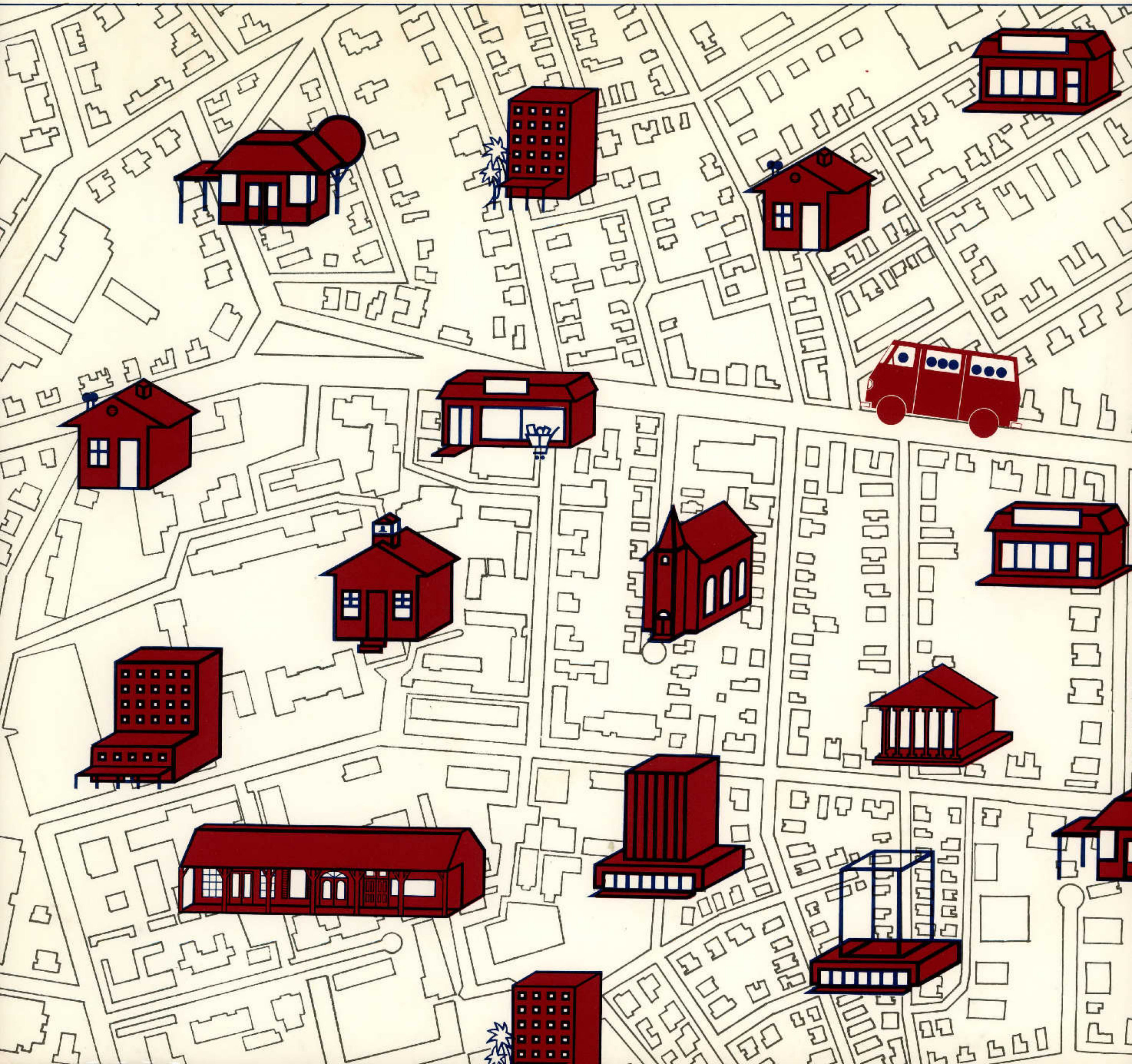
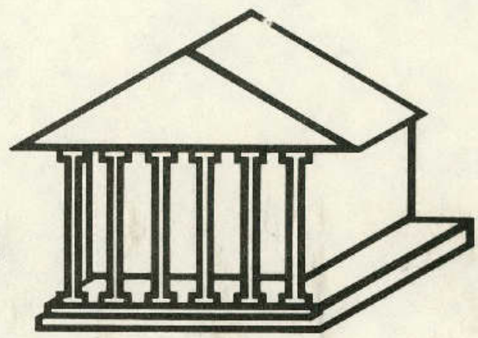
TEXAS ENERGY MANAGEMENT



TEXAS ENERGY MANAGEMENT

LOCAL GOVERNMENTS



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Energy Management in Local Governments

An Awareness Program Sponsored by
The Governor's Office of Energy Resources
STATE OF TEXAS

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ACKNOWLEDGMENTS

The Governor's Office of Energy Resources is indebted to the many groups, individuals and publications which contributed to development of this workbook.

Special thanks goes to the following agencies which supported promotion of the workbook and program through their various association meetings:

Texas Association of Counties
Texas Association of Regional Councils
Texas City Management Association
Texas Mayors and Councilman's Institute
Texas Municipal League

PURPOSE

These materials are intended to encourage an awareness of the wide range of ideas, programs and services of potential use in the development of local government conservation programs. References to specific ideas, products and services should not be construed as endorsements. It is hoped that the information provided through this workbook will be useful as you explore your many options and opportunities for encouraging energy conservation.

FOREWORD

This workbook, Energy Management in Local Governments, is intended to supplement the 1978 Energy Conservation Workbook for Local Governments. The earlier publication was distributed in conjunction with 24 regional workshops conducted by the Governor's Office of Energy Resources in 1978.

Portions of Energy Management in Local Governments convey some of the same information; however, where entries or contributions appear identical, there may actually be changes and updates incorporated as of May, 1979. This is particularly true of the Directories for federal, state and non-governmental contacts and related information.

Each of these manuals is intentionally broad in scope and therefore addresses a variety of conservation opportunities; many other supporting publications have been developed under this program to amplify major concepts. For example, the Local Government Energy Audit Training Manual prepared for use in approved training for local government energy auditors presents specific technical and grant procedure information.

Together, these documents and others mentioned in the enclosed bibliography are the basis of a practical, reliable and local government-specific energy conservation library.

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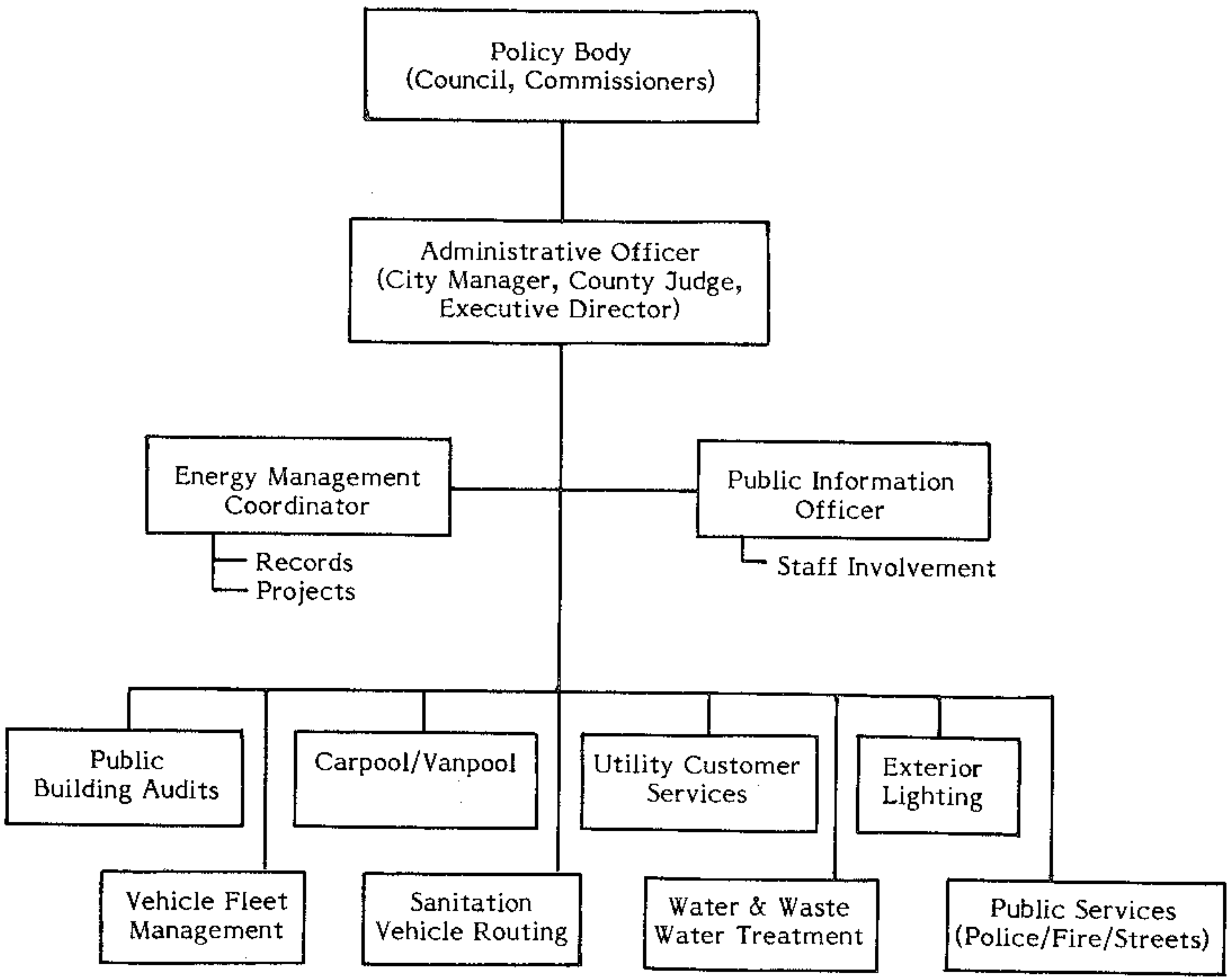
ORGANIZING THE LOCAL ENERGY MANAGEMENT EFFORT



Assistance

NATIONAL ENERGY CONSERVATION POLICY ACT OF 1978

The National Energy Conservation Policy Act (NECPA) of 1978 provides $65 million for assistance to general local governments and public care institutions conducting three levels of energy audits of public buildings:

Level I - Preliminary Energy Audit (PEA) -- An information gathering survey not requiring on-site audit or outside assistance.

Level II - Energy Audit -- A more site-specific review of facilities requiring a review of maintenance and operating procedures and opportunities for Energy Conservation Measures (retrofit) by persons who have received state-approved training.

Level III - Technical Assistance -- An on-site, detailed energy analysis by a registered engineer or engineer/architect team. The result is to be a careful estimate of Energy Conservation Measures (ECMs), the costs, the expected savings and the payback period of each.

Schools and hospitals only are eligible for additional assistance -- Level IV, Energy Conservation Projects (Retrofit), general local governments and public care institutions do not qualify for Level IV.

Additional information on this program is contained in the Public Buildings Section of the workbook.

INNOVATIVE GRANTS FOR ENERGY CONSERVATION

The Governor's Office of Energy Resources has again awarded Innovative Energy Conservation grants to 13 local governments in Texas for 1979. The grants are part of a concerted, statewide effort of the Governor's Office of Energy Resources to promote planning and awareness of energy efficiency methods and needs.

The grant program has provided at least $200,000 each of the last two years to fund worthwhile projects submitted by any local agency qualifying under State law as "political subdivisions." This includes cities, counties, school districts, regional councils of governments, and many other entities. Grants require a one-third cash or in-kind match by the applicant. The grants are normally limited to $20,000 or less.

The State of Texas must achieve stated goals through 1980 in order to contribute to national conservation efforts. The grants program aids the development, implementation, evaluation and transfer of projects by local governments. Projects must be innovative, demonstrate a likelihood of successful energy conservation, and be transferable to other entities.

1979 grants ranged from $10,000 to $20,000, and were awarded to:

Alamo Area Council of Governments, Regional Energy Advisory Plan

City of Arlington, Energy Conservation in Portable Water Distribution Systems

City of Austin, Heat Rate Improvement for Texas Public Utilities

City of Canyon, Wind Energy for Municipal Water Systems

Dallas County Community College District, Energy Awareness Training for Physical Plant Directors

City of El Paso, Municipal Government Energy Management Program

Frankston Public Schools, School-Community Energy Conservation Awareness and Action Program

City of Galveston, Energy Conservation Component Neighborhood Plan: East End - North Central

City of Garland, Public Library Energy Information Program

City of Lufkin, Lufkin Worm Ranch

North Central Texas Council of Governments, Regional Energy Newsletter

South Plains Association of Governments, Aerial Infra-red Images for Heat Loss Determination

City of Texarkana, Direction 84 - Development of Comprehensive Plan

For further information please contact:

Governor's Office of Energy Resources
7703 N. Lamar, Fifth Floor
Austin, Texas 78752

DIRECTORY OF FEDERAL, STATE AND NON-GOVERNMENTAL ENERGY CONTACTS

PART ONE

Federal Assistance

Department of Energy
Washington, D.C.

Key contacts in local energy conservation activities.

Office of Conservation and Solar Application

- John Milhone, Director, Division of Buildings and Community Systems, (202) 376-4646
- Donald Walter, Area: Urban Waste and Municipal Systems Branch, (202) 376-1964
- John Cable, Area: Architectural and Engineering Systems Branch, (202) 376-4672
- Isiah Sewell, Comprehensive Community Planning and Design Branch, (202) 376-4818
- Vincent Esposito, Director, Division of Transportation Energy Conservation

Office of Intergovernmental and Institutional Affairs

- Jack Daly, Director, Division of Program Planning and Analysis, (202) 252-5660

DOE/Region VI
P.O. Box 3528
Dallas, Texas

- Dan Rambo, Regional Representative
  (214) 749-7345
- Dan Deaton, Director
  Conservation and Environment Division
  (214) 749-7714
- William Nikolis, Intergovernmental Affairs
  (214) 749-7621
- Darrell Greenwell
  Planning & Analysis Division
  (214) 749-2661

Bureau of Motor Carrier Safety
FHA
400 7th Street, S.W.
Washington, D.C. 20590
(202) 426-1803

Center for Building Technology
24th & M Streets, N.W.
Washington, D.C. 20234
(301) 921-3637
Energy conservation in buildings

Citizen Advisory Committee on Environmental Quality
1700 Pennsylvania Avenue, N.W.
Washington, D.C. 20006
(202) 223-3040
How to promote energy conservation through a community-wide public information program.

Commission on Natural Resources
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
(202) 389-6861
Energy conservation in buildings

Committee on Energy
1600 Pennsylvania Avenue, N.W.
Washington, D.C. 20500
Policies dealing with energy conservation

Cooperative State Research Service
USDA
14th Street & Independence Avenue, S.W.
Washington, D.C. 20250
(202) 447-7273
Energy conservation in agriculture

Council On Environmental Quality
722 Jackson Place, N.W.
Washington, D.C. 20006
(202) 383-1415

Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20590

Energy and Environment Division
(202) 426-2022
Research reports and other materials on improving vehicle fuel economy through new and retrofit devices

National Bureau of Standards
Department of Commerce
Center for Building Technology
Building 226, Room B-244
Washington, D.C. 20234
Energy conservation in buildings

National Highway Traffic Safety Administration
Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20591
(202) 426-1836

National Institute of Environmental Health Science
HEW
P.O. Box 12233
Research Triangle Park, North Carolina 27709
(919) 549-8411

National Petroleum Council
U.S. Department of Interior
1625 K Street, N.W.
Washington, D.C. 20006
(202) 393-6100

National Science Foundation
1800 G Street, N.W.
Washington, D.C. 20550
(202) 632-4110
Makes grants for studies of various aspects of energy conservation

Oak Ridge National Laboratory
Energy Division
P.O. Box X
Oak Ridge, Tennessee 37830
(615) 483-8611

Office of Community Planning & Program Coordination
Department of Housing & Urban Development
451 7th Street, S.W.
Washington, D.C. 20410
(202) 755-6234

Office of Energy Programs
14th Street & Constitution Avenue, N.W.
Washington, D.C. 20230
(202) 967-5001

Office of Policy Development & Research
HUD
451 7th Street, N.W.
Washington, D.C. 20410
(202) 755-5597

Urban Mass Transportation Administration
Research Development and Demonstration Programs
(202) 426-4043
Dial-a-Ride bus programs, fringe parking coordiation

Urban Planning Division
Federal Highway Administration
(202) 426-0210
Bus-on-freeway programs, exclusive bus and carpool lanes

Economic Development Administration
Department of Commerce
14th Street & Constitution Avenue, N.W.
Washington, D.C. 20230
(202) 377-5103
Local government energy conservation activities

Environmental Protection Agency
Resource Recovery Division
1835 K Street, N.W.
Washington, D.C. 20006
(202) 386-6102

General Services Administration
Federal Supply Service & Public Buildings Service
18th & F Streets, N.W.
Washington, D.C. 20406
(202) 343-6117
Tips for conserving gasoline in large vehicle fleet operations. Energy conservation aspects of building heating, cooling, and ventilating systems; new building design; methods of conserving energy in existing buildings.

Government Printing Office
North Capitol & H Streets, N.W.
Washington, D.C. 20400
(202) 541-3000
Energy conservation publications.

House Education & Labor Committee
Rayburn House Office Bldg., Room 2181
Washington, D.C. 20515
(202) 225-4527
Federal scholarships on energy program.

Law Enforcement Assistance Administration
Emergency Energy Committee
633 Indiana Avenue, N.W.
Washington, D.C. 20530
(202) 386-4551

Small Business Administration
1441 L Street, N.W.
Washington, D.C. 20416
(202) 382-1891
Energy loans

Tennessee Valley Authority
507 Market Street
Knoxville, Tennessee 37902
(615) 546-8911
Energy conservation programs.

Transportation Systems Center
Kendall Square
Cambridge, Massachusetts 02142
(617) 494-2741

PART TWO

State Assistance

Bureau of Economic Geology
P.O. Box X
University Station
Austin, Texas 78712
(512) 471-1534

Center for Energy Studies
University of Texas
Austin, Texas 78711
(512) 471-7792

Center for Urban Studies
The University of Texas at Arlington
P.O. Box 19588
Arlington, Texas 76019
(214) 273-3071

Energy Institute
University of Houston
Houston, Texas 77044
(713) 749-3272

Governor's Office of Energy Resources
7703 North Lamar, 5th Floor
Austin, Texas 78752
Contact: Larry Morgan, Local Governments Program Coordinator
(512) 475-5407

Office of State-Federal Relations
Sam Houston Building
Austin, Texas 78701
(512) 475-7805

Public Utility Commission of Texas
7800 Shoal Creek Blvd.
Austin, Texas 78757
(512) 475-3174

Texas Department of Community Affairs
210 Barton Springs Road
Austin, Texas 78711
(512) 475-6744

Texas Department of Health
Radiological Health Program
1100 West 49th Street
Austin, Texas 78756
(512) 454-3781

Texas Department of Highways and Public Transportation
State Highway Bldg.
Austin, Texas 78701
(512) 475-6338

Texas Education Agency
201 E. 11th
Austin, Texas 78701
(512) 475-3042

Texas Energy Advisory Council
7703 N. Lamar, 5th Floor
Austin, Texas 78752
(512) 475-3106

Texas Energy Extension Service
Dr. Stephen Riter
Texas A&M University
College Station, Texas 77843
(713) 845-8025

Area Offices

San Antonio

Dr. Richard S. Howe
Energy Extension Service
University of Texas at San Antonio
San Antonio, Texas 78285
(512) 224-6331

Houston

Mr. Andy Sansom
College of Technology
University of Houston
4800 Calhoun
Houston, Texas 77004
(713) 749-1756
(Tex-An) 852-1756

Arlington

Dr. Tom J. Lawley
Texas Energy Extension Service
University of Texas at Arlington
Arlington, Texas 76019
(817) 273-2996
(Tex-An) 832-2996

El Paso

Mr. John A. Whitacre
Texas Energy Extension Service
University of Texas at El Paso
El Paso, Texas 79968
(915) 747-5809

Lubbock

Mrs. Jane Cohen
Texas Energy Extension Service
4232 Boston Avenue
Lubbock, Texas 79413
(806) 792-4780

Texas Fuel Allocation Office
P.O. Box 12577
Capitol Station
Austin, Texas 78711
(512) 475-5491

Texas Industrial Commission
P.O. Box 12728
Capitol Station
714 Sam Houston State Office Bldg.
Austin, Texas 78711
(512) 485-4331

Texas Office of the Attorney General
P.O. Box 12548
Austin, Texas 78711
(512) 475-2501

Texas Railroad Commission
P.O. Drawer 12967
State Capitol
Austin, Texas 78711
(512) 475-2439

Regional Councils of Governments

Alamo Area Council of Governments
400 Three Americas Building
San Antonio, Texas 78205
(512) 225-5201

Ark-Tex Council of Governments
P.O. Box 5307
Texarkana, Texas 75501
(214) 774-3481

Brazos Valley Development Council
P.O. Drawer 4128
Bryan, Texas 77801
(713) 822-7421

Capital Area Planning Council
611 South Congress, Suite 400
Austin, Texas 78704
(512) 443-7653

Central Texas Council of Governments
P.O. Box 729
Belton, Texas 76513
(817) 939-1801

Coastal Bend Council of Governments
P.O. Box 6609
Corpus Christi, Texas 78411
(512) 854-3081

Concho Valley Council of Governments
7 West Twohig Bldg., Room 505
San Angelo, Texas 76901
(915) 653-1214

Deep East Texas Council of Governments
272 E. Lamar Street
P.O. Drawer 1170
Jasper, Texas 75951
(713) 384-5704

East Texas Council of Governments
5th Floor, Allied Citizens Bank Bldg.
Kilgore, Texas 75662
(214) 984-8641

Golden Crescent Council of Governments
P.O. Box 2028
Victoria, Texas 77901
(512) 578-1587

Heart of Texas Council of Governments
110 South 12th Street
Waco, Texas 76701

Houston-Galveston Area Council
3701 W. Alabama
Houston, Texas 77027

Lower Rio Grande Valley Development Council
First National Bank Bldg., Suite 207
McAllen, Texas 78501

Middle Rio Grande Development Council
P.O. Box 1461
Del Rio, Texas 78840
(512) 775-1581

Nortex Regional Planning Commission
1914 Kemp Blvd.
Wichita Falls, Texas 76309
(817) 322-5281

North Central Texas Council of Governments
P.O. Drawer COG
Arlington, Texas 76011
(817) 640-3300

Panhandle Regional Planning Commission
P.O. Box 9257
Amarillo, Texas 79105
(806) 372-3381

Permian Basin Regional Planning Commission
P.O. Box 6391
Midland, Texas 79701
(915) 563-1061

South East Texas Regional Planning Commission
P.O. Drawer 1387
Nederland, Texas 77627
(713) 727-2384

South Plains Association of Governments
1611 Avenue M
Lubbock, Texas 79401
(806) 762-8721

South Texas Development Council
P.O. Box 2187
Laredo, Texas 78041
(512) 722-3995

Texoma Regional Planning Commission
1000 Arnold Blvd.
Denison, Texas 75020
(214) 786-2955

West Central Texas Council of Governments
P.O. Box 3195
Abilene, Texas 79604
(915) 672-8544

West Texas Council of Governments
Mills Building
303 N. Oregon Street
El Paso, Texas 79901
(915) 532-2910

PART THREE

Non-Governmental Assistance

American Gas Association
1515 Wilson Boulevard
Arlington, Virginia 22216
(703) 524-2000
A computer program for analyzing building energy requirements (ECUBE).

American Institute of Architects
1735 New York Avenue, N.W.
Washington, D.C. 20006
(202) 785-7300
Conserving energy through better building design.

American Institute of Architects
Research Corporation
1735 New York Avenue, N.W.
Washington, D.C. 20006
(202) 785-8778
Research in energy conservation in buildings through improved design.

American Institute of Planners
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

American Petroleum Institute
1801 K Street, N.W.
Washington, D.C. 20006
Statistics, research reports, and other materials on oil, gasoline, and natural gas.

American Public Power Association
2600 Virginia Avenue, N.W.
Washington, D.C. 20037
(202) 333-9200
Energy conservation approaches of publicly-owned electric utilities

American Public Works Association
1313 E. 60th Street
Chicago, Illinois 60637
(312) 324-3400
Energy conservation in motor vehicle equipment.

American Society of Heating, Refrigerating and Air-Conditioning Engineers
345 E. 47th Street
New York, New York 10017
(212) 752-6800
Energy conservation as a function of building equipment systems and comfort conditioning

American Society of Planning Officials
1313 E. 60th Street
Chicago, Illinois 60637
(312) 947-2074

Association of Home Appliance Manufacturers
20 North Wacker Drive
Chicago, Illinois 60606
(312) 236-2921
The energy requirements of various household appliances.

Center for Science In Public Interest
1757 South Street
Washington, D.C.

Concern, Inc.
2233 Wisconsin Avenue, N.W.
Washington, D.C. 20007
(202) 965-0066
Conducts research on energy conservation and energy alternatives. Energy conservation tips free.

Conservation Foundation
1717 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 797-4300
Conducts studies in general energy conservation.

Critical Mass
P.O. Box 1538
Washington, D.C. 20013
(202) 546-4790
Promotes energy conservation

Environmental Law Institute
1346 Connecticut Avenue, N.W.
Washington, D.C. 20036

Grumman Aerospace Corporation
Energy Systems Division
Plant #30
Bethpage, New York 11714
(516) 575-9630
Energy conservation in buildings, particularly short-term measures; solar energy applications

Illuminating Engineering Society
345 E. 47th Street
New York, New York 10017
(212) 752-6800
Lighting systems, energy conservation aspects of lighting efficiency, heat of light recovery.

International City Management Association
1140 Connecticut Avenue, N.W.
Washington, D.C. 20036

Motor Vehicle Manufacturers Association
320 New Center Building
Detroit, Michigan 48202
(313) 872-4311
Fuel economy tips for purchasing new fleet vehicles, gasoline consumption aspects of axle and compression ratios and gross weight.

National Association of Counties
1734 New York Avenue, N.W.
Washington, D.C. 20006
(202) 785-9577
Public interest group looking at problems of energy impact.

National Association of Regional Councils
1700 K Street, N.W.
Washington, D.C. 20006
(202) 296-5253

National Center for Resource Recovery, Inc.
1211 Connecticut Avenue, N.W.
Suite 800
Washington, D.C. 20036
(202) 223-6154
Solutions to more solid waste problem--conversion of solid wastes to fuel.

National Governor's Association
1150 17th Street, N.W.
Washington, D.C. 20036
(202) 624-5300

National League of Cities/U.S. Conference of Mayors
1620 I Street, N.W.
Washington, D.C. 20240
(202) 293-5150

National Planning Association
1606 New Hampshire Avenue, N.W.
Washington, D.C. 20009
(202) 265-7685
Promotes energy conservation and planning for future utilization of resources.

Public Technology, Inc
1140 Connecticut Avenue, N.W.
Washington, D.C. 20036
(202) 452-7700
Fuel conservation through more efficient vehicle routing and through more effective fleet management practices.

The RAND Corporation
Energy Policy Program
1700 Main Street
Santa Monica, California 90406
(213) 393-0411
State energy policy analysis, energy conservation in buildings and transportation, total energy system evaluation.

Resources For the Future, Inc.
1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036
(202) 462-4400
Conducts research and training in conservation.

Richard Stein and Associates
588 Fifth Avenue
New York, New York 10036
(212) 757-0284
Energy utilization in school design and operation.

BIBLIOGRAPHY OF ENERGY CONSERVATION PUBLICATIONS

ASHRAE Standard 90-75, Energy Conservation in New Building Design
To order: ASHRAE, Inc., 345 East 47th Street, New York, New York 10017

Assistance in Local Government Energy Conservation in Massachusetts, Volumes 1-5, 1976.
To order: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

Automated Fuel Dispensing for State & Local Governments, 1977
To order: Public Technology, Inc., Automated Fuel Dispensing, 1140 Connecticut Ave., N.W., Washington, D.C. 20036 ($5.00)

Benefit-Cost Methodology for Evaluating Energy Conservation Programs
To order: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

Building Standards and Energy Conservation In Public School Buildings,
To order: National Technical Information Service, U.S. Department of Commerce, Springfield, VA, 22161 ($5.00)

Carpool Incentives: Evaluation of Operational Experience, March, 1976
To order: Superintendent of Documents, U.S. Government Office, Washington, D.C. 20402 ($2.40)

Citizen Action Guide to Energy Conservation
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 ($1.75)

Comprehensive Community Planning for Energy Management and Conservation, April, 1977

Conservation: A New Source of Energy, May, 1978
To order: New Jersey Department of Energy Conservation, 101 Commerce Street, Newark, N.J. 07102

Decision-Makers Guide in Solid Waste Management, 1976
To order: U.S. Environmental Production Agency, Solid Waste Information, Cincinnati, Ohio 45268

Double Up America Car Pool Kit, April, 1975
To order: Federal Highway Administration, 826 Federal Office Building, 300 East 8th Street, Austin, Texas 78701

Efficient Energy Use, 1977
To order: Pergamon Press, Inc., Maxwell House, Fairview Park, Elmsford, NY 10523

Energy Conservation: A Management Report for State and Local Governments, March, 1975
To order: Public Technology, Inc., 1140 Connecticut Ave., N.W., Washington, D.C. 20036

Energy Conservation: A Technical Guide for State and Local Governments, March, 1975
To order: Public Technology, Inc., 1140 Connecticut Ave., N.W., Washington, D.C. 20036 ($10.00)

Energy Conservation in Buildings: New Roles for Cities and Citizen Groups, January, 1975
To order: National League of Cities, Publications Center, 1620 Eye Street, NW, Washington, D.C. 20006 ($3.00)

Energy Conservation Retrofit for Existing Public and Institutional Facilities, 1977
To order: Public Technology, Inc., 1140 Connecticut Ave., N.W., Washington, D.C. 20036 ($6.00)

Energy Conservation Site Visit Report: Toward More Effective Energy Management, 1976
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Energy Conservation Through Improved Solid Waste Management, 1974
To order: U.S. Environmental Production Agency, Solid Waste Information, Cincinnati, Ohio 45268

Energy Conservation Through Urban Transportation Planning, March, 1975
To order: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

Energy Management for California Cities, Volumes 1-6, 1976
To order: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

Guide to Constructing an Energy Efficient Home, 1977
To order: Owens-Corning Fiberglass Corporation, Insulation Operating Division, Fiberglass Tower, Toledo, Ohio 43659

Guide to Reducing . . . Energy Use Budget Costs
To order: Federal Energy Administration/DOE, Conservation and Environment, 2626 W. Mockingbird Lane, Dallas, Texas 75235

Guidelines for Saving Energy in Existing Buildings - Building Owners and Operators Manual, 1975
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

The Handbook of Moving Air, 1977
To order: American Ventilation, P.O. Box 7464, Houston, Texas 77008

How To Pool It, March 1975
To order: Federal Highway Administration, HHP-26, Washington, D.C. 20590

In the Bank . . . Or Up The Chimney? A Dollars and Cents Guide to Energy-Saving Home Improvements, April 1977
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 ($1.70)

Life Cycle Costing: A Guide for Selecting Energy Conservation Projects for Public Buildings, 1978
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

Life Cycle Costing Emphasizing Energy Conservation Guidelines for Investment Analysis, 1976
To order: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161

Methodology for the Development of Energy Management Plans for Small Communities, 1978
To order: U.S. Department of Energy, Community Systems Branch, Washington, D.C. 20545

Model Code for Energy Conservation in New Building Construction, Interim Code, July, 1977
To order: DOE/Energy Research & Development Administration, Office of Public Affairs, Washington, D.C. 20545

Model Procurement Guide for State and Local Governments, 1976
To order: American Bar Association, 1700 K Street, N.W., Washington, D.C. 20006

Municipal Energy Management - A Comprehensive Approach, 1978
To order: Institute of Urban Studies, University of Texas at Arlington, P.O. Box 19069, Arlington, Texas 76019

The Planner's Energy Workbook, A User's Manual for Exploring Land Use and Energy Utilization Relationships, October, 1976
To order: DOE/Federal Energy Administration, Office of Conservation and Environment, Washington, D.C. 20461

Preferential Facilities for Carpools and Buses, May, 1976
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 ($1.10)

Public Fleet Management, 1975
To order: National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550

The Role of Local Government in a National Energy Strategy, October, 1977
To order: National League of Cities, Publications Center, 1620 Eye Street, N.W., Washington, D.C. 20006

Solid Waste Collection Systems: A Five State Improvement Process, 1973
To order: Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

State and Local Government Purchasing, 1975
To order: Council of Governments, Iron Works Pike, Lexington, Kentucky 40511

State of Texas Energy Conservation Plan, Volume II, Plan Report, June, 1977
To order: Governor's Office of Energy Resources, 7703 N. Lamar Blvd., Fifth Floor, Austin, Texas 78752

Texas Conservation Guide for Municipal Services
To order: Institute of Urban Studies, University of Texas at Arlington, P.O. Box 19588, Arlington, Texas 76019

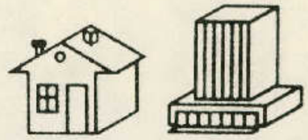
Total Energy Management: A Practical Handbook on Energy Conservation and Management, 1976
To order: National Electrical Contractors Association, 7315 Wisconsin Avenue, Washington, D.C. 20014

Using Construction Management for Public and Institutional Facilities, March, 1976 ($6.00)
To order: Public Technology, Inc., 1140 Connecticut Ave., N.W., Washington, D.C. 20036

Pamphlets available from the Department of Energy/Office of Public Affairs, Washington, D.C. 20545:

"Energy Conservation: Heat Pumps"
"Energy Conservation: Landscaping"
"Energy Conservation: Windows"
"Energy Conservation Program for State & Local Building Officials"
"Energy and the Environment"
"Energy Savings Through Automatic Thermostat Controls"
"Gas Heat Pumps: More Heat From Gas"
"Heat Pumps"
"Insulate Your Water Heater and Save Fuel"
"Integrated Community Energy Systems"
"Minimum Energy Dwelling"
"New Energy Saving Light Bulbs"

ENERGY CONSERVATION IN NEW BUILDING CONSTRUCTION



ENERGY PERFORMANCE STANDARDS FOR NEW BUILDINGS – 1980

In 1976 Congress passed legislation which directs the federal government to develop and carry out energy conservation performance standards for all new buildings by 1980. What this means is that new buildings can use only a certain amount of energy; they must meet an "energy budget." According to the legislation, plans for new buildings must be certified as being in compliance with the federal standards. The legislation also provides that federal financial assistance for new construction can be withheld in the event building plans do not comply. Hopefully, this measure will not be needed.

Federal financial assistance includes not only direct or indirect federal assistance, but also loans by banks and savings institutions regulated or insured by federal agencies. In other words, into this category fall virtually all sources of funding for new construction.

ENERGY CONSERVATION IN TEXAS...

In 1975 the federal government established a grant program to help states develop energy conservation programs. The Texas Energy Conservation Program, approved in August, 1977, is designed to reduce Texas energy consumption 5% by 1980.

...VOLUNTARY THERMAL & LIGHTING STANDARDS PROGRAM

The section of this program aimed at energy conservation in new building construction is the thermal and lighting standards program. Thermal standards deal with heat loss or gain through the building envelope in relation to energy usage. Lighting standards concern building interior and exterior illumination levels in relation to energy usage. The goal of this voluntary program is to reduce energy consumption in the State by pilot-testing and then establishing for voluntary adoption, minimum thermal and lighting standards for new buildings in Texas. This program will help us prepare for the 1980 federal building performance standards.

The Governor's Office of Energy Resources (GOER) is in charge of the thermal and lighting standards program. The major project tasks include:

- Pilot-testing in Texas cities, the Model Code for Energy Conservation in New Building Construction which is made up of thermal and lighting standards.
- Modifying the model code so that it is suitable for Texas.

- Recommending to the Texas Legislature that the modified version of the code be made available for voluntary adoption by Texas cities.

- Training city code personnel throughout the State in the use of the model code.

pilot-testing a model energy conservation code

In February, 1978 GOER selected 13 cities from those expressing interest in testing the model energy conservation code (thermal and lighting standards). These cities include: Dallas, Carrollton, El Paso, Sherman, Kerrville, Beaumont, Nederland, La Grange, Greenville, Austin, Alpine, Sonora and Corpus Christi.

For approximately 1 year, pilot cities will test the Model Code for Energy Conservation in New Building Construction, modifying it to accommodate their local conditions. The National Conference of States on Building Codes and Standards (NCSBCS) contracted with the major model code organizations in the nation to jointly develop the model code. Because of the great national importance of energy conservation in buildings, Building Officials & Code Administrators International, Inc.; International Conference of Building Officials; and Southern Building Code Congress International, Inc.; perhaps for the first time, unified their efforts to create a consensus model energy conservation code for nationwide use.

The NCSBCS code is a translation of American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) Standard 90-75 into code language. The ASHRAE Standard, "Energy Conservation in New Building Design," is the most widely accepted standard for energy conservation.

In September, 1977 a Model Energy Conservation Code Committee composed of Texas building officials and representatives of the construction industry recommended the NCSBCS code as the best available energy conservation code for use in Texas.

the building community's role

Pilot cities will work toward adopting the NCSBCS model code. Input from the building community--the people who are in the field every day and know the business--is critical in making the model energy conservation code workable for the city, and on a larger scale, for the State.

code training

Under the direction of GOER, the Texas Engineering Extension Service of Texas A&M University will provide model code training for city staff and for members of the building community.

Training will include 3 series:

- Series 100 - For field inspectors and construction superintendents.
- Series 200 - For building officials and plan checkers.
- Series 300 - For professional engineers, architects and plan checkers.

code implementation

Each pilot city will determine its own strategy for implementing the NCSBCS model code.

program monitoring

Pilot cities will report to GOER the effectiveness of the code and any problems encountered in its implementation.

Energy savings creditable to code adoption will be determined by comparing the energy use of buildings built according to the code to consumption by buildings not built to code standards.

TEXAS INPUT -- DEVELOPING FEDERAL PERFORMANCE STANDARDS

Since the federal government is developing national performance standards for new buildings, it is important that Texans provide input. The federal government has stated that it will consult the states in the formulation of these standards. Local and state input is desired.

Our pilot-testing of thermal and lighting standards will provide actual documentation of the effectiveness and problems of thermal and lighting standards when applied. Our findings will be conveyed to the federal staff working on national performance standards for incorporation into the final document.

IN CONCLUSION...

Actual field experience has shown that buildings can be constructed to use less energy. Modifications can be made, such as better insulating the building envelope and using task area lighting, which in turn reduce the amount of equipment needed for heating and cooling a building. These changes result in a building which costs significantly less to operate and can be built for about the same cost as a conventionally constructed building.

GOVERNOR'S OFFICE OF ENERGY RESOURCES

THE TEXAS VANPOOL PROGRAM

Vanpool Census of April 1, 1979

The remarkable growth enjoyed by vanpooling in 1978 is continuing into 1979. Three new programs have been added to the Census since January. These new programs plus the growth by existing programs push the overall totals to: 405 vans on the road with 36 on order. Without a doubt the recent increase in gasoline prices has spurred increased interest by commuters and their employers are responding by putting vans on the road.

The following table illustrates the growth of vanpooling in Texas and the progress toward the state's goal of 1500 vans.

	1977	*1978*	*1979*	*Goal 1979*
PROGRAMS	*14*	*26*	*29*	*40*
SITES	*20*	*30*	*34*	*--*
VANS				
On the road	*196*	*343*	*405*	*650*
On order	*--*	*51*	*36*	*100*
TOTAL	*196*	*394*	*441*	*750*

Credit for this phenomenal growth of vanpooling in the state must go to the individual program coordinators. Many of them have not only worked long and hard to establish successful programs at their own companies, but have also given the needed assistance and encouragement to other companies starting up programs.

Questions about any of the programs in the state may be directed to program coordinators, listed in this census. More general questions pertaining to the statewide vanpool program may be directed to:

James P. McIntyre
Governor's Office
of Energy Resources
7703 North Lamar, Rm. 502
Austin, Texas 78752
(512) 475-5491

Donald A. Maxwell
Texas Transportation Institute
Texas A&M University
College Station, Texas 77843
(713) 845-2418

Aramco Services
Ms. Kathi Townsend
1100 Milam, Suite 4104
Houston, Texas 77002
(713) 651-4024

Type of vanpool program: *Employer Owned; (Lease)*

Program initiation date: *March 1976*

Active carpool program? *Yes, formal*

Public transit available? *Yes, not adequate*

Location of worksite(s): *Milam at Smith Streets (Downtown)*

Total number of employees at worksite(s): *850*

Number of shifts at worksite(s): *Flex-time*

Daily round trip length: High *70* Average *45* Low *22* *miles*

Monthly fare for a 50-mile round trip: *$20*

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	6	10	19	22	

Additional Information: *Program serves employees in Milam office and offices in One and Two Allen Center.*

Armco
Mr. Dale Eschleman
1455 W. Loop South
Houston, Texas 77027
(713) 960-5111

Type of vanpool program: *Employer Owned; (Purchase)*

Program initiation date: *July 1977*

Active carpool program? *No*

Public transit available? *No*

Location of worksite(s): *W. Loop South (Urban)*

Total number of employees at worksite(s): *350*

Number of shifts at worksite(s): *1 shift*

Daily round trip length: High -- Average -- Low -- *miles*

Monthly fare for a 50-mile round trip:

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	---	--	2	2	2	

Additional Information: *3 vans on order.*

Brown & Root Mr. Robert D. Reed P.O. Box 3 Houston, Texas 77001 (713) 676-4188	Type of vanpool program: Employer Owned; (Purchase) Program initiation date: March 1976 Active carpool program? Yes, formal Public transit available? Yes

Location of worksite(s): Clinton at Hirsch Streets (Suburban)

Total number of employees at worksite(s): 6,000

Number of shifts at worksite(s): 2 shifts (Program for 1st shift)

Daily round trip length: High 104 Average 46 Low 22 miles

Monthly fare for a 50-mile round trip: $27

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	15	25	30	

Additional Information: Budgeted for 50 vans by the end of 1979.

Comet-Rice Mr. Ed Theodore 505 N. Belt Houston, Texas 77060 (713) 447-7423	Type of vanpool program: Employer Owned; (Lease) Program initiation date: June 1977 Active carpool program? No Public transit available? No

Location of worksite(s): N. Belt at I-45 (Suburban)

Total number of employees at worksite(s): 50

Number of shifts at worksite(s): 1 shift

Daily round trip length: High -- Average 70 Low -- miles

Monthly fare for a 50-mile round trip: $18

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	1	1	1	

Additional Information:

CONOCO
Mr. William R. Fortune
5 Greeway Plaza East
Houston, Texas 77001
(713) 965-1484

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: March 1975

Active carpool program? Yes

Public transit available? No

Location of worksite(s): S.W. Freeway at Richmond (Urban)

Total number of employees at worksite(s): 1,550

Number of shifts at worksite(s): Flex-time

Daily round trip length: High 112 Average 49 Low 20 miles

Monthly fare for a 50-mile round trip: $27

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	15	25	36	47	51	

Additional Information: CONOCO also sponsors 2 van in Big Spring, 1 van in Carizzo Springs, 1 van in Fall City, 1 van in Hamlin, 2 vans in Midland, and 1 van in Pecos.

First City National Bank
Mr. J.W. Pieper
P.O. Box 2557
Houston, Texas 77001
(713) 658-6303

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: February 1979

Active carpool program? Yes, formal

Public transit available? Yes

Location of worksite(s): Main at Lamar (Downtown)

Total number of employees at worksite(s): 1,750

Number of shifts at worksite(s): 3 shifts (program for 1st shift)

Daily round trip length: High 62 Average 55 Low 45 miles

Monthly fare for a 50-mile round trip: $27

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	1	4	

Additional Information: 1 back-up van available. 3 vans on order to be put in operation some time in April.

Foley's Department Store
Mr. Vince Rachal or
Ms. Michelle Mordell
P.O. Box 1971
Houston, Texas 77001
(713) 651-6086 or 651-6561

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: March 1977

Active carpool program? Yes, formal

Public transit available? Yes, but not adequate

Location of worksite(s): Main at Lamar (Downtown)

Total number of employees at worksite(s): 3,000

Number of shifts at worksite(s): Multiple (Program for 1st shift)

Daily round trip length: High 35 Average 25 Low 20 miles

Monthly fare for a 50-mile round trip: $30

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	2	4	5	

Additional Information: 278 employees are participating in a discount program with the city bus service. Limited parking available for employees of downtown store.

General Crude
Mr. Gerald R. Smith
Box 2252
Houston, Texas 77001
(713) 651-9261

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: June 1978

Active carpool program? Yes, formal

Public transit available? Yes

Location of worksite(s): Allen Center (Downtown)

Total number of employees at worksite(s): 240

Number of shifts at worksite(s): 1 shift

Daily round trip length: High 60 Average 52 Low 44 miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	5	6	

Additional Information: Discount program available for employees who use public transit.

Gulf Oil
Mr. Ken Sawicki
P.O. Box 2001
2 Houston Center, Rm. 2156
Houston, Texas 77001
(713) 750-3498

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: November 1977

Active carpool program? Yes, formal

Public transit available? Yes, not adequate

Location of worksite(s): Fannin at McKinney (Downtown) & Corporate Dr. (Suburban)

Total number of employees at worksite(s): 2,400 (Downtown); 1,600 (Suburban)

Number of shifts at worksite(s): 1 shift

Daily round trip length: High 95 Average 55 Low 24 miles

Monthly fare for a 50-mile round trip: $27 (Parking not included)

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	35	69	80	

Additional Information: 2 back-up vehicles available. Operating vans in Texas, Louisiana and Georgia; expanding into New Mexico, Oklahoma and Pennsylvania.

Hermann Hospital
Ms. Marcia Folloure
1203 Ross Sterling Ave.
Houston, Texas 77030
(713) 797-3981

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: August 1978

Active carpool program? Yes, formal

Public transit available? Yes

Location of worksite(s): Texas Medical Center, Fannin and Outer Belt (Urban)

Total number of employees at worksite(s): 2,600

Number of shifts at worksite(s): 4 shifts (Vans currently on 1st, 2nd & 3rd)

Daily round trip length: High 65 Average 50 Low 30 miles

Monthly fare for a 50-mile round trip: $27

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	6	9	

Additional Information: 1 on order.

Hughes Tool
Ms. Toppy Vordenbaum
P.O. Box 2539
Houston, Texas 77001
(713) 924-2607

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: January 1976

Active carpool program? Yes, formal

Public transit available? Yes, but not adequate

Location of worksite(s): Polk at Wayside (Downtown)

Total number of employees at worksite(s): 5,000

Number of shifts at worksite(s): 3 shifts (Program for 1st shift)

Daily round trip length: High 110 Average 60 Low 25 miles

Monthly fare for a 50-mile round trip: $37

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	6	9	10	11	

Additional Information: 2 vans on order.

Mitchell Energy & Development
Mr. Joe Collard
2201 Timberloch
The Woodlands, Texas 77380
(713) 367-7000

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: November 1978

Active carpool program? No

Public transit available? No

Location of worksite(s): Woodlands (Suburban)

Total number of employees at worksite(s): 200

Number of shifts at worksite(s): 1 shift

Daily round trip length: High -- Average 100 Low -- miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	1	1	

Additional Information: Service is provided from Houston to Woodlands.

Mobil Oil
Mr. B.C. Long
9 Greenway Plaza East
Suite 2700
Houston, Texas 77046
(713) 871-5000

Type of vanpool program: *Employer Owned; (Purchase)*

Program initiation date: *February 1977*

Active carpool program? *Yes, informal*

Public transit available? *Yes*

Location of worksite(s): *S.W. Freeway at Richmond (Urban)*

Total number of employees at worksite(s): *470*

Number of shifts at worksite(s): *Flex-time*

Daily round trip length: High *80* Average *48* Low *29* *miles*

Monthly fare for a 50-mile round trip: *$27*

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	*14*	*19*	*20*	

Additional Information: *2 back-up vans available.*

Prudential Insurance Company
Mr. Bob Kerns
Box 2075
Houston, Texas 77001
(713) 663-5962

Type of vanpool program: *Employer Owned; (Purchase)*

Program initiation date: *April 1976*

Active carpool program? *Yes, informal*

Public transit available? *Yes, but not adequate*

Location of worksite(s): *West Loop at Bissonet (Urban)*

Total number of employees at worksite(s): *1,600*

Number of shifts at worksite(s): *Flex-time*

Daily round trip length: High *86* Average *48* Low *28* *miles*

Monthly fare for a 50-mile round trip: *$22*

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	5	*15*	*15*	*15*	

Additional Information: *3 back-up vans available.*

Texas Instruments
Mr. Jim Bishop
12201 S.W. Freeway
Stafford, Texas 77477
(713) 491-5115 ext. 2424

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: August 1978

Active carpool program? Yes, formal

Public transit available? No

Location of worksite(s): 9777 West Gulf Bank Road (Suburban); S.W. Freeway at Wilcrest in Stafford (Suburban)

Total number of employees at worksite(s): 1,000; 5,000 (Stafford)

Number of shifts at worksite(s): 3 shifts (Program currently for 1st & 2nd shifts)

Daily round trip length: High 84 Average 65 Low 45 miles

Monthly fare for a 50-mile round trip: $25

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	2	6	

Additional Information: Each site has 3 vans. 1 van commutes from the Stafford plant to the West Gulf Bank Road plant. The Stafford program began operation in February 1979. 2 vans commute from Wharton and 1 from the Highway 290 and F.M. 1960 area. There are plans to expand the program at both sites in the near future.

Texas Medical Center
Mr. Richard Somerville
1133 M.D. Anderson Blvd.
Houston, Texas 77030
(713) 797-0100

Type of vanpool program: Third Party; (Purchase and Lease)

Program initiation date: August 1978

Active carpool program? Yes, formal

Public transit available? Yes, also private transit

Location of worksite(s): S. Main at Holcomb (Urban)

Total number of employees at worksite(s): 30,000

Number of shifts at worksite(s): Multiple; 4 shifts per day

Daily round trip length: High 70 Average 50 Low 20 miles

Monthly fare for a 50-mile round trip: $30

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	5	5	

Additional Information: 5 vans on order. 2 alternatives to be in effect in April: (1) Lease program where TMC purchases vans and leases them to individual vanpool drivers withooption to buy in 3 years. TMC will provide administrative assistance. (2) TMC is arranging 100% financing with local bank for individuals desiring to form vanpools.

TRANSCO Gas Pipeline
Mr. O.R. Hutto or
Ms. Carolyn McCarty
P.O. Box 1396
Houston, Texas 77001
(713) 871-8000

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: February 1979

Active carpool program? Yes, informal

Public transit available? Yes, limited

Location of worksite(s): S. Post Oak at West Alabama (Urban)

Total number of employees at worksite(s): 900

Number of shifts at worksite(s): Flex-time

Daily round trip length: High 73 Average 65 Low 45 miles

Monthly fare for a 50-mile round trip: $24

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	--	3	

Additional Information:

TXT Inc.
Mr. Dick Bullis
P.O. Box 60706
Houston, Texas 77205
(713) 443-7000

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: August 1978

Active carpool program? No

Public transit available? No

Location of worksite(s): Rankin Road at I-45 (Suburban)

Total number of employees at worksite(s): 400

Number of shifts at worksite(s): 3 shifts (Program for 1st shift)

Daily round trip length: High -- Average 85 Low -- miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	1	1	

Additional Information:

The Woodlands Commercial Development Corporation
Mr. John Franklin
2201 Timberloch
The Woodlands, Texas 77380
(713) 367-7000

Type of vanpool program: Third Party; (Lease)

Program initiation date: September 1976

Active carpool program? N/A

Public transit available? No

Location of worksite(s): N/A

Total number of employees at worksite(s): 1,200

Number of shifts at worksite(s): N/A

Daily round trip length: High N/A Average N/A Low N/A

Monthly fare for a 50-mile round trip: N/A

<u>Growth</u> <u>of</u> <u>program</u>	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	2	14	18	20	

Additional Information: For residents of the Woodlands, a major development 28 miles from Houston. Rates are governed by the Texas Railroad Commission. Service provided from the Woodlands to Downtown, Galleria and Greenway Plaza areas. 3 vans on order. 1 back-up van available.

Type of vanpool program:

Program initiation date:

Active carpool program?

Public transit available?

Location of worksite(s):

Total number of employees at worksite(s):

Number of shifts at worksite(s):

Daily round trip length: High Average Low

Monthly fare for a 50-mile round trip:

<u>Growth</u> <u>of</u> <u>program</u>	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year						

Additional Information:

Crum & Forester Insurance Companies
Mr. Ed Nitsche
P.O. Box 2639
4040 N. Central Expressway
Dallas, Texas 75221
(214) 827-6110

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: November 1977

Active carpool program? Yes, informal

Public transit available? Yes

Location of worksite(s): N. Central Expressway at Haskel (Urban)

Total number of employees at worksite(s): 850

Number of shifts at worksite(s): 1 shift

Daily round trip length: High 30 Average 27 Low 25 miles

Monthly fare for a 50-mile round trip: $28

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	1	1	2	

Additional Information: Assigned parking for carpools and vanpools is a real incentive due to limited available parking. There are 15 carpools of 4 or more persons now in operation. 1 van on order.

Dr. Pepper Bottling Co.
Mr. Bill Spicer
P.O. Box 225024
Dallas, Texas 75265
(214) 579-3217

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: March 1978

Active carpool program? Yes, formal

Public transit available? Limited

Location of worksite(s): Hwy. 183 at Spur 482 (Urban)

Total number of employees at worksite(s): 450

Number of shifts at worksite(s): Multiple (Program for 1st shift)

Daily round trip length: High -- Average 75 Low -- miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	1	1	

Additional Information: Vanpool initially set up to bring employees from Ft. Worth to Irving. Considering expanding program for employees in Dallas, Plano, and surrounding areas.

Mason & Hanger
Silas Mason Company, Inc.
Ms. Melynie Greaser
P.O. Box 30020
Amarillo, Texas 79177
(806) 335-1581 ext. 2461

Type of vanpool program: Employee Owned; (Purchase)

Program initiation date: July 1977

Active carpool program? Yes, informal

Public transit available? Limited from Amarillo

Location of worksite(s): 28 miles N.E. of Amarillo (Rural)

Total number of employees at worksite(s): 1,800

Number of shifts at worksite(s): 3 shifts

Daily round trip length: High 120 Average 64 Low 39 miles

Monthly fare for a 50-mile round trip: $30

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	23	31	31	

Additional Information: Plan to have 40 vans on the road by the end of 1979.

Mobil Oil
Mr. James Finger
7200 North Stemmons Freeway
Dallas, Texas 75221
(214) 658-4042

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: August 1978

Active carpool program? Yes, formal

Public transit available? No

Location of worksite(s): North Stemmons at Mockingbird (Urban); Empire Central at Harry Hines (Urban)

Total number of employees at worksite(s): 850

Number of shifts at worksite(s): Flex-time

Daily round trip length: High 50 Average 35 Low 25 miles

Monthly fare for a 50-mile round trip: $25

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	2	5	

Additional Information: Worksites are approximately one block apart and vanpool serve employees at both sites. Vanpool and carpool riders get first choice on flex-hours. When a driver's request for a vanpool is approved, the company purchases a van.

Schult Home Corporation
Mr. Bill Sears
2215 Industrial Drive
Navasota, Texas 77868
(713) 825-7501

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: May 1978

Active carpool program? No

Public transit available? No

Location of worksite(s): 2215 Industrial Drive (Suburban)

Total number of employees at worksite(s): 110

Number of shifts at worksite(s): 1 shift

Daily round trip length: High -- Average 114 Low -- miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	1	1	

Additional Information: Driver shares in paying for expenses.

Texas Instruments
Mr. Bob Seiwell
Mail Station 361
13500 North Central Expressway
P.O. Box 225474
Dallas, Texas 75269
(214) 238-3787

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: March 1974

Active carpool program? Yes, informal

Public transit available? Yes, but limited

Location of worksite(s): North Central Expressway at LBJ (Urban)

Total number of employees at worksite(s): 14,000

Number of shifts at worksite(s): 3 shifts (Program for 1st shift)

Daily round trip length: High 130 Average 95 Low 25 miles

Monthly fare for a 50-mile round trip: $30

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	9	12	14	14	16	

Additional Information: Program started in 1974 with 9 vans. 2 vans on order. Expecting 25 vans by the end of 1979. Carpool program is set up for employees at other sites in Dallas.

Texas Instruments
Mr. Marvin L. Powers
Mail Station 3208
5701 Airport Road
Temple, Texas 76501
(817) 774-6407 ext. 6407

Type of vanpool program: Employer Owned; (Lease)

Program initiation date: April 1979

Active carpool program? Yes, informal

Public transit available? No

Location of worksite(s): Airport Road (Rural)

Total number of employees at worksite(s): 600

Number of shifts at worksite(s): 3 shifts (Program for 1st shift)

Daily round trip length: High 120 Average 95 Low 70 miles

Monthly fare for a 50-mile round trip: $35

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	--	2	

Additional Information: Program to begin operation in April.

United Service Automobile Association
Mr. W.F. "Bill" Borellis
Director of Facilities
USAA Building
San Antonio, Texas 78288
(512) 690-2694

Type of vanpool program: Employer Owned; (Purchase)

Program initiation date: December 1977

Active carpool program? Yes, formal

Public transit available? Yes, being improved

Location of worksite(s): N.W. San Antonio (Suburban)

Total number of employees at worksite(s): 4,450 + 200-500 contract employees

Number of shifts at worksite(s): 1 shift, staggered; 4-day work week

Daily round trip length: High 110 Average 56 Low 14 miles

Monthly fare for a 50-mile round trip: $20

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	5	27	37	

Additional Information: 16 vans on order. Plans to be operating 60-70 vans by December 1979. Considering a buspool. Current carpool program has 770 riders.

Vought Corp.
Mr. E.J. Notebaert
P.O. Box 225901
Dallas, Texas 75722
(214) 266-5555

Type of vanpool program: Employee Owned; (Purchase)

Program initiation date:

Active carpool program? Yes, formal

Public transit available? No

Location of worksite(s): Jefferson at 14th Streets (Downtown)

Total number of employees at worksite(s): 8,000

Number of shifts at worksite(s): 2 shifts

Daily round trip length: High -- Average -- Low -- miles

Monthly fare for a 50-mile round trip:

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	8	8	

Additional Information: This is an employee owned program. The company in considering sponsoring a vanpool program. There are approximately 900 employees involved in the carpool program.

Department of Health, Education and Welfare
Mr. Roy Washam
1200 Main Tower, Rm. 1635
Dallas, Texas 75202
(214) 767-3491

Type of vanpool program: Employee Owned

Program initiation date: April, 1979

Active carpool program? Yes

Public transit available? Yes

Location of worksite(s): Main at Field (Urban)

Total number of employees at worksite(s): 1,577

Number of shifts at worksite(s): 1 shift

Daily round trip length: High 30 Average 24 Low 18

Monthly fare for a 50-mile round trip: $30

Growth of program	1975	1976	1977	1978	1979	1980
Number of operative vans as of end of year	--	--	--	--	2	

Additional Information: Plan to have van operating from Arlington by May 1. Program goal for 1979 is 10 vans.

Public Buildings

TOTAL ENERGY MANAGEMENT

All buildings have three fundamental systems which affect energy use. These are energized systems, non-energized systems, and human systems.

Energized systems are those which consume energy directly. Typical energized systems include, among others, those used to provide heating, ventilation, cooling, humidification, dehumidification, lighting, hot water heating, interior conveyance, food cooking, dishwashing, and waste handling as well as various pieces of equipment such as typewriters, computers, copying machines, and specialized process equipment unique to the process conducted in the building.

Nonenergized systems are those which do not consume energy directly, but which do affect the amount of energy which an energized system must expend to get its job done. Typcial nonenergized systems include walls, windows (glazing), floors, roof, ceiling, doors, etc., as well as weather, landscaping, siting and similar factors.

Human systems comprise those persons who affect when and in what quantity energy is consumed. These persons include building owners and managers; operating and maintenance personnel; as well as occupants or users of the building. Were it not for this third category of systems, energy management conducted solely by operating and maintenance personnel might suffice. But since there are so many ways the tenant or occupant can influence the amount of energy used, there is a need for total energy management. The word total thus implies actions on the part of every person who in any way is connected with the use of the building.

Viewed in the total context, total or overall energy management becomes not a series of disconnected unrelated actions, but rather a logical progression of management and planning actions. The necessary and desirable actions are listed here:

(1) Decide to implement Total Energy Management System

- -- assign responsibility
- -- sell idea

(2) Set up system to track energy use in BTU/SQ. FT./MONTH and YEAR

- -- past year(s)
- -- future

(3) Develop Total Energy Management Program with involvement at all levels

- -- orientation, education, program for all employees or occupants
- -- operations and maintenance
- -- plant modifications, mechanical and lighting systems, building shell

(4) Conduct an energy audit

- -- preliminary energy audit, walk-through survey or mini-audit
- -- computerized analysis
- -- detailed energy analysis or maxi-audit

(5) Establish tough and measurable energy use goal, using energy tracking system for measurement

- -- implement all no-cost actions
- -- implement selected capital improvement retrofit projects and measure energy savings

(6) Report the results in both energy and dollar terms.

Accomplishment of total energy management goals requires that top management be committed to the concept. Based on this commitment, managers and operators can set in motion the necessary management actions. The first of these involves the assignment of responsibility and the initiation of actions to convince all personnel of the need for such a program.

The first substantive management effort should be a review of the building's past energy consumption. It should include the development of an energy use index in BTU's (British Thermal Units) of energy used per square foot of heated and cooled space -- computed monthly and added for all twelve months for the year for an annual use index. Such computations are necessary for NECPA and permit energy use in the building to be compared with similar sized energy efficient buildings.

Concurrently with this use analysis for each building, a program of actions and a schedule should be established. These actions should and must involve all employees or occupants, and all operating and maintenance personnel. All of these personnel must be trained in the recognition of inefficient situations and in the proper actions to be taken.

An energy audit is next. An energy audit is a comprehensive building survey, the purpose of which is to determine where opportunities for energy conservation exist. In many cases significant waste can be eliminated through repair of faulty equipment and improved maintenance and operating practices. Numerous other options are available, some requiring little change from current procedures, other involving modifications much broader in scope. The energy audit may vary in detail and complexity, usually with final results proportional to the initial invested effort, from a walk-through survey to a computerized analysis and to a detailed energy analysis.

Following a review of the audit results, it is management's responsibility to turn opportunities into actual savings and to establish priorities. Many of these will require little or no cost, others will require more study, detailed cost analysis, and major expenditures of funds.

Finally, the results of the program should be reported to all those involved from time to time to insure continued maximum effectiveness of the programs.

Source: "Total Energy Mangement for Hospitals", Department of Health, Education and Welfare.

TRAINING FOR ENERGY AUDITORS UNDER THE NATIONAL ENERGY CONSERVATION POLICY ACT

The State of Texas will offer a number of training programs to qualify auditors to perform energy audits under the National Energy Conservation Policy Act (NECPA) of 1978. Only training or exemptions approved by the Governor's Office of Energy Resources will qualify trainees for a Certificate of Completion of the training necessary to qualify as an Energy Auditor under NECPA and State of Texas guidelines.

Training courses that are approved will so indicate. Programs have been scheduled to provide opportunities for early training for agencies wanting to participate in the first funding cycle; others are scheduled later in the summer throughout the state for agencies that will apply in later cycles. Schedules are included in the pocket of this workbook.

Purpose

The Governor's Office of Energy Resources has prepared the Public Building Audit training course with a dual purpose in mind:

(1) To qualify maintenance and operation personnel in conducting Energy Audits that can qualify local governments for further funding under the 1978 National Energy Conservation Policy Act (NECPA), and

(2) To provide simple tips and recommendations for building operations that should allow at least 15% energy -- and dollar -- savings with little or no capital investment.

What is NECPA?

The 1978 Act provides $965 million over 3 years for energy conservation audits and improvements in local governments, hospitals, schools and public care institutions. Local governments can share in 50-50 matching grants amounting to $65 million for Energy Audits and Technical Assistance. Energy Audits performed by individuals **trained by the State** are a prerequisite to Technical Assistance funding.

Who Should Attend?

* Administrative coordinators
* Maintenance supervisory staff
* Building engineers
* Operating personnel
* Building supervisors
* Others responsible for day-to-day operation and maintenance of public buildings

HEATING, VENTILATING AND AIR CONDITIONING

The Heating, Ventilating and Air Conditioning (HVAC) system is the largest of the "energized" or direct energy consuming systems found within the general-purpose public building. It provides the environmental control required to produce specific comfort levels throughout the building and/or complex. The HVAC is by far the largest consumer within the facility (60% of the total).

The study of energy consumption within HVAC equipment and/or systems, tends to evolve into two important areas of consideration:

* Reduction of energy usage with little or no sacrifice to comfort and safety levels, and

* Recovery of energy from the various forms produced or wasted so that it can be reused within the system.

This section describes the common HVAC equipment, and provides general recommendations for Energy Conservation Opportunities:

Single Zone System

A zone is an area or group of areas in a building which experince similar amounts of heat gain and heat loss. A single zone system is one which provides heating and cooling to one zone controlled by the zone thermostat. The unit may be installed within or remote from the space it serves, either with or without air distribution ductwork.

Energy Conservation Measures include the following:

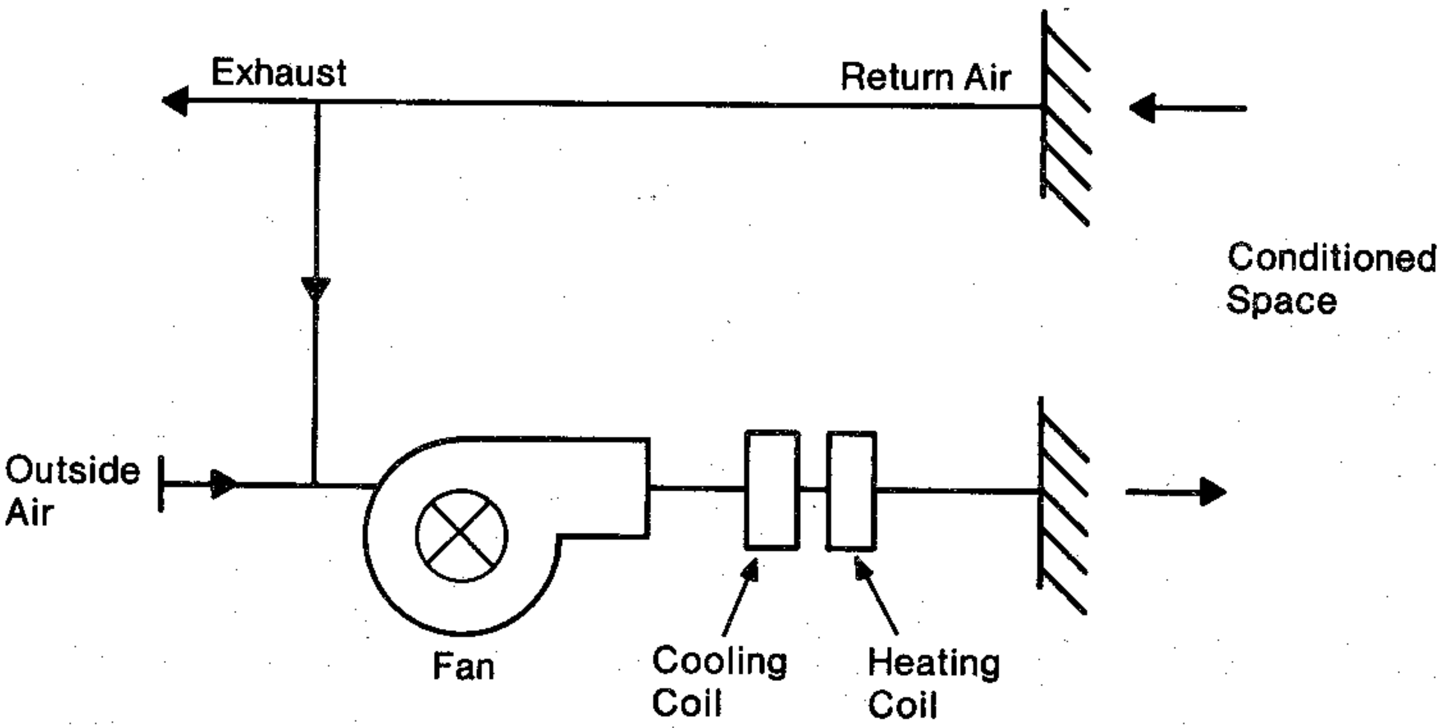
(1) Implement energy conservation measures which reduce the heating and/or cooling or air handled by HVAC system to reduce fan power input requirements.

(2) Raise supply air temperatures during the cooling season and reduce them during the heating season.

(3) Avoid simultaneous heating and cooling except as required for humidity control in critical areas.

(4) Consider converting single zone, single duct systems to variable volume by adding variable volume boxes at each branch. Fan volume preferably should be controlled according to demand, either by installing inlet guide vanes or by installing a variable speed motor or two speed.

Central Station
Single-Zone



Multizone System

A multizone system heats and cools several zones--each with different load requirements--from a single central unit. A thermostat in each zone controls dampers at the unit which mix the hot and cold air to meet the varying load requirements of the zone involved. Steps which can be taken to improve energy efficiency of multizone systems include:

(1) Reduce hot deck temperatures and increase cold deck temperatures. While this will lower energy consumption, it also will reduce the system's heating and cooling capabilities as compared to current capabilities.

(2) Consider installing demand reset controls which will regulate hot and cold deck temperatures according to demand. When properly installed, and with all hot deck or cold deck dampers partially closed, the control will reduce hot and raise cold deck temperatures progressively until one or more zone dampers is fully open.

(3) Consider converting systems serving interior zones to variable volume. Conversion is performed by blocking off the hot deck, removing or disconnecting mixing dampers, and adding low pressure variable volume terminals and pressure bypass.

Terminal Reheat System

The terminal reheat system essentially is a modification of a single-zone system which provides a high degree of temperature and humidity control. The central heating/cooling unit provides air at a given temperature to all zones served by the system. Secondary terminal heaters then reheat air to a temperature compatible with the load requirements of the specific space involved. Obviously, the high degree of control provided by this system requires an excessive amount of energy. Several methods for making the system more efficient include:

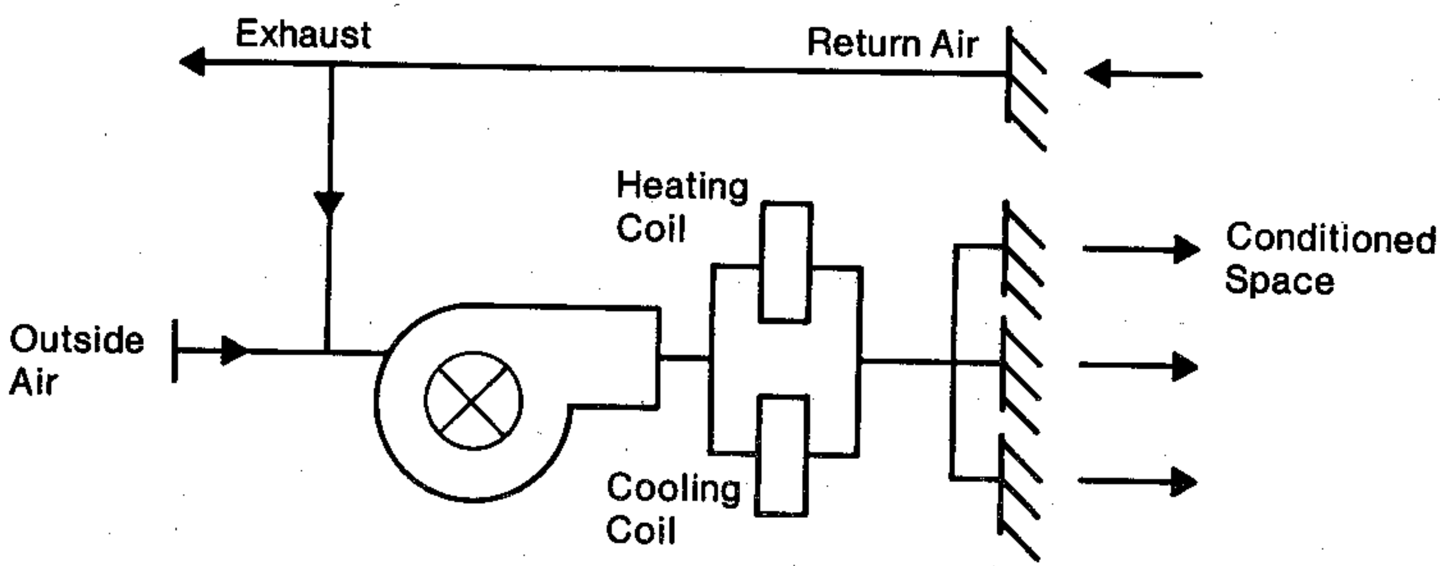
(1) Reduce the supply air quantity.

(2) De-energize or shut-off reheat coils and raise the chilled water supply air temperature in summer months in increments of 3°F. to determine the highest supply temperature which will maintain satisfactory room conditions.

(3) Consider adding zone demand reset controls which will regulate supply air temperature according to demand.

(4) Adjust outside air, return air and mixed air damper controls in winter to raise supply air temperature to a level between 64°F. and 70°F., depending on the conditions in the area served by the system.

Multi-Zone



- Reheat System
- Convert Interior Zones To VAV
- Change Control Settings To Require At Least One Cold Deck And One Hot Deck Damper To Be Closed At All Times
- Dampers Often Leak

(5) If close temperature and humidity control must be maintained for equipment purposes, lower water temperature and reduce flow to reheat coils. This still will permit control, but will limit the system's heating capabilities somewhat.

Fan Coil System

A fan coil system usually comprises several fan coil units, each of which consists of a fan and heating and/or cooling coil. The individual units can be located either in or remote from the space or zone being served. Guidelines for reducing energy consumption of such systems include:

(1) Reduce air flow to minimally satisfactory levels.

(2) Balance water flows to minimally satisfactory levels.

(3) When heating and cooling loads are minimal, shut off fans, enabling the coil to act as a convector.

(4) Consider installing interlocks between the heating and cooling systems of each unit to prevent simultaneous heating and cooling.

Airside Economizer

In this era of increasing energy costs, the concept of "free cooling" becomes more desirable and should be closely evaluated in the design phase of buildings.

One such method which should be evaluated is the Airside Economizer. This system allows for the use of ambient air when the condition of that air is such that the load on the mechanical cooling equipment may be reduced and supplemented with outside air. When this can be done, the economics of the overall mechanical system can be greatly improved, especially if the building is subject to the following parameters.

(1) Building occupied more than the normal number of hours per week: the more the building is used, the greater are the potential savings.

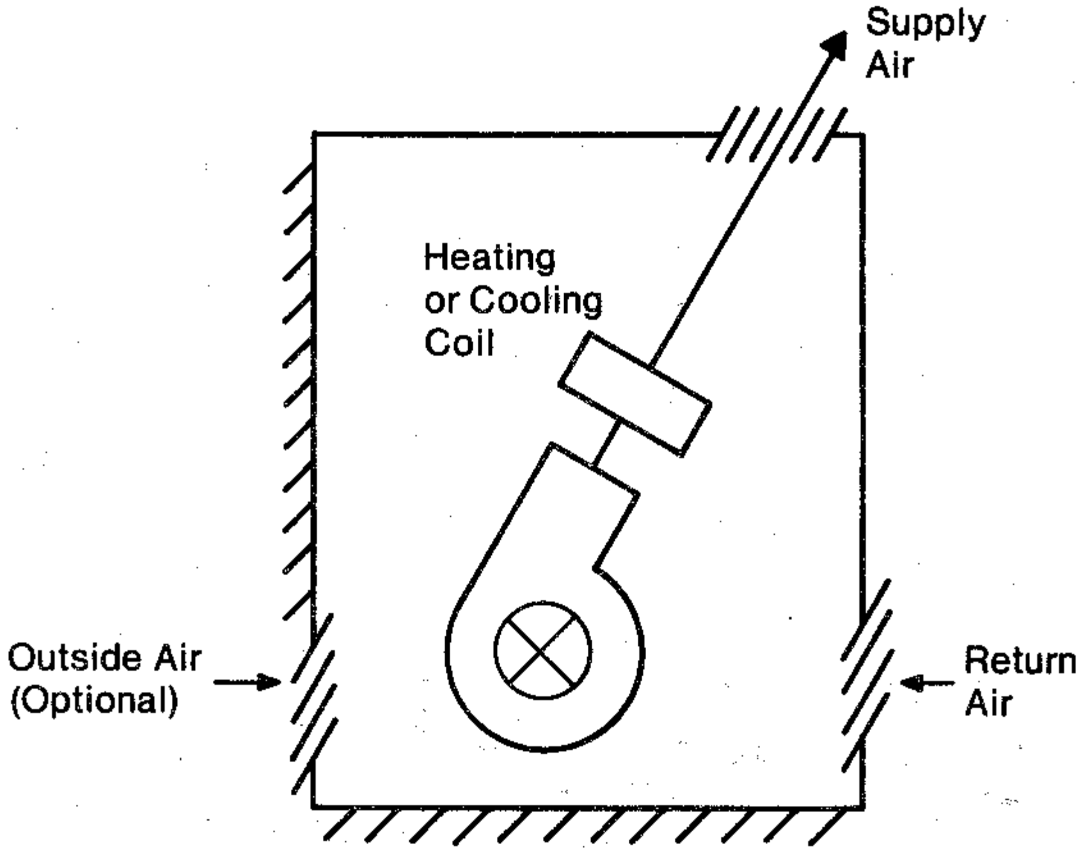
(2) Higher percentage of moderate ambient conditions: outside air does not add to the building heat gain.

(3) Compatible systems; certain systems such as Double Duct or Multizone do not lend themselves to use of economizers.

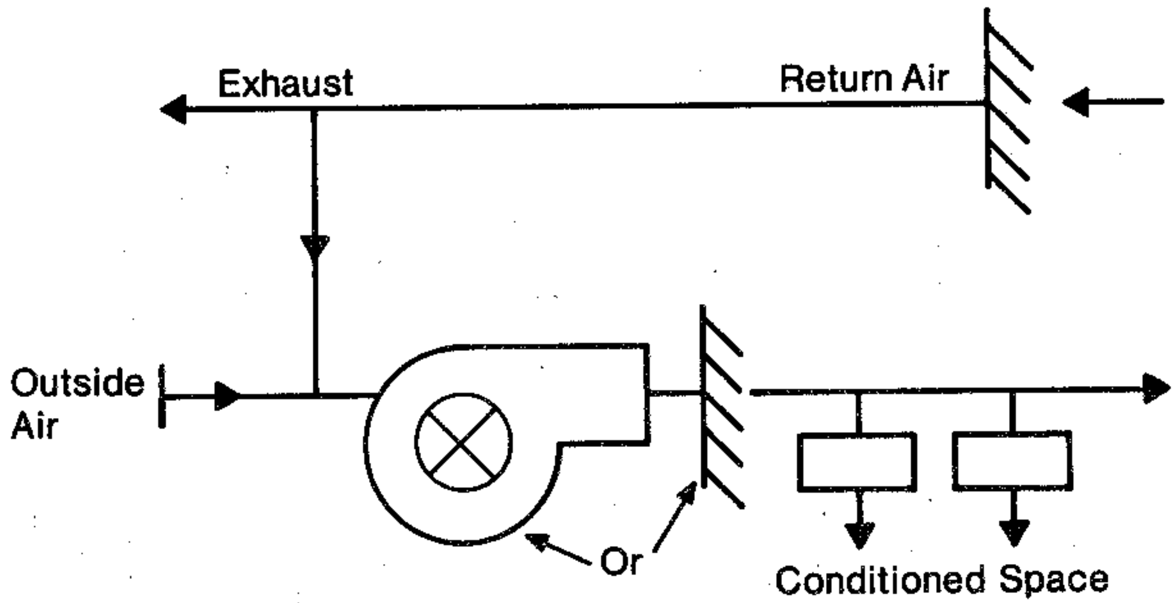
Variable Air Volume

Most conventional air distribution systems operate on a constant volume variable temperature arrangement which, regardless of the requirements of the

Fan Coil Unit (2-Pipe)



Variable Volume



* Generally A Very Efficient System
* Inlet Vanes Or Discharge Dampers
  Create Varying Volume

conditioned space, provides a constant volume variable temperature arrangement which, regardless of the requirements of the conditioned space, provides a constant quantity of air and simply reduces or increases the conditioning capacity of that air.

Now consider an air distributing system that will satisfy zone requirements and, at the same time, take advantage of reduced loads to decrease fan horsepower, refrigeration horsepower and ventilation air quantity. This type of system is available today and is called a variable air volume (VAV) system.

Experience with this system has shown other interesting and desired effects such as:

(1) Generally lower first cost
(2) Virtually self-balancing distribution
(3) Inexpensive temperature controls
(4) Increased flexibility in zone changes or usage
(5) Lower reduced load noise levels

Increased savings may be gained through the use of the variable air volume systems when the following conditions exist:

(1) Major building axis oriented east and west with high glass content--system takes advantage of wide solar variations.

(2) High perimeter/interior area ratio with high daily load variations.

(3) Diverse usage of area.

Total Return System Bleed-Off System

In a total return system, air is introduced into the room through coventional air diffusers and all of it is returned through the luminaires. A fixed portion of the return air is exhausted to the outside for ventilation purposes, while all or part of the remaining air may be recycled or exhausted, depending on outdoor temperature and humidity conditions.

Total return has the advantage of maximizing light output from fluorescent fixtures while reducing the temperaure of the luminaire surfaces and thus minimizing radiant heating effects. This is accomplished with little change in the cooling tonnage required from that of a conventional ducted air system. This may be applicable especially to computer rooms and kitchen facilities.

In a bleed-off system most of the air entering a space is returned to the air handling unit directly through conventional registers. Only a portion is drawn off through the lighting fixtures and this is vented directly to exhaust. This bleeding-off of ventilation air through the lighting fixtures offers the greatest potential reduction in cooling capacity of all air handling methods, especially in those applications where high ventilation rates are required. Lighting efficiency is increased and radiant heating effects are diminished, but not as much as in total return systems.

Heat Pumps

Reduced to essentials, the objective of the concepts discussed up to this point for optimizing energy use in HVAC systems is to transfer heat. Because heat transfer is also the basic function of the refrigeration cycle, it is not surprising that apparatus using the principle has found valuable service in the field of heat recovery.

By virtue of its name alone, the heat pump deserves the attention of designers concerned with optimizing energy use through heat transfer. The heat pump is essentially a heat-transfer refrigeration device that puts the heat rejected by the refrigeration process to good use. It offers the engineer a single equipment installation that:

(1) can provide either heating or cooling;

(2) can switch from one to the other automatically as needed; or

(3) can supply both simultaneously if so designed.

LIGHTING

Lighting systems in public buildings present a special challenge in design and operating techniques. Initital design criteria must often be conceived without precise knowledge of how a space will be ultimately used, but with definite restrictions on initial cost. To compound the matter, lighting requirements vary widely, from a non-critical area such as a storage closet to areas where lighting is highly critical such as drafting and other work areas.

The objective of this section will be to look at the various components of a lighting system and relate them not only to each other, but to the other functions and systems in the building. While conservation of energy is the primary purpose of this section, it is to be achieved without the sacrifice of quality of light and visual comfort. Furthermore, it is equally important to realize that as waste is reduced in the lighting system, it, in turn, will impact the operation of heating and cooling systems which were designed to compensate for the heat generated by the original lighting system. With technical assistance, this effect can be used as a further reduction of energy needs in the building and as a source of additional savings.

Operation

The first area involved in any energy conservation plan is modification of usage patterns. This simply implies using the lighting systems in the most effective and efficient manner.

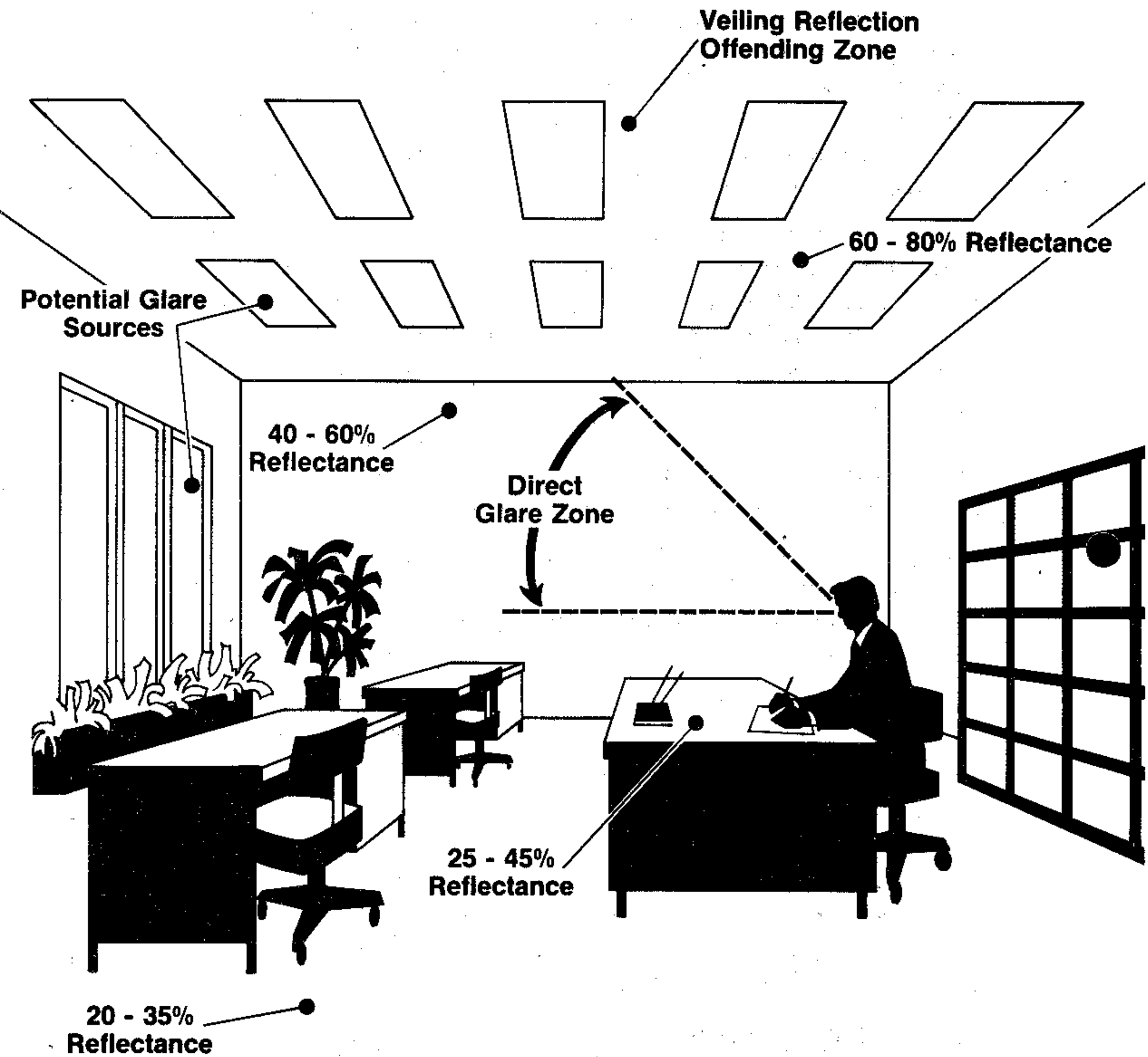
The investigation into usage patterns is based on the results of the building survey which should identify any problem areas in the system, in addition to any problems in the method in which it is utilized.

Utilization of Work Space

Proper planning can take the best advantage of existing lighting systems or allow changes which make it possible to utilize fewer lights and fixtures. Some modifications that you may wish to explore are given below. The more complex changes will require technical assistance and it is again advised that this assistance be obtained before modifications are begun.

(1) Improve the quality of light by taking care to reduce glare and veiling reflections. This can be done by rearranging desks and work surfaces, controlling glare from fixtures and windows, and controlling reflections and glare from walls or other glossy surfaces. This is illustrated in Figure 1.

FIGURE 1



from "Office Lighting", General Electric brochure TP-114

(2) Where possible, group tasks that require high lighting levels in common areas. This reduces the need for numerous, separate highly lit areas thereby reducing the total quantity of light needed.

(3) Use the natural light available in the work area more effectively. Locate work surface where this light will not be left unused. Keep in mind that these areas will need adequate artificial light at night and on overcast days.

Fixtures

The fixture is the total lighting unit, consisting of light reflectors, diffusers, the bulb, etc. It plays an important role in determining lighting effectiveness and therefore in conserving energy, since fewer lights are needed if they are more effective ones. The fixture's vital role is to maximize light output and also to direct light to the point where it is needed.

(1) Consider replacing outdated fixtures with newer ones. In choosing light fixtures for replacement or for new construction, purchase those with the highest coefficient of illumination (CU). A CU is the ratio of light which reaches the work-plane to the total light emitted by the bulb.

(2) The reflective surface on many fixtures will deteriorate with time, thereby lowering effective light output. Paint these deteriorated surfaces with a reflective acrylic paint which is specially formulated for fixture application.

(3) Consider the feasibility of lowering ceiling light fixtures, making them closer to the work plane. This will increase light levels since the intensity of light is directly proportional to the distance from the light source.

(4) The ballast is a wire coil placed inside the light fixture which is used on certain types of lamps to regulate electric current and voltage. Ballasts must be removed when bulbs are taken out because they continue to consume energy.

(5) Lenses can be placed on a light source which will focus light in a particular area. This will improve lighting effectiveness for circumstances in which highly concentrated light is needed for visual tasks.

Reduction of Lighting Levels

It is very often the case that an area is overlit for the purposes for which it is to be used. Excessive lighting is a waste of energy and reduction of lighting levels should be considered. Though individual lights may cost only a very small amount to operate all day long, the effect over a year or more of even small reductions in lighting can result in significant savings for a building as large as a hospital.

(1) Reduce lighting levels or turn lights off altogether in areas which are unoccupied for any appreciable length of time.

(2) Take measurements with a light meter of lighting levels throughout the facility. Generally accepted lighting level recommendations, formulated by the Federal Energy Administration (FEA) are given in Figure 2.

(3) Consider changing the type of print and/or paper that office workers ordinarily must read so that the contrast between print and paper is heightened. This might make possible the reduction of lighting levels without affecting visual acuity.

Maintenance

For lighting, just as for any other mechanical system, proper maintenance is a practice which will pay for itself in lower operating costs and trouble-free operation.

(1) Clean Reflecting and Transmitting Surfaces.

(2) Use Light Colored Reflecting Surfaces.

(3) Follow Good Maintenance Procedures.

Use of More Efficient Lamps

Each type and model of light bulb will have a different operating efficiency, which is measured in terms of light output per power input (lumens/watt). Using higher efficiency bulbs will mean higher energy savings. Although there are numerous other considerations in choosing lighting systems, operating efficiency should be a major one.

(1) Figure 3 shows the relative efficiency of different kinds of lights in terms of light output per power input. Take inventory of the types of lighting used in your facility, and where feasible replace one type of light with another that is more energy efficient.

(2) Avoid using extended life bulbs. These bulbs are often used in locations that are hard to reach, making replacement difficult. However, the extended life of these bulbs is gained at the expense of lower energy efficiency.

(3) Avoid using multi-level lamps. They do not produce as many lumens per watt as do single level bulbs, and their light output deteriorates more rapidly.

Controls

If the controls on a lighting system are not adequate, the inevitable results will be operating inefficiencies and waste of energy and money. For a facility the size of larger public buildings, an investment in controls can be a profitable one. Some available lighting control means are discussed below.

(1) Multiple Level Lighting - Oftentimes a room is used for a variety of purposes, each with a different lighting need. Use of multiple level lighting can save energy in such instances.

FIGURE 2

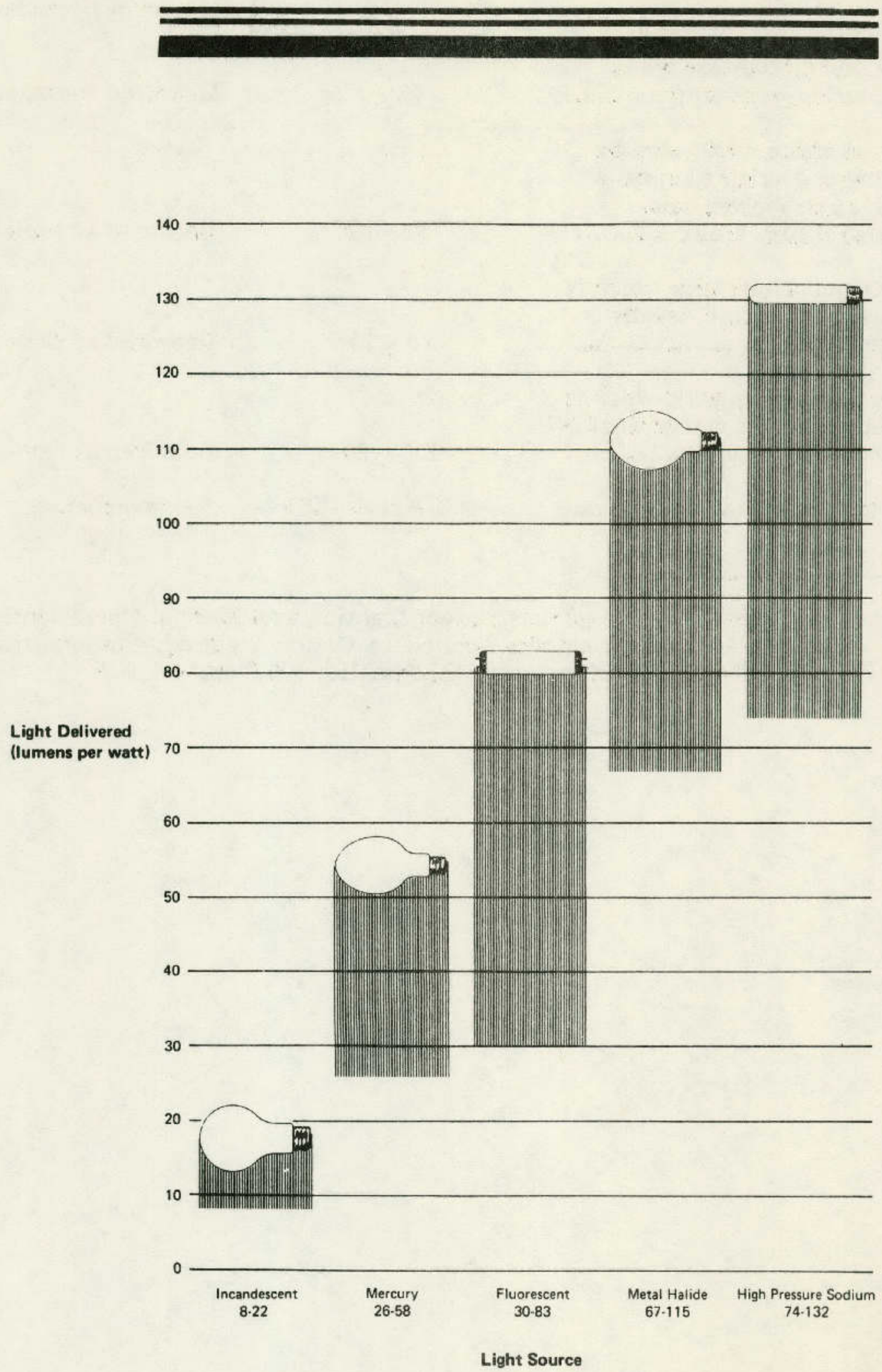
RECOMMENDED FEA MAXIMUM LIGHTING LEVELS

Task or Area	Footcandle Levels	How Measured
Hallways or corridors	10 ± 5	Measured average, minimum 1 footcandle
Work and circulation areas surrounding work stations	30 ± 5	Measured average.
Normal office work, such as reading and writing (on task only), store shelves, and general display areas	50 ± 10	Measured at work station.
Prolonged office work which is somewhat difficult visually (on task only)	75 ± 15	Measured at work station.
Prolonged office work which is visually difficult and critical in nature (on task only)	100 ± 20	Measured at work station.
Industrial tasks	ANSI-A11-1-1973	As maximum.

Source: Federal Energy Administration, Lighting and Thermal Operations: Energy Conservation Principles Applied to Office Lighting, Conservation Paper Number 18, (Washington, D.C., April 15, 1975) pp. v-6, v-7

FIGURE 3

Efficiency of Various Light Sources



One option is to have several switches, each controlling a fraction of the total number of lamps, so that one-third, two-thirds, or all of the lights may be turned on as needed.

(2) Light Timers - Timers can be integrated into the lighting circuits which turn lights off a certain time period after they have been turned on. These would be applicable for rooms which are commonly used for only a short period of time. If the room had to be used for an extended time period, the timer switch can be overridden.

(3) Timeclocks - Timeclocks are an excellent way to control the operation of security, parking and decorative lighting, as they will negate any forgetfulness on the part of staffers whose job it is to turn off these lights.

(4) Photo-Cells - If outdoor lighting is controlled by photo-cells instead of timeclocks, the problems of seasonal lighting variation and inaccurate timeclocks are overcome. A photo-cell senses the amount of sunlight present, turns on lights only when darkness sets in, and turns them off when it becomes light again. There are also photo-cell based controls which can be used effectively for interior lighting operation.

(5) Light Monitoring - For rooms in which the light switch is outside the room, neon "pilot" lights may be installed in series in the lighting circuit to indicate whether room lights are on or off. These lights use very little energy, and at a glance inform one whether lights need to be turned off. Similarly, pilot lights for several different lighting loads can be placed on a central control panel, where one person can check lighting status from a remote location.

BUILDING ENVELOPE

David McCandless, A.I.A.
PLANERGY, Inc.

The total use of energy required in a public building to provide the proper environmental conditions of temperature, humidity, light and fresh air involves not only the mechanical systems and service within the facility, but also the entire BUILDING ENVELOPE which must **contain** that man-made environment and **exclude** the often adverse outside conditions.

Total Energy Management in public buildings, therefore, must take into account all the possible ways that conductive and convective heat losses and gains, outdoors--to-indoors and indoors-to-outdoors, can occur through the **building envelope,** through the seasons of the year. It must also consider solar heat gains, helpful in winter and unwanted in summer. And, because of the functional complexities of larger buildings, energy management should extend also to the separation of the environmental zones inside that building envelope.

There are many small ways to conserve energy in the building envelope, as well as larger, more expensive improvements which can be made, and it is important to put these opportunities into some overall perspective. From the broad point of view there are five major areas of concern. They are, in the general order of importance for existing buildings:

(1) Reduction of infiltration and exfiltration.
(2) Reduction of solar heat gain through windows (in summer).
(3) Reduction of heat loss through windows.
(4) Reduction of heat gain and loss through walls, roof, etc.
(5) Reduction of internal heat transfer.

A general analysis of each of these five subjects is presented in the discussion which follows.

Infiltration and Exfiltration

The energy used for heating and cooling many public buildings is about 60% of its total energy needs. A large portion of that results from the heat gains and losses through the building envelope. In the "typical" building the major portion of that occurs as infiltration and exfiltration--air leakage through all kinds of cracks and crevices in the building envelope.

Outside air can leak through cracks around operative window sash and doors, between the door or window frames and the wall materials they are set in, and through joints in the basic wall construction, especially in panelized wall systems.

At the same time consider the quality of the installation and the caulking materials used. These can vary from good to poor, and caulkings can change in quality with age.

Infiltration and exfiltration vary with wind velocities and wind pressure, both positive and negative, on different sides of the building. Air pressures inside the building envelope can also be positive and/or negative, and these can combine with the exterior conditions to induce leakage wherever the potential exists.

There is also a stack effect in tall buildings, especially in such vertical spaces as stairways, elevators, and mechanical service shafts. Since warm air tends to rise, when outside air is cold there is a strong potential for infiltration at the bottom floors and exfiltration at the top.

Caulking between fixed systems and weatherstripping of movable window sash and doors are the major means of reducing infiltration and exfiltration in the building envelope.

Storm windows are often used to increase the thermal resistance through glass. Double glazing is also used for this purpose, but the storm window units have an advantage, generally, in increased control over leakage of air around the window frames.

Solar Heat Gain

Heat gain from solar radiation through windows in public buildings can have a major impact on energy use depending on such factors as orientation, exposure and shading, winter and summer, types of glass and glass treatment. Since Texas is in an area where winters are not so severe, the need of cooling due to solar gain through windows is much more significant than for heating due to heat losses in the winter.

There is so much more heat gain from solar radiation than from conduction through the glass that radiative gains must be solved before considering the conductive heat transfer through the glass. When double glazing is then considered for reducing summer heat gains there will also be a real benefit in controlling heat losses in the winter season.

The effects of orientation are different for winter and summer. In winter the sun rises a little south of east, is low in the south sky at noon, and it sets correspondingly south of west. This sun movement allows a little east and west wall solar heat gain the morning and afternoon, respectively, and a lot of mid-day sun on the south walls and into south facing windows. In the summer, the sun rises a little north of east and it sets a little north of west, and at noon it is high overhead, barely shining on southerly walls and windows. Summer solar radiation, therefore, is most severe on eastern and western exposures and not so serious on southern exposures. Exterior architectural shading for windows must relate to these sun angles.

External shading devices are the most effective method of controlling solar heat gain because they prevent the sun from shining directly on the glass.

Internal shading devices include drapes, venetian blinds, vertical louver blinds, roller blinds, and variations of these basic types. While less effective than other methods of solar heat gain, internal shades are relatively inexpensive and they are much more easily adjustable to the times of most solar gain and to the needs for light and view.

Heat Loss Through Windows

On the national scale it has been estimated that 20% of our energy goes to space conditioning in residential and commercial buildings similar to most public buildings. Of this, 25% results from heat losses and gains due to the relatively high thermal conductivity of windows -- an energy use equivalent to an average of 1.7 million barrels of oil a day.

Although, as was pointed out earlier, there is in Texas more of an energy concern for solar gain in summer than conductive heat loss through glass in winter, the heat loss is still significant. And there are some things which can be done to help save energy in this regard.

There is a greater concern for heat flow through glass than through the "solid" parts of the building envelope, the exterior walls, the roof, and floors over unheated space. It is helpful to put this difference into some sort of perspective. If individual windows set in a brick wall add up to only one-tenth of the total wall area, and if the windows are double-glazed, the heat transfer through wall and windows is equivalent. If those windows are in continuous bands they would probably equal about a third of the wall area, so there would obviously be more conductive heat gain and loss through the glass than the solid wall.

As discussed above, using double glazing will reduce the conduction heat loss of single glazing by one-half, but this will occasionally be modified somewhat by solar radiation and wind, and therefore by orientation.

Storm windows are often easier to add to existing windows than to change to double-glazing in the original frame. The choice will vary with the physical conditions, the present needs and replacement plans, etc., for each public building. The use of storm windows may provide greater reduction in heat transfer through the windows because of the greater air space, and storm windows should give more control over air infiltration because of the second frame set tightly in the window opening.

The use of various types of drapes or blinds, appropriate linings, etc. to cover the windows when not needed for light or view will also help reduce heat flow through windows.

When rooms or zones of the building are unused or closed off, the thermal transmission through the windows, in both winter and summer, can be meaningfully reduced by closing off the windows with various types of thermal barriers. Depending on the time the space is to be closed off, and on how the space heating and cooling is to be maintained, the thermal barriers can range from simple drapes and blinds to storm windows and even opaque, insulated panels.

Heat Flow Through Walls, Roof, Floors

In energy conservation we are concerned with the rate of conductive heat flow through various types of building construction. This is the "U"-value of each complete construction, inside-to-outside, including air films, as discussed above. By contrast, we are also concerned by thermal resistance of materials such as insulation, masonry, wood, plaster, etc., to heat flow through them. The thermal resistance of a material is its "R"-value. The R-value of all materials in a wall construction can be added, and the resulting total R-value is the reciprocal of the U-value of the whole construction.

This relationship of the U-value to the total R-value, and then to the R-values of the parts of a construction, is meaningful in discussing the improvements that might be achieved by the addition of certain insulation materials. They are commercially rated by their R-values, even though we usually use the U-value as a rating of the total construction.

It is best to remember simply:

(1) the higher the R-value, the better the "insulation"; and

(2) the lower the U-value, the better the "insulation" of the whole construction.

For most constructions of walls, and also for roofs, the basic structural materials by themselves are inadequate as thermal barriers and various amounts and types of insulation are included in their design. Part of the physical examination of the building envelope in the basic energy audit of a public building should be an anlaysis of the plan, details, and specifications of its construction to determine the resistance to heat flow of its many parts. This should be done for the various details of wall and roof construction, and for any floors over unconditioned spaces.

For most of Texas the heat gain of summer will be more of an energy concern than the heat loss in winter, but there are enough variables to consider that this should be determined for each situation.

Heat gain and loss through roofs can also be reduced by lowering the U-value by adding insulation. Again there are techniques for this additional treatment both on top of the roof and on the underside.

When adding insulation to the top of the roof the work is less disruptive and may be timely if the existing surface needs repair. The surface must be prepared according to what techniques are used. Both sprayed foam and rigid board insulation are available for use on roofs.

Adding insulation below the roof structure may be achieved by applying it to the underside of that structure by spray application or with fitted pieces of insulation board. The complications of working above and around existing utility lines, pipes, ducts and structural members may be the determining factors involved. The need for insulating pipes, ducts, etc., should not be overlooked, nor should their location in the attic space allow some area of the roof underside to go untreated. If the insulation is laid over the existing ceiling it is important to consider the pipe and duct insulation and possibly the need for attic ventilation.

When floors over unconditioned spaces (crawl spaces, vented and unvented; pipe and mechanical spaces, rough storage spaces; outdoor spaces) are deemed to have inadequate resistance to heat flow, the U-value can also be lowered by the addition of insulation materials. Types of treatment will vary with accessibility. Again, they include the spray applications and rigid board treatment. Where concrete floors are poured on grade, and additional floor insulation is desired it can be installed as an exterior, perimeter treatment (Dow Styrofoam, Fiberglas, etc.) of insulation board placed against the foundation, from the bottom of the exterior wall facing down to a point approximately 24 inches below grade.

Internal Heat Flow

Buildings often must house many functions, and as a result are often zoned both functionally and mechanically into a number of related areas. Occasionally the temperature, humidity and air movement requirements of these zones must be isolated or separated. Sometimes there is a contrast in the environments of two adjacent areas because one is "shut-off" momentarily or temporarily. Under these varying conditions there may well be need for energy conservation measures due to air leakage or heat flow through inadequate barriers.

Air leakage is probably the more serious of these two types of heat gain and loss, and probably the hardest to treat completely. Besides the conditions of door cracks, and leakage around electrical and utility boxes in walls, already discussed, there are the various types of ceiling penetrations: recessed lights, air conditioning grilles, etc., which need appropriate seals in certain situations.

Conclusions

While many small efforts can be made for energy conservation in the existing public building envelope, some of the more complicated measures are both expensive and disruptive. Such treatment should not be viewed with dismay. Texas is a state of growing communities, and almost all governments have programs for various degrees of expansion. Not only can the expensive, disruptive opportunities for energy conservation be planned to be carried out in the remodeling which goes with expansion, but also the experience of energy audits and total energy management can make a major impact on the planning of future facilities.

LIFE-CYCLE ANALYSIS FOR ENERGY MANAGEMENT DECISIONS

Del Fowler, P.E., Planergy, Inc.

For those who are serious about energy managment, energy use computations from past bills for a given building or facility are usually followed by a detailed energy audit of that building or facility. Observations during the audit and computations and analysis following the audit will provide a "shopping list" of energy conservation opportunities, or as I prefer to call them, Dollar Saving Opportunities (DSOs). To compile a list of such potential retrofit projects is not enough, however; we will need other information if we are to make good decisions based on sound economics. For example, we might want to know:

- should this project be done at all
- which of the many potential projects should be done first
- for my yearly budget of "X" dollars for such projects, which of those on the "shopping list" will provide me the greatest return on investment

This section discusses how to go about this analysis.

Simple Pay-back

Most of us would probably think of this analysis even if we had never heard of it. It is simply the first cost (estimated cost of labor and materials required for the retrofit project) divided by the net annual savings; in other words how many months or years will it take to recover the cost of the project.

$$\text{Payback Period} = \frac{\text{First Cost}}{\text{Net Annual Savings}}$$

In this case net annual savings would, in the simplest form, be the annual fuel or energy saving (computed using projected fuel or energy prices) less any additional operating cost which might be required for the energy-saving equipment installed.

$$\text{Payback Period} = \frac{FC}{(AFS \times PFP) - AAOC}, \text{ where}$$

FC = First Cost
AFS = Annual Fuel Saving
PFP = Projected Fuel Price
AAOC = Additional Annual Operating Cost

The payback period is then compared to the expected lifetime of the investment in order to make some rough judgement as to its potential for cost recovery. A payback period of less than one-half the life time of an investment would generally be considered profitable where the lifetime is ten years or less.

Return on Investment

Return on Investment (ROI) is somewhat superior to the above because it takes into account the depletion of the investment over its economic life by providing for renewal through a depreciation charge. Using a straight line depreciation charge (DC) where

$$DC = \frac{\text{FC (First Cost)}}{\text{EL (Estimated Lifetime)}}$$

the percent return on investment can be calculated using

$$\text{ROI, \%/yr} = \frac{S\text{-}DC}{FC} \times 100\%$$

S = Net Annual Savings

ROI has the advantage of putting investments with different life expectancies on a comparable basis. It is frequently used in the financial analysis of potential investments because of its simplicity of calculation.

These measures, payback period and return on investment, as measures of performance, give rise to problems, however. For instance, they do not consider debt service, price escalations, or energy cost increases. One cannot say, for example, that an initial capital investment of $100,000 which results in annual energy savings of $20,000 has a payback period of five years. To do so ignores the fact that interest must be paid on the loan of $100,000, or that -- if no loan is involved -- the $100,000 would otherwise be earning interest. So for the larger projects in particular, we need measures of performance which will incorporate the time value of money.

Life-Cycle Costing

Once we have taken the mental step of deciding to include the price of money from year to year, we have entered the world of life-cycle costing. To examine what we mean by life-cycle costing, we might look at how you might buy an automobile. If you decide you want a specific model of automobile, say based on style and appearance, then you are really going to base your decision to buy based only on first cost. You will most likely buy from a dealer which offers the lowest sales price, even though a second dealer with a slightly higher price might have a cheaper source of money which would finance your loan for the car purchase with a lower monthly payment. Buying without checking on the cost of money for the car loan is certainly buying on first cost alone, and without considering the principles of life-cycle costing.

Additionally, if you ignore gasoline mileage, other operating costs, maintenance costs, and "salvage value" or trade-in cost at the end of a certain period of time, you are ignoring the principles of life-cycle costing.

> DEFINITION -- The term "life-cycle cost" means the total costs of owning, operating, and maintaining a building or a piece of equipment over its useful life.

In the National Energy Conservation Policy Act of 1978, the Federal Government has directed that all federal agencies develop and establish methods for applying life-cycle costing for all federal buildings. This same act, to give you a picture of what the federal government is in the process of doing, requires that:

1. The Secretary of Energy and others shall establish and publish energy performance targets for all federal buildings.

2. Each federal agency must conduct a preliminary energy audit of all federal buildings with more that 30,000 square feet as soon as possible and report to Congress in 1979 on the accomplishments.

3. Similarly, they are to next conduct preliminary energy audits of all federal buildings with 1,000 or more but less that 30,000 square feet of floor space, and report to Congress in 1980 on the accomplishment.

4. In the first year, all federal agencies should retrofit 1% of the total gross square footage of floor space as recommended in the preliminary energy audits.

5. By 1990, all federal building will be retrofitted so as to assure their minimum life-cycle costs.

Because there are always alternative investment opportunities available for funds, a dollar held today is worth more than a dollar held at some future time. This is true even without continuing inflation, which promises to reduce the value of that future dollar even more. To bring into the analysis this cost of money we will use standard interest tables and present worth factors. In life-cycle costing, the most commonly included costs are first cost (in place), operating costs, maintenance costs, and interest on the investment. To use interest tables we must know the life of the system. This is one judgement we must make --that is, the useful life.

In addition we must make judgements on interest rates (i.e., the cost of money or capital), on inflation rates, and on rate increases in costs of energy and of maintenance.

Cost of Money

Let us examine this question, since it is probably the most important judgement or decision management will have to make.

Financial managers in any company will usually know what return in percent they want to realize on cash or capital which they spend from earned income. They arrive at their decision by looking at the various earning alternatives available for that same cash, to include investment in savings instruments of some kind, as well as the reinvestment of that cash in their own business. These alternate investment decisions can be based on the rate of return before taxes, but sound financial decisions must take into account corporate income and other taxes. We can take income taxes into account by setting the "before income tax rate" of return at a higher value than the "after income tax rate". If a 12% return is the minimum desired after taxes, the rate before taxes can be determined by

$$i_b = \frac{i_a}{1-I} = \frac{.12}{1-.48} = 23.1\%$$

where

i_b = before tax rate of return

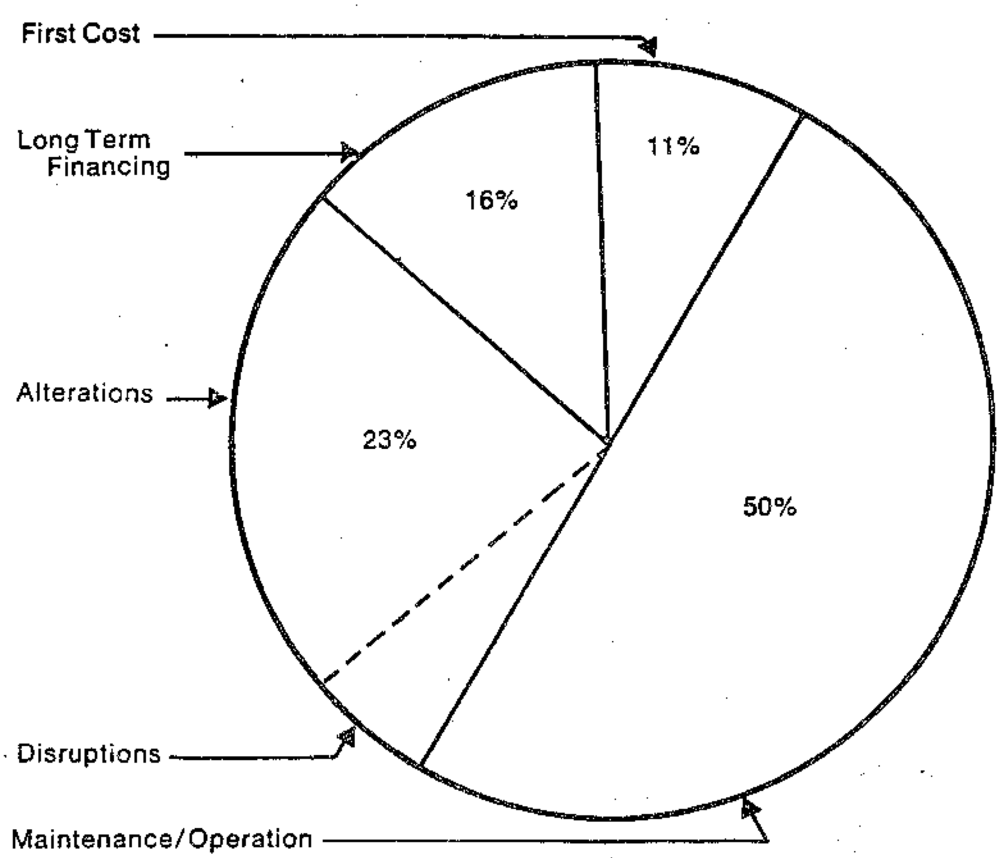
i_a = after tax rate of return

I = income tax bracket (48% in above example)

at the 48% corporate tax level, it can be seen that the before tax rate of return must be about twice that of the desired after tax rate.

WHY LIFE CYCLE COSTING?

The Educational Facilities Laboratories, Inc., of Menlo Park, California, portrays the lifetime cost of a building as shown below.



With the first cost representing only 11% of the total, the reason for considering all costs seems obvious. And since maintenance and operations are 50% of the total, again the logic in designing a facility to minimize energy use and operating costs is obvious.

Present Value Analysis

If all the factors involved in life-cycle costing did not change with time from year to year and if every energy investment were for the same number of years, there would be no need to reduce what happens from year to year to a common base. But as we know only too well, things do change, and the useful life of various energy projects are quite different. The rate of inflation as measured by the cost of living index or the wholesale price index, or any other such index, has varied in the past few years from month to month from 6 or 7 percent for year to as much as 14 percent. This rate obviously affects maintenance costs where the provision of supplies and services is involved.

We also know that energy prices are going to escalate for several years at a rate greater than those in the rest of our economy, primarily since price controls on energy are to be removed gradually, so as to bring our domestic energy supplies up to free world prices. So we need some analytical method of comparing these different investment opportunities.

Life-cycle costing in terms of present worth or present values provides us such a tool. Life-cycle costing extends our decision-making time frame from one year and first costs to a time frame of future years and all costs. Present worth or present value analysis does for the future of an analysis what a telescopic lens does to distance. It brings the future up to the present, allowing future costs to be reflected in their true value today, considering that all money will be invested in some area every year. Just as first costs have been compared and decisions made according to the lowest or first-cost bid, now we will begin using life-cycle costing and present worth or present value concepts to compare pieces of equipment or hardware, or in our case, alternative energy saving and dollar saving opportunities.

The concept of present worth or present value in life-cycle costing is based on the assumption that funds that are borrowed always carry interest charges for their use; in similar manner, if cash on hand is to be used, that cash, if not used, could be invested in some manner and earn interest. Present value analysis provides us a tool to reduce future annual savings to a common, or equivalent, basis with current savings or current costs. Such a reduction is necessary because a dollar saved today is worth considerably more than a dollar saved some years from now, because a dollar available today can be invested and earn interest whereas the future dollar cannot so earn interest in any year prior to its receipt. What we are able to do is answer this type of question:

> "I want to invest $10,000, which I either have in cash, or will borrow. Should I reinvest it in my business in added inventory, in added sales space, in the stock market, or in an energy and dollar saving opportunity? In other words, will my energy saving investment provide me with the highest equivalent interest rate of all the investment opportunities available?"

We are all accustomed to thinking in interest terms; for example, we readily understand and can compute or find in interest tables what $1.00 invested today at 10% will be worth ten years from now. This so-called future value would be

$1.00 (2.57) = $2.57

The future value factor of 2.57 is shown below under column A opposite year 10.

PRESENT VALUE ANALYSIS

A Future Value of $1.00 at 10%	Years (n)	B Present Value of $1.00 at 10%	C Present Value of $1.00 Received Annually for each of "n" years at 10%
1.10	1	.91	.91
1.21	2	.83	1.74
1.33	3	.75	2.49
1.46	4	.68	3.17
1.61	5	.62	3.79
1.77	6	.56	4.35
1.94	7	.51	4.87
2.13	8	.46	5.33
2.34	9	.43	5.76
2.57	10	.38	6.14
2.83	11	.35	6.49
3.11	12	.31	6.80
3.42	13	.29	7.09
3.76	14	.27	7.36
4.14	15	.24	7.60
4.55	16	.22	7.82
5.01	17	.20	8.02
5.51	18	.18	8.20
6.06	19	.16	8.36
6.67	20	.15	8.51

Present worth or present value analysis just "turns this upside down" or reverses the process. In other words the $2.57 ten years from now has a present value of $1.00 if invested at 10%. We could actually do most of our present value analysis from interest tables like that in column A, but it could be awkward and we would constantly be interpolating between figures in the table. So we have constructed tables which are based on the same interest principles, but which give us a quickly read present value factor instead of the future value factor we got from interest tables. For example, we can look in column B at 10 years and get the present value factor of .38; that factor used with the earlier $2.57 will give us the original $1.00.

$2.57 (.38) = $1.00

What this says is that $2.57 received 10 years from now has a present value of $1.00 if it were invested at 10%.

But with some energy-saving investments, we will be saving an amount each year, in contrast to the previous example when the saving was only in year 10. Referring to column B we can see that if $1.00 were saved in year 1, it's present value is .91, and another $1.00 in year 2 has a present value of .83. Note now that column C is the sum of these two. In other words the figure 1.74 opposite year 2 in column C reflects the present value of $1.00 saved in year 1 and another $1.00 saved in year 2. And in similar manner the 8.51 in column C opposite year 20 reflects the present value of $1.00 saved each of the 20 years, and is the collective sum of all the present values in column B between year 1 and year 20, both inclusive. Another way of looking at this same set of numbers is that if $8.51 were invested now at 10%, the return or yield would be $1.00 for the next 20 years.

The very simple table above covers only an interest rate of 10%. We will obviously use a range of possible interest rates in our life-cycle cost computations. Such a range is provided in Table I; note that the figures in column C of the illustrative example are identical to those in the 10% column of Table I.

Benefit/Cost or Savings/Investment Ratio

At this point, we need to look at a simple illustrative problem. And in doing so we are now returning to the energy audit and the "shopping list" of energy saving or dollar saving opportunities (DSOs) we mentioned in the introduction to this section. In this illustrative problem, we want to compare two alternatives.

	Alternative A	Alternative B
First Cost	$100,000	$100,000
Annual Energy Savings	3.0 billion BTUs	2.7 billion BTUs
Energy Cost	$11.72/million BTUs	$14.65/million BTUs
Useful life	15 years	15 years
Cost of money (or desired return on investment before taxes)*	20%	20%

*In general, a 20% return before taxes is necessary for a 10% return after taxes.

The best analysis of such alternatives will be one which provides for each alternative or option a single number which reflects both benefits and costs. Public or governmental agencies normally use these two and produce a benefit/cost ratio. The same principle is used in the business world with what is called a savings/investment ratio. Keeping in mind all the earlier discussion on life-cycle costs and present value, what we need to do for both System A and System B is to determine the present value of the savings for both alternatives A and B, and the present value of the necessary investment for both.

	Alternative A	Alternative B
Investment cost (present value)	\$100,000	\$100,000
Energy Savings (present value)		
Millions BTUs saved/year	3000	2700
Cost per million BTU	x 11.72	x 14.65
	\$35,160	\$39,555
Cumulative Present Value Factor	x 4.67	x 4.67
	\$164,197	\$184,722
Savings/Investment Ratio	$\frac{164,197}{100,000} = 1.64$	$\frac{184,722}{100,000} = 1.85$

The cumulative present value factor of 4.67 used was obtained from the 20% column (opposite 15 years) of Table I.

As can be seen, both alternatives A and B have Saving/Investment ratios greater than 1.0, indicating that both will return all funds invested at a rate greater than the desired rate of return of 10%. The greater the savings/investment ratio (SIR), the higher the rate of return and the more effective the investment. Thus Alternative B with a SIR of 1.85 is a better investment than Alternative B, a fact which was not obvious even in this rather simple illustration.

Energy and Maintenance Differential Cost Escalation

As was mentioned earlier it is quite possible that maintenance costs may increase at a higher rate from year to year than other costs, and it is a certainty that energy prices will rise at a more rapid rate than other elements of our economy. Actual rates of increase in costs of energy are being projected as high as 15 or 20%. Any differential increase, even 2%, materially affects normal present value computations. For example, in the illustrative situation just discussed, the present value factor for energy saving would have been 10.86 instead of the 4.67 if an annual energy price increase of 15% had been factored in. Because of the need to include these annual increases in our computations, Tables II and III have been included, for desired returns of 10% and 20%. Respectively, the 10.86 figure just quoted is obtained from the 15% column of Table III opposite 15 years.

To illustrate the effects of these factors, let us go back to the illustrative problem and add an annual energy price increase of 15% and an annual price increase in maintenance costs of 4%. In this illustration the maintenance cost is that which is required on the new energy-saving devices being installed. Hence the present value of the added maintenance cost must be subtracted from the present value of the energy savings to obtain the overall net saving.

	Alternative A	Alternative B
First Cost	$100,000	$100,000
Annual Energy Savings	3.0 billion BTUs	2.7 billion BTUs
Energy Cost	$11.72/million BTUs	$14.65/million BTUs
Added Annual Maintenance Cost	$1500/year	$2000/year
Useful Life	15 years	15 years
Desired Return on Investment	20%	20%
Annual Energy Price Increase	15%	15%
Annual Maintenance Price Increase	4%	4%

Our savings/investment ratio previously looked like this:

$$\frac{\text{present value of energy savings}}{\text{present value of investment}}$$

With maintenance costs added to the equation, the SIR will now be:

$$\frac{\text{(present value of energy savings) - (present value of added maintenance)}}{\text{present value of investment}}$$

In addition, we will need to refer to Table III for present value factors for both energy and maintenance, rather than Table I.

		Alternative A	Alternative B
Investment Cost (present value)		$100,000	$100,000
A.	Energy Savings (present value)	$35,160	$39,555
	Cumulative Present Value Factor	10.86	10.86
		$381,838	$429,567
B.	Added Maintenance Costs	$1500	$2000
	Cumulative Present Value Factor	5.74	5.74
		$8,610	$11,480
	A - B	$373,228	$418,087
Savings/Investment Ratio		$\frac{373,228}{100,000} = 3.73$	$\frac{418,087}{100,000} = 4.18$
Earlier SIR (w/o energy & maintenance cost escalation)		1.64	1.85

The effect of escalating energy prices on this analysis is unmistakable, and points out that this factor should be included in all computations for all such energy decisions.

This type of problem can be shown graphically as an aid in visualizing the time and relationships involved; such a graphical portrayal of Alternative B alone is at Figure 1.

Energy Audits

The only requirement which remains is how to pack all this knowledge into something more compact for an energy audit report. For each of the energy conserving Dollar Saving Opportunities (DSOs) we fill out a one page form like the one shown at the end of this section, and secondly we set priorities, based on the SIRs for each DSO, on a second one page form, a copy of which is also included at the end of this section.

TABLE I

CUMULATIVE PRESENT VALUE OF $1.00 RECEIVED ANNUALLY FOR n YEARS

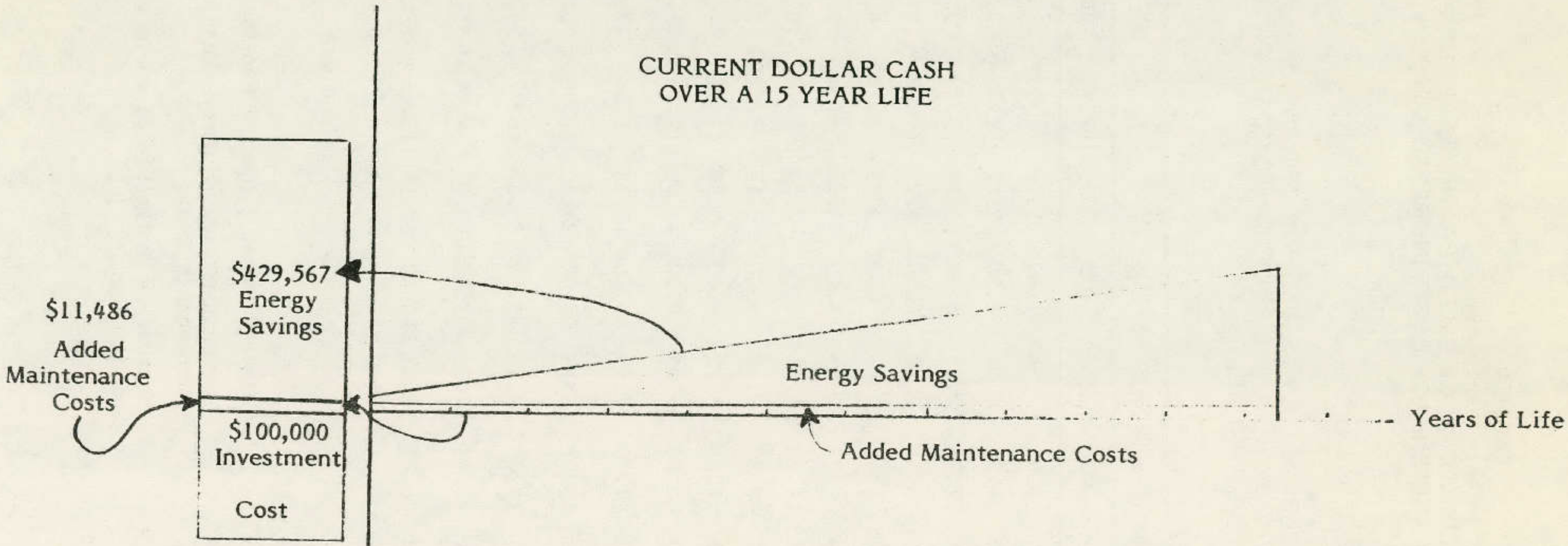
Years (n)	6%	8%	10%	12%	14%	16%	18%	20%
1	0.94	0.93	0.91	0.89	0.87	0.86	0.85	0.83
2	1.83	1.78	1.74	1.69	1.65	1.61	1.57	1.53
3	2.67	2.58	2.49	2.40	2.32	2.24	2.17	2.11
4	3.46	3.31	3.17	3.04	2.91	2.80	2.69	2.59
5	4.21	3.99	3.79	3.61	3.43	3.27	3.13	2.99
6	4.92	4.62	4.35	4.11	3.89	3.68	3.50	3.33
7	5.58	5.21	4.87	4.56	4.29	4.04	3.81	3.60
8	6.21	5.75	5.33	4.97	4.64	4.34	4.08	3.84
9	6.80	6.25	5.76	5.33	4.95	4.61	4.30	4.03
10	7.36	6.71	6.14	5.65	5.21	4.83	4.49	4.19
15	9.71	8.56	7.60	6.81	6.14	5.56	5.09	4.67
20	11.47	9.82	8.51	7.47	6.62	5.93	5.35	4.87
25	12.78	10.67	9.08	7.84	6.87	6.10	5.47	4.95
30	13.76	11.26	9.43	8.05	7.00	6.18	5.52	4.98
40	15.05	11.92	9.78	8.24	7.10	6.23	5.55	5.00

$$\text{Present value} = \frac{(1 + i)^n - 1}{i(1 + i)^n} \quad \text{where}$$

n = Number of years

i = Interest rate, 6%, 8%, 10%, etc.

FIGURE 1



$$\text{Savings/Investment Ratio} = \frac{\text{Energy Saving (PV) - Added Maintenance Costs (PV)}}{\text{Investment Costs (PV)}}$$

$$= \frac{\$418{,}087}{100{,}000}$$

$$= 4.18$$

TABLE II

CUMULATIVE PRESENT VALUE OF $1.00 SAVED EACH YEAR WHEN THE COST OF MONEY IS 10% (C) AND ENERGY COSTS INCREASE AT 0, 2, 4, 6, 8, 10, 12, 15, OR 20% ANNUALLY

OR

CUMULATIVE PRESENT VALUE OF $1.00 SAVED (OR SPENT) EACH YEAR WHEN THE COST OF MONEY IS 10% (C) AND MAINTENANCE COSTS INCREASE AT 0, 2, 4, 6, 8, 10, 12, 15, OR 20% ANNUALLY

	ANNUAL INCREASE (AI)								
Year (n)	0%	2%	4%	6%	8%	10%	12%	15%	20%
1	.91	.93	.94	.96	.98	1.00	1.01	1.05	1.09
2	1.74	1.79	1.84	1.89	1.94	2.00	2.07	2.14	2.28
3	2.49	2.58	2.68	2.79	2.89	3.00	3.14	3.29	3.58
4	3.17	3.32	3.48	3.65	3.82	4.00	4.20	4.49	4.99
5	3.79	4.01	4.24	4.48	4.73	5.00	5.28	5.73	6.54
6	4.35	4.64	4.95	5.28	5.63	6.00	6.38	7.04	8.23
7	4.87	5.24	5.63	6.05	6.51	7.00	7.50	8.40	10.07
8	5.33	5.78	6.27	6.80	7.37	8.00	8.68	9.82	12.07
9	5.76	6.29	6.87	7.51	8.22	9.00	9.86	11.32	14.26
10	6.14	6.76	7.44	8.20	9.05	10.00	11.06	12.88	16.64
15	7.60	8.64	9.86	11.30	12.99	15.00	17.38	21.80	32.26
20	8.51	9.93	11.69	13.87	16.59	20.00	24.30	32.96	56.39
25	9.08	10.82	13.07	16.00	19.87	25.00	31.87	46.87	93.66
30	9.43	11.43	14.11	17.78	22.86	30.00	40.15	64.29	151.25
40	9.78	12.13	15.49	20.48	28.08	40.00	59.14	113.11	377.64

$$\text{Present Value} = \frac{1 + AI}{C - AI} \left[1 - \left(\frac{1 + AI}{1 + C} \right)^n \right] \quad \text{where}$$

C = Cost of money (10% for this table)

AI = Annual Increase in Energy Costs or Maintenance Costs

n = Number of years (life of energy-saving item)

TABLE III

CUMULATIVE PRESENT VALUE OF $1.00 SAVED EACH YEAR WHEN THE COST OF MONEY IS 20% (C) AND ENERGY COSTS INCREASES AT 0, 2, 4, 6, 8, 10, 12, 15, OR 20% ANNUALLY

OR

CUMULATIVE PRESENT VALUE OF $1.00 SAVED (OR SPENT) EACH YEAR WHEN THE COST OF MONEY IS 20% (C) AND MAINTENANCE COSTS INCREASE AT 0, 2, 4, 6, 8, 10, 12, 15, OR 20% ANNUALLY

	ANNUAL INCREASE (AI)								
Year (n)	0%	2%	4%	6%	8%	10%	12%	15%	20%
1	.83	.85	.86	.89	.90	.91	.94	.97	1.00
2	1.53	1.57	1.62	1.67	1.71	1.76	1.81	1.89	2.00
3	2.11	2.19	2.27	2.35	2.44	2.53	2.62	2.76	3.00
4	2.59	2.71	2.83	2.96	3.10	3.23	3.37	3.61	4.00
5	2.99	3.15	3.32	3.50	3.69	3.88	4.09	4.42	5.00
6	3.33	3.53	3.74	3.98	4.22	4.48	4.75	5.18	6.00
7	3.60	3.85	4.11	4.39	4.77	5.02	5.36	5.93	7.00
8	3.84	4.13	4.43	4.76	5.13	5.51	5.94	6.65	8.00
9	4.03	4.35	4.71	5.10	5.52	5.97	6.48	7.31	9.00
10	4.19	4.55	4.95	5.38	5.86	6.39	6.97	7.98	10.00
15	4.67	5.17	5.74	6.39	7.15	8.02	9.03	10.86	15.00
20	4.87	5.45	6.13	6.94	7.90	9.08	10.47	13.41	20.00
25	4.95	5.57	6.32	7.23	8.35	9.75	11.51	15.07	25.00
30	4.98	5.62	6.41	7.39	8.62	10.19	12.24	16.58	30.00
40	5.00	5.66	6.48	7.55	8.87	10.66	13.12	18.81	40.00

$$\text{Present Value} = \frac{1 + AI}{C - AI}\left[1 - \left(\frac{1 + AI}{1 + C}\right)^n\right] \quad \text{where}$$

C = Cost of money (20% for this table)

AI = Annual Increase in Energy or Maintenance Costs

n = Number of years (life of energy-saving item)

CONSIDERATIONS FOR NEW PUBLIC BUILDING DESIGN

Initial Design Considerations

- Orient buildings so as to minimize solar heat load in the summer and exposure to cold winds in the winter.
- Orient rectangular buildings so as to optimize the window area exposed to solar radiation (maximize or minimize depending on regional climate).
- Build partially below grade and employ earth berms to reduce solar leads and transmission losses.
- Orient new buildings to take advantage of existing buildings and trees as shields against excessive solar heat gain in the summer and cold wind in the winter.
- Design solar shades, side fins, balconies, overhangs, vertical louvers, or awnings over windows facing south or west to provide summertime shading.
- Plant deciduous trees and vines on the south and west sides of buildings to provide protective shade against summer sun.
- Design buildings for multiple uses. For example, one structure could serve as a school during the day, a community recreational center at night, a synagogue on Saturday, and a church on Sunday.
- Establish maximum energy consumption values in BTUs per square foot of floor space.
- Design heating and cooling systems to maintain desired conditions for all but the 5 percent of the time during which the weather exceeds design conditions. (2.5 percent has been the common design limit. This has resulted in designing systems of excessive size and lower efficiency.)
- Have the building architect help select the site before purchasing it.
- Design new buildings with operable windows or some other means so that natural ventilation can be used to maintain comfortable conditions in moderate weather.
- Put the fewest number of windows in the south and west walls to reduce the summer solar heat load.
- Orient roof surfaces to the south so that solar collectors may be added to the building.
- Bill organizational units for the electricity, gas, space heat, hot water, and air conditioning they use. This will require separate utility metering.
- Install heating-ventilating-air conditioning systems that utilize heat recovery technology. These include heat wheels, electrohydronic (closed-loop, water-circuit) systems, and heat pumps.
- Reduce piping friction and pumping power requirements by using generously sized lines.
- Reduce duct losses and fan power requirements through use of large duct work and variable air flow heating and cooling.
- Exhaust the heat and moisture released in cafeteria kitchens and laundries directly to the outside. This is best accomplished by using double-duct systems that use outside air to remove moisture generated rather than inside conditioned air.
- Situate buildings so that natural screens shield doorways from the wind on the north or west face of the building.
- Require central heating and cooling in designs for new buildings, since central systems are more efficient than individual units.

- Avoid terminal reheat systems unless waste heat is used in the reheat loop. While they provide good humidity control in air conditioned buildings, they consume fossil fuels during the cooling cycle.
- Select hot water heaters with high efficiency and insulation having high thermal resistance (R-value).
- Design buildings to make maximum use of natural light year-round, consistent with efforts to reduce heat flow through windows.
- Design fixtures for one large bulb rather than several smaller ones.
- Choose fluorescent rather than incandescent lamps.
- Use fluorescent fixture with long bulbs since these are more efficient than those with sort bulbs.
- Avoid the use of energy-inefficient "long-life" incandescent lamps. Check the "lumens per watt" rating.
- Use lighter colors for walls, rugs, draperies, and furniture to reduce the amount of artificial lighting required.
- Cut down the lighting in garages and parking lots to an extent compatible with security.

Low-Cost Measures (2-Year Payback)

- Make use of special window glass having desired heat-reflecting or heat-absorbing characteristics as appropriate.
- Weatherstrip and caulk where air infiltration is contributing to heat loss (or adding to the cooling load in the summer).
- Install demand limiters to reduce the peak electric load. If this were done by all large power users, the electric utility could reduce the use of inefficient peaking units.
- Install power-factor correction equipment. This is particularly important when electric motors consume a significant portion of the electric energy in a building.

Moderate-Cost Measures (5-Year Payback)

- Provide a separate temperature control zone for each office if the building is electrically heated.
- Employ heating and cooling energy storage systems to reduce peak demands and improve overall efficiency.
- Install solar hot water heaters to lighten the load on electric or gas-fired hot water heaters.
- Design buildings with a vestibule or second set of doors at lobby entrances to reduce loss of heated or cooled air.
- Use natural draft cooling towers in lieu of mechanical draft towers.

The effectiveness of any one measure will depend on the building type, size, intended use, climatic region, and other factors. Architects and consulting engineers must assess the appropriateness of each measure in the process of planning and designing new buildings.

Reprinted from "Energy Conservation: A Technical Guide for State and Local Governments," Public Technology, Inc. & National Science Foundation, March, 1975.

Transportation

FLEET MANAGEMENT

Because city and county governments own and operate a large number of vehicles, public vehicle fleet management offers opportunities for substantial energy savings. For local governments, the energy conservation potential through fleet management is second only to public building operations. As the prices of gasoline, diesel fuel and other petroleum products has increased dramatically in the past few years, fuel conservation measures have become an economic necessity. Many of the steps taken for energy conservation can result in a vehicle fleet that performs its function more effectively at a lower cost.

As with any other administrative task, the first step in a fleet energy program is to define current conditions and establish a system for monitoring performance in the future. Based on this type of data, energy conservation measures can be tested for their effectiveness. Issues which will be addressed below include the development and maintenance of a data base, and identification of conservation opportunities in four areas: vehicle operations (including driver assignment and performance, vehicle assignment, and routing), and vehicle maintenance, used oil recycling, and vehicle modification and replacement.

Development of a Data Base

The first step in establishing a fleet management program for energy conservation is to inventory the fuel consumption of the current vehicle fleet. Such an inventory should include all the vehicles owned by the local government in all of the various departments: schools, fire, police, public works, and others. The fleet manager(s) should assemble as complete a picture as possible of the vehicles comprising the fleet, as well as the number of miles traveled, the fuel consumed, and the tasks performed by each vehicle. Sources of this information will be the inventory of equipment, records of fuel purchases, vehicle maintenance records, and schedules and reports prepared by each department.

Once the available data has been assembled, fuel consumption should be described in as much detail as possible. Gaps in data and a review of the current record-keeping system will suggest methods to monitor fuel consumption in the future. Regular monitoring of total energy consumption and of individual vehicle consumption is an essential part of a fleet management program. This data can be a useful management tool for a variety of purposes, such as:

* to evaluate the effectiveness of fuel conservation options;
* to define normal consumption patterns for particular types of vehicles;
* to identify vehicles whose rate of fuel consumption is substantially different from other similar vehicles or from the vehicle's own previous fuel consumption.

While simpler manual record keeping systems may be appropriate in a jurisdiction with few vehicles, more sophisticated tools may be required by larger fleets to provide data in easily accessible form. For any record system, the amount of fuel and oil consumed and the miles traveled are basic information. More information is required, of course, for vehicles using power take-offs, such as waste collection trucks. Automated fuel dispensing equipment and computer based record systems can be valuable tools for larger fleets. Public Technology, Inc. has developed an Equipment Management System which can monitor fuel consumption for all fleet vehicles. This program can also provide a master record for each vehicle which indicates when maintenance is needed to improve fuel economy.

Vehicle Operations

There are many measures which can be taken in vehicle operations to minimize fuel consumption without changing the vehicle fleet. These measures generally fall into one of the following categories: assigning the most appropriate vehicles for a given job, minimizing the number of miles traveled, and improving driver performance. Some operational measures, such as instructing operators to turn off engines when stopped, can be easily implemented. Others, such as rerouting waste collection, may require detailed analysis and a longer period of time to implement.

Vehicle Choice

Vehicle dispatchers and department heads are responsible for insuring that the appropriate vehicle is assigned to each job. When possible, trips should be combined to limit mileage. Large vehicles with low fuel economy should be used only when there is no alternative which would consume less fuel. In some cases, it may be appropriate to encourage employees to use public transportation for errands rather than a fleet vehicle. Increases in vehicle occupancy or using fewer vehicles for a task should be considered.

Routing and Reducing Mileage

Reducing the number of miles traveled is one direct way to conserve fuel. For tasks which are accomplished on a regular basis, analysis and revision or routes and schedules can minimize travel distances and reduce delay time. Restructuring of routes should be considered for scheduled activities such as refuse collection, school bus services, library bookmobile services, and street sweeping. To assist routing revisions, computer programs are available, such as Public Technology Inc.'s "Refuse Districting Program and Parking Procedure," and IBM's "Vehicle Scheduling Program" which can be used for school bus routing. Manual methods can be equally effective at lower cost if applied with sense and judgment.

Driver Assignment and Performance

Because drivers can have a substantial effect on the fuel consumption of their vehicles, they should be encouraged to be conscious of fuel economy. In some cases this encouragement may be simply a list of driving tips, while in other cases it may be worthwhile to consider a driver training program for vehicle operators, or an incentive system. Whenever possible, a driver should be regularly assigned to the same vehicle. If he knows that he will benefit by having a better performing vehicle, he will be more likely to note problems and take care of them.

Vehicle Maintenance

A preventative maintenance program is an essential part of public fleet management since a properly maintained vehicle uses less fuel. Regular maintenance schedules for all vehicles and immediate attention to minor problems or increases in a vehicle's fuel consumption are the most important elements of a maintenance program. Involving drivers and maintenance personnel in the fuel conservation program can increase its effectiveness.

Maintenance checks and tune-ups should be scheduled for each vehicle as specified by the manufacturer. A vehicle that needs a tune-up may be wasting as much as 20 percent of its fuel.

As indicated above, fuel consumption records are a necessary corollary to a scheduled preventative maintenance program. Records of fuel consumption for each vehicle should be used to check its performance against similar vehicles as well as its own historical efficiency. If the increase in fuel is not due to changes in utilization, maintenance personnel should identify and correct the problem. Fuel records can provide both an interim check on vehicle fuel economy, and a long-term record of fuel consumption by a particular model vehicle. This information can then be used to help determine the appropriate time to replace a vehicle. Comparisons of fuel economy among vehicles with similar functions may also be used to influence decisions about appropriate replacement vehicles.

Drivers and maintenance personnel are the third factor in a maintenance/fuel conservation program. They should be encouraged to flag vehicle performance or fuel consumption problems and to make suggestions for improvements. Drivers should also be encouraged to check their vehicles regularly.

Used Oil Recycling

Proper disposal of dirty, waste lubricating oil is a problem faced by every fleet manager. Municipal operations, which require both automobiles and heavier vehicles, generate large amounts of waste oil every month. Provision for its disposal should be made. Waste oil is a dangerous substance -- it is full of heavy metals and toxics, so ordinary disposal in landfills or sewers is pollution of the worst kind. Even road oiling has some dangers -- one EPA study showed that 99 percent of the road oil placed on a surface was gone in ten years, most of it entering the water and the remainder polluting the air. Incineration of waste oil without proper precautions is also highly polluting.

The question, then, is what options are left -- how can a local government dispose of waste oil in an inexpensive and environmentally sound manner, with energy savings on the side? The answer is recycling.

Waste oil can be reprocessed and re-refined to make products which lubricate as well as new oil, and cost less. In most cases, the community will receive payment for the spent lube oils. The first consideration is to have a safe receiving tank for the waste oil storage between pickups -- in some cases such tanks will be provided by the recycling or scavenging firm. And, of course, the waste must go to a reputable reprocessing firm, such as a member of the Association of Petroleum Re-refiners.

Vehicle Modification and Replacement

The above discussion has focused on how to save fuel with the existing vehicle fleet. However, as the fleet is replaced, energy considerations should guide the selection of replacement vehicles. Keeping vehicles longer than their useful life will be a false economy, particularly for energy conservation. As a general policy, a local government should purchase the smallest class vehicle which meets program requirements and should consider the energy efficiency of any vehicle or vehicle parts purchased. Diesel powered vehicles should be considered when the option exists. For light duty trucks, diesel power leads to savings of 20% to 40%, with larger savings on larger vehicles. Radial tires improve fuel economy about 7%, leading to significant savings even at current fuel prices.

In preparing specifications for new vehicle purchases, keep in mind that better gasoline mileage is positively related to:

* smaller gross weights;
* smaller horsepower engines;
* smaller axle-to-wheel ratios (especially with automatic engines);
* larger engine compression ratios; and
* lower engine displacements

(Source: "Energy Saving Techniques for Use by Local Governments," prepared for the Federal Energy Administration by Urban Systems Research & Engineering, Inc., Washington, D.C., 1976.)

"RULE OF THUMB" ROUTING OF COLLECTION VEHICLES

Determine the path or "route" the collection vehicle is to follow as it collects waste from each service in a specified area (micro-routing).

Objective: To minimize the non-collection distance and delay times for each collection vehicle.

The Office of Solid Waste Management Programs of the U.S. Environmental Protection Agency has developed a simple non-computerized "heuristic" or common sense approach based on the following rules of thumb:

(1) Routes should not be fragmented or overlapping; they should be compact, continuous, and contiguous.

(2) The collection route should be started as close to the garage or motor pool as possible, accounting for heavily traveled streets.

(3) Heavily traveled streets should not be collected during rush hour periods.

(4) One way streets should be collected starting at the "upper" end, working down.

The heuristic rules are guides which help in determining the vehicle path or route.

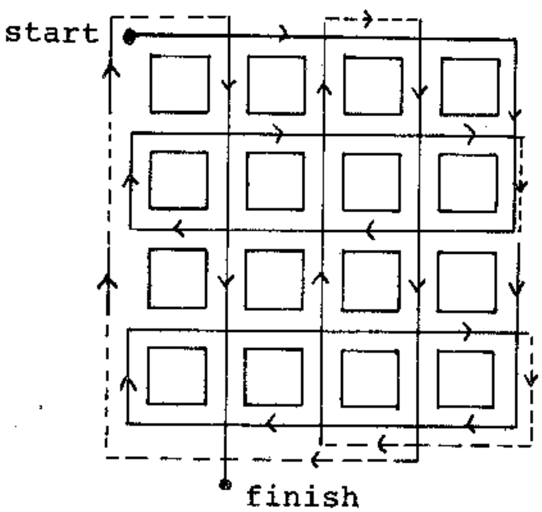
Once the starting point has been selected, the last two heuristic rules (the street segment selection procedures) become the basis for routing, keeping in mind the other heuristic rules and the two points below:

(1) At each decision point the "router" looks ahead and behind several street segments and asks several questions:

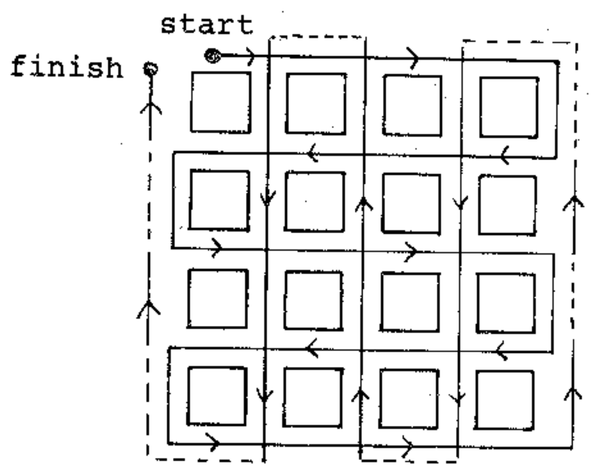
- Do any of the heuristic rules apply here? Are they being violated?
- Are there any street segments that are being left behind that will require a long "dead" distance to go back and pick up?
- Are there already any long dead distances that might be reduced through slight modifications?
- Are there any peculiar or unique characteristics of the area which should be considered?
- Are there any patterns that can be utilized in the routing?

(2) Once the initial route layout has been determined, the route should be retraced and alternate routings or modifications attempted wherever apparently long "dead" distances exist.

In summary, the street segment selection procedures, and other heuristic rules, facilitate the routing process, but must be tempered with a common sense examination at the decision points to determine the final route for implementation. Emphasis should be placed on utilizing routing patterns where appropriate.



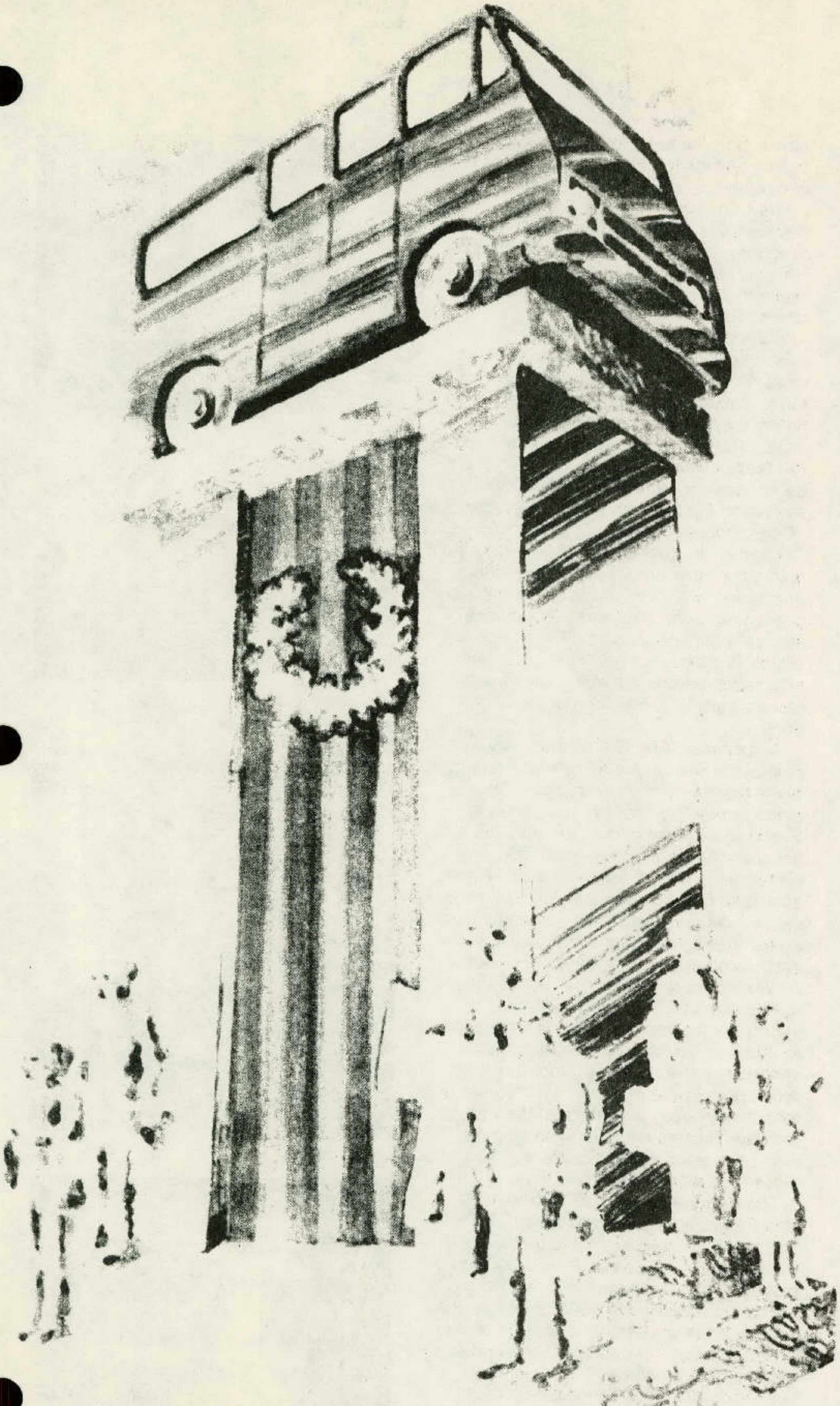
pattern A



pattern B

Specific routing patterns for both sides of the street collection demonstrate variations in the long-looping procedure. Pattern A entails no left turns; pattern B requires 9 left turns. Dash lines represent "dead distance" or non-collection segments of the route.

Reprinted from "A Guide To Reducing. . . . . .Energy Use Budget Costs," Federal Energy Administration.



'Everybody Wins With Vanpooling'

By Ruth Ann Patrick

Employers across the nation are discovering that van pools can help save hundreds of thousands of gallons of gasoline, increase employee promptness and morale, reduce traffic noise and air pollution and substantially cut down on costly parking space.

Van pools differ from car pools in one important respect. The employer or sponsoring organization provides the vans that are used in the program. Costs are then split among the riders; the driver usually rides free.

"Everybody wins with vanpooling," says Robert Owen of the 3M Company of St. Paul, Minn., who is credited with conceiving the idea of employer-sponsored van pools four years ago.

"Our company has won because of decreased investment in traffic congestion," he said. "The employee wins because he has a better way to go to and from work. And the general public wins because of the reduced use of energy, less air pollution and less congestion on the highways."

A number of commuter van programs sponsored by employers have already made dramatic progress in reducing commuter traffic and increasing satisfaction among their employees. The Minnesota Mining and Manufacturing (3M) Company in St. Paul was the first firm in the country to adopt a van pool program. This was immediately followed by similar programs by two other Minnesota companies, Cenex and General Mills.

The 3M Company introduced the van pool program to its employees in 1973. The company decided to purchase six twelve-passenger vans and agreed to provide a van for a minimum group of

Vans Save Fuel, Parking Space

eight persons within a given geographical area. Ridership in each van was gradually increased to 12 persons.

The vans were operated by employee-drivers in a manner similar to a small private business. The company charged each employee a proportionate share of the operating costs for this service based on the mileage to and from the employee's home plus a share of the fixed acquisition cost of the van. As compensation for his services, the driver of each van was not required to pay for the commute.

By the end of 1975 there were over 900 employees in the van pool program, and the company had 75 vans in operation and four more on order. Overall in 1975, the 3M Company's van pool program "saved" 1.8 million vehicle miles not driven to and from work (an average of 2,200 miles per person) and 135,000 gallons of gasoline, or 175 gallons per employee.

Even with a 23 percent increase in employment at 3M's St. Paul facility from 1970 to 1975, the company's total parking space requirement was reduced by 1,500 spaces, a savings of $2.5 million in construction costs. The average number of passengers in 3M's commuter program is now 11.36 per van, the average round trip is 49 miles, and the total operating cost is slightly more than six cents per vehicle mile, with an average monthly cost per rider of $23.72.

The Cenex program began in October 1973 with two 12-passenger vans; today there are 21 vans carrying approximately 160 of the company's 620 St. Paul area employees. Starting with five deluxe 12-passenger vans in January 1974, General Mills doubled its van fleet within three months and now has 15 vans serving nearly ten percent of the company's 1,800 employees. Through the continued expansion of their programs, these companies have shown that commuter vans are highly successful in many ways.

At these companies, both the people who initiated the venture and those who participate in it feel great satisfaction with the program and speak of it enthusiastically. For instance, according to a recent employee survey, 80 percent of the employees at 3M using the vans think this method of transportation is more convenient than any other, and 97 percent said they wanted to continue commuting by van.

Another successful employer van pool program is the joint effort of the Aerospace Corporation and the Air Force's Space and Missile Organization (SAMSO) installation in Los Angeles, Calif. This differs from that of the 3M Company, first because it is a multi-employer van pool program, and also because it has three unusual features: the van style, the method of procuring the vehicles and the fare structure.

Rider comfort was a major consideration in selecting the type of van to be used. Since the vans are used over longer routes (the average round-trip is 65 miles) they have airplane-type reclining seats. The additional ridership induced by this feature more than compensates the companies for the additional cost of the seats and the reduced vehicle capacity of 10 passengers per van.

Another unusual aspect of this program is that the vans are leased rather than purchased, with the full cost paid through passenger fares. Fuel and maintenance service, partly provided by Aerospace facilities, is charged to each van on a per-mile basis, as are nominal costs of commercial liability and van program insurance.

Aerospace-SAMSO Commute-A-Van employs a unique fare system which combines monthly and daily charges. The average monthly cost per rider is $43. Each regular rider is charged one-third of his share of the monthly costs, and the remaining two-thirds is divided by 17 and assessed for each day the rider uses the van. In this way, each van breaks even if riders miss an average of one day a week each, in other words, if they ride 17 out of 21 work days a month.

According to Aerospace-SAMSO, strong management support is essential for the success of a van program. While vanpooling assures the prompt arrival of employees in the morning, it also guarantees their speedy departure at the end of the day. This may not prove compatible with companies which require their employees to work a lot of overtime.

The Aerospace-SAMSO Commute-A-Van Program was initiated in April 1975. Today it has 18 leased vans providing transportation for approximately 200 employees. An Aerospace Corp. study showed a reduction in 1975 of two million vehicle miles driven and a savings of 130,000 gallons of gasoline attributed to the van pool program.

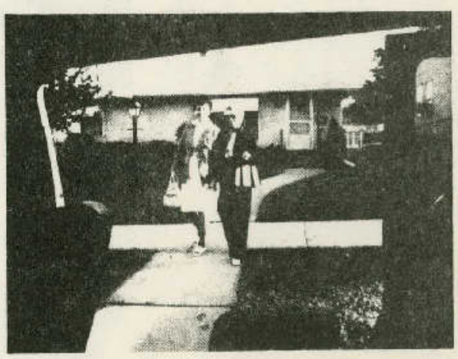
In April 1974, the Tennessee Valley Authority in Knoxville initiated a van pool program in cooperation with the TVA Employees Credit Union. The program began

Shown below (from top) are vanpools operated by Commercial Credit Company in Baltimore, Aerospace-SAMSO in Los Angeles and 3M Company in St. Paul, Minn.


(By Lance Strozier)


(Aerospace Corporation)


(3M Company)


(3M Company)

Commercial Credit Company's new van pool program has already eliminated 30 cars from Baltimore's rush hour.

(By Lance Strozier)

with the lease of six 12-passenger vans from Hertz Car Leasing. The TVA credit union handled the leasing and insurance arrangements for the vans since legal restraints forbid the use of government-owned or leased vehicles for transporting government employees between their homes and place of employment. Six 15-passenger vans have since been added to the program, which now provides transportation for over 140 TVA employees.

Starting with five deluxe 12-passenger vans . . . General Mills doubled its van fleet within three months and now has 15 vans . . .

The door-to-door van pool service costs $23 per month for a 40-mile round trip, or less than four cents per passenger mile, based on 10 paying passengers. Continuous patronage for 11 months entitles a passenger to one free riding month. Van pool users pay monthly, either through payroll deductions or by check. Drivers are responsible for recruiting a group of 10 riders using lists provided by TVA and other sources, but ride free and have the personal use of the van for seven cents per mile.

During the day, between commuter trips, the van can be subleased by charitable organizations for a minimum charge of $63 per month.

Overall, TVA has increased van pool participation by about 40 percent in two years. Knoxville Mayor Kyle C. Testerman, a supporter of the program, stated, "Substantial evidence has been gathered that the car/van/bus pool plan can do more to save energy, reduce congestion and pollution, reduce parking problems, and increase access to the downtown area than any other program which we might be able to implement within the city."

In January 1973, Dr. Stephen Dickerson of the Georgia Institute of Technology, near Atlanta, began a van pool program with the purchase of one van. Now a public corporation known as Modnar, it operates four vans serving about 70 residents of the Atlanta metropolitan area. Modnar presently offers daily commuter transportation from two suburban areas to the Atlanta business district, and one van also serves a suburban shopping district. The Modnar Corporation carries two classes of passengers—regular and casual. Regular passengers have monthly standing reservations and are charged a daily fare; this arrangement is unusual in that each must pay for a minimum of two-thirds of the van trips made. Casual passengers make reservations on a space-available basis and pay about a 50 percent higher daily fare.

Some 75 companies are operating van

pool programs using 1,000 communter vans. Thirty of these companies recently formed the National Association of Van Pool Operators and chose David Lester of Atlantic Richfield Company as president. Here are some other examples of successful programs:

Continental Oil Company's year-old van pool program now consists of 10 vans transporting 103 commuters in the Houston, Tex. area.

In a year and a half, Montgomery Ward in Chicago has expanded its program from six to 14 vans which carry approximately 150 employees.

In May of this year, Commercial Credit Company became the first employer to provide an employee van pool in Baltimore, Md. It has leased six vans which carry a total of 55–60 employees. This will eliminate 25 to 30 cars from the Baltimore rush hour, and 500 employees at Commercial Credit have indicated an interest in joining the program.

Van pools have proven attractive to many people for a variety of reasons. First, vans can carry up to three times as many people for less than twice the operating cost of a compact car. This results in lower costs per passenger mile.

Second, since there is no need for van pool riders to take turns driving as in the typical car pool, some riders have been able to dispense with their second car.

Third, van pools can operate more economically from areas of lower employee concentration and longer distances than can buses.

Fourth, van pools provide door-to-door service which makes them much more convenient for most people.

Finally, there is no problem with storing the van after work hours since in most cases the van pool driver uses it as a personal vehicle.

For the rider, these advantages result in convenient, lower-cost commuting with door-to-door service. For the driver, the benefits are even more rewarding. In addition to getting free transportation to and from work, the driver and his family may have personal use of the van during nonworking hours, usually within a specified radius and at a reasonable cost per mile.

As a result of new legislation, employers may now find vanpooling more practicable. New federal highway legislation provides that certain van pool expenses, particularly the cost of obtaining vans for ride-sharing projects, may now be paid by the states from federal-aid highway funds made available by the Federal Highway Administration. These funds may not be used to acquire automobiles or buses for ride-sharing projects.

The Federal Aid Highway Act of 1976 provides that these funds may be used by the states for 90 percent of the costs to acquire 8 to 15-passenger vans; to pay personnel and other direct expenses of establishing van pool programs; and to recover any actual financial losses incurred if the van pool project fails. Certain other lesser costs may also be covered, depending on the requirements and eligibility of the van pool project.

The legislation stipulates that if a van pool project is supported by the state from federal funds, then commuters using the vans must be charged a proportionate user fee or rider fare to cover the reasonable costs of vehicle operation, maintenance and depreciation. This interest-free loan of federal-aid funds used to acquire the vans must be repaid from riders' fares within four years.

This legislation opens the door to employers interested in realizing the many benefits already well demonstrated by car pool programs. What makes vanpooling especially attractive is the unique funding arrangement available whereby there is minimal financial risk to the employer in establishing a van pool program. Through the federal-aid funds allocated to each state, the employer can avoid heavy "front-end" costs but still take advantage of the many positive aspects of a van pool program such as self-sustaining operation, flexibility in terms of both employer's and employees' needs and the guarantee against losses should the project fail.

Contrary to some opinion, van pools do not compete with mass transit; rather, they aim at reducing the number of single occupant cars in cities . . .

Federal-aid highway funds can also be used for implementing other aspects of car/van pool and bus programs and improving the utilization of existing highways for pool vehicles.

Capital and operating assistance funds of the Urban Mass Transportation Administration (UMTA) can also be used to assist cooperative ridesharing projects such as commuter van pools, subscription buses, and other cooperative services for the transportation of small groups.

Contrary to some opinion, van pools do not compete with mass transit; rather, they aim at reducing the number of single-occupant cars in cities, especially during peak traffic hours. This is particularly true in the outlying areas surrounding the very large cities where the average occupancy of commuter automobiles is less than two passengers per vehicle and where there is inadequate or nonexistent mass transit service. As a spokesman for a north Baltimore County, Md. auto leasing firm put it, "Such a low auto occupancy rate is expensive, adverse to our national energy conservation program, harmful to the air, adds to traffic congestion and parking problems, and unnecessarily adds to the physical and emotional fatigue of everyone, especially commuters."

Employer organizations or individuals interested in solving their transportation problems through carpooling or vanpooling may receive detailed information and technical assistance for implementing a ride-sharing program by contacting their state transportation or highway agencies or the division office of the Federal Highway Administration located in each state. Or write to: Carpools, U.S. Department of Transportation (HHP-26), Washington, D.C. 20590.

Ruth Ann Patrick is a public information officer, Office of Public Affairs, Federal Highway Administration.

Availability of Vanpool Film

A film on vanpooling titled "No Fuelin'...We're Poolin'" was produced by the Delaware Regional Planning Commission (DVRPC) as part of the ridesharing promotional program in the Philadelphia area. The Federal Highway Administration (FHWA) has reproduced sufficient copies of the film to allow more widespread loan distribution.

Although the film can be used to demonstrate the concept of vanpooling to employers and decisionmakers, its primary purpose is to explain vanpooling to employees or prospective participants after the decision has been made to start a vanpool program. Thus the film is most often requested and presented by major employers or other vanpool sponsors. The DVRPC, for example, recorded the film on videotape for continuous display in the lobby or cafeteria at employment sites where a vanpool program was being started.

Loan copies of the film may be obtained from FHWA Regional Offices in Albany, Baltimore, Atlanta, Homewood (Illinois), Fort Worth, Kansas City, Denver, San Francisco, and Portland. Loan copies are also available from the National Highway Institute (HHI-4), telephone 202–426–4878; and the Urban Planning Division (HHP-26), telephone 202–426–0210, of FHWA in Washington, D.C. 20590.

The film is available for sale from the National Audiovisual Center, Attention: Order Section, Washington, D.C. 20409, at a cost of $36.25 (Order No. 008693).

Related Publications

Guidelines for the Organization of Commuter Van Programs. Urban Mass Transportation Administration, February 1976. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 — Price $1.65, Stock No. 050–001–00115–2.

How to Pool It: A Ridesharing Manual for Employers. Federal Highway Administration, May 1975. Available free from the Federal Highway Administration, Urban Planning Division (HHP-26), Washington, D.C. 20590, telephone 202–426–0210.

Vanpool Implementation in Los Angeles. The Aerospace Corporation, November 1975. Available free from the Federal Highway Administration, Urban Planning Division (HHP-26), Washington, D.C. 20590, telephone 202–426–0210.

Van Pooling: A Commuting Alternative that Works. Continental Oil Company, P.O. Box 2197, Houston, Texas 77001, telephone 713–965–1484.

Another source of guidance is:

Mr. David Lester, President
National Association of Vanpool Operators
Atlantic Richfield Company
515 Flower Street, Suite 1677
Los Angeles, California 90071
telephone 213–486–3458

GPO 914-652

United States
Department of Transportation
Washington, D.C. 20590

"HOW TO POOL IT"

Introduction

As an employer, you are the key to the success of ride sharing in this country, and ride sharing is one of the keys to helping solve our energy, our pollution and congestion problems.

This article will give you an overview of ride sharing, show what it can do for you, as an employer, and what it can do for your employees. It is also a definitive publication that will show you how to start a ride sharing program at your company.

Management's Role

Employer benefits include:

1) Reduced parking facility costs;
2) Increased employee availability;
3) Improved employee relations;
4) Improved community relations; and
5) Reduced congestion, pollution and energy consumption.

There is some cost to the employer, in terms of time and money, but the benefits of a ride sharing program far outstrip the costs.

Management commitment--Top executives need to decide the organization's role in a program and they need to show all potential participants that they are 100% behind ride sharing before any program will be successful.

Assignment of responsibility--Top management needs to assign a person or department the responsibility of coordinating the company's pooling effort.

Type of Ride Pools

1) Carpools--conventional, collector or company cars;
2) Vanpools--private or employer provided; and
3) Buspools--employer organized, rider organized or transit company arranged.

Putting the Program Together

Getting started--There is no one best way to structure a ride sharing program. Each situation is different; each company must decide on its own needs, goals and objectives. There are some basic steps common to most programs:

1) Find out what has been done by checking with the pooling agency in your area;
2) Set goals and objectives;
3) Establish success benchmarks;
4) Allocate a budget;
5) Assign personnel to take charge of the program;
6) Identify in what areas your employees reside;
7) Select a system to match your employees into pools using either
   a) a manual system or
   b) a computerized system;
8) Match your potential poolers;
9) Inform your employees of potential poolmates; and
10) Maintain a file of how many pools have been formed, who has left a pool and any changes in poolers status.

Try to coordinate your program with others in the community; you may wish to combine programs in the future.

Selling the Program

The major concerns in selling the program to your employees should be:

1) Clearly define the program;
2) Spread the word on the program in simple, direct terms to all potential poolers;
3) Make every effort to persuade potential poolers that the advantages of ride sharing are a tangible personal benefit.

Eight incentives that have been successfully used in getting employees to participate in ride sharing are:

1) Financial;
2) Fuel savings;
3) Time savings and convenience;
4) Recognition;
5) Replacement services;
6) Personalized attention;
7) Example by lenders; and
8) Social duty.

Legal Aspects

A voluntary program will mean less liability for the employer.

Pooling situations differ from area to area; therefore, the employer should check with his insurance agent about liability coverage.

Carpoolers should be informed they can possibly save money on their insurance.

Source: "How To Pool It", U.S. Department of Transportation

Public Participation

PUBLIC PARTICIPATION PROGRAMS

Before employees of public agencies are likely to commit themselves wholeheartedly to energy conservation on the job, they may need to understand the hard economic facts of energy waste.

The Governor's Office of Energy Resources has developed several residential energy conservation programs aimed at helping people save energy at home. By promoting such programs at work, employees may be encourged to conserve energy on the job.

Following are publications representing various residential programs:

- Texas Conserve, a "Class B Audit" in which the homeowner completes a simple questionnaire, mails it to a central computer facility in Austin, and receives a computerized analysis of needed conservation improvements, including cost and payback.

- New Homebuyer's Guide to Energy Efficient Homes, an information brochure for prospective homeowners.

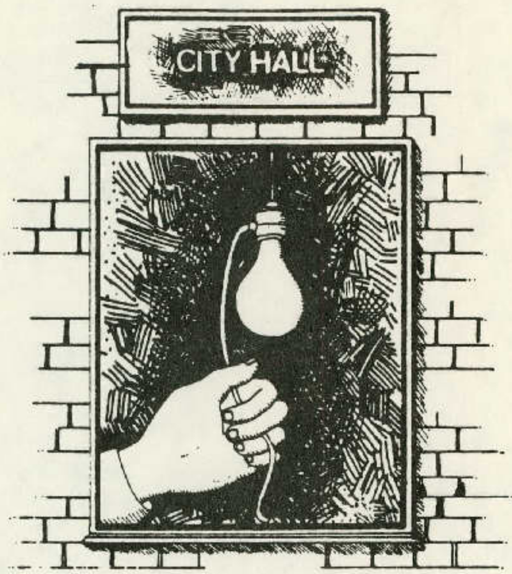
- Saving Energy is Saving Money, a "Class C" residential audit in which the homeowner completes an enclosed worksheet and performs simple calculations of potential conservation improvements he may be considering for the home. The result is similar to the Class B audit, Texas Conserve.

Large quantities of these publications are available on request, without charge, by writing:

Governor's Office of Energy Resources
7703 N. Lamar, Fifth Floor
Austin, Texas 78752

Energy Conservation...

we all need to do our part



Corpus Christi City Council

The above is an example of a public service announcement that can be placed in your newspaper, employee newsletter, magazine or other publication.

Governmental Services

CASE STUDIES IN TEXAS LOCAL GOVERNMENTS

The availability of energy conservation technology today is immense but sometimes local governments have a difficult time gaining access to this information.

The Governor's Office of Energy Resources is conducting several projects to promote energy conservation efforts in local governments. One area is Technology Transfer which will provide, on a loan basis, video tapes, slide presentations and written case studies of successful and transferable local government programs. The topics will include transportation, fleet management, energy management and thermal and lighting standards. The energy conservation case studies on the following pages are examples of transferable programs.

The first five elements of this section are 1978 Innovative Grant case studies and the last is a sample energy audit, in this instance an audit performed in 1978 for a medium-sized hospital in Beaumont. Audits resulting in similar findings are basic to public agency energy conservation.

For additional information on the Technology Transfer program contact:

Governor's Office of Energy Resources
7703 N. Lamar, Fifth Floor
Austin, Texas 78752

Governor's Office Of Energy Resources
Local Energy Conservation Program
Case Study

ALAMO AREA COUNCIL OF GOVERNMENT (AACOG) REGIONAL ENERGY PROFILE

The Governor's Office of Energy Resources (GOER) awarded thirteen innovative grants during 1978 to encourage local energy conservation in Texas. Touche Ross & Co. was retained to evaluate each grant program and to identify energy conservation programs which might be transferable to other Texas localities. Case studies were prepared to facilitate the transfer of successful energy conservation programs. Each case study includes a detailed project description, an identification of the major benefits of the program, and identification of potential local users. The case studies also define the recommended approach to implementing the program, financial requirements, and potential energy savings. This case study describes the grant program conducted by the Alamo Area Council of Governments (AACOG) to develop a regional energy profile.

PROJECT DESCRIPTION

The Regional Energy Conservation and Management Plan consists of two phases. Phase I, funded by a 1978 GOER grant, was to build a data base for the region and identify specific energy conservation opportunities for member governments. Phase II, funded by a 1979 grant, will allow AACOG to develop a Regional Energy Advisory Plan and to provide technical assistance to members as their own plans are being developed.

The 1978 grant was used to develop the energy use profile for the region. The profile compiles background and analytical information concerning energy supply, demand, and cost for the twelve-county AACOG region.

Demand and costs are estimated by end use energy source (gasoline, natural gas, electricity, L.P.G., jet fuel, diesel fuel, and heating oil). Demand and costs are also estimated by user (industrial, commercial, residential, agriculture, and transportation). In addition, the primary source fuels for electrical energy and related conversion losses are presented.

MAJOR BENEFITS

The regional energy profile provides the basis for a Council of

Government to undertake detailed energy conservation program planning. The profile is also intended to create public awareness.

Based on the AACOG experience, the development of the regional energy profile will

- provide useful information for other master plans which are the responsibility of the Council of Government (COG).
- facilitate cooperation between the COG energy planning staff and their counterparts in member governments.

Although energy savings do not result directly from this program, the profile provides the basis to plan energy saving projects.

POTENTIAL USERS

The approach used by AACOG would be appropriate for other Councils of Government considering the development of such regional profiles. Councils interested in developing an energy data base and projections should review the AACOG report and methodology. Depending on the needs, resources, requirements, and characteristics of the area, the locality should consider:

- using the methodology contained in the report applied to local data; or
- hiring a consultant to do a similar report for the area.

The value of the AACOG data base is as a tool for more detailed planning.

Localities may also use the conservation opportunities identified in the AACOG report as a starting point for their own plans.

HOW TO DO IT

The following sections describe the organization employed by AACOG to complete the grant program, an evaluation of grant activities, and a discussion of pitfalls to be avoided by future project users.

Organization and Staffing

The profile and a slide show were developed by a contract consultant within six months at a cost of $18,000.

AACOG used a grant project manager and a supervisor on the project. The grant project manager spent approximately 20% of his time during the year coordinating the project, supervising and assisting the consultants, and reporting both performance and financial status to GOER. The supervisor to whom the senior planner normally reported also supervised the grant. He spent less than 10% of his total time on the project.

An Advisory Committee comprised of qualified engineers, architects, and other technically experienced members of the community was established. The Advisory Committee reviewed project end products and advised the Council staff.

The AACOG Executive Committee reviewed and approved the final product.

Major Activities

The detailed workplan to conduct the project is provided in Attachment A. The majority of the project was conducted by a contractor, although nothing would preclude a local government with qualified personnel from conducting such a project internally. The Request for Proposal for consultant services is provided in Attachment B.

The consultant developed information concerning the current level of energy use and cost by economic sector. The consultant also developed data on available energy by type of fuel based on information provided by suppliers and studies performed by other governmental agencies. This information was developed for the twelve-county AACOG region using 1975 information. Energy cost and use by sector were projected for the years 1980 and 1983.

The energy profile document presents the consultant's findings concerning current and projected energy costs and use. The profile also documents ideas concerning

- the role of local government in energy conservation.
- the economic impact of energy cost projections.
- the impact on utility rate structures.
- energy conservation actions.

Additional information developed that could be useful in a similar profile includes

- identification of the energy savings potential in each sector and by each energy source that are peculiar to the region. For example, a region that has a locally controlled utility can probably institute changes in its rate structure to affect consumption.

- identification of potential energy savings for each opportunity listed in the profile. This will assist local governments in comparing the cost of implementing a project to the potential benefits.

- identification of priority projects. Criteria for a priority project might include potential energy savings, cost, ease of implementation, feasibility, and public acceptance.

Cautions and Pitfalls

Local governments considering a similar project must clearly define their objectives and uses for the energy profile before the project is undertaken. The study must be designed to meet the planning requirements of local governments using the results.

GENERAL FINANCIAL REQUIREMENTS

Total project costs including AACOG staff time was approximately $33,000 over thirteen months. About $15,000 was for AACOG's administrative expenses associated with contracting for, supervising, and assisting the consultant. The consultant's fee was $18,000.

A locality undertaking a similar project using consultants can expect to spend about $15,000 to $16,000 for administrative expenses. The consultant's fee will vary with the scope of the project. For localities considering the use of a contractor, the AACOG Request for Proposal is provided in Attachment B.

For organizations planning to develop such a profile internally, the budget requirements would be dependent on the scope of the project. Assuming a scope of work similar to AACOG's, approximately $30,000 to $35,000 should be budgeted, dependent on contract consultant costs. This should include at least one full time analyst.

POTENTIAL FOR ENERGY SAVINGS

The development of the profile does not directly result in energy savings. However, the profile provides a sound basis for initiating energy conservation efforts. Energy savings may eventually be realized if the energy conservation opportunities identified in the plan are implemented.

FURTHER INFORMATION

For information contact GOER or

Mr. David Frost, Senior Planner
Alamo Area Council of Governments
400 Three Americas Building
118 Broadway
San Antonio, Texas 78205
(512) 225-5201

Additional information may be obtained from "Comprehensive Community Energy Planning"; prepared by Hitman Associates, Inc. under contract No. EC-77-C-10-0023 with the U.S. Department of Energy Resources (April 1978).

Governor's Office Of Energy Resources
Local Energy Conservation Program
Case Study

ALAMO HEIGHTS INDEPENDENT SCHOOL DISTRICT (AHISD)
CAMPUS ENERGY AUDITS

The Governor's Office of Energy Resources (GOER) awarded thirteen innovative grants during 1978 to encourage local energy conservation in Texas. Touche Ross & Co. was retained to evaluate each grant program and to identify energy conservation programs which might be transferable to other Texas localities. Case studies were prepared to facilitate the transfer of successful energy conservation programs. Each case study includes a detailed project description, identification of the major benefits of the program, and identification of potential local users. The case studies also define the recommended approach to implementing the program, financial requirements, and potential energy savings. This case study describes the grant program conducted by the Alamo Heights Independent School District to conduct school energy audits.

PROJECT DESCRIPTION

The Alamo Heights Independent School District conducted campus energy audits. Each of the six schools in the AHISD formed a Campus Energy Team made up of school staff, parents and students, under the overall direction of the school principal. The Campus Energy Team, using volunteer technical expertise from the community, performed an energy audit and developed an energy conservation plan for the school. The AHISD maintenance department implemented selected recommendations from these plans at low cost to the school district. Dollar savings from decreased energy use would be returned to the schools.

MAJOR BENEFITS

The major benefits of the program are the energy savings ideas that result from the campus energy plan. For example, a recommendation was implemented by Alamo Heights to modify custodial schedules to enable janitors to complete their work by 6:00 p.m. This eliminated the need for evening lighting, heating and air conditioning. Several campus energy plans are contained in Attachment A to show the diversity of ideas that resulted.

A second major benefit was changing staff attitudes toward energy conservation. As a result of the program, the Maintenance Department began a "preventive maintenance" approach toward plant equipment. Test equipment was purchased to insure present equipment was operating efficiently. Department personnel procuring equipment began to consider life expectancy and energy efficiency in their purchases.

POTENTIAL USERS

The volunteer aspects of the program make it attractive to school districts of any size. The school has the ability to draw on the resources available in the community through the parents of its students. The program is a way of identifying energy saving opportunities at low or no cost and could result in energy savings for districts which cannot afford costly modifications. The student's experience may also result in increased awareness of energy conservation needs in other areas such as the home.

In addition, the concept of returning savings to the section of the organization that contributes to energy savings is a concept applicable to any organization.

HOW TO DO IT

The following sections describe the organization employed by AHISD to complete the grant program, an evaluation of grant activities, and a discussion of pitfalls to be avoided by future project users.

Organization and Staffing

Administrative staff from AHISD involved in the grant project included the Assistant Superintendent, the Director of Maintenance, and each of the six school principals.

Assistant Superintendent - coordinated the program and visited the schools to oversee maintenance modifications. He and the Maintenance Director developed the energy savings formula that would be used to refund cost savings to the schools. About ten percent of his time over the year was spent on the program.

Maintenance Director - implemented the changes recommended in the campus energy conservation plans and instituted changes in maintenance policy to consider energy conservation. Approximately ten percent of his time over the year was spent on the grant program.

School Principals - administered the campus energy conservation program by organizing, directing, and reviewing the Campus Energy Teams. About 2.5% of each principal's time was spent on the effort over the year.

Campus Energy Teams (CET) were created under the direction of the principal on each of the six campuses. Each Campus Energy Team had eleven team members including three staff members, a custodian, and the school principal. The parents often had technical knowledge in some area related to energy (e.g., environmental analyst, architect, contractor). The CETs conducted energy audits of the physical facilities and developed an energy conservation plan for each campus. Attachment A contains examples of Campus Energy Plans.

Finally, students from each school were selected for the Campus Energy Patrol. The patrols controlled energy consumption by recording temperature in classrooms twice a day and checking for open doors, windows, or other sources of energy waste.

Major Activities

The program began with the School Board's approval. The Assistant Superintendent developed and presented program information to school principals. From there, the program was conducted in two phases.

- Phase one established the Campus Energy Teams in each school. After a series of meetings the Teams developed recommendations for low cost energy conservation actions. At the same time the Assistant Superintendent and the Maintenance Director developed base period data for measuring energy savings.

- Phase two implemented selected recommendations from the Campus Energy Plans and monitored energy savings progress. Student Energy Patrols were in each school to monitor energy consumption in the classrooms.

Energy savings are monitored quarterly and compared to the base period consumption. Energy cost savings will be returned at the end of the school year by

- returning one-third of the cost savings to the school for educational programs on the campus, and

- depositing the other two-thirds in an interest-bearing account to address long-range energy needs of the District.

Cautions and Pitfalls

The recommendations in the AHISD plans reflect the expertise of the volunteers to the school. In some schools, the technical knowledge of the participants was more substantial than in others. A school district implementing a similar program may wish to distribute this knowledge in some way among all the schools. One possible method is to appoint the technical resource volunteers to a committee. The committee could develop an energy audit procedure and an outline for each campus energy plan. The audit procedure and plan outline could be used by the Campus Energy Teams in each school.

Given the volunteer nature of the program, in-depth direction and commitment to implement must be provided by school district management. Top management should devote adequate time to the project to assure that it is managed properly and demonstrate commitment to the participants. The Maintenance Department must also demonstrate its willingness and ability to implement the recommendations from the Campus Energy Plans.

GENERAL FINANCIAL REQUIREMENTS

The volunteer nature of the program makes it a relatively low cost undertaking when compared to the potential benefits. AHISD spent about $14,000 on salaries, energy testing supplies, and an air distribution study. Cost and administrative effort of schools undertaking a similar effort will vary with the number of schools participating, and the types of actions required of the maintenance department.

POTENTIAL ENERGY SAVINGS

Estimates of potential energy savings for the average school vary from 10% to 35%. The degree of savings will be dependent on

- the insulation and construction of the physical plant
- the amount of energy consumption which is variable:
  - lighting
  - heating
  - cooling
  - ancillary systems

FURTHER INFORMATION

For further information please contact GOER or

Mr. Harry Orem
Assistant Superintendent
Alamo Heights Independent School District
7101 Broadway
San Antonio, Texas
(512) 824-2483

Governor's Office Of Energy Resources
Local Energy Conservation Program
Case Study
ARLINGTON
WATER UTILITY ENERGY AUDIT

The Governor's Office of Energy Resources (GOER) awarded thirteen innovative grants during 1978 to encourage local energy conservation in Texas. Touche Ross & Co. was retained to evaluate each grant program and to identify energy conservation programs which might be transferable to other Texas localities. Case studies were prepared to facilitate the transfer of successful energy conservation programs. Each case study includes a detailed project description, an identification of the major benefits of the program, and identification of potential local users. The case studies also define the recommended approach to implementing the program, financial requirements, and potential energy savings. This case study describes the grant program conducted by the City of Arlington to increase the energy efficiency of the local water treatment plant.

PROJECT DESCRIPTION

The City of Arlington performed a detailed energy audit of its water treatment plant. The project involved the determination of energy usage and expense for each piece of plant equipment. Engineering tests were performed on pumping equipment to determine how the equipment was functioning as compared to the manufacturer's specifications. The City planned to use information obtained to implement changes in plant operating and maintenance procedures.

MAJOR BENEFITS

The energy audit identified the greatest potential for energy conservation in reducing water pump energy consumption. Other communities with a number of pumps and fluctuating demand could develop operating procedures to cut energy consumption without reducing the quality of water service. An energy audit and associated data collection methods will identify energy-efficient pump combinations to meet given demand levels. The more efficient the pump combinations, the less energy consumed.

Communities can improve repair and maintenance programs by performing engineering tests on pumps to determine operating conditions. The tests may identify pumps which have been operating inefficiently, resulting in increased energy usage. The tests may also isolate pumps that are not being operated under conditions for which the equipment was designed. Matching anticipated demand conditions and equipment design will help communities build an energy efficient water system.

The equipment review may also provide ideas to consider in plant expansion planning. For example, the installation of variable speed pumps, which can be adjusted to varying demand conditions, can be used to maximize operating efficiency and energy usage.

Arlington also identified a number of "quick-fix" conservation practices which can be readily implemented by other communities with minimal expense. These are identified in Attachment A.

POTENTIAL USERS

A similar energy audit of a community water treatment facility would be beneficial to any municipality which operates a series of pumps to meet water demand and whose demand fluctuates greatly. The results should aid plant management in utilizing pumping equipment more efficiently and reduce energy costs. Additionally, consideration of equipment design and demand conditions will allow management to consider energy conservation in its capital budgeting.

The energy conservation methods developed from these studies would be of particular benefit to a community with variable electric rates. Utility companies which use variable rate schedules charge more for electric consumption during periods of high demand (e.g., daytime vs. night). By maximizing pump selection and optimizing storage facilities to meet demand, pumping could be maximized during the lowest rate period. Variable rate scheduling could also have an additional impact on capital investment decisions. For example, it might prove less expensive in the long run to increase storage capacity to meet demand rather than adding pump equipment.

HOW TO DO IT

The following sections describe the organization employed by Arlington to complete the grant program, and explanation of grant activities, and discussion of pitfalls to be avoided by future project users.

Organization and Staffing

The participants and their roles in the Arlington grant program were:

Grant Coordinator - managed the project effort and prepared the end product.

Consulting Engineers - performed the detailed energy audit and developed indicators of pump operating condition from engineering tests.

Industrial Departments of Various Texas Universities - assisted in the development of analytical and measurement techniques.

City Utility Management - coordinated data collection activities and provided local technical expertise.

Pump Operators and Part-Time Personnel - gathered data on pump selection, demand conditions, energy consumption, discharge pressure and flow rates.

Major Activities

The first step in the grant program was to perform a detailed energy audit of water plant equipment to determine sources of energy consumption. The consulting engineers installed utility meters at various areas in the plant and identified equipment energy usage to be measured by each meter. The electrical requirements to operate each piece of equipment were obtained from the manufacturer's specifications. Plant personnel recorded the period of time each piece of equipment was in operation. Equipment electrical requirements were multiplied by operating time to determine energy consumption by piece of equipment. Actual metered energy consumption was allocated to individual pieces of equipment using this method.[1] Because the majority of energy consumed was due to pumping operations, the remainder of the project effort was devoted to identifying opportunities to reduce pump energy consumption.

Tracking methods were implemented to record water demand, pumps in use and energy consumption on an hourly basis. Analysis of this data indicated that the energy consumed to meet a given demand level varied with the combination of pumps used. The tracking system was incorporated into normal water plant operations.

The consultants also performed engineering tests on pumps to determine their general operating conditions. The flow rate of each pump was measured under varying levels of pressure. The test results were compared with operating efficiency data prepared by the equipment manufacturer. The comparison indicated that some pumping equipment was being operated under conditions for which the pumps were not designed. The pumps operate less efficiently and consume more energy. This data will be incorporated into the preventive maintenance program under development.

(1) The energy audit indicated energy consumption by equipment category as follows:

Heating, air conditioning & lighting	2%
Water treatment	5%
Pumping	93%
TOTAL	100%

Cautions and Pitfalls

The collection of accurate data is essential to the development of operating procedures and maintenance routines which will reduce energy consumption. This requires the cooperation of plant staff. Management must explain to operating personnel the purpose for the volume of data collected. This will minimize operating personnel viewing the activity as "busywork".

A second caution is the need to track pump combinations, water demand and energy consumption over a long period of time and under different conditions. A reliable base of historical data must be developed before changes in operating procedures are developed.

Once efficient pump combinations are identified, management must be careful not to overreact to changes in demand conditions. Water demand may change greatly hour to hour. Changing the pump combination every time demand changes may actually increase energy consumption due to the large amount of energy required to start-up pumps. Pump operators should realistically attempt to maintain pump combinations and demand within a range of the most efficient pump combination, minimizing the number of pump changes.

The selection of the most efficient pump combination can be complicated. Arlington is developing a computer model which will determine, based on historical data, the most energy-efficient pump combination to meet a given demand level. This model should be adaptable by other Texas communities.

GENERAL FINANCIAL REQUIREMENTS

The cost of conducting a similar water plant energy audit is estimated at $30,000 - $40,000. This assumes the use of an engineering consultant to perform the detailed energy audit and pump equipment testing. This estimate does not include the cost of programming time, computer usage, etc., which would be required in the future to implement automated programs as planned by Arlington.

POTENTIAL ENERGY SAVINGS

The Arlington study found potential energy savings of 26.3% for raw water pumps and 33.3% for high service pumps. However, the savings are based on ideal operating conditions which may be unrealistic given the number of variables impacting water pumping/demand.

FURTHER INFORMATION

The City of Arlington is willing to share information gained during the water plant project. For further information, contact GOER or

Mr. John Bayles
Technology Agent
City of Arlington
Box 231
Arlington, Texas 76010

ATTACHMENT A

"QUICK-FIX" METHODS TO CONSERVE ENERGY CONSUMPTION

The following is a list of short run methods to help reduce water plant energy costs. These methods can be implemented into normal operations immediately and require no capital investment:

1. The turning on-and-off of pumps for short periods of time should be minimized as this practice consumes much energy.

2. Pump operators should attempt to offset peril water demand with storage inventory while maintaining a constant rate.

3. Pump operators should concentrate elevated storage facility pumping during periods of low demand.

4. The practice of "throttling" or operating pumps with valves partially closed must be minimized. When pumps are throttled, the same amount of energy is consumed to pump a smaller volume of water which makes the pump less energy efficient.

5. The hourly pumping data report used to track efficient pump combinations can be used as a short run management tool. With this data, the water manager can review the pump operator's decisions.

Governor's Office Of Energy Resources
Local Energy Conservation Program
Case Study
FORT WORTH
MUNICIPAL ENERGY BUDGETING SYSTEM

The Governor's Office of Energy Resources (GOER) awarded thirteen innovative grants during 1978 to encourage local energy conservation in Texas. Touche Ross & Co. was retained to evaluate each grant program and to identify energy conservation programs which might be transferable to other Texas localities. Case studies were prepared to facilitate the transfer of successful energy conservation programs. Each case study includes a detailed project description, an identification of the major benefits of the program, and identification of potential local users. The case studies also define the recommended approach to implementing the program, financial requirements, and potential energy savings. This case study describes the grant program conducted by the City of Fort Worth to develop a municipal budgeting system.

PROJECT DESCRIPTION

Fort Worth's program was to develop a method to track energy consumption by the City Operating Department. This tracking system would provide management with a tool to make energy budgeting decisions.

MAJOR BENEFITS

The energy tracking system provides City management with historical information on departmental energy consumption relative to services provided by each department. The system provides management with base data to identify potential energy savings opportunities during the budget process which could lead to reduced energy consumption.

The system also provides management with a method to allocate energy resources to areas where the greatest benefit will be realized. This will be of particular importance during periods of energy supply curtailments when City management will have to allocate limited energy resources.

POTENTIAL USERS

The energy budgeting and tracking system would be readily transferable to any municipality as long as energy costs can be developed by the Operating Department. Justification of projected energy usage and costs is a logical extension of the municipal budget review process.

HOW TO DO IT

The following sections describe the staffing and organization employed to complete the grant program, an explanation of grant activities, and discussion of pitfalls to be avoided by future users.

Organization and Staffing

The project participants and their roles were:

City Energy Coordinator - responsible for the overall project effort.

Administrative Assistant - responsible for data collection and analysis.

Graduate Student - assisted in data collection and analysis activities.

City Budget and Accounting Personnel - provided periodic assistance on where to locate energy data, how to interpret it.

Major Activities

Historical consumption and utility costs were determined from billing records of the local gas and electric utilities. Each facility consuming energy is identified separately on the City's utility bills (e.g., traffic signals, fire stations). Energy consuming facilities were then assigned to the City Operating Department responsible for it.

The only major exception was the municipal building where many of the City's administrative offices are housed. No attempt was made to allocate energy consumption by department in the Municipal Building. However, total energy consumption for the Municipal Building was included in the data developed and tracked.

Three years of historical information on energy consumption and costs were developed for each City department. Electric consumption was documented in kilowatt hours, natural gas consumption in cubic feet, and vehicle consumption in terms of gallons of fuel. All consumption data was converted to dollars by department.

The next step of the energy budgeting program will consist of each department performing an energy evaluation of its operations. Each department will relate the amount of energy used to the level of services provided. Services will be ranked by priority and departments will attempt to identify the impact on total services, personnel requirements and energy consumption that would occur as a result of cutting individual services. The development of the services ranking and energy usage data should help management identify energy savings opportunities by isolating services which consume more energy than is justified by the service provided.

Based on the historical data collected, operational departments will be advised to budget energy consumption and costs during the upcoming budget cycle. Departments requesting increases in energy consumption budgets will have to justify the increase by identifying additional services to be provided in the upcoming year. Budget analysts will use the base consumption data as a basis for scrutinizing budget requests. Forms have been designed to document this process.

Cautions and Pitfalls

The Fort Worth energy tracking and budgeting system should be readily transferable to other Texas cities. Top city management must support the energy budgeting process if it is to be successful. Department management must be made aware that the program is an important factor in top management's budget approval process.

The key to undertaking such a project is the ability to divide energy consuming facilities among operating departments. If local utility billings do not specify energy consumption by facility, the community should discuss with the local utility companies the expense associated with installing additional metering equipment. This will be of particular concern in smaller communities where a number of municipal departments may be housed in one structure with a single meter.

For those communities with inadequate metering equipment, care should be exercised in attempting to develop an allocation method by department. Departments should only be accountable for the energy consumption which they can control.

GENERAL FINANCIAL REQUIREMENTS

The cost of similar program is estimated at $30,000 - $40,000. The major cost is personnel. This estimate assumes funds to develop the energy tracking system, gather historical data, and integrate energy budgeting into the fiscal budget process. Additionally, it provides funds to coordinate the ranking of energy usage and services performed by operating departments.

POTENTIAL ENERGY SAVINGS

Energy savings from this type of project are difficult to predict. The real benefit will stem from management's ability to analyze energy consumption relative to services provided. This will identify for management areas where energy is wasted and where conservation practices should be explored. It may also provide the justification for seeking alternative energy sources for selected services.

FURTHER INFORMATION

The City of Fort Worth is willing to share information developed. For further information, contact GOER or

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Fort Worth, Texas 76102

Governor's Office Of Energy Resources
Local Energy Conservation Program
Case Study
TEXARKANA
OPERATION RECOVERY

The Governor's Office of Energy Resources (GOER) awarded thirteen innovative grants during 1978 to encourage local energy conservation in Texas. Touche Ross & Co. was retained to evaluate each grant program and to identify energy conservation programs which might be transferable to other Texas localities. Case studies were prepared to facilitate the transfer of successful energy conservation programs. Each case study includes a detailed project description, an identification of the major benefits of the program and identification of potential local users. The case studies also define the recommended approach to implementing the program, financial requirements, and potential energy savings. This case study describes the grant program conducted by the City of Texarkana to coordinate building surveys of various City agencies.

PROJECT DESCRIPTION

Operation Recovery provides free surveys to residences, businesses, schools and churches in the areas of energy efficiency, fire protection, crime prevention, and structural soundness. The joint surveys are a cooperative effort of the City's energy surveyor, police and fire departments.

The energy portion of the survey is assisted by an aerial scan to locate structures within the City showing heat losses and a camera equiped infrared scanning device which takes photographs of building heat loss.

MAJOR BENEFITS

Cooperation among City departments has been facilitated by the project. Each department has become aware of how suggestions made in the interest of security may seem in conflict with the interests of fire safety. For example, burglar bars on homes may make the residents safe from intruders but jeopardize escaping in the case of fire.

The aerial survey, and the ground level photographs, graphically display energy losses to the public. This technique appears to be an effective way of encouraging voluntary action to implement residential energy conservation.

The multi-purpose survey appears to encourage more citizen participation than if an energy inspection alone were offered. In addition, participation is encouraged through requiring the survey prior to approving housing rehabilitation loans.

POTENTIAL USERS

The concept, the use of thermography, and the survey instrument are transferable to other communities.

- The concept of conducting comprehensive surveys for energy efficiency, fire protection, crime prevention, and structural soundness can be used by other communities. Cooperation between city departments could result in cost savings to the city due to the consolidated surveys. Cooperation between the departments has identified areas where advice given by the Fire and Police departments may have been in conflict. For example, burglar bars on windows may enhance security but may also block escape routes in case of fires.

- The use of thermography (e.g., interior infrared photographs or aerial scans) has a positive effect on public participation in the energy program and provides more precise information on critical areas for corrective action.

- The survey instrument conforms to the codes and recommendations used in the City of Texarkana. However, the survey could be modified to fit the requirements of other localities.

HOW TO DO IT

The following sections describe the organization employed by Texarkana to complete the grant program, an evaluation of grant activities and a discussion of pitfalls to be avoided by future project users.

Organization and Staffing

The major participants and their roles in Operation Recovery were the:

City Manager - provided policy direction for Operation Recovery, prepared the leasing bid for the infrared scanning device and contract for the aerial heat loss scan. Less than 10% of his time was devoted to the project over the 13 month grant period.

Energy Coordinator - coordinated the activity between City Departments, including scheduling and follow-up on survey results. One-third of her time was devoted to the project over the 13 month grant period.

Energy Surveyor - conducted the energy portion of the survey, notified survey participants of the findings by mail, and calculated the energy savings estimates for the program. He was employed full time on the program.

In addition, a member of the Fire Department conducted the fire protection portion of the survey. An average of 7% of one person's time was spent on the program over the 13 months.

Also, a member from the Police Department Crime Prevention Team had general responsibility for conducting the security portion of the survey. Less than 20% of one officer's time was devoted to the program over the 13 months.

Major Activities

Grant activities consisted of developing the survey instrument, publicizing the program, conducting the surveys, and evaluating the results.

Much of the survey instrument was adopted from the forms used by the Police and Fire Departments. The energy section was developed with assistance from the Public Works Department and energy conservation literature. Attachment A contains the survey.

Once the survey instrument was designed, a public awareness program was implemented to encourage participation in the program. Public awareness activities included: printed notices on the bottom of customer water bills, announcements in the city government newsletter, and newspaper articles on the program. Public service announcements were made on television and radio throughout the year and the project director was interviewed twice on television. In addition, cable television donated advertisements on the printed news service.

An information packet containing energy and other information was distributed free to the public as part of Operation Recovery. Brochures in the packet were provided by State agencies, Federal agencies, and universities at no charge to the City.

Surveys were conducted Monday through Friday between 9:00 a.m. and 4:00 p.m. A camera equipped infrared scanning device was used in the energy survey to document heat loss in and outside of structures. The photographs were an effective technique of demonstrating energy loss. Initial findings and recommendations were made to the participant at the time of the visit. Written findings are mailed within a week.

On January 24, 1979, an aerial scan was taken to identify heat loss from structures in the City. Texarkana plans to continue the energy conservation program beyond the grant period and expects the aerial photographs to boost interest in the energy surveys.

Cautions and Pitfalls

Citizen interest in energy conservation is vital to the success of the program. An ongoing publicity campaign using a variety of media can help keep public participation high. Texarkana found the most effective techniques to be the printed messages at the bottom of the monthly water bill (See Major Activities). The City plans to use the aerial scan photographs to further publicize the surveys through news articles.

GENERAL FINANCIAL REQUIREMENTS

The cost of conducting a similar program of the same number of surveys is $40,000 - $45,000. This assumes a similar staffing pattern (See Organization and Staffing); a thirteen month lease of the infrared scanning device (@$1,000 per month); and an aerial scan (@$4,700). Additional costs would be associated with additional aerial scan work or with implementing a more accurate method of determining energy savings.

FURTHER INFORMATION

The City of Texarkana is willing to share information developed during Operation Recovery. For further information, contact GOER or

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AUSTIN, TEXAS 78711

WILLIAM P. CLEMENTS, JR.
GOVERNOR

ENERGY AUDIT FOR BAPTIST HOSPITAL

Project Description:

Baptist Hospital in Beaumont, Texas, was also the recipient of an energy audit provided by the Governor's Office of Energy Resources. Having been established in 1949, the hospital has built a number of additions to the main facility bringing total square footage to over 291,000 square feet. The facilities now encompass three separate buildings housing 387 beds.

In 1978, Baptist Hospital paid nearly $325,000, for electricity and over $120,000 for natural gas. The audit team's recommendations were calculated to offer savings of over $37,000 annually, with none of the actions recommended having a payback period of more than 25 months.

This audit points out the very significant savings that can result from low cost or no cost actions. About 1/3 ($12,000) of total calculated possible savings of $37,000 were due to actions of this nature. These involve such things as adjusting temperature settings of water to fan-coil units, changing operating hours of certain systems, turning off un-needed equipment, reducing excessive light levels and repairing equipment. Such actions are applicable to a great majority of hospitals in the state.

A summary of the recommendations made to Baptist Hospital follows.

Low Cost and No Cost Improvements

The following are items that would cost less than $100 (exclusive of staff time and administrative actions) to implement:

Action	Cost to Initiate	Projected Annual Savings	Simple Payback
1. Turn off 5 hp fan motor located above boiler.	$ 0	$ 600	immediate
2. Turn off 5 hp motor in chiller room during the night and on cool days.	0	200	immediate
3. Fix steam leaks:			
-to kitchen steam pots	60	185	4 mos.
-at heat exchange tank in chiller room.	30	90	4 mos.
4. Reduce hot water temperature- Alice Keith North to 115°.	0	80	immediate
5. Remove 1/2 of the incandescent lights in the hallways of Women and Children's Unit.	0	2,365	immediate
6. Reduce the operating hours of the incinerators to approx. 2-4 hours/day. Burn all the day's trash within this allotted time.	0	2,950	immediate
7. Add insulation to the main boiler. 2", 1 lb. density, foil backed, 300 sq.ft.	60	350	2 mos.
8. Eliminate 1/2 of the 40 watt fluorescent bulbs and ballasts in overlit halls and waiting rooms of main building.	0	1,577	immediate

Action	Cost to Initiate	Projected Annual Savings	Simple Payback
9. Eliminate reheat systems in Alice Keith North and Auditorium hall/ Library.	$ 0	$ 964	immediate
10. Raise chilled water temperature to Auditorium hall/ Library AHU from 45° to 50° after #9 is accomplished.	0	73	immediate
11. Turn off the AC units at night to Alice Keith South, north (downstairs) and Auditorium, halls, and Library.	0	1,170	immediate
12. Repair air dampers in mechanical rooms of Auditorium, Women and Children's Unit (AHU-03-21), and Alice Keith North.	--	-- (amount of air leakage not measured)	
13. Fix seal on refrigerator in Alice Keith North laundry room.	0	12	immediate
14. Control AC to auditorium by use of a 7-day timeclock. Given the week's schedule for Auditorium use, set AC unit to cycle on approx. 1 hour before scheduled use, and off 30 minutes after scheduled meeting. Timeclock control over-ridden by room thermostat.	240	605	5 mos.
15. Turn off all electrically chilled water fountains during 6 winter months and raise their water temperatures during summer.	0	Over $50 per refrigerated fountain ($8.25/month for each one cut-off)	immediate

Action	Cost To Initiate	Projected Annual Savings	Simple Payback
16. Re-adjust controls on Auditorium air handling unit to cycle within a five degree range rather than two degrees.	0	$ 685	immediate
17. Fix air leak in AHU in Auditorium mechanical room and in Main Building "A" wing.	0	(cfm loss not measured)	immediate
18. Block supply grille to storage room in kitchen, Women and Children's Unit.	0	30	immediate

Significant Cost Recommendations

Action	Cost to Initiate	Projected Annual Savings	Simple Payback
1. Insulate the following items: 6 autoclaves (a 2" strip on each) In the Women and Children's Mechanical Room: -Pipe from boiler to storage tank -Heat exchanger -Pipe from heat exchanger to storage tank -Autoclave boiler -Approx. 6 feet of refrigerant line to kitchen cooler condenser units In the Main boiler Room: -steam pipe from heat exchanger tank in chiller room -4 valves and pipe between and above the two large hot water tanks -Seven valves over boilers In Alice Keith North: -Pipe from Rheem water heater to storage tank	$ 850	$1,475	7 mos.
2. Repipe the three pipes losing steam (over the laundry and boiler rooms) back into steam system	1,200	2,500	6 mos.

Action	Cost to Initiate	Projected Annual Savings	Simple Payback
3. Add heat recovery system to the exhaust stack of main boiler.	$9,172	$4,313	25 mos.
4. Add chilled water controls to main chiller. Condenser & Evaporator pressure drop sensor.	6,000	8,910	8 mos.
5. Install demand limiter (ex. savings: if reduce to 2069 kw peak w/5.5% annual increase).	3,800	2,634('79) 2,768('80)	17 mos.
*6. Install controls to modulate boiler pressure. Reduce to 50 psi, if possible, after laundry closes each day.	2,900	1,512	23 mos.
7. Convert approx. 250 incandescent (100-150w) to fluorescent in main building. Replace with approx. 52 fixtures.	650	3,600	3 mos.

*Could be done manually by night shift maintenance. If so, remove to No Cost/Low Cost section with immediate savings.

Presented by the
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WILLIAM P. CLEMENTS, Jr., Governor

David B. Marks, Director

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