Rural Electric Efficiency Prospects

Tom Potter

March 2008

Southwest Energy Efficiency Project
2260 Baseline Road, Suite 212
Boulder, Colorado 80302
www.swenergy.org
# Table of Contents

Executive Summary ................................................................. iii

Glossary .................................................................................. ix

Acknowledgements ................................................................. xi

Introduction ............................................................................. 1

Part 1: Electricity Use in the Southwest ................................. 11


Part 3: Prospects for Rural Electricity Savings .................... 47

Part 4: Utility Program Recommendations .............................. 78

Appendices ............................................................................. 109

  Appendix A: The CEDAR4Rural Demonstration ............... 110
  Appendix B: Utility Programs and Related Resources ......... 113
  Appendix C: A Short List of Utility Concerns ................. 122
  Appendix D: Further Reading .............................................. 123
Executive Summary

Introduction
Growth in the use of electric power, especially in the rural Southwest, has fostered economic growth and increased the level of energy services enjoyed by residents of the region. But high growth in electricity demand has also contributed to problems such as rising energy costs, controversies over new power plants or transmission lines, and increased greenhouse gas emissions contributing to global warming. There is growing interest in promoting more efficient electricity use as a way to mitigate these problems.

This report focuses on the prospects for improving the efficiency of electricity use in rural areas of the Southwest, in particular rural areas of Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming. The primary emphasis is on electricity use in residential and commercial buildings. These buildings constitute the majority of rural electric load in many parts of the Southwest, and are an important contributor to demand peaks throughout the region. The report also focuses on existing rather than new buildings. New construction in rural areas is unlikely to add more than 20% of the load in 20 years, so addressing existing buildings that will account for at least 80% of the load in the foreseeable future makes the most sense.

Improving energy efficiency (meaning less energy use for a given level of service; e.g., more efficient lights or appliances) and promoting conservation (meaning reducing unnecessary energy use; e.g., turning off lights or appliances when not needed) pays off on nearly every level. An energy-efficient building is more comfortable and less expensive to operate. Energy-efficient appliances and equipment do the same work as standard ones, but cost less to operate. Finally, improving efficiency and conserving energy are almost always less expensive than producing, transmitting, and distributing power from new resources—whether from a new coal-fired plant, natural gas-fired plant, or renewable energy facility.

Most of the technologies discussed in this report for saving energy in buildings are not new. Most have been in use for decades, and are mature, well understood, and readily available in the marketplace. Other technologies, such as compact fluorescent lamps, are now less costly and perform much better than models available even 5 or 10 years ago. In addition, many strategies discussed in the report are not technologies, but practices (i.e., different ways of accomplishing the same objectives). All the technologies and actions described here are proven, off-the-shelf ways to reduce energy use cost effectively. This aspect is important in rural areas where service and trouble-shooting assistance for newer, riskier technologies are less available.

Given the wide array of energy efficiency and conservation measures and practices now available, we believe it is technically feasible and cost-effective to achieve 20-40% electric savings throughout the Southwest. Such savings can be achieved while base functions (i.e., safety, comfort, services, and lifestyle) are maintained. This potential is not determined using the cost effectiveness tests required by utility commissions—it represents an intentionally looser definition and allows for the more creative conception of non-hardware solutions and benefits, as we believe are appropriate for rural areas.
The Rural Context

A. The Land and People

The Southwest is drier and sunnier than any other region in the United States, and with larger temperature variations. Some rural areas of the Southwest have high space heating requirements, while other areas require substantial space cooling and just modest space heating. People who live in the Southwest are more able and likely to use evaporative cooling rather than refrigerated air conditioning due to the arid climate.

The production, transmission, and use of energy is a challenge in this region because electricity must travel farther to less densely populated areas, at greater expense, and is used to heat and cool buildings that are, on average, older and less energy-efficient than those in urban areas. Thus, per-household energy use is relatively higher in the rural Southwest than in urban areas. In addition, windshield time—the large amount of time that program staff and contractors must spend traveling to and from customers—is a consideration in the design and implementation of energy efficiency and conservation programs.

Rural residents of the Southwest are often described as independent, politically conservative, and wary of unproven changes to the way they do things. They also tend to be intensely loyal to their local institutions, and communicate much more informally than their city relatives. Recent discussions with residents also indicated they are mostly unaware of the effect their daily energy-using behavior has on utility costs. Most people are skeptical that anything they could do would make a difference in their energy bills, without greatly modifying their lifestyle (“we don’t want to freeze in the dark”), but appeared to be open to demonstration. And while some were interested in doing something to save energy, in general they said they did not know what to do or where to go for help.

B. The Economy

Electricity use in the residential sector in rural areas is similar to that seen in urban or suburban areas. Major end-uses include space heating and cooling, water heating, appliances, electronics, and lighting. In addition, there is greater rural use of domestic well pumps and security lighting.

The major rural industries are more often agriculture-, forest-, or extraction-related, as compared to the heavy manufacturing industries in urban areas, and each relies more heavily on liquid fossil fuels than electricity. In agriculture, electricity is mainly used in motors for powering irrigation pumps, compressors, fans, conveyors, and the like; resistance heating of buildings, water, and products such as milk; lighting of offices, processes, and livestock shelters; and electronics. The recent growth in energy and mineral extraction has changed the load profile of some rural utilities in the Southwest, and increased their load factors due to addition of 24/7 loads such as motors, pumps and compressors.
The rural commercial sector uses fewer and smaller motors, and concentrates its electricity use in lighting, electronics, and resistance heating. The load profiles of shops, businesses, and offices on Main Street in any small rural town resemble those in urban areas.

C. Electricity Suppliers

Rural electric cooperatives (co-ops) built the far-flung distribution infrastructure that serves these less-populated rural areas; they operate and maintain the facilities to provide reliable electricity at the lowest possible cost. As nonprofit, member-owned organizations, their focus is different than that of the better known investor-owned utilities (IOUs). Co-ops serve their member-customers rather than shareholders, but have far fewer customers per mile of transmission line (an average of 7 compared to about 35 per mile for IOUs, and nearly 47 for municipal utilities). As a result, they also have far less revenue per mile of line. In small towns, rural customers may pay their bills to their local municipal utility, which may buy power from an IOU or a public utility. Rural utilities are pragmatic organizations and have had to be unusually knowledgeable about electricity distribution.

Distribution co-ops typically buy their power from larger IOUs or co-ops with generation facilities. Most of the co-ops in Colorado, New Mexico, and Wyoming buy power and transmission services from Tri-State Generation and Transmission (Tri-State G&T), a wholesale electric power supplier owned by the 44 electric co-ops and public power districts that it serves. Five of the six co-ops in Arizona buy their wholesale power from a G&T cooperative, the Arizona Electric Power Cooperative. The six Utah co-ops buy wholesale from a Utah G&T, Deseret Power, while the four Nevada co-ops buy wholesale from Bonneville Power Administration (BPA). Other co-ops and municipal utilities in the region buy power from Xcel Energy (in Colorado and New Mexico), PNM (in New Mexico and Arizona), the Western Area Power Administration (all SWEEP states), and other generators.

A major consideration in planning for improved electric efficiency is the relatively limited experience with energy efficiency program delivery in rural areas of the Southwest. Lack of financial incentives and other considerations, too, will likely prompt institutional reluctance to fielding extensive efficiency efforts, putting the achievability of deep rural energy savings in question. These barriers must be addressed.

Finally, the lack of energy efficiency program history and product and service delivery systems (except for the Federally-funded Weatherization Assistance Program for low-income households) means that a comprehensive efficiency program infrastructure in the rural Southwest must be built almost from scratch. On the positive side, this will provide many rural entities and entrepreneurs the opportunity for new jobs and profit opportunities. The downside is that it will require determination and creativity to develop programs that have an impact in the short- to mid-term, during infrastructure build-out.
**Energy Efficiency and Conservation Potential**

Energy use and costs can be reduced by 20-40% in all parts of the rural Southwest by employing a wide range of no-cost, low-cost measures and practices, as well as investment-grade energy efficiency measures. Low-cost, no-cost measures and practices for households will pay themselves back in less than a year and include:

- better control of lights, temperatures, and appliances
- reducing water heater temperatures
- installing low-flow showerheads and faucet aerators
- using clothes lines instead of electric dryers
- installing compact fluorescent lamps (CFLs), and
- unplugging or using power strips to shut off electronic devices when not in use, thereby eliminating standby power waste.

Investment-grade opportunities include retrofit of the building envelope, ENERGY STAR appliances, high efficiency heating and cooling equipment, and sealing leaky heating and cooling ducts.

In rural businesses, a wide range of efficiency measures and practices are available including some of the same no-cost, low-cost options available in homes, more efficient lighting devices, and efficient heating and cooling equipment. And on farms and ranches, efficiency measures include premium efficiency motors and variable speed motor drives, more efficient irrigation pumps, and more efficient ventilation systems. Part 2 of this report discuss these and other efficiency and conservation opportunities in greater detail.

The good news is that all of these measures and practices are cost effective; i.e., they yield utility bill savings that are greater than their initial cost. In many cases the payback on the first cost is three years or less, meaning a return on investment of 33% or greater. As both Great River CEO David Saggau and Colorado Governor Bill Ritter have said, “The cheapest kilowatt-hour is the one we don’t have to produce.”

Besides the economic benefits, this report examines the other drivers for, and impediments to, increased energy efficiency and conservation in rural areas. New findings show that non-energy benefits such as better comfort, enhanced productivity, and greater self-reliance can be important drivers for the adoption of energy efficiency and conservation measures. With a growing understanding of the ways energy impacts our economy, our national security, and our environment, more and more households, businesses and utilities are making energy efficiency their first choice among energy options.
Utility Program Recommendations

Considering the institutions available to carry out energy efficiency and conservation programs in rural areas, electric co-ops and municipal utilities appear to be in the best position to lead the campaign. These utilities are already in the field, know about energy use, are respected institutions, and already charge customers through monthly utility bills. At the same time, these utilities will have to accept a new and challenging action agenda if they are going to become effective champions for more efficient electricity use.

To gain the most for their specific system, utilities should analyze energy savings opportunities and achievable demand reduction potential, and develop energy savings goals that reflect the types of customers and loads they serve. Utilities should view promoting energy efficiency as a way to better serve their customers (by helping them reduce their energy use and energy bills), not as a threat to utility revenues and margins. Furthermore, delivering new energy efficiency services can and should be viewed as a business opportunity and potential new source of revenue for co-ops and municipal utilities.

Rural utilities should involve their rate-payers early on. These end-users will want to know the estimated impacts of the measures on their power bills, the broader economies in the overall service area, and other non-energy public benefits. Such early involvement builds credibility and trust in the utility, develops understanding of and support for the program, improves the speed and ease of program launch (which translates to program cost savings), and improves the performance of practices and measures implemented (which translates to improved program cost effectiveness). Finally, utilities should view their customers as partners in the pursuit of greater energy efficiency. Customers after all must agree to adopt efficiency and conservation measures. To motivate customers, utilities can appeal to both self-interest (saving money) and community pride with statements such as “we, the owners and end users, can improve costs and reliability in this electric service area by taking informed, responsible action.”

A. Begin with the Current Energy Harvest

This report suggests launching the first phase of energy efficiency and conservation programs through rural Southwest utilities without delay, and highlights the elements we suggest including in these programs. We cite many successful models for such programs, and they are applicable in one form or another in most service territories in the Southwest. Generally, efficiency and conservation programs should include educating customers regarding low-cost/no-cost options (paid for by the end-user) as well as promoting investment-grade efficiency measures that are paid for in part through utility rebates or financed by the utility through low-interest or zero-interest loans. These programs will deliver the most payoff where the utility also provides supporting rates, incentives, and regulations; optimizes program budgets by leveraging program partner contributions; provides consumers with credible and practical information; and performs a “prospects triage” specific to the region to focus limited program resources. At the same time, we urge utilities not to ignore underserved market segments such as low-income households, in order to achieve broad customer benefits.
B. Prepare for the Follow-On Energy Harvest

To support program growth and continuity beyond the initial phase, utilities will need to address a range of underlying market and behavioral barriers. Doing so will open up new market niches in this second phase and increase the cost-effectiveness of the program as it moves beyond the Early Adopters and into the range of Late Adopters and Laggards, market segments common to marketing campaigns of all types. In this phase utilities should improve energy-use awareness, program delivery, and communications to overcome end-user apathy and perception of “hassle”; find ways to make energy saving visible and desirable; address split incentives; develop a private sector marketing and delivery infrastructure; develop major rebate programs and low-interest or zero-interest loan funds to reduce first-cost resistance; and resolve the “windshield cost” issue with innovative program delivery that minimizes site visits.

Utilities also could encourage the adoption of state-of-the-art building energy codes in rural communities to ensure that new buildings and major renovation projects meet a minimum level of efficiency. Energy codes help to address the split incentives between builders (who want to minimize first cost) and buyers (who will be paying the energy bills). Good energy codes make sense in part because it is more practical and cost effective to construct buildings “right” than to try to retrofit energy efficiency measures later. In addition to advocating for state-of-the-art codes, utilities can offer builder and contractor training on how to comply cost effectively with energy codes, and how to prosper through the substantial rural building renovation effort that will result if utilities implement comprehensive energy efficiency programs.

C. Help Plant the Next Energy Efficiency Crops

Utility energy efficiency and conservation programs place most of their emphasis on promoting and encouraging widespread adoption of well-established measures and practices. But utilities in rural areas may also want to engage in research, development, and demonstration (RD&D) on the next generation of efficiency practices and measures. Utilities can test and demonstrate such promising technologies as adding thermal mass to buildings, improved daylight harvesting, light-emitting diodes (LEDs), retrofit passive solar heating, new evaporative cooling technologies, heat pump water heaters, low-cost demand indicators and controls, and localized heating and cooling of people rather than entire buildings. By performing RD&D, utilities can evaluate what impact the new technologies will have on customers’ energy use and load profile, assess how customers react to the technologies, and determine whether the technologies are likely to be cost effective and accepted. If the results are positive, the utility may want to take the lead in marketing and promoting a new technology; e.g., as some rural utilities have done in the case of ground-source heat pumps.
**Glossary**

ACEEE – American Council for an Energy Efficient Economy

AMCA – Air Movement and Control Association

BPA – Bonneville Power Administration

CAFO – concentrated (or confined) animal feeding operation

CBSM – community-based social marketing

CEDR – Group term for the energy-saving categories of Energy Conservation, Energy Efficiency, and Demand Response

CFL – compact fluorescent lamp

Comfort conditioning – treating the air (e.g., heating/cooling) to ensure occupant comfort

Cooperative – In rural America there are many types of cooperatives, including those for fuel, telephone, marketing, commodity, and purchasing. In this report “cooperative” (or co-op) means the rural electric cooperative, a nonprofit, member-owned organization forming the electricity distribution infrastructure serving many less-populated rural areas

Demand response – The improvement of efficiency of the larger electricity generation, transmission, and distribution system by modifying the time at which end-use power is drawn, reducing the peak demand for power from the system.

DMEA – Delta Montrose Electric Association

DOE – U.S. Department of Energy

DSM – demand-side management

EC/EE – The achievement of electricity savings through the combined effort of energy conservation and energy efficiency.

EIA – U.S. Department of Energy’s Energy Information Administration

Energy conservation (EC) – The reduction of electricity use without extensive new equipment or systems, relying mostly on different behavior by the system operator

Energy efficiency (EE) – The reduction of electricity use by means of equipment that produces more output or service per unit of electricity consumption, with little reliance on different behavior by the system operator
ENERGY STAR® – A United States government labeling program to promote energy-efficient consumer products, including major appliances, office equipment, lighting, home electronics, as well as new homes and commercial and industrial buildings.

ETS – electric thermal storage

G&T – generation and transmission cooperative, e.g., Tri-State Generation & Transmission serving Colorado, New Mexico, and Wyoming.

Green building – Term that refers to designing and building structures that are environmentally friendly and follow the tenets of sustainability.

HVAC – heating, ventilation, and air conditioning systems

IOU – investor-owned utility

kVA – kilovolt-ampere

kWh – kilowatt-hour

LC/NC – low-cost/no-cost

LED – Light-emitting diode

Muni – municipal electric utility

MW – megawatt

MWh – megawatt-hour

NEB – non-energy benefit

NPCC – Northwest Power and Conservation Council

RE – renewable energy

RECO – residential energy conservation ordinance

SWEEP – Southwest Energy Efficiency Project

V2G – Vehicle-to-grid; an even newer electric systems concept is captured with the abbreviation V2H, meaning vehicle-to-home. In both cases, the power also flows (directly) from the grid to the vehicle, or from (via) the home to the vehicle, charging the vehicle’s propulsion power storage battery

VER – ventilation efficiency ratio
Acknowledgements

The author gratefully acknowledges the help of many people in assembling this report. Special thanks to Maureen McIntyre for her early contributions and editing, to Howard Geller for sharing his excellent insight to the field of building energy use, and to the staff of many rural electric utilities (cooperatives, investor-owned, and municipalities) for valuable information about rural utility capacities and interests with regard to the wise use of energy. We appreciate receiving detailed comments on a draft of this report from Jim Spiers of Tri-State Generation and Transmission Association. Finally, thanks to Crystal Potter and Christina Panoska for help with editing and final document preparation, and special appreciation to Stefanie Woodward for editing and topic compilation. Please note that despite the best attempts of contributors and editors to clarify the content, the author takes full responsibility for all errors, omissions and attitudes.

This report was prepared by Tom Potter, SWEEP’s Director of Rural Programs. Comments on the report may be directed to Tom by phone at (303) 503-2230 or by email at tpotter@swenergy.org.

About SWEEP

Founded in 2001 and based in Boulder, Colorado, the Southwest Energy Efficiency Project (SWEEP) is a public interest organization promoting greater energy efficiency in Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming. SWEEP focuses on electricity and natural gas conservation along with promotion of combined heat and power systems while working in the following areas:

- state energy legislation
- utility energy efficiency policy and programs
- building energy efficiency
- education and training, and
- information development and exchange.

For more information, visit SWEEP’s website at www.swenergy.org
Introduction

Rural Energy Use

Growth in the use of electric power, especially in the rural Southwest, has fostered economic development and increased the level of energy services enjoyed by residents of the region. But high growth in electricity demand has also contributed to problems such as rising energy costs, controversies over new power plants or transmission lines, and increased greenhouse gas emissions contributing to global warming. There is growing interest in promoting more efficient electricity use as a way to mitigate these problems.

As everywhere else, energy is used in rural areas for health and safety, work and leisure, transportation, comfort and entertainment. Until quite recently energy was everywhere and generally understood to be a bargain, considering the work it did, and was a matter of little discussion. Its direct cost, which is related most often to the payment required for gasoline or electricity, for example, is also well understood.

Less understood is what we call “embodied energy,” that is, the energy that has been expended to prepare and deliver products (such as fertilizer from natural gas or an apple from Chile) and services (such as communication), in rural and in urban places. Though farmers are amused by city kids’ belief that milk comes from the grocery store, the origin and many invisible uses of energy are similarly not a common topic of discussion in the coffee shops of the rural Southwest. So the fact that energy does not just come from the power line outside the house or farm is, for some people, rural and urban, a new and startling observation, as the underlying sources for electricity generation have not been questioned until relatively recently.

But rural residents do have a different understanding of energy. They are far more accustomed than city dwellers to seeing, in the cycle of days and seasons, the significant amount of the useful energy that comes directly and indirectly from the sun. They understand that photosynthesis transforms sunlight into plant cells, with energy stored initially as carbohydrates, and via livestock, as a wide range of proteins, fats, and amino acids. This is of great interest, because these are the agricultural products that keep the rural economy humming.

They also see more clearly than most the effects of direct solar heating of the entire environment, making their climate and weather the way it is, and how the tremendous power of the wind is provided indirectly from the sun by the uneven heating of the air. This rural sun enables crops to be planted, and the wind dries crops, fields, and clothes, cools via evaporation and transpiration, and pumps water from old wind pumps by transforming mechanical force from horizontal wind power to a vertical pumping rod.

Direct solar and wind energy use is common in rural America, but garnering electricity from the sun and wind is a relatively recent phenomenon, and still about as unknown
among most farmers as is the fossil source for most rural electricity generation today. Renewable energy generation has not had to develop quickly because, over time, low-cost energy has become available from reliable vendors of electricity, gaseous fossil fuels, and liquid fossil fuels. With low electricity prices ensured by well-known technologies and a historical policy of “greater good” subsidies for rural power delivery, life in non-metropolitan areas has been made progressively easier and faster. In turn, residents of rural areas have acquired more energy-using devices to substitute for human, animal, and natural resource energies.

But the cost of those substitutions now is becoming more evident. As noted in “The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest,” rapidly increasing electric load growth:

- Places upward pressure on electricity and natural gas prices
- Causes power plant and transmission line siting controversies
- Increases the risk of power outages and diminished electrical reliability
- Increases air pollution and other adverse environmental impacts
- Increases water consumption
- Increases the greenhouse gas emissions that contribute to global warming.¹

**Emphasis of This Report**

This report focuses on the ways electricity can be used more wisely and less wastefully in rural areas to reduce or remove the load-growth pressures cited in the previous subsection. The main sections discuss Energy Conservation (EC), Energy Efficiency (EE), and to a lesser degree Demand Response (DR) as it relates to the institutional implementation of EC/EE programs.

The report focuses on the prospects for improving the efficiency of electricity use in rural areas of the Southwest, in particular rural areas of Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming. The primary emphasis is on electricity use in residential and commercial buildings. These buildings constitute the majority of rural electric load in many parts of the Southwest, and are an important contributor to demand peaks throughout the region.

Of course, many end uses for electricity, or even electricity generation, could be carried out with the new generation of renewable energy (RE) devices. That alternative is not the emphasis of this report, for two reasons:

- Energy use and costs can be reduced significantly with a wide range of no-cost, low-cost, and rapid payback EC/EE measures and practices. These measures and practices should be always put into place in conjunction with renewables systems, so they will always be, by themselves, a better initial investment of funds and effort than those renewables systems alone. As Great River CEO and David Saggau and Colorado Governor Bill Ritter have both said, “The cheapest
kilowatt-hour is the one we don’t have to produce.” For that reason, EC and EE deserve greater programmatic attention during the analysis and design of overall utility resource programs. Another observer has stated, “You’ve got to eat your vegetables first.”

- Reducing on-site energy use before incorporating renewables is therefore a smarter way to use the more benign, but more expensive, renewable resource. Such EC/EE preparation allows a smaller, less-expensive, renewables system to carry a larger part of the energy load.

We also do not delve into the embodied electrical energy represented by packaging and non-recycled materials, though their contribution to overall energy use is high, because the impact of reduction mainly would be felt in distant places, and we are concentrating on the micro- and macro-economic impacts of electrical energy use in the rural sector.

This report therefore concentrates on the rural on-site use of electricity, the techniques and technologies that can reduce electric energy use, and the implementing mechanisms to bring those approaches into widespread use.

This report examines three tests to apply to each use:

1. Can electricity use in this end-use application be reduced without extensive new equipment or systems, but relying mostly on different behavior by the energy-using system operator (consumer)? (The question of how to achieve that behavior is not considered yet.) This set of actions is called Energy Conservation (EC).

2. Can electricity use in this end-use application be reduced with higher efficiency equipment or systems, with little reliance on different behavior by the system operator? (The cost and effectiveness of such equipment or systems is not considered yet.) This set of actions is called Energy Efficiency (EE).

3. Can the efficiency of the larger electricity generation, transmission, and distribution system (the grid) be improved by modifying the time at which end-use power is drawn, reducing this “peak demand” for power from the system? (The devices or incentives needed to accomplish these modifications are not considered yet.) This set of actions is called Demand Response (DR), and will be discussed more fully in the Prospects section.

Rural energy use when seen from these perspectives of EC/EE and DR is a very interesting and promising area of investigation and programmatic action when applied to the Southwest.

We write this report expecting a broad audience for such a comprehensive, independent perspective of rural energy use and efficiency, either for its use in direct program application or for its relevance to broader rural efficiency programs and benefits. We believe interested parties will include:

- Managers of rural retail electricity operations (e.g., line management and board members of rural electric cooperatives and investor owned utilities serving rural areas, and city council members with regard to rural municipal utilities)
• Executives responsible for oversight of wholesale electricity operations in the Southwest (e.g., management and board members of Generation and Transmission [G&T] cooperatives [mainly Tri-State, Arizona Electric Power, and Deseret Power])
• Staff of federal power marketing authorities responsible for rural sales [mainly the Western Area Power Administration [WAPA or Western], the Bonneville Power Administration [BPA or Bonneville], and the Tennessee Valley Authority [TVA]]
• Policy-makers and regulators at all levels
• Clean energy interests, media, and advocates
• Academia and national laboratories
• Other rural economic interests and advocates
• Concerned energy consumers

The Land

The rural landscape and climate in the Southwest (defined here as Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming) greatly affect energy use, and are about as diverse as anywhere in the United States. The landscape ranges from high dryland prairie farms and ranches, deserts, salt flats, sand hills, national grasslands, and forests, to rugged foothills and mountain ranges, to irrigated farmland. On the whole, this region is characterized as drier and sunnier than any other in the United States. Maximum temperatures also vary greatly; both the seasonal highest and lowest daily temperatures in the lower 48 states are often reported here.

The People

Rural residents of the Southwest are often self-described as independent, politically conservative, and wary of unproven changes to the way they do things. They also tend to be intensely loyal to their local institutions.

In recent discussions with rural residents, individually and in small groups, we observed a number of interesting rural energy perspectives. Though un-quantified in a research manner, these anecdotal observations show that a number of energy-use changes may be possible with relatively modest effort:

• Some people were oblivious to the effect their daily energy-using behavior had on the gradual accumulation of energy utility costs.
• Many people were only vaguely aware of the connection between energy-use decisions they made every day and the monthly power bills.
• Most people were skeptical that anything they could do would actually make a difference in their energy bills, without greatly modifying their lifestyle (i.e., “we don’t want to freeze in the dark”), but appeared open to demonstration.
• When people did express interest in doing something, they said they really did not know what to do, or where to go for help, and relied mainly on commercial
advertising to guide their purchase decisions.

- More people appeared to understand how a “product fix” could reduce energy use than understood the idea that changing energy-use habits or other behavior could have the same effect at far less cost.
- When considering a “product fix,” many rural residents were not able to describe where they, personally, could conveniently purchase the product (e.g., attic insulation, energy-efficient appliances).
- Renewable energy appeared to be a fairly foreign concept to most rural residents, but when explained as something they used everyday they immediately grasped the basics. However, they still did not see how simple, low-tech use of surrounding natural resources could affect either their use of purchased energy or its cost.
- Rural people are apparently accustomed to one-way communication with their utility companies, mainly in response to their requests for payment. The idea that two-way communication, in the form of informational/educational programs by their utility, could reduce the cost and improve the reliability of their electricity service seemed to be a novel one.

### Energy Suppliers

While there are many electricity providers in rural areas, the rural electric cooperatives (co-ops) built the far-flung distribution infrastructure that serves most of these less-populated rural areas. They operate and maintain the facilities to provide reliable electricity at the lowest possible cost. As nonprofit, member-owned organizations, their focus is different than that of the better known investor-owned utilities (IOUs), because they serve their member-customers rather than shareholders. In three states of the Southwest, co-ops deliver power to a significant portion of the total state population, as shown in Table 1.

**Table 1. Cooperative customers as a proportion of all customers in the Southwest**

<table>
<thead>
<tr>
<th>Co-Op</th>
<th>Cooperative Customers</th>
<th>Cooperative MWh Sales</th>
<th>Cooperative Customers as % of Total Customers</th>
<th>Cooperative MWh Sales as % of Total MWh Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>163,704</td>
<td>2,529,489</td>
<td>5.98%</td>
<td>3.65%</td>
</tr>
<tr>
<td>Colorado</td>
<td>557,137</td>
<td>11,102,447</td>
<td>23.71%</td>
<td>22.96%</td>
</tr>
<tr>
<td>Nevada</td>
<td>33,795</td>
<td>1,650,489</td>
<td>3.02%</td>
<td>5.08%</td>
</tr>
<tr>
<td>New Mexico</td>
<td>194,672</td>
<td>4,285,937</td>
<td>20.94%</td>
<td>20.77%</td>
</tr>
<tr>
<td>Utah</td>
<td>38,543</td>
<td>844,375</td>
<td>3.96%</td>
<td>3.38%</td>
</tr>
<tr>
<td>Wyoming</td>
<td>88,611</td>
<td>4,182,562</td>
<td>29.38%</td>
<td>29.58%</td>
</tr>
<tr>
<td>SW Region</td>
<td>1,076,462</td>
<td>24,595,299</td>
<td>12.80%</td>
<td>11.71%</td>
</tr>
</tbody>
</table>
Electric cooperatives (or co-ops) have far fewer customers per mile of transmission line (an average of 7 compared to about 35 per mile for IOUs, and nearly 47 for municipal utilities [munis]). As a result, they also have far less revenue per mile of line ($10,565, compared to $62,665 for IOUs and $86,302 for munis). In small towns, rural customers often pay their bills to their local muni, which may buy rural power from an IOU or from a rural co-op. Rural utilities are pragmatic organizations and have had to be unusually knowledgeable about field fixes, because for many energy systems they are the suppliers and the maintenance people.

Co-ops typically buy their power from larger IOUs or co-ops with generation facilities. For example, most of the electric co-ops in Colorado, New Mexico, and Wyoming buy power and transmission services from Tri-State Generation and Transmission (Tri-State G&T), a wholesale electric power supplier owned by the 44 electric cooperatives and public power districts that it serves. Five of the six co-ops in Arizona similarly buy their wholesale power from a G&T cooperative, the Arizona Electric Power Cooperative, the six Utah co-ops buy wholesale from a Utah G&T, Deseret Power, and the four Nevada co-ops buy wholesale from Bonneville Power Administration (BPA). Other co-ops and munis in the region buy power from Xcel Energy (in Colorado and New Mexico), PNM (in New Mexico and Arizona), the Western Area Power Administration (all SWEEP states), and other generators.

From the energy suppliers’ point of view, the geographic and climatic variations in the region result in wide variations in patterns of energy demand. In mountain areas such as the Holy Cross Electric Association’s service area (Aspen, Vail, and other less-populous mountain regions), annual electricity demand peaks in the winter because of the winter recreation-intensive local economy. In areas of high recreational use, the commercial end uses seasonal and residences may be occupied for only 4 to 6 weeks each year. This introduces the problem of energy savings payback when many systems in the home are on low-level standby status, and the related issue of how to get the attention of the transient occupant/bill-payer. The Holy Cross system peak, typically reached just after dark 11 months of the year, is about 230 megawatts (MW).

In contrast, warm desert regions such as Arizona Electric Power Cooperative’s service area experience annual electricity peak demand in the summer, and daily peaks when air-conditioning loads are high—typically between 3:00 p.m. and 5:00 p.m. on sunny summer afternoons after a string of very hot days, for example. Because the demand peaks for utilities with cooling-dominated loads depend on variables such as weather and consumer behavior, they can present a planning challenge.
In areas with economies such as Highline Electric Association’s service area in the northeast corner of Colorado that are dominated by irrigated farmland, annual peak demand occurs during late July and August, and is driven by irrigation pumping loads, which may continue 24/7 for weeks on end, depending on weather. The daily loads during the summer rarely vary by more than 5% or so, because the pumping loads are relatively constant day and night, but any daily peaks tend to occur in the morning. Demand peaks are predictable and easy to plan for. Highline’s highest peak in 2006 was 185 MW in the summer and the low was about 25 MW during the winter, without irrigation pumping. The “average” annual Highline peak of 70 megawatts is not very descriptive of the actual end use.

Conversely, Delta Montrose Electric Association (DMEA) in southwest Colorado experiences a winter peak of about 115 MW; heating and lighting dominate the demand loads for this utility. As more people move into this service territory, though, DMEA’s air-conditioning loads are also growing.

The Sustainable Power Plant

Some electricity suppliers may take the limited view that the rural cooperatives exist only to provide reliable electric service at the lowest cost possible. They could perceive EC/EE as the end user’s problem, but in fact, the mission statements of both wholesale and distribution electric co-ops speak of community service in a much broader sense than just to provide electric service. And the character of the business is changing, too, as USDA Rural Utility Service’s Georg Schultz notes: “Now the (utility) industry is in a transition period, and energy efficiency is the new business model.” He also offers the observation that “Utilities already have the relationship with their customers and the technical skills and tools. With funding from (USDA’s) Rural Development, power providers (will) have all they need to build acceptance and commercialization of energy-efficient technology. Many pioneers among electric co-ops are ready to implement such programs right now.” As Shultz suggests, EC/EE offers a chance for rural cooperatives to demonstrate leadership, and help end users address the increased rates and environmental impact associated with the way electric service is provided today.

Rural energy suppliers in the Southwest could look to the City of Austin, Texas, for one example of how to integrate EE into a utility’s business model. While Austin can no longer be considered rural in nature, its mix of municipal, residential, and small commercial loads are typical of the cross-section of loads that every muni and many co-ops must address. Austin Energy’s portfolio of EE programs is among the most comprehensive in the nation, including rebates and low-interest loans to help residential and business customers conserve energy, save money, and improve comfort; “Green Building” or earth-friendly techniques for the average homeowner and building professionals; and the option for consumers to buy energy from renewable sources such as wind and methane gas landfills.

According to Tombari, Austin substituted programs and policies for bricks and mortar, achieving 550 MW of documented, sustained energy savings. This allowed the Austin
utility to take a planned 450 MW coal-fired plant off its books, during a period of 14 years when Austin’s economy grew by 46% and its population doubled. The Austin municipal utility avoided building at least one large power plant by promoting EC/EE via rebates, codes and standards, information and education, giveaways, marketing promotions, and partnerships with trade allies. In this way Austin Energy was able to meet its business standard of providing clean and reliable power, and help its customers obtain energy services at a lower cost than if it built or contracted for new generation. From this observation came the term “Sustainable Power Plant,” which could apply to many other areas in the Southwest, and which could include renewables in the following loading order: 1) Conservation, 2) Efficiency, 3) Demand response, and 4) Renewables generation.

The major focus of this report is on the end-use savings of electrical energy in the rural Southwest, which is now seen as more important than previously thought. To better understand the reasons for the new urgency for energy efficiency in rural America, we need to answer the questions “Why now?” and “Why here?” A person could well ask what has changed from just a few years ago, when it was commonplace to be intellectually interested, but not strongly engaged, in better managing energy anywhere, including the rural sector. York and others, in recognition of one major factor, have noted that “global climate change has moved from an issue of debate to an issue of action” (emphasis added). This climate imperative has captured the attention of many more people than before, with its implication of higher stakes for our way of life, urban or rural. Cities, states and regions have responded with steps to reduce greenhouse gases by means of increased efficiency and conservation. Nationally, there is even a growing demand for the federal government to take a leadership role on this issue, because of the potential importance of climate change to national security and economics. The rural sector will have its contribution to make to this current dialogue.

We are also more widely recognizing the serious near- and long-term economic impacts and security implications of rural dependence on fossil fuels, especially

- Derivatives of crude oil (e.g., the rapidly increasing prices of rural Liquified Petroleum Gas [LPG] used for home heating; securing foreign petroleum supplies from unfriendly sources)
- Natural gas (e.g., farm fertilizer prices rapidly escalating; securing foreign supplies from unfriendly sources via Liquefied Natural Gas [LNG] tankers)
- Coal (e.g., a huge domestic resource, but with the high risk that “externalities” associated with its mining, transportation, and burning will become pay-as-you-go liabilities that could cripple rural economics in the future)

“Why here?” is perhaps a more interesting question, since it speaks more directly to the rural condition. The answer to this question relates to a growing recognition that rural America is an important part of the energy equation, and to the belief that opportunities for improved energy management have been relatively untapped in rural areas. For
numerous reasons defined later in this report, little attention has been paid to the use of energy in the rural sector. Perhaps more importantly, both the incentives for better managing rural energy use, and the infrastructure to deliver energy-reduction programs, have been missing.

Additionally, rural rate-payers in the Southwest have the highest portion of their electricity generated by coal, so the rapid recent increases in coal prices, and the projection of 60% increases in the near future,\(^9,\)\(^10\) are of particular concern to this sector. And larger changes are coming. Rep. Waxman has introduced legislation that will essentially ban all but the cleanest of new coal plants. The bill also bars new coal-fired power plants without state-of-the-art control emissions technology from receiving any free or reduced cost emissions allowances under a future federal program to address global warming.\(^11\)

With all things considered, it is time to pay more attention to rural energy use, and the program-related opportunities to use energy more efficiently. The following sections of this report better define the very large benefits for the rural Southwest of doing so.

Figure 2. Many remote homes already use trees for windbreaks.
Notes for Introduction:


3 Personal communication with Jim Donahue, Grand Canyon State Electric Cooperative Association, the state’s state cooperative group. The sixth co-op, Navopache Electric Cooperative, buys power from PNM, not from the G&T. Also, Mohave Electric Cooperative and Sulfur Springs Valley Electric Cooperative have chosen to become “partial requirements” customers of the G&T, allowing them to find power on the open market for any future growth.


9 The Casper (WY) Star-Tribune reported on February 9, 2008, that a) Peabody Energy, the world's largest private-sector coal company, has predicted the price of coal increasing nearly 60 percent by 2009; and b) a new forecast from Citigroup says world coal prices could double in the near future.

10 While most coal is bought on long-term contracts, protecting rural utilities from rapid price escalation, the movement in the spot market for coal should sound a warning since it indicates what future contracts will cost. The New York Times reported in its March 18, 2008 edition that the benchmark American grade of coal from the Powder River Basin, which supplies much of the Southwest, has been rising for the past 12 months, and that while those prices had eased in the past few days, they were 64% higher than a year ago. Accessed in March, 2008, at [http://www.nytimes.com/2008/03/19/business/19coal.html?pagewanted=2&_r=1&ref=science](http://www.nytimes.com/2008/03/19/business/19coal.html?pagewanted=2&_r=1&ref=science)

Part 1: Electricity Use in the Rural Southwest

Overview of Energy End Use

This section discusses only the use of electric energy on-site, but there are significant energy losses in fossil fuel transportation, as well as in generation, transmission and distribution of electricity. About 70% of the primary energy content is lost there, whether the fuel is coal, oil, or natural gas. Central hydropower and wind, too, have unavoidable losses transmitting their power output to major load centers.

In contrast to the fairly equal use of electricity by industrial, commercial, and residential users in many large urban areas, in the service territories of co-ops nationwide, the commercial and industrial sectors each use about 20% of the total electricity consumed; the residential sector consumes nearly 60% of the total. While this may have once been so for the Southwest, our huge growth in extraction-related loads and irrigation has turned this figure on its head, with much more of the end-use power now going to commercial-industrial than to residential loads.

The major rural industries are more often agriculture-, forest-, or extraction-related rather than the heavy industries in urban areas, and each relies heavily on liquid fossil fuels rather than electricity for their vehicles and on-site or mobile equipment. Electricity is used in agriculture, by far the largest of the rural industries, mainly in motors for powering irrigation pumps, compressors, fans, conveyors, and the like, resistance heating of buildings, water, and products such as milk, lighting of offices, processes, and livestock shelters, and electronics (see Figure 5).

Figure 3. Harsh winters in the Southwest can yield large heating loads
The rural commercial sector uses fewer and smaller motors, and concentrates its electricity use in lighting, electronics, and resistance heating. The load profiles of shops, businesses, and offices on Main Street in any small rural southwestern town resemble those in urban areas. The rural residential sector’s energy use is also similar to that seen in suburban end-user profiles (space heating and cooling, water heating, appliances, electronics, and lighting); domestic well pumping and security lighting are more often used in remote housing.

Climate variables in the region account for major variations in energy end uses. Larger heating loads of rural consumers in states such as Wyoming that are further north prompt fuel switching for space and water heating from electricity to gas or liquid heating fuels. This practice may become less common because of the high and volatile price of natural gas and petroleum-based fuels, and because the availability of pipeline gas is limited in many rural areas. Also, many end users in hot, arid areas avoid the higher electric operating costs of refrigerated residential and commercial air-conditioning by cooling with evaporative chillers.

Energy use is most often associated with making our work easier, but it is also true that energy use has taken on, in the United States at least, the characteristics of our expansive culture. As Friedmann notes, we should address lifestyle as a topic that is “fair game” for energy saving efforts by offering alternatives that discourage what he calls “excessive consumption” of energy. This does not mean that every EC/EE recommendation will somehow diminish the quality of life; it does mean that better energy management can help us all live these “better lives electrically” without as heavy an impact. And such a path can help us go back to the fundamental question, What do we really need to live well? EC/EE will help create safer and more comfortable living spaces, and ways to do so as simply and effectively as possible.
Electricity Use by Sector

Residential
Rural residential electric use profiles often closely resemble typical suburban electric use profiles, with two unique additions—domestic water pumping and security lighting. According to the U.S. Department of Energy’s (DOE) Energy Information Administration (EIA), in 2001, the typical American household consumed an average of 10,656 kWh. For comparison, the average electricity consumption for a house in the Mountain census division (which includes the entire Southwest region) is about 9,900 kWh/year.15 Most homes in this area heat with combustion equipment, not electricity.16

Highline Electric Association’s service area in northeastern Colorado is representative of high plains farming communities with economies dominated by irrigated farming. In 2006, the average residence that Highline serves consumed 12,166 kilowatt-hours (kWh) of electricity, considerably more than the average North American household, which most often has gas space heating and water heating.17 The electric energy consumption in 2006 for houses in towns in Highline’s service area averaged 8,284 kWh, closer to the state average.

Because the energy consumption per house is significantly lower for houses in town, various other farming-related loads are probably included in the total farmhouse electricity consumption number. Even after taking into account the probable water well pump load (about 400 kWh/year18) and a 1,000 kWh allowance per year for security lighting, the average farmhouse without electric heat still uses more than 20% more electricity than a similar home in town. This extra use is likely associated with small agriculture-related loads such as barn and enclosure lighting, resistance heating, fans, and electrified fencing.

Using an average electricity price of $0.10/kWh, Table 2 shows the breakdown of electricity use and cost by major end use for typical electricity heated and gas-heated homes. These numbers are representative for large parts of the Southwest in which moderate climates prevail. In extreme southern and extreme northern parts of the territory, the actual numbers will be skewed to reflect heavier heating or cooling loads.
Table 2 – Domestic Electricity End Uses (nominal) at $0.10/kWh – Electric and Gas Heat

<table>
<thead>
<tr>
<th>End Use</th>
<th>Electric Heat</th>
<th>Gas Heat</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Annual $</td>
</tr>
<tr>
<td>Space heating (H)</td>
<td>25</td>
<td>500</td>
</tr>
<tr>
<td>Space cooling (C)</td>
<td>25</td>
<td>500</td>
</tr>
<tr>
<td>Water heater (W)</td>
<td>12</td>
<td>250</td>
</tr>
<tr>
<td>Lighting (L)</td>
<td>8</td>
<td>170</td>
</tr>
<tr>
<td>Dryer (A)</td>
<td>6</td>
<td>120</td>
</tr>
<tr>
<td>Refrigerator (A)</td>
<td>6</td>
<td>120</td>
</tr>
<tr>
<td>Electronics (E)</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>Washer (A)</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>Dishwasher (A)</td>
<td>0.5</td>
<td>10</td>
</tr>
<tr>
<td>Well pump (A)</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>2200</td>
</tr>
</tbody>
</table>

Buildings
There are far fewer multi-family buildings in rural areas than in urban areas, but a larger proportion of mobile or manufactured homes, which have their own set of difficult energy-use issues. Energy use in buildings, whether commercial or residential, is always complex, in fact, and involves a wide variety of end-use systems, the interactions between those systems and the occupant’s requirement for energy services, and the external effects of climate (ambient temperature, relative humidity, wind, and solar radiation). And energy use varies significantly between even very similar structures; this report uses the averages above, derived from multiple studies, only as a stable base for assessing the differential impacts of various energy retrofit scenarios. Actual program implementation will require much better understanding of the building energy use in a particular service territory, so that recommended practices and measures can be “tuned” to the requirements on the ground.

Heating
According to the EIA, only about 30% of households in western states use electricity as their main heating fuel, and 36% of households have heating equipment that is at least 20 years old.20

Only about 8.5% (270) of the farmhouses in Highline’s service area use electric heat, which raised their total annual consumption to an average of 27,680 kWh per home in 2006,21 higher than the average we will be using for the Southwest. Of the homes in town, about 2% had electric heat, and these homes averaged about 21,000 kWh each in 2006, also higher, but not as much so. Again, farmhouses in this sample consumed nearly 25% more electricity than the houses in town. The homes, without electric heating, use electricity to operate their furnace fans, which typically consume 500 kWh/year.
Cooling
According to EIA, in 2001, the average whole-house air conditioner used 2,796 kWh of electricity, room air conditioners consumed an average of 950 kWh, and about 78% of American households had air conditioning. The use of air conditioning continues to grow quickly in the American West, especially as development expands in the warmer areas of Arizona, Nevada, New Mexico, and Utah, and as immigrants from hotter, more humid climates demand it when their new homes are built. Unfortunately for the instantaneous demand strain on the electric supply system, the trend for new cooling units in the West is toward compressor-based systems.

Evaporative cooling is already used widely in the Southwest because the climate—with its large diurnal temperature swings and low humidity—is ideal for evaporative cooling. For example, in 2001, in Utah homes with some form of cooling, 29% used evaporative cooling and 34% used central air conditioning. Also in 2001, 28% of the single-family residences along Colorado’s Front Range used evaporative cooling, and 27% used central air conditioning.22

In Arizona, however, which has some of the largest cooling loads in the region, evaporative cooling has been less successful. Evaporative coolers are most effective when the humidity is lower than 50%, but when it rains on a hot summer afternoon and the humidity increases—during the summer “monsoons,” for example—homes with evaporative cooling can become uncomfortable. Twenty years ago, 70% of Arizona Electric Power Cooperative’s customers used evaporative coolers; today only about 20% use them.23 If they can afford it, customers prefer to install compressor-based air conditioning so they can be comfortable even when the humidity rises during the monsoons. Some observers note that the micro-climates developing in Arizona cities because of extensive landscape water use, are not prevalent in rural areas, so these effects may be weaker in the homes and businesses discussed in this report, and evaporative cooling may be more appropriate.

Water Heating
Electric water heaters used 2,500 kWh on average in 2001 and about 40% of American households used electricity to heat water. If 40% of the rural households in the Southwest also use electric water heaters that would total more than 865 megawatt-hours (MWh)/year just to heat water, a rather large number in an area with such an abundant solar heating resource. In fact, though, the market penetration of solar domestic water heaters in the Southwest is less than 1% (even in the relatively more aware neighbor, California, fewer than 1000 home solar water heater are sold per year).24

Appliances
Half the typical energy use in American homes is related to comfort conditioning (heating and cooling), but most rural homes use fossil fuels for space heating. With house heating removed, the largest end use of electricity in the average rural household is for appliances (which includes in many compilations refrigerators and lighting), which consume approximately two-thirds of all the electricity used. No single appliance dominates the use of electricity. Lighting consumes the most electricity, at 17% of the
total electricity used for all purposes), followed by refrigerators and clothes dryers (both at 12%), and electronics (10%). Many other appliance contributors increase the percentages to more than 60% in a gas-heated home, for example.

Nationally, nearly every household (99.8%) had at least one refrigerator (1,239 kWh/year), more than 86% had a microwave oven (209 kWh/year), 56% had an electric range, 53% had a dishwasher, 45% had an electric oven, and 32% had a separate freezer (1,039 kWh/year). Most rural households have the normal American complement of appliances, although they tend to have a higher percentage of freezers.

*Electronics and Computers*

According to EIA 2001, nearly every American household (99%) has at least one color TV; the household average is 2.3. Each unit uses about 137 kWh for a total annual household electricity consumption for TVs of about 315 kWh. Rural families are more likely than their urban and suburban counterparts to have satellite dishes for their TVs, each of which consumes an average of 130 kWh/year.

Residents of the rural Southwest are becoming increasingly dependent on computers, and most rural homes presumably have at least one computer. EIA reports that in 2001, half of American households had at least one desktop computer, which used 262 kWh/year. About 13% of households had laptop computers that used about 77 kWh. Desktop printers create relatively insignificant electrical loads when operated (they may use more than that over their lifetime while in “standby” mode), but the EIA 2001 data demonstrate that printers without fax and copying capability use far less electricity—45 kWh annually—than printers with those functions, which use an average of 216 kWh.

The standby losses of modern electronics constitute a significant amount of wasted energy, because functions like “instant on,” remote control, and memory are powered whether the device is on or off. Although the power savings are only a few watts per unit, the number of units is large—about 260 million TVs, 120 million VCRs, and 10 million TV/VCR combination units in U.S. homes, for example. In addition, 41% of U.S. homes had DVD players as of 2003, and many more do today. On average, standby power consumes around 10% of household electricity use, or around 1,000 kWh per year. This is more electricity than is consumed by a typical new refrigerator!

*Lighting*

According to DOE, indoor and outdoor residential lighting consume an average of 1,950 kWh/household. Rural residents are likely to have larger security lighting systems, which we estimate adds another 500 to 1,000 kWh/household/year.

*Water Well Pumps*

Except for those living in towns with water systems, most rural residents use pumps to extract domestic water from wells or storage tanks. In 2001, the average residential water well pump used about 400 kWh.
**Per-Household Electricity Use in Selected Southwest States**

To arrive at these numbers, we used information from EIA to combine the number of residential consumers served by co-ops with the number of consumers served by municipal utilities with fewer than 10,000 customers. Table 3 shows the number of rural dwellings in each state served by co-ops and small munis in 2005.

<table>
<thead>
<tr>
<th>State</th>
<th>Rural Homes (x 000)</th>
<th>Avg. kWh (x 000)</th>
<th>Total kWh (x 000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>170</td>
<td>9.7</td>
<td>1,570</td>
</tr>
<tr>
<td>Colorado</td>
<td>524</td>
<td>8.8</td>
<td>5,053</td>
</tr>
<tr>
<td>Nevada</td>
<td>49</td>
<td>13.5</td>
<td>672</td>
</tr>
<tr>
<td>New Mexico</td>
<td>192</td>
<td>6.3</td>
<td>1,270</td>
</tr>
<tr>
<td>Utah</td>
<td>119</td>
<td>9.2</td>
<td>1,049</td>
</tr>
<tr>
<td>Wyoming</td>
<td>89</td>
<td>9.7</td>
<td>1,042</td>
</tr>
</tbody>
</table>

**Commercial**

In farming communities, much of commercial energy use is agriculture-related. Because co-ops are not consistent about the way they report end-use data, some farming energy use is included in other categories, such as the farmhouse data noted above, and the reliability of end-use data varies from one co-op to another. In some service territories, commercial meters may number only 10% of the count, but their consumption and contribution to peak can account for most sales.

Electricity use on the farm may be large, in aggregate, but is dwarfed by the use of other energy sources for production, much of it as liquid fuels and just as much as that embodied in the “inputs” farmers use to produce good crops. Figure 5 shows the split of energy use on the farm.

**Commercial Buildings**

In Highline’s service area, the 32 churches, schools, and other community buildings used nearly 20,000 kWh/meter of electricity in 2006 for lighting, equipment, and other electrical loads.

**Other Commercial Loads**

In rural areas, small commercial loads are remarkably similar to those in urban and suburban areas, and include lighting, air conditioning, and refrigeration. Commercial enterprises include grocery stores, welding shops, and auto repair businesses. In Highline’s service area, the 914 small commercial customers used nearly 147 million kWh in 2006, or about 16,000 kWh/meter/year.
Industrial
Water Pumping
Water pumping is the major energy end use in rural areas with economies dominated by irrigated farming (see Figure 6). In Highline’s service area, customers consumed 237 million kWh for irrigation pumping, broken down by installation in Table 4. Electricity for irrigation pumping, which occurs only during the growing season, uses far more electricity than for all other annual uses combined. Pumps are often in the 75- to 150-hp size, and in many areas the concentration of pumps powered by electricity is growing because of the continued volatility of natural gas and diesel prices.

The impact of well pumping is even more dramatic on-peak. Consider that in Highline’s service area the summer peak, driven by irrigation pumping, is 185 MW; in the winter it is only 25 MW.31

Table 4: Highline’s Electricity Consumption for Irrigation Pumping, 200632

<table>
<thead>
<tr>
<th>Type of Installation</th>
<th># of Accounts</th>
<th>kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center Pivot Sprinkler</td>
<td>98</td>
<td>264,820</td>
</tr>
<tr>
<td>Open Ditch</td>
<td>436</td>
<td>11,250,232</td>
</tr>
<tr>
<td>Sprinkler</td>
<td>2,420</td>
<td>225,448,256</td>
</tr>
<tr>
<td>Tail Water Pit</td>
<td>79</td>
<td>308,134</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,033</strong></td>
<td><strong>237,271,442</strong></td>
</tr>
</tbody>
</table>
Stock pumps represent a more consistent year-round load. Among Highline’s customers, 1,229 stock pumps consumed 1.5 million kWh in 2006, for an average of 1,264 kWh/unit. In Highline’s service territory, customers also use about 139,015 kWh (distributed among 51 meters) to augment irrigation by pumping water in the non-irrigation months to cover river depletions. Of course, recent water court rulings may change the way electric energy is used in these areas.

Sewage Treatment
Community energy use is also similar to that in urban and suburban areas, where large consumption is attributed to street lighting (in some towns) and treatment of water and sewage (nearly everywhere). For example, one sewage treatment plant in Highline’s service area consumed more than 3 million kWh in 2006. To better understand the scope of total rural energy use for water in the Southwest, consider that 6.5% of California’s total energy consumption in the state is used to treat or transport water or wastewater.33

Oil Pumping
Many customers in Highline’s service area use electricity to pump crude oil from the ground, and to pump it through collector systems into and out of storage. Some 185 consumers who require a 50 kilovolt-ampere (kVA) or smaller transformer, used about 2.8 million, or about 15,000 kWh per meter in 2006. Highline’s seven larger oil-pumping customers, with services greater than 50 kVA, used nearly 2.4 million kWh, or about 340,000 kWh per meter. The six largest customers, who receive a 10% discount for using primary metering, used almost 4 million kWh or nearly 700,000 kWh each. (Primary metering measures current at the voltage used in the local distribution system, which can be several thousand volts, rather than the voltage usually used by pumps and other equipment, usually 120 or 240 volts. The customer is responsible for step-down transformation in exchange for what amounts to a quantity discount.)
Gas Compression
Natural gas production and transport are commonplace and growing activities in rural areas in the Southwest. A single gas compression site in Highline’s service area used nearly 39 million kWh in 2006, and was expected to use 70 million kWh in 2007. In other co-op service areas, too, natural gas compression is becoming a major load, as fossil fuel exploration and production in the Mountain states swings into high gear. It is adding regular, reliable revenue to the balance sheets of many rural utilities that are otherwise seeing overall declines in electricity consumption, but is creating significant load growth that must be met.

Other Large Energy Loads
In agriculture-based rural economies, other large energy loads currently include grain elevators and concentrated animal feeding operations (CAFOs). The former feature intermittent demand peaks for grain handling; the latter use large amounts of power year-round for ventilation fans. In Highline’s service area, these large customers used a total of nearly 31 million kWh, or about 188,000 kWh per customer in 2006.

The growth in regional processing of biofuels is a new and growing source of energy demand in rural areas. For example, ethanol fermenters and distilleries, biomass conversion plants, and biodiesel reactors, and their associated feedstock preprocessing operations, are already having an impact on electricity demand in some areas.

Future Trends in Rural Energy End Use
One likely future for rural areas in the Southwest is a gradual change toward a hotter, drier climate, which will have an impact not only on the crops and livestock that will thrive, but on the costs for maintaining humans in relative thermal comfort. Figure 7 graphically represents the warm weather we experienced between 2000 and 2006, compared with the 50-year rolling average. Figure 8 shows what the climate experts believe is rolling our way, and for the Southwest, it looks like more heat and less rain.
While major new appliances have greatly reduced energy consumption compared to the ones they are replacing, a more important demand component is now being addressed. Appliances like refrigerators, dryers, air conditioners, and dishwashers are being developed that can easily be demand controlled in a way that is relatively transparent to the end user. They will take their place with electric storage water heaters as a major opportunity for demand response and load management in rural areas.

The uptake of new types and larger sizes of televisions could have an effect on aggregate energy use, as they use as much as 5 times the power of conventional TVs. On the other hand, there is a wide range of power consumption across TVs of the same type or size, yielding significant potential to reduce electricity use through labeling and minimum efficiency standards. Also, LCD type screens tend to use less power than plasma screens and are growing in popularity.

Electric water heating has gained market share from natural gas because of a combination of fossil fuel price increases and volatility, and the easier installation of an electric heater, which requires no flue penetration of the structure and roof membrane. Electric water heating now accounts for more than 50% of storage water heaters installed in the United States each year.

In some areas of the High Plains of Colorado and New Mexico, irrigation pumping is likely to be curtailed in the mid-term (5 to 10 years), as aquifers are depleted and adverse court rulings shut down the pumps. This energy-related development will significantly affect the viability of the existing rural way of life on the High Plains.

According to Geller, households in the Southwest are migrating away from evaporative cooling to much more electricity-intensive compressor-based air conditioning. Given the rapidly growing peaks in the Southwest, compared to the somewhat slower growing consumption figures, this is a troubling trend.  

With the better understanding of the shallow, mid-temperature geothermal resource, we will certainly see more use of ground and water temperatures for heating and cooling of residential and commercial spaces, but also for tempering agricultural processes like dairy cooling and pasteurization.

Two technology-related changes are likely for rural electricity distribution systems:

- **Renewables** - The largest change likely for the windy states of Wyoming, Colorado and New Mexico will be the rapid build-out of wind turbines over the next 10-20 years, at all scales. This new source of electrical power, often added at the end of the distribution network, will cause large shifts in the use of existing power resources and controls. Also, the excellent solar resource throughout the region will yield an extensive array of central station and distributed solar panels, which will impact utility’s peaks as much as their consumption. And revenue-offset requirements will bring forward the widespread promotion by utilities of geothermal heating and cooling; the advantage of 3-5 times the heat delivered per
kilowatt-hour compared to resistance heating will make it competitive against other heating fuels.

- **V2G** – The other, and perhaps larger, technology-related change will be the broad market introduction in the next few years of plug-in hybrid vehicles. While it may take a while for these electric-powered cars to gain a market share in rural areas, they have a great potential to improve grid reliability and capacity when used in vehicle-to-grid (V2G) mode during peak demand periods, and to increase load factors when used in the recharge mode at night. Night recharge will also make intermittent wind resources more valuable, as these resources peak in many high-quality wind power locations in Wyoming, Colorado, and New Mexico at night, just when the new hybrid or electric vehicles are being recharged. Years in the making, these developments are yet important to consider in light of decisions on electric generation assets that will be in service for decades.

The largest policy-related change will be the evolving role of energy in a carbon-constrained world. Certainly, rural areas will see the largest growth over the next 20 years in alternative “crops” of clean energy-producing hardware, just because that’s where the land is to plant them. Less likely, but a distinct possibility, is that these areas also will see the broad sequestration of carbon (possibly produced as a co-product with synthesis gas from pyrolysis of forest slash) in open fields. One vision is of bio-char granules sowed annually with the seed as a second form of cash crop.

The largest program-related change in the energy picture will be the rapid growth of companies, including utilities, offering energy-cost reductions with Conservation, Efficiency, and Demand Response (CEDR).

**Focus on Existing Buildings**

As noted previously, buildings have constituted until recently the most significant consistent electric loads in many rural places. Even with the mushrooming growth of extraction electrical loads in many parts of the West, buildings are a logical target because they will be there long after the extraction loads are gone, and because they are the main point of contact between the large majority of utility end-use customers and their utility provider.

This report focuses on existing rather than new buildings because

- Many energy codes are related to new construction, so a focus on new buildings would be duplicative and would dilute the contribution of this report.

- New construction in rural areas is unlikely to add more than 20% of the load in 20 years, so addressing existing buildings that will account for no less than 80% of the load makes the most sense. This is especially so considering that SWEEP believes energy savings aggregating Conservation and Efficiency can be achieved for 2 cents to 5 cents/kWh in rural homes.
• Rural homes now comprise the largest identifiable group (14 million) of unaudited, non-retrofit buildings in the country, and as such represent the best opportunity to save significant energy in America’s residential building stock.

In the next section we discuss the practices and products that can achieve cost-effective energy savings in buildings and other rural end-uses.

Notes for Part 1:
12 Derived from overview.pdf, obtained from Mark Farnsworth, General Manager, Highline Electric Association, April, 2007. NRECA 2007 data.
13 Personal communication with Mark McGahey, Tri-State Generation and Transmission Association, Inc., April 2007. Said natural gas prices have spiked as high as $26/MMBtu, and are now mostly in the $8-9/MMBtu range.
16 In personal communication during January, 2008, Rob DeSoto suggested we point out that such gas-fired heating systems will, of course, benefit from increases in their efficiency (cleaning and tuning existing units), replacement with high efficiency combustion equipment, and paying more attention to controls (automatic thermostat, on-off fan settings, etc.).
19 Estimate by SWEEP, August 2007.
23 Personal communication with Dennis Criswell, VP Marketing and Strategic Ventures, Arizona Electric Power Cooperative (AEPCO), 5.07.
25 Personal communication with Howard Geller, SWEEP; November 2007.
26 More recent Mountain States energy end-use estimates from EIA have been delayed until “early 2008,” per EIA September 2007.

29. Derived from EIA data: [www.eia.doe.gov/cneaf/electricity/erl/erl_sum.html](http://www.eia.doe.gov/cneaf/electricity/erl/erl_sum.html).


32. Ibid.


34. Personal communication with Dennis Herman, Highline Electric Association, May 2007.


36. Ibid

Part 2: Electricity Energy-Saving Practices and Measures

Improving EE and using energy more wisely are strategies that work on nearly every level imaginable. An energy-efficient building is more comfortable for occupants and less expensive for owners to operate. Energy-efficient tools and equipment do the same work as standard tools and equipment, but cost less to operate. Communities benefit when EE programs stimulate economic development (new jobs, new capital investment, and better lives) and keep money circulating locally. Businesses that improve the energy efficiency of their operations also improve their bottom lines. Utilities that adopt demand-side management (DSM) programs benefit through reduced peak loads and by postponing—or even eliminating—capital expenditures for generation, transmission, and distribution system expansions and upgrades.

The list continues, but improving EE and conserving energy are almost always less expensive than producing, transmitting, and distributing energy by any means. As noted earlier, typically less than one-third of the energy in the fuel used to produce electricity reaches the end user, so savings at the end of the line multiply themselves to triple those savings at the point of power plant input.

Most of the technologies discussed in this report for saving energy in buildings are not new. The great majority have been in use for decades, and are mature, well understood, and readily available in the marketplace. Other technologies, such as compact fluorescent lamps, are now less costly and perform much better than models available even 5 or 10 years ago. In addition, many strategies discussed in the report are not technologies, but practices (i.e., different, lower-energy, ways of accomplishing the same objectives, or maintaining the same level of safety or comfort). All the technologies and actions described here are proven, off-the-shelf ways to reduce energy use cost effectively. This aspect is important in rural areas where service and trouble-shooting assistance for newer, riskier technologies are less available.

Rural Residential and Farm

The opportunities for EE and EC in rural dwellings are similar to those in urban and suburban homes. To be clear, EE involves receiving the same level of services with less energy, usually by operating the system in a better way. This can require an initial capital outlay, but will often pay back that outlay quickly in reduced energy costs. EC, on the other hand, can require some behavioral changes—putting on a sweater rather than turning up the heat, for example—but it does not require dramatic lifestyle changes.

Everyone can do something simple right now that will save energy and money in their homes or businesses. Small shifts in behavior and investments in low-cost EE improvements can make a big difference in energy use, typically saving as much as 10% to 20% of the energy bill in a home or on a farm.

It’s a good news/bad news story — the bigger the waste, the bigger the savings. Most homes and farms in the United States waste so much energy that there are plenty of energy- and money-saving opportunities. But implementing EE improvements, that is, putting investment-grade
measures to work, offers a handsome return on investment, as Figure 10 illustrates:

![Figure 10: The Return on Investment of Various Efficiency Measures](image)

**Strategies for Rural Residential**

**Low-Cost/No-Cost Strategies**

**Information/Education/Training** – Educating residents results in measurable energy savings. Through awareness and cooperation, a building’s residents (and managers in multifamily housing) can reduce their energy use by at least 4% to 5%. Energy can be saved, at little or no cost, just by consumers knowing what to do and how to do it; they will often then do it themselves. The key to program cost-effectiveness, of course, is convincing end-users to avail themselves of the information/education/training programs that are offered.

**Tracking** – Energy end-users that track monthly energy costs will know precisely how much energy they are using, and can use this information to identify potential problems or ways to improve efficiency. When a household or business tracks energy costs, there are two other benefits:

- Errors in utility billings can be more easily identified and corrected.
- Malfunctions in key equipment such as air-conditioning or refrigeration equipment are more obvious sooner, allowing timely remedial action.
Weatherization – Winter heat loss and summer heat gain have different causes and require different fixes. For instance, because warmer air rises, a form of “chimney effect” draws warmer air out through leakage sites higher in the structure during the winter, and draws cold outside air in through lower leakage site, creating uncomfortable cold drafts on the floor even when there is no cold breeze blowing. This calls for sealing the thermal envelope.

Weatherization techniques (e.g., sealing air leaks in a building) reduce energy use—often dramatically—and simultaneously lower utility bills and improve comfort. For homes heated with electricity or propane, improving the energy efficiency of the thermal envelope even modestly—say 20%—would result in a dollar savings of $200 to $400 annually, and be much less expensive on a first-cost basis than buying a new heating system.41

To avoid the need for reapplication, good quality, long-life caulks and sealants should be used to seal air leaks in the building shell and to seal air-handling ducts. Fireplace dampers can be sealed so they do not leak when they are not in use. Leaky ducts waste energy by leaking conditioned air and by creating pressure imbalances that increase air leakage. Where the ducts are accessible in a basement, garage, attic or crawl-space, homeowners can apply new long-life mastic materials (not duct tape, which does not provide a long-life seal) to the joints to correct the problem.

Temperature maintenance – To save energy and money, owners can set back the temperature when a home or other building is unoccupied at night or in the winter, and set up the temperature when it is unoccupied in the summer. Turning off heating and cooling in rooms or sections of the house that are unused can result in major savings with no loss of comfort. Energy also can be saved simply by closing the blinds to keep the sun out on hot summer afternoons, and opening them to let the sun in on sunny winter days. Waterbeds should be insulated with rigid foam underneath and bed coverings and comforters on top to help reduce the amount of energy required to maintain their temperature.

Water heating – Installing low-flow plumbing fixtures or flow restrictors on fixtures saves energy and water (another precious resource in the Southwest) by reducing hot water use. Well-performing showerheads are now available with rated flow rates of 1.5 to 2.0 gallons per minute (rated at 80 psi water pressure).42 The savings in pumping power from wells on remote properties increases the energy cost payoff. Insulating older water heaters, and draining tank sediment annually, have been recommended for years to help save energy. Water heaters should not be set higher than 120°F. Most common uses do not require higher temperatures, and a 10°F reduction can save up to 5% on water heating costs. This saves the extra energy constantly lost from a hotter storage tank and reduces the likelihood of scalding.

Appliance operations – Appliances should be operated using the energy saving settings, if they have them. Dishwashers and clothes washing machines are more energy efficient when they are operated with full loads, and using cold or warm (not hot) water increases the energy savings.

In the refrigerator and freezer, moist food and all drinks should be well sealed to avoid adding moisture to the internal environment (which requires defrosting when it condenses on cold
Door gaskets and coils should be kept clean. Old refrigerators or freezers kept in the basement or garage drag on power and should be unplugged and removed if they are underused. A good exercise is to consider how much cold beer could be bought for the $10 to $15 a month it costs to keep it cold in the garage beer refrigerator!

Using a clothesline rather than an electric dryer saves about 1,000 kilowatt-hours (kWh) of electricity and roughly $100/year, compared with drying two loads of laundry per week in an electric dryer. Clothes will have a fresh scent and last longer. An indoor clothesline can be used during the winter that will add welcome humidity to indoor air.

Lighting – An immediate energy saving can be achieved by replacing the most frequently used standard light bulbs in the house with CFLs, even before the old bulbs burn out. The electricity savings dwarf the cost difference between the old and new types of bulbs, and the effective cost of CFLs is dropping so quickly that there will soon be no differential at all. Replacing a 100-W incandescent bulb with a 23 to 26-W CFL can save nearly $60 over the life of the bulb, based on an 8,000-hour bulb lifetime, burning three hours every day at a utility rate of $0.10/kWh. CFLs are available widely in bulk packs at $3 or less (often $1 or less during promotions) per lamp and will pay for themselves in energy savings in less than a year. In addition, the cost and hassle of replacing burned-out light bulbs is greatly reduced as CFLs last 5 to 10 times longer than ordinary incandescent bulbs.

Standby power waste – Standby power is the electricity drawn by an electronic device such as a TV, DVD player, video game console, PC, or printer, even when the device is turned off. The standby power draw of all electronic devices in today’s homes can exceed 100 Watts, meaning the equivalent of a 100-W light bulb (or greater) wasting power round the clock. The combination of awareness and good habits will make a big difference in reducing standby power waste. Setting PCs, monitors, and copiers to “sleep” mode when not in use can reduce energy costs up to 50%. But the best way to cut standby power is to unplug electronic devices when not in use. Putting most or all electronic equipment on a power strip that can be easily turned off at night or when traveling simplifies the task. Battery chargers similarly should be unplugged when not in use. This is the modern equivalent of turning off the lights after leaving a room (also a good habit to adopt).

Investment-Grade Opportunities (for which many types of rebates are offered by rural utilities)

Appliances – ENERGY STAR® -labeled appliances should be purchased whenever a new appliance is needed. ENERGY STAR is a federal program that enables consumers to easily identify more efficient appliances and products in many categories (see www.energystar.gov for a list). When rebates are high enough, it will pay to retire an appliance before the end of its useful life, saving energy and improving performance at the same time.

Lighting - In garages, barns, and other outbuildings, CFLs and energy-efficient T-8 fluorescent lamps and electronic ballasts can replace incandescent or old fluorescent lighting. Timers and motion detectors can greatly reduce electricity use by controlling outdoor and farm building lights.

Traditional decorative holiday displays can be a tremendous seasonal energy drain. A good
practice is to replace the lights with the new LED lights, which use about 10% of the energy and last much longer than the miniature incandescent bulbs. Common sense suggests the use of an automatic timer to shut off the holiday lights late at night and during daylight hours.

Insulation and ventilation – These measures apply to all the buildings that have comfort conditioning, not just the house. First, consider how trees and bushes can protect the building from the highest wind velocities in winter, and channel cooling breezes to the building in the summer. According to Smucker, a good evergreen windbreak will reduce wind velocity at the house by as much as 50%, which can translate to a heating energy reduction of 20% to 40% -- not bad for a feature that adds other value to the property, and hosts wildlife.45

Storm windows, storm doors, and replacement windows are often not very cost-effective. The problem is not with their energy-saving effectiveness, but with their cost compared to the amount of energy they will save. A better bet is to try one of the low-cost ways of reducing heat loss through a window (for example, by installing plastic films that create a dead air space) to achieve equivalent comfort and better cost-effectiveness. However, windows that are in very poor shape and aesthetically displeasing may need to be replaced with high-efficiency windows.

Insulation should be added to ceilings and walls where appropriate, with care given to sealing around openings in the building shell. Some forms of blown-in insulation such as cellulose reduce air leakage and increases insulation values, being densely packed. Air flowing through and around insulation can degrade its thermal resistance; densely packed, blown-in insulation can reduce air leakage and increase thermal resistance. This suggests a strategy of blowing in dense insulation wherever it is practicable and stopping other air leaks with caulking and weatherstripping.

Regular cleaning or replacing filters in the furnace, air-conditioner, and heat pump will ensure the easy delivery of air through the system, creating better air handling performance and reducing the load on the motor.

Much of summer heat gain comes through the roof or attic, creating hot ceilings that radiate discomfort during hot summer afternoons and evenings. The solution in this case is better attic insulation, and possibly natural or powered attic ventilation. Installing radiant barriers in attics in hot climates is another potentially effective option.

When planning a remodeling or renovation project, homeowners should consider adding thermal mass inside the insulated building shell to take advantage of daily air temperature swings. Adding an extra layer of drywall or building indoor concrete, masonry, adobe, stone, or water walls can help stabilize diurnal variations within the conditioned zone.46 Combined with properly sized overhangs that allow the sun to shine on floors and other thermal mass in the cold winter months but block solar gain in warmer months, thermal mass can increase comfort and reduce the cost of heating and cooling a building. For remote areas with less reliable electric service, such thermal moderating performance also can provide life-safety value in winter, especially in conjunction with a sealed-combustion wood or pellet stove.
**Heating and cooling equipment** – We advise completing other changes in the energy use of the residential or commercial building (meaning CE and EE improvements) before installing new heating or cooling equipment. This “staging” of energy-saving upgrades allows the equipment to be sized closer to the new requirements, improving comfort and system efficiency often at a lower cost for units with a smaller heating or cooling capacity.

**Evaporative coolers** – In areas with cooling loads, low humidity, and large diurnal temperature swings—in other words, much of the Southwest—modern evaporative cooling systems can provide comfort at considerable energy and dollar savings. These cooling systems can use 80% to 90% less electricity for cooling compared to standard compressor-based air conditioning systems. They can be placed on the side of a house or on the ground, they require less maintenance, and they are less water intensive than the older evaporative coolers. Depending on the cooling load and other factors, new evaporative coolers can save $100 to $500/year on cooling costs compared with conventional air conditioning.

For co-ops and other electricity providers with cooling-driven peak demand, there is a huge potential for peak energy savings when members switch from compressor-based air-conditioning units to modern evaporative cooling units. Whereas replacing an older air-conditioning system with a new ENERGY STAR system results in a 14% annual energy saving (about $36 annually), replacing that system with a modern evaporative cooler could save $180 or more every year.

One caveat about evaporative cooling is that in areas prone to summer “monsoons,” these units have been less successful. Because evaporative coolers are most effective when the humidity is lower than 50%, homes with evaporative cooling can become uncomfortable during the infrequent periods when temperatures and humidity are high after a summer rainstorm. In such climates, a combination of an energy-efficient evaporative cooler used during drier periods and a central air-conditioning unit for wetter days may make sense.

One field performance practice that is achieving traction in the form of increased sales, and which may be particularly suited to the rural Southwest, is whole-house contracting. According to Thomas, it “can greatly reduce energy use in existing homes.” He says that savings of 20% to 30% are typically achievable, “with savings of up to 40%-50% of total energy use possible with some degree of regularity.” Whole-house contracting typically involves an energy audit, then installation of an entire suite of energy-saving measures, intended to provide the synergistic benefits of mutually reinforcing performance. According to Knight, it often consists of the following measures:

- Air sealing
- Insulation
- Crawl space isolation
- High-e heating
- High-e cooling
- Sealed/upgraded ducting
• Improved filtration/air distribution
• Major appliance replacement
• Hot water delivery improvements

In addition to the energy savings, it provides the following non-energy benefits (NEBs):

• Increased comfort
• Less noise
• Better health
• Increased safety
• Improved home and equipment durability
• Sense of environmental citizenry
• First-on-the-block status
• Better value-holding of home
• Overall peace of mind

**Rural Commercial**

The “Main Street” commercial electricity end uses in rural areas of the Southwest are similar to businesses in any other small town or suburban shopping area, with the same opportunities for EE and EC. With business energy use, as with residential, the bigger the waste, the bigger the savings, so the commercial buildings and businesses that are the least energy efficient will experience the most dramatic savings and the fastest paybacks.

In a perfect world, all commercial facilities would have thoughtfully integrated systems that worked together efficiently and seamlessly. In the real world, business and building managers have to retrofit buildings, which have often been designed for other uses, with off-the-shelf components. EE often is not even on their “top 10” list of priorities, but it should be because, as an expense reducer, energy savings can go directly to the bottom line of Profit on an accounting spreadsheet. And when those savings are achieved at little or no cost, the return on investment is very high.

Business owners and managers are often risk-averse and unaware of the financial and operational benefits of improving EE. EE projects must compete with other capital project proposals, but because they offer an excellent return on investment—EE investments can reduce energy costs by 20% to 40%—they can often be sold on the basis of economics alone.53

Like their urban and suburban counterparts, rural businesses are typically subject to utility demand billing. Because the difference between regular rates and demand rates can be substantial, demand billing supplies a further incentive to save energy, particularly during the building’s (or local utility’s, depending on service territory) periods of peak demand. A discussion with the utility’s customer service representative will reveal whether a particular utility offers incentives to customers who shift their power use to off-peak times, as many do.
**Money Talks**

Although EC/EE upgrades offer many benefits, from improved occupant comfort to increased retail sales to reduced environmental impact, the most compelling benefit for most business owners and managers is the improvement in their bottom line. When discussing the benefits of saving energy, thinking and talking in terms of dollars (rather than kilowatt-hours) is useful. Improving EE reduces operating costs, which increases net operating income. Besides increasing income and profit, it is important for calculating the long-term financial health of a company, because for many companies net operating income is used to calculate asset value. In this case, asset values increase by as much as $3 for every $1 invested in EE. This parallels the often-cited figures used by National Association of Realtors that show a $20 increase in the value of a home for every $1 reduction in the utility bill.

In addition to improving EE, energy upgrades can increase productivity in work areas. Increasing EE usually improves lighting as well as heating, ventilating, and air-conditioning (HVAC) performance. Studies have shown that energy-efficient HVAC systems and improved lighting enhance employee productivity and reduce absenteeism in offices, factories, and schools. Because payrolls typically constitute a large percentage of the total expenses of any business, small increases in productivity can result in significant increases in the organization’s bottom line.

Better lighting and daylighting can even increase sales in retail environments. A study by the California Energy Commission linked daylighting to higher retail sales—as much as 40% higher—compared to stores with conventional lighting.

Energy expenditures directly affect the financial health of businesses and indirectly affect the economic health of the local community. Dollars spent on EC/EE stimulate more local economic activity and create more local jobs than dollars spent on energy bills, many of which leave the area and possibly the state to pay for distant mining, transportation, and generation. This is because most of the payments for EC/EE measures go to people who live and do business in the local community, but a large portion of payments for electric energy bills is for distant-generated power or imported fuel costs, and they leave the local economy without generating further economic activity. In contrast, most of the money saved by a consumer after an EC/EE project is implemented stays in the local economy, and is spent supporting even more jobs. Economists refer to this phenomenon as the “economic multiplier” effect, and it varies from as low as 4.1X for every dollar paid to a farmer for corn to 7.0X for fillets of farm-raised catfish, clearly depending on how much local content and labor are included in the added value of the product. This encourages the development of local capabilities for stocking and delivering the EC/EE products and services.

As an eye-opening regional example of the economic magnitude of the effect of energy costs, consider that the annual end-use energy bill for Colorado alone is about $10 billion, and that about $8 billion of that cost leaves Colorado each year in payment for imported oil, gas, coal, and electricity. In a typical year, that outflow may be about equal to the entire farm gate income for Colorado. To the extent that less money is sent out of any state because residents use energy more wisely, that amount of money will increase the standard of living of state residents.
Strategies for Rural Commercial Buildings

Low-Cost/No-Cost Strategies

Most experts agree that embarking on an energy-saving mission at your place of business should be more than a solo effort. Successful energy-efficiency case studies stress the importance of a strong advocate or group of advocates in the organization. The more buy-in a company gets from its members, the more savings it’s likely to realize from the energy-efficiency effort, and the longer those savings are likely to persist.

Many of the savings previously discussed for residential buildings will apply to most small commercial buildings, too. These are not repeated here, but note the additional opportunities, based on the following 2004 energy use profile by EIA:

<table>
<thead>
<tr>
<th>Service</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooling</td>
<td>26%</td>
</tr>
<tr>
<td>Lighting</td>
<td>23%</td>
</tr>
<tr>
<td>Equipment</td>
<td>18%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>7%</td>
</tr>
<tr>
<td>Heating</td>
<td>8%</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>9%</td>
</tr>
<tr>
<td>Other</td>
<td>9%</td>
</tr>
</tbody>
</table>

Many businesses still use the old T12 fluorescent lighting systems. In virtually every case an energy advisor will suggest their replacement with T8 or T10 systems, all of which now are installed with higher performance, lower energy, electronic ballasts.

Electrical signage can be a good opportunity for immediate savings. The common neon “open” sign that uses 200 W can be replaced with an LED “open” sign that uses less than 100 W. Thirty dollars of savings each year will go directly to the bottom line, profit, for each sign replaced.

Storage rooms, warehouses, and unoccupied areas that do not require full-time heating and cooling can waste a lot of energy. Unused areas should be sealed off, and heating and cooling in these spaces reduced or eliminated. A good practice is to keep exterior doors closed and use shades, curtains, and other window coverings to reduce energy use.

Energy savings are a good reason to perform routine and regular maintenance on mechanical equipment and building systems. Well-maintained equipment runs much more efficiently, reducing operating costs and extending its life, in addition to saving money on energy. This means regularly inspecting and patching leaks, cleaning or replacing air filters, checking fan belts, lubricating motors, pumps, and fans, cleaning condenser coils of air conditioners and refrigeration units, and making sure refrigeration seals are airtight and the refrigeration charge is correct.

Motion sensors can reduce lighting costs up to 80% in areas where lights are habitually left on all the time, and those habits apparently cannot be changed. Similar savings can be achieved by installing motion sensors in conference rooms, closets, restrooms, and break rooms.
Although water heaters generally do not need to be set higher than 120°F, local codes and regulations may require businesses involved in food service or sales and medical facilities to maintain higher temperatures. Low-flow showerheads should be installed in guest rooms in the hospitality sector, and other places (e.g., many truck stops) where showers are used.

Employees should be encouraged to turn off or program office equipment to power down when not in use. Turning off just one computer and monitor nightly and on weekends, for example, can save a small business up to $80 a year. Setting PCs, monitors, and copiers to “sleep” mode when not in use can reduce energy costs up to 50%. If most or all of the electronic equipment is on a power strip, it can be easily turned off at night, thereby cutting standby power waste.

Managers who track monthly energy costs will find it easier to identify potential problems or ways to improve efficiency. With the precise knowledge of how much energy is being used, it is much easier to manage effectively.

Investment-Grade Opportunities

Again, many of the more substantial energy-saving opportunities initially discussed for the residential sector are not repeated here. But there are additional areas of good savings potential.

Energy-efficient equipment is a smart investment when upgrading or replacing equipment. ENERGY STAR products meet federal specifications for EE and often cost no more than other models, but can reduce equipment-related annual energy expenses by 30%. Many types of commercial products have ENERGY STAR labels.

Better control of heating and air conditioning with programmable thermostats can save up to 20% of heating and cooling costs. Where a boiler system also supplies domestic hot water to a commercial building, installing a separate water heater and shutting down the boiler in the summer will save energy. Low-flow showerheads, rinse nozzles for cleanup, and aerators on faucets reduce hot water consumption, and insulating hot water tanks and pipes that run through unheated areas further reduces water heating expense.

With demand charges more often associated with commercial power billing, it is even more important to replace incandescent bulbs with CFLs. CFLs create less heat (which can reduce cooling energy consumption and related kilowatt-hour costs, as well as peak kilowatt-hour costs), use up to 80% less energy, and last about 10 times longer than incandescent bulbs.

With the discussion of demand charges, regional peaks (e.g., 1000 seasonal hours) and super-peaks (e.g., 100 seasonal hours), and the possibility of rates that would reflect current (and preventative) values of energy use offset need to be acknowledged. For example, peak pricing could be priced at 3 to 5 times off-peak, and super-peak pricing 6 to 10 times off-peak, with corresponding reductions in on-peak use so that the rate is neutral for current energy use patterns. This would encourage two things:

- The rigorous adherence to the schedule by a growing number of economy-minded end-users.
The private sector development of practices (e.g., secure night purging with mechanical ventilation\textsuperscript{61}) and products (e.g., retrofit double drywall) to help these innovative end users accomplish their goals. This is all advantageous to the system as a whole, increasing load factor and rate equity, reducing price volatility and emissions, improving reliability, and helping keep rates low for all customers in the service area.\textsuperscript{62}

Replacing fluorescent and incandescent lights in exit signs with LED fixtures will use 80\% to 95\% less energy and last 10 to 20 times longer. LED exit signs may cost about \$100 more than incandescent signs, but a typical exit sign will last 10 years or more, and the energy saved and reduced maintenance costs will pay back the investment in less than three years. Again, occupancy sensors are a boon for turning off lights in unoccupied spaces if manual turn-off is not reliable.

**Tailoring Savings to Specific Nonresidential End Uses**

Different businesses use energy differently and have different opportunities for saving money through EE. Because EC/EE strategies involve mature, well-understood technologies, businesses can adopt these strategies with confidence.

In rural small towns, many of the commercial energy end uses are similar to comparable businesses in urban and suburban settings. The line-up of Main Street businesses look alike, and the energy uses are similar. That means that substantial energy savings are also possible.

Consider this example of an 1800-ft\textsuperscript{2} small town shoe store. Energy use, divided by square feet, yielded an average of 1.9 W/ft\textsuperscript{2}. With retrofit of mainly the lighting and air sealing systems, and better energy use practices, energy use was reduced to 0.9 W/ft\textsuperscript{2}. With a saving of 52\%, and a cost of \$843, payback was less than 18 months. Such savings should be possible in many downtown storefronts in the rural Southwest.\textsuperscript{63}

In most rural towns, grocery stores, restaurants, schools, and hospitals are the most energy-intensive facilities, and typically offer excellent energy saving opportunities. Large agricultural energy consumers such as irrigation pumps, CAFO operations, and regional meat processors are also good candidates for savings through EC/EE.

**Schools and hospitals** – Where and when occupancy loads require that make-up air be introduced from the outside, cold winter air can be tempered during the day with transpired south-facing air pre-heaters (Figure 11 shows the pre-heaters installed on an overnight-package facility).

**Grocery and convenience stores** – In these stores, refrigeration loads dominate, consuming 38\% of the whopping 52 kWh/ft\textsuperscript{2}/yr of the electricity the average grocery store uses. Lights represent the next biggest load, with 23\% of the total, followed by heating (13\%), cooling (11\%), cooking (5\%), ventilation (4\%), water heating (2\%), and miscellaneous (4\%).\textsuperscript{64}
Most grocery stores have many opportunities to save money on energy, including installing high-efficiency lighting and upgrading HVAC equipment, high-efficiency refrigeration systems, and controls. By teaming with the local utility, one grocery upgraded its lighting and freezers, for an annual dollar saving of $48,000 on energy bills. The improvements had a 3-year payback period, and an unanticipated 15% up-tick in sales. A Whole Foods grocery store in Denver saved more than $1,300/month on its electricity bill by replacing incandescent bulbs with CFLs. That saving does not account for the reduced maintenance costs of CFLs, which can last 10 times longer than incandescent bulbs. Grocery stores also should consider installing high-efficiency refrigerators, freezers, and vending machines.

Restaurants – Restaurants have a different load profile, but still use a lot of energy—an average of 43 kWh/ft²/yr. Restaurant energy use is divided among cooking (21%), cooling (18%), refrigeration (16%), lighting (13%), heating and water heating (11% each), and ventilation and other loads (5% each). Among the efficiency measures specific to restaurants: “smart” exhaust hood controls, strip curtains for walk-in refrigerators, low-flow pre-rinse sprayers for cleaning dishes, and ENERGY STAR commercial refrigerators and freezers, fryers, and hot food cabinets.

Because they are big energy consumers, most restaurants can save big money through improved EC/EE. In the restaurant business, profit is typically only 3% to 9% of total revenue. Though owners point out that the energy bill is often about the same per month as the pastries bill, there’s a difference. You may not be able to run a restaurant without bread, but you can manage your energy use better, and money saved on those operating costs improves that margin directly. Because of this, though the energy bill is often as little as the bakery bill, saving even 20% on energy operating costs can increase profits as much as one-third. Many restaurants have also experienced other benefits after completing EC/EE improvements, such as improved worker productivity and increased repeat business.

Hospitality and tourism – Hotels and motels can greatly reduce energy costs by installing energy-efficient lighting, high-efficiency heating and cooling equipment, occupancy sensors in great rooms, low-flow showerheads, and other measures. Businesses that use neon lighting can consider replacing those fixtures with the LED equivalent. Even though vendors often provide neon advertising lighting to drinking establishments at no cost, the energy expense to the business is very high. Managers can tell their vendor representative that they would like to remove that energy drain from their power bill, but would be willing to replace the original promotional fixture with a low-energy version.

Commercial building management – Most rural communities have office buildings, though most in rural areas are smaller than 10,000 ft². The average office building in the United States consumes 16.5 kWh/ft²/yr. The largest energy users in commercial buildings are heating, cooling, and lighting, which each account for about 25% of total electricity use. Ventilation is next, accounting for 11% of total use. All other uses (water heating, cooking, refrigeration, and miscellaneous) use the balance.
Commercial building managers can choose from many cost-effective energy-saving measures that have paybacks of a few years or less.\textsuperscript{70} For example, replacing lighting systems with more efficient fixtures, lamps, and ballasts and controls can save more than 50\% of lighting energy use. The payback period for these improvements in commercial buildings is only about 2 years on average. A lighting retrofit offers the added bonus of reducing cooling loads, because more efficient lights produce less heat.

Another cost-effective energy-saving strategy in commercial buildings is to replace older HVAC equipment with more efficient units or improve the efficiency of older HVAC systems. Installing more efficient fans, chillers, and packaged air-conditioning equipment can reduce overall electricity consumption by 15\% to 20\% with a payback of 4 years or less on the incremental first cost. In parts of the region, including in Arizona, Nevada, and New Mexico, where cooling loads are high, these efficiencies translate into deep dollar savings.\textsuperscript{71} Businesses should also consider using evaporative cooling rather than mechanical cooling.

Testing and sealing air distribution ducts can save 9\% to 15\% of a commercial building’s total electricity consumption with an average payback period of about 3 years. Other building retrofits that are cost-effective include shading windows in the summer and installing an ENERGY STAR-rated “cool roof,” which will reduce heat gain to interior spaces in the summer.

Replacing inefficient office equipment such as computers, printers, copiers, and fax machines with new ENERGY STAR models can save money on energy by reducing the cost of operating these devices and cutting cooling loads by reducing the amount of heat they produce. An office building can cut its total electricity consumption by 15\% to 20\% by upgrading to more efficient office equipment and enabling energy-saving features such as sleep or automatic power-down modes when the device is not in use. This yields a simple payback of about 6 months.\textsuperscript{72}

**Natural gas compressors** – With the rapid growth in gas compressor loads, end users should be helped with the choice of premium-efficiency equipment. Because of the 24/7 schedule, even small percentage improvements in efficiency will pay for themselves within a relatively short time, and provide a profit bonus after that. The heat generated by these units can be captured and put to use, also, as described for Highline’s northeast Colorado service territory.\textsuperscript{73} One unfortunate consequence of the waste-heat generation sale is that it will reduce or eliminate the ability of any other renewable producer to use the “5\% all-requirements waiver” extended by Tri-State to its local cooperatives, and will partially satisfy Highline’s requirements to provide renewables power from the more common resources like solar or wind, also abundant in northeast Colorado.
According to Hedman, as many as 100 natural gas compressor stations in the United States could cost-effectively benefit from waste heat recovery projects, at today’s power prices and available technologies, representing as much as 600 megawatts of potentially new power generation capacity. Qualifying stations will have a capacity of at least 15,000 horsepower, and operate with an annual load factor of at least 60%. This report lists three technologies for capturing waste energy: 1) Waste heat recovery to power systems on pipeline compressor drives, which is being used at Ormat’s Highline site; 2) Turbo-expanders for pressure let-down recovery; and 3) Turbine inlet air cooling. At least one new station in northeast Colorado is rated at 35,000 horsepower, and with the extensive build-out of natural gas extraction, collection, distribution, and transmission now taking place in this region, many more such opportunities likely exist.

The Value of an Energy Audit

Although the air can be effectively sealed by carefully observing leakage sites, knowing precisely where to add insulation and seal air leaks can sometimes be key to a more successful energy retrofit, making investment in an energy audit worthwhile. (A directory of available energy audit services by state is available at <www.resnet.us/directory/raters.aspx>.) The energy auditor will identify the most cost-effective and practical improvements, and then estimate the likely energy savings from these improvements. With this information in hand, a homeowner, rancher, farmer, or business owner can make informed decisions about reducing energy use. Good energy auditors translate energy savings into dollar savings and help their customers compare projected savings with the cost of the retrofit. They can often save more money, beyond what would have been saved without them, than the cost of their service. Ideally, the cost of the audit should include a follow-up building performance evaluation to ensure that the improvements have had the desired effect. Embarking on an energy retrofit without this information can produce disappointing results. USDA’s Conservation Security Program offers $500 reimbursement for rural audits; a do-it-yourself home energy audit and other useful EC/EE information also are available on-line at <http://hes.lbl.gov/>.

In many ways the implementation of EC, EE, and DR practices and measures in a building works to the improved cost effectiveness of solar and wind generating technologies at the same site.

Rural Industrial

General Agriculture

Agriculture is by far the largest rural industry in the Southwest, and small agricultural operations greatly outnumber large ones. In California field trials by Global Energy Partners, interesting patterns of kilowatt-hour savings potential emerged:

- High-efficiency ventilation fans (25% of total consumption [kilowatt-hour] savings)
- CFL retrofits (22%)
- High-efficiency motors (6%)
- Variable-speed drives (7%)
- Tank insulation (2%)
Top-ranked kilowatt savings:

- CFL retrofits (27% of total demand [kilowatt] savings)
- High-efficiency ventilation fans (19%)
- High-efficiency motors (6%)
- Tank insulation (5%)
- High-efficiency refrigeration (2.5%)

According to Kingland, farm lighting conversions and retrofits could save up to 75% of the lighting load, and such an energy-saving retrofit also provides a good opportunity to replace deteriorated fixtures, controls and wiring.77

Irrigation Pumping

In areas dominated by irrigated farming, irrigation pumping is typically responsible for utility peak loads.78 In Colorado, electricity is the dominant energy source for irrigation. In 1998, electricity powered 85% of all on-farm irrigation pumps in Colorado. In that year, electricity also accounted for 84% of all acres irrigated by pumps and 87% of total energy costs for irrigation. Colorado farmers spent nearly $49 million on electricity for irrigation pumping in 1998, or an average of $13,500 per farm.79

The Colorado State University Cooperative Extension Service has confirmed that there are good opportunities for energy savings in irrigation pumping in the region. A fact sheet issued by the Extension Service states, “Field testing programs in Colorado, Wyoming, Nebraska and other states have shown that overall ‘wire-to-water’ plant efficiencies for electrically driven pumps average less than 50 percent, as compared to realistically achievable efficiency of 67 percent. This implies that 25 percent of the electrical energy used for pumping is wasted due to poor pumping plant efficiencies alone.”80

EXEMPLARY AG EFFICIENCY CASE STUDY #1
Focus on Energy – Wisconsin
“Agricultural and Rural Business Program”
(Funded by a System Benefits Charge [all customers])

Background - Begun in 2001, the program serves in 3 ways:
- Delivering direct EE services to end-use customers
- Exercising trade ally networks to offer EE equipment and services
- Linking with association and government EE programs

Focus - Began with dairy only, now includes livestock, greenhouse, irrigation and storage, and biofuels

Approach - Private-public partnership oversees contractor field service delivery

Highlights
Non-energy benefits
- Higher quality ag products
- Greater production capacity
- Increased farmer profitability

Energy Savings
- 87 million kWh/year
- 22 MW
- 1.9 million therms

Cost Effectiveness - Net benefit/cost ratio of 2.1
Improved irrigation technologies and management practices have consistently provided up to 40% savings of both electricity and water,\textsuperscript{81} and, with regard to cost effectiveness, one study estimated that it is cost effective to reduce electricity use for irrigation by 25% on average through more efficient pumping, better water management practices, and other technologies.\textsuperscript{82} Among these measures are high-efficiency motors and pumps, and variable-speed drives for pumps and fans that operate at varying loads. These practices could save the average Colorado farmer more than $5,000 per year on electricity costs for irrigation alone.

CAFO – This is another extremely energy-intensive agricultural practice. CAFOs confine large numbers of animals for efficiency in management, which produces large amounts of manure. As a result, CAFOs offer the opportunity not only for money savings through EC/EE improvements in insulation and ventilation, but also through electricity generation. One hog operation, Colorado Pork (a.k.a. Custom Swine Partners), reduced its gross electricity consumption per sow by 42%, and peak demand for electricity per month per sow by 43% compared to a “business as usual” farm by improving EE and at the same time generating 437 MWh of electricity per year from hog waste.\textsuperscript{83}

\textit{Ventilation Systems}

Ventilation systems on farms use huge amounts of electricity. On most farms, improving the efficiency of the systems can save substantial amounts of money. Agricultural operations use fans and ventilation systems for tasks such as continuous ventilation in CAFOs to avoid heat stress and the buildup of toxic levels of ammonia.

Ventilation efficiency is determined by motor performance, speed, blade design and shape, housing design, and clearance between the fan blades and the housing. The ventilation efficiency ratio (VER) is a function of cubic feet of air moved per minute for each Watt of electrical power input. The VER range is typically 5 to 25; higher values equate to higher efficiency. A 1998 Clemson University study that evaluated the sizing of farm ventilation systems found that none of the farm systems it examined were properly sized. Simply sizing fans to meet production requirements can result in savings on energy bills. In addition, variable-speed drives are an attractive EE option for fans operating with varying load. Optimizing a ventilation system will require capital outlays, but the effort will pay for itself in reduced electricity costs in about 2.2 years.\textsuperscript{84}

Maintenance is also important. Dust and dirt buildup of 1/8 inch on blades can reduce efficiency up to 30%. Some fan blades are designed to minimize dirt buildup. Dust collecting on shutters and safety grills also affects performance, by up to 40% in one estimate.\textsuperscript{85} Fan louvers and guards should be cleaned and lubricated regularly (using graphite to prevent dirt accumulation) to prevent large airflow reductions in fans. Louvers can be removed where fans are running continuously to avoid restricting airflow, but guards should remain in place to prevent personal or animal injury. Properly sizing openings can also keep ventilation systems operating efficiently.

Fan efficiencies are measured in cubic feet per minute per watt (cfm/W). Replacing old, inefficient fans with energy-efficient models can increase the initial cost, but the payback in reduced electricity costs is typically only 1 or 2 years.\textsuperscript{86}
In cold climates, shutters should be inspected regularly to ensure that they have not frozen in one position. Thermostats, fan belts, inlets, and other system equipment also should be regularly cleaned and adjusted to ensure that the system is performing as efficiently as possible.

New fans should be certified by the Air Movement and Control Association (AMCA). AMCA ensures that fans have been evaluated by standard test conditions and their performance meets or exceeds the specifications cited in the manufacturer’s literature.

Factors to consider when evaluating ventilation fans:

- For desired airflow rate and static pressure, a large diameter fan is more efficient.
- For desired airflow rate and static pressure, one large fan is more efficient than many small fans.
- For fans of the same blade diameter, a fan with lower horsepower or motor current input rating is more efficient.
- For two fans with the same airflow and static pressure, the fan with the slower speed is more efficient and quieter.87

Agricultural warehouses, indoor livestock enclosures, or other buildings that require large amounts of make-up air can take advantage of a cost-effective, low-tech solar technology to reduce costs. Transpired solar collectors use large, unglazed solar absorbers attached to the south wall to preheat ventilation make-up air (see Fig. 11). Depending on rebates and other incentives available in a particular locale, transpired solar collectors can pay for themselves in less than 4 years.

### EXEMPLARY AG EFFICIENCY CASE STUDY #2
Interstate Power & Light (Alliant) – Iowa and Minnesota
“Agriculture Energy Efficiency Program”
(Funded by a charge on all customers’ bills for energy efficiency offerings only)

**Background** - Serves end-users and dealer network with audits, rebates and equipment comparisons

**Focus** - Develop an in-house team of specialized ag representatives, fielding an advisor who is “one of their own”

**Approach** - Look for ag background, personal aptitude and interest, empathy and credibility

**Highlights**
Program’s new ag energy audit supported the award of many Farm Bill Section 9006 grants to end-users

Vendor equipment offerings are now more efficient

**Energy Savings**
- In Iowa, 4-5 GWh per year, 903 kW at peak

**Cost Effectiveness**
- Iowa: cost/benefit ratio: 1.99
- Minnesota: cost/benefit ratio: 3.09

Motors
Motors are widely used throughout the rural Southwest, consider: irrigation pumping, processing agricultural products, ski lift motors, mining, extracting oil and compressing natural gas. Motors use more than 40% of the total electricity consumed in the agricultural sector, and 90% of the electricity consumed on average in the United States for mining and oil and gas extraction.\textsuperscript{88}

Optimizing entire electric motor systems can achieve savings of more than 50% of that electricity because poorly matching components and electrical loads waste large amounts of energy\textsuperscript{89}. Although energy-efficient premium motors cost 10\% to 30\% more than standard models, the annual cost of electricity to run a constantly operated motor can easily come to 5 to 10 times the purchase price of the motor. Because so much of the life-cycle cost of a motor system is consumed in operating the system, improving efficiency even a few percentage points yields sizable savings. As a bonus, optimized and well-maintained high-efficiency motor systems offer reliable, trouble-free operation and longer equipment life.

Motors that power pumps, fans, compressors, or conveyors with varying loads should use variable-speed drives. In such cases, investing in a variable-speed drive can yield a payback in 3 years or less through the electricity savings.

Oil and Gas Operations
Global Energy Partners reports on California field trials show top-ranked kilowatt-hour savings for EE in small oil and gas operations in California\textsuperscript{90}:

- High-efficiency motor and pump (35\% of the total energy-use savings)
- Pump-off controller (35\%)  
- Variable-speed drive (18\%)

Further information about many of these savings opportunities can be found in the on-line Business Energy Efficiency guides on the SWEEP web site: www.swenergy.org.

Two Special Opportunities for Municipal Utilities
- Because of the high demand rate of $19.20/kW applied to utilities in the Southwest under allocation from federal hydro power sources\textsuperscript{91} and the inability to easily collect that demand component from residential and other small end users, munis should see a special opportunity in the kinds of CEDR programs that disproportionately attack coincident demand versus consumption. Such programs could include:

<table>
<thead>
<tr>
<th>Low-Cost/No-Cost</th>
<th>Investment Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumer education</td>
<td>Demand controllers</td>
</tr>
<tr>
<td>Time of use rates\textsuperscript{92}</td>
<td>Air conditioner cycling</td>
</tr>
<tr>
<td>Peak watering restrictions</td>
<td>Replacement air conditioner</td>
</tr>
<tr>
<td></td>
<td>Evaporative cooler substitution</td>
</tr>
</tbody>
</table>

Figure 14. Ag-related loads can be large
Because munis often are responsible for both energy and water, certain low-cost/no-cost (LC/NC) practices and measures and other investment grade measures make special sense because they address both water and energy in the munis service area. For example:

**Low-Cost/No-Cost**
- Low-flow showerheads
- Flow restrictors
- Faucet aerators
- “Best energy practices”
  - Clothes washing
  - Dishwashing
  - Personal hygiene
  - Vehicle washing
  - Leaf removal
  - Cooking

**Investment Grade**
- Replace clothes washer
- Replace dishwasher
- Replace toilet

The next section examines the prospects for bringing these EE technologies into widespread use in rural areas.
Notes for Part 2:


41 Based on cost of heating homes with electric heat in Highline Electric Association’s service territory (Farnsworth, Mark, 2007. Op. cit.).


43 We note as a reflection on the current times the comments of utility efficiency managers (wishing to remain nameless) to the effect that in the San Luis Valley “only families with kids would use clotheslines for drying, and then only in the summer.”


49 Utilities that can reduce peak demand on their system benefit their end-users in two ways: 1) they reduce their payments to wholesale power suppliers for peak demand power, which can be charged at rates 10 times or more the rate during an off-peak period, and 2) by forestalling the building of new generating plants, which are often driven mainly by the need to meet peak requirements, rates for all end-users can be stabilized

50 Personal communication with Dennis Criswell, Vice President of Marketing and Strategic Ventures, Arizona Electric Power Cooperative (AEPCO), May 2007


53 From Best Practice Guide Food and Beverage Growers and Processors, accessed May, 2007: www.fypower.org/bpg/module.html?b=food_and_bev&m=Funding_and_Approval&s=Selling_the_Program.


Personal communication with Skip Laitner, July 2006.


Personal communication with J.P. Bressieux, former maintenance supervisor, January 2007.


Ibid.


Ibid.

Ibid.

Personal communication with Mark Farnsworth, Highline Electric Association, April 2007. As a follow-up on this topic, in July, 2007, Highline completed a 20-year agreement with Ormat Technologies, Inc. to buy 4 MW of power generated from the waste heat recovered from the existing gas turbines. Revenues are anticipated at over $1 million/year to start.

Environmental Analysis, Inc., Washington, DC.


77 Kingland, Mark, 2008. “Implementing Ag Efficiency with Section 9006,” presented at the ACEEE Ag Forum. ACEEE, Washington, DC.

78 Personal communication with Mark Farnsworth, Highline Electric Association, March, 2007.


86 Ibid.

87 Ibid.


92 Time of use rates are often not practical for far-flung rural utilities, where the “windshield time” reading the meter may be excessive. Until centralized meter reading becomes more widely available, especially in rugged terrain, this logistical issue will remain.
Part 3: Prospects for Rural Electricity Savings

Having explored ways to achieve the goal of deep electric energy savings, we now provide the rationale for considering deep electricity savings, achieved through CEDR, as an important prospect for the rural Southwest. We describe the advantages of these kinds of electricity savings, considering short- and long-term economic factors (energy bills, rural jobs, rural career options), as well as in measures such as lifestyle and environmental impact.

We establish feasible rural electric savings, and the achievable potential for reducing electricity use while maintaining the base function (with regard to safety, comfort, services, and lifestyle). This potential is distinct from various tests required by utility commissions, thus representing an intentionally looser definition and allowing for more creative conception of non-hardware solutions.

This definition of optimal electricity savings is taken to a level of detail that includes the specific technologies, products, and practices that will achieve energy-savings goals for each rural end use. The important role of human behavior in achieving implementation is considered, and well-proven strategies for encouraging action are offered. Finally, we examine the transferability of these savings and benefits, often achieved elsewhere, to a wide range of rural settings in the Southwest.

In Part 4, we will combine this accumulated analysis into recommendations for specific programs to capture the CEDR savings and benefits for utilities and end-users.

CEDR for the Rural Southwest

Before discussing the specific measures most likely to contribute to a more energy-efficient Southwest, and how the savings from those measures can add up to major impacts on many aspects of rural economic life, this section looks at the context within which these savings are likely to take place. To begin, we acknowledge that utility companies have offered energy-saving
programs for nearly 30 years, and that nearly every utility in the country today offers one or more such programs. The point of this report and SWEEP’s CEDR program outreach effort is to dramatically accelerate the pace of successful program delivery to meet the twin challenges of rural economic stability and an increasingly carbon-constrained world.

When considered on the whole, major (20% to 40%) CEDR savings in homes and businesses are practical and achievable; however, we examine in this section how some aspects of the rural Southwest context appear to be supportive of such energy-saving programs, and how some appear to discourage them.

**The Broader Cultural Context**

The level of urgency now surrounding the impacts of energy use is assumed to continue, if not increase, given the growing agreement of scientists worldwide about climate change, and this level of urgency is assumed to slowly permeate more into the rural Southwest. For example, Johnson notes that Colorado has recently created a climate action plan and inventory, and asks the rhetorical question “What do you think is next?” From that assumed base two further assumptions follow:

- **Technical and economic savings potential will grow substantially with the anticipated cascading technology improvements with this increased attention, and the larger markets that are growing for those improvements.**
- **Achievable potential will grow even faster as energy use decision-making at every level becomes better understood and implemented to guide the rapidly expanding sensibility of the market.**

As another example, it’s apparent to any observer that the “rules of the game” are being changed even as we watch. Stan Lewandowski, General Manager of Intermountain Rural Electric Association, and a noted critic of the new directions, has observed that “the rules are being rewritten for renewable energy, for the environment and for global warming.” This cultural factor of increased awareness and changing priorities bodes well for increased efficiency across the United States, including the rural Southwest.

What organization might be the agent for successful energy-reduction programs, for example, a rural home retrofit program? The ideal entity would offer unbiased, hassle-free, no-cost access to major energy savings specific to each home. While no such model exists for homes today, many rural institutions and agencies act as social networks that already provide formal or informal information on energy use in the rural community. These institutions, agencies and social networks could provide models for the household practices that conserve energy, and for buying, installing and maintaining efficient equipment that will reduce energy use even more. Such possibly-relevant rural institutions and social networks include agricultural equipment dealers, conservation districts, the Extension Service, communities of faith, farmer associations, civic groups, energy suppliers of all sorts, neighborhood associations, and social groups.

Of course, a social network must be combined with residential energy expertise so that the information is correct and the recommendations sensible. Finally, information and intent must be provided to action agents immediately able to follow up on a householder’s decision to proceed,
who can then offer:

- consultation specific to the home
- delivery of further relevant information on conservation practices and efficient products
- demonstration of relevant practices and recommendations for other no-cost actions
- delivery and installation of efficiency products
- help to determine the best follow-up actions
- access to funding for some or all of the product and service costs

With an issue like home energy use, for which the best path forward is perceived by many to be relatively complicated and unclear, people will attribute even higher importance than usual to their social networks. In an existing rural energy culture that is not now energy-attentive, with few credible information outlets describing energy-use reduction positively, this could mean that a few highly-visible actors could strongly influence people against programs that effectively target energy waste. On the other hand, if that social network could have its basic belief changed so that reducing energy waste is seen as important and possible, widespread reception of home energy retrofits and other such programs could be expected.

At the same time, conspicuous by its absence today is strong rural Southwest leadership demanding clean energy programs. As a counter-example, Harrington et al. have noted that a common characteristic of successful clean energy programs in other places has been the “presence of a champion – a governor, a legislative leader, a utility commissioner – who has a sustained interest in making clean energy happen and will advocate effectively for it.”97 This observation does not bode well for increased efficiency in the rural Southwest.

**The Economic Context**

Economic times are difficult and growing more challenging for most rural residents in the Southwest. The problems caused by the continued depopulation of many rural areas cascade as the critical mass needed to sustain many towns is threatened. Even in areas with booming growth in mineral extraction or suburbia, the economic losers often outnumber the winners, and growth impact issues can quickly overwhelm the rural way of life.

Commodity prices and continuing drought impacts are now joined by rapidly increasing costs for liquid fuel, natural gas and electricity to produce less and less net profit from production agriculture, the long-term economic driver of many rural areas. Additionally, many areas in the Southwest are particularly hard hit as local irrigation and municipal water supplies become harder to maintain because of drought and water conflicts with neighboring states. In these difficult times, reducing the input and operating costs of energy is important to keep rural businesses alive and rural homes out of foreclosure.

From a larger perspective, without increased rural income, jobs, and career options, many Southwest rural communities will simply wither away. We believe that broad programs to reduce the use of conventional energy through CEDR and renewable energy can change the economic equation in the rural Southwest. These programs will put desperately needed investment directly into rural communities by creating long-term jobs and new sources of income and lifestyle sustainability. This factor bodes well for increased efficiency in the Southwest.
The Structural Context

Rural housing in the United States has been characterized as the 14 million homes most in need of both an energy audit and an energy retrofit, but least likely to get either. The reason, of course, is that the distance between sites makes it impossible for standard energy programs to operate as efficiently as they do in urban areas, where the population density is much greater. Our description of average customer density per mile of conductor line in rural areas could be a surrogate for customers per mile of rural road: seven customers on average per mile for co-ops, 35 for IOUs, and 47 for munis. In northern Wyoming, the number at one co-op is fewer than 2 per mile.

Figure 17. Rural homes often have outbuildings that use power, too

Other rural observers have said that rural cooperative members “have old homes and farms, with poor insulation and zero air sealing.” Therefore the typical Southwest residence is classified as an “old house, not upgraded.” According to Francouer et al., this places rural Southwest housing firmly in the bottom category of housing stock efficiency in energy ratings (as they have developed this rating, initially for Canadian homes; see Table 5):

Table 5: Energy Efficiency Ratings by Category of Housing Stock

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old house, not upgraded</td>
<td>0–50</td>
</tr>
<tr>
<td>Upgraded old house</td>
<td>50–65</td>
</tr>
<tr>
<td>Energy-efficient old house or typical new house</td>
<td>65–74</td>
</tr>
<tr>
<td>Energy-efficient new house</td>
<td>74–81</td>
</tr>
<tr>
<td>Highly energy-efficient new house</td>
<td>81–90</td>
</tr>
<tr>
<td>Advanced energy-efficient new house</td>
<td>90–100</td>
</tr>
</tbody>
</table>

This means that if standard energy retrofit programs are made available to rural areas, we should expect to see significantly greater savings than in areas with newer housing stock and/or greater availability over time of audit and retrofit services. This factor bodes well for increased efficiency in the Southwest.
The Demographic Context

The increase in the average age of rural residents means that many of the decision makers in rural places will be older than their equivalents (homeowners, business owners) in urban places. In addition, though there are certainly areas of exception, the rural Southwest has become poorer over the past 20 years. Both of these demographic observations will affect CEDR uptake. Mahapatra has found that owners with larger incomes, and we might add, larger houses, are more likely to install expensive new systems that will save them money, but older homeowners find it more difficult to change their behaviors, and are less likely to install expensive new systems if they do not expect the investment to be paid back during their lifetimes. In addition, customers in the Southwest have the same “first cost” bias of consumers everywhere that energy is considered a commodity (that is, not yet considered with its broader implications of economic, environmental, and security impacts); this bias favors buying the least expensive energy-using product without factoring in the total life-cycle costs. These factors bode poorly for increased efficiency in the Southwest.

The Capacity Futures Context

There are different ways to approach the energy supply (capacity) picture in the Southwest, and different opinions about the likely success of each.

The usual way to approach electric energy supply in the Southwest is simply to schedule the addition of new fossil-fueled generating units. This has the advantage of using the excellent long-term experience of experts in the utility and financing industries, and of being, until recently, one of the most prudent choices for utility system planners. With the addition of one or more large generating units, though, come the down-side risks of overbuilding. These risks are more present now than ever before, and include (based on Western Resource Advocates and SWEEP):

- Rate increases (often demanded by the financial market to better ensure repayment of the debt)
- Locking member utilities into even-longer term contracts (in an energy market that is going to need more, not less, flexibility to compete)
- Reduced credit worthiness (resulting in higher interest rates for other private sector loans taken out by the utility, driving up power rates)
- Excess generating capacity (which, when idle, costs interest expense without income offsets, driving up power rates)
- Susceptibility to carbon taxes (which could make the power increasingly expensive over time for rural end users)
- Commitment to paying off increasingly unpopular plants (which plants could be seen, with each successive year, as part of the larger problem and not part of the solution)
- Crowding out the possibility for significant economic contribution of alternatives to conventional capacity (e.g., major CEDR, solar, wind, and other alternative capacity
programs)

- Possible loan default (e.g., the experience of the Washington Public Power System in Washington state and, closer to home, Colorado-Ute, which was headquartered in Montrose, Colorado, with huge resulting economic development impacts on the region and the agricultural sector in particular)
- Bankruptcy (Colorado-Ute should be the object lesson for anyone inclined to overbuild)106

Livingston suggests an alternative to overbuilding conventional capacity. He notes that the main drivers for CEDR programs in Minnesota were 1) the “excess capacity at the Laramie River (Generating) Station is used up,” which led to a “requirement to meet the growth needs of our members” (in some other way), and 2) the strong encouragement by the Minnesota PUC.107

The Northwest Power and Conservation Council (NPCC) looks for strategies that will yield satisfactory outcomes across a wide range of plausible futures. This is different than looking for a single strategy that is optimal in an expected future. The difference, according to NPCC, is that “we are in a period of time in which there are far too many possible future risks to the cost and availability of power to plan a course based on one “most likely” scenario. For this reason, the Council’s plans include acquisition of EC and DR, along with generating resources, to increase the chance of a satisfactory outcome despite the down-side risk of whatever actual future we may see (emphasis added).”108 109

Four other NPCC findings that may be relevant to Southwest CEDR program considerations:

- “Conservation contributes some value irrespective of market price, whereas most generation resources do not;”

---

**EXEMPLARY AG EFFICIENCY CASE STUDY #3**

Pacific Gas & Electric – California
“Agriculture and Food Processing Efficiency Program”
(Funded by all California rate-payers with Public Goods Charge on monthly bill)

**Background** - Challenging new energy performance objectives prompted a “blank slate” review of how best to deliver efficiency in the ag and food processing sectors

**Focus** - Targeted marketing aligned with industry and partner organizations

**Approach** - Integrate a rational retrofit sequence of analysis, efficiency retrofit, and self-generation to address energy and financial goals; assign goals to in-house and vendor staff

**Highlights**
- Postcard marketing, subsidized pump test/repair, rebates and other incentives for new EE construction and retrofit, focused workshops, no-cost on-site ag or food processor audit, benchmarking tools and support for specific sub-sectors, 20% of budget set aside for third-party programs competitively awarded to test innovative EE approaches, retro-commissioning, simplified rebates

**Energy Savings (2007)**
- 9.5 MW
- 51 million kWh/year
- 1.7 million therms

• Development of conservation earlier in time “allows an ability to defer risky (i.e., potentially costly) decisions on generating resources; and

• Relative to other resources, conservation is a low-cost and low-risk way to maintain economic reserve margins, which reduces market price volatility.”

• The Council’s analysis found that acquiring conservation at a price premium of one cent per kilowatt-hour over the expected avoided cost produced both the lowest present value system cost and lowest system risk.¹¹⁰ ¹¹¹

To show just one example of a simple low-cost EE measure with great economic benefits, Table 6 compares the cost of lighting to the consumer using either an incandescent lamp or a CFL. The table shows that CFLs provide light for about one-third the cost of incandescent lamps considering both the lamp and electricity costs. As George Schultz of the Rural Utility Service has pointed out, CFLs can offset the need for very costly generating capacity as well as provide a significant cost reduction for consumers.¹¹²

Table 6: Lighting Cost Comparison: Incandescent vs. Compact Fluorescent Lamps

<table>
<thead>
<tr>
<th></th>
<th>Incandescent</th>
<th>Compact Fluorescent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost of Light Bulbs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lumen</td>
<td>850</td>
<td>830</td>
</tr>
<tr>
<td>Watts</td>
<td>60</td>
<td>15</td>
</tr>
<tr>
<td>Life in hours</td>
<td>1000</td>
<td>8000</td>
</tr>
<tr>
<td>Bulb cost (1)</td>
<td>$2.00</td>
<td>$4.00</td>
</tr>
<tr>
<td>Operating Cost (2)</td>
<td>$48.00</td>
<td>$12.00</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>$50.00</td>
<td>$16.00</td>
</tr>
</tbody>
</table>

(1) Costs for 8,000 operating hours
(2) Assumes electricity cost of $0.10/kWh

Source: Southwest Energy Efficiency Project

The Programmatic Context

Advocates of Oregon EE claim their state has “arguably one of the most sophisticated EE markets in the U.S.” We use their list of Oregon’s strengths as a metric for comparing the readiness of the rural Southwest to embrace EE programs in rural areas (see Table 7).

Table 7: Subjective Rating Conditions for Successful EE Programming in Oregon and the Rural Southwest¹¹³ (Key – Low L: 1, L/Med: 2, Med M: 3, M/High: 4, High H: 5)

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th>AZ</th>
<th>CO</th>
<th>NV</th>
<th>NM</th>
<th>UT</th>
<th>WY</th>
<th>T (SW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strong environmental ethic</td>
<td>H</td>
<td>L/M</td>
<td>M/H</td>
<td>L/M</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>15</td>
</tr>
<tr>
<td>Stringent energy code</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>M/H</td>
<td>M/H</td>
<td>M/H</td>
<td>L</td>
<td>19</td>
</tr>
<tr>
<td>Prior utility-operated programs</td>
<td>H</td>
<td>M</td>
<td>L/M</td>
<td>L/M</td>
<td>L/M</td>
<td>L/M</td>
<td>L</td>
<td>12</td>
</tr>
<tr>
<td>Other-operated programs</td>
<td>H</td>
<td>L</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>12</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>20</td>
<td>9</td>
<td>12</td>
<td>9</td>
<td>12</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By this scoring system, which is obviously subject to modification by more knowledgeable observers, one might conclude that the rural Southwest would not be an easy territory to open to
EE, because it lacks energy program experience and a strong energy conservation ethic. This bodes poorly for increased EE in the Southwest, although the stronger codes may “pull through” more efficiency in all sectors.

The Institutional Barriers Context

Historically, electricity service area development in the rural Southwest yielded an early split in the type of institution that provides energy utility services. In the rural areas of three of the Southwest’s six states (Wyoming, Colorado, and New Mexico) electricity service is provided mainly by the vertically integrated electric cooperative structure. Power to the co-ops comes mainly from coal mines and fossil generating plants owned by the G&T cooperative, Tri-State Generation and Transmission (Tri-State). Tri-State is owned by the 44 member distribution co-ops (18 of which are in Colorado, 12 in New Mexico, and 8 in Wyoming). In Arizona, the major rural wholesaler is Arizona Electric Power Cooperative, with 10 member utilities. Rural utilities in Nevada receive their wholesale power from the BPA, and in Utah from Deseret Power. In the rural balance of those states not served by the co-ops, IOUs and munis deliver electricity services in urban and rural areas.

Tri-State is by far the largest wholesale supplier in the rural Southwest, so we are particularly interested in improving our understanding of the prospects for rural uptake of CEDR in its three-state region. Also, the drivers we have identified and list below for CEDR programs at Tri-State, may provide guidance about the likely reception in the entire area, including by the investor-owned utilities and others who are larger rural players in the three other states of the Southwest.

Based on discussions with people in the broad interest chain (including Tri-State staff, co-op managers, end users and owners, and system critics) the main barrier to the successful implementation of CEDR programs for the wiser use of energy for most end users who reside in three of SWEEP’s six states (Wyoming, Colorado, and New Mexico) could be institutional reluctance. The effective pursuit of challenging program goals for CEDR will require a corporate intent that appears to be missing today, from any objective perspective, essentially caused by the lack of 10 conditions that are often called “enabling:”

1. Financial incentives at all levels
2. Fit of CEDR within the internal culture
3. Extensive in-house (central) experience with any of the CEDR program elements
4. Expertise in many of the underlying fields of study and practice
5. Belief in programs even though they can be perceived to be, in the short term, inequitable to one class or group of customers or another
6. A clear path to a simple, tested program with known costs
7. Perceived good cost-effective logistics (vs. the long distances between customers, on average, in Tri-State’s service area)
8. Perception of CEDR as a practical resource alternative to fossil-fired generating plants
9. A strong mandate or other impetus to do things in any way differently
10. Member or end-user desire for CEDR programs

This overall list of institutional barriers bodes poorly for increasing EE in large parts of the Southwest.

Essentially this set of barriers was common until relatively recently among most electric utilities. The author was involved as a utility program planner in utility meetings in the late 1970s that presented this set of barriers, and (perhaps as a consequence) the meetings were spiced by discussion of national program resistance to DOE’s Residential Conservation Service Program (RCS), the program “where it all began,” according to Xcel’s Deb Sundin. Wiser heads prevailed, though, and since that time many IOUs have embraced the prospects of CEDR because they make so much better economic sense for those utilities and their ratepayers than business as usual. Others have come along grudgingly because their regulators have encouraged this type of energy stewardship as a reasonable accompaniment to the market protection afforded by monopoly status. Others yet have begun to participate reluctantly, but have grown to respect (if not fully embrace) the benefits potential for them and their customers. In any case, it is rare to find many of these program-discouraging factors at work today in the investor-owned electric utility world, but it is encouraging to observe that with sufficient motivation, over time, such factors apparently can be overcome.

In this case, the development of institutional intent will require that many or all of the following steps be taken:

- Reduce or eliminate the entire range of financial disincentives inherent in the electric cooperative structure, and incorporate substantial financial incentives at all levels.
  - Particularly burdensome is the disconnection in time between CEDR program costs and benefits, if any, to the co-op.
  - Another major problem is the revenue erosion that such programs will visit upon the local cooperative and the G&T cooperative (compare this to IOUs serving rural areas, most of which have mechanisms for cost recovery of CEDR impacts).

- Encourage development of alternative paths to cooperative success
  - In a following section we discuss other revenue sources that could diversify the cooperative’s income portfolio.

- Become more experienced with harnessing the benefits of CEDR and renewables programs to serve the core electric cooperative mission of rural economic viability.

- Buy expertise in the form of staff, consultants, and contractors.
  - This must start soon, with the long time it usually takes to ramp up programs even after contractors are in place.
  - Rural community economics immediately will look brighter when the co-op contractor is required to train and educate local workers in the skill and crafts required in CEDR programs.
• Accept the likelihood that resource contributions to CEDR programs, which initially appear to benefit one group disproportionately, will serve the overall best interests of the cooperative.

• Require an overall CEDR program plan (by in-house development or contractor deliverable) that is based on elements that are clear, simple, and tested, and for which costs can be confidently estimated.

• Reduce the difficult logistics of rural “windshield time” with an initial focus on non-standard CEDR programs, specifically those that can be crafted for fielding without a strong and immediate G&T or co-op presence.118

• Develop enough trust in a combination of CEDR partners and processes to yield a significant amount of program control for effective programs, accompanied with central support, where necessary.

• Proactively address the likelihood that ever-increasing costs and ever-stronger resistance will be associated with “business as usual” in the electric cooperative structure.

• Increase demands for relief (in the form of lower rates and alternative programs) by increasingly dissatisfied electric cooperative end users and owners, directly119 and via their elected boards.

These steps must be quickly initiated to sway institutional intent, because even with the best institutional intent, program implementers will be faced with significant end-user resistance, irrespective of the service area (after Albert,120 Payne,121 Fairey,122 and Waide123):

• A lack of awareness of energy, related to the relative invisibility of most energy use
  o The CEDR program must show just how energy use adds up, and is important; in effect, we must inform and educate people so that they want something (energy-use reduction) that they really don’t know exists

• If energy awareness exists at all, there is often a poor attitude toward reduction efforts, e.g.,
  o “It’s too much of a hassle, and I don’t have the extra will-power to think all the time about how I can save more energy”
    ▪ The CEDR program must make it quick, low-hassle, and relatively maintenance-free
  o “I don’t think it will actually work like you say it will.”
    ▪ The CEDR program must overcome the perception of poor CEDR reliability, possibly with guarantees and certainly with working local examples and case studies
  o “Saving energy is going to cost me money I don’t have right now”
    ▪ The CEDR program must overcome the sticker shock, possibly with zero-cost financing paid back at a rate less than the rate of energy cost savings, and certainly with numbers that show positive cash flow and increased comfort and value of the home
“I don’t know what to buy, or even if I did, where to buy it.”

- The CEDR program must inform and educate about an unfamiliar class of CEDR products, practices, and services, and overcome the perception of poor availability by working with trade allies to offer products and services

“So much has been done in the past few years; surely there’s not that much left to do”

“What little I could save is not going to make a difference in the big picture”

- The CEDR program must show how aggregation of the efforts of many people has accomplished great things, including erecting the Statue of Liberty with school-kids’ dimes

“It looks to me that you really have to buy into a whole lifestyle proposition, don’t you; what’s in it for me?”

- The CEDR program must overcome the negative stereotypes of environmentalism, and describe how personal and local benefits can be achieved incrementally with it

“It’s easier and not all that expensive, all things considered, to do nothing.”

- The CEDR program must show the relevance of energy savings with CEDR and describe why each person’s contribution is important – to them and to the larger community

- The diffusion of responsibility about energy use
- A lack of information about energy-saving options and benefits (especially as “word of mouth” from a credible individual or organization), and how to assess economic priorities, in particular
  - Information gaps dissuade end users from seeking out better solutions
  - End-users feel little control over the provision and pricing of energy
  - Energy-saving investments are perceived as relatively risky, most importantly with regard to the misperception that there must be reduced comfort, safety, or utility (or why wouldn’t we have done it before?)
    - CEDR must be positioned as providing the resources for a safer, easier lifestyle that is more secure and comfortable
- A lack of training in self-installation or performance-ensured contracting
- Misplaced incentives in the forms of energy pricing and rates
- A lack of sufficient quality products and services in rural areas
- Critical nature of timeliness (e.g., “Talk to me at an appropriate time within the plant-harvest-slack time cycle”)
- Avoidance of hassle (e.g., “I don’t have staff or time for a lot of details or hand-holding”)
• Resistance to bureaucratic requirements and paperwork (e.g., “Save me from burdensome requirements and ‘stupid’ forms”)

**The Community-Level Context**

Most economic analyses of EC and efficiency options take little or no account of benefits beyond the direct financial benefit to the end user. For our qualitative economic analysis in this report, though, we felt driven to use more realistic assumptions. Based on our understanding of rural economics, we believe it reasonable to urge that the broader community impact of local energy savings programs be considered. Following are reasons we think CEDR programs respond better than conventional capacity alternatives to community needs.

• CEDR programs are an immediate and direct response to the growing energy customer demand for clean energy alternatives that can be cost effective at all levels of the supply and demand chains.

• CEDR is a cheaper way to provide electric service capacity than any other electric power alternative: conventional (fossil), nuclear or renewable. In fact, CEDR is the largest of the few negative cost resource alternatives. According to Harrington et al., “Using untapped efficiency is the single most effective step energy and energy markets regulators can take to reduce environmental pollution, power costs, and price volatility.” 124

• CEDR can be added in a modular fashion, can be ramped up or down depending on near-term needs (siting and permitting issues are insignificant), and can typically be verifiably achieved at far lower costs than other resources.

• A utility’s investment in CEDR programs “amounts to ‘buying’ the resource from members, which builds relationships and provides economic development benefits” in the service area. 125 126 Of course, CEDR is not like most electricity production resources, in the sense that you can’t just throw money at it and get a corresponding level of defined output. You’ve got to be a lot smarter, which has positive and negative aspects:
  o Positive, because it means you may be able to get huge and dependable savings, quickly, with little investment, if you do it right
  o Negative because it takes a lot more thought and effort to do a good job developing reliable resources with a CEDR program than it does to order new conventional production equipment and interconnection

• CEDR strengthens rural areas’ economic competitiveness with nearby service territories, in some cases territories where IOUs are engaging in aggressive energy savings programs. For example, Opsahl observes that EE businesses use 30% less energy than their competitors, with implications for net profit and overall visibility of the enterprise. 127 (In fact, CEDR should have the same effect anticipated by Tri-State in their support of biomass energy “as a way to boost the rural economy”). 128

• CEDR also better enhances rural energy reliability and security from disruptions caused by weather, accident, or malicious acts; CEDR helps build community self-sufficiency, and at the same time prepares for better public acceptance if conventional generation is needed. 129

• CEDR programs provide a visible opportunity for rural utilities to invest in their own in-house EE, thus encouraging more efficient local electric system operations and lower
rates.

- CEDR hedges against the growing risks of
  - Future price increases,
  - Reduced overall grid reliability with environmental constraints on generation,
  - Energy emergencies (from weather, error, or malice), and
  - Increased capital costs for unneeded capacity (on-site end use equipment or grid generation).

- CEDR improves any rural energy supply scenario, a good reason for doing it first.\(^{130}\)

- CEDR improves the case-by-case cost effectiveness and system integration of distributed renewable energy generating sources, and widespread implementation of CEDR sets the stage for the more effective application of RE measures and practices.

- This uptake of RE, in turn, could usher in a similar set of cascading community economic benefits, with more efficient local businesses that carry out both CEDR and RE, and with increased potential for any rural community to be a net energy exporter to improve its economic diversity.

- CEDR places downward pressure on natural gas prices by reducing gas use for power generation, which reduces its cost and the cost of other fossil gases (propane, LPG, etc.) used for grain drying and fertilizer feedstock, which is also good for farmers’ bottom lines. And because of its distributed, grid off-loading benefits, CEDR is more valuable the further it is from the generator.

- CEDR reduces transmission bottlenecks and the need for investment in future generation, transmission, and distribution. CEDR improves local and regional sustainability and competitiveness by reducing rural end-user costs for production inputs and operations. Additionally, it converts capital improvements (customer-bought efficiency measures) into future-cost-reducing operating systems, with long-term benefit to the customer, the utility, and the community.

- From a utility’s strategic perspective, CEDR could be considered to be Fire Prevention versus Fire Fighting,\(^{131}\) especially if the utility gains long-term advantage by being involved as a supplier of a new range of CEDR and renewables products and services.\(^{132}\) These stronger rural utilities will be better for rural communities.

- We can reasonably assume a community multiplier of increased local net income derived from lower utility bills. We can also assume the development of new local rural jobs and
career options in CEDR’s energy-saving services and products, similar to what has been documented in Colorado and New Mexico with the advent of wind farms. Full-scale CEDR programs have large infrastructure needs, not the least of which is a cadre of experienced practitioners in rural areas. These jobs can and should be filled by local residents, slowing or reversing the movement of people away from rural places. CEDR programs will build the rural workforce by providing a steady, long-term demand for marketable skills in efficiency and renewables.

- CEDR attracts new capital to the rural service territory, for hardware and other systems-level improvements to the EE of homes, businesses, and industry. It may be the highest and best use of public and rate-payer money because this investment lowers the short- and long-term cost of living and cost of producing.

- CEDR frees up excess capital (which would have paid for costly new conventional generation) for other social and economic development priorities in rural regions.

CEDR has implications for broader rural sustainability efforts.

- CEDR builds on the substantial rural investment in the existing housing stock, making buildings more durable and comfortable, by shifting investment and spending back to the local rural economy. This improves:
  - the end-user’s quality of life
  - the performance of most consumers’ largest lifetime asset
  - the consumer’s long-term financial security.

- CEDR reduces water consumption both directly by stimulating greater adoption of energy- and water-savings devices such as low-flow showerheads and ENERGY STAR clothes washers, and indirectly through reduced operation of conventional power plants that consume large amounts of water in their cooling
systems. This means retaining more water for use by agriculture and people.

- CEDR better supports the sustainability of rural communities in the face of widespread predictions of a hotter and drier climate, and reduces energy-related toxic emissions and greenhouse gases.
- CEDR improves the safety of end-users by reducing their exposure to the wind and temperature extremes that can cause power system outages.

**The Utility Revenue Context**

Does success with CEDR always mean revenue loss? A discussion of DSM or CEDR programs usually provokes this nagging but urgent question from every manager of every co-op. Although it may appear that reducing electricity use could threaten co-ops throughout the Southwest, this perception is not necessarily accurate for the following reasons:

- Many rural areas are experiencing what is becoming a capacity/cost-control crisis. CEDR programs will make a major positive contribution to relieving the energy supply crisis by reducing the need for very costly new power plants of whatever type. Furthermore, although CEDR generally reduces the rate of electricity demand growth, it generally will not eliminate this growth in many areas. So utility sales and revenues will continue to grow, but not as fast as if CEDR options are ignored. Furthermore, CEDR efforts often reduce peak demand more than total electricity sales in percentage terms, which improves the use of a utility system (providing a higher load factor, in utility jargon).

- CEDR programs will help address the “constrained regions” in many rural utility systems, within which the load/supply relation is out of balance, and where the imbalance cannot be resolved by import or export. CEDR and renewables programs will be most useful in these constrained regions, because both will take the pressure off the balancing of conventional resources.

- Retail power suppliers who embrace CEDR practices and programs will lower the costs of services and remove themselves somewhat, along with their retail customer/owners, from the pressure of rising rates. These co-ops will achieve better demand control, thus ensuring lower and more stable electricity bills in the future. In turn, improved community economics will strengthen those co-ops.

- Providing and delivering CEDR services and products in the utility’s service territory will yield new forms of income, jobs, and career options for rural residents.

- Expanding the utility’s service offerings into CEDR-related areas can improve revenue flow.

The case is similar for the wholesale power supplier. With a commitment to CEDR practices and programs, a lower cost of service and improved regional economics will result. Higher income from excess power sales, made possible by lower system demand during peak periods, can further reduce rates across the system, affording better asset management.

Some rural utilities already have begun working with CEDR programs and have received positive feedback from their consumers for doing so. In our discussions with more than 20 of the
rural utilities serving the Southwest, we typically noted one or more programs already in place. However, other utilities have pointed out that they are almost exclusively driven by new oil and gas extraction loads; this customer already may have the most efficient equipment, and further cost-effective energy savings opportunities will appear to be limited. The response, even in these cases, is that prospects for CEDR savings are still usually available. The reason is that the most efficient practices may not always be exercised because of a lack of product, installation expertise, or simple expedience.

Innovation and product advances in the CEDR field are taking place at an accelerating rate. So the “best practice” from just a few years ago often has the potential for a cost-effective upgrade today. Effective CEDR outreach programs will closely examine actual field practice, with few presuppositions, and confirm or improve on it.

So, if the question is *does EE success mean revenue loss for utilities?* The answer must be - *not necessarily.* In most areas, revenues are still likely to grow from current levels. Any revenue loss is likely in relation to some hypothetical future where inefficiency and energy waste are not addressed. Furthermore, the practice of customers paying lower energy bills for necessary energy services should be viewed as a good thing by utilities that are owned by these customers and must act in the customers’ best interests.

The actual cost of delivering energy services can be a factor if actual program delivery of retrofit measures is implemented. The largest data set for such programs is from Canada, where, with more than 50,000 retrofit projects accounted for, about 75% of the recommended program measures are installed at a cost of about $7,350.\(^{133}\) Assuming more expensive measures were typically foregone by the Canadian end users, this data would indicate (for the Canadian list of measures, in Canadian housing stock, in Canadian climates) that a typical “full” retrofit would have cost more than $10,000. We believe the figure will be substantially lower in the Southwest, and describe in Appendix A a field demonstration of a program that is expected to capture 35%-60% savings in a home for less than 8,000.

Clearly EE is good for the individual, the community and the rural economy in ways that are far more diverse and meaningful than just an immediate payback on investment or higher profit margins. The benefits will outweigh costs, if any, for most customers, power retailers and power wholesalers.

**Prospects for Achieving Energy Savings**

CEDR is poised to benefit the rural Southwest and its stakeholders, even beyond measures of short-term economic gain. However, in the real world, stakeholders must be assured of some reasonable indicators of return. For a framework from which to evaluate the best potential for energy savings, we again consider the three tests introduced in Part 1:

- **Energy conservation (EC)** – Can electricity use be reduced in this end-use application without extensive new equipment or systems, relying mostly on different behavior by the system operator?
- **Energy efficiency (EE)** – Can electricity use in be reduced this end-use application with
higher efficiency equipment or systems, with little reliance on different behavior by the system operator?

- Demand response (DR) – Can the efficiency of the larger electricity generation, transmission, and distribution system be improved by modifying the time at which end-use power is drawn, reducing the peak demand for power from the system? This is of great interest to planning CEDR programs because demand savings often can be achieved very inexpensively. Larger demand savings will then help pay for CEDR programs that create awareness, support behavior change, and improve hardware acquisition among electricity users; effectively lowering total program costs for all participants.

An additional consideration, of course, is the type of programmatic interventions will be necessary to create the desired synergies between consumers and utilities.

Finally, recent history suggests that setting the bar high by planning for the program delivery of deep energy savings will yield positive private sector support and innovative delivery solutions that cannot be predicted. Such responses can pave the way for the next generation of efficiency technologies, similar to the breakthroughs seen with CFLs over the past 20 years.

**How We Assessed What Is Feasible**

To arrive at a reasonable level of potential energy savings in the Southwest and recommended specific program steps to take, we did the following:

- examined the extensive literature on energy savings experience and new technologies.
- discussed in-field details with many program operators.
- investigated the types of electric end uses in the Southwest.
- discussed the practical options with many interested observers in the energy field (academics, industry, utilities, businesspeople, homeowners, and other end users).
- analyzed the transferability of savings and benefits demonstrated in programs elsewhere to rural Southwest settings.

The consensus findings that most affected our determination of a practical level of energy-saving prospects were the following, considering that it will take at least 10 years to realize these average levels of energy savings across the entire stock of rural households and businesses:

- In an informal survey of 11 utility managers in the rural Southwest, the typical answer to the question “What level of cost-effective energy savings do you think could be achieved today in buildings?” was “20% to 25%.”

- According to Rob DeSoto, a national Weatherization Program manager with DOE, savings have been measured on several Weatherization retrofit programs in the lower part of a 20% to 40% range, and one more detailed program measurement of actual reductions demonstrated savings in the upper part of that range.

- With 57,000 residential retrofit projects in their database, Canadian researchers estimate the EE improvement saved 28% of the total energy used.
• Technical experts in the field of energy use have found that a 60% level of energy reduction in existing buildings is technologically achievable with hardware fixes, if cost is not considered;\textsuperscript{137} for a practical example, the Colorado Energy Science Center has predicted actual savings in existing homes of 30% to 70% for its full “energy makeover.”\textsuperscript{138}

• With cost considered, analysts suggest cost-effective levels of 30% to 40% in buildings, even without the assumption of major future escalations in the cost of energy or the inclusion of energy externalities.\textsuperscript{139}

• Examples are legion of the measured low pumping efficiency of irrigation pumps in the field, despite significant rebates and industry support of higher efficiency.\textsuperscript{140}

• A visit to almost any rural commercial establishment is a frustrating experience because of the many visible opportunities to save money by using energy more wisely, of which the operators are apparently unaware or apathetic.

• Energy engineers have found that more than 40% (according to Sonderegger, 54%) of the energy use in residential buildings is within the control of the operator, without sacrificing function (safety and comfort).\textsuperscript{141, 142, 143}

• The California Efficiency Plan is to reduce household energy in the existing residential market sector by 40% by 2020
  o Matches the Bali Treaty “high goal” for achieving carbon neutrality, with half of the “net zero for carbon” by 2020 coming from existing homes
  o 40% from the existing California energy-use average of 5190 kWh/y (which includes the heating equivalent of other fuels) amounts to a 2000 kWh/y/home reduction!\textsuperscript{144}

• Examination of many distinct energy end uses in light of the best practices and most efficient products for reducing those energy uses while retaining function, revealed savings potentials of more than 50% in all but the largest industrial categories.\textsuperscript{145}

• Affordable Comfort, Incorporated (ACI) convened a summit in July, 2007, called “Moving Existing Homes Toward Carbon Neutrality,” with the goal of creating and clarifying a vision of “deep energy savings – a 70% to 90% reduction in total energy use in existing single-family and multifamily dwellings.” Wigington states that this level of reduction is achievable now through a combination of technical interventions and behavioral choices.\textsuperscript{146}

• Pillen and Doerrie have concluded, after a study of 143 homes in Germany, that new methods of integrating home energy measures in a home energy makeover can reduce the total energy use of an existing building by an average of over 80%.\textsuperscript{147}

These key findings informed our thought process as follows:

• We should not assume the “maximum technologically feasible” level for any program, as that level of goal is likely to be a poor use of program resources, but should focus on the achievable cost-effective level of 20% to 40%. This very well could be a conservative estimate considering that energy costs are volatile and escalating rapidly in most places.
• Although the suggested 40% or more savings that social scientists believe are achievable on behavioral grounds alone seems to be a difficult goal for most buildings with which we are familiar, our judgment is that less than half that, or a 10% to 20% reduction resulting only from operator decision, seems an attainable target (a conclusion made easier by the observation that just saving half your lighting energy with CFLs may get you almost halfway to the lower mark).

• The 50% savings or more that have been demonstrated as achievable by end users could be difficult to attain in a practical program because it would likely be very expensive. But a less-ambitious program goal of 25% would likely yield creative ways to tunnel down into the broad array of smaller savings opportunities that, in aggregate, can amount to meaningful results.

• The irrigation pump and commercial building examples demonstrate what we all know about energy use anywhere: it varies greatly from end use to end use, from climate to climate, and from operator to operator; no one-size-fits-all solution will be right for everyone. Because our broader philosophies and predispositions can so greatly affect our judgment, this observation encourages us to look at any site-specific energy-saving opportunities from the point of view of “yes, we could achieve that level of savings...if,” rather than “no, we couldn’t achieve that level of savings...because,” to more effectively address the possible ways of achieving the goal.

For example:
• In the pump case, dealers could be encouraged (incented with a relatively small compensating payment) to have premium pumps available in a range of sizes (an otherwise expensive inventory proposition for the dealer) so a high-efficiency model of the correct capacity could be installed immediately to replace a field pump that goes out of service. This method of improving the efficiency of installed hardware would be relatively inexpensive to the program.

• In the tenant-occupied building case, split incentives could be addressed directly with balancing incentives, so that the building operator has a reason to act differently.

However, in neither case will a rigid delivery program work very well. Program flexibility must come from experts nearest the end-use site, which defines a level of program acceptance and delivery effectiveness that is not now normal in the energy-saving field. Of course, this is another reason we must discount effective savings from
theoretical levels, while aspiring to and advocating for improvements in the effectiveness of program delivery.

From this thought process, we arrived at the following supported conclusions:

- With as much as 20% energy savings (already discounted from the theoretical level) achievable through changes in energy use practices and habits (including low-cost, no-cost measures), and perhaps as much as 30% additional savings (similarly discounted from the theoretical) achievable through the application of better (investment-grade) products, systems, and technologies, we are looking at an apparently practical aggregate savings potential of about 50% in buildings.

- A self-imposed “reality check” suggests further program planning prudence (for example, given the often-repeated observation that a utility does not currently have the staff or the time for such programs) to reduce the psychologically daunting number of 50% to a less-robust level of 20% to 40% in total prospective energy savings for residential and commercial buildings. Given the fact that buildings constitute 66% or more of the energy use of many rural utilities, we are comfortable defining that practical goal of 20% to 40% as the consumption reduction prospect for the residential and commercial sectors in the Southwest.

- We are prepared to increase or decrease the estimate based on our work with rural partners in the field and detailed on-site examination of prospects over the next year or so, but we believe that level is strong enough for program cost-effectiveness planning and launching by utilities and others. For the non-agricultural industrial sector, we will delay setting a similar consumption goal until we can examine, in more detail, the industrial end uses in the extraction, utility, and recreation industries.

Consumption Savings

A total consumption savings of 20% to 40% will be achieved by realizing EC potential (10% to 20%) and EE potential (10% to 20%).

The general argument for a total consumption savings of 20% to 40% (from the average use in that sector) is made up of two parts:

1. Savings of 10% to 20% with LC/NC conservation practices and measures, and
2. Savings of an additional 10% to 20% by replacing old, energy-inefficient products with their best commercially available counterparts.

The latter can be done when equipment or appliances need to be replaced, or as soon as possible for retrofit measures, such as installing insulation in an electrically heated building or a variable-speed drive for a ventilation system operating with varying load. The combination of EC and EE provides the best savings overall, and the great value in the first-loaded LC/NC category speeds up the payback period for investment-grade measures (e.g., ENERGY STAR appliances, and equivalent) to a very attractive point.

- Energy Conservation – About 10% to 20% of the total consumption savings potential is achievable from cost-effective measures (i.e., LC/NC practices and measures that use energy more wisely without sacrificing function). “No-cost” is defined as measures that
require only changes in behavior and practices (e.g., disconnecting and removing unused or underused refrigerators and freezers, or reducing or eliminating unnecessary power draws such as lights in unoccupied rooms). “Low-cost” is defined as products that pay back their first costs through energy bill savings in less than one year (e.g., installing CFLs in the five most-used lighting fixtures in a home, or reducing air leakage with fresh caulking and weatherstripping, or night purging of household air in summer). These figures are based on the fact that the aggregation of a number of such small measures can make a significant impact. The broadest LC/NC opportunities in Southwest rural buildings are more efficient lighting (e.g., CFLs), air sealing, and increasing cooling comfort by better using the arid climate, rather than so much electricity.

- **Energy Efficiency** – About 10% to 20% of total consumption savings can be achieved by reducing electricity energy use with investment-grade efficiency improvements to the thermal envelope and equipment. We predict a simple payback of 1 to 10 years for measures that have life expectancies longer than 15 years, in most cases. In terms of deepest energy savings potential from EE measures, the biggest investment opportunities in the Southwest are insulation, high-efficiency air conditioning (of all kinds) and appliances upon replacement, and high-efficiency lights, fans, pumps, motors, and compressors in commercial buildings, agriculture, and other industries.

- **Categorizing the retrofits** – In existing residential buildings, retrofits will be either LC/NC (conservation) or investment-grade (efficiency) retrofits. Applicable LC/NC measures may reduce electric energy use in a building by more than 20% in theory, but considering the difficulties influencing and changing behavior in the real world, this potential is discounted to 10% to 20%. Applicable investment-grade measures can also theoretically reduce electric energy use in a building by more than 20%, and again that number is discounted for conservative program planning purposes to a 10% to 20% achievable potential range. This potential could be realized over about a 10-year period from a combination of utility and non-utility programs such as promotional information and education, energy makeovers, better building codes, appliance standards, and training. The following sections summarize these estimates.

**Demand Savings**

This report estimates a demand savings potential of 35% across the residential and commercial sectors. This 35% total will be achieved through an aggregation of:

- 10% to 20% total demand savings that result directly from overall conservation efforts (LC/NC).
- 10% to 20% total demand savings that result directly from overall efficiency (investment-grade) measures.
- 10% total demand savings realized through the use of specific additional load control equipment.

This level is supported by program results, where Swisher and Wang report that reliable per-home demand savings of 29% to 38% are possible through automated demand response programs, and Maxwell’s reports of 22% peak demand by small commercial prompted his
observation that more could be achieved by focusing on high-end users with higher usage densities.\textsuperscript{150} A 10% load control level for new equipment is conservative, but is achievable even in the absence of demand control tariffs. Incentives will likely be needed to stimulate the adoption of whole-system demand controllers and other peak-shaving technologies like air conditioning cycling controllers and thermal storage.

**Substantiating Our Low-Cost/No-Cost Figures**

*Air Sealing Materials*

The best application of limited funding to upgrade the energy use of most homes is the wise use of air sealing materials. Blocking most of the infiltration paths around windows, doors, and through other fixed and movable penetrations of the thermal envelope, and out of air ducts, can be done with minimal cost or training.

Homeowner installation of air sealing materials (e.g., caulking, weatherstripping) costs less than $100, the proportion (assumed to be one-third) of the heating and cooling load derived from gross infiltration through the thermal envelope can be halved, saving 16% of the home’s heating load and 16% of its cooling load. For an electricity-heated home, with about 25% of the annual use attributable, each, to heating and cooling, this yields annual electricity savings of 8%, for a gas-heated home, 4%. This yields simple energy payback of about a year to the consumer for either fuel, qualifying air sealing as a LC/NC measure.

*Insulating Wrap*

Adding insulating wrap around accessible hot water pipes, and the storage tank if permitted, typically saves more money in a year than it will cost, qualifying hot water insulation as a LC/NC measure. Annual electricity savings will be 1% for an electricity-heated home, and 0% for gas-heated.

*Window Air Space*

Another low-cost measure is adding an air space to single-pane windows with simple plastic sheeting, which doubles their resistance to heat flow (from R1 to R2). For non-south, non-view windows, the use of bubble-wrap, taped to the glass framing, will triple the R-value for a very small investment. In either case, payback is less than one year.

Assuming half the windows in a house have their R-value doubled, and half have their R-value tripled, annual electricity savings for an electricity-heated home will be 1%, and for a gas-heated home .5%.

*Better Use of Natural Heating and Cooling*

One of the simplest ways to reduce the use of purchased energy is to take advantage of the abundant energy that surrounds us all the time. This is especially relevant in the rural Southwest as the area enjoys significantly higher solar radiation, and greater daily temperature swings, than in most other locations in the United States.

- Passive solar – Taking advantage of the solar resource during the heating season by removing daytime obstructions to south-facing windows makes good sense, as does insulating those and other windows during winter nights. The reverse is true during the
summer, when the sun’s heating contribution must be reduced by shading, solar screening, or reflecting the direct and reflected sunshine away from windows and doors during the day, and providing house venting through them at night.

- Night cooling – House venting in the summer is more effective in most areas of the Southwest than elsewhere in the United States because another consequence of our dry air is that nighttime temperatures often drop 30°F or more from the high air temperatures of a summer afternoon. This allows warm air and accumulated humidity (and pollutants and odors, too) to be purged from the house, and the home’s thermal mass to be cooled, often by simply opening windows. Fans are not needed when night breezes are present, though fans should be available for still nights. This practice works best when gross infiltration and solar gain are greatly reduced during the day, allowing the cooler thermal mass to absorb daytime internal gains (from lights, appliances, people, etc.) without greatly raising the inside air temperature.

Better use of natural solar heating and cooling resources, as described above, can be made with a change of habits, but with little or no out-of-pocket expense, yielding savings that may equal 10% of the annual heating load and 20% of the annual cooling load. In an electricity-heated home, the annual electricity savings would then be 7.5%, and in a gas-heated home, 5%. Payback is nearly immediate, categorizing better use of natural heating and cooling as a LC/NC measure.

**Efficient Lighting**

Every watt of electric energy used for lighting immediately becomes internal heat generation. By reducing the input for electric lighting in a home by 50% or more, accomplished by substituting CFLs for all incandescent lamps, summer cooling loads will be reduced by the same number of kilowatt-hours. Of course, winter heating loads will be increased by the same amount, but they do not have the same impact on instantaneous grid energy delivery as do summer air-conditioning loads.

Replacing all incandescent lighting with CFLs could reduce lighting energy and cost by about 75%, and therefore has the potential to reduce annual electricity costs in an average electricity-heated home by 6%, conservatively, without taking into account any savings from air-conditioning reductions. In a gas-heated home, those savings will be at least 10%, again without crediting air-conditioning savings. The time to achieve simple payback in energy savings will depend on the cost of CFLs and the electricity rate, but since CFLs cost less than $2.00 each if purchased in multi-packs and with electric rates of $0.10/kWh or higher, the payback time will average less than one year, putting this retrofit in the LC/NC category.

Among the additional aggregated practices and measures that may account for an additional aggregate 6% to 20% of electricity saving in a home, depending on heating mode, are:

**Additional low-cost practices:**

- Conserve water generally, and hot water specifically
- Regularly clean and service air delivery equipment
- Increase daylight harvesting in summer
Control household humidity to be lower in the summer, higher in the winter

Dress appropriately for the season

Manually manage the space heating/cooling thermostat (absent a programmable thermostat)

Reduce the water storage set point

Use appliances more wisely (e.g., cover pots, air-seal refrigerator food, run only full washers, use cooler water settings in washing appliances)

Use an outside clothesline in the summer, an inside drying rack in the winter

Block hot or cold air delivery to unused rooms, and close them off, making them buffer spaces for the conditioned balance of the house

Turn off unneeded lights, and de-lamp where fixtures over-light

Turn off electronics like TVs and radios when not in use

Reduce or eliminate standby power draw by computers and other electronics

Additional low-cost measures:

Very low-flow showerhead and faucet aerator

Programmable thermostat

Summer shading of sun-lit windows with awnings, trees, vines and bushes

Combustion air ducting

Added insulation to reduce heat losses or gains to water heater and pipes, chest freezers, water beds, hot tubs, spas, and swimming pools

CFL equivalents replacing quartz-halogen floor lamps and dimming fixtures

Earth-coupling and insulation to replace stock water heaters on farms and ranches

These measures and practices are among many that, in concert, can greatly minimize the use of purchased energy in the home.

The Important Role of Behavior

For all participants in the process, i.e., end users, distribution co-ops, rural generation and transmission co-ops, achieving energy savings will depend on some form of behavior change. A “simple” behavior change might be a decision to buy CFLs for the house, and a “complex” behavior change would be a decision to reduce the farm’s carbon footprint. Whether simple or complex, something must spur the individual to action. A seemingly purely technical retrofit program actually depends on attitudinal/behavioral changes at every level of involvement.

Knowledge alone is not sufficient to bring about change in energy use. By now most people “know” that using energy more wisely is good for their wallet, their business, their community, their environment, their descendents, and even for their peace of mind. Most will agree with this
statement, even the people that sell the energy. Still, there’s always a big disconnect in life between what we know and what we do; if that wasn’t so, we’d all be risk-averse. This disconnection between knowledge and action applies to energy, too, of course:

- It easily can be shown that we regularly get little or no useful product from more than 50% of the energy that we use in our homes, businesses and vehicles.
- The magnitude of the remaining energy-saving opportunity is not well known, and grasping that opportunity is going to mean paying better attention and a lot more effort.
- Yet most of us believe that we already are doing a good job saving energy.\textsuperscript{152}

As Shipworth has noted: “People rationalize their actions. They emphasize the positive aspects of their current actions and the negative aspects of the alternatives they could have chosen.”\textsuperscript{153}
It is likely that Shipworth’s observation relates as well to families, companies, and institutions.

The baseline uptake of rural efficiency program offerings today could be near zero, if the repeated reports on passive member resistance to co-op efficiency offerings are any indication. It’s clear that widespread changes in energy-using habits and practices are needed, which may require an evolution in rural cultural norms regarding energy management. Though lack of program experience and infrastructure initially appeared to be the most imposing barriers to launching successful rural efficiency programs, as we compiled this report, it is possible that the rural culture’s prospective inability to evolve its energy use patterns may, in fact, be a more pressing programmatic issue. Our optimistic speculation is that sufficient drivers and innate rural leadership\textsuperscript{154} exist to encourage the development and testing of reduced energy-use paths at small scale, then to grow those that are most cost-effective for the rural community.

Program planners can take heart from, and be instructed by, recent research from the field. These studies show that factors beyond demographics and traditional marketing considerations of price or advertising greatly influence a consumer’s decision to adopt energy-efficient behavior. Faced with new technologies, products, or strategies, consumers are more likely to be influenced by their own deeply held attitudes and self-interest.\textsuperscript{155} In rural areas, this can mean “selling” EC and EE as practical measures to advance individual and community goals in addition to cost savings,\textsuperscript{156} for example by promoting the CEDR benefits of:

- self-sufficiency and self-reliance (essential qualities of many rural people),
- improved product quality and quality of life (key elements to a happy, profitable existence),
- increased productivity and capacity for growth (a better future for the individual, the family, and the rural business), and
- improved security and peace of mind.

In addition to consideration of participant benefits, the studies show that social marketing, or community-based social marketing (CBSM) through engaging personal commitments, social interaction, pledges, and other personal responsibility elements to achieve behavioral change, can be an effective approach.\textsuperscript{157} Skumatz notes that these techniques have been integrated into such diverse fields as hazardous waste, recycling, and health for some time, and suggests that “with the increasing focus on the link between EE and greenhouse gas, and the increasing familiarity” with these techniques, more EE marketing campaigns should consider them.\textsuperscript{158}
According to Skumatz et al., five key elements define the successful social marketing program:

- Commitments to behavioral change (written commitments, public or group commitments, active involvement, leveraging from existing points of contact, and helping people view themselves as concerned),
- Prompts (reminders that are noticeable, self-explanatory, proximate, and encouraging),
- Norms (evolution of visible community norms, reinforced by personal contact),
- Incentives (paired to behavior, rewarding, visible, monetary and non-monetary), and
- Communication (credible, well-framed, personalized, memorable, goal-oriented, feedback-providing) to effect changes and participation.¹⁵⁹

Skumatz believes that the CBSM literature implies that programs based on this approach provide greater participation and behavior change, greater penetration to previously unconverted participants, and greater retention of the behavioral change.¹⁶⁰

To achieve program goals, energy customers must be reached with messages that change behavior. With regard to energy-using products, systems and facilities, consumer behavior can be measured against three indicators:

1. *Awareness*: the end-user behavior desired by the program will reflect a better awareness of energy impacts in the daily operation of energy-using products and systems.
2. *Purchasing*: end-user behavior desired by the program will reflect a longer range vision of energy impacts in the more thoughtful purchase of products and systems.
3. *Advocacy*: end-user behavior desired by the program will reflect a broader view of energy system interactions by demanding better efficiency from product and system manufacturers and upstream system operators.

Lifestyle energy-use changes are harder to accomplish than providing free light bulbs,¹⁶¹ and reliable results yet harder to measure, but we suggest that a range of program options can have the desired effects. As examples, time-of-use rates with very high on/off differentials and direct load control for a sizeable fee are both known to be quite effective at providing efficient energy use behavior that pays off for the utility and the participant. A real-time rate indicator, another option, enables the customer to self-monitor energy use, which can create a greater commitment to energy savings than external pressures or payments. These examples show that this can be done at better than just an intuitive level; the effects need to be better understood for reliably produced results.

In the next section, we draw these conclusions into the form of CEDR program recommendations.

Notes for Part 3:


Skumatz, Lisa A.; Gardner, John; Smith-McClain, Lisa; 2006. “Attributing NEB Values to Specific Measures: Decomposition Results from Programs with Multiple Measures.” Proceedings of ACEEE 2006 Summer Session. ACEEE, Washington, DC.


Harrington, Cheryl; C. Murray; L. Baldwin; 2006. “Energy Efficiency Policy Toolkit.” Regulatory Assistance Project (RAP), Hallowell, ME.

Anonymous, first heard by the author in 2005 at the DOE Weatherization Program Office, Golden, CO.

Personal communication with Jeff Umphlett, General Manager of Big Horn Rural Electric Company, October 2007.


While we agree that “Long term contracts and certainty are what the cooperatives by and large want and expect,” as noted by Jim Spiers of Tri-State in personal communication in March, 2008, we do not agree that that truism necessarily holds with extending contracts even longer to satisfy lender requirements for supporting new fossil generation. We believe such extensions inevitably restrict future flexibility by a rural cooperative and must have a negative effect on the potential and deployment of CEDR.

Of course, as Spiers (Ibid) has noted, complex situations surrounded the bankruptcies of both the WPPS and CUEA systems, but we observe that in both cases the main element was the belief that utility projections by expert and experienced engineers were sufficient. A parallel of confidence exists today with current utility projections by expert and experienced engineers of the requirement for new fossil generation, yet the energy future is far murkier than it was 25 years ago.


A Cooperative Board Member’s Guide to G&T Resource Planning” A white paper prepared in November, 2007, for Western Resource Advocates, accessed in February, 2008 at irp_white_paper_final.pdf. In this report another growing risk is noted: that of being unable to timely build a fossil generating facility, if at all. “Utilities know that certain types of resources will create more opposition than others and must plan for the potential effects of such opposition. In some cases, this may mean developing a ‘backup’ plan or even selecting alternative resources if the potential costs resulting from a cancellation or delay of construction would be too high. This could also be called the ‘buildability factor.’” As previously noted, such a factor is much less a concern with the CEDR alternative. CEDR programs will provide time for utility planners to become more familiar with the new generation of demand- and supply-side resources (e.g., conservation behavior, higher-efficiency products, energy makeovers, demand response, geothermal heating and cooling, charge/discharge of distributed electric storage like electric and hybrid vehicles, and distributed generation with solar and wind). With this additional time, the development of carbon regulations and related incentives will have evolved and utility management can then better determine the most advantageous future path.

To apply the Northwest Power Planning Council’s practice to a Southwest case, let us use the facts of the next fossil generating plant proposed to serve Colorado, which was estimated to cost 4-6 cents/kWh to build (before the run-up in steel, concrete, etc.). Conservatively using the arithmetic mean of that range, we would put out an RFP for the delivery of whatever reliable energy savings could be achieved in the territory at a cost of 5 cents/kWh. This author contends that the response to such an RFP would deliver an amount of energy savings in the rural sector equal to or greater than the output of the proposed fossil generating plant. Further, a lot of money would be spent in thousands of rural places to capture those savings, perhaps $800-1200 million over 10 years. This spending spree would improve the economy and the prospects of the territory for years to come, make the residents safer, more comfortable, and more financially secure, and spin off entrepreneurial ventures that retain and attract back the younger rural generation that otherwise will be lost to the sector.

Subjective rankings provided by SWEEP, March 2008.

We suggest that the ownership (by what Tri-State refers to as “the community of cooperatives”) of the value chain of coal mines, electricity generating plants, electric transmission lines, transformer substations, distribution lines, meters, and billing mechanisms looks very much like OECD’s definition of “vertically integrated:” A vertically integrated enterprise is one in which different stages of production, which are usually carried out by different enterprises, are carried out in succession by different parts of the same enterprise (the output of one stage becomes an input into the next stage, only the output from the final stage being actually sold on the market). Accessed March 13, 2008, at www.stats.oecd.org. Since the actual corporate arrangement at Tri-State may not be so clearly vertically integrated as a classic textbook case, perhaps “strongly integrated” is a better term. In either case, with regard to decisions to build new fossil generation rather than strongly investigating CEDR alternatives, we believe there should be concern about an effective daisy-chain of inter-related risks and fragilities that could negatively impact rural residents long-term.

Some reviewers were concerned that this list was unreasonably harsh in its description of electric co-
management practices. This was not our intent; in fact, many of the solutions listed are not within the purview of the rural co-ops, and are presented to encourage external support (from others in the report’s intended audience, e.g., rural economic interests, policy makers and the clean energy community) for mechanisms that will enable and encourage the co-ops to improve end-use energy management in ways that don’t fiscally threaten their continued operation. For everyone else, the list is intended to provide a window into the complex workings of a domestic energy system, the rural electric supply system, too large to be any longer ignored by clean energy advocates.

Other observations on the list are related to the utilities’ management of the rural energy supply picture, and must be mentioned as hopefully constructive observations of how things could evolve toward improved energy management and rural economic development. These are not idle and thoughtless observations, but are meant to offer a solid alternative perspective based on decades of experience in the CEDR field, and years of non-profit work with and for rural Southwest energy clients. More detailed recommendations will be found later in the report, but this list is intended to at least define the wide range of rural program barriers we believe must be addressed.

118 We consider that these programs will include those in the general categories of a) Energy Conservation, b) Low-Income Direct Install, c) Whole House Retrofit, and d) Trade Allies. An example of such a program that recognizes the logistical issues of rural distance is described in Appendix A. We additionally note that two national energy retrofit program vendors, EnSave and GDS Associates, have each provided over 1000 on-site Farm Audits, showing that for some rural programs distances have not been allowed to become an intractable problem.

119 Johnson, Katherine (Market Development Group), 2007. “Do the Math: Calculating and Articulating the Value of DSM.” Presented at Power Administration’s Workshop “How to Plan and Implement Demand Side Management Programs,” in Westminster, CO, January 2007. Market Development Group, Montrose, CO. Johnson notes that sometimes consumer demand trumps purely economic analyses, gives the examples of hybrid cars, clean/renewable energy, and recycled paper products, and points out that in many aspects of our lives we make decisions that are not the most rational from an economic perspective.


126 Bony, Paul (Delta-Montrose Electric Association), 2006. “We think energy efficiency is a key community issue; the more money members have in their pockets, the more they have to spend in the local economy,” quoted in USDA’s May, 2006 publication “Colorado Success Stories.”


132 Erickson, Paul, General Manager of Sangre de Cristo Electric Association, 2007. Personal communication regarding utility growth futures, November, 2007. Erickson suggests that owning the assets has several advantages for co-ops, including controlling long-term costs, and making the energy product more tangible to the local community.


134 Potter, Tom, SWEEP, 2007. Survey notes on discussions with 17 rural electric cooperatives, April to October (unpublished).

135 DeSoto, Rob (DOE Weatherization Program, Golden CO) personal communication, January 2008.


137 Personal communication with Brent Griffith, NREL, October 2007.

138 While Colorado’s energy makeover by the Colorado Energy Science Center includes a small solar generation panel in its more-recent estimate of “energy bills will drop by 20% to 80%,” the main savings come from a full menu of energy retrofits. Accessed March 13, 2008 at http://smartenergyliving.org/cm/Contest/Home.html.

139 Ibid.


142 Personal communication with Barbara Farhar, September 2007.

143 Personal communication with Lisa Skumatz, November 2007.

144 The inference for the widespread application of CEDR and on-site renewables in California can only be called stunning. The exponential program growth required to meet this challenging goal will throw off significant program benefits (e.g., product improvements and program templates) that will accelerate the development of efficiency programs in other regions


148 We are encouraged by programs in several states (e.g., Colorado and California) that demonstrate deep energy savings with a comprehensive retrofit of homes, the “whole-house” or “home performance” approach. Such an approach fits the rural geographic situation well, minimizing costs and maximizing performance with fewer trips by fewer people to a work-site. We have adopted the term “makeover” to describe such a comprehensive treatment, compared to the former term “retrofit,” which could mean either a piece-meal or comprehensive approach, but is a word that always has a “techie,” jargon feel that makes efficiency not as approachable by end-users.


151 Many common electronic devices have significant continuous power draws (TV: 6W, VCR: 8W, set-top TV boxes: 5-20W, PC: 1-5W; printer: 2-10W). In addition, some models of standard chargers and power transformers for kitchen appliances, cordless phones, answering machines and cellular phones use 2 W or more continuously. (Ref: 2006, Joint Research Centre, EU; Memo 06/386; Brussels, October 19, 2006).


154 As Summit Blue, Op. cit., has noted, “Tri-State has the opportunity to take a leadership role and to build on the knowledge and experience developed by some (of its own) member cooperatives with existing demand-side programs. Tri-State need not mandate the implementation of energy efficiency or demand response programs to involve additional member systems; it need only create incentives and the support infrastructure for a selection of appropriate DSM programs for its member systems to implement.”


156 We note that for many consumers the highest value of an energy reduction project, in fact, may not be the energy saving, per se, but some combination of other non-energy benefits.


158 Ibid.

159 Ibid.

160 Ibid.

161 Which will reduce the co-ops’ kWh revenue without providing much help reducing kW at the time of their system peak
Part 4: Utility Program Recommendations

In the range of people or institutions most likely to carry out EE and EC programs in about half the rural areas of the Southwest (Wyoming, Colorado, and New Mexico), co-ops and munis appear to be in the best position to lead the campaign. These utilities are not-for-profit entities formed to act in the best interests of their members and customers. They have close ties to their owners and customers and often are trusted sources of information and technical assistance. And these utilities are in a good position to fund such programs and recover the costs through monthly utility bills, at the same time recognizing and communicating to customers that investing in EE and EC is a better buy than electricity from new power plants.

In Arizona, Nevada, and Utah, investor-owned utilities provide these services, and in Arizona the Salt River Project, a political subdivision of the State of Arizona. Similar to other rural utilities, these utilities often are information sources and efficiency program supporters. In addition, these utilities more often have mechanisms separate from the rate process to recover CEDR program costs.

But what should rural utilities do? Where should they begin? And what can they expect to accomplish if they make a concerted effort to help their customers conserve energy and improve EE?

As a practical matter, utilities must first accept CEDR as a legitimate energy resource that can replace or eliminate the need for new generation. Once utility management and decision-making boards internalize and accept the underlying CEDR concept, they will be able to make the most rapid progress by following these steps:

- Analyze energy savings opportunities and achievable potential in the specific service area, especially as the CEDR opportunities and potential can help meet the utility’s load objectives.

- Develop system-specific energy savings goals and load-shaping targets, with costs and associated savings ramping up over time as experience is gained with CEDR programs. The time it takes to ramp up could be a significant factor in broader system planning, as many of the best programs today are new compendia of known elements, and just like the first generation of fluorescent lamps, they’re haven’t yet been developed with rapid-start versions.

- Visibly partner in the announcement and the implementation effort with one or more respected CEDR and socially responsible entities, nonprofit entities with standing as relatively objective and principled brokers, in addition to the various state energy offices (and possibly collaborating utility systems).

- Describe the estimated impacts on power bills, the broader economies in the overall service area, and other non-energy public benefits, and involve the public with these and other program discussions early on. Such early involvement:
  - Builds credibility and trust in by showing the utility as a community leader,
- Develops understanding of and support for the program,
- Improves the speed and ease of program launch, which translates to program cost savings, and
- Improves the performance of practices and measures implemented, which translates to improved program cost effectiveness.

- Acknowledge that program actions taken by end users could be immediately cost-effective, or they could be closer to cost-neutral long-term, but that they will in either case improve the delivery of electric services to homes and businesses in rural communities, and affect the well-being of every rural rate-payer, the strength of the local economy, and the health of the environment.

- Involve citizen pride with statements such as “we, the owners and end-users, can improve costs and reliability in this electric service area by taking informed, responsible action,” and show them how CEDR will
  - Keep more money in the local economy, circulating and multiplying benefits
    - The municipal utility in the little town of Osage, Iowa, (pop. 3400) uses energy efficiency as an economic development strategy. They have found that every dollar spent on energy efficiency in Osage generates $2.23 in economic activity.
  - Create quality, sustainable new jobs in the energy field
  - Attract community-friendly industry with a long-term stake in the community
    - By carrying out their energy-reduction programs, Osage was able to attract desirable industries due to reduced energy operating costs.
  - Use less water and produce fewer emissions

- Piggy-back on energy programs that will be proceeding without regard to energy efficiency. One excellent example is the renewable portfolio standard now in place or planned for many of the Southwest states. To gain leverage from this renewables program, consider a scheme whereby the rebate for solar, for example, is dependent on the efficiency of the home, so that it is less if the home is not up to a fairly tight standard, with reimbursement of the rebate balance if the home tests out to the proper level within a year.

- Support local follow-up by alerting citizens to the profitable opportunities in this growing field, with specific local information about likely cost and broader economic impacts, both direct and indirect, immediate and long-term. For example, an entrepreneur could build onto an existing HVAC or remodeling business, expanding current offerings and establishing a premium position in the CEDR market by differentiating the business from “box sellers” and less-capable vendors. An added advantage for the HVAC business is that such CEDR work can even out seasonal staffing.

Once the underlying goals have been established, partners engaged, and the CEDR concept publicly launched, the programs can be delivered.
Begin with the Current Energy Harvest

This report suggests the broad launch of the first phase of CEDR programs through rural Southwest utilities take place without delay, selecting the most regionally appropriate programs that have developed excellent histories of cost effectiveness in other areas. Costs and deliverables for these program elements are very well known, applicable in one form or another to most service territories in the Southwest, and need no further “testing.” The programs should be able to be launched with little difficulty, and only modest investment, i.e., beginning with 1% to 2% of a utility’s retail sales revenue.

- Encourage end users to choose many items from a comprehensive list of LC/NC practices and retrofit options, tailored to the service territory.
- Support a locally appropriate menu of investment-grade measures.
- Provide supporting rates and regulations that have worked elsewhere.
- Optimize lean utility program budgets by leveraging program partner contributions. For example, in many rural areas the CEDR infrastructure must be built up almost from the bottom. A utility sponsor can help by
  - Providing direct marketing for the program, improving its reach and credibility
  - Helping contractors with their own marketing and business development
    - Analysis of savings
    - Integration of measures
    - Locally appropriate inserts and other marketing materials
  - Helping contractors with the financing or collection effort
  - Helping contractors with quality training in energy use, analysis and measure retrofit.
- Empowering consumers with practical information.
- Performing a “prospects triage” specific to the local area, to focus resources.
- Targeting underserved segments to achieve broad system benefits.

Low-Cost/No-Cost Options

Establish CEDR Goals
Target the opportunistic capture of pent-up demand for EC and EE. Figure 8 shows one view of how to capture very early energy savings with little effort or cost: target those customers who will be the Innovators and Early Adopters in your service area. They have been characterized as having one or more of the following characteristics: wealthier, more motivated, innovator mindset, one of the credit-score elite, but in fact come from every strata of society and are motivated to act for many different reasons.
At the far left tail of the curve is represented a relatively small number of end users, the Innovators, who already have decided that CEDR makes sense for them based mostly on non-energy benefits (NEBs) such as prestige, comfort, environmental stewardship, energy security, or community contribution. They’re already sold on conservation and efficiency, and will need little incentive to carry out the activities you describe for saving energy and for making your delivery system work better with demand response. Enabling them to act (or act further) on those decisions will yield the program good energy and peak capacity results at little cost. Added to this group could be those customers with high bill complaints, who are motivated to do something about it. With some avoided cost rates in states neighboring the Southwest already at $0.20/kWh or more, high bill complaints will become more of a chronic institutional issue.

The next category is the Early Majority (or, in some related schemes, Early Adopters), and they are also predisposed to participate in a CEDR program, especially if there are home improvement or other non-energy benefits, but may need more support and incentive than the Innovators. Considering their predisposition, though, participation could be arranged fairly easily, and not expensively.

Further categories of participants, appropriately named Late Majority to Laggard, will need progressively more program support and financial incentives to participate in CEDR programs. By initially concentrating on the left tail of the curve, however, utilities can reduce program costs per kilowatt-hour and kilowatt saved. They will also be optimizing their programs and providing the kind of “as-built” energy savings experience that will speak most strongly to the unconverted, in later program offerings.

---

**RURAL UTILITY EXAMPLE 1**

Waverly Municipal Utility, a 5000-member utility in Iowa

- History as leader in energy matters
  - Developed safer soy oil for electric transformer fluid
  - Installed 1<sup>st</sup> large wind turbine in Iowa; now there are more than 350
- Waverly board said to reduce capacity needs defined by Integrated Resource Plan by 40%, then meet that capacity with efficiency
- Programs: HVAC, Heat Pump, Lighting, Appliances, Good Cents
- Also: Inverted summer rate beginning at 8.5 cents, jumping to 17 cents over 1500 kWh
- Resulting capacity costs in 2006 from CEDR were about $800/kW
- Reaction: at public meetings, members cheered the equity and good sense of this course of action
A framework for this early work will be to define CEDR program goals for saving energy and reducing peak demand. In the early stages of these efforts, utilities may want to emphasize either peak demand reduction or energy savings, depending on their particular load shape, load growth and financial characteristics. For example, high growth utilities with expensive marginal power purchase costs may prefer an emphasis on energy savings, while slower growth utilities with a poor load factor (i.e., high peak-to-average power demand) may prefer to emphasize peak demand reduction. Nearly all the CEDR practices and measures we discuss can be implemented in ways that support either goal.
Prepare and Communicate Low-Cost/No-Cost Information
A critical step will be to tailor the CEDR message to specific audience motivations, e.g., increased comfort, cost savings, pollution prevention, energy independence, community self-sufficiency, etc., as determined by focus groups or surveys (or simply by exercising the judgment that comes from understanding your customer base very, very well, and being prepared to go back to Square One if you’re wrong). At this stage, it would be appropriate to establish an in-house CEDR presence and program-dedicated staff supported, if necessary, with experienced program-delivery contractors to staff a help line, prepare website updates, hand out advertising materials, etc.

An early task would be to screen regional selections from a comprehensive list of do-it-yourself actions, with clear how-to instructions for suppliers, homeowners, farmers, ranchers, business owners, industry groups, and others. An example of a popular, utility-involved, LC/NC measure with very rapid payback for both utility and end user is the Second Refrigerator Turn-in. Other examples were listed previously in Section Two: Practices and Measures. For commercial end users, this could include providing audits for free or at a reduced cost, including installing low-cost/no cost measures such as CFLs, weatherstripping, and low-flow showerheads, faucets, and rinse nozzles during the audit in order to provide “instant savings.” Aspen Utilities finds that CFLs, for example, are a great door opener, in that they

- Touch all customers,
- Allow the utility to relate more with the public, and
- Introduce the chance to talk about other CEDR options like appliances.

Aspen Utilities has high school students hand out the “energy starter kits” with notes that amount to CEDR information and education, and may give end users a reason to care about their energy use. Being a part of such an informational campaign is important for utilities that wish to maintain and build on their “leadership position as a trusted energy savings information broker,” as suggested by Thomas.

Conduct CEDR Outreach
This is where utility and CEDR advocates extend the message to community leaders (e.g., elected and appointed officials, leaders of organizations and groups), innovators and local CEDR working partners. Trade allies

---

RURAL UTILITY EXAMPLE 3
Delta-Montrose Energy Association, a 25,000-member rural electric cooperative in Montrose, Colorado
- EPA Energy Star award for innovative CFL promotion
- Hosts regular efficiency seminars
- Started own insulation company to fill local market need
- Long a leader in promoting ground source heat pumps and fuel cells
- Offers attractive loan packages (e.g., no down, 7.5%, 30-year for heat pump system)
- From DMEA’s Vision related to Energy Efficiency
  - Will be the efficiency benchmark for cooperatives throughout the nation.
  - Will promote and educate customers on the effective use of new energy efficient products, and have fun as the vision is realized.
  - Will develop key measures of internal efficiency to become a part of the “big goal.”
  - Will be the leader of energy cooperatives in promoting environmentally feasible projects and distributive energy technology.
  - Will be the nation’s choice for consulting intellectual capital for comfort, convenience and efficiency programs.
  - Will deliver customer energy savings equal to 25% of its 2000 electric sales by 2010.
can be recruited to involve their financial interests in program implementation at any level possible. Thomas sees such motivated trade ally collaboration as one of three keys to leveraging cost-effective program delivery.\textsuperscript{179} These CEDR trade allies will often include energy-saving product wholesalers, distributors and retailers (e.g., big box retailers as well as “mom and pop” hardware stores), energy-saving service providers, and possibly other energy-related industries, e.g., renewable energy (solar, wind, geothermal, biofuels), transportation (e.g., liquid fuels), feed and implement, and extraction (e.g., gas, oil, minerals).

Beyond these working partners, utilities should make it a priority to reach rural community economic interests, enlisting broad field support for CEDR messaging and program delivery. This group would include the local Resource Conservation & Development Council, Extension Service, and other rural economic development groups, e.g., county administrators and commissioners, state and federal elected officials, Chambers of Commerce, independent and franchise banks, farmer/rancher associations, etc.

Other community partners have roles to play as well. Schools can help involve youth in crafting their energy futures through activities such as energy-saving educational and motivational curricula, practical hands-on energy-saving training through class and extra-credit projects, and technical training for energy-related employment through shop courses. Future Farmers, 4H, and Scouts can become involved in extracurricular energy exploration activities. Local offices of government agencies such as the U.S. Department of Agriculture (USDA), Housing and Urban Development, U.S. Environmental Protection Agency (EPA), DOE, national laboratories and the land-grant university Extension Service can provide access to expertise and field experience with energy topics. Congregational youth groups and civic organizations (e.g., Rotary, Lions) could also be involved in community energy upgrade/economic uplift efforts.\textsuperscript{180} Communication about programs and opportunities must go to hard-to-reach energy end-users as well, through nontraditional channels such as community action and weatherization agencies, immigrant support and advocacy groups, faith-based organizations, senior citizen groups, and community legal services.\textsuperscript{181}

*Use the Available Research To Help Get Your Program Off to a Good Start.*

First, according to Mapp and Smith,\textsuperscript{182} state weatherization programs can help stabilize new technologies in an area, helping to identify models prone to failure, improve installation practices, and drive the price down, while reducing concerns related to reliability and call-back. Knowledge of this finding can help utilities partner with retrofit colleagues that can make their jobs easier and cheaper.

Second, many researcher have shown that consumers will act effectively and use energy wisely if they are sufficiently motivated and have the know-how. Many people have concrete strategies for affecting know-how, but we must look to the latest communications research and recent advances in the understanding of how energy decisions are made to inform our communication with consumers about CEDR. For example, it is now known that to be effective you should:

- Keep the message simple and consistent throughout the energy saving campaign, as in:
  - Saving energy is important, and is the smart thing for you to do right now
  - We have practical, cost-effective energy-saving options for every end user
You can make a difference, and start saving money, today.

- Emphasize easily understood concepts such as cost and performance rather than on energy jargon references to “peak hour,” “audits” and “retrofits.”
- Obtain “individual commitment” to making a small EC or EE improvement; such commitments are known to translate to larger efficiency improvements later. Also, once homeowners or businesses start to see benefits, they become much more willing to take additional (and more costly) actions.

Third, Skumatz reports that promoting non-energy benefits can be used as a utility program sales strategy.\textsuperscript{183} Building on her findings, a utility could couple energy savings with other benefits such as better home esthetics and comfort, greater occupant productivity, and lower maintenance costs to yield a greater demand for CEDR programs, practices and measures.

Fourth, Lutzehizer believes that if we can show the consequences of lifestyles and acceptable alternatives “graphically, vividly, and convincingly,” we may be able to tap the capacity of consumers to be strongly motivated to act, as shown by the California energy crisis of 2001. The factors he says were shown then include, in addition to the expected cost-consciousness:

- Efficiency consciousness (avoiding waste)
- Environmental values, and
- An altruistic interest in “doing our part”\textsuperscript{184}

\textit{Investment-Grade Options}\textsuperscript{185}

\textbf{Residential} – Products could include less-common types of CFLs (the more common sort should already be distributed under LC/NC programs), insulation, ENERGY STAR appliances and light fixtures, high-efficiency air conditioning or evaporative cooling, air- and ground-source heat pumps, and high-efficiency domestic well pumps. Less-common investment-grade offerings by utilities include trees to reduce solar gain,\textsuperscript{186} 187 188 189 geo-exchange systems,\textsuperscript{190} 191 thermal walls, and automatic standby generators.\textsuperscript{192}

Utility program actions can include these strategies:

- Survey homeowners to assess their motivations for CEDR action, and focusing the utility’s regional program on those drivers.
- Provide rebates that cover at least 50% to 75% of the first cost of efficiency measures, or the incremental cost in the case of products like high-efficiency appliances or HVAC equipment, to help homeowners overcome their resistance to buying energy-efficient products with higher first costs.
- Apply the utility’s unique knowledge of regional housing stock to customize residential do-it-yourself energy retrofit instructions for relevance and effectiveness.
- Facilitate high-quality instrumented home audits at a discount for homeowners who want detailed home energy assessments. In more than 50,000. Canadian audit/retrofit projects, about 75\% of the recommended program measures were installed, at a cost of about $7,350 per home.\textsuperscript{193} Assuming that more expensive measures were typically foregone,
this would indicate that (for the Canadian list of measures, in Canadian housing stock, in Canadian climates) a typical “full” retrofit of cost-effective measures would cost more than $10,000. The demonstration of home energy makeover for the Southwest that we describe in Appendix A should cost less than $8,000 per home for 35%-60% savings.

- Provide training, certification, and outreach to increase the skills of builders, contractors, and EE service providers in the utility’s residential service areas.
- Educate the public and promote the CEDR technologies to increase the availability of and demand for energy-efficient home products and services.
- Have experienced residential CEDR specialists available for on-site visits, help line, and website contributions, preferably persons from within the distribution utility, or a local contractor.
- Facilitate energy makeovers with performance guarantees and no-interest financing.

Commercial – Products could include high-efficiency lighting products, ENERGY STAR commercial appliances, high-efficiency air conditioners or evaporative coolers, heat pumps, and premium motors and drives. Utility program actions can include:

- Survey commercial-rate customers to assess their motivations for CEDR action, and focus the utility’s regional commercial energy savings program on those drivers.
- Provide rebates and other incentives to help overcome the resistance that businesses have to purchasing energy-efficient products that have higher first costs.
- Understand and leverage business-specific energy-related and non-energy motivations (e.g., cost savings, increased profits, higher productivity, visibility in the community).
- Apply knowledge of commercial building stock to customize commercial do-it-yourself energy retrofit instructions for relevance and effectiveness.
- Arrange high-quality instrumented business energy audits at a discount for businesses that want detailed energy assessments.
- Provide training, certification, and outreach to increase the skills of builders, contractors, and EE service providers in the utility’s commercial service areas.
- Educate the public and promote the technologies to increase the availability of and demand for energy-efficient commercial building products and services.
- Have experienced commercial sector CEDR tech support specialists available for on-site visits, help line, and website contributions, preferably a person within the distribution utility or a local contractor.

Nearly all commercial meters are for very small enterprises, as any utility demographer will confirm, with the great majority of monthly demand peaks less than 20kW. Although 10% of the meters can account for 65% of the load in some service areas, these hard-to-reach smaller businesses have a difficult time participating in traditional utility rebate programs because of lack of time, lack of know-how, and lack of money available for taking on CEDR projects, as Geller has noted.
Consequently, some utilities include a direct installation component or program for small businesses as part of their suite of business CEDR programs. This means hiring a contractor (or multiple contractors) to conduct marketing and install CEDR measures free or at a deep discount (e.g., paying an incentive of 75% to 80% of the installed cost) for small businesses. In addition, some utilities offer to finance the remainder of the project cost with a low-interest or zero-interest loan. This type of program minimizes the hassle and upfront monetary cost for small businesses, resulting in much greater program participation for small businesses compared to rebates alone. Programs along these lines have been successfully implemented by various utilities in New England and California, and have been proposed elsewhere.\textsuperscript{195} An important program-planning observation is post-surveys data suggesting that over 70\% of participants in one successfully retrofit program first heard about the program from a “feet on the street” marketing effort.\textsuperscript{196} This suggests that mailers and other low-cost program offers may not be sufficient to get good program participation for this class of end-users.

**Agricultural** – Products could include high-efficiency lighting, evaporative cooling, premium motors and drives, fans, pumps, and compressors, process heat capture. Utility actions can include:

- Survey farmers and ranchers to assess their motivations for CEDR action, and focus the regional agricultural energy savings program on those drivers.
- Provide on-site technical help (like pump testing\textsuperscript{197} and incentives to upgrade the efficiency and reduce the peak demand from water pumping and irrigation systems) and rebates to help overcome farmers/ranchers’ resistance in buying energy-efficient products with higher first costs.
- Provide other technical and financial to farmers, ranchers, and agricultural industries that want to improve the cost effectiveness of their energy use.
- Understand and leverage regional agriculture-specific motivations, including non-energy drivers (e.g., independence, self-reliance, and adaptability).
- Apply the utility’s knowledge of regional agricultural operations to customize do-it-yourself energy retrofit instructions for relevance and effectiveness.
- Facilitate high-quality instrumented agricultural energy audits at a discount for farmers and ranchers who want detailed energy assessments.
- Provide training, certification, and outreach to increase the skills of builders, contractors, and CEDR service providers in the utility’s agricultural service areas.
- Educate the public and promote the technologies to increase the availability of and demand for energy-efficient agricultural products and services.
- Have experienced agricultural CEDR specialists available for on-site visits, help line, and website contributions, preferably a person within the distribution utility, or a local contractor.
Snead has identified a number of areas where funding (from the utility or other program interests) can help optimize CEDR savings:

- Cost of CEDR equipment purchase
- Cost of educating consumers
- Technical assistance with analysis and equipment
  - For example, our discussions with rural energy interests indicate that little of the following building diagnostics equipment if available in rural places:
    - Blower door (to pressurize the house as part of an air-sealing retrofit)
    - Duct blaster (to pressurize heating/cooling ducts to reduce their leakage)
    - Infrared camera (to identify thermal anomalies through their radiant energy signature)
    - Combustion analyzer (to help improve efficiency of fuel-fired equipment)
- Program promotion
- Training energy system operators (residential, commercial, and industrial)
- Measurement and verification of initial savings and savings persistence, with feedback to program implementation

Technical program assistance also is available from two companies, EnSave and GDS Associates, which have each already conducted over 1000 on-farm energy audits, and can accomplish this on a contract basis for other utilities, too.

What Is Already Happening in the Rural Southwest
Across the region, CEDR budgets are growing. Table 9, compiled by SWEEP, shows the growth of utility DSM programs over the past few years. However, this growth and commitment to efficiency are, to this point, predominantly by IOUs and a fewmunis serving primarily urban and suburban areas (though in Arizona, Nevada, and Utah the IOUs have a major role to play in rural areas as well). Very little of the funding is from cooperative rural utilities as far as we know, though discussions indicate that a more equitable share to the existing growth is likely to be forthcoming. One reason for that conclusion is the future direction described by experts in the field. For example, EUCI notes that “utilities must adapt to survive and stay competitive in this new digital era. The power network of the future will be real-time, responsive, eco-sensitive, price-smart, self-diagnosing, self-healing, and interconnected. Regulators will mandate – and consumers will demand – the integration of renewable energy along with energy efficiency and conservation programs.”
### Table 9: Growth of Utility DSM Programs in the Southwest, 2002-2008

<table>
<thead>
<tr>
<th>State</th>
<th>2002</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007 (est)</th>
<th>2008 (est)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arizona</td>
<td>4</td>
<td>4</td>
<td>10</td>
<td>19</td>
<td>32</td>
<td>42</td>
</tr>
<tr>
<td>Colorado</td>
<td>11</td>
<td>21</td>
<td>24</td>
<td>18</td>
<td>25</td>
<td>32</td>
</tr>
<tr>
<td>Nevada</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>30</td>
<td>38</td>
<td>54</td>
</tr>
<tr>
<td>New Mexico</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Utah</td>
<td>9</td>
<td>16</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Wyoming</td>
<td>≈0</td>
<td>≈0</td>
<td>≈0</td>
<td>≈0</td>
<td>≈0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Region</strong></td>
<td>29</td>
<td>54</td>
<td>70</td>
<td>93</td>
<td>129</td>
<td>171</td>
</tr>
</tbody>
</table>

*Source: Southwest Energy Efficiency Project*

A selection of the exemplary policies and EE programs being implemented in the region follow:

**Multi-State**

- Rocky Mountain Power
  - ENERGY STAR New Homes Program and Energy FinAnswer and FinAnswer Express business rebate and technical assistance programs. Both were recently cited as Exemplary DSM Programs by ACEEE.\(^\text{202}\)

- Xcel Energy
  - Energy Design Assistance – Custom Consulting Program, One-Stop Efficiency Shop Lighting Rebate Program, and Lighting Efficiency Program. All three were cited as Exemplary Programs by ACEEE,\(^\text{203}\) and the Energy Design Assistance – the Custom Consulting Program is available in Colorado.\(^\text{204}\)

**Arizona**

- “Economic benefit” is a new statewide focus; energy savings are projected to provide $5.6 B in net benefits by 2020.\(^\text{205}\)

- Tucson Electric Power\(^\text{206}\)
  - Shade tree program

- Arizona Public Service
  - ENERGY STAR Lighting Program, buying down the cost of CFLs at many retailers, was cited as an Exemplary Program by ACEEE.\(^\text{207}\)

**Colorado**

- Statewide
  - Governor Ritter is calling for 20% energy savings by 2020
  - New PUC rules establish
    - Precedence of lower bill over lower rates
    - Building energy standards must be applied statewide
Utility Reports

- Delta-Montrose (see text box)
- The Platte River Power Authority (PRPA, a G&T providing power to four municipal utilities in northern Colorado)
  - Provides incentives for high efficiency air-conditioning equipment and for other measures that reduce summer peak demand.
  - DSM programs are implemented via the municipal utilities that PRPA serves.
  - PRPA spent $2.2 million on these programs between 2002 and 2005 and reduced peak demand by 5 MW, meaning a cost to PRPA of just $440/kW.
  - In addition, PRPA provides other energy services including energy audits, building design review, EE training for customers, and distributed generation assistance.

- Holy Cross Electric Association – An Evolution of Customer Attitudes

  - This section compares customer surveys in 2003 and 2007
    - 2003
      - Management should prioritize 1) reliability, 2) cost, and 3) environmental impact
      - Customers willing to pay 5.1% more for environmental effort
    - 2007
      - Management should prioritize 1) environmental impact, 2) reliability and 3) cost
      - Customers willing to pay 7.7% more for environmental effort
      - Also willing to pay surcharge for large renewables projects
  - Green power programs are fully subscribed, with long waiting lists, indicating a desire for alternatives to conventional power capacity

- Xcel Energy

  - Consent decree yielded a 2006-2013 plan for the company to save 320 MW at peak, 800 gWh total, and has filed a program to double that goal by 2020
  - In October 2007, Public Service Company of Colorado (PSCo), a subsidiary of Xcel Energy, proposed greatly expanding its CEDR programs in Colorado. In fact PSCo proposed achieving 50% of the economic potential for electricity savings identified in a recent DSM market potential study through DSM programs implemented during 2009-
2020. PSCo projects that these programs will reduce peak demand in 2020 by nearly 700 MW and save consumers and businesses $1.3 billion net.\textsuperscript{210} PSCo supplies 55\% of the power consumed in Colorado, mainly in urban and suburban areas. The fact that PSCo is planning to greatly expand its CEDR programs, and that other investor-owned utilities in the region have already done so, should make it easier to implement CEDR programs in rural areas of the Southwest, by increasing the availability of energy-efficient products and services in the region.

**New Mexico**

- **Statewide\textsuperscript{211}**
  - Mandatory energy code is being updated
  - Governor Richardson recently signed legislation directing gas and electric IOUs in the state to achieve 5\% reduction in energy use, adjusted for growth, by 2014, equivalent to 12.5 gWh/y,\textsuperscript{212} and 10\% by 2020.\textsuperscript{213} Said House Speaker Ben Lujan: “As the price of traditional energy sources continue to skyrocket, energy efficiency is a proven means to keep citizens’ utility bills as low as possible.”\textsuperscript{214}

- **Utility Reports**
  - Rebates for advanced indirect evaporative cooling systems\textsuperscript{215}
  - Direct Install program for low-income residents\textsuperscript{216}

**Nevada**

- **Statewide\textsuperscript{217}**
  - Renewable Portfolio Standard: 20\% of sales by 2015
    - 25\% of the 20\% renewables must be energy use reductions
    - 50\% of the 25\% energy use reductions must be in residences
  - Financial incentives being provided for DSM program costs
  - First state to outlaw poor efficiency lighting technologies (incandescent)
  - New legislation proposes energy assessment at time of home sale

- **Utility reports\textsuperscript{218}**
  - Nevada Power
    - Direct Install program for small commercial and industrial customers
    - Award-winning Hispanic outreach

**Utah**

- **Statewide\textsuperscript{219}**
  - Governor Huntsman is calling for 20\% energy savings by 2015
  - 2006 IECC energy code standards now mandatory statewide

- **Utility Reports**
Rocky Mountain Power\textsuperscript{220}
- Controlled irrigation loads will amount to 10 MW in 2008, built on success in Idaho, where the controlled irrigation loads amount to 80 MW
- Time of use rates are available to all customer classes
- Summer inverted rates for residential customers
- Proposed DSM programs with a spend rate capped at 1\% of revenue

Pacificorp\textsuperscript{221}
- Ramping up to putting 2.5\% of revenue into CEDR programs

Other notable program and performance highlights from entities and utilities serving rural areas outside the region, and from experienced energy program analysts, include:

- Sacramento Municipal Utility District (SMUD, California)\textsuperscript{222}
  - 15\% energy savings expected system-wide over 10 years

- Aquila (Iowa)\textsuperscript{223}
  - School-based energy education

- Xcel Energy (Minnesota)\textsuperscript{224}
  - Minnesota commission has changed the title of “Least Cost Resource Planning” to be “Cost Effective Resource Planning” (CERP)
  - Under CERP, Renewables and EE have been elevated in importance, as added to definitional language: CERP will take into consideration “beneficial contributions of clean energy and energy-efficient technologies”
  - CEDR (or DSM) has gained importance in resource planning universally due to:
    - “Long-running programs have steadily increased the total impact in energy savings”
    - State mandated “stretch” CEDR goals are sweeping the country
    - Climate Action Plans/carbon management

- Peak control at East River Cooperative (South Dakota)\textsuperscript{225}
  - Directly controlling 60,000 separate point sources of load, including air conditioning, irrigation pumps, water heaters, and industrial processes
  - About 25\% (105 MW) of total load is now under peak control

- Irrigation Pumping Insights from Nebraska Public Power District\textsuperscript{226}
  - Average demand savings from control of irrigation pump systems is
    - 14 kW for the pump
    - 17 kW for the water delivery system
  - Two out of three irrigation systems have EE opportunities
• If We Pretend Climate Warming Is Real, What Will It Take? (National)\textsuperscript{227}
  o CEDR goals will have to be made deeper, broader, and more comprehensive
  o We will have to save 30\% to 70\% in customer facilities, rather than the 5\% to
    25\% projected by many current programs
  o We will have to acknowledge the perception of policy makers (and likely the
    public), that the electricity sector is not only crucial but one of the easiest in
    which to achieve greenhouse gas reductions
  o We will have to proceed with CEDR as the “best” way to gain greenhouse gas
    reductions in the electricity sector; it is not only the easiest and cheapest, it
    provides net economic benefits

• Persistence of Annual Electricity Savings Targets (New York)
  o Technical/economic feasibility (30\%/25\% energy savings) in New York State
    remained unchanged from 1989 to 2003 despite major CEDR programs over the
    14-year period.\textsuperscript{228} This suggests that rural buildings in the Southwest, which have
    not enjoyed far-reaching audit/retrofit treatments, should achieve much higher
    levels

• National Rural Consultancies
  o The consulting firm EnSave, Inc. specializes in the design and delivery of EE
    programs for America’s farms and ranches. EnSave is implementing programs in
    New York, Minnesota, California, and elsewhere promoting use of variable speed
    drives and other EE measures. In New York, 570 farms are participating in the
    program and saving 10 GWh per year of electricity as a result.\textsuperscript{229}

\textit{What Utility Managers Can Do}

\textbf{Start in-house} – Energy suppliers can get first-hand program experience with consumer
motivation, push-back, and logistics by launching a mini-version of a CEDR program in-house. Following are a few ways to get started:

• Begin by tightening up your own utility operations (buildings, yards, shops, vehicles)
  from an efficiency perspective, acquiring experience in your own headquarters and shop
  buildings with the wide range of energy-efficient products and practices that will
  significantly reduce energy use.

• Find ways to experiment with load-shaping in your own headquarters building, leading
  you to experiment with on-site controls and other devices (like thermal mass) that limit
  peak demand and/or shift demand from on-peak to off-peak periods.

• Acquire experience with V2G by purchasing a plug-in hybrid for company use and
  seeing how it can be used to increase your system efficiency (load factor) by providing
  load off-peak and providing resource on-peak. Prepare for the day when you may see
  hundreds or thousands of biodiesel-electric plug-in hybrids in your service territory.

• Launch a simple energy efficiency outreach program, at small scale, to discover how well
  you can apply the capabilities of your staff and your community. To apply CEDR most
cost-effectively, try first to leverage the resources of your customers who want to use energy more wisely but may not know how to do that. Appendix A describes a simple four-step process that will accomplish this and other worthwhile objectives. SWEEP is ready and able to help with such a process.

**Provide supporting rates and regulations** – Adopt inverted block rates for residential customers, similar to those already in place at many utilities (e.g., in which the tiers are reversed from today, with higher rates per kWh as consumption increases) that encourage EC and EE. Such rates leverage appropriate action from end users, and utility program experience has shown that they will more often help achieve program goals if the following conditions are met:

- Customers are given adequate early notification that new rates will go into effect.
- Customers are given information and financial assistance (e.g., rebates) to help them control their energy bills by reducing their energy use.
- CEDR programs are targeted to some degree to customers whose bills will increase after the new rates are implemented.

**Leverage other resources** – Smaller utilities can optimize the effectiveness of what is likely to be very limited CEDR program dollars if they:

- Team up with other nearby rural electric coops or munis to implement programs on a regional scale
- Replicate appropriate elements of programs that have delivered results cost-effectively in similar situations elsewhere
- Use “lessons learned” from programs that have been offered elsewhere, both successful and unsuccessful
- Use materials from and marketing national energy-saving brands like EPA/DOE’s ENERGY STAR® program
- Find and cultivate community leaders and trade allies who will
  - Help planners understand the particular non-energy motivators in each community
  - Spread the word about the program
  - Promote the program as a good opportunity for the community
- Locate and engage contractors who can provide “one-stop” program implementation support (i.e., marketing, installation, and rebate fulfillment), even in rural/semi-rural areas. Examples of such national companies, their contacts, and the regions within which they have done most of their work to date, include
  - Conservation Services Group – Paul Berkowitz
    - Pacific Northwest, California
  - Performance Systems Development – Gregory Thomas
    - Maine, Pennsylvania
  - ICF Consultants
    - Building on the Austin (TX) experience
First Targets

Overall approach – Utility program planners should apply a form of “triage” to end-user prospects in their service territory, that is, split their end-user market into three groups: 1) those that are ready to participate right now, 2) those that will never be ready to go, and 3) the large group between the two extremes. This is not the daunting task it may appear to be, given that many consumers in the first group have already identified themselves as such, or would readily do so if asked, and in this way they will provide a ready point of access for any new program.

- This first of three groups of electric energy end users is composed of individuals who essentially are already “sold” on CEDR and who will carry out a broad array of such practices and measures with simply information and technical support, with little added incentive (these end-users are often called “Innovators,” “Early Majority,” and “Early Adopters,” as identified on the bell-shaped curve shown previously). This group is growing daily via something that might be called the “media ripple effect” as it relates to climate issues, and they will provide rapid and extensive program impact, program feedback, and sites for program demonstrations.

There is no law that says incentives are needed to encourage CEDR, or that they must be the same for all takers. It is a common occurrence for auto dealers, for example, to change their incentive programs on a weekly basis. They are responding to the observation that many car-buyers are going to buy the car anyway, and the dealer benefits from that by saving their incentive dollars. With each succeeding sale, though, the dealer has to put in more effort and more resources to keep sales volume at an acceptable level.

- The second most easily-identifiable group of electricity end users is made up of those very reluctant to undertake conservation practices or invest in efficiency measures (they are the so-called “Late Adopters” or “Laggards”). This group may finally act when the community consensus is perfectly clear or regulations are enacted, but are likely to hold out until forced by inconvenience (e.g., when it becomes impossible to find or buy an inefficient appliance) or regulation. Program dollars would be wasted trying to convince this group before its members are ready to be convinced.

- The final group, which forms the majority middle area, should be our focus after the Innovator group has been tapped, as they are by far the largest group and have not decided yet whether CEDR is worth the trouble. Education and financial incentives (e.g., rebates) will likely be needed to convert this group to action, but their buy-in will create important momentum for the CEDR movement.

Underserved customer segments – Utilities should address low-income end users and very small, often struggling, businesspeople, who are often harder to reach but have ability-to-pay problems that can be reduced with Conservation and Efficiency. As Geller has noted, helping these customers use electricity more efficiently is especially important given the high energy cost burden that low-income households and businesses bear.230

- Low-income individuals and businesses often occupy structures they do not own, so have some structural inefficiencies to contend with and have little control, or long-term incentive, to change the structure even if they had the financial wherewithal (which, by definition, they probably do not). Many small rural businesses fall into this category.
• Utilities can save their members and owners some of the cooperative costs accrued through arrearages, higher collection costs, and disconnection costs\textsuperscript{231} by fixing these chronic structural forms of energy waste, reducing end-user economic stress and, hopefully, supporting bill-paying customers.

• The lasting nature of the multiple forms of savings in these energy-wasting rental structures will pay off for the utility over time through the succession of low-income tenants who often occupy the same structure, and could have similar collection histories.

• Small businesses can be effectively reached through a one-stop direct installation approach where a contractor installs EE measures free or at a steep (70\% to 90\%) discount.

Consider a neighborhood saturation program (often called a Blitz or a Sweep,\textsuperscript{232} or direct-apply) in which a team of energy practitioners provides a concentrated effort over a limited period of time. They provide actual on-site information, products, and services that are known to yield reliable energy savings, reducing program costs that are otherwise attributable to wasted analysis and communication, windshield time, and relatively poor uptake. Reaching this market segment usually requires free measures and weatherization services, but the effort pays off with reliable energy savings in settings that have low savings potential under standard programs.

Common sense - Finally, common sense should prevail in the planning of programs. To fit well within a utility’s interest and capacity, CEDR programs should reflect the specific local situation with regard to climate, power delivery constraints, socioeconomic status, and market flexibility. For example, a systems approach like Home Performance (a new concept for addressing comprehensive retrofit [or energy makeover] for existing homes) is especially useful in rural areas from a logistics and program efficiency perspective because you avoid the multiple iterations of analysis, sales, installation, rebate, and operational issues with each efficiency widget, each of which could occasion an expensive site visit.

As another example, any utility in the Southwest is aware that refrigerated air conditioning is a major driver of facilities cost and peak power costs. A “good fit” program will leverage the innate knowledge of the climate in the Southwest, taking advantage of:

• The dry air to encourage evaporative cooling (from absorptive media to cool the air and from the skin to cool the person)

• The nighttime “valleys” in the demand curve to pre-chill existing or added thermal mass,\textsuperscript{233} taking some or all of the building’s cooling load off the following day’s peak

• The customer’s desire to maintain comfort, not consume kilowatt-hours, which desire can be satisfied in ways that do not require “brute force” on-peak chiller operation.

• The dry air benefits, which will be far greater than those of a “one size fits all” CEDR menu built up in consideration of other climates, load profiles, and end users.
**Accomplishments**

Successful CEDR programs will provide many or all of the benefits listed previously, most notably the reduction in need for additional and costlier generating capacity of any sort. For example, Xcel Energy has achieved 0.75% system-wide kilowatt-hour savings annually, or greater, from its DSM programs in Minnesota over many consecutive years of operation. Xcel has proposed achieving close to this level of savings from its DSM programs in Colorado. Other leading utilities nationwide are cutting their electricity energy by 0.8% to 1% per year with CEDR programs, and Utah has set goals of at least 0.5% per year for municipal and rural utilities with more than 5000 meters.

While it would be extremely difficult to forecast for the entire rural Southwest savings at the 20% to 40% level suggested here for the rural residential and commercial sectors, supportive analysis has taken place on related program proposals. For example, Colorado’s House of Representatives passed HB-1107 in February 2008, describing an energy efficiency spending plan for the state’s rural and municipal utilities with over 5000 meters. With a required spend rate of 2% of annual revenues beginning in 2010, this legislation is projected to save Colorado residents more than 1.5 billion kilowatt-hours by 2020, and 420 megawatts of peak power. The proposed Colorado rural program builds on precedent, as the covered municipal utility in Fort Collins has had an active and effective efficiency program for many years, saving electricity at the rate of 1.5 cents/kilowatt-hour, one-quarter the cost of new electricity supply.

**Prepare for the Follow-On Energy Harvest**

To provide program growth and continuity, the most common barriers that today restrict the ready uptake of CEDR must be addressed; then further program elements for launch can be prepared. In this case, the program costs and impacts of these CEDR practices and measures are reasonably well known, but may need further clarification before program details can be fully defined. Below, programmatic solutions are followed by the bulleted issues/concerns they address.

1. Improve energy-use awareness, program delivery, and communications to overcome end-user apathy and perception of “hassle”
2. Adapt (from other marketing programs) ways to make energy-saving visible and desirable
3. Encourage the use of energy codes in rural communities, and address the various forms of split incentives
4. Demonstrate the market readiness for new CEDR products, to encourage the private sector to carry more of the commercialization and marketing load
5. Develop major rebate programs and zero-interest loan funds to reduce first-cost resistance to CEDR measures
6. Encourage the local capacity for delivering and financing CEDR
7. Resolve the “windshield cost” issue, common throughout rural areas, with innovative ways to deliver programs that minimize site visits
Improve the awareness of end users to the broad energy problems confronting us (e.g., demand constraints, resource cost escalations, energy security, environmental impact) and what could be done to resolve them, to address:

- Lack of energy awareness as an issue
- Lack of, or poor information, or misinformation about energy supply and use specifics, and how energy supply and use can be improved
- Lack of visibility of most energy waste, which often is in the form of almost unnoticeable low-grade heat generation
- Poor understanding of the physical facts of energy use; this understanding is often necessary to provide end-users the flexibility for wiser energy use in site-specific cases
- First cost, or “sticker shock,” associated with proposed CEDR options
- Resistance by entrenched energy interests with ready communication channels to end users, but corporate business objectives that may be in conflict with effective energy-saving programs (e.g., avoiding revenue erosion, maintaining tight staffing, etc.)

Build on the experience of other marketing programs in order to make energy savings desired and achieved on a wide scale. As Phelan has observed, this stuff is not new – if you are looking at a CEDR program option, it has probably been done many times before; look to others for help with collaboration and experience. Then start the buzz going by helping consumers identify and obtain energy savings options, and provide recognition to those who take action. This can be done using:

- Product labels,
- Published lists of “energy smart” households and businesses,
- Window decals (e.g., We’re doing our part),
- Bumper stickers (e.g., keeping energy costs down with efficiency), and
- Easily-recognized CEDR brands, colors, shapes, and logos.

Improve the user friendliness of the utility’s energy-saving programs, and the use of communications to overcome the significant end-user perception of a hassle factor associated with CEDR, to:

- Overcome the frequent mental barriers to becoming informed about the economic and broader impacts of energy use,
- Make the connection between the “big picture” and a person’s own energy use,
- Help an individual decide how to do something about their energy use, via
  - Making personal changes in the energy use under that person’s influence
  - Contracting for modifications in buildings, equipment, energy supply, and energy practices used in the household, business, or industry associated with the person
  - Providing examples of others in the community who have done it already,
• Provide practical information on how to get the job done – including do-it-yourself information and lists of vendors and certified contractors.240

Encourage the application of building energy codes in rural communities:

• Up-to-date energy codes ensure that new buildings (homes and commercial buildings) as well as major renovation projects meet a minimum level of efficiency.

• Building energy codes address one of the common split incentives, the one between the builder (who wants to minimize first cost) and the buyer (who will be paying the energy bills).

• To be most effective, builders and contractors should be trained on how to comply cost effectively with building energy codes, and codes should be well-enforced. Utilities can play a major role in providing this training and assisting with code enforcement.

Address the general problem of split incentives between different energy stakeholder interests, which discourages end-user EC and EE, namely:

• The persons who use the energy and the persons who pay for the energy use (typically, occupant versus building owner in rental property).

• The person who owns the building or energy system and the person who pays for its energy use (typically, landlord versus tenant).

• The persons who install or specify energy systems and the persons who use and pay for the resulting operation of the energy system (typically, architect, engineer, or builder versus end user).

• The utility that must pay for power on a demand rate versus the residential end user, for whom the least-cost billing solution has been a consumption-only rate, with no incentive to control when their energy is used.

This will require acknowledgement of regional peaks (e.g., 1000 seasonal hours) and super-peaks (e.g., 100 seasonal hours), and pricing that reflects current (and preventative) values of energy use offset. For example, peak pricing could be priced at 3 to 5 times off peak, and super-peak pricing 6 to 10 times off peak, with corresponding reductions in on-peak use so that the rate is neutral for current energy use patterns. This would encourage rigorous adherence to the schedule by a growing number of economy-minded end-users, and the development by the private sector of practices (e.g., secure night purging with mechanical ventilation241) and products (e.g., retrofit double drywall) to help these innovative end users accomplish their goals. This is advantageous to the system as a whole, increasing load factor, reducing price volatility and emissions, improving reliability, and helping keep rates low for all customers in the service area.242

The split incentives in buildings may be unique in another way. As noted by Baden et al., most “owner-occupied buildings undergo multiple changes in ownership during their lifetimes, and thus each owner has a limited financial interest in undertaking investments to minimize the building’s long-term energy costs.” We must find ways to “monetize long-term energy costs in near-term investment decisions.”243
We propose several alternative ways to monetize the future energy and pollution benefits, based on Baden’s suggestions:

- We suggest that the cooperative G&T utility apply USDA/Rural Utility Service money previously available mainly for power-plant construction to establish a revolving loan fund (elaborating on a basic idea proposed by USDA’s Georg Schultz)\(^\text{244}\) with the following features:
  - The local utility oversees a no-collateral, no-interest loan to the qualifying end user for a package of approved retrofits, to be self- or contractor-installed.
  - In either case, to qualify for loan funds, the end user uses an independent contractor to ensure proper installation.
  - Payback of the principal is arranged on the monthly utility bill at a rate equal to or less than the average estimated energy cost reduction.
  - Costs for bad loans, administrative and transaction costs, interest, and other items are absorbed by the Rural Utility Service as an excellent pollution-free and economic development alternative to power plants costing three times as much (or more) for the same contribution to rural energy and peak demand capacity.

In a second alternative proposal, to limit federal government involvement, multiple parties could be involved in a similar loan structure:

- The utility lends money from a revolving loan fund established with funding from one or more of the following sources:
  - The co-op’s own patronage capital credit accounts, which the by-laws of cooperatives allow directors to use to finance activities that serve the utility.
  - Private sector contributions made in exchange for the resulting Carbon Tags (pollution) and White Tags (offset [saved] energy).\(^\text{245}\)
  - Federal grants (e.g., USDA, DOE, DOC, Homeland Security).
  - State grants to improve rural economic development.
  - Clean energy bonds implemented at state, county, or local level.
    - One advantage of such bonds is to encourage the issuing authority itself to make its facilities the first target for CEDR programs.
  - Foundation grants to support the viability of the rural way of life.
  - Local/regional benefactor grants to improve the way of life in the area.
  - System benefit charges that all utility customers pay, justified based on the avoided supply side investments\(^\text{246}\), according to Johnson, 16 states (and counting) have public benefit funds dedicated to supporting CEDR projects.\(^\text{247}\)

- The recipient and expenditure must be pre-qualified, and loan repayment proceeds, as before.
Other similar alternative funding mechanisms are possible, of course. Identifying those that will operate efficiently in the rural Southwest and can be used by small rural utilities, should be a high priority for policymakers, G&Ts, and others who can see the very broad economic development potential for rural areas. Help with financing may come from the private sector in another way. According to Peter Fusuro: “Higher sustained energy prices, more rapid technology shift and a price for carbon will materialize investment in tangible projects for today and next generation technologies for tomorrow.”

Help to address the limited supply of energy-efficient products or infrastructure in rural areas:

- Encourage local or regional hardware stores and grocery stores to carry energy-efficient products, in part by offering rebates and advertising support.
- Train builders and contractors who serve rural areas in energy-efficient retrofit techniques.
- Offer training directly to homeowners, small business owners, and farmers who would prefer to “do it yourself” than hire a contractor.

Provide financial incentives to overcome the first-cost barrier:

- Rebates have been the preferred approach for financial incentives, based on 30 years of experience with utility EE programs around the country, though lack of product in rural areas must be addressed for rebates to work efficiently.
- Low- or no-interest loans might be feasible for big ticket projects such as a major home weatherization project or a ground-source heat pump, especially if the payback can be on the utility bill at a rate less than the rate of energy cost saving. Or low-interest loans can be combined with rebates to eliminate any first cost for low- and moderate-income households and small businesses.
- It often is most cost effective simply to give away low-cost measures such as CFLs, low-flow showerheads and aerators, and starter amounts of caulking, weatherstripping, and window films. In Colorado, the Governor’s Energy Office proposes to distribute 40,000 such kits in 2008 through several efficiency outreach pilot programs.

Concentrate on improving lower cost ways to support remote rural CEDR (e.g., by phone, mail, e-mail, posters, on-line tools and resources, workshops, seminars, and field program saturation techniques). Without creative local solutions to the rural distance issues, there always will be much higher costs of delivering information, on-site audits, products and retrofits in rural areas with sparse populations, because distance equals dollars, and program cost is a major field program barrier for most rural utilities.

Address the energy supplier business objectives that can conflict with planning and implementing effective energy-saving programs. The biggest problem appears to be concern about revenue erosion, and the simplest solution will be to define other practical sources of revenue for cooperatives to make up for the revenue that certainly will be lost when conservation and efficiency reduce monthly end-user bills. Four of the many ideas that have come from creative energy technologists and utility company staff:
• The utility goes after the energy-saving and energy-alternatives market. It gains new sources of revenue by becoming itself a local CEDR (and renewables) product and service supplier, establishing a rudimentary new infrastructure for a few or many measures in the absence of an effective private-sector presence. Where this has been tried, as at Delta-Montrose Electric Association in Colorado with insulation and ground source heat pumps, the market for such products and services has been changed dramatically. In this case DMEA generates sales where a robust market for such sales previously did not exist.

• The utility goes after more of the home heating energy market. It gains new sources of revenue by so increasing the efficiency of the electric heating option that customers convert from other heating fuels to capture the net monthly savings. With the ever-better efficiency of heat pump water heaters and space heaters, this revenue source should be a “natural,” as it includes better utilization of the utility’s existing earth-moving capabilities and equipment. Resistance to higher first cost can be overcome, of course, with acceptable loan terms, grants and rebates. In this case the utility generates sales at the expense of sales to the competitive energy source supplier (often propane, liquefied petroleum gas, or wood).

• The utility goes after the transportation energy market. It gains new sources of revenue by selling “convenience outlet” electricity to the growing fleet of electric and hybrid-electric vehicles. In addition to large kWh sales displacing energy that had been supplied by the petroleum industry, access to the distributed electrical storage of the large storage batteries will allow many rural utilities to change their demand profiles dramatically, possibly to the point of providing a system resource at peak.

• The utility goes after the farm implement energy market, a natural extension of the transportation fuel market. While it is hard to imagine the electric equivalent of a huge combine, improvements in batteries have already yielded growing electric recharge markets in landscaping equipment, all-terrain vehicles, and snow removal. This market will grow with promotion, again at the expense of the petroleum sales infrastructure.

Help Plant the Next Energy Efficiency Crops

Utility energy efficiency and conservation programs place most of their emphasis on promoting and encouraging widespread adoption of well-established measures and practices. But utilities in rural areas may also want to engage in research, development, and demonstration (RD&D) on the next generation of efficiency practices and measures. This focus should, first, gain a solid understanding of the potential contribution and cost of innovative new CEDR practices and measures, then field-test and demonstrate their performance and cost-effectiveness, and finally prepare these further program elements for launch. In this case of future technologies and products, costs and impacts are not well known, but look promising based on known physical and system parameters. Pilot studies and development of program elements are needed to ensure optimal program cost-effectiveness.
Here are some of the more innovative, emerging energy-saving technologies that rural utilities can test and demonstrate:

1. Adding thermal mass to buildings to take advantage of diurnal heat-cool cycles; with such mass, heating and cooling loads can be reduced dramatically, especially at peak.

2. Daylight harvesting to reduce electric lighting loads.

3. Using existing domestic well shafts to access thermal resources for ground coupled heat pumps or off-peak cooling of thermal mass.

4. Light-emitting diode (LED) lighting.

5. Retrofit passive solar heating.


7. Localized (conductive, convective and radiative) heating and cooling of people (rather than entire buildings).

8. Low standby power electronic devices.

9. Annual cycle thermal storage.

10. Replacing electrical stock tank heaters with frost-free, earth-coupled devices.

11. Low-cost demand controls.

12. Low-cost two-way energy communication.

13. Plug-in electric and hybrid-electric vehicles.


15. Alternative EE financing and ownership structures.

16. Integrating CEDR with Renewables.

17. Using bio-char (a prospective co-product of Combined Heat and Power developed from pyrolyzing forest and agricultural wastes in rural places) as an on-farm carbon sequestration material to offset fossil emissions.

By performing RD&D, utilities can evaluate what impact the new technologies will have on customers’ energy use and load profile, assess how customers react to the technologies, and determine whether the technologies are likely to be cost effective and accepted. If the results are positive, the utility could take the lead in marketing and promoting a new technology; e.g., as some rural utilities have done in the case of ground-source heat pumps.
Notes for Part 4:

162 For example, from the corporate website of Delta-Montrose Electric Association (accessed in January, 2008): “The customers-owners we serve are the most important part of our rural electric cooperative. The customers-owners are the ones who, through their electric bills, pay for every act, deed, and decision we make. The customers-owners must be served in every way possible. The customers-owners must know what we are doing, why we are doing it, and how it will affect them.”


165 See Perry, 2007. Op. cit. Perry notes that with CFLs, for example, many people like the color compared to incandescent, like the fact that they will not have to get up on a ladder so often, and like the idea of “saving the whales.”


167 See Dickey, Bob, 2007. Op. cit. Dickey acknowledges that communications with rural end users is a major problem in his service territory. Eastern Illini reports that members don’t read their “Country Living” magazine, and the co-op occasionally finds that they’ve been on the wrong rate for 8 years or more.

168 Usera, Mutch (Black Hills Power), 2007. Presented at the Colorado Utility Efficiency Exchange in Aspen, Colorado, November 2007. Usera reports that 42% of his customers are walk-in bill payers, making the utility payment location an excellent place for educational and promotional messages, and for working demonstrations of CEDR options.

169 A basic but comprehensive list of over 150 residential Low-cost/No-cost options for the Southwest is available at www.swenergy.org. SWEEP believes that the use of the list could reduce home energy end-use by 10% to 20%, on average, with a simple payback of much less than a year. The use of this list is free, and utilities are welcome to use it “as is” or modify it as they see fit for their customers.


Most of these efforts will require rebates and confirmation or development of dealer/installer networks and adequate product stocking.


Snead, Bruce, 2006. “Energy Efficiency and Conservation in the Public, Residential, Commercial, and
Industrial Sectors.” Engineering Extension, Kansas State University, Manhattan, KS.

199 Amelia Gulkis, of Ensave (800.732.1399) and Jennifer Brinker of GDS Associates (920.544.9420) presented findings from their extensive ag audit experience at the ACEEE Ag Forum, February 21-22, 2008, in Des Moines IA.


203 Ibid.

204 Personal communication with Chris Kohls, Xcel Energy, March 14, 2008.


206 Ibid.


212 Ibid.


214 Ibid.


216 Ibid.


Calculations by SWEEP; full text of proposed bill available at www.swenergy.org.

Ibid


Horstman, 2007. Op. cit. For example, Western Area Power Administration has loan equipment (e.g., IR cameras and blower doors) available for utilities that are developing CEDR programs.

We note the continual reference to successful utility programs based on the selling and up-selling of rebate-level energy efficient equipment and services by vendors and certified contractors


Johnson, Katherine (Market Development Group), 2007. “Getting Management Buy-In: The Drivers to


For example, rebate programs have thrived for years on a “onesy-twosy” approach, being open to anyone who wanted to acquire the particular product. With the unique distance issues confronting rural program delivery agents, it’s clear that a more comprehensive approach is needed to be cost-effective. Such an approach may feature:

- Fewer visits to the site
- More contribution by the end-user
- Broader capabilities of the program delivery agents
- Greater flexibility to combine rebates and other incentives within a “whole-house” approach for homes, and the equivalent for businesses.
Appendices

Appendix A: The CEDAR4Rural Demonstration 110
Appendix B: Utility Programs and Related Resources 113
Appendix C: A Short List of Utility Concerns 122
Appendix D: Further Reading 123
Appendix A – The CEDAR4Rural Project Demonstration

Concept
Establish a rational series of rural energy-use improvements in a way that maximizes program savings and minimizes program costs. Target the largest stock of residential buildings with the greatest need for an energy retrofit, but least likely to get one: the homes of rural America. Include high-profile farm energy use in the application of on-site energy-reduction practices and measures.

Background
• There are very deep (20%-40%) rural energy savings opportunities across the very wide variety of residential buildings and farm operations
• Few field demonstrations have applied deep energy savings programs in rural areas, though extensive commercial advertising continues to sell products that may not be the most rational choice for the end-user, if he or she had more complete market knowledge (information and education).
• The largest immediate potential appears to be in 1) residential buildings, and 2) large-load opportunities on the associated farmstead
  ○ Because of the very large distances involved in most rural service territories, logistics suggest that expert on-site assistance primarily addressing home energy use also address high-profile commercial energy use outside the home during the same site visit (i.e., basic energy use in farm operations)
• There are significant institutional and logistical barriers to achieving deep energy savings goals in rural residential buildings and agricultural processes, but we believe these can be overcome by aggregating the parallel intent or coincident objectives of key rural institutions (e.g., electric utilities, USDA Cooperative Extension Service, community and youth groups, farmer associations, academic institutions, WorkForce centers, and business development centers)

Need and Goals
• Show how farmers and other rural energy end-users can become even better energy managers than they are today, in their home and in their work
• Assemble the elements of a long-term training program to disseminate the basic and task-specific information, education, and skills needed to better manage rural energy use
• Show the viability of prospective alternatives for delivering deep energy savings in rural areas, and introducing renewable energy, by combining Conservation, Efficiency, Demand response, and Renewables (CEDAR) in a simple, four-step delivery program most suitable for areas with long distances between end-users
• Develop practical, replicable program elements that can broaden rural participation in deep rural energy savings in homes and on farms in other regions
Project Objectives
1. To establish the convention of reducing energy waste in rural homes rationally by starting with Low-cost/No-cost practices and measures before installing, in priority order, investment-grade efficiency or renewables retrofits
2. To leverage rural homeowners’ volunteer contributions to reducing energy waste in their own homes, reducing program costs and increasing program accomplishments
3. To show how incentives and direct installation can help achieve savings goals in a practical, cost-effective program
4. To reduce the program cost penalty of long rural distances by minimizing travel and site visits through program design and electronic communication

Approach
The CEDAR4Rural Project Demonstration will accomplish this in the field with a simple 4-step process:

Step One - Upgrade community and personal energy information, specifically about the cost and benefits of Conservation, Efficiency, Demand response, and Renewables (CEDAR). In this step, the Project presents workshops and seminars for rural residents. Facilitators guide residents through the steps of a home-specific energy-savings plan, which will include
- Significant initial participant contribution, guided by the Project, of low-cost/no-cost practices and measures which the participant will buy and/or incorporate in the home
- Incentives provided by the Project at no cost to the participant (consisting of further on-site energy-reduction measures and help in evaluating the home for an energy makeover)
- A Project-designed and facilitated home energy makeover specific to the home, for which the participant will be offered a no-interest, no-recourse loan

Facilitators will ask for residents willing to volunteer for the project demonstration

Step One outcomes
- Total Energy Savings – 0%-5%/participant
- Participant Cost
  - Direct: $20 (workshop fee); In-kind (time): $125
- Project Cost
  - Direct: $20/participant; Indirect: $20/participant

Step Two - Incorporate Conservation (low-cost/no-cost practices and measures) in the home first (before major investment in Efficiency, Demand response, or Renewables). The Project supports and guides the resident’s application of a range of energy reduction practices and measures, accomplished with the resident’s own resources.

Step Two outcomes
- Total Energy Savings – Additional 10%-20%/participant
- Participant Cost
  - Direct: $200; In-kind: $200
- Project Cost
  - Direct: $0/participant; Indirect: $100/participant
Step Three – Deliver Initial CEDAR Services. Upon resident completion of the low-cost/no-cost package, the Project delivers and direct-installs further applicable low-cost/no-cost Conservation measures and an initial Efficiency measure as an incentive. Project technician also advises on the application of renewables (solar, wind, geothermal) to the home or farm.

Step Three outcomes
• Total Energy Savings – Additional 5%-10%/participant
• Participant Cost
  o Direct: $0; In-kind: $50
• Project Cost
  o Direct: $800/participant; Indirect: $200/participant

Step Four - Facilitate an Investment-grade Home Energy Makeover of Efficiency, Demand Response, and Renewables measures, improving home comfort and energy savings through
a. Consumption savings, important for reducing the end-user’s retail bill
b. Demand savings, important for reducing the utility’s wholesale bill

Step Four outcomes
• Total Energy Savings – Additional 15%-25%/participant
• Participant Cost
  o Direct (loan): $5000* (average or cap); In-kind: 0
• Project Cost
  o Direct: $0/participant; Indirect: $500/participant

* $5000 participant cost carried as no-interest loan from the Efficiency Fund and paid back by the participant on monthly utility bill at rate lower than rate of monthly energy program savings

Summary of Project Savings and Costs
• Total Energy Savings – (0-5) + (10-20) + (5-10) + (15-25) = (35% - 60%)
• Participant Cost
  o Direct 20 + 200 + 0 + 5000 (loan) = $5220
  o In-kind 125 + 200 + 50 + 0 = $375
• Project Cost
  o Direct 20 + 0 + 800 + 0 = $820/participant
  o Indirect 20 + 100 + 200 + 500 = $820/participant

Total savings anticipated are 40% to 60% of total home energy use. Total cash investment in each home is $5220; total, all-in, cost to participant and Project totals $7235/participant. Direct and in-kind cost to the participant is $5595, of which $5000 is carried as a no-interest loan. Direct and indirect cost to the Project is $1640/participant.

If participant’s total energy cost is $2000 and savings are 50% (or $1000/year), payment of the loan at 90% of savings (so that the average monthly bill, including loan payoff, is less than the original energy-only bill) yields payments of $900/year. This rate provides loan payoff at ($5000/$900) = 5.6 years, assuming no escalation of energy prices.
Appendix B – Utility Programs and Related Resources

Opportunities abound to help individuals and businesses offset the cost of CEDR improvements. Many federal and state government tax incentives are available for the purchase and implementation of CEDR measures and technologies for homeowners as well as commercial and industrial business owners and operators. Included here are incentives and programs available through federal, state, and local governments, as well as a few rural utility programs that serve residents and businesses in the rural Southwest.

More and more local governments and utilities are offering incentives to residents and businesses for improving EE. Even if you do not see your utility or community mentioned below, contact the office and ask about CEDR incentives. It is in the utilities’ and their customers’ interest to encourage EE, so if the utility does not offer incentives now, it soon will.

National and state energy information sources are included at the end of this report.

Federal Financial Incentives

Residential

Residential Energy Efficiency Tax Credit
The Residential Energy Efficiency Tax Credit provides tax credits for EE improvements in the building envelope of existing homes and for the purchase of high-efficiency heating, cooling, and water heating equipment. These improvements and equipment must have been placed in service between January 1, 2006 and December 31, 2007, and must serve a dwelling in the United States owned that is used by the taxpayer as a primary residence. The maximum amount of homeowner credit for all improvements combined is $500 during the two-year period of the tax credit. Building envelope improvements qualify for tax credits of up to 10% of the cost of the following eligible upgrades: insulation materials, exterior doors and windows, and pigmented metal roofs.

Purchasers of high-efficiency heating, cooling, and water heating equipment are eligible for the following tax credits: electric heat pump water heaters ($300); electric heat pumps ($300); geothermal heat pumps ($300); central air conditioners ($300); and advanced main air circulating fans ($50).

For more information, contact Information Specialist, Internal Revenue Service, 1111 Constitution Avenue, N.W., Washington, DC 20224, 800.829.1040, website: www.irs.gov.

Commercial/Industrial/Agricultural

Energy-Efficient Commercial Buildings Tax Deduction
The Energy-Efficient Commercial Buildings Tax Deduction provides a tax deduction of $1.80/ft² o owners of new or existing buildings who install interior lighting; building envelope; or heating, cooling, ventilation, or hot water systems that reduce the building’s total energy and power cost.
by 50% or more compared to a building meeting minimum requirements set by ASHRAE Standard 90.1-2001.

Deductions of up to $0.60/ft² are available to owners of buildings in which individual lighting, building envelope, or heating and cooling systems meet target levels that would reasonably contribute to an overall building saving of 50% if additional systems were installed. This provision has been extended to December 31, 2008.

For more information, contact Information Specialist, Internal Revenue Service, 1111 Constitution Avenue, N.W., Washington, DC 20224, 800.829.1040, website: www.irs.gov.

New Energy-Efficient Home Tax Credit for Builders
The New Energy-Efficient Home Tax Credit for Builders provides tax credits of up to $2,000 for builders of new energy-efficient homes, including manufactured homes constructed in accordance with the Federal Manufactured Homes Construction and Safety Standards. Site-built homes qualify for the credit if they are certified to reduce energy consumption by 50% relative to the International Energy Conservation Code standard and meet minimum efficiency standards established by the U.S. Department of Energy. Building envelope component improvements must account for at least 20% of the reduction in energy consumption. This provision has been extended to December 31, 2008.

For more information, contact Information Specialist, Internal Revenue Service, 1111 Constitution Avenue, N.W., Washington, DC 20224, 800.829.1040, website: www.irs.gov.

Farm Bill – Renewable Energy and EE Program
The Renewable Energy Systems and Energy Efficiency Improvements Program makes direct loans, loan guarantees, and grants to agricultural producers and rural small businesses to purchase renewable-energy systems and make energy-efficiency operational improvements. The maximum grant award is 25% of eligible project costs up to $500,000 for renewable energy projects and up to $250,000 for EE improvements. Under the guaranteed loan option, funds up to 50% of eligible project costs up to $10 million are available. Guaranteed Loans and Combined Guaranteed Loans and Grants Applications must be completed and submitted to the appropriate USDA Rural Development State Office no later than July 2, 2007.

State Financial Incentives

Residential
Arizona
Individual Income Tax Subtraction
Arizona provides an individual income tax subtraction to the original owner of a new energy-efficient home. The credit may be claimed in the year that the house is sold. It is equal to 5% of the sales price excluding commissions, taxes, interest, points, and other brokerage, finance, and escrow charges and cannot exceed $5,000. Energy-efficient residences include new single family-residences, condominiums, or townhouses that exceed the 1995 Model Energy Code Threshold by at least 50% (90 points) as determined by an approved rating program. The subtraction is valid for taxable years beginning after December 31, 2001 and ending before December 31, 2010. Instructions for receiving the subtraction can be found in the instructions for
New Mexico
**Sustainable Building Tax Credit**
SB 463, enacted in April 2007, established a personal tax credit for sustainable buildings in New Mexico. Residential buildings certified as sustainable homes can qualify for the tax credit. Eligible residential buildings include single-family homes and multi-family homes that are certified as either Build Green NM Gold, or LEED-H Silver or higher, and ENERGY STAR certified manufactured homes. The amount of the credit varies according to the square footage of the building and the level of certification achieved.

For more information, contact the Tax Information Office, New Mexico Taxation & Revenue Department, P.O. Box 630, Santa Fe, NM 87504, 505.827.0700, poffice@state.nm.us, website: www.state.nm.us/tax/home.htm or Susie Marbury, New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Division, 1220 S. St. Francis Drive, Santa Fe, NM 87505, 505.476.3254, FAX 505.476.3322, susie.marbury@state.nm.us, website: www.emnrd.state.nm.us/ecmd/.

Commercial/Industrial/Agricultural

Nevada
**Energy Efficiency Property Tax Abatement**
In June 2005, Nevada passed Assembly Bill number 3, which includes provisions for partial abatement of property taxes for property that has a building or structure that meets or exceeds the United States Green Building Council (USGBC) LEED Silver rating system. The partial abatement must be for a duration of not more than 10 years and must not exceed 50% of the property taxes due.

To receive a tax abatement, the building project must be registered with the USGBC and have a letter of verification from the Director of the Nevada State Office of Energy. Once a project has its letter of verification, an application can be made to the Nevada Commission on Economic Development for the partial abatement of real property taxes.

For more information, contact Tim Rubald, Commission on Economic Development, 108 East Proctor Street, Carson City, NV 89701, 775.687.4325, Phone 2: 800.336.1600, FAX 775.687.4450, website: www.expand2nevada.com/newsite/#

New Mexico
**Sustainable Building Tax Credit**
SB 463, enacted in April 2007, established a corporate tax credit for sustainable buildings in New Mexico. Commercial buildings that have been registered and certified by the USGBC at
LEED Silver or higher for new construction (NC), existing buildings (EB), core and shell (CS), or commercial interiors (CI) are eligible for a tax credit. The amount of the credit varies according to the square footage of the building and the level of certification achieved.

For more information, contact the Tax Information Office, New Mexico Taxation & Revenue Department, P.O. Box 630, Santa Fe, NM 87504, 505.827.0700, poffice@state.nm.us, website: www.state.nm.us/tax/home.htm or Susie Marbury, New Mexico Energy, Minerals and Natural Resources Department, Energy Conservation and Management Division, 1220 S. St. Francis Drive, Santa Fe, NM 87505, 505.476.3254, FAX 505.476.3322, susie.marbury@state.nm.us, website: www.emnrd.state.nm.us/ecmd/.

**Wyoming**

*Energy Audit Grants*

This matching grant provides 75% of up to $4,000 for a level 2 energy audit. It is open to all who meet the SBA definition for small business. Topics include building shell, lighting, HVAC, and process energy. Manufacturers may use the audit to qualify for sales tax abatement on energy used in the manufacturing process.


**Local Financial Incentives**

**Residential**

**Arizona**

*Energy Efficiency Rebates*

Sulfur Springs Valley Electric Cooperative (SSVEC), a Touchstone Energy Cooperative, is a nonprofit, member-owned distribution cooperative servicing parts of Cochise, Graham, Pima, and Santa Cruz Counties and includes the communities of Sierra Vista, Huachuca City, Patagonia, Elfrida, Benson, St. David, Bowie, San Simon, Willcox, Sonoita, and Pearce-Sunsites.

SSVEC’s residential rebate program offers a $500 rebate for homes with 14 SEER or higher electric and dual fuel heat pumps. Members may receive rebates on water heaters worth up to $300 per heater per home based on whether they are replacing a fossil fuel heater, installing one for a new home, or replacing an existing electric water heater. New all-electric homes receive $2,000 in rebates; manufactured homes and existing homes converting to all electric may receive $1,000 and $1,500, respectively.

For more information, contact Jack Blair (jackb@ssvec.com) or Albert Gonzales at Sulfur Springs Valley Electric Cooperative, P.O. Box 638, Sierra Vista, AZ 85636, 520.458.4691, Phone 2: 520.515.3473, FAX 520.458.6860, website: www.ssvcc.org.
**Energy Efficiency Loans**

(SSVEC) offers the Member Loan Program to assist individuals who have at least a year membership with no more than two delinquencies in the past year to improve the EE of homes. Qualified members may apply for the loan online with a $20 processing fee, and a $30 recording fee and payable at the time loan papers are signed.

For more information, contact Jack Blair (jackb@ssvec.com) or Albert Gonzales at Sulphur Springs Valley Electric Cooperative, P.O. Box 638, Sierra Vista, AZ 85636, 520.458.4691, Phone 2: 520.515.3473, FAX 520.458.6860, website: www.ssvec.org.

Trico Electric Cooperative, a Touchstone Energy® Cooperative, is a nonprofit rural cooperative in southern Arizona. Through qualifying sponsored contractors, Trico Electric Cooperative’s EC Home Improvement Loan program offers its members home improvement loans up to $15,000, requiring no down payment or application fee. EE products that can be financed include heat pumps, air conditioners, water heaters, replacement windows and doors, insulation, and geothermal systems

For more information, contact Member Services Representative, Trico Electric Cooperative, Inc., 8600 West Tangerine Road, Marana, AZ 85653, 866.337.2052, Phone 2: 520.744.2944, FAX: 520.744.2329, website: www.trico.coop.

**Colorado**

**Geothermal Incentives**

Delta Montrose Electric Association (DMEA), a distribution utility serving western Colorado, gives its residential members the opportunity to improve their homes’ EE. Through a program called “Co-Z,” DMEA will pay for the installation of the components of a GeoExchange system that is outside a member’s home (does not include ductwork or other “inside the house” elements). This upfront installation cost is recouped over time by DMEA through monthly payments applied to the utility bill. The exact monthly payment and energy savings potential varies depending on the home’s size, design, and construction quality, as well as the type and condition of the heating system.

For more information, contact Co-Z Energy Plan, DMEA, 21191 H75 Road, Delta, CO 81416, 970.874.2300, website: www.dmea.com/.

**Renewable Energy Loans**

Gunnison County Electric Association’s (GCEA) low-interest loan program was started January 1, 2003. Loans are available to members and nonmembers in the GCEA service territory for the installation of photovoltaic, wind, and other renewable energy projects as approved by the board of directors. A loan of up to $25,000 over 10 years is available to qualifying participants. Current interest rates vary by month but are fixed at the time the loan is made. The loan does not cover batteries.

For more information, contact Gunnison County Electric Association, Inc., 37250 Hwy. 50, P.O. Box 180, Gunnison, CO 81230, 970.641.3520, FAX 970.641.5302, gcea@gcea.coop, website: www.gcea.coop.
Appliance Rebates
Holy Cross Energy, a Touchstone Energy Cooperative, has developed a voluntary carbon reduction strategy designed to slow the growth of carbon dioxide emissions created in the generation of electricity used by consumers. The Appliance Rebate Program provides cash rebates for members who purchase eligible ENERGY STAR and other energy-efficient appliances for their home.

The program covers the following residential appliances:

- Refrigerators, $75.00
- Dishwashers, $25 to $75
- Clothes Washers, $25 to $75
- Compact Fluorescent Bulbs, cost or $25.00, whichever is less
- Programmable Thermostats, cost or $25.00, whichever is less
- Conventional Electric Water Heater, $75.00

For more information, contact Member Service Representative, Holy Cross Energy Cooperative, 3799 Highway 82, Glenwood Springs, CO 81601-9349, 970.945.5491, FAX 970.945.5491, website: www.holycross.com.

Renewable Electric Rebate
Holy Cross Energy’s WE CARE (With Efficiency, Conservation And Renewable Energy) Program offers a $2.00/W DC incentive for renewable energy generation using wind, hydroelectric, photovoltaic, biomass, or geothermal technology. Payments are not to exceed 50% of actual installed costs, and the maximum rebate per installation is $50,000. While systems larger than 25 kW are capped at the $50,000 rebate level (and also exceed net metering eligibility) there is technically no capacity limit to participate in the rebate program. Systems must be connected to Holy Cross Energy’s electric system to qualify for renewable energy incentives.

For more information, contact Craig Tate, Holy Cross Energy Association, P.O. Drawer 2150, Glenwood Springs, CO 81602, 970.947.5421, FAX 970.945.4081, ctate@holycross.com, website: www.holycross.com.

Energy Efficiency Credits
Mountain View Electric Association, Inc. (MVEA) and Tri-State Generation and Transmission Association Inc., MVEA’s power supplier, will pay credits to MVEA customers who install selected electrical heating systems and/or selected electrical appliances. The items covered by this credit program are provided in detail online.

For more information, contact Member Services, Mountain View Electric Association, Inc., 1655 5th Street, Limon, CO 80828-1600, 719.775.2861, Phone 2: 719.775.9513,
The Sangre De Cristo Electric Association (SDCEA) serves Colorado customers in Lake, Chaffee, Fremont, Custer, and Saguache counties. To encourage its residential and commercial customers to purchase energy-efficient products, SDCEA offers the Energy Efficiency Credit Program, a rebate program for space heaters and water heaters that run at off-peak time periods.

Space heating is eligible for rebates under this program. Only permanent installations are eligible and the minimum installation allowed is 1,000 W. To receive this rebate, the building should have insulation in the ceiling and walls that is equal to R-30 for existing construction and R-49 for new construction. Rebate amounts are: $10 per kilowatt for resistive devices, $25 per kilowatt for electric thermal storage devices, and $25 per timer installed. Heat pumps are also eligible for rebates.

New and replacement water heaters are also eligible for rebates under this program. Eligible water heaters are at least 30 gallons, have a 6-year warranty, and satisfy the energy factor requirements on the program webpage. Water heaters are eligible for a $100 rebate per unit, and a $25 rebate per timer device. In addition, the customer can receive another $25 rebate for purchasing a lifetime warranty on the water heater.

For more information, contact Program Manager, Sangre De Cristo Electric Association, 29780 North U.S. Highway 24, P.O. Box 2013, Buena Vista, CO 81211, 719.395.2412, Phone 2: 800.933.3823, sangre@sdcea.com, website: www.sdcea.com.

Energy Efficiency Credits
United Power, a Touchstone Energy Partner, serves approximately 100,000 people throughout Colorado’s front range. Tri-state Generation & Transmission, United Power’s energy supplier, is extending its Energy Efficiency Credits program. Customers should contact a United Power Member Services representative before purchasing and installing any new equipment to ensure program requirements are met. All credits must be requested within 180 days of installation. An inspection report signed by a United Power Energy Management Specialist is required to qualify for any of these credits.


Energy Efficiency Rebates
Poudre Valley Rural Electric Association is a Touchstone Energy Cooperative serving consumers in Boulder, Larimer, and Weld counties. They offer a residential EE rebate program for qualified water and space heaters and heat pumps.

For more information, contact Danny Martinez, Poudre Valley REA, P.O. Box 27255, Fort Collins, CO 80527-2550, 970.226.1234, FAX 970.226.2123, pvrea@pvrea.com, website: www.pvrea.com/memberinfo/consumer%20form%20index.htm.
New Mexico

Energy-Efficient HVAC Incentives
Kit Carson Electric Cooperative offers financial incentives for its members to install energy-efficient heating/cooling equipment. Customers who install an Electric Thermal Storage (ETS)/Heat Pump system or a stand-alone ETS system qualify for a discounted, Time-Of-Use electric rate for space and water heating usage. Rebates from $924 up to $3009 are also available to customers who use this technology.

For more information, contact Customer Service, Kit Carson Electric Cooperative, 118 Cruz Alta Road, P.O. Box 587, Taos, NM 87571, 505.758.2258, website: www.kitcarson.com/.

Energy Service Companies
An energy service company (ESCO) manages and coordinates all phases of an energy project—energy audits, construction management services (including preparation of performance specifications, project design, and project commissioning), project financing, project monitoring and guarantee of energy savings, and equipment maintenance and operations. Some ESCOs enter into performance contracts that guarantee that the cost of the project is recovered from the energy savings. If the project fails to meet the guaranteed savings amount, the ESCO may be required to compensate your organization. Hiring an ESCO can be a way to improve EE without incurring much up-front expense.

National Information Resources

Residential

- The U.S. Department of Energy has updated its Energy Savers: Tips on Saving Energy & Money at Home brochure and website (www.eere.energy.gov/consumer/tips/) providing the latest and greatest tips on ways to save energy at home. The site includes quick, easy tips to save energy, as well as tips for long-term energy savings.


- The Alliance to Save Energy’s Power Smart home energy booklet site (www.ase.org/powersmart/index.html) includes tips on saving energy in the home, checklists, and links to other resources.

- The U.S. Environmental Protection Agency and U.S. Department of Energy’s ENERGY STAR® Products website (www.energystar.gov) lists ENERGY STAR appliances, heating and cooling equipment, lighting products, office equipment, windows, and more.

- Lawrence Berkeley National Laboratory’s Home Energy Saver website (http://hes.lbl.gov/) is a web-based do-it-yourself home energy audit tool.

- The Rocky Mountain Institute (www.rmi.org) provides extensive recommendations on making any home or business more energy efficient.
Commercial/Industrial/Agricultural

- The Rocky Mountain Institute (www.rmi.org) provides extensive recommendations on making any home or business more energy efficient.

- The Database of State Incentives for Renewable Energy and Energy Efficiency website at www.dsireusa.org provides detailed information on EE and renewable energy tax and other incentives around the country. This database is updated regularly.

State Information Resources

Residential

Colorado

- ColoradoEnergy.org (www.coloradoenergy.org) is a comprehensive energy information site for the state, and includes a Home Energy Checklist (www.coloradoenergy.org/tips/homeowner/hec/) and an Energy Action Guide (www.coloradoenergy.org/tips/homeowner/actionguide.htm).

Commercial/Industrial/Agricultural

Colorado

SWEEP developed a web-based resource, Energy Efficiency Guide for Colorado Businesses (www.coloradoefficiencyguide.com), which is designed to assist businesses in saving energy and money through improved EE.

Utah

SWEEP developed a web-based resource, Energy Efficiency Guide for Utah Businesses (www.utahefficiencyguide.com), which is designed to help businesses save energy and money through improved EE.

---

253 Most of the incentive information is from the Database of State Incentives for Renewable Energy (DSIRE) website (www.dsireusa.org).
Appendix C – A Short List of Utility Concerns

In preparation of this report, we talked to many people in the rural utility industry. Following is a list of today’s barriers they have observed regarding the prospects of CEDR in the rural Southwest.

- One size of CEDR solution certainly does not fit all, as new rural loads are often regionally specific. For example, most high-growth rural retail utilities have major loads different from their neighbors, and these are mainly derived from Irrigation Pumping, Extraction, New Suburbs, or Recreation.

- Many rural utility systems in the Southwest experience broad-shouldered summer peaks, and CEDR may not be able to provide the kind of peak demand relief that is needed for that scenario.

- Many rural utility systems also have constrained regions, areas within which the load/supply relation is out of balance, and where the imbalance cannot be resolved by import or export. Could CEDR or renewables really help resolve those problems?

- The cost to deliver such significant rural CEDR programs in a conventional manner would be very high, because of the typically low meter densities in rural places, where in some remote cases there are only 1.3 or fewer meters per mile of line.

- Rural electric cooperatives operate in a very lean fiscal environment, to keep costs low to their rural end users; this means they do not have extra people on staff just waiting to field these types of CEDR programs.

- In a world where just the maintenance and upgrade costs for large rural electrical systems are staggering, and consume the bulk of revenues, it is impossible to find CEDR-financing procedures and conventions that fit the need, compared to the almost-effortless financing of conventional power. In addition, you should consider what kind of institution would have the interest and the capacity to lend these huge amounts of money for something other than a conventional generating plant.

- Revenue loss from successful CEDR could add up to more than a rural electric company’s annual margin; this implies running a deficit, which is unacceptable under most rural utility by-laws.

- The cost of the CEDR program itself will also add to the net revenue loss that could devour a rural utility’s annual margins.

- It does not seem fair that one or another of the rural utilities already carry out most or all of these kinds of CEDR programs now, in their own way and at their own pace, but seem to be accused of doing nothing.

- Some utilities are almost exclusively driven by new extraction loads, where the customer is already motivated to install the most efficient motors, etc.; there may be little prospects in those cases for CEDR savings.

- It is hard to motivate customers with good CEDR deals; most customers are just apathetic with regard to energy use, and decline to participate in the excellent programs we offer today.

- CEDR could not provide the timely response to what is shaping up in many rural areas to be a capacity/cost-control crisis, unless it could provide the distributed equivalent of significant (e.g., 500 MW, delivered) generation resources in a reasonable (e.g., five-year) time frame.

- CEDR should really be the end user’s problem; the rural cooperatives are just here to provide low-cost, reliable electric service.
Appendix D – Further Reading and Links

Alliance to Save Energy – www.ase.org

American Council for an Energy Efficient Economy (ACEEE) – www.aceee.org


Building America – energy efficiency programs at DOE www.buildingamerica.gov


DSIRE data base of state and other energy incentives – www.dsireusa.org

Energy Star (sponsored by EPA and DOE) – www.energystar.gov


Farm energy website of the National Center for Appropriate Technology (NCAT). www.attra.ncat.org/energy.


McPherson, E. Gregory; J. Simpson; P. Peper; S. Maco; Q. Xiao; E. Mulrean; 2004. Desert
Southwest Community Tree Guide: Benefits, Costs, and Strategic Planning. Arizona State Land Department, Phoenix AZ.

National Renewable Energy Laboratory – information on efficiency and renewable energy www.nrel.gov


Southwest Energy Efficiency Project – information on efficiency in Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming www.swenergy.org

Solar light pipe for agricultural and industrial buildings. www.oriones.com

Tax Incentives Assistance Project (TIAP). www.energytaxincentives.org


Web-based Farm Energy Assessment developed by GDS Associates for the University of Wisconsin. www.uwex.edu/energy/esa

Western Governors’ Association. 2006.
  • Clean and Diversified Energy Initiative
  • Summary Matrix of Potential Near-Term Energy Efficiency Programs.