DSM Pocket Guidebook

Volume 1: Residential Technologies

Western
AREA POWER
ADMINISTRATION

DSM Pocket Guidebook

Volume 1: Residential Technologies

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Foreword

The original series of demand-side management (DSM) guidebooks was published in the 1990s, when rising energy prices and mandates to conserve made DSM programs popular. Today, interest in energy efficiency and renewable energy technologies continues to grow.

As an increasing share of the nation's fuel supply is provided by other countries, energy efficiency and renewable energy technologies are seen as a way to improve the nation's energy independence. Concerns about global warming contribute to interest in reducing carbon emissions that result from combustion technologies.

Researchers and manufacturers have worked diligently over the past several decades to improve the performance of these efficiency and renewable technologies, to the point where many are cost competitive with conventional technologies.

This version of the Residential DSM booklet has been updated to cover these proven new technologies, which promise to help our nation meet its energy goals.

This series of guidebooks is intended as a tool for utility personnel involved in DSM programs and services. Both the novice and the DSM expert can benefit from the information provided.

Acknowledgements

This updated version of the Residential Technologies Demand-side Management Pocket Guidebook is the result of the hard work and expertise of a number of people on Western Area Power Administration's Energy Services Team and the National Renewable Energy Laboratory staff.

Introduction

In 2004, residential buildings accounted for 36% of U.S. electricity consumption. The typical U.S. family spends more than $1,600 per year on home utility bills. All too often, some of that energy is wasted. And electricity generated by fossil fuels for a single home puts more carbon dioxide into the air than two average cars.

Many opportunities are available to make homes more energy efficient. ENERGY STAR® qualified homes are at least 15% more energy efficient than homes built to the 2004 International Residential Code.

A building code can be understood not as the goal for a new or existing home, but as the minimum standard that a home should meet. There are many opportunities to exceed the building code with technologies that are cost effective and offer quick payback.

A Department of Energy program, Building America, conducts systems engineering research to produce homes on a community scale that use 30% to 90% less energy. By integrating onsite power systems, "zero-energy" homes that produce as much energy as they use will be designed by 2020.

These highly efficient homes can include a variety of energy-efficient features, such as effective insulation, high-performance windows, tight construction and ducts, efficient heating and cooling equipment, and ENERGY STAR-qualified lighting and appliances. These features contribute to improved home quality and comfort, and to lower energy demand and reduced air pollution.

Technology Selection

Utility DSM programs typically consist of several measures designed to modify the utility's load shape (for example, innovative rate structures, direct utility load control, promotion of energy efficiency technologies, and

customer education). The coordinated implementation of such measures requires planning, analysis of options, engineering, marketing, monitoring, and other coordination activities. This guidebook addresses one facet of an overall DSM program: selection of end-use technologies by the electrical utility.

All facets of a utility's DSM program, including technology selection, must be planned with the utility's overall objectives in mind. Selected technologies must make the utility better able to serve its customers by providing low-cost reliable power. yet the utility must also be able to recover its fixed and operating costs. In practice, this usually means that the technology must provide the same or expanded cost-effective energy service to the customer, smooth out the utility's load curve, and delay the need for additional power plants. This guidebook directly addresses these requirements by providing formulas for estimating the simple payback (to the end user) for energy-efficient end-use technologies and their impacts on the utility's load curve.

A number of additional factors must be considered in technology selection. Primary among these are customer acceptance of different end-use technologies, the type of marketing effort required to promote each, and the potential impact on the utility's revenues. These factors are not addressed in this guidebook.

Intended Audience

This guidebook is intended to be a quick reference source for utility field representatives in their customer interactions and for utility planners in the early stages of developing a DSM program. It is designed to allow a quick screening of commercially available electric end-use technologies for the residential sector.

This guidebook is also directed primarily at small municipal utilities and rural electric cooperatives within the Western Area Power Administration service area. Large utilities with more staff resources may find the guidebook useful as a starting point. Their technology selection pro-

cess will undoubtedly also include reviews of other source documents and detailed system and engineering analyses of the options.

How to Use This Booklet

Because of the condensed nature of this guidebook and our desire to keep it simple, we have provided only overviews of the technologies. The guidebook is not intended to substitute for detailed analysis, but rather to point the reader toward technologies that are most likely to benefit both the energy user and the utility. For more details, the reader should consult "For More Information" provided at the end of each technology brief. A wealth of information is provided on these technologies on the Web.

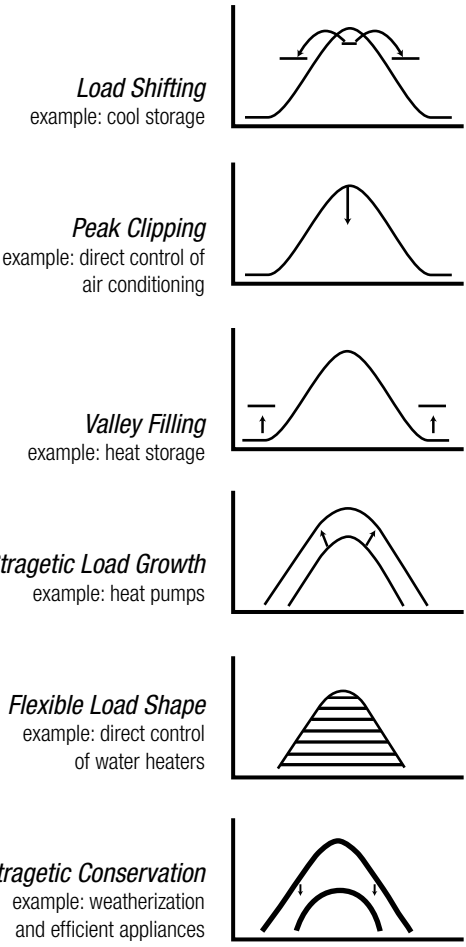
DOE Western Area Power Administration

www.wapa.gov

DOE Office of Energy Efficiency and Renewable Energy (EERE)

www.eere.energy.gov.

Many software programs and online calculators are available as well; search for "Calculators" on the EERE Web site.



Typical load shape changes resulting from selected demand-side management alternatives.

Adapted from Clark W. Gellings, highlights of a speech presented to the 1982 Executive Symposium of EEI Customer Service and Marketing Personnel.

Energy Use and Energy Audits

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An energy audit will pinpoint areas in a home that waste energy and money and suggest the most effective measures for cutting energy costs. A homeowner can conduct basic energy audits, contact the local utility, or hire an independent energy auditor for a more comprehensive examination.

A home energy audit is the first step to saving energy and money for a homeowner. After the homeowner has identified where the energy is being lost, he or she must then formulate a plan to correct the problem. Below are some questions that can help a homeowner to prepare an energy savings plan for the entire house:

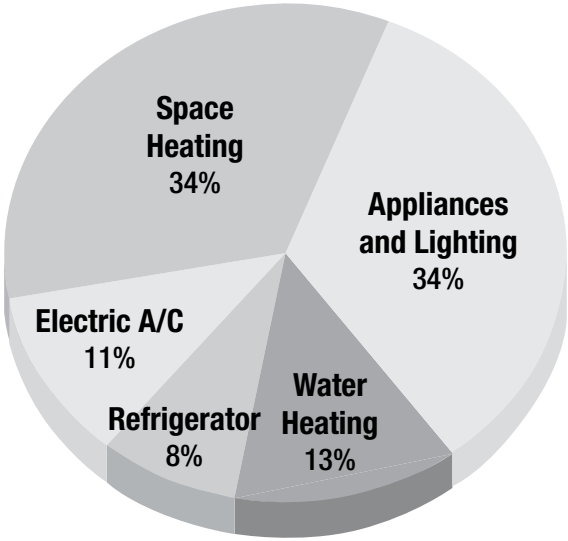
- What percentage of the household income is being spent on energy?
- How much money is spent on energy?
- Where are the greatest energy losses?
- How long will it take for an investment to pay for itself?
- Do the energy saving measures provide additional benefits (e.g., increased comfort)?
- How long does the homeowner plan to own the home?
- Can the job be done by the homeowner or is a contractor required?
- What is the budget for improving energy efficiency?
- How much time is available for maintenance and repair?
- What effect will identified improvements have on the resale value?
- How much of the identified improvements' costs can be recovered on resale?
- What is the remaining life expectancy of the home?

A good energy plan will maximize energy efficiency while saving the most money.

If a contractor is required, the homeowner should look for licensed, insured contractors with references. Another good idea is to obtain at least three bids for cost comparison.

Several factors determine how much energy is used in the home and the percentage of each energy use category. These factors include:

- Climate/location
- Building envelope efficiency
- HVAC, appliance, and lighting systems efficiency
- Home size.



How We Use Energy in Our Homes (U.S. Average)
Heating accounts for the biggest chunk of a typical utility bill.

Energy Audit

A home energy audit is the first step in assessing how much energy a home consumes and to evaluate the measures that are required to make it more energy efficient. An energy audit will reveal problems that, when corrected, can save homeowners significant amounts of money over time. An audit may also show homeowners ways to conserve hot water and electricity. Homeowners can perform a simple energy audit or hire a professional energy auditor to carry out a more thorough inspection. A professional auditor uses a variety of techniques and equipment including energy analysis computer software to determine the energy efficiency of a home. Thorough audits often use equipment such as blower doors, which measure the extent of leaks in the building envelope, and infrared cameras, which reveal hard-to-detect areas of air infiltration, and missing insulation.

Types

Simple Energy Audit – Homeowners can easily conduct a home energy audit with a simple, but diligent, walk-through of the home. Homeowners should keep a checklist of inspected areas and problems found. Below is a simple checklist of things to look for:

- Check for holes or cracks that leak air around walls, ceilings, windows, doors, lighting and plumping fixtures, switches, and electrical outlets.
- Check the insulation levels in the attic, exterior and basement walls, ceilings, floors, and crawl spaces.
- Check for open fireplace dampers.
- Check appliances and heating and cooling equipment to make sure they are working properly and are properly maintained.
- Replace standard light bulbs with compact fluorescent lights (CFLs).

- Look for ways to use lighting controls such as occupancy sensors, dimmers, or timers in high-use areas like living rooms and kitchens.

Professional Energy Audit – A professional energy auditor will examine energy loss in the home in great detail, including an examination of each room as well as past utility bills. Many professional energy audits will include a blower door test and thermographic scan. A less common technique is a PerFluorocarbon tracer gas (PFT) air infiltration scan. Before meeting with an energy auditor, homeowners should make a list of problems (e.g., drafty rooms) and request copies of their yearly utility bills from their local utility. A professional energy auditor will examine the outside of the home for size and features, occupant behavior, and use equipment to detect sources of energy loss such as blower doors, infrared cameras, furnace efficiency meters, and surface thermometers.

To find an authorized energy auditor, homeowners can contact their state or local government energy office, their local utility, or their local yellow pages under "Energy." Before contacting any energy auditor, they should speak to several references.

A good professional energy audit provides a roadmap for the homeowner to follow while making improvements to the home. It includes recommended measures, estimated costs for each measure, first year savings, and simple payback. This information allows homeowners to make wise decisions and considers available budget, return on investment, and other factors.

High energy prices and greater awareness of global warming have increased homeowners' interest in purchasing home renewable energy systems like photovoltaic (solar) panels. The interest in zero energy homes is also increasing. The term "zero energy home" indicates a home that both produces and uses energy; over the course of a year, the home offsets the energy used by the energy it produces, usually by generating electricity from photovoltaic panels. During certain