounting Procedures Manual for Local Governments and School Districts*, Minnesota Energy Agency, 1981.

3.2
LOCAL GOVERNMENT OPERATIONS

STEPS

Fleet management practices should be approached in a general procedure such as the following:

1. Inventory current fleet, including the number, type, and age of vehicles.

   Review current maintenance procedures, including accounting and scheduling procedures.

3. Review current operating patterns to determine whether trips can be consolidated or avoided, idling time reduced, or the number of vehicles reduced.

4. Review fuel allocation procedures to identify opportunities for better reporting, mileage performance, etc.

5. Review alternative fuel options in replacing some or all of the fleet, including diesel fuels, alcohol fuels, natural gas, and electric vehicles. Contact local dealers for estimates on diesel vehicles and alcohol fuels; contact the Minnesota Energy Agency or Minnesota Department of Transportation for more information on natural gas Minnesota vehicles, electric vehicles, and other new technologies.

6. Implement driver education programs for employees.

REFERENCES

Other States

City of Huntsville, Alabama
205/532-7000

Dade County, Florida
Fuel Management Program
305/532-7468

Greensboro, North Carolina
Vehicle Management Committee
City of Greensboro
Drawer W-2
Greensboro, NC 27402
919/373-2002

Motor Equipment Division
City of Toledo
2411 Albion Street
Toledo, Ohio 419/247-6408

Minnesota Cities

Edina
Engineering and Public Works
612/927-8861

Hennepin County Public Service Bureau
612/935-3381

New Ulm
507/359-8233

City of Hopkins
Public Works Department
612/935-8474

Minnesota Members of the Voluntary Truck, Bus, and Fuel Economy Program:

- Motor Vehicle Manufacturers Association
  612/224-4366
- U.S. Department of Energy
  Program Coordination Contractor
  Coleman and Christison Advertising Agency
  612/227-9391
- Minnesota Department of Transportation
  612/296-8530
- Minnesota Energy Agency
  612/296-5175

Building Energy Audits

Almost every local government owns buildings of one variety or another, and all buildings use energy in various forms. One of the first and most common steps governments have taken in responding to the energy crises is conducting energy audits in their buildings. In Minnesota, all public buildings are now required to conduct energy audits.

STEPS

What is an energy audit? It has several components:

1. Develop a historical energy profile from the previous year's energy bills.

2. Inventory the building's energy using equipment, their rated capacity, and normal hours of operation.

3. Survey the energy using equipment for:

- operating efficiency improvements
- proper scheduling
- potential for retrofit
- potential for replacement

4. Calculate energy and dollar saving potentials from implementing efficiency measures.

5. Calculate cost to implement and operate energy saving measures.

6. Prioritize measures by simple payback. Divide total first cost by expected annual savings (minus annual operating costs, if applicable); the result is simple payback in years.

7. Develop implementation plan, including:

- recommended measures
- cost and payback estimates
- source of funding (operating budget, capital budget, etc.)
- needed training for personnel
- needed publicity
- system for monitoring performance via future energy bills

On the following page is a partial checklist of the energy conservation measures that are most often cost effective.

REFERENCES

The Minnesota Energy Agency's Institutional Buildings Grants Program
612/296-1882

Mini-Audit Manual and *Maxi-Audit Manual*

Edina
612/927-8861

Hopkins
612/934-8474

A Guide to Reducing Energy Budget Costs National League of Cities, Washington D.C.

Total Energy Management
National Electrical Contractor's Association
7315 Wisconsin Avenue
Washington, D.C. 20014
301/657-3110

Energy Conservation and Management Guide for Small Municipalities and School Districts
Southeast Georgia Planning Commission
P. O. Box 2049
Waycross, Georgia 31501
912/285-6097

BUILDING ENERGY MANAGEMENT CHECKLIST

LIGHTING

1. Change incandescent fixtures to flourescent.
2. Replace flourescent tubes with lower wattage tubes (Watt-Miser, etc. - 40 watts to 35 watts).
3. Disconnect unneeded fixtures — check spaces with light meter against Illuminating Engineering Society Standards (IES) — especially corridors.
4. Change from area lighting to task lighting, using IES standards.
5. Install timers in limited use areas, storage, etc.; set to turn off after a short interval or in known unoccupied periods.
6. Clean fixtures, reflectors and lenses, regularly.

HVAC

1. Reduce space temperatures in winter, increase in summer (68°F - 78°F).
2. Set back temperatures during unoccupied periods.
3. Make space temperature controls tamper proof.
4. Reduce ventilation volumes to minimum by reducing fan speeds.
5. Reduce use of outside air except in moderate weather.
6. Eliminate terminal reheat coils.
7. Increase boiler efficiency by stack testing, burner adjustment, water treatment, etc.
8. Reduce hot water temperature to 120°F or lower.

MORE EXPENSIVE MEASURES

- Install enthalpy controls on HVAC intake ducts.
- Install variable speed fan motors and make air system variable volume.
- Increase return air quantity with additional ducting.
- Reclaim heat from boiler stack, blowdown, condensate.
- Reclaim heat from HVAC exhaust ducts.
- Reclaim heat from lighting fixtures.

BUILDING SHELL

1. Reduce air leaks around windows, doors, pipe joints.
2. Double glaze windows and glass doors.
3. Use reflective film on exposed windows.
4. Add insulation to:
   ceilings and roofs
   walls
   exposed floor areas
5. Use blinds, curtains for controlling solar heat gain.

Energy Conservation Through Water and Waste Reduction

Waste reduction is the process of preventing waste before it occurs. Similary, water reduction is a process of preventing or minimizing the use of water. Through the 1960's and 1970's the generation of waste per person in Minnesota rose steadily, even faster than the overall rate of consumption. This rise in the quantities of waste generated has been for the most part unnecessary and has substantially increased consumption of energy and natural resources. The rapid growth of waste, however, can be curbed on a community level in an effort to conserve energy and natural resources.

Water reductions can save energy by reducing pumping and water treatment.

KEY ISSUES

WATER

The main energy use in water systems is for pumping, although the production of chemicals used for treatment requires considerable amounts of energy. Energy saving options include:

- a water conservation publicity campaign to reduce water volume pumped;
- distribution of free showerhead flow restrictors, possibly combined with a publicity campaign as above;
- revising water rates to discourage excessive use;
- revising pumping operations to avoid high peak electric demand, lower power factors, and unnecessary run time (see reference below).

SEWAGE

Wastewater pumping and treatment embodies energy saving potentials in such areas as:

- reducing unnecessary pumping through better scheduling and process control;
- avoiding high peak electric demand through coordinated scheduling of process operations and pumping;
- reducing overuse of treatment chemicals and aerators through process controls;
- recovering methane gas from sewage digestors (see Tool 3.6 "Energy Recovery from Solid Waste & Sewage Sludge", for more details).

SOLID WASTE

Solid waste and sanitation operations can be conducted with less energy through practices such as:

- efficient vehicle routing;
- reduced vehicle idling time;
- minimizing weekly pickups;
- waste reduction through recycling (see Tool 3.5, "Energy Conservation Through Recycling and Composting", for more details);
- reducing disposal costs through alternatives to traditional landfilling.

VOLUNTARY WASTE REDUCTION AND PUBLIC EDUCATION

Voluntary waste reduction is a non-regulatory, inexpensive means of waste reduction, entailing development and promotion of waste reduction information and ethics.

VARIABLE GARBAGE CAN RATE

The variable garbage can rate is an energy-efficient way to reduce solid waste, by billing for garbage collection according to the number of cans that each household fills per week. In Seattle, the monthly single family rates for 1981 are:

0 cans	- $1.00
1 can	- $6.40
each additional can	- $1.50 added to the one-can rate.

Thus, citizens may reduce their rates for disposal if they so choose.

OFFICE PAPER REDUCTION

Office paper reduction could result in the savings of 10,000 tons of office paper per year in Minnesota, equal to 500 billion BTU's at the point of manufacture.

DEPOSIT PROGRAM

Deposit programs result in an extra charge to the consumer to encourage re-use of a product. When the reusable portion of the product is returned, the deposit is refunded. Deposit programs can be enacted by local ordinance to regulate the amount of energy and natural resources buried in the landfill. A shift to a refillable system, or a system in which non-refillables are available for recycling will result in significant energy savings. The General Accounting Office has documented energy savings with the deposit system citing up to a 30% reduction in energy use in manufacture and distribution.

PACKAGING PROGRAM

Packaging consumes a large portion of our energy and natural resource base. Community programs can operate to require labeling that identifies energy efficient packaging. Public education programs can inform the public of the energy inefficiency of much packaging. The Minnesota Pollution Control Agency is starting a packaging program in September of 1981.

STEPS

Reducing energy use in water, sewer and sanitation operations involves the following basic steps:

1. Establish a city or county task force of citizens and staff to initiate action. Past experience indicates that such a task force has been the most effective first step in establishing waste and water reduction programs.

2. Inventory current operations:

- water — pump stations, treatment facility, energy used in recent years, water pumped in recent years;
- wastewater — collection system, pump stations, treatment plant equipment, energy used in recent years, wastewater treated in recent years;
- solid waste — packaging program, voluntary waste reduction, office paper reduction, variable garbage can rate, deposit program, vehicle routing and scheduling, collection and hauling efficiencies.

3. Evaluate current operations for potential application of the energy-saving options described above.

4. Estimate potential energy savings from feasible conservation measures, and potential costs to implement and maintain the conservation measures.

5. Calculate simple payback: divide annual energy savings (minus annual operating costs) by total cost of purchased installation. The result is a simple payback period in years.

6. Develop an implementation program that specifies measures to be enacted and includes procurement requirements (bids, specifications, etc.), schedule (for budget inclusion), and funding source (maintenance budget, capital improvement program, etc.).

REFERENCES

Energy Conservation in Municipal Wastewater Treatment by the U.S. Environmental Protection Agency available from:

Centralized Mailing List Services
Federal Services Administration
Building 41, Denver Federal Center
Denver, Colorado 80225

Energy Conservation Manual for Water and Wastewater Facilities
University of Wisconsin-Extension
Department of Engineering and Applied Science
Madison, Wisconsin

Proposed Policies for Waste Reduction in California, Solid Waste Mgmt. Board, 1976.
California State Solid Waste Management Board
1709 11th Street
Sacramento, CA 95814
916/322-3330

Metropolitan Council, 612/291-6546.

Choices for Conservation, Resource Conservation Committee, Final Report to the President and Congress. July 1979.
Office of Solid Waste Management
Environmental Protection Agency
Waterside Mall Building
401 M St. SW
Washington, D.C. 20460
202/755-9140

MPCA, Solid and Hazardous Waste Division, 612/297-2724.

California Office of Water Conservation
1416 9th Street, Room 816
Sacramento, CA
916/322-5234

Energy Conservation Through Recycling and Composting

Recycling is recovering and reusing materials that have been disposed of by individuals, businesses, and industries into the solid waste stream. Materials that are currently economical to recycle include paper, glass, and metals, particularly ferrous metals and aluminum. Recycling process can vary but the most efficient system is for recyclables to be separated at the source. In other words a source separation program is for recyclable materials to be separated at their source — homes, offices, etc. — before entering the waste stream. Recyclables must then be collected and processed.

Composting is the controlled biological decomposition of organic residues, solid waste, sewage sludge, or a combination of sludge and solid waste. The end result of composting is a humus like material that is a valuable soil amendment and source of plant nutrients. Composting operations of many different sizes and types are possible, including individual backyard compost piles, neighborhood composting of yard and vegetable wastes, centralized composting of leaf and yard waste collected by the community and centralized co-composting of leaf and yard waste collected by the community and centralized co-composting of solid waste with sewage sludge.

The purpose of recycling and composting is to save money, energy, and other natural resources. Land requirements for waste disposal can also be reduced. Recycling and composting projects should occur in conjunction with waste reduction programs. See Tool 3.4 for additional information.

KEY ISSUES

- Financial savings are a significant motivation for recycling and composting projects. For example, Roseville, Minnesota realized an across-the-board savings of approximately $61,000 in 1980 by composting leaves rather than disposing of them in a landfill
- Recycling and composting are also considered to be cost effective both in terms of up front and operating costs.
- Market analysis to determine the demand for recyclables, compost, and any other by-products is essential to insure economic operation.
- Energy savings will result from reusing recycled materials because the need for energy input into manufacture of new products will be reduced. Also, transportation energy necessary for travel to landfills will be reduced.
- Reducing the need for additional landfills will reduce land use and environmental conflicts that arise when siting landfills.
- Recycling and composting programs must be workable for individuals in the community. For example, there must be public acceptance of whatever method of recyclable collection is chosen, (drop-off center, curbside collection, or other options).
- Publicity and public education should accompany recycling or composting projects.

STEPS

1. Identify markets and develop marketing strategies.

- Contact potential buyers.
- Determine what will be recycled and collected for composting.

2. Determine method of collection.

- For recycling consider a drop-off center, on-call collection, curbside or commercial collection, or buy-back programs. Coordinate with local haulers and charities to resolve conflicts.
- For composting consider drop-off centers for organic wastes, especially leaves, or leaf pick-up in spring and fall possibly with a special vacuum-equipped truck.

3. Determine processing needs.

- Select a site. For example, community scale composting of leaf and yard waste requires a well drained site of approximately one acre for every square mile of town served.
- Processing methods; for example careful evaluation of different composting methods is necessary to insure selection of a process suitable for the feedstock, available equipment, expertise of personnel, and space available.
- Collection and storage containers.
- Equipment.
- Labor: who will manage the project and how?

4. Determine type and amount of publicity and public education efforts. (School programs, public displays, newspapers, television, radio, etc.)

REFERENCES

Minnesota Pollution Control Agency
Solid Waste Division
612/297-2734

Institute for Local Self-Reliance
1717 18th St., N.W.
Washington, D.C. 20009
202/232-4108

BioCycle: Journal of Waste Recycling (Composting only)
JG Press Box 351
Emmaus, Pa 18049
Jerome Goldstein, editor
215/967-4135

City of New Brighton (Composting only)
612/633-1533

St. Paul Citizen Participation Planning District 12
(Community District 12, St. Anthony Park) (Composting only)
612/646-8884

City of Seattle, Washington (Composting only)
206/367-4576 or
206/367-5177

Ramsey County Environmental Health Division
612/298-5972

Energy Recovery from Solid Waste and Sewage Sludge

Energy recovery potentials exist for both solid waste and sewage sludge. Solid waste contains approximately 4600 BTUs per pound. Recovery of methane gas at sewage sludge treatment facilities can yield approximately 500,000 BTUs per person per year. For both solid waste and sewage sludge, there are two means of recovering energy — incineration and digestion with methane recovery. Energy can be recovered through a variety of incineration methods. Net energy gains generally result from incinerating solid waste. Sewage sludge incineration, however, can at best recover some of the energy needed to dewater sludge before incineration.

Digestion with methane recovery is a means of waste treatment that relies on microorganisms to consume the waste material and produce methane and carbon dioxide as by-products. Solid waste, sewage sludge, or both together are all suitable feedstocks for digestion. An additional benefit of digestion is that the remaining residue is a humus-like material similar to compost in plant nutrient value. This residue can be applied on land and used as compost.

KEY ISSUES

- Both incineration and digestion systems are expensive.
- More energy can usually be recovered through waste reduction, composting, and recycling methods on a per ton basis than can be recovered through energy recovery. Not all wastes can be economically reduced, recycled, or composted, however, so opportunities for energy recovery may exist.
- Incineration methods of energy recovery will increase air and water pollution in the local area. Digestion methods should have fewer environmental problems than incinceration methods since digestion primarily emits water, carbon dioxide, and methane.

STEPS

1. The first step in evaluating energy recovery from solid waste and sewage sludge is to establish a waste reduction program. Reducing waste flows is a vital materials and energy conservation step that should occur before energy recovery from wastes is considered. See Tool 3.4 for additional information.

2. The second step is to evaluate materials recovery, source separation, recycling, and composting programs as compared to energy recovery options. Evaluation should consider technical and economic feasibility including an analysis of market potentials for recycled materials, compost, and energy resources that would be available through digestion or incineration. Economic analyses should also include estimates of capital and operation costs for the variety of possible options. Finally, public acceptance and environmental concerns should be considered. See Tool 3.5 for additional information.

3. Contact the Solid Waste Division of the Minnesota Pollution Control Agency for assistance in beginning feasibility studies on energy recovery from solid wastes and sewage sludge. The MPCA has technical assistance documents and personal assistance available.

REFERENCES

Minnesota Pollution Control Agency, Division of Solid Waste
612/297-2734

BioCycle: Journal of Waste Recycling, the JG Press Box 351
Emmaus, PA 18049
Jerome Goldstein, editor
215/967-4135

Institute for Local Self-Reliance
1717 18th St., N.W.
Washington, D.C. 20009
202/232-4108

Contingency Planning

Contingency planning is preparing for energy emergencies — gasoline shortages, heating fuel shortages, etc. More than once in recent years, states and communities have had to mobilize to meet energy shortage emergencies. This has pointed out the need for planning for such contingencies.

KEY ISSUES

The elements of contingency planning include:

- developing reserve storage capacity;
- buying fuel supplies strategically, using seasonal variations in supply and price;
- prioritizing energy uses for curtailment;
- developing allocation formulas for different activities;
- developing emergency transporation procedures;
- developing emergency building operating procedures;
- developing emergency municipal service curtailment plans.

Most planning to date by local governments has been for gasoline, but natural gas, heating oil, and electricity shortages have also been felt.

STEPS

Some basic steps are involved in developing a local contingency plan:

1. Evaluate the local government's legal authority to control energy use and supply.

2. Review state emergency plan requirements.

3. Assemble key actors — utility fuel dealers, business leaders, community leaders — and organize a task force and steering committee.

4. Use task force structure to develop a plan.

5. Obtain adoption of the plan by the official governing body.

6. Implement the plan via department memos, public seminars, drills, etc.

7. Periodically review and update the plan based on changes in the energy use and supply situation, and state rules.

The State Energy Agency published rules on its State Emergency Energy Plan in the March 9, 1981 State Register. It contains a number of measures affecting local governments, including employer conservation measures, school conservation measures, and others.

REFERENCES

Minnesota State Energy Agency
612/296-5120

Energy Accounting

Energy accounting is a set of methods for collecting, evaluating, and reporting energy use and cost data for buildings, vehicles, or other operating units. Every energy management program benefits from a system that allows management to evaluate the effectiveness of programs on an ongoing basis.

STEPS

Setting up an energy accounting system has several phases:

1. Taking inventory of all energy supply accounts from utilities, dealers, etc.;
2. Taking inventory of all major energy consuming facilities and functions;
3. Allocating supply accounts to energy — using functions;
4. Developing a baseline profile on energy use and cost by facility, function, department, or other desired categories;
5. Performing periodic calculations, usually monthly, for each functional unit identified in phases 2 and 4;
6. Evaluating period performance against the baseline, or a target, for each functional unit;
7. Performing annual review and rebudgeting of energy use and cost targets and performance.

REFERENCES

The Minnesota Energy Agency has commissioned an *Energy Accounting Procedures Manual for Local Governments and School Districts*, which takes the user through the above process, and provides specific forms and procedures for energy accounting in buildings, vehicles, street lights, and special functions like water and sewer utilities. Call the Energy Agency at 612/296-8899 for more information or to obtain a copy of the accounting procedures manual.

Energy-Efficient Procurement

The items that a local government purchases, from paving material to air conditioners, all use energy in two ways: the energy used to make the product and the energy used to operate it. The former energy is "invisible" to the buyer, except to the extent that the cost of the energy shows up in the cost of the product. The buyer can reduce energy consumption by purchasing products which use less energy in manufacture, particularly recycled products. The latter kind of energy the buyer pays for directly, and it is this kind that procurement practices can be used to control.

KEY ISSUES

Purchasing practices affect energy costs in several ways:

- traditional "lowest-bidder" policies may not select the most energy-efficient product;
- energy bill review practices may not capture billing errors, better rate opportunities, volume discounts, seasonal discounts, etc.;
- "life-cycle costing", payback analyses, and other analytical techniques can help capture the energy impact of purchasing practices. (See sample of life-cycle costing methods.)
- procurement specifications may prohibit purchase of recycled materials by including requirements for "virgin only", brightness or dirt counts, etc.

STEPS

1. Review current purchasing policies to determine whether energy costs and other long-term operating costs are included in purchasing decisions and to identify barriers to the purchase of products containing recycled materials.

2. Revise policies as needed to capture energy cost impacts, by using life-cycle costing, payback analyses, etc.

3. Review fuel purchasing practices to see if discounts are available for larger volume purchases, or purchases in the off season. This requires ensuring that storage capacity is adequate, or can be expanded.

4. Review purchasing policies to eliminate products which are contaminated with materials which reduce or eliminate recyclability. For example, plastic- or glycene-windowed envelopes, non-recyclable glues, dyed paper, and hot melt adhesives result in a contamination of recycled paper products.

LEGISLATIVE REFERENCE LIBRARY
STATE OF MINNESOTA

REFERENCES

Energy Efficient Purchasing for Local Governments
Institute of Government
Terrell Hall
University of Georgia
Athens, Georgia 30602
$7.50 (Limited copies may be available at a reduced price from the Minnesota Energy Agency, Community Outreach Program.
612/296-5120

State Government Programs for Waste Reduction, Procurement, Reuse and Recycling. Biannual Recommendation to the Commissioner of the Minnesota Department of Administration, MPCA, July 1, 1980.

Collection of Data Pertinent to the EPA's Development of Guidelines for Government Procurements of Paper Products Containing Recycled Materials. EPA, SW-179C, September, 1979.

Minnesota Pollution Control Agency
Solid and Hazardous Waste Division
612/297-2724

EXAMPLE LIFE CYCLE COSTING WORKSHEETS

1. LIFE CYCLE COST DATA

LINE	REQUIRED INFORMATION	SOURCES
1. $ 3,800	PURCHASE PRICE	DEALER: EQUIPMENT SUPPLIER
2. 30,000 MI	EXPECTED ANNUAL MILEAGE	DEPARTMENT HEADS
3. 3 YRS	NUMBER OF YEARS VEHICLE TO REMAIN IN FLEET	VEHICLE RECORDS
4. $ 500	EXPECTED RESALE (SALVAGE) VALUE OF VEHICLE AT RETIREMENT	DEALER ESTIMATE DEPARTMENT HEADS VEHICLE RECORDS
5. 5 %	DISCOUNT RATE	LOCAL POLICY
6. 10 MPG	VEHICLE FUEL ECONOMY	EPA MILEAGE RATING (CITY)
7. $ .50	PRICE OF FUEL PER GALLON	LOCAL FUEL DEALER
	OPTIONAL INFORMATION	
8. $ 1,020	EXPECTED ANNUAL MAINTENANCE COST	VEHICLE RECORDS
9. $ 0	ANNUAL INSURANCE COST	VEHICLE RECORDS
10. $ 0	OTHER ANNUAL COST	VEHICLE RECORDS

2. ANNUAL OPERATING COSTS

LINE		
1. ENTER the expected annual mileage (line 2, worksheet 1)		30,000 MI
2. ENTER the price of fuel per gallon (line 7, worksheet 1)	X	$ .50
3. MULTIPLY and enter the result		15,000
4. ENTER the fuel economy of the vehicle in miles per gallon (line 6, worksheet 1)		.10 MPG
5. DIVIDE the result in line 3 by the fuel economy in line 4 and enter the result		$ 1,500 ANNUAL FUEL COST
6. ENTER the annual maintenance cost (line 8, worksheet 1)		$ 1,020
7. ENTER the annual insurance cost (line 9, worksheet 1)		$ 0
8. ENTER miscellaneous annual costs (line 10, worksheet 1)		$ 0
9. ADD the costs of lines 5-8 and enter the result		$ 2,520 ANNUAL OPERATING COST

EXAMPLE LIFE CYCLE COSTING WORKSHEETS

3. PRESENT WORTH OF FUTURE OPERATING COSTS AND SALVAGE VALUE

LINE		
1.	ENTER the number of years the vehicle is to remain in the fleet (line 3, worksheet 1)	3 YRS
2.	ENTER the acceptable discount rate (line 5 worksheet 1)	5 %
3.	SELECT an operating cost discount factor in table A using the values specified in lines 1 and 2	
4.	ENTER the appropriate discount factor from table A	2.723
5.	ENTER the annual operating cost (line 9, worksheet 2)	$ 2,520
6.	MULTIPLY lines 4 and 5 and enter the result	$ 6,262 TOTAL OPERATING COST
7.	SELECT a salvage value discount factor in table B using the values specified in lines 1 and 2	
8.	ENTER the appropriate salvage value discount factor from table B	.8638
9.	ENTER the resale value of the vehicle (line 4, worksheet 1)	$ 500
10.	MULTIPLY lines 8 and 9 and enter the result	$ 422 DISCOUNTED SALVAGE VALUE
11.	SUBTRACT the discontinued salvage value (line 10) from the total operating cost (line 6) and enter the result	$ 6,430 NET VEHICLE OPERATING COST

TABLE A
DISCOUNT RATE

YR	3%	4%	5%	8%	10%
1	0.971	0.962	0.952	0.926	0.909
2	1.913	1.866	1.859	1.783	1.736
3	2.829	2.755	2.723	2.577	2.487
4	3.717	3.630	3.546	3.312	3.170
5	4.580	4.452	4.329	4.623	3.791
6	5.417	5.242	5.076	5.206	4.355
7	6.230	6.002	5.786	5.747	4.868

TABLE B
DISCOUNT RATE

YR	3%	4%	5%	8%	10%
1	.9709	.9615	.9524	.9259	.9091
2	.9426	.9246	.9570	.8573	.8264
3	.9151	.8890	.8538	.7938	.7513
4	.8885	.8548	.8227	.6805	.6830
5	.8626	.8219	.7835	.6302	.6209
6	.8375	.7903	.7462	.5835	.5645
7	.8131	.7599	.7107	.5403	.5131

4. COMPUTE LIFE CYCLE COST

LINE		
1.	ENTER the purchase price of the vehicle (line 1, worksheet 1)	$ 3,800
2.	ENTER the net vehicle operating cost (line 11, worksheet 3)	$ 6,430
3.	ADD lines 1 and 2 and enter the result	$ 10,230 LIFE CYCLE COST
	OPTIONAL	
4.	ENTER the number of years vehicle is to remain in fleet	3 YRS
5.	DIVIDE line 3 by line 5 and ENTER the result	$ 3,410 ANNUAL AVERAGE LIFE CYCLE COST

Source: Energy Management in Municipal Vehicles. U.S. Dept. of HUD, 1977.

LIFE CYCLE COSTING WORKSHEETS

1. LIFE CYCLE COST DATA

LINE	REQUIRED INFORMATION	SOURCES
1. $_____	PURCHASE PRICE	DEALER: EQUIPMENT SUPPLIER
2. _____ MI	EXPECTED ANNUAL MILEAGE	DEPARTMENT HEADS
3. _____ YRS	NUMBER OF YEARS VEHICLE TO REMAIN IN FLEET	VEHICLE RECORDS
4. $_____	EXPECTED RESALE (SALVAGE) VALUE OF VEHICLE AT RETIREMENT	DEALER ESTIMATE DEPARTMENT HEADS VEHICLE RECORDS
5. _____ %	DISCOUNT RATE	LOCAL POLICY
6. _____ MPG	VEHICLE FUEL ECONOMY	EPA MILEAGE RATING (CITY)
7. $_____	PRICE OF FUEL PER GALLON	LOCAL FUEL DEALER
	OPTIONAL INFORMATION	
8. $_____	EXPECTED ANNUAL MAINTENANCE COST	VEHICLE RECORDS
9. $_____	ANNUAL INSURANCE COST	VEHICLE RECORDS
10. $_____	OTHER ANNUAL COST	VEHICLE RECORDS

2. ANNUAL OPERATING COSTS

LINE		
1.	ENTER the expected annual mileage (line 2, worksheet 1)	_____ MI
2.	ENTER the price of fuel per gallon (line 7, worksheet 1)	X $_____
3.	MULTIPLY and enter the result	_____
4.	ENTER the fuel economy of the vehicle in miles per gallon (line 6, worksheet 1)	_____ MPG
5.	DIVIDE the result in line 3 by the fuel economy in line 4 and enter the result	$_____ ANNUAL FUEL COST
6.	ENTER the annual maintenance cost (line 8, worksheet 1)	$_____
7.	ENTER the annual insurance cost (line 9, worksheet 1)	$_____
8.	ENTER miscellaneous annual costs (line 10, worksheet 1)	$_____
9.	ADD the costs of lines 5-8 and enter the result	$_____ ANNUAL OPERATING COST

LIFE CYCLE COSTING WORKSHEETS

3. PRESENT WORTH OF FUTURE OPERATING COSTS AND SALVAGE VALUE

LINE

1. ENTER the number of years the vehicle is to remain in the fleet (line 3, worksheet 1) _____ YRS
2. ENTER the acceptable discount rate (line 5 worksheet 1) _____ %
3. SELECT an operating cost discount factor in table A using the values specified in lines 1 and 2 _____
4. ENTER the appropriate discount factor from table A _____
5. ENTER the annual operating cost (line 9, worksheet 2) _____
6. MULTIPLY lines 4 and 5 and enter the result $_____ TOTAL OPERATING COST
7. SELECT a salvage value discount factor in table B using the values specified in lines 1 and 2 _____
8. ENTER the appropriate salvage value discount factor from table B _____
9. ENTER the resale value of the vehicle (line 4, worksheet 1) $_____
10. MULTIPLY lines 8 and 9 and enter the result $_____ DISCOUNTED SALVAGE VALUE
11. SUBTRACT the discontinued salvage value (line 10) from the total operating cost (line 6) and enter the result $_____ NET VEHICLE OPERATING COST

TABLE A
DISCOUNT RATE

YR	3%	4%	5%	8%	10%
1	0.971	0.962	0.952	0.926	0.909
2	1.913	1.866	1.859	1.783	1.736
3	2.829	2.755	2.723	2.577	2.487
4	3.717	3.630	3.546	3.312	3.170
5	4.580	4.452	4.329	4.623	3.791
6	5.417	5.242	5.076	5.206	4.355
7	6.230	6.002	5.786	5.747	4.868

TABLE B
DISCOUNT RATE

YR	3%	4%	5%	8%	10%
1	.9709	.9615	.9524	.9259	.9091
2	.9426	.9246	.9570	.8573	.8264
3	.9151	.8890	.8538	.7938	.7513
4	.8885	.8548	.8227	.6805	.6830
5	.8626	.8219	.7835	.6302	.6209
6	.8375	.7903	.7462	.5835	.5645
7	.8131	.7599	.7107	.5403	.5131

4. COMPUTE LIFE CYCLE COST

LINE

1. ENTER the purchase price of the vehicle (line 1, worksheet 1) $_____
2. ENTER the net vehicle operating cost (line 11, worksheet 3) $_____
3. ADD lines 1 and 2 and enter the result $_____ LIFE CYCLE COST

OPTIONAL

4. ENTER the number of years vehicle is to remain in fleet _____ YRS
5. DIVIDE line 3 by line 5 and ENTER the result $_____ ANNUAL AVERAGE LIFE CYCLE COST

Source: Energy Management in Municipal Vehicles. U.S. Dept. of HUD, 1977.

These tools focus on individual buildings, mostly existing buildings. There are tools for site planning, design and construction of new buildings (4.1 and 4.4), using building codes (4.2), and controlling real estate transactions (4.3). There is the "thermal flyover" method of taking a "heat loss picture" of the whole community (4.5), a tool on training homeowners in energy techniques (4.6), a tool on energy audits (4.7), and one on energy services (4.8) that go beyond audits.

These tools can work individually, but are best conceived as part of a larger program. For example, training programs are effective when combined with energy audits; thermal flyovers can lead to detailed energy audits, then to training programs. Real estate transaction codes should be supported by energy audit or energy services programs to be most effective.

Site Planning For Energy Efficiency

Site Planning is the process of planning a structure in its natural environment; energy efficiency in the building can be strongly affected by its orientation, landscaping, and related features.

KEY ISSUES

Site planning and building design should be an integrated process. Local governments can exert only limited control over building design through zoning rules and building codes, but can nonetheless help incorporate energy efficiency principles in site planning (see Tool 1.6 for more information on subdivision controls).

Some of the basic principles in energy efficient site planning include:

- assessing the microclimate of the development site;
- using the south-facing slopes;
- using natural wind shelter, including vegetation, and topography;
- using earth sheltering principles, (see Tool 1.9);
- orienting sites for solar access;
- protecting solar access (see Tool 1.7)

STEPS

To incorporate energy efficiency into the site planning process, follow these basic steps:

1. Inventory existing local government zoning and subdivision controls to determine if regulatory mechanisms exist for controlling physical features of building sites.

2. Refer to reference materials below for specific methods of revising current controls for improved energy efficiency.

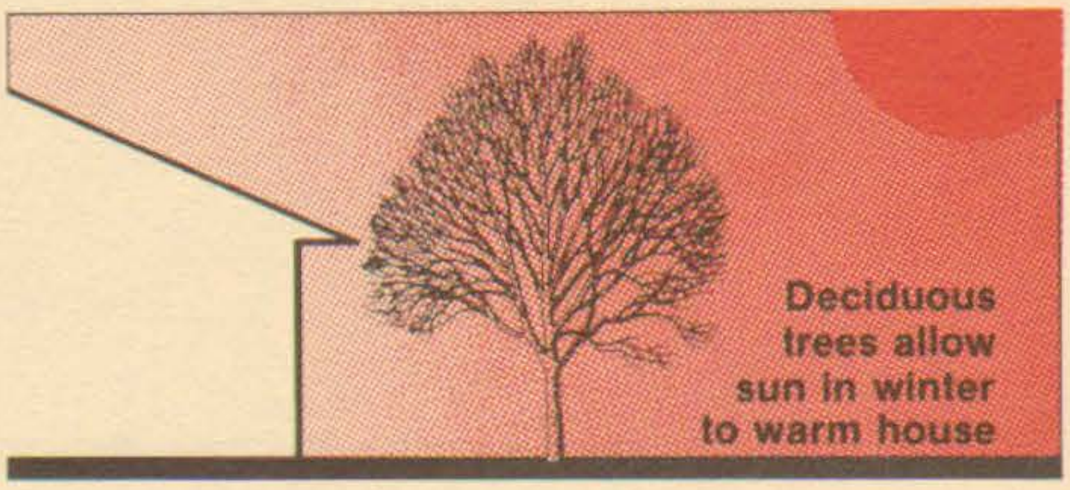
3. Revise current control mechanisms to reflect energy efficiency princples.

4. If current legal controls are inadequate to significantly affect site planning, use reference materials and planning assistance from local, county, or regional planning bodies to provide information to developers, homeowners, etc.

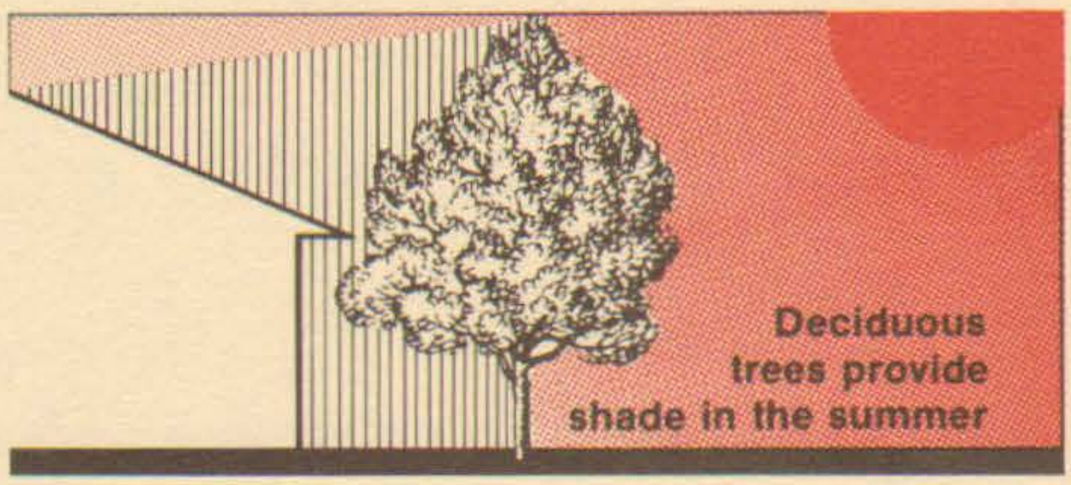
5. Incorporate energy-efficient site design into all new municipal building developments.

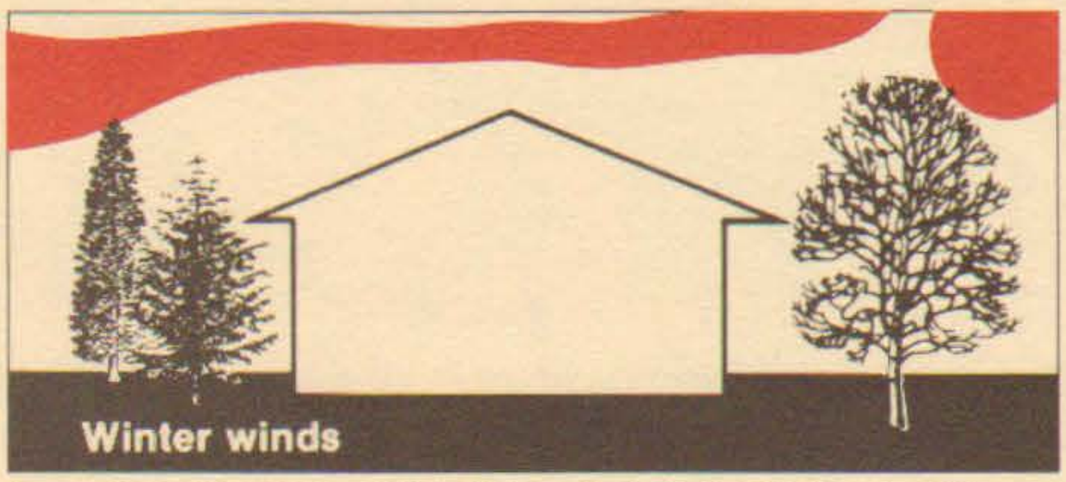
Landscaping-Using Trees and Landform

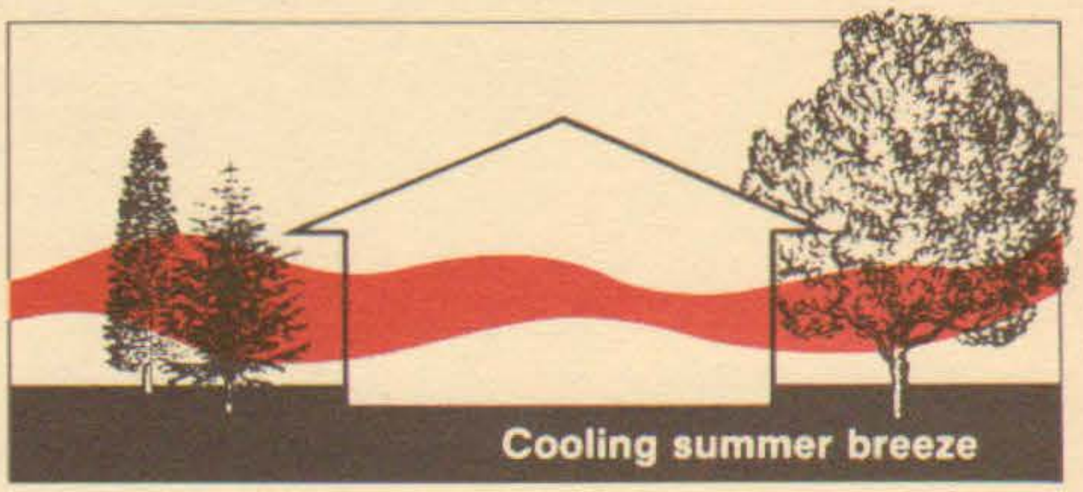












Source: National Association of Home Builders, *Cost Effective Site Planning*, 1976.

REFERENCES

Site Planning for Solar Access
Duncan Erley and Martin Jaffe
American Planning Association
1313 E. 60th Street
Chicago, Illinois 60637

Energy Conserving Site Design Case Studies
Greenbriar Case Study
Greenbriar Associates
Chesapeake, Virginia 23320

Radisson, New York Case Study
The Riemann Buechner Partnership
Syracuse, New York 13202

The Woodlands, Texas Case Study
The Woodlands Development Corporation
The Woodlands, Texas 77380

Solar Access Handbook
Earth Sheltered Handbook
contact The Minnesota Energy Agency
612/296-5120

Energy Codes For Buildings

A great deal of research and development has gone into improving basic building design and construction practices. Most states, including Minnesota, have adopted an energy code for new buildings, additions and remodeled elements of buildings based on one devised by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), known as "ASHRAE Standard 90-75, Energy Conservation in New Building Design". Local governments are not required to adopt a building code, but must use the state code if they use any code. This code, which is a part of the State Building Code (SBC), prescribes minimum standards for the following building features:

- Exterior envelope (roofs, walls, and floors) maximum heat loss or gain (U-value), and air leakage through windows, doors and construction joints.
- Heating, Ventilating, and Air-Conditioning (HVAC) systems
- HVAC equipment
- Service water heating
- Electrical distribution systems
- Lighting power
- Energy requirements for building designs based on system analysis
- Requirements for buildings utilizing solar, wind, or non-depleting energy sources.

KEY ISSUES

The energy code is not (and cannot be) a maximum energy-saving standard; it sets minimum requirements only. The real challenge is to convince builders to exceed codes. (see Tool 4.4)

FIGURE 13

DESIGN FEATURES FOR ENERGY CONSERVING HOMES

2" x 6" stud wall construction plus insulation

Insulating sheathing

Basement wall insulation

Rim joist insulation

R38 - R48 attic insulation

Unheated vestibules

A large number of south-facing windows

Insulating shutters or curtains

Shading of windows from the summer sun

Tighter construction coupled with controlled ventilation

More efficient furnaces and water heaters

Earth sheltering

Triple glazing on east- north- and west-facing windows

Source: Minnesota Energy Agency 1980 Biennial Report

STEPS

1. Determine whether the municipality or county has adopted the state energy building code.

2. If the state energy code is not in effect, investigate incentives for encouraging builders to meet or exceed the code, such as:

- workshops showing how to design for energy efficiency and its potential costs and benefits;
- using density incentives to encourage energy-efficient designs;
- encouraging utilities to provide preferential rates for energy-efficient buildings;

3. If the code is in effect, investigate the above incentives for encouraging builders to exceed the code. Also, consider providing technical assistance in evaluating building designs for energy efficiency, possibly through the resources of educational institutions, or local architects and engineers.

REFERENCES

State Division of Building Codes and Standards
612/296-7037

Cities who use energy considerations in building codes:
Vadnais Heights
612/429-5343

Brooklyn Park
612/425-4502

Cottage Grove
612/458-2824

Figure 13 contains basic energy efficient design features for homes.

Energy Considerations In Real Estate Transactions

The time at which a building is sold affords an opportunity to evaluate and possibly upgrade its energy efficiency. Energy considerations in real estate transactions are a tool for encouraging or requiring energy evaluations and improvements.

KEY ISSUES

Portland, Oregon, was the first city to create a "time of transfer" ordinance requiring buildings to meet energy efficiency standards before being sold. Minnesota law now requires homeowners to have an energy audit performed before selling the home, unless the buyer waives the requirements. Owners of rental buildings are also required to conduct energy audits.

Local governments can use this law to encourage homebuyers to be "smart shoppers". A pamphlet of energy tips for homebuyers could be used to "educate the market"; if buyers become educated as to what to look for, sellers will begin to install energy measures to increase the saleability of their home.

Banks can also be involved in this area. Since they normally conduct independent appraisals of properties under application for mortgages, they can be encouraged to look at specific energy features, such as insulation values, air leaks, and double windows in conducting their appraisals.

Local chapters of the Minnesota Association of Realtors have conducted the workshop "The Realtor's Guide to Residential Energy efficiency" for the benefit of all real estate agents. Urge your local chapter of MRA to cosponsor this workshop in your area.

The University of Minnesota Continuing Education Department has sponsored the workshop "Energy Considerations in Real Estate Appraising" as part of its Real Estate Certification Program. Contact the program coordinator at the Department of Conferences (612/373-5361) about when their next offering of this workshop will be, then publicize this information to local appraisors.

STEPS

1. Consult the Minnesota Energy Agency for details on the energy audit.

2. Create information flyers or pamphlets to educate community residents, on what to look for in buying or renting to get the most energy-efficient dwelling.

3. Consult local lenders about including energy efficiency criteria in reviewing mortgage applications. Work with them to help improve energy efficiency review practices. Offer to supply them with educational materials as in step 2; banks may also want to help develop, print, and distribute such materials in a joint effort with the local government.

REFERENCES

Minnesota Energy Agency
612/296-5175
or 800/652-9747

Energy Considerations in Real Estate Appraising, available for purchase by members of Society of Real Estate Appraisers and American Institute of Real Estate Appraisers.

The Realtor's Guide to Residential Energy Efficiency, text available only to members of National Realtors Association.

The following four reports are available free from Dow Chemical Company, 1703 Saginaw Road, Midland, Michigan 48640:

Energy in the 80's-What America's Builder's say, 1980, U.S. #17907343, Minneapolis #17907357.

Perspective on Energy: America's Homeowners Speak Out, 1979, #17907268

Realtors & Appraisers Discuss Home Insulation and Other Energy-Related Issues, 1978, #17907222.

Rising Fuel Costs Heighten Minneapolis Homeowner's Concern for Energy-Efficient Housing, #2, #17907296.

Energy-efficient Building Design and Construction

The design of new buildings and renovations or additions to existing buildings will have a major impact on those buildings' energy requirements over their entire life. If developers, designers and builders can give due consideration to energy, then the building occupants will save on energy bills, and the demand on the community's energy supply will be reduced.

Traditionally, major considerations which have influenced building designs have been first cost, function, marketability and appearance. As energy has grown in importance, energy-conscious design has developed as an important part of residential, commercial, institutional and industrial development.

KEY ISSUES

Many diverse groups of people influence the energy efficiency of new buildings. The challenge is to both **educate** these groups of people on how to design and build an energy efficient building, and to **motivate** them to spend the extra effort needed to do it.

Getting people to consider the long range economic and social impacts beyond the first cost of the building can significantly change the attitude of the developer, designer and builder toward energy conscious design.

STEPS

1. Identify people and companies in the community who influence new design and construction. Identify formal groups and associations of these people.

2. Encourage energy conscious design courses and programs at community education facilities or local post-secondary educational institutions. Help make these events a success by publicizing their availability to the people and groups identified above.

3. Obtain information (see References) on energy conscious design and distribute it to people and groups identified above.

4. Work with the community library to stock books and journals on the subject. Publicize the availability of these materials.

5. Specify energy conscious design for any new construction or renovations and additions to municipal buildings.

6. Inform developers of any positive energy efficient building that has occurred in the communty.

REFERENCES

Minnesota Energy Agency Information Center
296-5175 (metro area)
800/652-9747 (toll-free outstate)

"Building an Energy Efficient Home" bibliography.
Free from MEA Information Center.

"Design for Energy Efficient Commercial and Institutional Buildings"
Free from MEA Information Center.

"Energy Efficient New Industrial Building Design Bibliography"
Free from MEA Information Center.

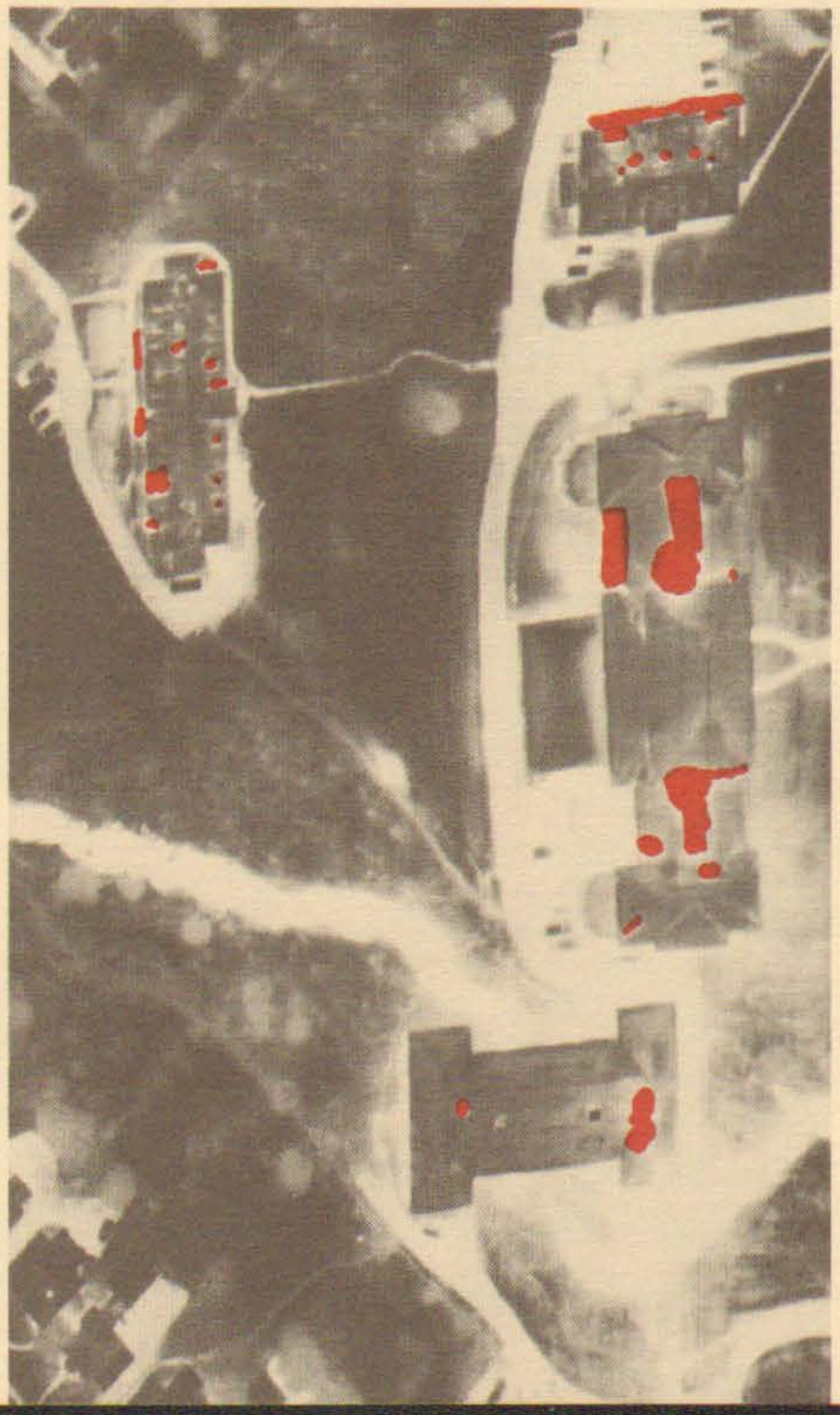
Thermal Flyovers

Cities like Champlin and Mankato, as well as Wichita, Kansas, Philadelphia, Pennsylvania, and many other local governments have had aerial photo-surveys made with infrared film. This heat sensitive film shows where energy is being lost and in what magnitude.

KEY ISSUES

While the flyover doesn't provide as much detail as an energy audit, it is a fairly inexpensive way to get a "snapshot" of the whole community. The infrared photos can be displayed at a special publicized event so building owners can come see how they compare to their neighbors. It can be a way to launch an energy audit program or attract attention to the energy program as a whole.

Local governments have used Community Development Block Grants (see Tool 7.5) or other public funds to pay for flyovers. The service is available through aerial survey (photo-grammetry) specialist firms. Planning Commissions may know who the nearest aerial survey firms are.



Hot spots or thermal anomalies, symptomatic of localized structural or insulation flaws can be seen in this thermogram. The buildings are typical of institutional type structures such as schools or hospitals.

STEPS

To conduct a thermal flyover program, follow these basic steps:

1. Consult communities who have conducted these surveys.
2. Identify firms available to perform the survey; obtain bids if possible, with examples of previous work.
3. Select a firm and conduct the survey, normally on a cold winter day.
4. Obtain results in a form that shows individual buildings.
5. Create an exhibit at the library, or a special event to display the results, so homeowners can see where their houses are losing heat.
6. Provide a handout which explains how to read the infrared pictures, and distribute brochures from the state energy office, local utilities, and other sources on how to reduce "heatleaks" identified.
7. Integrate the flyover program with other programs such as energy audit or weatherization programs, so the program is not a one-time event but leads to action.

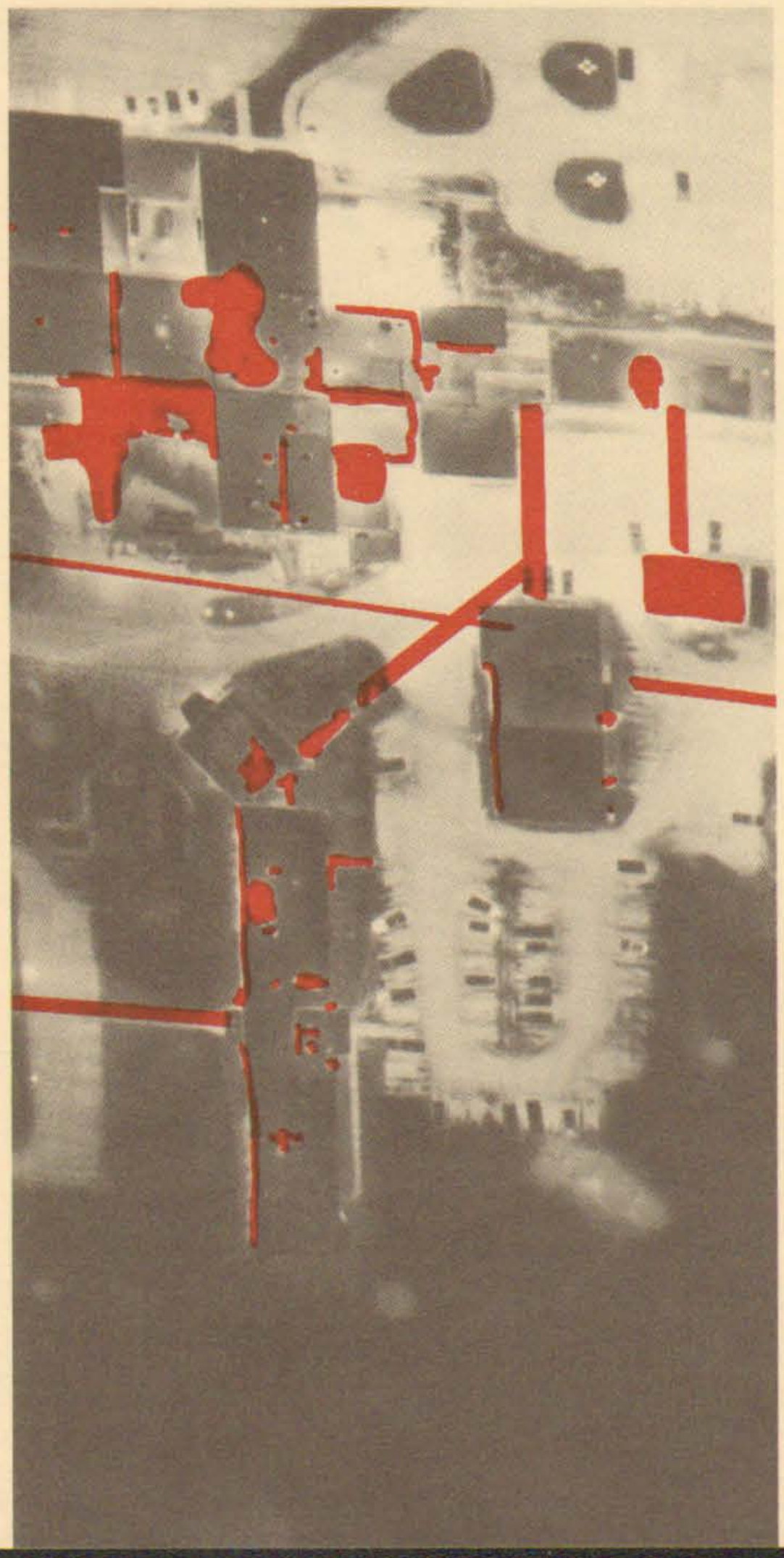
REFERENCES

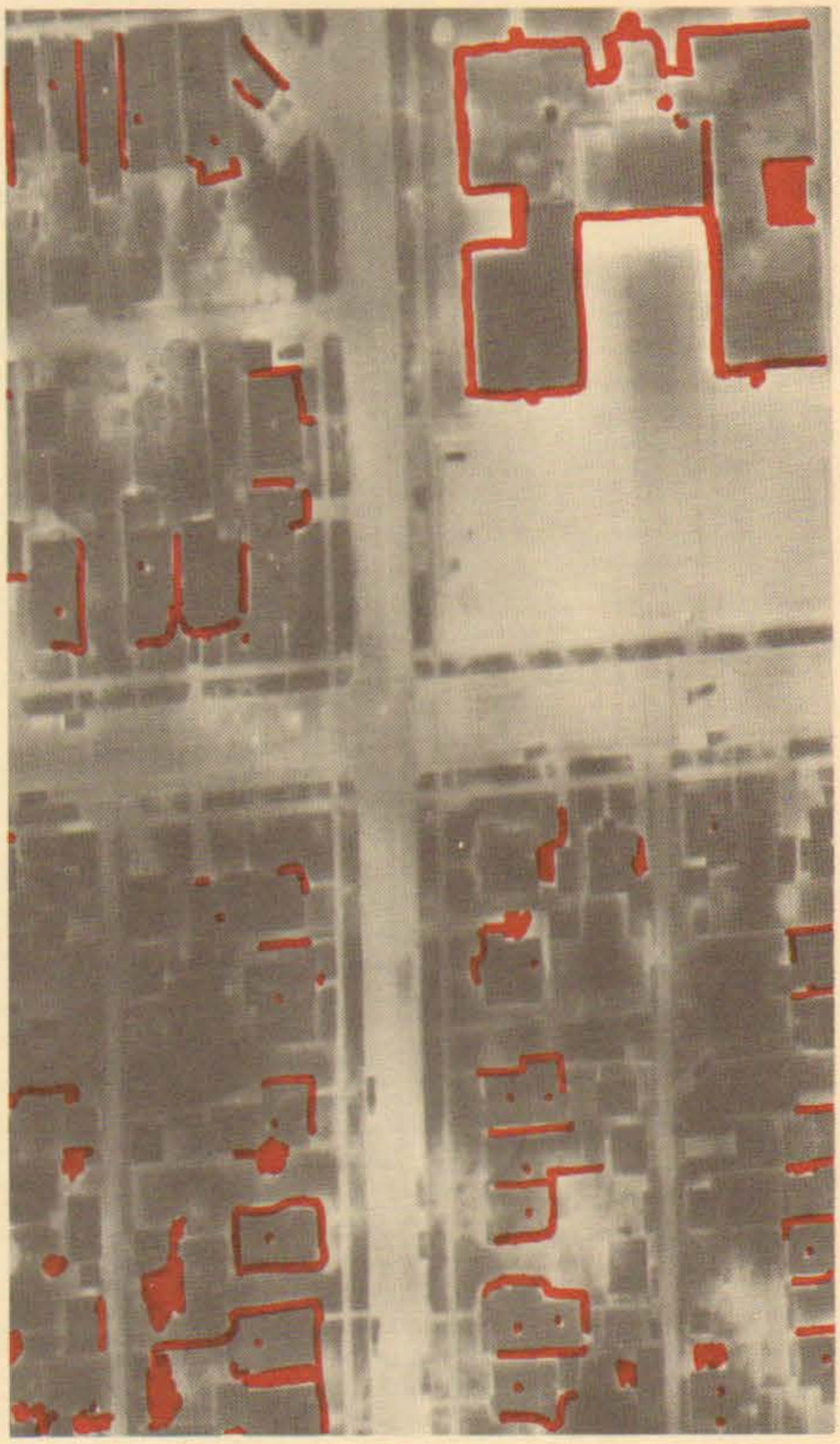
Aerial Infrared Users' Manual
National Technical Information Service
U.S. Department of Commerce
Springfield, Virginia 22121

State Energy Agency Information Center
612/296-5175 (metro)
800/652-9747 (statewide)

Champlin
612/421-8064

Mankato
507/625-3161





A variety of thermal responses are evident in this residential rooftop community (above). A bright pin point indicates active heating of the dwelling. The large structure, (top, right) possibly a school, shows evidence of moisture on its flat roof surfaces.

Several thermal features associated with this industrial building complex can be traced in this thermogram (left). The heating plant at the center is connected to other buildings by heat tunnels or steam lines. Areas of the roof on the large buildings are affected by severe heat loss. Note that sewer systems (left) are connected to the municipal system and clusters of lights are evident in the parking lot areas.

Energy Training Programs

One of the best ways to build energy efficiency into the community is to directly train homeowners and other energy users on a "do it yourself" basis. Such options as:

WEATHERIZATION
Caulking, weather-stripping, plugging air leaks, installing insulation, and other measurers;

PASSIVE SOLAR
Trombe walls, greenhouses, thermal storage;

EARTH SHELTERING
Berming, wind and sun orientation, vegetation sheltering, etc. can be taught directly to people without special skill or mechanical aptitutde. Utilities, local contractors, engineers, firemen, and university faculty and students can be enlisted to develop and teach these programs.

KEY ISSUES

Many communities have used money and personnel from Community Development Block Grants, Community Action Agencies, and other funding sources to help support training programs. One of the most effective ways to support training and other programs is the acquisition of an "energy House" demonstrating various energy princples. This can be a very effective way to provide a training facility, build public awareness, and test specific energy ideas to be used as a community focus for energy programs. Wichita, Kansas, did this as part of their home energy loan program. A house called Ourobouros was built at the University of Minnesota. In Concord, New Hampshire, the Bank of New Hampshire sponsored a Solar Demonstration House. In Allentown, Pennsylvania, Pennsylvania Power and Light has an Energy Demonstration Home, and in Washington, D.C., the Anacostia Energy Alliance headquarters includes solar and other energy demonstration features. These examples show that local groups, banks, and utilities and universities can all play a part in developing energy training faciities.

STEPS

1. Consult local professionals, universities, utilities, and others on what they can provide in expertise, materials, sites, etc.

2. Set up programs based on available resources in cooperation with neighborhood groups and other active groups.

REFERENCES

Residential Energy Audit Manual
Fairmont Press
P.O. Box 14227
Atlanta, Georgia 30324

Area Vocational Technical Institutes (AVTI's)
The Minnesota Energy Conservation Service (MECS) energy auditor training program is available at several AVTI's. Contact your AVTI for more information.

State Energy Agency
Outreach Program
612/296-8899

Information Center
612/296-5175 (metro)
800/652-9747 (statewide).

Ourobouros South
Rosemount
612/373-5170

Red Wing Energy Education Center

Moorhead Housing Redevelopment Authority
Weatherization workshops

Bank of New Hampshire
Concord, New Hampshire
Solar Demonstration House

Pennsylvania Power and Light
Allentown, Pennsylvania
Energy Demonstration Home

Energy Audits

An energy audit is a survey of a building which reviews past consumption and cost trends, analyzes current usage patterns, and identifies specific measures which could save energy.

KEY ISSUES

One of the most effective ways to motivate people to take energy efficiency measures is through an energy audit program. St. Paul conducted a massive Energy Mobilization which audited almost 100,000 homes; Austin surveyed more than 700 homes; New Hope and Minneapolis are using HUD programs for energy audits and related programs.

Most utilities, including Northern States Power and many of the municipal and cooperative utilities, are beginning to offer conservation service programs under the statewide Minnesota Energy Conservation Service (MECS) program. Also, local contractors and other professionals can be persuaded to participate in free or low cost audit programs if their business will be stimulated by making customer contracts.

Energy audits are most effective when combined with:

- training programs for installing conservation measures;
- financial incentives such as low interest loans or materials discounts;
- publicity programs to make them visible and interesting;
- delivery systems for conservation measures — coordination with contractors, suppliers, etc.

Energy planners should try to create a total "conservation service delivery" package for the energy user, so that the user will be able to get his needs met in a "one-stop shopping" fashion (see Tool 4.8). Too often the audit is not connected to financing or other follow-up services to ensure that the audit results are put to use.

STEPS

1. Consult local utilities to determine the status of their energy audit program.
2. If utilities have active programs, work with them to advertise the program and link it to other programs.
3. If no audit program is underway, work with utilities, professionals, contractors, and other resource groups to develop a program, linked to other programs as much as possible.

REFERENCES

Minnesota Energy Agency
MECS Program
612/297-2117

Information Center
612/296-5175 (metro)
800/652-9747 (statewide)

St. Paul Energy Office
612/292-6730

Austin Energy Program

Minneapolis Energy Office
612/348-6829

Moorhead Housing Redevelopment Authority

Figure 14 shows some cost-effective home energy conservation measures.

FIGURE 14

EXAMPLES OF COST-EFFECTIVE ENERGY CONSERVATION MEASURES APPLIED TO AVERAGE 1500 SQUARE FOOT HOME IN MINNESOTA

		SAVINGS						SIMPLE PAYBACK YEARS			
		OIL HEAT		NAT. GAS HEAT		ELECTRIC HEAT					
CONSERVATION MEASURE	INSTALLED COST	FUEL SAVED -GALLONS- (mm Btu)	$	FUEL SAVED -MCF- (mm Btu)	$	FUEL SAVED -kWh- (mm Btu)	$	Oil	Gas	Electric	ANNUALIZED COST per mm Btu
Set back thermostat 5°F 24 hrs per day	0	123 (17)	133	19.7 (20.3)	69	2880 (9.8)	102	0	0	0	—
Additional night set-back 5°F 8 hrs per day	0	57 (7.9)	62	9.2 (9.5)	32	1340 (4.6)	48	0	0	0	—
Caulk and weatherstrip to reduce air infiltration from 1.3 to 1 air change per hour	425[2]	141 (19.5)	152	19 (19.5)	66	3440 (11.7)	122	2.8	6.4	3.5	$1.11
Increase attic insulation from 3½" to 10" of cellulose, add 4 soffit vents and 4 roof vents	925	170 (23.5)	184	22.8 (23.5)	80	4150 (14.1)	147	5	11.6	6.3	$1.53
Insulate rim joist with R-19 fiberglass batt	64	8 (11.2)	87	10.8 (11.2)	38	1970 (6.7)	70	.7	1.7	.9	$ .22
Insulate walls with blown in cellulose	800	534 (73.7)	577	71.5 (73.7)	250	13,000 (44.2)	460	1.4	3.2	1.7	$ .42
Install storm windows (15 windows - 200 sq. ft.)	1125	262 (36.2)	283	35.1 (36.2)	123	6380 (21.7)	226	4.0	9.4	5	$1.58
Install 2 wood storm doors (40 sq. ft)	350	22 (3)	24	2.9 (3)	10	535 (1.8)	19	14.7	34	18.5	$5.95
Replace 60% seasonal efficient furnace with 80% seasonal efficient one	1200	205 (28.3)	221	33 (33.8)	115			5.4	10.4		$2.39
Install insulating shades on 200 sq. ft. of windows	800	102 (14)	110	14 (14)	48	2470 (8.4)	88	7.3	16.8	9.1	$3.84

1 Includes labor costs at prevailing rates.

2 The cost of $425 is for high-quality, long-lasting (30 years) caulking and weather stripping, professionally installed. Self-installed caulking and weather stripping lasting 5 years can cost as low as $30 and still produce significant energy savings.

SOURCE: Minnesota Energy Agency, Conservation Division.

Energy Conservation Services

Energy conservation services go beyond energy audits; they are a complete package involving an audit, installation of equipment or materials, and a financing program for repayment of costs.

KEY ISSUES

Much of the direct conservation service work done so far has been by local CAP agencies under the federal weatherization assistance program. Some utilities, including Northern States Power, are providing insulation installation and financing as well as basic energy audits. The statewide MECs program now requires larger utilities to develop services of this type. Some local programs, such as St. Paul's and Moorhead's, have received free or discounted conservation materials as part of their programs.

STEPS

To establish an energy conservation service program in your community, follow some basic steps:

1. Identify local organizations capable of delivering services, such as Housing Redevelopment Authorities, CAP agencies, utilities, heating or general building contractors, banks and others.

2. Identify target groups such as low income homeowners, middle income homeowners, rental unit owners, small businesses, etc.

3. Work with responsive organizations from step 1, to package conservation services for each target group, with careful attention to:

- information campaigns for the program;
- cost and pricing issues, including financing methods, so users will find services attractive;
- coordinating phases of the service through one organization, so the user deals only with one source.

There are innumerable variations and versions of energy service programs. They are, almost by definition, creative. Each community should look at its local needs and resources. Utilities, banks, local contractors, municipal agencies, and state and federally supported agencies can often work out innovative programs that benefit everyone.

REFERENCES

local Community Action Agencies
local Housing Redevelopment Authorities
local banks
local utilities
local contractors

State Energy Agency
MECS Program
612/297-2117

Information Center
612/296-5175 (metro)
800/652-9747 (statewide)

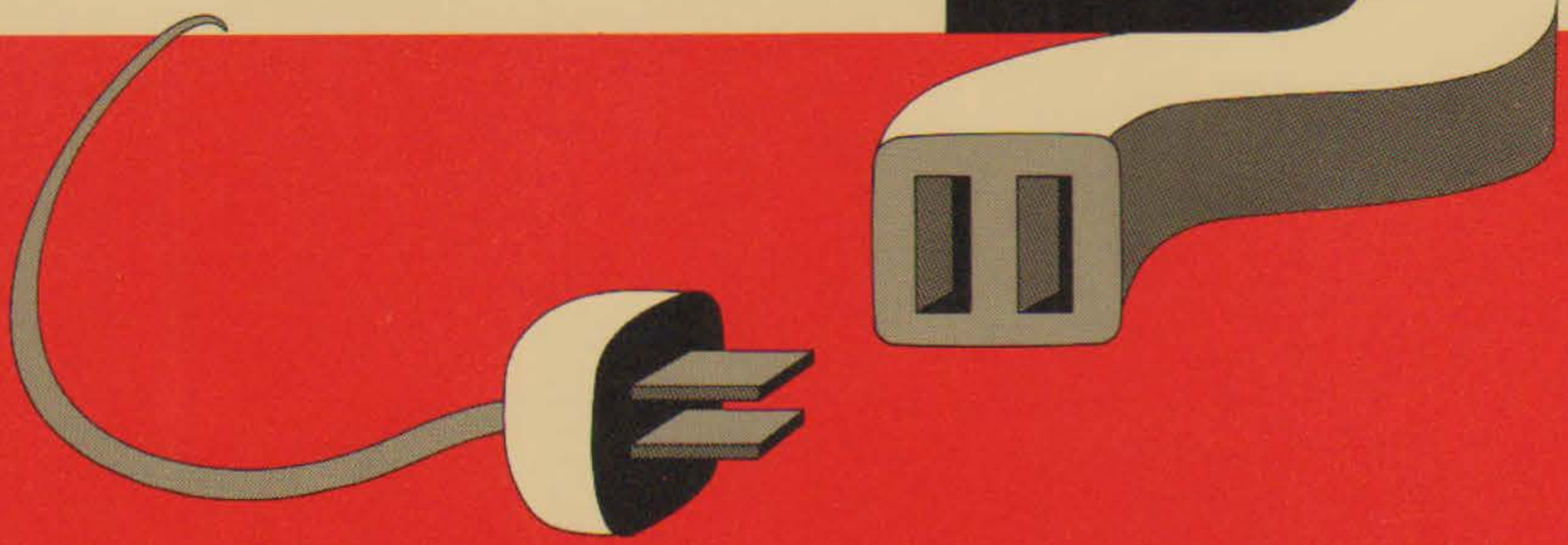
Block Grant Energy Conservation
U.S. Department of HUD
contact Minnesota Area Office
612/349-3019

State Department of Economic Security
Weatherization Program
612/296-5744
800/652-9747 (statewide)

Moorhead Housing Redevelopment Authority

Austin Energy Program

St. Paul Energy Office
612/292-6730



Public participation is a broad term for getting people involved, both as individuals and part of neighborhood, civic, and other community groups. Public participation should be one of the first steps in any energy program or plan, and effective, broad-based citizen involvement should continue throughout the program.

Three tools are presented here, but each has several variants, and all are inter-related. Energy commissions and committees (5.1) are among the first organizing options. Energy information programs (5.2) help increase interest and awareness of ongoing and planned programs. Energy education programs (5.3) are an investment in the future, building energy awareness and knowledge in the next generation.

Citizen Energy Committees

Often the first step in starting an energy program is the establishment of a community Energy Commission, Energy Awareness Committee, or other central body to guide the energy program. Champlin, Austin, St. Cloud, Edina, St. Paul, Minneapolis and many others have active energy committees. The State Energy Agency's outreach program supports a number of Local Energy Awareness Committees, and publishes the Local Energy Awareness Handbook.

KEY ISSUES

It may be fairly easy to start an energy awareness committee; it can be accomplished with a resolution of the city council, or with an informal statement. It is most effective to combine the committee's inception with:

- effective publicity that reaches the whole community, and shows each member of the community that energy is in his self-interest;
- a major event or program to provide a sense of action and a concrete focus, such as an energy fair, thermal floyover, etc.

Participation in energy committees can be solicited by working presentations to group meetings, through direct appointment by the chief executive official, or by placing advertisements in local newspapers. It is important that potential members be made aware of the committee's purpose, authority, and responsibilities. Representation should be sought from as many community groups as possible, including:

- neighborhood associations
- business groups (Chamber of Commerce, Jaycees)
- service clubs (Rotary, Kiwanis)
- church groups
- League of Women Voters chapters
- environmental groups
- professionals (architects, engineers, contractors)
- utilities and energy suppliers
- local government staff

Energy committees can take several forms: they can be appointed bodies reporting to the chief executive official or governing body; they can be volunteer groups working informally with the planning department or another municipal agency. They can elect their own officers, or have an appointed leader. They may have paid professional staff, or volunteer help. Each group's structure should be a function of the initial source of interest, the resources available to support the group, and local political issues.

STEPS

1. See official endorsement of the proposed group, including a resolution of the governing body and chief executive's proclamation.
2. Advertise the group's existence and purpose, calling for participation, either by formal submissions for appointment of members or volunteer attendance at an organizational meeting.
3. Hold an organizational meeting, in which the group develops and adopts a mission statement, by-laws, sets an initial work plan and schedule, and elects officers.

REFERENCES

Minnesota Energy Agency
Outreach Program
612/296-5120

St. Paul Energy Office
612/292-6730

Minneapolis Energy Futures Committee
612/348-6829

Champlin Energy Commission
612/421-8064

Austin Energy Commission
507/437-7671

Energy Information Programs

Energy information programs include a wide range of activities designed to spread awareness and knowledge of energy programs and concepts. They should be part of all energy programs.

KEY ISSUES

Some of the most effective information dissemination techniques include:

CONSERVATION KITS
Assembling a packet of literature combined with sample energy conservation material like weatherstripping, flow restrictors for showers, etc. can be effective. Utilities sometimes provide these kits as "bill stuffers."

ENERGY HOTLINES
Ramsey County has set up an emergency call-in service. Given the cost of such a service, it may be best focused on a one-week or weekend "marathon" basis with heavy publicity.

CONTESTS
Posters, slogans, employee award programs, and other contests have been used to stimulate creativity and interest.

BUMPER STICKERS
This time-honored technique can be used to promote local energy programs, slogans, etc.

LIBRARIES
Special exhibits in public libraries and other public places can effectively distribute a lot of information.

MAJOR MEDIA
Newspapers, radio, and TV will carry energy news if it is made interesting. In planning energy fairs or other events or programs, try to organize the event so as to attract media attention. Also, feel free to actively solicit media coverage by sending out articles, news releases, pictures.

STEPS

1. Evaluate overall publicity and information needs of all energy programs.

2. Create a total information plan for the community energy efforts; create a letterhead or graphic design to clearly identify the overall program.

3. Plan media campaigns or publications as part of the total plan, coordinated with event schedules and program cycles so that information becomes available at the right time in the right form.

REFERENCES

Minnesota Energy Agency

Outreach Program
612/296-5120

Information Center
612/296-5175 (metro)
800/652-9747 (statewide)

Energy Education Programs

Energy education programs are intended to involve students in current programs, and to build energy awareness and knowledge for the future.

KEY ISSUES

School programs can include:

- energy-oriented science fairs
- poster contests
- energy elements in the science curriculum
- energy courses integrating science, economics, and other disciplines.

STEPS

1. Review existing and planned energy programs, evaluate needs for public awareness, and identify specific materials or seminars that can meet these needs.

2. Review current school curriculum in cooperation with school authorities to identify ways to build energy into the current curriculum, create new energy programs, and involve the school system in various community programs.

REFERENCES

Region 9 Development Commission, Mankato

Minnesota Energy Agency Outreach Program
612/296-5120

Minnesota Energy Agency Education Programs
612/296-5120

State Energy Agency Information Center
612/296-5175 (metro)
800/652-9747 (statewide)

The SEED Program (Schoolhouse Energy Efficiency Demonstration) developed by:

Tenneco, Inc. Public Affairs Department
P. O. Box 2511
Houston, Texas 77001
713/757-2777

Energy Education Action Center
U.S. Office of Education
Room 514, Reporters Building
300 Seventh Street, S.W.
Washington, D.C. 20202
202/472-7777

St. Paul Energy Office

Austin Energy Program

Red Wing Energy Education Center

Energy Conservation Fairs
League of Women Voters of Manitowoc, Wisconsin
848 N. 6th Street
Manitowoc, Wisconsin 54220

So You Want To Have A Fair
Center for Renewable Resources
1001 Connecticut Avenue, N.W.
Washington, D.C. 20036

Field-Proven Programs to Conserve Energy In Schools
Association of School Business Officials
720 Garden Street
Park Ridge, Illinois 60068
312/823-9320



This section can be used in conjunction with the resource assessment process in Chapter 4 of the Guidebook as part of the comprehensive energy planning process, or the tools can be used individually.

The focus of these tools is more on gross resource potential than specific technologies; each section contains a simplified assessment procedure to help estimate how much each resource could contribute to a community's resource base. More detailed assessment requires determination of specific technologies, conversion efficiencies, cost factors, financing, and institutional arrangements.

Renewable energy resources replenish themselves within a year or a few years. The first three tools consider solar energy (6.1), wind (6.2), and hydro (6.3) which are readily available energy sources. The next group of tools discuss resources that require longer periods of time to replenish themselves, conventional crops (6.4), wood (6.5), animal wastes (6.6) and special energy crops and peat (6.7). These energy resources are called biomass resources. Biomass is a solar energy captured by plants in photosynthesis and bound into the natural food chain, in plants, plant wastes, and animal wastes. District heating and cogeneration (6.8) are energy strategies that can use different conventional and alternative fuels.

Solar Energy

Solar energy can be harnessed in several ways: in flat-plate collectors capturing heat for hot water and space heating, in concentrating collectors for higher-temperature uses in commercial and industrial applications, in photovoltaic cells which convert solar energy directly to electricity, and in "passive solar" designs of buildings which capture and retain solar heat without special collectors or mechanical pumps.

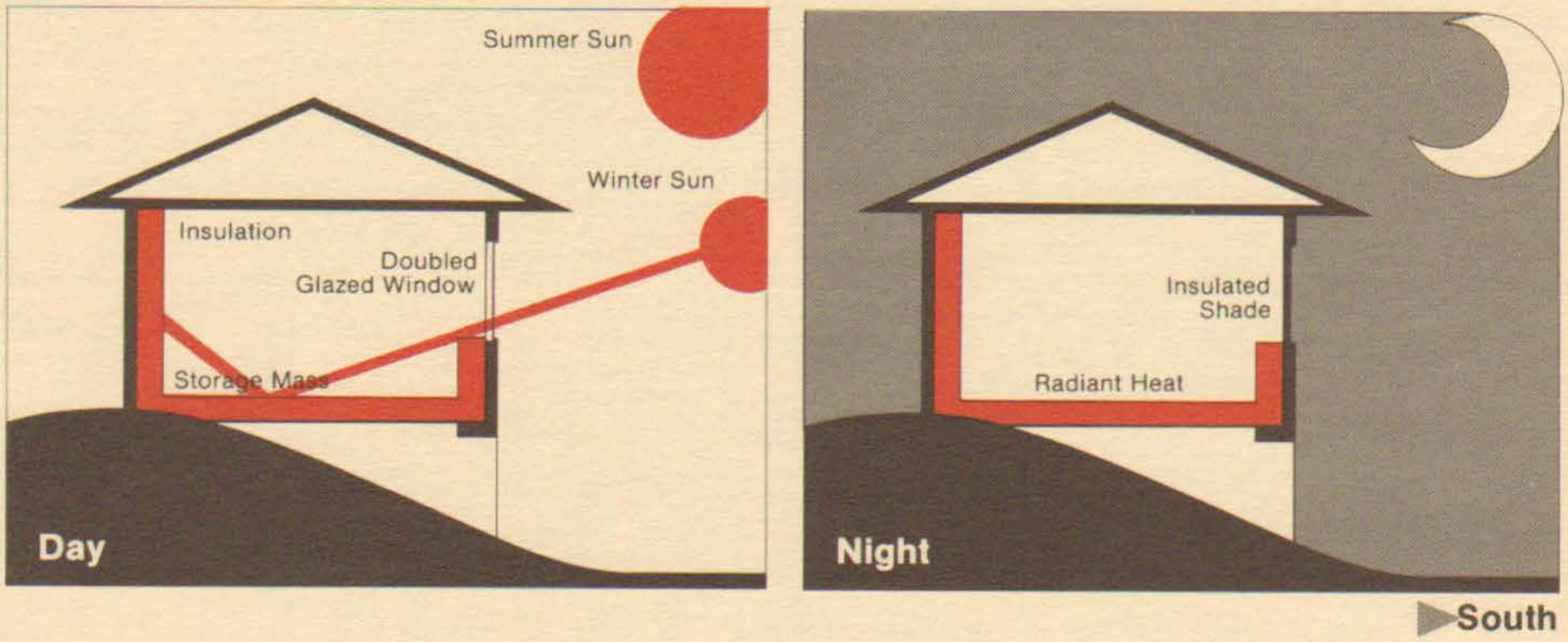
KEY ISSUES

Developing the private and public use of solar energy has been a widely popular movement across the country. Solar projects have been started in a number of ways:

- homeowners, movtivated by environmental concerns, fuel shortages, or Federal tax credits have taken them on individually; HUD's solar demonstration program has also built hundreds of systems on homes;
- Santa Clara, California, has started a municipal solar utility in which the City owns the equipment, installs it, and leases it to the customer for a monthly fee;
- commercial projects have been started by firms with an interest in the technology or because of fuel shortage concerns; HUD and DOE have also sponsored a lot of commercial demonstrations;
- public buildings have been "solarized" usually with the help of Federal grants, though more and more governments are taking their own initiatives in either encouraging or requiring solar projects often with direct funding.

Solar projects can be an effective way to crystallize interest in renewable energy and conservation. They are visible and usually simple to understand; they can be a natural "showpiece" for an energy library. Solar panels on the town hall, library, or school, combined with publicity and educational programs, can be a concrete way to focus interest on the local government's energy program. Passive solar projects like trombe walls and greenhouses are equally effective demonstrations.

Passive Solar System/Direct Gain



6.1
RENEWABLE ENERGY RESOURCE DEVELOPMENT

STEPS

Estimating the potential of direct solar can be done in two ways. The first method is to survey the community and assess the potential for solar retrofits on existing buildings and for solar orientation and design in areas of the community expected to be developed in the future.

Assessing retrofit potential for existing buildings involves determining the amount of unshaded roof and south wall area, the solar radiation the community receives, and calculating conversion efficiencies. This assessment method will give a reasonably accurate assessment of the potential for solar energy use. However, it does not consider the economic, political or other factors that affect the feasibility of realizing the potential available. This assessment is complicated and is discussed more thoroughly in the accompanying *Solar Access Workbook*.

The second method of estimating solar energy potential is based on statewide projections of new and retrofit solar applications in the year 2000. This method involves the following steps:

1. Determine the number of existing single family homes and multi-family dwelling units expected to be in use in the year 2000: _____ # of units in 2000. (Calculations based on number of dwelling units in use in other years can also be made.)

2. What percentage of these existing housing units will be retrofit with solar hot water systems? A guideline figure based on statewide projections is 50%:

_____ # of units x .5 = RH # of retrofit hot water systems in 2000.

3. What percentage of these existing housing units will be retrofit with active solar space heating systems? A guideline figure is 5%: _____ # of units x .05 = RA # of retrofit active solar systems in 2000.

4. What percentage of these existing housing units will be retrofit with passive solar space heating systems? A guideline figure is 10%: _____ # of units x .10 = RP # of retrofit passive solar space heating systems in 2000.

5. Total residential retrofit solar potential can be calculated using the following formula:

RS = (RH x 10) + (RA x 30) + (RP x 6)
where
RS = residential retrofit solar potential in million BTU/year
RH = number of potential DHW retrofits
RA = number of potential active space heating retrofits
RP = number of potential passive space heating retrofits

6. Estimate the number of housing units (single family homes plus number of multi-family dwelling units) that will be built between the base year and the year 2000.

7. What percentage of these new housing units will be built with solar hot water systems? A guideline figure based on statewide projections is 50%: _____ # of new units x .50 = NH # of new hot water systems by 2000.

8. What percentage of new housing units will be built with active solar space heating systems? A guideline figure is 10%: _____ (# of new units) x .10 = NA # of new active space heating systems by 2000.

9. What percentage of new housing units will be built with passive solar space heating systems? A guideline figure is 50%: _____ (# of new units) x .5 = NP # of new passive space heating systems by 2000.

10. Solar energy use potential in new housing can be calculated using the following formula:

NS = (NH x 10) + (NA x 30) + (NP x 30)
where
NS = solar potential in new housing units
NH = number of potential new hot water systems
NA = number of potential new active space heating systems
NP = number of potential new passive space heating systems

11. Total solar energy use potential for the residential sector can be calculated then by adding retrofit solar (RS) and new solar (NS) values derived above:

S = RS + NS

Estimating the solar energy use potential for commercial, institutional, and industrial buildings in the community is more difficult because of wide variety in type and sizes of potential solar applications. To get a rough estimate of solar energy use potential in these sectors, contact individual facility managers or a solar energy firm or architect with solar design experience.

REFERENCES

Minnesota Energy Agency
Solar Access Workbook

Minnesota Solar Research Advisory Panel
P.O. Box 9815, Minneapolis 55440
612/292-8805

Minnesota Solar Office
980 American Center Building
St. Paul, Minnesota 55101
612/296-5120

Mid-America Solar Energy Complex
612/853-0400

Wolverton
solar addition to Community Center
218/995-2218

Mankato
solar mall study
507/625-3161

Wind Energy

Wind energy systems, including the traditional windmill, convert the motion of wind into mechanical energy, which then can be converted to electricity, heat, or stored energy.

KEY ISSUES

Windmills provided a lot of energy on farms in the midwest until the Rural Electrification Act in the 1930's replaced them with cheap public power. Now wind systems are reappearing as a supplemental power source. Recent legislation now allows cities to finance wind systems with municipal bonds, which opens the way for local governments to become more active in this area.

Relations with utilities are important in getting windmills accepted in the community. Several issues involving selling power back to the utility at times when the windmill provides more power than the owner needs remain to be worked out. But more and more manufacturers are getting interested in making the equipment and wind should follow solar as a popular supplemental energy source, especially in rural areas.

The primary problem is cost — smaller systems are still often more expensive per kilowatt-hour than buying utility power. Larger systems can be more economical per kilowatt-hour, but their initial cost is very high.

STEPS

A simple estimate of potential wind energy, based on individual sites, goes as follows:

1. In rural areas, identify sites using the Minnesota Energy Agency's *Wind Siting Manual*, or by looking for sites with:
   - high wind speeds
   - good exposure - hills, ridges, etc.
2. In urban areas use the siting manual, or look for nearby sites with adequate exposure, high wind speeds, far enough from structures to meet aesthetic and other criteria.
3. In rural areas, assume 4-kilowatt machines are used. Multiply the number of sites by 30 to derive the energy yield in million BTU per year.
4. In urban areas, assume 40-kilowatt machines are used. Multiply number of sites by 300 to derive energy yield in million BTU per year.

This method is very simplistic: individual site analysis is a much more complex process and the Energy Agency's *Wind Siting Manual* should be used for more in-depth analysis.

REFERENCES

Minnesota Energy Agency
Alternative Energy Division
612/296-5120

Lincoln, Nebraska Electric System
402/475-4211

Minnesota Energy Agency. *Wind Machines and Zoning*

A Siting Handbook for Small Wind Energy Conversion Systems.
Harry L. Wegley, et al., Pacific Northwest Laboratory.
Richland, Washington. March 1980.

Small-Scale Hydroelectric Power

Small-scale, or "low-head" hydro power is the generation of electricity at dams with a head (the difference in water level between the upriver and downriver side of the dam) of less than 20 meters (about 60 feet).

KEY ISSUES

In the last few years interest has greatly increased around the country in small-scale hydroelectric projects. There are thousands of sites that have abandoned hydro facilities, or potential for hydro development. A Department of Energy feasibility grant program and recent federal legislation that allows tax-exempt municipal bond financing for small hydro projects have helped stir local interest.

Key elements to a successful small hydro project are:

- assuring that water rights, flow projections, etc. will provide enough water flow for a reliable power source;
- finding a reliable power purchaser and a sufficient price per kilowatt hour;
- clearing a number of permit hurdles involving various enrivonmental laws.

STEPS

This estimating method for hydro resource assessment should be used only in communities with existing dams. The basic steps in the method are:

1. Identify hydro sites using data from the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota, the Army Corps of Engineers, local planning commissions, or the U.S. Geological Survey.

2. Obtain head (difference between water level above and below dam, in feet) and average annual flow (in cubic feet per second) data from the same sources.

3. Multiply head by flow and divide the result by 13.7 to yield power capacity in kilowatts.

4. Multiply capacity (in kilowatts) by hours in the year (8760) times a capacity factor (.5 is a typical average, .33 to .65 is a typical range) to get power generated annually, in kilowatt hours.

5. Multiply kilowatt hours by 3413, and then by .9 to allow for transmission losses, to obtain BTU production potential.

As with wind power, each hydro site needs detailed, careful analysis based on economics as well as energy yield. The above method is a quick "first cut" to determine energy potenial.

REFERENCES

St. Anthony Falls Hydraulic Laboratory
University of Minnesota

City of Rochester
507/285-8940

Nebraska Municipal Power Pool
402/474-4759

EG&G, Inc.
Idaho Falls, Idaho
208/526-8224

Energy From Conventional Crops And Crop Residues

Crops grown for human and animal food contain a great deal of energy, almost half the projected state demand for energy in 2000. Crops can be converted to liquid and gaseous fuels through various technologies. The best-known technology at present is distillation to alcohol. Crops residues (stalks, cobs, wheat straw, etc.) could provide as much as 7% of state energy needs in 2000.

KEY ISSUES

The principal crops suitable for energy use, with their energy content, are:

CORN (#2)	317,000 BTU/BUSHEL
SOYBEAN	398,000 BTU/BUSHEL
OATS	212,000 BTU/BUSHEL
WHEAT	398,000 BTU/BUSHEL
BARLEY	318,000 BTU/BUSHEL
HAY	14 MILLION BTU/TON

It is important to note that diversion of large amounts of crops to energy uses is not anticipated because of increasing value of the crops as food. Residues, however, may be more available, and thus may be a more practical resource, despite their smaller overall resource potential.

STEPS

To calculate potential from crops:

1. Estimate acreage available in each crop type shown above.
2. Estimate crop yields in bushels per acre.
3. Multiply bushel yields by the BTU factors above to obtain total BTU content. Divide 1,000,000 to obtain million BTU.

To calculate potential from crop residues, follow the same procedure above, but multiply the result by .3. The .3 value is a reasonable recovery factor of 30% which accounts for residues that cannot be recovered and those that should be left as soil conditioning. This 30% value is a statewide average and the recovery factor can vary widely throughout the state.

REFERENCES

Minnesota Energy Agency
Alternative Energy Division
612/296-5120

Farmers Home Administration
612/725-5842

Alcohol Update
P.O. Box 35211
Minneapolis, Minnesota 55435

Minnesota Department of Agriculture
Planning Division
612/296-7686

Energy From Wood

Thousands of Minnesotans heat with wood; several plants in the forestry industry fuel their operations from wood wastes. Wood has become a popular form of home heating; about a million cords a year are used for this purpose.

KEY ISSUES

Though Minnesota's land is about 25% forested, increasing pressure on wood resources for use in building materials may limit the quantity and increase the price of wood available for home heating in coming years. Perhaps the most important issue is the use of small and medium-sized private woodlots. Properly managed, their productivity could more than double. In a given community, a cooperative effort among lot owners could produce substantial yields of wood for both fuel and materials.

Safety and environmental concerns should also be considered when evaluating the use of wood for fuel. Safe operation of wood stoves is essential to avoid fires and other hazards. Although wood is a relatively clean fuel, wood burning does release particulates and other emissions which can harm air quality.

STEPS

The State Department of Natural Resources estimates that natural yield for wood biomass is about .32 cords per acre per year, which translates to an average of .46 dry tons or 7.4 million BTU per acre per year. To estimate the wood biomass potential in a given area:

1. Determine the number of acres available for wood harvesting.

2. Multiply acreage by 7.4 to derive million BTU per year potential.

REFERENCES

Minnesota Energy Agency
Alternative Energy Division
612/296-5120

Minnesota Department of Natural Resources
612/296-6157

Single copies of
Wood Stove Safety Checklist
and
Using Wood Stoves and Fireplaces Safely
are available from:

Energy Information Center
Minnesota Energy Agency
980 American Center Building
150 E. Kellogg Blvd.
Saint Paul, MN 55101
612/296-5175 (Metro area)
800/652-9747 (Outstate)

Energy From Animal Wastes

Manure and bedding from animal feedlots and dairies have a high energy content. Animal wastes are especially suitable for digestion to natural gas.

KEY ISSUES

Gas production from animal wastes is economical for community use only in large volumes near consumption centers. Hence a large poultry feedlot or a dairy operation near the community is a prerequisite for this type of energy to be effectively developed. Otherwise, its use will be limited to on-farm applications; some farmers are already using manure gas.

The energy content of various manures is shown below:

Animal	Weight	BTU yield per day (as gas at 600 BTU per cubic foot)
DAIRY COW	1,600 lb.	12,600
BEEF FEEDER	1,000 lb.	17,100
HORSE	850 lb.	15,000
HOG BREEDER	500 lb.	5,400
CHICKEN	4 lb.	120

STEPS

1. Estimate population of each applicable animal type.
2. Multiply population by BTU yield factors above to yield BTU content per day.
3. Multiply daily yield by 365 to produce animal yield; divide by 1,000,000 to express the result in million BTU per year.

REFERENCES

Minnesota Department of Agriculture
Planning Division
612/296-7687

Minnesota Energy Agency
Alternative Energy Division
612/296-5120

Special Energy Crops and Peat

Minnesota has significant biomass potential in what are called special energy crops. These crops include alder, cattails, willows, and certain grasses and reeds. Special energy crops are a valuable energy resource because they have little food or raw material value and they are grown in areas that are generally unsuitable for other agricultural or forest uses. About 20% of Minnesota's land area falls in this category. Sixty percent of the land in this category is peatland which can be used for special energy crop production. Energy crop data are very limited; available research indicates potential yields of 15 dry tons per acre per year. At 8000 BTU per dry pound, that yield would contain 240 million BTU per acre per year.

Peat is dead, partially decayed plant material. There are approximately 7.2 million acres of peatland in Minnesota. Unlike special energy crops and other biomass resources, however, peat renews itself at such a slow rate that it is considered a nonrenewable resource.

KEY ISSUES

Although peat is used for fuel in Ireland and the Soviet Union, peat fuel has not been developed in the United States. Minnesota has sponsored studies of alternatives for using peat, including burning, gasification, and harvesting techniques. For some communities, gasification represents an opportunity to displace expensive Canadian natural gas. Direct burning or wet air oxidation may be alternatives for large municipal or industrial installations. Minnesota's peat is typically low in sulfur content, which reduces the need for expensive pollution control equipment. There is little information available on technical aspects of peat or special energy crop production and harvesting. An important option to consider is growing special energy crops on peatlands without harvesting the peat.

Few communities will have special energy crop lands or peatland suitable for inclusion in local energy planning efforts. The energy potential of these resources could make a significant contribution, however, to the state's overall energy supply.

Special energy crops and peat, like many biomass resources, require large scale recovery to be economical, which may limit their availability for development by local communities. These resources may be an option for a community to pursue, however, if small-scale technologies prove economical or if a community enters into energy production as an economic development project either by itself or with adjacent communities, or if a community encourages private development ventures.

STEPS

Evaluation of peat and special energy crops as an energy alternative is complex, and a procedure for resource assessment is not currently available. The equipment for harvesting and processing is not readily available at this time. Most of the peat in Minnesota is on state-owned land on which a permit for harvesting and reclamation of mined areas is required. Production of special energy crops may also occur on state-owned land, and again, permits may be required. Compliance with environmental regulations for peat and special energy crop production will also be necessary.

REFERENCES

Minnesota Department of Natural Resources
Minerals Division
612/296-4807

Minnesota Energy Agency
Alternative Energy Division
612/296-5120

BioEnergy Coordination Office
270 Biological Sciences Center
1445 Gortner
University of Minnesota
Saint Paul, MN 55108
612/373-2211

District Heating And Cogeneration

REFERENCES

Minnesota Energy Agency
612/296-5120

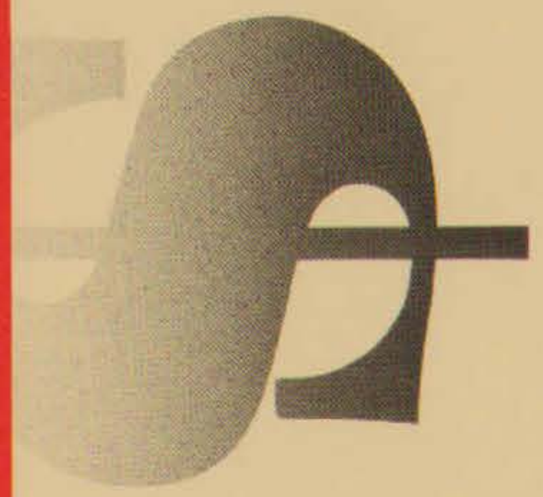
Minnesota organizations involved in district heating:

Cities of:

Mountain Iron
Owatonna
Worthington
Minneapolis
St. Paul
Moorhead
Rochester
Austin
Virginia
Duluth
Hibbing
Blue Earth
Detroit Lakes
Fairmont
New Ulm
Sleepy Eye
Springfield
Willmar

Minnesota Municipal Utilities Association
612/682-4104

International District Heating Association
Upper Midwest Section
138 Bremer Building
417 N. Robert
St. Paul, Minnesota 55101
612/297-8955



Financing energy programs in the community may be the hardest challenge in the energy program. This section presents a few tools that have been used successfully. Using the capital budget (7.1) can be an important means of shifting energy costs out of short-term energy bills into long-term energy investments. Operating budget set-asides (7.2) in the operating budget are another form of budget funding, more oriented to the short-term. Loan financing (7.3) is presented in several alternatives; tax incentives (7.4) are an important "carrot" to most financing efforts. Federal funds (7.5) can be used for some purposes; bond financing (7.6) may be a feasible approach for some local governments, acting alone or together.

Capital Improvement Project Review

This tool is designed to develop ways to ensure that the local government's budget or capital improvement program contains projects that enhance long-term energy efficiency.

KEY ISSUES

Items in the budget or capital plan can be an important means of building energy efficiency into the community for the future. To do this, the submission and reivew process needs specific ways to affect energy efficiency in capital projects, such as:

- giving higher priorities to submissions that have energy efficient innovations; and
- creating energy efficiency review procedures to make sure that capital projects are as energy efficient as possible, and that energy-efficient alternatives are considered.

As an example of the latter item, the city could require that an "energy budget" be prepared along with a financial submission. This "energy budget" should include:

- the total "life cycle" energy cost for the project;
- evaluation of alternatives to the project that would use less energy, with cost projections; and
- possible modifications to the project that would reduce its energy use, with cost estimates.

STEPS

1. Develop a method for reviewing capital improvement program items that assesses energy impacts and evaluates alternatives.
2. Use above method to review current CIP items to identify potential conflicts with energy goals and programs.
3. Develop amendments to the CIP to reduce conflicts with energy efficiency goals.
4. Adapt the method from Step 1 as part of the regular CIP item review process.

REFERENCES

Capital Budgeting and Energy Use
Portland, Oregon, Bureau of Planning, Office of Policy Analysis

Life-Cycle Costing: A Guide for Selecting Energy Conservation Projects for Public Buildings. U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234. (U.S. Government Printing Office Number: 54-003-003-10980-1)

Simplified Energy Design Economics. (NBS Special Publication 544). U.S. Department of Commerce, National Bureau of Standards, Washington, D.C. 20234.

Operating Budget Set-Asides

Many cities list small capital outlay items in their operating budget funds, usually for equipment items pertaining to a specific department or function. This method can be used to dedicate money to small or moderate size energy projects that are not big enough to be part of the capital improvement program, or that are repetitive in nature such as light bulb replacement or boiler servicing.

KEY ISSUES

Portland, Oregon, has made a policy of using 1% of its annual budget for energy expenditures. Of course, this was done as part of a comprehensive overall energy plan that prioritizes energy saving measures and plans the timing and procedures for implementing them.

STEPS

A practical approach to developing energy set-asides would include the following steps:

1. Develop a comprehensive list of energy conservation measures.
2. Develop a priority list on a year-by-year basis for each department or fund area.
3. Determine how much money will be available in each department or fund budget for the energy set-aside for the coming year.
4. Earmark specific energy measures for funding with the coming year's set-aside.
5. Develop specific action plans for each energy measure.

REFERENCES

Capital Budgeting and Energy Use
Portland, Oregon, Bureau of Planning

Loan Financing

Loans are the most common method of financing home improvements, business renovations, and other building improvements that can include energy measures.

KEY ISSUES

Loan programs have become a popular way to finance energy projects in the home. Some of the most effective approaches have been:

- The Minnesota Housing Finance Agency Home Improvement Loan Program; the agency issues low-interest funds, and uses the proceeds to create low-interest loans through local banks
- using Community Development Block Grant funds to create non-profit corporations, which can issue loans on a revolving basis, on a deferred-payment basis, and at low interest.

Loan programs are best supported by grant programs for those unable to afford loans; the MnHFA program has such a companion grant program. Local Community Action agencies also have had weatherization grants; however, these grants will likely be made part of a larger block grant program.

STEPS

1. Consult local bankers to see if they are participating in the MnHFA home improvement loan program. If not, work with them to develop participation. If so, work with them to increase participation and link the loan program to other energy programs.

2. Consult local utilities to identify energy loan programs underway. If programs exist, help increase participation and link the program to other energy efforts. If not, encourage utilities to develop financing programs in cooperation with other energy efforts.

3. If the community is a block grant recipient, review the program and its rules to identify opportunties for energy financing through the CDBG program.

REFERENCES

Minnesota Housing Finance Agency
612/296-8844

City of Wichita Home Insulation Loan Program
City of Wichita, City Hall
455 N. Main Street
Wichita, Kansas 67202

local banks

local utilities

Tax Incentives

Tax incentives include federal and state income tax credits, and abatements on property taxes for energy improvements.

KEY ISSUES

Local governments can help encourage energy conservation and renewable resource investments through property tax credits. Federal tax credits already exist (up to 15% of the first $2,000 of expenditures, or $300) for conservation, and solar equipment (up to 40% of the first $10,000 or $4,000). Minnesota's renewable energy tax credit allows direct state income tax credits of up to 20% of the first $10,000 in expenditures, for items such as:

- passive solar systems
- earth sheltered homes
- biomass conversion equipment

Some property owners, however, are reluctant to install energy features which raise the assessed value of their buildings and thus increase their property taxes. Some cities have developed "tax abatement" policies that exclude energy improvements from tax assessments.

The tax abatement approach can be combined with land use strategies. If the local government seeks to attract higher density development in selected areas, it can offer tax abatements that assess properties built in desired areas at reduced rates.

STEPS

1. Obtain information and brochures on state and federal tax credits from the Minnesota Energy Agency Information Center.

2. Distribute information on tax credits independently and as part of other programs.

3. Review current property tax assessment rules to assess possibilities for exempting energy improvements from assessment increases.

REFERENCES

Minnesota Energy Agency Information Center
612/296-5175 (metro area)
800/652-9747 (outstate)

Federal Assistance Programs

Several federal programs can be used to support or enhance local energy efforts. They include:

WEATHERIZATION ASSISTANCE

Local CAP agencies have been providing direct weatherization services to low income and elderly residents. In some cases, CAP agencies have worked with the Title I Home Improvement Loan Program to provide both direct grants and financed improvements:

Contact:
Local CAP Agency, or the
State Department of Economic Security
612/296-5744

TITLE I HOME IMPROVEMENT LOANS

The Minnesota Housing Finance Agency works with hundreds of local lenders, purchasing home improvements loans that can include energy measures. MnHFA issues bonds to create capital for these loans and uses HUD's Title I insurance program to assure local lenders.

Contact:
Local lenders
or the Minnesota Housing Finance Agency
612/296-8844

COMMUNITY DEVELOPMENT BLOCK GRANTS (CDBG)

The CDBG program has been widely used for a variety of community improvements, and recently energy projects have been included as eligible uses of CDBG funds. CDBG funds have been used for reducing loan interest rates, for thermal flyovers, and for building solar ad conservation demonstration sites.

Contact:
HUD Area Office
612/349-3019

Piqua, Ohio
513/773-1284
(CDBG funds used to reduce interest rates on loans for district heating program.)

Hutchinson, Kansas
City of Hutchinson
125 E. Avenue B
P.O. Box 1567
Hutchinson, Kansas 67501
(CDBG funds used for thermal flyovers, educational campaign, and low interest loans.)

Evanston, Ilinois
Planning Department
312/328-2100
(CDBG funds used for neighborhood solar and conservation demonstration and training program.)

APPROPRIATE TECHNOLOGY GRANTS

The Department of Energy's Appropriate Technology Small Grants Program provides grants up to $50,000 to develop, design, or build innovative small scale renewable resource technology projects. Funding is limited but paperwork is not burdensome and eligibility is fairly open.

Contact:
Department of Energy
Region 5 Office
Chicago, Illinois

Tax-exempt Bonds

Tax-exempt bonds are financing instruments issued by public entities, the interest on which is exempt from federal income tax. This tax exemption makes the bonds attractive to investors, and allows the bonds to be issued below the market interest rate. The low interest rate and long term makes bonds an attractive financing tool, because periodic payments can be relatively low.

KEY ISSUES

Tax exempt bonds are becoming an important source of financing for energy programs, especially in an era of high commercial interest rates. The Minnesota Housing Finance Agency's Revenue Bonds are used for home improvement loans that can include energy measures. Burlington, Vermont, recently passed a $2 milllion bond issue to finance its energy conservation program. Minneapolis plans to issue $3 million in tax exempt financing to fund a low interest energy conservation loan program in association with the Minnegasco gas utility.

Besides conservation programs, recent federal legislation has permitted tax-exempt financing to be used for certain kinds of energy technologies, including:

- biomass
- alcohol
- hydroelectric
- wind energy
- solar energy
- geothermal

Red Wing issued a general obligation bond to finance a solid waste combustion plant. General Obligation (G.O.) bonds are easier to issue than revenue bonds, if the issuer's bond rating is good, because G.O. bonds are backed by the issuers taxing power and "full faith and credit". Revenue bonds are backed only by projected revenue from the funded project. Revenue bonds may be more popular locally in that they don't affect taxes or the public debt, but careful negotiations are needed to ensure a revenue stream that will cover bond payments over the funding period.

Bond financing can be an effective way to fund a loan program. It can create low enough interest rates and long enough loan repayment terms that the loans become attractive to consumers. However, bond issues may require extensive prospective analysis, documentation, and negotiation, and should be considered carefully. Also, the costs of issuing bonds require that bond issues be fairly large. This means that instead of each local government issuing its own bonds, a consolidated issue by a state or regional authority is often more economically feasible.

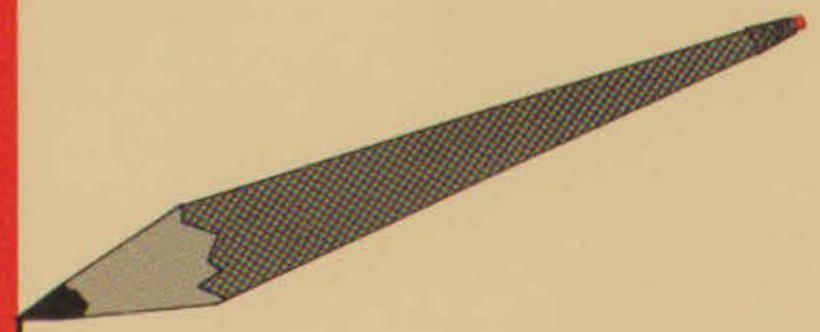
STEPS

1. Review the local government's current bond-issuing practices, bond rating, etc.
2. Review major energy projects needing substantial financing, and identify financing needs.
3. Evaluate feasibility of financing energy projects through local bonds, either on a project-by-project or consolidated basis.
4. Review potential for participating in a bond issue with other units of government to reduce bond issuance costs and debt burden.

REFERENCES

Minnesota Housing Finance Agency
612/296-8844

Minneapolis Housing and Redevelopment Authority
612/349-2513



Sample Resolution

RESOLUTION NO. 80-26

RESOLUTION ESTABLISHING A CHAMPLIN ENERGY COMMISSION AND DEFINING DUTIES AND RESPONSIBILITIES THEREOF.

WHEREAS, the City of Champlin is promoting conservation and efficient use of energy resources within the community, and

WHEREAS, in response to the increasing concern for energy conservation it is desirable to establish an Energy Commission, and

WHEREAS, the City Council has the authority to establish advisory commissions to formulate policy for municipal functions and activities, and

WHEREAS, in pursuit of such goals the City Council recognizes the need to define the duties and responsibilities to be assigned to an Energy Commission.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Champlin that there is hereby established within the City of Champlin an advisory Energy Commission as follows:

Subdivision 1. TITLE: This organization shall be known as the Champlin Energy Commission.

Subdivision 2. SCOPE: The scope of activity of this Commission shall consist of advising the City Council and other Champlin advisory commissions regarding matters relevant to energy use and conservation.

Subdivision 3. PURPOSE: The general purpose of this Commission is to monitor data to the community on effective conservation and the efficient use of energy resources, and matters relevant to energy conservation in Champlin.

Subdivision 4. DUTIES AND RESPONSIBILITIES: In fulfillment of its purpose, the duties and responsibilities of the Commission shall be to:

(1) Develop, recommend, and, upon adoption by the City Council, monitor the implementation of a comprehensive energy plan for operation of all municipal buildings in the City of Champlin.

(2) Report to the City Council regarding achievements toward fulfillment of the comprehensive energy plan and recomend amendments to the plan as may be warranted.

(3) Develop, recommend, and, upon adoption by the City Council, disseminate information on a City plan for energy emergencies.

(4) Develop and recommend feasible methods to promote energy conservation programs.

(5) Serve as a forum for the citizens of Champlin to voice opinions regarding energy conservation.

(6) Disseminate information to the citizens of Champlin and community organizations.

Subdivision 5. COMPOSITION: The Commission shall be composed of a chairman and six members, all of whom shall be appointed and serve as set forth in Subdivision 6.

Subdivision 6. MEMBERS METHOD OF SELECTION — TERM OF OFFICE — REMOVAL:

Chairman: The Chairman shall be appointed annually by the Mayor with majority consent of the Council. The Chairman may be removed by the mayor with majority consent of the Council. The Chairman shall assure fulfillment of the following responsibilities in addition to those otherwise described herein:

(1) Preside over meetings of the Commission;

(2) Appear or appoint a representative to appear, as necessary, before the City Council and City advisory commissions to present the viewpoint of the Commission on matters pertaining to energy conservation as it relates to issues under consideration by the City Council or said commission.

(3) Provide liaison with other governmental and volunteer units in matters relating to energy conservation for the purpose of obtaining and providing information.

Vice Chairman: A Vice Chairman shall be appointed annually by the Chairman. The Vice Chairman shall perform such duties as may be assigned by the Chairman and shall assume responsibilties of the chair in the absence of the Chairman.

Member's Term of Office: Members of the Commission shall be appointed by the Mayor with majority consent of the Council for terms of three years, except that any person appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. Upon expiration of his term of office, a member shall continue to serve until his successor is appointed and shall have qualified.

Representation Requirements: Commission members shall reside in the City of Champlin: one member from each ward and three members-at-large, provided there shall be no more than two commissioners residing in the same ward. The Chairman of the Commission shall be one of the members-at-large.

Qualifications for Membership: Members of the Commission shall be residents of the City of Champlin while serving on the Commission and shall represent a broad range of interests in energy conservation.

Initial Appointment: The Commission under this resolution shall become effective on March 1, 1980, and shall consist of three members appointed for a term through December 31, 1982, two members appointed for a term through December 31, 1981, and two members appointed for a term through December 31, 1980.

Resignations—Removal from Office—Vacancies: Commissioners may resign voluntarily or be removed from office by the Mayor with consent of the majority vote of the City Council. Three consecutive unexcused absences from duly called Commission meetings shall constitute automatic resignation from office. Vacancies in the Commission shall be filled by mayoral appointment with majority consent of the City Council.

Compensation: Commissioners shall serve without compensation.

Subdivision 7. RULES AND PROCEDURES: The Commission shall adopt such rules and procedures not inconsistent with these provisions as may be necessary for the proper execution and conduct of business.

Subdivision 8. MEETINGS: The initial meeting of the Commission shall be convened at the call of the Chairman during March 1980. Thereafter regular meetings shall be held with the date and time to be determined by the Commission. Special meetings may be called by the Chairman.

Subdivision 9. EX OFFICIO MEMBERS: The Mayor or her/his Councilmember appointee may serve as an ex officio member of the Commission privileged to speak on any matter but without a vote, and shall provide a liaison between the Commission and the City Council.

The motion for the adoption of the foregoing resolution was duly seconded by Councilmember Rick and upon vote being taken thereon, the following voted in favor thereof: Mayor Nunn, Councilmembers Baldwin, Johnson, Rick and Winch and the following voted against the same: none, whereupon said resolution was passed this 22nd day of January, 1980.

_____

Josephine D. Nunn, Mayor

ATTEST:

_____

County Energy Program Organization

COUNTY BOARD OF COMMISSIONERS

COUNTY COORDINATOR, EXECUTIVE SECRETARY OR ADMINISTRATOR (25 COUNTIES)

COUNTY ENERGY COORDINATOR
(New Position or Existing Employee)

COUNTY-WIDE ENERGY ADVISORY COMMITTEE

- City, School, and Township Representatives
- Business Groups
- Energy Suppliers
- Educational Institutions
- Civic Organizations
- Community Leaders
- Energy/Environmental Organizations

INTERGOVERNMENTAL CONTACTS

- School Districts
- City Governments
- Other Counties
- State Agencies
- Regional Agencies
- Association of Minnesota Counties
- National Association of Counties

COUNTY DEPARTMENT ENERGY COMMITTEE

- Representatives of County Departments
- Special Emphasis on County Engineer, Planning and Zoning Officer, Sheriff, and Building Operations Staff

SAMPLE RESOLUTION

RESOLUTION ESTABLISHING A COUNTY ENERGY MANAGEMENT POLICY

WHEREAS, the national economic, environmental, and energy availability situation requires that the citizens of the United States and its organizations and institutions engage in an ongoing energy management effort; and

WHEREAS, the County of _____ acknowledges the need for vigorous local community action and county government leadership in energy management;

NOW THEREFORE, BE IT RESOLVED, by the Board of Commissioners of _____ County that the following steps will be taken to promote energy conservation practices and the development of alternative energy sources:

1. The use of energy in all county operations shall be annually budgeted and regularly monitored.

2. The use of alternative fuel supplies for county buildings, vehicles, and service provision activities shall be periodically analyzed and promoted where practical.

3. An on-going energy conservation program shall be conducted with respect to county building equipment and operating practices.

4. County board members and employees will join with representatives of city, school, and township government and with business and community leaders in comprehensive energy management programs.

5. County board and administrative actions with respect to community planning and development shall be encouraging of and consistent with energy management objectives.

BE IT FURTHER RESOLVED, that the _____ shall appoint a County Energy Coordinator and an Energy Management Committee to coordinate the above activities.

EXAMPLE

COUNTY ENERGY MANAGEMENT POLICY

County Y becomes interested in developing an energy planning approach after regular prodding and encouragement by some county board members and the county auditor, engineer, and zoning administrator, who all give the same message, "We have to begin dealing with the energy situation". As with most activities in county government, an evolutionary approach takes place:

1. The county board chairman requests that a resolution be drafted calling for the county government to undertake energy planning (management, conservation, programs), the designation of an energy coordinator, and for department heads to begin meeting together to develop a county energy approach. The resolution will likely pass in a consensus fashion.

2. The Energy Coordinator (possibly a staff person to the county board, the Civil Defense Director, the Zoning Administrator, or a member of the county engineering staff) begins meeting with departments to determine energy conservation measures that the county government could undertake. As a result of these meetings:

   a. The Planning and Zoning Administrator begins raising the issue of energy planning as a factor in their decision-making. More energy information is requested.

   b. The County Auditor begins to explore the possibility of energy costs being budgeted and accounted for by each department.

   c. The County Engineer, Sheriff, and Purchasing Agent begin to review the specifications for purchases of county vehicles.

3. The County Energy Coordinator begins to make contact within the county and in neighboring counties to determine the current efforts and interest in energy management on the part of the cities, schools, and businesses.

4. As the County Energy Coordinator and department Energy Committee begin to bring energy planning recommendations to the county board, county commissioners begin to discuss whether their energy planning effort should expand throughout the county. If discussion is favorable toward this idea, the county board chairman will probably call a public meeting of mayors, school board members, businesses, the media, and community leaders to consider the idea. Special attention will be given to avoiding the appearance of taking over or competing with energy planning efforts already underway. Special consideration will also be given to determine who will staff the expanded energy committee. There will be some media attention given to this event.

5. Given a favorable response at the public meeting, the county board will adopt a resolution creating a Countywide Energy Comittee. The rationale of the resolution ("whereases") and the size and composition of the Energy Committee will likely be developed from the results of the public meeting.

6. The organizational meeting of the Energy Committee will be convened by the county board chairman. The County Energy Coordinator and representatives of business and other public agencies within the county will discuss their approaches to energy management. Discussion will also take place about how to organize and staff the Committee.

7. At the following meeting(s), the Committee will adopt operating bylaws, develop a work plan, and begin a process of regularly meeting with energy suppliers and users to develop a sense of the opportunities for energy mangement and planning within the county.

8. As Committee objectives become set, a process begins for collecting energy use data.

Community Energy Data Summary

YEAR 1980

COMMUNITY SECTOR / ENERGY TYPE		HEATING OIL (#2) (GALLONS)	NATURAL GAS (THERMS)	ELECTRICITY (KILOWATT-HOURS) (See Note C)	GASOLINE (GALLONS)	OTHER	TOTAL
RESIDENTIAL	UNITS	900,000		32,800,000			
	MMBTU*	124,000		112,000			236,000
	COST	$801,000		$1,314,000			$2,115,000
COMMERCIAL/ INDUSTRIAL	UNITS						
	MMBTU						
	COST						
LOCAL GOVERNMENT	UNITS	12,000		1,500,000	8276		
	MMBTU	1,656		5119	1068		7843
	COST	$ 10,680		$60,000	$10,760		$81,440
TRANSPORTATION	UNITS				1,379,000		
	MMBTU				178,000		178,000
	COST				$1,793,000		$1,793,000
TOTAL	MMBTU	125,656		117,119	179,068		421,843
	COST	$811,680		$1,374,000	$1,803,760		$3,989,440

BTU CONVERSIONS

HEATING OIL (#2)	NATURAL GAS	ELECTRICITY	GASOLINE	COAL	WOOD
Gallons	Therms	KWH	Gallons	Tons	Cords
x	x	x	x	x	x
0.138	0.1	0.003413	0.129	22	30
=	=	=	=	=	=
MMBTU	MMBTU	MMBTU	MMBTU	MMBTU	MMBTU

*MMBTU = MILLION BTU

EXAMPLE

Shown above is a sample energy data summary table for Community X. The basic steps followed in completing the table were:

1. Energy use and cost data for 1980 were obtained from the following sources:

HEATING OIL
estimates from census data;

ELECTRICITY
the serving utility provided residential and municipal user data;

GASOLINE
estimated using vehicle registrations and mileage and travel estimates.

2. Usage and cost data were entered in the table in the appropriate cells. No natural gas was used, so that column was left blank. Commercial usage was insignificant, so that row was left blank.

3. Usage was converted to MMBTU using the formulas at the bottom.

4. Rows and columns were totalled, and total usage and cost were summed and entered in the lower right-hand cell.

INSTRUCTIONS

This table is to be used for recording base year energy use and cost data, following the data collection methods in Chapter 3. It is also usable for energy forecasts.

STEPS

Steps for using the table are as follows:

1. Obtain energy data from suppliers or other sources as described in Chapter 3.

2. Enter units of each energy source (gallon, kilowatt-hours, etc.) in appropriate cells of the table.

3. Enter total costs in dollars for each energy source and user category.

4. Convert units to million BTU (MMBTU) using formula at bottom.

5. Total columns and rows to produce total energy used (in MMBTU) and total dollars spent in the base year, in the lower right cell of the table.

NOTES

a. Energy sources may not be available as shown in the table. If one of the types shown is not available, simply cross out that column (or leave blank). If an energy type is used significantly in the community and is not shown in the table, record it in the "other" column.

b. Energy user categories may not correspond to the rows of the table. If one of the categories shown is not applicable or data are is not available, cross out that row (or leave blank). If a category cannot be separated from another, use one of the rows, cross out (or leave blank) the other, and note the row as representing combined categories.

c. The BTU conversion factor for electricity (3413) represents only the energy value at the point of use. It takes 10,000 or more BTU in raw fuel to generate a kilowatt-hour of electricity . So while the user can only **use** 3413 BTU, 10,000 or more BTU have been **consumed** to provide that kilowatt-hour. The higher conversion figure may be preferred by communities with a municipality-owned electric generating station who wish to assess total energy usage in the community, or by any community interested in considering the total amount of energy expended in the production of its electrical energy supplies.

COMMUNITY ENERGY DATA SUMMARY

YEAR _____

COMMUNITY SECTOR	ENERGY TYPE	HEATING OIL (#2) (GALLONS)	NATURAL GAS (THERMS)	ELECTRICITY (KILOWATT-HOURS) (See Note C)	GASOLINE (GALLONS)	OTHER	TOTAL
RESIDENTIAL	UNITS						
	MMBTU*						
	COST						
COMMERCIAL/ INDUSTRIAL	UNITS						
	MMBTU						
	COST						
LOCAL GOVERNMENT	UNITS						
	MMBTU						
	COST						
TRANSPORTATION	UNITS						
	MMBTU						
	COST						
TOTAL	MMBTU						
	COST						

BTU CONVERSIONS

HEATING OIL (#2)	NATURAL GAS	ELECTRICITY	GASOLINE	COAL	WOOD
Gallons	Therms	KWH	Gallons	Tons	Cords
x	x	x	x	x	x
0.138	0.1	0.003413	0.129	22	30
=	=	=	=	=	=
MMBTU	MMBTU	MMBTU	MMBTU	MMBTU	MMBTU

*MMBTU = MILLION BTU

Energy Problem Definition Table

COMMUNITY SECTOR	ENERGY TYPE	HEATING OIL	NATURAL GAS	ELECTRICITY	GASOLINE	OTHER
RESIDENTIAL	FACTORS	A B C D		A B C D		
	WEIGHTS	2 2 3 3		2 2 1 3		
	TOTAL WT	10		8		
COMMERCIAL/ INDUSTRIAL	FACTORS					
	WEIGHTS					
	TOTAL WT					
LOCAL GOVERNMENT	FACTORS	A B C D		A B C D	A B C D	
	WEIGHTS	1 2 3 2		1 2 1 2	2 3 3 2	
	TOTAL WT	8		6	10	
TRANSPORTATION	FACTORS				A B C D	
	WEIGHTS				3 3 3 3	
	TOTAL WT				12	
AVERAGE WEIGHT		9		7	11	
TOTAL RANK		2		3	1	

Potential Problems
(ranked in order of total weights in cells of the table)

1. GASOLINE (PRIVATE CARS)
2. RESIDENTIAL HEATING OIL
3. MUNICIPAL VEHICLE GASOLINE
4. RESIDENTIAL ELECTRICITY
5. MUNICIPAL HEATING OIL
6. MUNICIPAL ELECTRICITY
7.
8.
9.
10.

EXAMPLE

Community X, in filling out the energy problem definition table, goes through the following steps.

1. Each cell (for which energy data was recorded on the data summary table) was ranked, by assigning weights (1, 2, or 3) to each factor (A, B, C, D), and then adding the factor weights to yield a total weight for the cell.

SAMPLE CELL
(Residential heating oil):

Factor:

USAGE
ranked as important (2), because usage is high, but other sources are higher.

COST
ranked as important (2), because cost is high, but other sources cost more;

VULNERABILITY
ranked as very important (3), because shortages are expected to occur;

CRITICALNESS
ranked as very important (3), because loss of heat has severe health implications.

Total weight: 2 + 2 + 3 + 3 = 10.

2. Cell weights are totalled in each row and column.

3. Individual cell ranks begin with Gasoline (private car) followed by Residential Heating Oil, etc.

4. Individual cell ranks are listed under *Potential Problems* at the bottom of the table.

INSTRUCTIONS

This table is to be used for ranking energy problems based on data collected in earlier phases of the planning process. Refer to the energy data summary tables for base year and forecast data.

STEPS

To fill out the table, follow these steps:

For each cell of the energy data table for which data is entered, rank the importance of that energy type/user category combination using the following method:

1. Consider these factors:

USAGE
How much energy do we use of this type, compared to other types and compared to total use?

COST
How much do we pay for this type, compared to other types and compared to the total cost?

VULNERABILITY
How likely are we to lose this source?

CRITICALNESS
How vital is this function, compared to others, i.e., can it continue in a shortage without causing major disruptions?

2. Weight each factor on the following scale.

   1. Not very important
   2. Important
   3. Very Important

3. Total the weights for the four factors, creating a total weight for the cell.

Rank individual cells, e.g., residential heating oil, commercial electricity, etc.

List ranked individuals at bottom of table under *Potential Problems.*

This method is not quantitative in that it requires judgment and choice based on uncertainty. It is meant to provide a consistent framework for comparing energy types and user categories.

COMMUNITY ENERGY PROBLEM DEFINITION TABLE

COMMUNITY SECTOR / ENERGY TYPE		HEATING OIL	NATURAL GAS	ELECTRICITY	GASOLINE	OTHER
RESIDENTIAL	FACTORS					
	WEIGHTS					
	TOTAL WT					
COMMERCIAL/ INDUSTRIAL	FACTORS					
	WEIGHTS					
	TOTAL WT					
LOCAL GOVERNMENT	FACTORS					
	WEIGHTS					
	TOTAL WT					
TRANSPORTATION	FACTORS					
	WEIGHTS					
	TOTAL WT					
AVERAGE WEIGHT						
TOTAL RANK						

Potential Problems

(ranked in order of total weights in cells of the table)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Energy Resource Inventory

DISPLACED ENERGY TYPE / ENERGY SOURCE	HEATING OIL		NATURAL GAS		ELECTRICITY		GASOLINE		OTHER		TOTAL	
	MMBTU*	(%)**	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)***
CONSERVATION												
Residential	31,000	25%			28,000	25%					59,000	14%
Commercial/Industrial												
Local Government	1,143	69%			3,587	69%	427	40%			5,157	1%
Transportation							71,000	40%			71,000	17%
SUBTOTAL	32,143	26%			31,587	27%	71,427	40%			135,000	32%
RENEWABLES												
Solar	45,500	36%			45,500	39%					91,000	22%
Wind					1,200	1%					1,200	0.2%
Hydro					4,400	4%					4,400	1%
Biomass	6,670	5%			6,670	6%	6,670	4%			20,010	5%
crops												
animal waste												
wood												
special crops												
SUBTOTAL	52,170	42%			57,770	49%	6,670	4%			116,610	28%
DISTRICT HEATING												
TOTAL	84,313	67%			89,357	76%	78,097	44%			251,767	60%

* MMBTU = Million BTU
** (%)= Percent of projected 2000 usage, for the individual sector, (e.g., residential heating oil)
*** Total % - based on total community energy use: hence percentages will be lower than for individual columns.

INSTRUCTIONS

This table is designed to be a summary format for data on energy conservation and renewable resource potentials developed in the resource process described in Chapter 4. Fill in the table as you go through the process; then use it to assess the potential for reducing the use of current energy sources with conservation and renewable resource strategies.

STEPS

1. Estimate conservation potentials in residential, commercial, local government, and transportation sectors. Obtain percentage estimates, then apply the percentages to projected energy demand in 2000 or another target year to obtain BTU estimates. Apply conservation potentials against energy types replaced, using the substitution table in Tool 8.6. Except in transportation, conservation potentials apply equally to all energy types used in buildings.

2. Total conservation potentials by row and column, enter results in subtotal row, and total column. **Note:** in summing the columns, calculate the percentage in relation to **total community energy use**, so that the far right hand column reflects the potential impact of that one resource strategy on total community energy use, not just on use in that sector. This reduces the percentage in the right hand column but allows different resource strategies to be compared on the same basis. As the example shows, residential conservation potential is 25% of **residential** energy use, but 14% of **total community** energy use.

3. Estimate resource potentials from renewable sources and enter the gross potentials in BTUs in the appropriate cells of the table. Use Tool 8.6 to allocate potential among energy types, unless a specific technology is to be used which would replace a specific energy type. **Note:** Unlike conservation, which begins with percentages and derives BTUs, renewable potentials develop BTU figures which then are calculated as percentages. This means that if, for instance, solar can produce 91,000 million BTU, that BTU total must be allocated among all the applicable energy types (in this case heating oil and electricity). So if a renewable potential can replace more than one energy type, divide the total BTU potential equally among all applicable energy types. This does not happen in allocating conservation potential; if the conservation potential is 25%, the 25% applies equally to all of the applicable energy types.

4. Total renewable resource potentials by row and column. Note that in totalling columns, the percentage in the far right hand column should be calculated against total community energy usage, whereas in adding up rows in a given column, the percentage applies only against that one sector. For example, the total solar potential of 91,000 million BTU is 36% of heating oil usage plus 39% of electricity usage, but only 22% of total community usage. However, when adding potentials under the heating oil column, the total for the column is applied only against heating oil usage to derive the percentage.

5. Summing rows and columns produces a total resource potential in terms of BTU and in terms of the projected "base case" scenario. This total potential can be treated as a single scenario, as an alternative to the "base case" scenario, or it can be used in two parts. If the conservation potentials are taken alone and applied against the "base case" scenario, a "conservation scenario" can be produced. As the example shows, this "conservation scenario" could require 32% less energy than originally expected. Then the renewable resource potentials could be applied against the conservation scenario. Compared with the reduced demand in the conservation scenario, the renewable resource potentials could supply a much higher percentage of total energy demand, almost 50% instead of the 28% estimated in the base case scenario.

ENERGY RESOURCE INVENTORY

DISPLACED ENERGY TYPE / ENERGY SOURCE	HEATING OIL		NATURAL GAS		ELECTRICITY		GASOLINE		OTHER		TOTAL	
	MMBTU*	(%)**	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)	MMBTU	(%)***
CONSERVATION												
Residential												
Commercial/Industrial												
Local Government												
Transportation												
SUBTOTAL												
RENEWABLES												
Solar												
Wind												
Hydro												
Biomass												
crops												
animal waste												
wood												
special crops												
SUBTOTAL												
DISTRICT HEATING												
TOTAL												

* MMBTU = Million BTU
** (%)= Percent of projected 2000 usage, for the individual sector, (e.g., residential heating oil)
*** Total % - based on total community energy use: hence percentages will be lower than for individual columns.

Energy Resource Substitution Table

ENERGY SOURCE / DISPLACED ENERGY TYPE	HEATING OIL	NATURAL GAS	ELECTRICITY	GASOLINE
CONSERVATION				
Residential				
Commercial/Industrial				
Local Government				
Transportation				
Subtotal				
RENEWABLES				
Solar				
Wind				
Hydro				
Biomass				
crops				
animal waste				
wood				
special crops				
DISTRICT HEATING				

INSTRUCTIONS

This table is to provide guidance as to which conventional fuels can be replaced by a given conservation strategy or renewable resource. It is meant to be used with the Energy Resource Inventory to show where conservation and renewable potentials should be entered in the inventory.

For each conservation or renewable strategy to be applied, first try to identify which conventional sources can be replaced. For example conservation normally reduces all sources by an equal percentage; so if the residential conservation potential is set at 36%, each residential energy type would be reduced by 36% from the base year energy data summary.

For renewable strategies, potentials are identified in BTUs rather than percentages. Also, the choice of technology affects which sources can be replaced; for instance if crops are used to make gasohol, the replaced source would be gasoline. If the technology is not known, divide the raw BTU potential equally among the conventional sources checked in the substitution table. For example, if crops contain 200,000 million BTU potential, the 200,000 should be divided equally among heating oil, natural gas, electricity, and gasoline, or 50,000 million BTU each.

It should be noted that solar, wind, hydro, and solid waste resource estimates include allowances for conversion losses, and the others are usually stated in raw BTU potential. These conversion factors should be kept in mind, in estimating resource potentials without specific technologies.

Energy Strategy Statement

PROBLEM: _____

GOAL: _____

STRATEGIES:

STRATEGY #1 _____

Cost Considerations

Capital and Funding Requirements _____

Payback _____

Cost Per Million BTU _____

Potential Conflicts: _____

STRATEGY #2 _____

Cost Considerations

Capital and Funding Requirements _____

Payback _____

Cost Per Million BTU _____

Potential Conflicts: _____

STRATEGY #3 _____

Cost Considerations

Capital and Funding Requirements _____

Payback _____

Cost Per Million BTU _____

Potential Conflicts: _____

8.7
FORMS AND SAMPLES

INSTRUCTIONS

A direct approach to developing energy goals and strategies is to match energy resource potentials directly, using data from the energy problem definition table (Tool 8.4) and the energy resource inventory (Tool 8.5). From these data a summary of problems and potential solutions can be created in the form of a goal and strategy statement.

A single sheet or set of sheets could be developed for each problem so that each problem is clearly identified with a set of potential solutions.

Each strategy should be specific, with quantifiable results and target dates stated as clearly as possible.

Sample Zoning Ordinances

MOORHEAD, MINNESOTA ZONING ORDINANCE AMENDMENTS EXEMPTING SOLAR ENERGY SYSTEMS FROM LOT COVERAGE RESTRICTIONS

Section 2.00 — **Definitions**, Subsection 2.02, is hereby amended to read as follows:

Lot Coverage for One and Two-Family Dwellings — Includes those areas covered by principal buildings, accessory buildings, and garages but does not include areas for walkways, access drives, parking spaces, open patios, swimming pools, tennis courts, landscaping elements, and solar energy systems which are not included in the floor area of the building.

Lot Coverage for Multiple-Family Dwellings — Includes those areas covered by principal buildings, accessory buildings, and garages but does not include areas used for walkways, access drives, parking spaces, open patios, swimming pools, tennis courts, landscaping elements, and solar energy systems which are not included in the floor area of the building.

Section 5-1 Streets and Alleys

Streets

Local — Local streets shall be laid out so that their use by through traffic is discouraged. When feasible, local streets shall be oriented on an east-west axis within a variation of 10° to the northwest and 25° to the southwest for the purpose of encouraging proper lot orientation for solar access. Variation from this standard shall be allowed for consideration of factors such as topography, natural features, existing street and utility patterns, adjacent land uses and use of other energy-efficient design techniques.

Section 5-2 Block and Lots

Lots

Side Lot Lines — Side lines of lots shall be substantially at right angles to straight street lines or radial to curved street lines. Variation from the right angle standard may be allowed by the Planning Commission when the variation results in the north-south orientation of lots for solar access.

MOORHEAD, MINNESOTA ZONING LANGUAGE ON PLANNED UNIT DESIGN AND SOLAR ACCESS

SUBSECTION 33.11

Planned Unit Design. For purposes of flexibility, uniqueness, innovative design, energy conservation and the encouragement of the use of renewable energy sources, it is hereby established that a modification of yard requirements may be granted if the applicant files and receives approval in accordance with Section 8.00 as it relates to Conditional Use Permits. The proposal shall meet the following criteria:

a. The parcel shall be a minimum of one (1) acre in size.
b. The proposal shall be compatible with adjacent land use.
c. Minimum side yard requirements of the parent district shall be maintained on its perimeter lot lines when abutting adjacent lots.
d. The proposal shall not increase the overall density as regulated by the requirements of the parent district, except that a density bonus of up to 20% may be granted in the R-1 single and limited two-family district and R-2 single and two-family district for developments that optimize creative and efficient use of land and housing to promote energy conservation and alternative energy sources. Approaches may include active and/or passive solar systems, earth-shelter structures, clustered units of up to four per structure (in the R-1 district), landscaping and energy construction standards that will achieve a heating load of not more than three BTU's per square foot per degree day per year.

The following requirements shall be required:

1. A site plan depicting the housing units, parking, drainage, streets, landscaping and adjacent buildings and landscaping.
2. A typical cross-section of each type of housing unit.
3. Building envelope heat loss calculations.
4. A tree shadow plan of all existing or proposed trees by species at expected maturity within the Planned Unit Design as cast by the sun on December 21st and June 21st at an azimuth of 50° ± due south. A building shadow plan cast by the sun on December 21st and June 21st at an azimuth of 50° of ± due south.
5. A building shadow plan cast by the sun on December 21st and June 21st at an azimuth of 50° ± due south.
6. Appropriate easements or covenants to assure future solar access.