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An Impact Evaluation of the Missouri Gas Energy Low-Income Weatherization Pilot Program

A Final Report Prepared for
Missouri Gas Energy Company

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Executive Summary

This report presents the result of an impact evaluation of Missouri Gas Energy's Low-Income Weatherization Assistance Pilot Program. The evaluation is the second phase of a multi-year process and impact evaluation. In 1998 a process and early feed-back impact evaluation was conducted. The 1998 study documented program processes and operational effectiveness. In addition, the early feedback impact documented energy savings in less than a year following program participation. In 1999 the impact evaluation was repeated. This allowed the program to experience a longer post-program consumption history and increased the reliability of the energy savings estimates.

The 1999 impact evaluation documents increased savings and an improved benefit cost ratio for the program. Between its inception and March of 1999, the Missouri Gas Energy Low-Income Weatherization Assistance Pilot Program served 343 clients providing an estimated savings to Missouri citizens of $61,720 a year in 1997 dollars or $1,167,540 over the 20 year life of the installed measures.

On average, the consumption of space heating fuel for units heated with natural gas was reduced by 34.4 million BTUs annually, or 20.9 percent of total gas consumption, for a program-wide savings 296 billion BTUs over the 20 year life of the installed measures. This gas savings is provided through a 28.2 percent reduction in heating related gas consumption and an 8.5 percent increase in baseload consumption and provides each customer with an annual savings of $155 dollars.

In addition, the program is providing an electric savings of 500 kWh per year per customer, or about $35.00 a year off the average bill. The benefit-to-cost ratio for the program is 1.62 to 1. On the basis of this, we conclude that the Missouri Weatherization Program is cost effectively providing weatherization services to the residents of Missouri.

Chapter 1. Introduction

TecMRKT Works is pleased to present this report describing the impacts of the Missouri Gas Energy (MGE) Low-Income Weatherization Pilot Program. The evaluation examines program impacts and the benefits associated with those impacts, including those provided to the customer and to the State of Missouri. This study repeats an earlier short-term impact analysis performed at the end of 1997. The short-term analysis provided an early indicator of program impacts using less than a year of customer consumption records for of the participants. The short-term analysis indicated that the program was producing cost-effective energy savings, but because of the short-term nature of the data used in the analysis a more rigorous impact analysis was needed to confirm the estimated savings. This report presents the results from the longer-term analysis and is based on between 1.5 and 2 years of consumption data following participation.

This report is based on an analysis of information provided by Missouri Gas Energy, the Kansas City Weatherization Assistance Program, Kansas City Power and Light the State of Missouri and the University of Dayton. Gas consumption data was provided by Missouri Gas Energy. The Kansas City Weatherization Assistance Program identified program participants, a comparison group and cost data. Kansas City Power and Light provided electric consumption data. Daily weather data was obtained from the State of Missouri and by the national weather tracking data base maintained by the University of Dayton.

Program Background

The Low-Income Weatherization Pilot Program is sponsored by Missouri Gas Energy Company which contracts the delivery of service to the Kansas City Weatherization Assistance Program. The primary objective of the program is to improve the energy efficiency of eligible low-income households. In addition to providing energy efficiency and health and safety benefits, the program also provides financial benefits to participants by reducing the amount of money needed to pay energy bills and by increasing participant's ability to control their consumption.

The Kansas City Weatherization Assistance Program has program implementation staff responsible for identifying and enrolling participants, conducting energy audits, installing measures, inspecting completed work and for educating participants about how to control energy costs.

Chapter 2. The Impact Evaluation Design and Methodology

The basic design for this impact study is a comparison group design in which the pre- and post-retrofit weather adjusted energy consumption for buildings with a single heating source are compared for a retrofit and a comparison group using time-series weather and participant consumption data. In this design, the weather normalized energy consumption of a retrofit and the comparison group is determined before and after weatherization measures are installed. For each group, the average change in energy consumption per unit between the before and after period is determined. The net savings are obtained by adding the per unit change in energy consumption for the two groups. In addition, electricity consumption before and after the retrofit for non-space heating uses was compared in order to estimate savings from non-space heating related changes.

Data Collection Techniques

The participation and energy consumption data collected in this analysis were obtained from five sources: the State of Missouri, the KCWAP, MGE, Kansas City Power and Light and the University of Dayton's national weather data archives. The specific data and the sources are described below.

Weatherization Program Data

TecMRKT Works requested program data from the Kansas City Weatherization Assistance Program for participants in the MGE program who have had measures installed and who were awaiting the installation of measures. The requested data included the Weatherization Program tracking number; account numbers for electric and gas service; personal identification information such as name, address, and telephone; a date when measures were inspected (a proxy for installation date); the installation costs associated with each of the nine measure categories such as infiltration, attic and wall insulation; and the total installation costs.

These data were contained in the KCWAP program database management system. This system tracks dollars expended per category of measure installed rather than the number and amount of measures on a measure by measure basis. For instance, the category for "infiltration" contains the cost of installing an array of measures such as window and door caulk, sill box insulation, etc. The costs include labor and material. This means that the part of the evaluation aimed at analyzing measure specific savings focuses on savings from categories of measures rather than measure specific results.

The KCWAP program provided two files, one for homes in which measures had already been installed (411 locations, 282 of which were in the previous analysis) and one for homes awaiting installations (63 locations) Many of the homes awaiting in the previous study are now among the 411 for which we have participation data. Homes which were awaiting installations were assigned to the comparison group. The homes which had had installations were largely assigned to the retrofit group although those whose retrofits were too recent to have sufficient post-retrofit data to make a pre and post analysis possible were assigned to the comparison group.

Gas Consumption Data

Based on the program data provided by KCWAP, TecMRKT Works made a data request to MGE for six years of monthly energy consumption data (four years of data were requested for the previous study), monthly bill reading dates, and data flags associated with each reading, as well as personal identification data for the 411 participants and the 63 homes awaiting installations. TecMRKT Works provided files with account numbers to MGE. MGE provided 399 participant cases, (346 of which were usable cases of data for participants), and 94 for non-participants, (93 of which were usable cases).

Electric Consumption Data

TecMRKT Works made a similar request to KCPL for monthly electric consumption data, monthly bill reading dates, and data quality flags associated with each reading and personal identification data for the same participant group and for those awaiting installations. KCPL provided 390 usable cases of data for participants and 124 for non participants. In the previous study, KCPL provided 258 cases of data for participants and 75 for non-participants.

Fuel Use Data

After reviewing the relevant gas data provided by MGE, TecMRKT Works identified 399 building units with sufficient fuel data to warrant inclusion in the study. Of these, 346 had sufficient pre- and post-retrofit data for possible inclusion in the energy savings analysis (Table 1). Of these 346 buildings, 255 had data of sufficient quality to pass the reliability checks for the analysis (see below).

In impact evaluations records with estimated data reduce the overall reliability of the analysis. This is especially the case when estimates are made following a retrofit and the formulas for estimating consumption have not been updated to reflect the retrofit. Also, when there are a small number of post retrofit records, a small number of highly variable readings may reduce the reliability of the data. These variations in fuel use can be influenced by changes in family size, energy related behaviors, and the social and economic conditions of the household. Together, these conditions often make energy consumption data unusable for estimating weatherization program impacts. Typically, in low-income programs as many as 50% of the units do not pass the reliability checks. MGE's rate of 74% passing this test indicates that most reads are actual meter reads and the number of estimated meter reads is low.

Weather Data

In order to conduct an energy savings analysis using the PRISM™ software (see below), approximately twelve years of average daily temperature data are needed in addition to the weather data for the pre- and post-program years. These data were obtained from the University of Dayton Department of Engineering Web site (http://www.engr.udayton.edu/weather/source.htm) which maintains a national weather data base for weather stations throughout the U.S. In addition, weather data from the Kansas City International Airport was obtained from the State of Missouri. These data were provided to TecMRKT Works. After reviewing data for the various weather stations in the Kansas City area, TecMRKT Works decided that the temperature data from the Kansas City International Airport most represented the program implementation area. This was the weather data used for comparing participant and non-participant energy consumption in this evaluation.

PRISM™

Program impacts were examined using PRISM™ Advanced Version 1.0 software for Windows developed at Princeton University's Center for Energy and Environmental Studies.

PRISM™ is a commercially available analysis software package designed to estimate energy savings for heating and/or cooling loads in residential and small commercial buildings. The current Advanced Version permits users to enter and edit data from a variety of sources, to carry out sophisticated reliability checks, to eliminate cases that do not meet standards, and to display results in graphical and textual forms.

PRISM™ allows the user to estimate the change in energy consumption per heating or cooling degree day for the periods before and after measures are installed in homes by combining energy consumption and weather data. By subtracting the estimate of energy use per degree day after the measures are installed from the value before the measures are installed and multiplying by an appropriate annual degree day value, total annual normalized energy savings can be estimated.

Degree days vary from year to year, which potentially presents a problem for deciding on a value for annual degree days. This is especially problematic if one is trying to determine paybacks. For example, one could normalize the savings to the period preceding the installation of measures or the period after. If one selects a warm period, then savings may be too low and paybacks too long. If one selects a cool period for normalization, then the estimate of paybacks may be too high.

PRISM™ mitigates this problem by effectively averaging temperatures over a twelve year period and providing an estimate of degree days that is typical for the region of the study, although not one that necessarily matches the specific weather conditions in any given year. The user can select a twelve year period or use the PRISM™ recommended period of January 1, 1980 to December 31, 1991. The advantage of normalizing to the PRISM™ recommended period is that the results will be consistent from study to study over a period of time. The same end can be achieved by consistently using the same user selected time frame. For this study we chose the period from January 1, 1982 through December 31, 1998. In the previous study we selected the period from July 1, 1982 through June 30, 1997.

A major feature of PRISM™ is the ability to evaluate cases against reliability criteria. The first criterion is the R^2 value (explained variance), a measure of the fit of the degree day and energy consumption data, or in statistical lingo, the amount of variance in energy consumption explained by changes in degree days. Energy consumption is assumed to be a linear function of degree days. R^2 varies from 0 to 1. If R^2 is close to zero, it means that factors other than outdoor temperature are driving heating fuel consumption. If the R^2 is close to 1 it means that outdoor temperature is almost entirely responsible for heating fuel consumption. Outdoor temperature is usually the overriding factor in heating fuel use and the goal of the weatherization program is to improve the thermal characteristics of the building shell and the fuel use rate of the heating system to reduce fuel use related to outdoor temperature. The PRISM™ default for R^2 is at .7. This means that at least seventy percent of heating fuel use is temperature related. If less than 70 percent of the fuel use in a building is temperature related, then it becomes difficult to understand the effects of the weatherization measures and the case is dropped from the analysis. We used .7 in this study although most all of the R^2 values in this study were .85 or higher. In other words, 85 percent or more of heating fuel use in this study is temperature driven. Very few cases were dropped because of the R^2 criterion.

PRISM™ has a second measure of reliability which is the coefficient of variation for the normalized annual consumption (CV_{NAC}). Normalized annual consumption is the amount of fuel consumed by a unit for a typical weather year. When estimating normalized annual consumption some estimates may have a very tight error band while others may have a band that is quite wide. In estimating the average consumption we want estimates of unit consumption that are very close to the actual and we want to eliminate values that may not be very close because they may cause the estimates of the average consumption for all units to vary significantly from the actual. Because the variation in the estimates of normalized annual consumption generally will be higher in homes with higher consumption, the estimate of the variation in normalized annual consumption is divided by the estimate of normalized consumption to obtain CV_{NAC}. This provides a standardized measure of the variability of the normalized consumption that is comparable across homes. The PRISM default for CV_{NAC} is 7 percent and that is the value used in this study. Housing units that failed the PRISM™ criteria most often failed this test.

Data Editing

We examined and cleaned data for natural gas as the predominant space heating fuel type. Because electricity consumption may decrease when the use of heating fuel is reduced, we examined household electricity consumption for all participants for whom we calculated savings for natural gas. Theoretically, improved efficiency would reduce furnace / boiler run times. In addition, increased electricity consumption (non-space heating) due to air conditioning use during summer months was also examined. However, for these households electricity consumption did not pass the PRISM™

reliability criteria because the R^2s were particularly low. We concluded that a temperature related component of electricity use could not be reliably extracted for the retrofitted buildings with non-electric primary space heating.

We examined the energy data for duplicates, estimated data, and out-of-range data, and for data comprehensiveness and established pre- and post-program participation dates for each home consistent with the Kansas City Weatherization Assistance Program inspection dates. We then formatted the data into files for import into the PRISM™ software. We subsequently ran the first PRISM™ analysis and examined raw data and PRISM™ results for each home.

We evaluated each home's R^2 and CVNAC values to identify "problem" homes to be singled out for more careful inspection. We also examined the pre- and post-retrofit energy consumption information and read dates. We confirmed that the retrofit dates used to assign energy consumption values to the pre- and post-program periods were correct. For homes where the dates were problematic, we examined the PRISM™ results by placing the values in question in both the pre- and post-program periods and identified in which period the best R^2 and CVNAC values were determined. If neither the pre- or post-program period provided an improved run, a reading which could not be clearly placed in either the pre or post retrofit periods was excluded from the analysis for the home. In some instances, PRISM™ runs were improved by merging consumption data from two or more periods into one period.

Chapter 3. Energy Impacts

Introduction

The Missouri Gas Energy Low-Income Weatherization Pilot Program saved an average of 34.4 million BTUs of natural gas and 500 kWh of electricity per home per year for the housing units examined in the savings analysis. This is an 11% increase in natural gas savings over the estimated savings identified in the short-term analysis conducted earlier and supports the need to conduct longer-term evaluations of these programs. This saving is provided by an average 28.2 percent savings in space heating fuel per unit, an 8.5 percent increase in household baseload consumption and a 1.3 percent net reduction in electric consumption. During the program an estimated 411 housing units were weatherized, achieving a total annual energy savings of 14.1 billion BTUs or approximately 104,000 gallons of oil equivalent or 141,000 therms and 205,500 kWh of electricity. Over the 20-year lifetime of the installed measures the energy savings are expected to equal 296 billion BTUs or about 2.2 million gallons of oil equivalent or 2,960,000 therms.

The Units Being Analyzed

According to the tracking information, the program served 411 single unit buildings between January 1995 and January 1998. The primary fuel examined in this analysis was natural gas. Table 1 presents the details of the inclusion of units in the PRISM™ savings analysis.

Table 1. Population of Units In Study

Fuel Type	Units originally identified by KCWAP	Units in gas or electric files received from the utilities	Units with Pre- and Post- Program Energy Records	Units with Pre- and Post- records for weatherization savings analysis[1]	Units meeting reliability criteria to be included in savings analysis[2]
Natural gas 1999 study (retrofit)	411	399	379	346	255
Natural gas 1999 study (comparison)	96	94	94	93	84
Electric cooling 1999 study (retrofit)	411	408	390	232	174
Electric cooling 1999 study (comparison)	126	126	126	124	100
Totals 1999 study			989	795	613

[1] Energy consumption analysis includes participants with data from January 1, 1992 through December 31, 1998.
[2] These units met the reliability criteria with PRISM R^2 levels of .7 or better and NAC of seven percent or less.

In order to estimate the energy savings from program efforts, it is necessary to make assumptions pertaining to the measures installed and how these measures are used in the average home. For this evaluation it is assumed that the savings calculated for the average unit in the impact analysis reflect the savings in the average participant's unit and that the measures installed in homes last 20 years or more.

Program Energy Savings for Natural Gas

Table 2 presents the basic data from the energy savings analysis. The rows in Table 2 represent the base load consumption, the heating portion of total consumption, total consumption and the calculated reference temperature. Columns 2 and 3 are the pre- and post-average dwelling unit normalized energy consumption estimates for natural gas for the retrofit group as determined by the use of PRISM™. Column 4 presents the gross estimate of savings for the retrofit group.

The retrofits resulted in a total average gross savings of 303 therms of natural gas per year or approximately an 18.4 percent gross reduction in total usage (not just space heating usage). When we take the energy consumption of the control group into account the net savings from the retrofits increases to 20.9 percent for all consumption and 28.2 percent savings (374 therms) in space heating related natural gas consumption.

For the average dwelling, approximately 81 percent of the usage (1338 of 1644 therms) is heating related and 19 percent is used for base loads such as water heating, pilot lights, etc. This is almost exactly the same ratio as the 1998 study where approximately 80 percent of the usage was heating related and 20 percent was used for base loads. Retrofit measures affect the heating portion of the load more than the base load. As we can see, the gross base load reduction for the retrofit was about 44 therms or 14.4 percent of the estimated base load and the heating load reduction was 259 or about 19.4 percent of the heating load. In the previous study, the gross base load reduction for the retrofit was about 50 therms or 14.7 percent of the estimated base load and the heating load reduction about 270 or about 19.3 percent of the heating load.

Columns 6 - 9 provide the same information for the comparison group. There was a slight increase in gross consumption for this group. Total base load consumption increased 115 therms but the heating portion of consumption decreased by 75 therms for an average increase in usage of 40 therms per household. For the comparison group, the percentage gross changes in base load, space heating and total consumption were 22.9 percent, -9 percent and –2.5 percent, respectively. The negative sign indicates an increase in consumption. If we subtract the gross savings for the comparison group from those of the retrofit group, we find the net savings due to the program are -31 therms of base load (44 therms – 75 therms) and 374 therms of heating load (259 therms - (-115 therms)) for a combined net savings of 344 therms. The percentage net savings in base load, space heating and total consumption are –8.5 percent, 28.2 percent, and 20.9

percent respectively. The 344 therms of net savings in this study is quite in line with savings in other localities with significant heating loads.

There are a couple additional points to be made in reference to the baseload data in this table. First, the net savings for the base load was –30 therms indicating a net increase in baseload consumption for the average participant home. However if we look at the data we see that the increase in baseload consumption is a net increase and not a gross increase. That is, both the participant group and the comparison group decreased their baseload consumption over the study period, however, the comparison group decreased their consumption at a rate faster than the participant group and that difference is 31 therms or 8.5 percent. What is interesting is that while the baseload consumption for the participant group decreased by 14.4 percent the comparison group's baseload consumption decreased by 22.9 percent. The participant group decreased consumption at a rate that was about 60 percent less than the decrease for the comparison group.

Second, we conclude that there is absolutely no indication of take-back effects with this program. The reference temperatures for pre and post consumption retrofit groups (row 4) are almost identical and they are almost identical to the reference temperatures for the comparison group. If there were a take back affect, we would expect to see these temperatures increase.

Finally, we should observe that the overall consumption of the comparison group is very similar to the retrofit group. The comparison group used about 44 therms less energy in their hypothetical "before" period. This suggests that the average size of homes were about the same in both the retrofit and comparison groups.

Program Savings from Electricity

A similar analysis was completed for electricity savings. The program was not designed to save electricity and therefore electric measures, such as compact fluorescent lamps, were not installed during the program. Electricity savings from the program would largely result from the reduced furnace run times due to weatherization measures and reduction in air conditioning energy savings. Consumption records indicate that the proportion of homes with air conditioning and which use the air conditioning for a significant number of hours during the summer does not appear to be very high.

For each home in the PRISM™ space heating analysis, we conducted a PRISM™ analysis of electricity consumption. We let PRISM auto-select the best model. During this run, 174 participant cases passed the reliability checks but the savings were actually negative, meaning this group of households used more energy rather than less. The mean savings for these 174 cases was –456 kWh or about a $3.00 per month increase. For the comparison group, 100 cases passed the reliability checks. However, the mean savings for these cases was –950 kWh or about a $6.00 a month increase, providing an almost 500 kWh or $3.00 dollars per month net decrease in electric consumption for program participants. This net reduction in electric savings is about 5 times what we would expect to see if we only consider the furnace run-time savings and provides an indication that there are electric savings from this program beyond the savings from increased heating efficiencies. These savings are most likely as a result of the educational training provided by the program or through air conditioning savings.

Table 2. Energy use and savings calculations

	Retrofit Group				Comparison group					
	Pre-retrofit usage	Post retrofit usage	Gross change in usage	Gross percent change	Pre-retrofit usage	Post retrofit usage	Gross Change in usage	Gross percent change	Net change	Net change percent
1999 Study										
Base load portion 1999 study (therms)	306	262	44	14.4	328	253	75	22.9	-31	-8.5
Heating portion 1999 study (therms)	1338	1079	259	19.4	1272	1387	-115	-9.0	374	28.2
Total 1999 study (therms)	1644	1341	303	18.4	1600	1640	-40	-2.5	343	20.9
Reference temperature (°F)	63.4	61.2	2.3		63.1	63.5	-.4			

Chapter 4. Program Costs

The Installed Measures

Figure 1 shows the percentages of eight measures installed as they were recorded in the KCWAP tracking system. Ninety-nine percent of all homes received infiltration and general heat waste installation measures and 95 percent received door, window, and / or plaster repairs. Examples of air infiltration measures are caulking around windows and doors and applying weather stripping.

Furnace repair and tune-up was done for health and safety reasons and for energy savings reasons. Eighty-eight percent of households were identified as having heating related measures installed for health and safety reasons and 71 percent for energy savings reasons. Many homes received heating related measures that were split between the two categories. Eighty-three percent of the homes had measures related to ducts, vapor problems and sealing electrical outlets. Almost half of the sites received attic insulation (52 percent) and wall insulation (51 percent). Forty-five percent installed foundation and / or floor insulation.

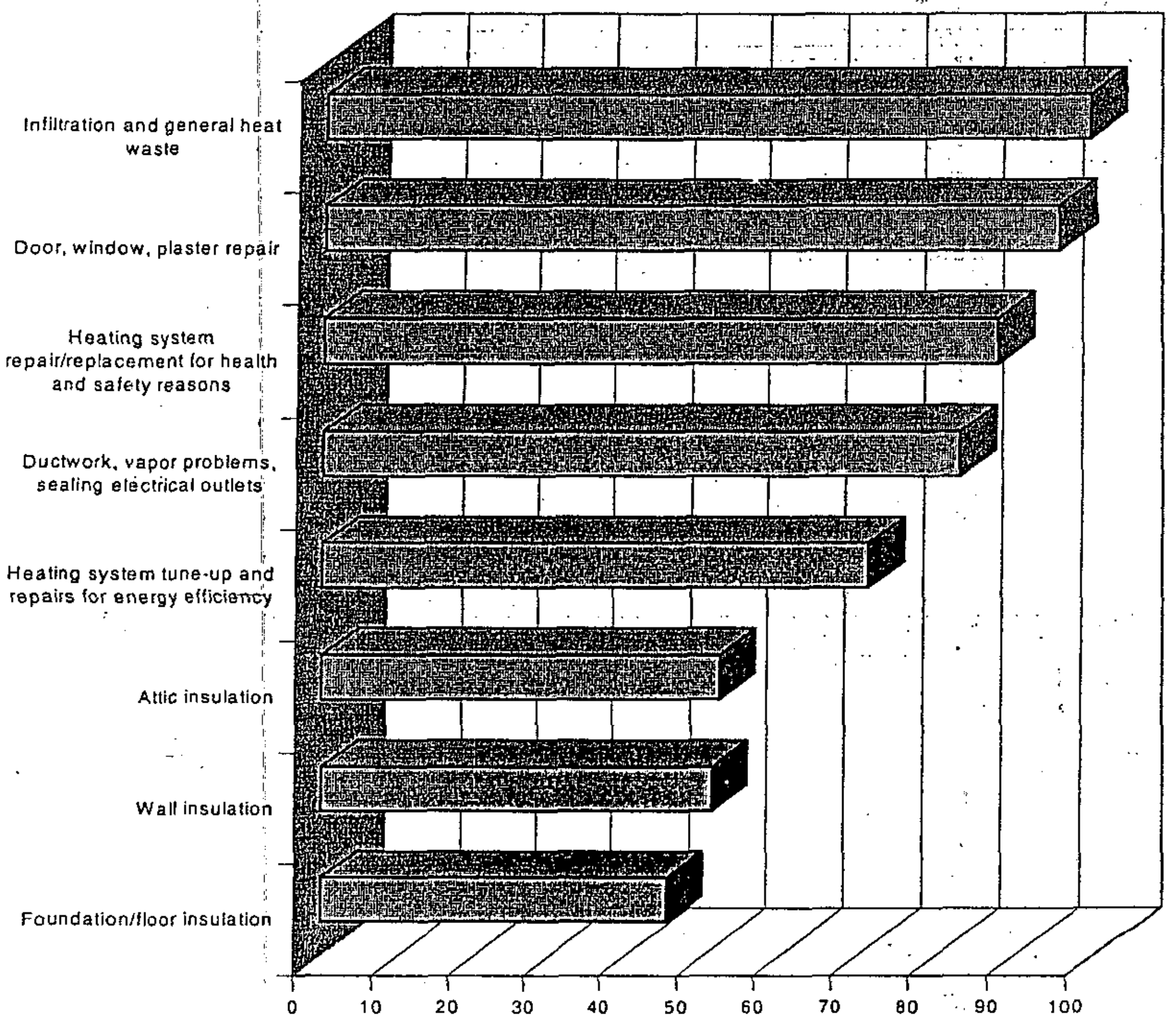

Figure 1. Percentages of measures installed

Measure Specific Installation Costs

Table 3 reflects the different average costs for installing measures. The data have been presented in three ways. Column 2 is the cost to install a measure averaged over the 343 homes (excluding mobile homes) in the program. However, not all homes had each measure installed. Accordingly, column 3 is the average measure cost for just those homes that received the specific measure. Column 5 is the average measure cost of installing the specific measure in homes that were included in the savings analysis.

These data suggest that the homes in our energy savings analysis had slightly more heating system work than did the average home.

Table 3. Average Cost Per Weatherization Measure

Measure	Average cost per unit for all housing units	Average measure cost per unit for units with measure	Number of units	Average measure cost per unit for units with measure included in savings analysis	Number of units
1999 Study (n = 343)					
Infiltration and general heat waste	$416.49	$428.99	333	$443.14	265
General repair needed to weatherize doors, windows, ceilings, etc.	$224.03	$245.50	313	$256.46	251
Foundation and floor insulation including repair	$56.12	$121.06	159	$114.63	121
Heating system repair/replacement for health and safety reasons	$503.03	$565.70	305	$583.34	234
Wall insulation	$236.34	$479.68	169	$501.63	139
Attic insulation	$197.81	$411.21	165	$418.59	135
Heating system tune-up and repair for savings reasons	$169.92	$237.88	245	$241.89	187
Ductwork, vapor problems, electrical outlets and miscellaneous items	$67.76	$84.82	274	$87.40	217
Total	$1871.50	$2574.84	343		268

Considering the average measure cost per unit (Column 3), we see that the most costly measure was the heating system replacement done for health and safety reasons at $566, followed by wall insulation ($480), infiltration and general heat waste ($429), attic insulation ($411),general repair needed to weatherize doors, windows, ceilings, etc. ($246), heating system tune-ups ($238), foundation / flooring insulation ($121), and miscellaneous items ($85).

The preceding estimates for the cost of the work do not include program administration costs. Program costs include the costs associated with a site visit, conducting an audit, developing a set of specifications, placing the specifications for bid, awarding a contract, and providing technical assistance. Based on data supplied by the KCWAP, TecMRKT Works estimated program costs to be 12 percent of installation costs. Using the average installation costs per unit weatherized ($1,871.50) and adding the 12 percent for program costs, the total cost to weatherize a unit is $2,096.08.

Table 4 summarizes the total program costs for the units that were weatherized.

Table 4. Total Program Costs

Description	Units Weatherized January 1995 to December 1998[2]
1999 Study (n = 343)	
Weatherization measure installation cost	$641,965.66
Kansas City Weatherization Assistance Program fixed and indirect costs	$77,034.37
Total costs	$719,000.03

[2] The totals are the number of units times the average cost per unit.

Chapter 5. Program Cost Effectiveness

To determine the benefit-to-cost ratio for the program we compared the program delivery costs to the value of energy savings. The benefits were calculated based on an assumed life of the measures of 20 years. The annual savings in each of the 20 years were adjusted for the projected change in fuel prices and the change in the value of the dollar and then summed for the 20 years.

The changes in fuel prices are based on changes in the projected prices of natural gas and electricity using data from the Department of Energy's, Energy Information Administration (EIA). Each year the EIA makes 20 year discounted fuel price projections and reports these projections in the Annual Energy Outlook. The discounted price projections used in this report are contained in the 1999 Annual Energy Outlook. This report is available on the world wide web and can be accessed via an Acrobat reader at http://www.eia.doe.gov/oiaf/aeo99/pdf/0383(99).pdf. However, regional prices of fuel can vary quite substantially from average national energy prices. Although EIA reports regional prices, it does not make similar regional projections of prices. Thus, regional price trend projections are available but not Kansas City area prices.

To overcome this problem, we assumed that Kansas City energy prices will follow national trends. By taking the local price of energy from MGE and from KCP&L and applying the national projections of price we arrived at a reasonable projection of fuel prices in Kansas City over the next 20 years. Column 1 of Table 5 shows the number of the year from 0 to 20. Column 2 provides the year from 1998 to 2018. Column 3 shows the EIA projected prices for natural gas in 1997 dollars using current MGE residential prices. Column 4 is the projected prices for electricity using current residential prices from KCP&L. Fixed customer charges are not included in these rates. Column 5 is the number of therms saved per participant. Column 6 is the present value, discounted price of the projected gas savings. Column 7 is the electric savings per participant in kWh. Column 8 is the present value, discounted price of the projected electric savings. Over the 20 year lifetime of the measures, the customer can expect to save $2,789 in natural gas costs and $614 in electric cost in 1997 dollars for a total savings of $3,403.

If the $3,403 in benefits to customers are compared to the levelized cost of the program, of $2,096, the benefit cost ratio the program is 1.62 to 1. In other words, the program returns a $1.62 in benefits to the customers for every dollar spent on the program.

The cost-effectiveness of measures

As part of the analysis, TecMRKT Works attempted to analyze the cost effectiveness of the various measures. A typical approach to this problem is to regress the presence or absence of the measures installed in homes on the savings for the homes. The resulting regression coefficients represent the average savings attributable to the measures. This approach works as long as there is sufficient variation in the measures installed between homes. If nearly every home has a particularly measure installed or almost none of the homes have a measure installed, then there is unlikely to be sufficient variation to accurately apportion the savings.

Table 5. Changes in projected fuel prices for 20 years

	Year	Gas price	Electric price	Therms saved / home	Gas dollars saved / home	kWh saved / home	Electric Dollars saved / home
0	1998	$0.450	$0.068	0	0	0	0
1	1999	$0.428	$0.066	344	$147.06	500	$32.88
2	2000	$0.432	$0.065	344	$148.65	500	$32.39
3	2001	$0.432	$0.064	344	$148.65	500	$31.88
4	2002	$0.428	$0.063	344	$147.06	500	$31.43
5	2003	$0.422	$0.062	344	$145.24	500	$30.89
6	2004	$0.418	$0.062	344	$143.87	500	$31.13
7	2005	$0.413	$0.063	344	$142.05	500	$31.28
8	2006	$0.413	$0.062	344	$142.05	500	$31.14
9	2007	$0.412	$0.062	344	$141.60	500	$31.11
10	2008	$0.408	$0.062	344	$140.46	500	$31.00
11	2009	$0.404	$0.062	344	$138.86	500	$30.87
12	2010	$0.400	$0.062	344	$137.73	500	$30.80
13	2011	$0.397	$0.061	344	$136.59	500	$30.72
14	2012	$0.394	$0.061	344	$135.45	500	$30.29
15	2013	$0.389	$0.060	344	$133.86	500	$29.96
16	2014	$0.386	$0.059	344	$132.72	500	$29.73
17	2015	$0.384	$0.059	344	$132.04	500	$29.62
18	2016	$0.383	$0.059	344	$131.58	500	$29.42
19	2017	$0.383	$0.058	344	$131.81	500	$29.22
20	2018	$0.383	$0.058	344	$131.81	500	$29.02
	Totals				$2,789.13		$614.78

Source of price trend projections: USDOE 1999 Annual Energy Outlook
Source of current fuel price: Natural gas: MGE Electricity: KCP&L

The application of this approach to the current problem was made difficult by a number of factors. The data available to us was not organized by discreet measures. For instance, several infiltration measures, such as caulking and weather stripping, were combined in a single category. There was no way to separate caulking from weather stripping. Secondly, the measures were presented in terms of their cost and it was not possible to effectively relate cost to activity. Using several tubes of caulk may have had greater effect than weather stripping doors but the cost of the two measures may have been relatively the same or quite different.

After a preliminary review and analysis of the measures we made several determinations. Infiltration measures were applied to nearly every house. Therefore, it did not make sense to identify infiltration as separate variable to be entered into the regression analysis. Secondly, the repair measures were necessary in order to complete other weatherization measures but do not contribute to savings directly. Plastering the ceiling in order to install ceiling insulation only marginally contributes to additional savings beyond the value of installing the ceiling insulation. Therefore, it was determined that the repair variable should be dropped from the analysis. This does not diminish the importance of repairs to the overall project, it merely indicates that we do not expect them to contribute to the overall savings.

We were also confronted with the problem of having two variables relating to heating systems. One variable included costs assigned to improving health and safety and the second assigned cost to improving energy efficiency. The fact that these variables were highly correlated caused severe problems with the analysis when they were entered at the same time. In order to deal with this problem, we combined the two variables to obtain a total cost for dealing with the heating system and then created two new variables. If the total cost of heating system repair was $800 or more we assumed that a new furnace was installed and we coded a variable that we called "furnace replacement." If the amount was less than $799 but more than zero we assume that there was a heating system tune-up or repair. By coding the variables in this way we were able to distinguish between new units and system repairs and tune-up.

Finally, we discovered that the category of miscellaneous caused a fair bit of disturbance in the analysis. We concluded after a bit of exploration that this variable included duct work which was related to heating systems and thus was correlated with the heating variables. We removed this variable from the analysis.

Table 6 shows the model with five variables, wall insulation, foundation and floor insulation, attic insulation, heating system repair and furnace replacement. Instead of using the dollar amounts, we recoded the variable so that if money was expended the variable recorded the presence of the measure and if money was not expended the absence of the measure was recorded. Because we used presence or absence and these are the unstandardized coefficients, they can be interpreted directly as the therms of savings resulting from the measure.

The largest savings are associated with furnace replacement and the next largest wall insulation. The constant can be interpreted as the average savings from all other sources including infiltration measures, repairs, and miscellaneous. In this model foundation and floor insulation, attic insulation and heating repair make relatively small contributions to the overall savings. Note that the standard errors for heating repairs and the constant are unacceptably large.

Table 6. Preliminary linear regression model based on the presence or absence of the energy saving measures

Measures	Unstandardized Coefficients			
	B (tens of therms)	Standard Error	t	Significance
Constant	104.64	99.04	1.057	.292
Wall insulation	171.81	50.30	3.416	.001
Foundation and floor	9.05	50.69	.179	.858
Attic insulation	21.45	50.63	.426	.671
Heating system tune-up and repair	42.32	97.85	.433	.666
Furnace replacement	227.33	101.77	2.234	.027

An alternative model in which heating repair is removed is shown in Table 7. In this model, heating repair is now represented in the constant. The coefficient of the constant now increases by about 49 therms but the standard error is significantly reduced and the constant is now significantly different than zero. Furnace replacement provides the largest amount of savings, wall insulation the next most savings, and the measures summarized in the constant, most particularly infiltration measures provide the next largest amount of savings.

Attic insulation and foundation and floor insulation provided the least savings. Some may be surprised that attic insulation provides so few savings but this finding is consistent with observations that we are making in other jurisdictions where we have found that infiltration and wall insulation provide significantly more savings than attic insulation in leaky homes.

These savings estimates are quite reasonable. For example, given the average pre retrofit heating energy consumption of 1400 therms, a furnace replacement represents about a 15 percent reduction in energy use which is about what one would expect if furnace efficiency is improved from 65 percent to 80 percent. According to program staff, the furnaces that are being installed have efficiency ratings of about 80 percent.

Table 7. Final linear regression model based on the presence or absence of the energy saving measures for 1999 Study

Measures	Unstandardized Coefficients			
	B (tens of therms)	Standard Error	t	Significance
Constant	153.41	39.03	3.930	.008
Wall insulation	141.51	39.24	3.606	.815
Foundation and floor	85.43	39.23	2.178	.031
Attic insulation	23.55	39.46	1.777	.077
Furnace replacement	70.12	61.37	.234	.000

Table 8. Final linear regression model based on the presence or absence of the energy saving measures for 1998 Study

Measures	Unstandardized Coefficients			
	B (tens of therms)	Standard Error	t	Significance
Constant	133.73	49.56	2.698	.008
Wall insulation	175.48	49.79	3.524	.001
Foundation and floor	11.03	49.90	.221	.825
Attic insulation	23.55	50.22	.490	.625
Furnace replacement	213.50	53.06	4.023	.000

Based on these data, we can begin to make some assessments of the cost effectiveness of the different measures. Table 9 presents the costs of the measures, the dollar savings from the measures assuming that the cost of energy in constant dollars is about $0.41 per therm over a 20 year period and that the life of measures is about 20 years. Forty-one cents per therm is used because it is the present value of fuel savings at the half-way point in the measure's useful life.

Table 9. Estimated benefit cost ratio of selected measures

Measure	Cost	Annual savings (therms)	20 year savings (dollars)	Benefit to cost ratio
Water heater blanket[1]	$20	30	$246	12.30
Infiltration measures	$442	70	$574	1.30
Wall insulation	$497	175	$1,435	2.89
Attic insulation	$429	24	$197	0.46
Heating tune-up and repair	$366[2]	30	$246	0.67
Heating system replacement	$1,621[3]	213	$1,747	1.08

1 Cost of a water heater blanket and installation estimated by TecMRKT Works

2 Cost of the heating repair is the average of the repairs in all homes that had heating repairs less than 800 dollars but greater than zero.

3 Cost of heating replacement is the average for all households with heating system costs identified as being greater than $800.

Based on the preceding it is clearly cost effective to install water heater blankets, wall insulation, infiltration measures, and heating system replacements. The value of heating system tune-ups and repair is questionable on the basis of energy savings along and attic insulation appears not to be cost effective. It is important to keep in mind that heating system replacements are usually installed for health and safety reasons. We have not estimated the health and safety benefits of replacing heating systems but they may be substantial in terms of reducing illness and reducing the need for emergency and service visits to households. Likewise, there may be significant non energy benefits from heating system tune-ups including reduced services calls and health and safety related benefits.

Chapter 6. Summary and Conclusions

Between its inception and December 1998, the Missouri Gas Energy Low-Income Weatherization Assistance Pilot Program served 343 clients providing an estimated savings to Missouri citizens of $61,720 a year in current 1997 dollars or $1,167,540 over the 20 year life of the measures. On average, the consumption of space heating fuel for units heated with natural gas was reduced by 34.4 million BTUs annually, or 20.9 percent of total gas consumption, for a program-wide savings 296 billion BTUs over the 20 year life of the installed measures. This gas savings is provided through a 28.2 percent reduction in heating related fuel consumption and an 8.5 percent increase in baseload consumption. The benefit-to-cost ratio for the program is 1.62 to 1.

We also analyzed the benefit to cost ratios for the various types of measures installed. Water heater blankets pay for themselves in two years or less. Wall insulation, infiltration measures, and heating system replacement are also cost effective. Heating system replacement is usually done for health and safety reasons so the energy savings is a bonus benefit. Heating system tune-ups and repair do not appear to be cost effective until health and safety benefits are included. Attic insulation does not appear to be cost effective. From a policy standpoint, the program may want to consider the merits of replacing a furnace rather than tuning and repairing an existing system and insulating an attic, especially if the estimated combined cost of the last two measures exceeds the cost of a furnace replacement.

It should be kept in mind that this evaluation has focused entirely on the benefits and costs of weatherization. There are other health and safety benefits and costs associated with this program that have not been fully evaluated here. In particular, the replacement and repair of furnaces may significantly reduce service calls and emergency service calls, and reduce the number and consequences of health problems associated with a poorly functioning furnace.

Report of the

Governor's Energy Policy Council

—

presented to

Governor Bob Holden

June 1, 2003

Exhibit (Schedule) 7

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Governor's Energy Policy Council

Vision Statement

Missouri energy policy shall ensure an adequate, diverse and reliable energy supply, produced and used in an efficient and environmentally sound manner, that is accessible, equitable and affordable to all Missourians.

Preamble

The Governor's Energy Policy Council shall serve in an advisory capacity to the Governor on matters of local, state, regional and national energy policy. The Council will serve as a public forum, sounding board and think tank on energy policy. The Council believes that the fundamental components of Missouri's energy policy include energy efficiency, conservation, self-sufficiency and diversity to benefit Missouri's energy security, environment and economy.

Executive Summary

Governor Holden established the Missouri Energy Policy Council by Executive Order 03-10 to serve in an advisory capacity on matters of local, state, regional and national energy policy. The Council will consider and make recommendations on several issues, including the following:

- Major aspects of energy policy, energy supplies and energy prices;
- Consumer protections, including consumer education, universal access, low-income assistance funding and the impact of regulatory changes;
- New energy technologies and trends;
- Opportunities to increase energy efficiency, and;
- Opportunities to increase the use of diverse and clean energy supplies to improve the economic vitality and environmental quality of Missouri residences, businesses, farms and transportation.

The executive order directed the Council to prepare a report by June 1 that describes Missouri's current and future energy supplies and demand, recommends how Missouri state government may demonstrate its leadership in energy efficiency, and analyzes the impact of the Standard Market Design rules recently proposed by the Federal Energy Regulatory Commission.

Missouri's Energy Use and Sources

Missouri depends heavily on energy resources from outside the state, importing more than 95 percent of its energy sources in the form of coal, petroleum and natural gas at a cost of $13.2 billion in 2000. Missouri lacks oil and natural gas resources. The state has only modest coal resources, which are difficult to use to fuel electrical generating plants because of air quality issues associated with the coal's high sulfur content. To continue the consumption of fossil fuels into the 21st century at current rates of increase, Missouri would have to more than triple its imports of fossil fuels by mid-century. Energy efficiency and the development and use of Missouri's renewable energy resources offer economic benefits to Missouri and should be fundamental components of how we meet our energy needs.

Missouri State Government as a Leader in Energy Efficiency

Missouri state agencies, including universities, spend about $78 million for energy use in state facilities. Energy efficiency saves taxpayer dollars that can be used to fund essential public services. If the state's energy bill were reduced just 10 percent, a very conservative estimate, savings to the state would be $7.8 million annually over the life of the efficiency measure. These dollar savings can play a valuable role in funding public services under the current budget situation.

For example, in January of this year, the Office of Administration implemented a number of simple, no-cost energy efficiency changes in 26 state buildings. As a result, the state has saved more than $100,000 in energy costs and reduced energy use by more than one million-kilowatt hours in five months. As a result of upgrades to lighting and heating and air conditioning equipment, the Department of Natural Resources is saving $55,000 annually in energy costs on one building alone. These improvements will pay for themselves in 11 years.

State government should be a model of energy efficiency and demonstrate its leadership through the efficient design and management of its facilities and fleets. Initial recommendations from the Council to increase energy efficiency in state facilities include use of performance contracting to finance improvements to state-owned buildings, demonstrations of model facilities, training staff in energy-efficient operations strategies and training architects and engineers in state building efficiency standards. State fleet efficiency recommendations include procurement of efficient vehicles, effective vehicle maintenance procedures, fleet management and telecommuting. The Council will evaluate additional recommendations in its future work.

Standard Market Design

The Federal Energy Regulatory Commission's (FERC) Notice of Proposed Rulemaking for Standard Market Design was issued on July 31, 2002, with the stated purposes of better ensuring competition in wholesale electricity markets and open access to transmission lines. In response to strident concerns among states, especially southern and western states, FERC issued a white paper April 28, 2003, to moderate and further explain aspects of its standard market design proposed changes. Because this proposed rule is subject to further change, this matter requires ongoing study and analysis. The Council believes FERC should take ample time to evaluate the proposed changes in wholesale market operation. The Council also recommends that Missouri take the position that Missouri citizens should not be adversely affected through higher electricity rates and/or reduced services.

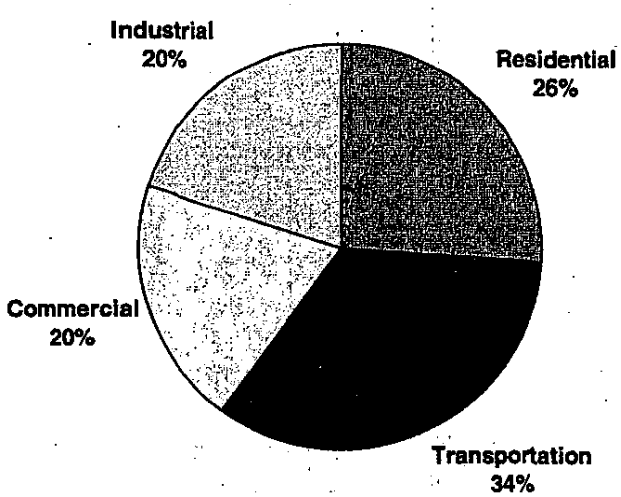
[1]An Overview of Missouri Energy Use and Sources

In calendar year 2000, the state of Missouri ranked as the 22nd largest energy consuming state overall at 1.7 quadrillion British thermal units (Btu) and the 38th largest energy consuming state per capita at 296 million Btus. Missouri ranked 17th in the nation in energy expenditures, spending about $13.2 billion in 2000 to meet its energy needs.

- **Missouri was ranked as the 22nd largest energy consuming state in the U.S. using a total of 1.7 quadrillion Btu of energy.**
- **Missouri was ranked 17th in the U.S. in total energy expenditures at $13.2 billion.**

Missouri's population has grown by about 8 percent in the past ten years (1991 – 2000) while energy demand has increased by nearly 11 percent. Missouri ranked in the top 20 states in all energy-using sectors except the industrial sector. Missouri consumption ranked 15th in the nation for residential, 13th in commercial, 31st in industrial and 17th in transportation. Missouri's major energy-consuming sectors and their share of total energy consumed is displayed below.

Missouri Energy Use by Sector



Missouri depends heavily on energy resources from outside the state, importing more than 95 percent of its energy sources in the form of coal, petroleum and natural gas. In 2000, Missourians paid $13.2 billion for energy, as compared to $11.3 billion in 1999, an increase of about 17 percent (in nominal dollars).

The majority of energy that Missourians consume is fossil fuels – coal, petroleum and natural gas. Of all energy consumed in Missouri in 2000, about 93 percent came from fossil fuels. From 1990 to 2000, expenditures for fossil fuels increased about 46 percent, from $6.6 billion to $9.7 billion. Missouri lacks oil and natural gas resources. The state has only modest coal resources, which are difficult to use to fuel electrical generating plants because of air quality issues associated with the coal's high sulfur content.

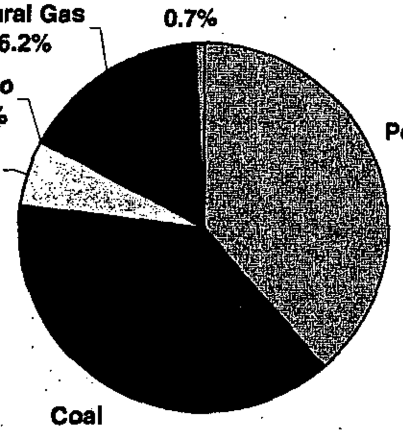
[1] The most current available data from the U.S. Department of Energy for calendar year 2000 is used throughout this report unless otherwise noted.

The pie chart at right shows a breakdown of Missouri consumers' use of primary energy sources in 2000 including coal, petroleum, natural gas, nuclear, hydroelectric, renewable and waste resources. From 1990 to 2000, coal use increased at an average annual growth rate of 2.5 percent, followed by natural gas at 1.8 percent and petroleum at 1.2 percent.

To continue the consumption of fossil fuels into the 21st century at these same rates of increase, Missouri would have to more than triple fossil fuel imports by mid-century.

The world's present supplies of coal, oil and natural gas are finite and non-renewable. Missourians have choices to make to ensure adequate future energy supplies. Choices include commitment to energy-efficiency programs that moderate energy demand and development of Missouri-based energy resources, both renewable and non-renewable resources with due consideration to the effect on environmental quality, public health and energy prices.

Sources of Missouri's Energy



A Comparison of Missouri and U.S. Energy Prices and Expenditures by Source
(Millions of Dollars)

Energy Source	MO $/MMBtu	U.S. Ranking	U.S. $/MMBtu	MO Total Expenditure (2)	U.S. Ranking	U.S. Avg. Expenditure
Electricity	$17.63	29	$20.04	$4,370	19	$4,500
Petroleum(1)	$10.33	27	$ 9.94	$7,142	17	$7,100
Natural Gas	$ 6.63	12	$ 6.63	$1,870	17	$1,900
Coal	$ 0.93	47	$ 1.27	$ 644	15	$ 563

(1) Includes distillate fuels, jet fuel, LPG, motor gasoline, residual fuel, asphalt, road oil, aviation gasoline, kerosene, lubricants, and petroleum coke.

(2) The four items in the "Missouri Expenditures" column add up to more than $13.2 billion because expenditures for coal, natural gas and petroleum used to generate electricity are included in the "electricity" item and also in the "coal," "natural gas" and "petroleum" items. In 2000, Missouri utilities expended $808 million for primary fuels including $609 million for coal, $135 million for natural gas, $22 million for oil and $42 million for nuclear fuel.

Electricity

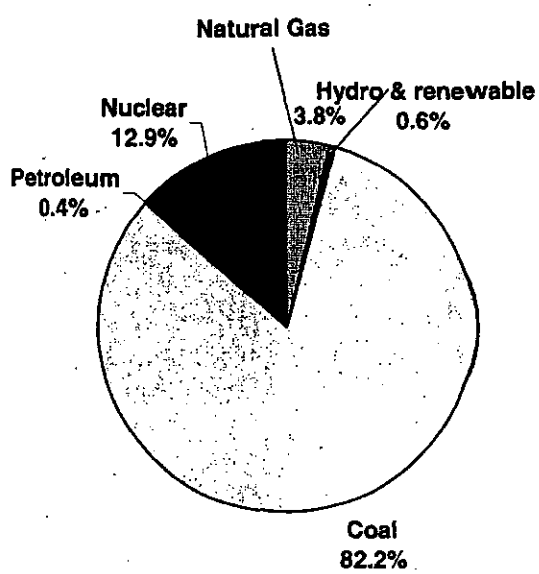
Missouri's electricity is produced predominantly by coal (82 percent) and nuclear power (13 percent). About four percent comes from natural gas. The remaining one percent comes from hydroelectric power, wood, fuel oil and other minor sources. Missouri spent $644 million to purchase coal in 2000.

- **Missouri consumed 72.6 billion Kilowatthours of electricity and was ranked 19th in the U.S.**
- **Electricity expenditures totaled $4.4 billion ranking 19th in the U.S.**
- **Missouri ranks 26th in its average utility retail price at 6.07 cents per kilowatt hour**

Generating facilities within Missouri provide the great majority of the state's electrical power. These utilities include investor-owned regulated electric utilities, municipal electric utilities and rural electric cooperatives. Missouri also receives some electricity from outside the state and exports some power from Missouri to other states. For more than two decades, Missouri has enjoyed abundant electricity and is a net exporter. Missouri electric consumption in 2000 for all energy end-use sectors totaled 72,643 million-kilowatt hours (kWh). Total Missouri utility and non-utility generation was 76,626 million kWh. Excluding out-of-state contracts for interstate transport into Missouri, the base difference between domestic generation and consumption was 3,643 million kWh.

The Missouri Public Service Commission (PSC) regulates Missouri's five electric investor-owned utilities.[2] The PSC works closely with these utilities to monitor current situations, provide direction if capacity or reliability concerns arise and set appropriate customer rates. The five regulated investor-owned utilities in Missouri are AmerenUE (St. Louis), Kansas City Power and Light, Light and Power (St. Joseph, a division of Aquila, formerly known as St. Joseph Light and Power Company), The Empire District Electric Company (Joplin) and Missouri Public Service (Kansas City, also a division of Aquila). These five utilities comprise approximately 70 percent of electricity sales to Missouri customers.

Missouri Electric Generation Sources



Rural electric cooperatives have 16 percent of the market share while municipal utilities have 12 percent. The municipal utility in Missouri's third largest city, Springfield, accounts for approximately 30 percent of the municipal utility sales in the state.

[2] Currently the PSC also regulates Citizens Electric Cooperative; however if the Governor signs SB 255 that was passed by the General Assembly in April 2003, Citizens Electric Cooperative will no longer be a regulated utility.

Missouri ranks as the nation's 20th largest consumer of electricity per capita. In 2000, Missourians spent about $4.4 billion for electricity. Missouri's average utility retail electricity price ranks 26th at 6.07 cents per kWh.

The U.S. Department of Energy projects that United States electricity demand will grow by 1.8 to 1.9 percent per year through 2025 due to growth in electricity use for computers, office equipment, and a variety of electrical appliances in the residential and commercial sectors.

Projected peak electricity demand and supply for Missouri is analyzed here based on the aggregate four-year projected peak demand and capacity for nine of the largest electric utilities in the state. These include the five investor-owned utilities; Associated Electric Cooperative Inc. (AECI), the primary source of power for 51 electric distribution cooperatives; and the state's three largest municipal electric utilities (Springfield City Utilities, Independence Power and Light and Columbia Water and Light).[3] (See Appendix A)

At present, the combined capacity of these nine utilities exceeds their combined required capacity (which includes a required reserve margin) by about four percent, a surplus of about 970 megawatts (MW).[4] However 2006 project capacity requirements for these utilities projected to exceed combined projected capacity by about 4 percent, a deficit of about 1,200 MW. However, in the normal course of business, investor-owned utilities work with the PSC to plan for future energy needs. Therefore, the projected 2006 capacity shortfall is not expected to be a critical issue because plans have begun to ensure sufficient generation.

A shortfall in peak capacity could be addressed through a variety of solutions: building or contracting for additional conventional generating capacity, moderating the growth in peak demand through energy-efficiency programs or load-management services, providing additional energy through renewable and distributed energy resources or a combination of all three. In addition, as a result of overbuilding of capacity by unregulated wholesale generators in the Midwest, there may currently be excess capacity available on the wholesale market at reasonable terms. The ability to move this electricity to Missouri assumes adequate transmission capacity exists to transport the power to Missouri consumers when and where it is needed. Federal and state experts recognize current limitations in transmission lines and related facilities periodically hamper the ability to transport power where it is needed. Refer to the Standard Market Design section of this report as it relates to federal efforts to address transmission needs.

[3] Data for AECI and the three municipal utilities was provided by the individual utilities; the Public Service Commission provided data for the investor-owned utilities.
[4] The capacity requirement includes a 12 to 16 percent reserve margin above the utilities' forecasted peak demands, determined by the power pool to which the utility belongs.

The majority of the forecasted need for additional capacity by 2006 focuses on meeting peak demand for the relatively few summer hours of the year when demand is greatest. Peaking plants provide additional short-term power to satisfy the additional load that occurs during peak periods. Peaking plants have relatively low up-front capital costs but high fuel costs. These peaking plants are typically natural gas fired combustion turbines that can be built in approximately eighteen months. Energy-efficiency efforts and load-management programs provide alternative or supplementary approaches to reducing peak demand.

Residential customers account for more than 40 percent of Missouri's electricity consumption, followed by commercial users at 37 percent, industrial at nearly 22 percent and the remaining balance for streetlights and other applications at 1 percent.

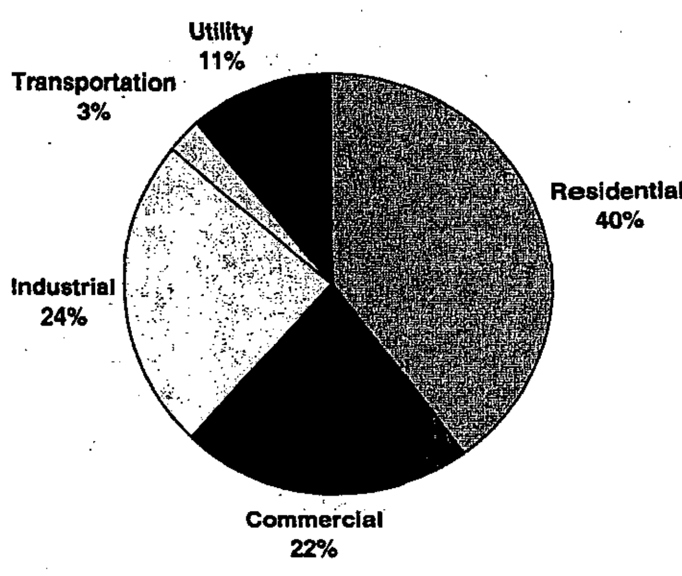
Natural Gas

Approximately 60 percent of Missouri households use natural gas to heat their homes. Natural gas also is used to produce goods and generate electricity. During 2000, Missourians spent about $1.9 billion and used approximately 285 billion cubic feet of natural gas.

A combination of several factors has contributed to higher natural gas prices. During the past decade, drilling rates were low because of low market prices. These decreased supplies of natural gas set the stage for price and supply volatility. In recent years, unusually cold winters placed additional demand on natural gas supplies, resulting in higher prices. When prices remained higher than the $2.00 per million Btu from previous years, less gas was purchased to place into storage.

Wholesale natural gas prices spiked 287 percent higher during the winter of 2002-2003 than during the winter of 2001-2002, moving from $2.36 to $9.13 per million Btu (*Missouri Energy Bulletin*, March 26, 2003). Similar spikes also accompanied the winter of 2000-2001. While well below the winter peaks now in spring 2003, the natural gas spot price has remained high in historical terms for this time of year. As of May 9, 2003, working gas in storage stood about 47 percent below 2002 levels at this time and 38 percent below the previous five-year average. The lower natural gas stockpiles indicate a continuation of prices higher than historical levels.

Missouri Natural Gas Use by Sector



Electric utilities are now using more natural gas to produce electricity. This new demand for natural gas places additional pressure on natural gas supplies and prices. Missouri's electric utilities used about 7 billion cubic feet of natural gas in 1997, 16 billion in 1998, 19 billion in 1999 and 30 billion in 2000 – an annual average increase of 23 percent.

The U.S. Department of Energy expects total U.S. demand for natural gas to increase at an average annual rate of 1.8 percent through 2025, primarily because of rapid growth in demand for electricity generation.

Natural gas is transported into Missouri by interstate pipeline from Arkansas, Oklahoma and Kansas to local distribution companies (gas utility companies) that, in turn, move the product to the consumer through local gas lines. Missouri is not a natural gas producing state having no commercial gas production and little potential for future production.

- **Missouri consumed 285 billion cubic feet of natural gas and rranked 23rd in the U.S.**
- **Natural gas expenditures totaled $1.9 billion and ranked 17th in the U.S.**

Propane

Propane is a byproduct of both crude oil refining and natural gas production. The U.S. Census Report for 2000 reveals that approximately 12 percent of Missouri households heat with propane. Propane also is used to support commercial operations, produce goods, dry grain harvests and fuel vehicles.

In 2000, Missourians spent about $459 million and used approximately 455 million gallons of propane. The residential sector consumed the largest share at nearly 55 percent, followed by industry (which includes agriculture) at approximately 34 percent. The commercial sector used 10 percent while the transportation sector consumed the smallest share at one percent.

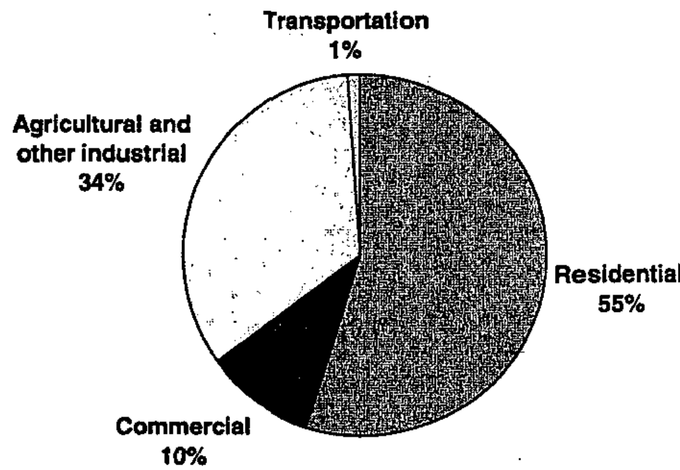
- **Missouri consumed 455 million gallons of propane**
- **Propane expenditures totaled $459 million**

Total propane expenditures in Missouri have increased by an annual average rate of more than 30 percent from 1998 through 2000, moving from $238.3 million to $459 million. Similar factors to those affecting natural gas – low inventories, cold winter and high fossil fuel prices – have contributed to higher propane prices and lower propane supply availability. During this same period, the average price of propane increased by nearly 45 percent.

Total propane sales volumes reported by Missouri retail companies totaled 592 million gallons in 2001, representing 5.2 percent of national sales.[5] This is a 28 percent increase from 2000 sales of approximately 462 million gallons that represented 3.8 percent of U.S. sales. The majority of sales (83 percent) in 2001 were to residential and commercial end users.

Propane is moved by pipeline and truck. Pipelines move propane to distribution terminals in Missouri located at Kearney, Moberly, Jefferson City, Belle, Mt. Vernon, and Dexter. From these points, large transport trucks move propane to retailers. Local propane retailers then supply propane to Missouri end-use customers using smaller delivery trucks. About 230 propane retail outlets with approximately 657 local storage locations serve Missouri customers. Ferrellgas Company, located at Liberty, is the second largest propane company in the U.S.

Missouri Propane Use by Sector



Petroleum

Consumption of petroleum-based products – about 15 million gallons per day – accounts for approximately 38.6 percent of all primary energy consumed in Missouri. Missourians spent about $7.1 billion on petroleum products in 2000.

- **Missouri consumed 130 million barrels of petroleum, ranked 18th in the U.S.**
- **Petroleum expenditures totaled $7.1 billion, ranked 17th in the U.S.**

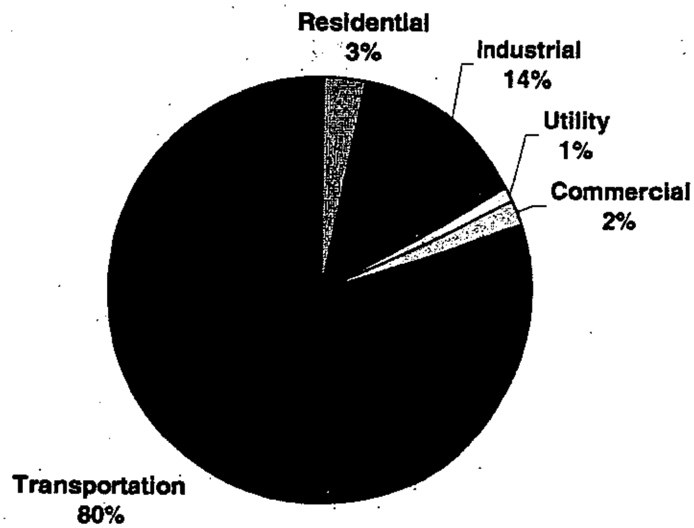
Motor gasoline, motor distillate fuel, kerosene/distillate and jet fuel accounted for over 85 percent of the total petroleum consumption. Nearly 80 percent of petroleum consumed in the state is for transportation use at a cost of about $6.6 billion in 2000.

Missouri consumes about 8.5 million gallons of gasoline each day – expenditures for gasoline totaled $4.4 billion in 2000. As a nation, and Missouri is no exception, Americans are driving less fuel-efficient vehicles. The number of miles Missourians drive per capita continues to increase. These two factors combine to increase Missouri's gasoline use by two percent annually.

[5] "2001 Sales of Natural Gas Liquids and Liquefied Refinery Gases," American Petroleum Institute, November 2002. This report presents results of a survey reporting estimated sales - not consumption.

The majority of petroleum products enter Missouri through pipelines, barges and large tanker trucks running from Texas, Louisiana, Arkansas, Oklahoma, Kansas and Illinois.

Missouri Petroleum Use by Sector



Energy Efficiency

Energy use plays an integral role in Missouri's ability to improve economic prosperity and greatly influences the quality of the environment. Using energy more efficiently helps the economy grow and reduces the environmental impacts on our air and water by displacing fossil fuel generation. Because Missouri imports more than 95 percent of its primary energy sources at a cost of $13.2 billion in 2000, actions that reduce the rate at which dollars leave our state for the purchase of fossil fuels benefit our economy.

Energy-efficiency measures reduce demand and essentially serve as an energy resource like coal, wind, biomass, oil, solar or natural gas. While additional energy supplies will be needed to meet increasing demand, energy efficiency also provides a means to moderate demand and reduce the number of new power plants needed and development of other energy sources. In contrast to supply options for new generation such as drilling for more natural gas or mining coal, energy efficiency helps contain energy prices by curbing demand instead of increasing supply. This means that energy efficiency provides additional environmental and economic value by preserving natural resources and reducing emissions. [6] Energy efficiency also can help reduce the vulnerability of our economy to energy supply disruptions.

Several reports show that Missouri stands to gain jobs and economic benefits from investing in energy efficiency and renewable energy development. The *Missouri Statewide Energy Study*, published in 1992, identified nearly 100 energy-efficiency measures with paybacks of five years or less and expected net jobs and income benefits from these measures. The study also estimated these parameters for dozens more measures with longer paybacks. The energy study "generally supports the wisdom in investment in energy efficiency from either the demand or supply side" and that "investments in energy efficiency represent a significant economic development opportunity for the state." [7]

In 1993, the Department of Natural Resources' Environmental Improvement and Energy Resources Authority (EIERA) completed a study in response to a request from the Missouri General Assembly pursuant to House Concurrent Resolution (HCR) 16. This study estimated Missouri environmental and macroeconomic benefits to be achieved from implementing three levels of energy standards for new residential and commercial buildings.[8] These levels were (1) the Model Energy Code (MEC) and ASHRAE[9]

[6] Source: "Utility Deregulation a Bust for Energy Efficiency Programs," Environmental Working Group, October 1998.

[7] "Missouri Statewide Energy Study," Department of Natural Resources Environmental Improvement and Energy Resources Authority, 1992 (Volume I, Chapter V, pg. I-33).

[8] "Report to the Missouri Legislature Pursuant to House Concurrent Resolution 16: Economic Opportunities through Energy Efficiency, and The Energy Policy Act of 1992," Department of Natural Resources' Environmental Improvement and Energy Resources Authority (EIERA), December 1993.

[9] ASHRAE, the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is an international organization that advances the arts and sciences of heating, ventilation, air conditioning and refrigeration through research, standards writing, continuing education and publications. Through its membership, ASHRAE writes standards that set uniform methods of testing and rating equipment and establish accepted practices for the heating, ventilation and air-conditioning industry worldwide, such as the design of energy efficient buildings. Council of

standards, (2) a higher standard based on recommendations by utilities and builders associated with energy-efficiency efforts in the state and (3) a more aggressive level of efficiency improvements. Estimates of benefits for the three levels were based on detailed examination of prevailing and available energy technologies for specific end uses in a number of building types. The study concluded that implementation of standards at any of the three levels would provide a net macroeconomic benefit compared to the baseline case of no energy standards. The estimated net benefits for the three levels of implementation were $101 million from implementing the MEC / ASHRAE standards, $550 million from implementing the next level of standards and $489 million for the highest standard (1993 dollars).

Both the *Energy Study* and the HCR 16 report projected significant macroeconomic benefits from adopting statewide energy codes. The *Energy Study* estimated that every $1 million spent complying with the ASHRAE 90.1 energy code would create about a half million dollars in net income, about 27 net jobs and have a simple payback of about four years. Every $1 million spent complying with the CABO residential code would create about $320,000 in net revenue, 16 net jobs and have a simple payback of about six years.[10]

Assessments of energy savings potential at dozens of individual Missouri industrial facilities, available from the University of Missouri-Rolla's Industrial Assessment Center, indicate that substantial economic benefit is available from energy efficiency in Missouri's industrial sector. A national study conducted in 1998 by the Energy Cost Savings Council (ECSC) and Energy User News reviewed more than 1,000 commercial and industrial building energy-efficiency upgrades such as lighting, motors, drives, building automation systems and HVAC. The study concluded that companies can save up to $1.00 per square foot in annual operations cost and obtain a 30 to 50 percent return on investment within two to three years of initial investment.

The 1998 study, *Opportunities Lost* conducted by the Alliance to Save Energy, compares the impact of implementing a residential energy code based on the MEC '93 standard in 34 states.[11] The study ranked Missouri fifth in potential for annual statewide energy savings and estimated that within 1.5 years the monthly savings per Missouri home would exceed the monthly increase in mortgage payments from implementing measures. This study shows that modern building energy codes save consumers money and energy every year, making housing more affordable over the life of the home while reducing air pollution.

Efficiency improvements that offer most potential for energy savings include efficient residential heating, ventilating and air conditioning equipment (HVAC); tune-ups and repair of HVAC equipment; proper installation, maintenance and use of commercial

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[10] CABO, the American Building Officials, is one of several building code organizations that comprise the International Code Council (ICC) and is responsible for establishing uniform building, electric and plumbing codes and standards.

[11] "Opportunity Lost: Better Energy Codes for Affordable Housing and a Cleaner Environment," Alliance to Save Energy, 1998.

HVAC and other building systems; and energy-efficient commercial and industrial sector lighting retrofits, motors, steam and compressed air systems.

Effective energy-efficiency programs address the barriers that inhibit customers from making investments in energy efficiency improvements – lack of money or competing demands for available funds, up-front costs that are perceived to be more real than long-term savings, lack of information or technical expertise, and lack of available technology.

Energy-efficiency programs can include low-income weatherization; low-cost customer financing for energy-efficient building improvements and appliances; information; new-home construction practices; reduced air infiltration; and incentives for energy-efficient heating systems, geothermal heat pumps, domestic water heating, lighting and windows. Efficiency programs in other states are funded through a utility company's investment of a percent of its revenues, customer charges, and tax incentives.

To achieve public benefits for Missouri citizens, financial incentives and ongoing funding such as a public benefits fund, are needed to encourage investments in energy efficiency. One effort to realize some of these energy savings for Missouri citizens is AmerenUE's recent agreement to provide $4 million in funding over a four-year period for residential and commercial energy-efficiency programs. As the result of a negotiated settlement in an over-earnings rate case, these programs will be developed in a collaborative process with the Department of Natural Resources, the Public Service Commission, Office of Public Counsel and AmerenUE.

Renewable Energy Sources

Renewable energy sources in the Midwest are playing an increasing role in providing energy needs. Diversifying energy sources in Missouri will provide numerous benefits by:

- reducing our vulnerability to volatile oil markets,
- improving grid reliability through on-site generation,
- increasing the competitiveness and reliability of businesses and energy systems,
- offering economic benefits from the development of renewable energy industries and keeping more of our energy dollars in the local economy, and
- improving the environment from reduced emissions that harm public health.

Clean domestic energy choices for power generation, including solar, wind and biomass, can improve efficiencies and reduce expenditures on transmission and distribution equipment by siting these technologies close to the point of consumption, where possible.

Other Midwest states have begun to realize the economic benefits from the development of renewable energy industries. Many of these economic benefits accrue, in particular, to the rural economy. In Iowa and Minnesota for example, wind-farm developers pay 115 farmers about $2,000 per year for each wind turbine placed on the farmer's property, for a statewide total of approximately $640,000 per year. The Iowa wind projects also generate $2 million per year in tax revenue to counties and have created 40 new jobs. An economic study by the Regional Economics Applications Laboratory estimates that the state of Illinois can add 13,500 new jobs and $1.5 billion in annual economic output by 2020 by investing in renewable energy technologies.[12] The study includes estimates for nine other states in the Midwest.

The Union of Concerned Scientists (UCS) studied the impact of a national policy called a renewable portfolio standard (RPS) to increase the United States' use of renewable energy to 20 percent by 2020.[13] The UCS analysis found that under a 20 percent RPS, Missouri could produce the equivalent of 3 percent of its electricity use from renewable energy (not including hydropower) in 2010 and 23 percent in 2020 from bioenergy resources (88%), wind (7%) and landfill gas (5%). If a RPS were in place, the study estimates that, between 2002 and 2020, renewable energy development could generate $1.6 billion in new capital investment in Missouri; $62 million in new property tax revenues for local communities; and $4 million in lease payments to farmers, ranchers and rural landowners from wind power (1999 dollars).

Missouri has adopted limited policies to develop and use renewable energy. These policies relate to transportation renewable fuels – ethanol and biodiesel -- and include tax incentives and subsidies for production. At this time, Missouri has no incentive policies that have resulted in additional use of renewable energy sources to generate electricity.

In a survey of 175 Missouri utilities conducted by the Energy Center in 2002, only 3 percent indicated plans to offer a renewable or alternative energy program or service. In a newly released study from the Union of Concerned Scientists, Missouri received a grade of "F" and is one of six states listed in the "Hall of Shame" for a lack of commitment to renewable electricity.[14] Thirty-four states received failing grades of D or F for their lack of commitment to renewable electricity. This report assigns grades to each of the 50 states based on their commitment to supporting wind, solar, and other renewable energy sources. Commitment is measured by the projected results of renewable electricity standards for electric companies and dedicated renewable electricity funds. Current state renewable energy generation is also considered.

The cost of wind energy is now in a competitive range with power technologies that use fossil fuels, ranging from 4.0 to 6.0 cents per kilowatt hour, not including the U.S. federal production tax credit.[15] Increasingly, utility companies are deciding to build wind-powered generation because it is economical to do so. Two Missouri utilities, Aquila

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[12] "Job Jolt: The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland, An Economic Study by the Regional Economics Applications Laboratory for the Environmental Law and Policy Center," November 2002.
[13] "Renewing Where We Live," Union of Concerned Scientists, 2002.
[14] "Plugging in Renewable Energy: Grading the States," Union of Concerned Scientists, May 2003
[15] U.S. Department of Energy National Renewable Energy Laboratory National Wind Technology Center. The federal production tax credit for renewable energy is 1.5 cents/kWh.

(formerly UtiliCorp United Inc.) and City Utilities of Springfield invest in wind generation as part of their generating mix.

Due to the substantial progress over the past 20 years in improving the cost-effectiveness of wind turbines, it is now possible to profitably operate wind farms on areas with a wind resource that 10 years ago was considered sub-marginal for utility-scale wind development. The Department of Natural Resources is working with the U.S. Department of Energy to develop a high-resolution, modern assessment of Missouri's wind resources. To assist Missourians interested in assessing their wind resources for small-scale wind turbines, wind-measuring devices are available for loan from the Department of Natural Resources.

Missouri has an average daily summer solar radiation comparable to the vast majority of the United States including the state of Florida, making solar energy in Missouri an untapped opportunity. As the cost of traditional fossil fuels increases and the cost of solar energy declines, solar energy for electrical power generation and water heating is becoming more cost-effective as a means to help meet peak electrical demand.

As an agriculturally productive state, Missouri also has substantial land area available for energy crops and crop waste that can be used for bioenergy production. If one-half of the energy content of these available biomass resources were used in technology that is as efficient as the average American electric generation plant, the net energy produced would be 15.2 million megawatt hours (MWh). This assumes that biomass fuel can be economically transported to plants capable of burning such fuel. This compares to 76.6 million MWh generated in Missouri in 2000, or 20% of our current generation. However, at this time, only a few units in Missouri can effectively burn biomass fuel.

A co-op in Iowa is testing the use of dedicated energy crops. In the Chariton Valley, farmers have planted 5,500 acres with switchgrass to be burned with coal in a large power plant. If successful, the project will scale up to 50,000 acres, producing 200,000 tons of switchgrass each year and supplying 5% of the plant's fuel.

Northwest Missouri State University in Maryville, Missouri, exemplifies a successful bioenergy project. The university's alternative energy project began in 1979 using chipped wood waste. In 1990, it expanded to include combustion of paper pellets reclaimed from un-recyclable and unsoiled paper waste products from the five-county regional landfill. In 1994, they began the third phase of using animal waste.
The university produces 85 to 90 percent of its campus heating and cooling needs through the use of these biomass energy sources. Since 1979, the university has saved more than $4 million in fuel costs, which is used for other operational costs.

In recent years Missouri has been active in the development and use of renewable transportation fuels – ethanol and biodiesel. In 2002, more than 40 million gallons of ethanol were produced in Missouri by two farmer-owned plants. Corn farmers in other areas of the state are currently studying ethanol plant feasibility, and this is a rapidly changing situation.

The two ethanol plants in north Missouri have added significant direct economic benefits to Missouri, with the Macon plant adding almost $14 million and the Craig plant adding slightly over $10 million in 2001. The direct benefits of the two corn-processing ethanol plants to the north Missouri economy accrued to 1) the more than 600 members of the two new -generation cooperatives that own and operate the two plants; 2) most of the other corn farmers in north Missouri; 3) the local businesses in north Missouri that supply products and services to the ethanol plants; and 4) the state in terms of tax collections.[16]

Operating the two ethanol plants in northern Missouri, with each producing 22 million gallons of ethanol annually, is projected to result in increased total economic activity of almost $173 million throughout the rural Missouri economy annually. The direct and indirect impacts of the two plants, each producing 22 million gallons of ethanol annually, have the following major positive impacts on the north Missouri economies:

- Added value to almost 16 million bushels of corn annually,
- Created 1,815 jobs,
- Increased income to labor by $31.3 million,
- Increased total value added of $55.4 million,
- Increased total state output of $172.8 million, and
- Increased tax revenues of $17.7 million.

Biodiesel demand in the past 12 months was 700,000 gallons -- three times that of the prior year. Most of the recent growth is from farmers using biodiesel in their farming operations. Depending on federal energy policy and tax incentives, potential exists for a 15-20 million-gallon production facility in Missouri.

Recommendations

Aggressively develop, produce and use Missouri renewable energy and energy-efficiency resources to achieve the public benefits of economic growth, environmental quality and public health.

Establish a Public Benefits Fund to provide support to programs that protect low-income Missourians, promote energy efficiency, provide energy education and assist in the development and use of Missouri's renewable energy resources.

[16] Employment and Economic Benefits of Ethanol Production in Missouri, Donald L. Van Dyne, LLC& Research Associate, Professor Retired, Department of Agricultural Economics; University of Missouri, Columbia, MO, February 2002

Establish policies including financial and other incentives to encourage investments in energy efficiency and renewable energy development, production and use.

Encourage all Missouri utilities to aggressively seek collaborations and partnerships to develop new and/or expand present facilities to substitute renewable energy sources in place of imported fossil fuels for electric generation. In many cases for example, cities manage both electric generation and waste (biomass) disposal systems. With the passage of Amendment 4 in 2002, municipal utilities have greater flexibility in developing joint projects with other political subdivisions.

Pursue any shortfalls in peak electricity capacity through a variety of solutions:

- **building or contracting for additional conventional generating capacity;**
- **moderating the growth in peak demand through energy-efficiency or load-management programs;**
- **providing additional energy through renewable and distributed energy resources; or**
- **a combination of all of the above.**

Consider the effect of energy efficiency programs and renewable energy and non-renewable energy electricity generation upon utility bills, environmental quality and public health.

Encourage Missourians to use renewable transportation fuels such as ethanol and biodiesel.

Missouri State Government as a Leader in Energy Efficiency

Missouri state agencies (departments, commissions, authorities, offices, colleges or universities of this state) own and operate approximately 12,000 motor vehicles. In addition, state agencies own approximately 62.5 million square feet of building space and lease an additional 4.3 million square feet. Annually, state agencies expend about $11 million for motor vehicle fuel and about $78 million for energy use in state facilities. Energy efficiency saves taxpayer dollars that can be used to fund essential public services. If the state's energy bill is reduced just 10 percent (a conservative estimate), savings would be $7.8 million annually over the life of the efficiency measure. These dollar savings can play a critical role in funding public services under the current budget situation.

State success in improving the energy efficiency of its own facilities and fleet will lower state government's energy bill. In recognition of the potential benefits to the state, Missouri enacted statutes establishing the State Fleet Efficiency and Alternative Fuels Program in 1991 and the Energy Efficiency in State Facilities Program in 1993.[17]

More importantly, success can be leveraged to influence, inform and motivate Missouri businesses and citizens toward greater energy efficiency. As the 2001 Missouri Energy Policy Task Force report states, the state should "lead the way to a comprehensive energy policy by setting the example."

The following recommendations for state government comprise an initial set of Council recommendations. The Council will evaluate additional recommendations in its future work.[18]

State Facility Management

The following discussion presents recommendations related to energy-efficient building construction and renovation, effective management of facility and equipment energy use, and procurement of energy-efficient equipment.

Properly implemented and well-maintained energy projects in state facilities typically return from 10 percent to 50 percent or more in avoided costs or cost savings over the life of the project. The Energy Policy Task Force concluded that comprehensive implementation of energy retrofit projects with a five-year payback would result in savings "exceeding several million dollars per year" and that significantly larger savings could be achieved if implementation were extended to meritorious retrofit projects with a longer payback period.

The state has audited approximately five percent of state structures. These audits identified energy-efficiency measures exceeding $7.5 million that could achieve annual savings of more than $1.3 million. Approximately 20 percent of the dollar value of these projects have been implemented, and savings are now being achieved. However, few audits or projects have occurred in recent years. As the Task Force report concludes, the state can and should do better. The Task Force recommends that all state buildings be analyzed for energy efficiency by fiscal year 2008.

Recommendation:

Increase the effectiveness of energy efficiency in state facilities by implementing "performance contracting" and allowing state agencies to retain a portion of energy savings.

[17] See Appendix B for the citations and a summary of the statutes related to these programs.

[18] Many of these recommendations are drawn from the final reports of the Missouri Energy Policy Task Force (Task Force report, 2001), the Missouri Energy Futures Coalition (Futures Coalition report, 1997) and the Missouri Statewide Energy Study (Energy Study report, 1992).

Energy Performance Savings Contracts (ESPCs) are frequently used by school districts and universities in Missouri and by state agencies in several other states. Their experience indicates that ESPCs are often a cost-effective method to realize potential energy savings. Large office buildings offer particularly good opportunities for cost savings. In Missouri, performance contracting has been used for energy projects on several state university campuses, but has not been used by state agencies.

The Missouri General Assembly passed bills in 2002 (SB810 and SB1012) that removed barriers to the use of ESPCs, and the Office of Administration is currently determining how best to implement these measures.

State agencies that achieve savings from energy efficiency measures should retain a portion of those savings to advance their mission. Both the Missouri State Energy Study and Governor's Energy Policy Task Force made this recommendation. This will require a change in the treatment of savings to allow the agency that initiated the energy-efficiency improvement to retain a portion of the savings for other agency needs. One innovative approach would be to allow state agencies to self-finance the cost-saving measures and repay the "conditional lease" through self-managed realized savings. Currently, state agencies may be reluctant to invest time and funds to develop capital-improvement requests for energy-efficiency projects because such requests tend to fare poorly competing with many other priorities facing the agencies.

Increasing the visibility of this effort among state agencies could also encourage participation. Governor Holden has directed the Energy Policy Council to publish an annual Green Progress Report, as recommended by the Task Force. The progress report is to assess how Missouri's public and private sectors are reducing their energy use and increasing their use of domestic renewable energy sources. This report could show state government's energy-conservation efforts and the resulting savings. In addition, the governor may choose to institute a governor's award to recognize agency achievement in energy efficiency and use of renewable energy in state facilities. This would complement governor's award programs directed outside state government, such as the existing Environmental Excellence and Pollution Prevention Awards or the annual Energy Efficiency and Renewable Energy Award proposed by the Task Force.

Recommendation:

Increase effectiveness of energy efficiency in state facilities by offering training to architects and engineers involved in designing state facilities and encouraging higher standards.

State law requires state-owned residential buildings that are at least three stories high to conform to ASHRAE/IESNA 90.1-1999 standards. Other ASHRAE and CABO standards are identified for state-owned buildings less than three stories. Revisions of these standards are automatically adopted by reference.

Training for ASHRAE 90.1 could be broken down by discipline, such as architectural, mechanical, and electrical disciplines. The state could also offer or facilitate training for architects and engineers on advanced standards such as the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™.

The LEED rating system addresses performance areas including selection of sustainable tenant space, efficiency of water use, energy performance optimization including lighting and lighting controls, resource utilization for interior building systems and furnishings, and indoor environmental quality including comprehensive emissions criteria. When incorporated in the planning and design of a building, established green building technologies can be built in at no additional cost.

The use of life-cycle costing methodology in the design or retrofit of energy systems and buildings is mandated in 10 CSR 140-7 and is endorsed in both the Energy Futures Coalition report and the Governor's Energy Policy Task Force report. Because the Office of Administration's Division of Design and Construction relies on consultants for design analyses, effective implementation of life-cycle costing requires that these consultants understand and adhere to clear guidelines for life-cycle analysis.

When cost-effective and appropriate, energy projects should exceed ASHRAE 90.1 and strive to achieve a LEED rating to maximize energy savings. The Task Force report recommends that the statutes related to energy efficiency in state facilities be amended as follows:

- Major new projects should exceed ASHRAE 90.1 standards where feasible, and
- Section 8.835 should be expanded to direct implementation of all energy projects with a simple energy savings payback period of 15 years or less.

The state could also encourage design professionals and local jurisdictions to adopt the International Energy Conservation Code (IECC) as the non-mandatory energy building standard. This effort could serve as a reference point for voluntary compliance, energy-efficiency ratings and efficiency incentive programs. The IECC was endorsed in 1999 by the Governor's Commission for the Review and Formulation of Building Code Implementation.

Recommendation:

Agencies should inform and train staff to design, implement and oversee energy-efficiency strategies and to purchase energy-efficient equipment.

Effective operation of energy systems and occupant behavior in state buildings extend the benefits of investing in efficient buildings and equipment by further reducing energy bills and extending the useful life of state investments.

The Task Force report provides specific recommendations for appointment and performance evaluation of energy-efficiency officers in various state agencies. The programs overseen by these officers should include not only compliance with state law but also other equipment procurement and energy-management initiatives discussed below.

Clearly assign responsibility for achieving energy-efficiency gains throughout the state. The Energy Study recommended that energy management should be brought into focus. A key aspect of energy management is energy accounting, monitoring and control. Effective communication and sharing of information between energy officers in the various state agencies comprise important components of achieving this goal. If all agencies use the same methods for energy accounting in facility management, data from the agencies could be integrated into a periodic, comprehensive assessment of state energy use and expenditures.

Steps to reduce energy use could range from simple e-mail reminders to employees to turn off lights and equipment to training for users of specific types of equipment. During the past few years, a number of states faced with energy shortfalls have undertaken emergency energy-conservation campaigns. The state could draw on this example to develop a campaign on an ongoing rather than emergency basis and could leverage efforts by collaborating with other public and private sector institutions.

In January of this year, the Office of Administration implemented a number of no-cost energy-efficiency changes in 26 state buildings. These operational changes included items such as reducing the temperature on hot-water heaters, turning off ventilation fans during hours when buildings are unoccupied, reducing lighting where appropriate, and ensuring that economizers operated properly on heating and air conditioning equipment. Since January, the state has saved more than $100,000 in energy costs and reduced energy use by more than 1 million kWh.

Programs to train state facilities maintenance personnel in the efficient operation of equipment could include training on the operation of the heating, ventilation and air conditioning (HVAC) equipment by representatives from industry or state technical college instructors. Training for electricians could focus on topics such as how to identify bad electrical connections, test transformers, and set up load-shedding programs to reduce demand during peak energy use periods.

For many categories of energy-using equipment and appliances, energy savings can be achieved by purchasing advanced products that are commercially available.

The federal government establishes minimum energy standards that all manufacturers must meet. However, there are significant limitations. First, federal standards fail to cover many energy-intensive products. Second, the federal standards for minimum energy efficiency typically lag well behind the energy efficiency available from advanced products that are readily available on the market.

Recognizing this lag, several organizations have developed systems to help consumers identify and compare advanced products. Most familiar is the ENERGY STAR® label, which is a voluntary labeling program sponsored by the U.S. Department of Energy

(DOE) and the U.S. Environmental Protection Agency (EPA). The ENERGY STAR® label helps businesses and consumers easily identify highly efficient products, homes, and buildings that save energy and money, while protecting the environment. Other organizations that have developed broadly recognized standards for advanced products include the Consortium for Energy Efficiency (CEE) and the Federal Energy Management Program (FEMP).

The Energy Futures Coalition report endorsed these voluntary efficiency-labeling programs and recommended that the state support their use. Setting advanced efficiency standards for the procurement of energy-using equipment allows further energy savings and allows the state to leverage its experience to encourage private-sector companies and institutions to follow the state's example.

State Fleet Management

Missouri's State Fleet Efficiency and Alternative Fuels Program requires state agencies to plan and achieve specific goals for fuel efficiency and alternative-fuel use. The recommendations presented here focus on the energy-efficiency aspects of this program. However, the program also forms the cornerstone of state efforts to promote use of alternative fuels and alternative-fuel vehicles in the state fleet.

The program requires state agencies to acquire and maintain fuel-efficient vehicle fleets, promote efficient trip planning and state vehicle use, and reduce single-occupant vehicle (SOV) trips by state employees through strategies such as carpooling and vanpooling. The program also requires state agencies to report fleet data such as vehicle numbers, vehicle miles traveled, fuel use, fuel expenditures and maintenance cost. This data is compiled by the Energy Center in an annual report to the governor and General Assembly.

The greatest opportunity to improve the overall fuel efficiency of agency fleets is through procurement, when older and less fuel-efficient vehicles are replaced. Each state agency should meet the legal requirement that overall fleet fuel efficiency meet or exceed the fuel efficiency that would be achieved if each vehicle in the agency's fleet met federal Corporate Average Fuel Economy (CAFÉ) standards. State agencies should be encouraged to purchase only vehicles that meet CAFÉ standards and to increase the proportion of highly fuel-efficient vehicles purchased.

Recommendation:

Achieve the statutory fuel-efficiency goal through procurement, effective vehicle maintenance procedures, fleet management and telecommuting. State agencies should report progress in their annual budget requests.

The Task Force report recommends that the governor require each agency to report on its compliance and its plans to reach the program goals in annual agency budget proposals. Because the annual budget process provides a highly visible forum for planning and monitoring progress on state-agency goals, objectives and priorities, this requirement would elevate the priority of achieving fleet-fuel efficiency.

State agencies should institute a formal maintenance program to maintain maximum fuel-efficiency ratings of all fleet vehicles, including routine assessments of tire pressure and wear on all vehicles.

State agencies are required by law to develop fleet energy-conservation plans that include procedures to promote efficient trip planning, efficient state vehicle use, carpooling and vanpooling. These plans should include provisions to accomplish the following:

- assign smaller and more fuel-efficient vehicles first if travel needs can be met with a smaller vehicle;
- develop energy-efficient routes and schedules for routine trips; and
- maximize alternative fuel usage in alternative fuel vehicles (AFVs). For example, agencies should base alternative-fuel vehicles at agency locations that are closest to refueling locations selling the alternative fuel used.

The Office of Administration fleet manager is currently working to develop a uniform tracking system for all state agencies. This system should promote efficient trip planning.

Another effective fuel-efficiency measure is telecommuting. State agencies should expand the use of telecommunications systems to decentralize work and reduce the need for travel to meetings, conferences and other offices and consider options such as e-mails, facsimile, and teleconferencing to reduce the need for travel.

Demonstration Projects

Recommendation:

Leverage state government successes by developing demonstration projects to influence, inform and motivate Missouri businesses and citizens toward greater energy efficiency.

For example, the Missouri Department of Natural Resources has begun construction of a new office building in Jefferson City that incorporates passive solar energy design; correct sizing and use of energy-efficient heating and cooling systems and appliances; and design of lighting systems, light shelves and glare-free thermal glass to provide daylighting, minimize heat gain and maximize ventilation and shading.

Similar demonstration opportunities exist or could be created in other state facilities. For example, the Kansas City Discovery Center, a joint venture between the Department of Conservation and the Department of Natural Resources, shares many design elements listed above. The Energy Study report recommends that the state incorporate displays of efficient lighting systems into public areas of state buildings.

The state could also use ENERGY STAR® program resources to promote building energy efficiency among other public institutions in the state.

The Department of Natural Resources earned state government's first ENERGY STAR ® label for its 41,500-square-foot state office building at 1659 East Elm Street. The energy-efficiency improvements cut energy costs in half and saves the state an estimated $55,000 annually. The award recognizes the 24-year-old building as being within the top 25 percent among buildings nationwide in terms of energy performance and indoor environment. The building's efficiency rating of 89, which places it in the top 11 percent of similar buildings in Jefferson City's climate zone, actually surpasses the ENERGY STAR threshold. Improvements included installation of a ground-source heat pump; other components of a higher efficiency heating, ventilation and air conditioning system; high-efficiency light fixtures; motion sensor controls; and high-efficiency office equipment. The energy savings from the upgrades are expected to pay for themselves in 11 years. The changes also will eliminate more than 3 million pounds of carbon dioxide, sulfur dioxide and oxides of nitrogen emissions through decreased electricity demands.

Standard Market Design: A Summary of Intent, Issues and Major Policy Direction

On July 31, 2002, the Federal Energy Regulatory Commission (FERC) issued its Notice of Proposed Rulemaking (NOPR) for Standard Market Design (SMD). The following discussion explains FERC's primary stated purposes for proposing these significant modifications in the operation and oversight of the nation's wholesale electricity markets. This background paper also reflects recent FERC policy changes issued April 28, 2003, in a special white paper intended to further clarify FERC's intent regarding SMD and to address concerns expressed by some states.

Intended Purposes for the Standard Market Design

- **Further Eliminate Undue Discrimination in the Provision of Transmission Service**

FERC's NOPR conveys the agency's stated intention to modify its existing transmission tariffs for the purpose of providing non-discriminatory open access to the transmission system for transacting electricity at wholesale.[19] Moreover, the purpose of the proposed rules is to restructure the wholesale markets for electricity, presumably to correct problems in the existing market structure. The NOPR focuses on utility companies as the source of the apparent discrimination. FERC characterizes these

[19] On April 24, 1996, the FERC established open access transmission in its Order Nos. 888 and 889. Open access transmission required all FERC jurisdiction utilities to offer transmission service, when available, on a first come, first served basis at FERC determined rates.

problems as both perceived and actual preference being given in the provision of transmission service by integrated utilities to their own generation. Thus, FERC believes the wholesale market has not provided open and adequate access to all parties. To correct this situation, all FERC jurisdictional utilities would be required to turn over the operation of their transmission systems to an Independent Transmission Provider (ITP).[20]

- **More Efficiently Allocate Scarce Transmission Capability and Increase Efficiency of Competitive Electricity Wholesale Markets**

In addition to preferences being given in the provision of transmission service, under the current market structure, the methods for managing congestion include (1) denying requests for firm transmission and (2) curtailing service on a proportional basis whenever a section of the transmission system becomes overloaded. Transaction curtailment without regard to economic value is an inefficient method of managing transmission congestion. The SMD proposes a system of centralized bidding in day-ahead and real-time electricity markets. The ITP would select the bids to equate supply with demand at least cost, subject to meeting the security constraints of the transmission system. This system of centralized dispatch is called locational marginal pricing (LMP), which theoretically provides an efficient mechanism for simultaneously allocating generation and transmission to end-use customers at the lowest cost.[21]

- **Provide Market-Based Price Signals for Investment in New Transmission**

Under the LMP form of pricing, transmission congestion costs reflect the electricity market's valuation of the loss in generation efficiency resulting from limited transmission capability. Since expansion of transmission capability through investment in upgrades to the transmission system will result in lower congestion costs, load-serving entities would determine when it would be less expensive to add new transmission capability as compared to continued payments of congestion costs under the proposed SMD market design.

Potential Undesirable Consequences from Standard Market Design

- **Increased Administrative Costs for Transmission.**

Because of the high cost for computer systems and personnel required to provide centralized day-ahead and real-time electricity markets, the SMD will significantly increase the costs for providing transmission service. In order to keep per customer costs as low as possible, large numbers of market participants will be required over

[20] The SMD NOPR sets out specific conditions for independence, but essentially, this entity must have no financial interest in the markets for electricity.

[21] LMP is currently being used in the northeast by the New England ISO (Independent System Operator), the New York ISO and the PJM (Pennsylvania, New Jersey and Maryland) ISO.

which to spread these higher costs, and the SMD NOPR therefore proposes that such markets be mandatory, not voluntary.

- **Promoting Regional Use of Transmission by Shifting Costs onto Regulated Utilities Providing Local Service and Putting Upward Pressure on Electric Rates.**

The SMD proposes access charges to be paid based on the electric power (load) delivered to customers. This eliminates usage charges for transmission, including the practice of charging transmission customers multiple rates for transactions that involve more than one utility's transmission system, which is often referred to as rate "pancaking." While this will reduce the costs for wheeling electricity through a regulated utility's transmission system, it will also mean less revenues to offset the cost of transmission to that utility's own customers. While the effect of this change will be a shift of transmission costs away from customers being served from more distant sources of generation, it will increase transmission costs for customers being served by a regulated utility from generation located within that utility's service territory. Because Missouri consumers are largely served from generation located within their utility's service territory, the proposed SMD will likely result in adverse electric rate impacts. A recent report from the U.S. Department of Energy projects that rate increases of 3 to 4 percent would occur in the MAIN (Mid-America Interconnected Network, Inc.) reliability council region (which includes eastern Missouri) as a result of a change to SMD.[22]

- **Create Greater Jurisdictional Tensions between State and Federal Regulation.**

In order to "eliminate undue discrimination" the FERC proposes that "the transmission component of bundled retail service must be taken under an open access transmission tariff."[23] This requirement would make mandatory the jurisdictional impact that occurs under Order 2000 when a utility is permitted to join an RTO. The FERC has proposed a couple of remedies in an attempt to compensate for the potential harm associated with this transfer of jurisdiction. First, the SMD proposes that the utilities serving bundled retail load be given financial transmission rights that would compensate them for congestion charges that would be applied under the new FERC open access tariff. It appears that there will not be sufficient financial transmission rights to cover all congestion charges and bundled retail load will be subject to the risk of having to pay some portion of these congestion charges. Second, the April 28, 2003, SMD White Paper has suggested that wholesale transmission contracts between the utility and the RTO include rates set at the level intended to recover the transmission costs of the utility's current retail bundled rate.

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[22] "Report to Congress: Impacts of FERC Proposal for SMD" U.S. Department of Energy, April 30, 2003.
[23] SMD NOPR at ¶ 118. Bundled retail load is the term used to describe the retail customers currently being served by utilities under state regulation where there is no retail competition. In Missouri there is no retail competition. Open access tariff is the term used to describe the FERC approved tariff charges for access, congestion charges and transmission losses.

These changes from state to federal jurisdiction will expose bundled retail customers to financial risks based on potentially volatile market prices rather than the limited exposure to costs of generation redispatch that regulated utilities face today in addressing congestion. These proposed changes in jurisdictional treatment for bundled retail load have resulted in strong reactions from state regulatory commissions that see no upside benefits from taking on these added downside risks.

Major Policy Recommendations:

The Utility's Bundled Retail Customers Should Not Be Exposed to Congestion Charges for Retail Use of the Utility's Transmission System by Placing Them under FERC Jurisdiction.

Missouri consumers should not be adversely affected. Electricity from the utility owned-and-operated generation plants to meet the load of bundled retail customers should be scheduled on its own transmission system without exposure to financial congestion charges. Such transactions should have priority on the transmission system. Historically, "native load" or bundled retail customers have paid for, and continue to pay for, existing transmission systems that utilities built to move electricity from local generation facilities to these native load customers throughout the utility company's service territory. It is poor public policy to charge the utility's bundled retail customers for transmission congestion costs that result from demands by wholesale transactions associated with wheeling power through or exporting power out of the utility's transmission system.

Transmission Upgrades for Reliability Purposes Should Be Funded by those Sub-Regions Requiring Reliability Improvements, and Transmission Upgrades for Commercial Purposes Should Be Funded by Participants that Benefit from the Added Transmission Capacity.

If upgrades to the transmission system are needed for purposes of system reliability, a determination should be made as to which sub-regions within the larger transmission system are inadequate with respect to transmission, and the costs of the upgrades should be assigned to those sub-regions. In Order No. 2000, the FERC stated that Regional Transmission Organizations (RTOs) should have sufficient geographic scope to cover significant market areas. For the Midwest, this RTO will likely include a region as far north a Manitoba and as far south as Kentucky. When the RTO region is this large, decisions regarding transmission in one sub-region may have little or no impact on other sub-regions within the RTO. Rolling in the cost of transmission upgrades to the entire RTO region when those upgrades are required to enhance the reliability of a sub-region is poor public policy and is likely to result in disputes among sub-regions.

In addition to upgrades needed for system reliability, upgrades to transmission can improve the commercial viability for various market participants. These decisions involve the trade-off between locating a generation plant close to the load versus building transmission to import the electricity from a distant generation location to meet that same load. In those instances where the decision is made to upgrade the transmission capacity rather than to build local generation, those that benefit from the transmission upgrade should fund its cost.

Minimum Resource Adequacy Requirements for Reliability Should Be Determined by Regional Reliability Organizations, and Any Additional Resource Requirements for Bundled Retail Load Should Be Determined by Individual State Regulatory Commissions and for Wholesale Load Should Be Determined by the FERC.

Resource-adequacy requirements are needed to ensure the reliability of a power system. The reliability of a power grid is a statistical determination involving both loss of load probability[24] and contingency conditions[25] on the power grid, and is not an economic determination, such as meeting load at a minimum cost. Regional Reliability Organizations (RROs) have set these criteria in the past and should continue to set them in the future.

In addition to attempting to address reliability considerations, the SMD's higher resource adequacy standards are intended to mitigate price spikes in the wholesale electricity markets like those that occurred two years ago in California. Where retail load rates remain regulated at the state level, such a determination should remain with the state regulatory commissions. At the same time, where there are municipal utilities that purchase electricity from competitive wholesale markets, the FERC has jurisdiction, and the FERC should make the determination concerning resource adequacy for those load-serving entities that are subject to its jurisdiction.

[24] Loss of load probability takes into account the probability of generation unit outages occurring along with the probability of loads occurring from various weather conditions. The criterion is determined as an upper limit on the probability of having insufficient generation to meet load. The various Regional Reliability Organizations have set these limits.

[25] Contingency conditions look at worse possible situations where either key power lines or generation plants are forced out of service. A reliable power system is one where under contingency conditions, the power grid will not cascade out of service from rolling black outs.

Appendix A

Projected Peak Electricity Demand and Supply for Missouri
(Megawatts)

	2003	2004	2005	2006
Capacity Available	22,986	23,151	22,161	22,137
Capacity Required	22,014	22,351	22,755	23,333
Excess/Shortage	972	800	(594)	(1,196)
Investor-owned				
Available	16,775	16,925	16,054	16,020
Required	16,310	16,526	16,805	17,252
Excess/Shortage	465	399	(751)	(1,232)
Coop and Municipal				
Available	6,211	6,226	6,107	6,117
Required	5,704	5,825	5,950	6,080
Excess/Shortage	507	401	157	37

- At present, the combined capacity of these nine utilities exceeds their combined required capacity (which includes a required reserve margin) by about four percent, a surplus of about 970 megawatts (MW).[26] However 2006 project capacity requirements for these utilities projected to exceed combined projected capacity by about 4 percent, a deficit of about 1,200 MW. However, in the normal course of business, investor-owned utilities work with the PSC to plan for future energy needs. Therefore, the projected 2006 capacity shortfall is not expected to be a critical issue because plans have begun to ensure sufficient generation.

- A shortfall in peak capacity could be addressed through a variety of solutions: building or contracting for additional conventional generating capacity, moderating the growth in peak demand through energy-efficiency programs or load-management services, providing additional energy through renewable and distributed energy resources or a combination of all three. In addition, as a result of overbuilding of capacity by unregulated wholesale generators in the Midwest, there may currently be excess capacity available on the wholesale market at reasonable terms.

- This data is based on the aggregate four-year projected peak demand and capacity for nine of the largest electric utilities in the state. These include the five investor-owned utilities; Associated Electric Cooperative Inc. (AECI), the primary source of power for 51 electric distribution cooperatives; and the state's three largest municipal electric utilities (Springfield City Utilities, Independence Power and Light and

[26] The capacity requirement includes a 12 to 16 percent reserve margin above the utilities' forecasted peak demands, determined by the power pool to which the utility belongs.

Columbia Water and Light). Data for AECI and the three municipal utilities was provided by the individual utilities; the Public Service Commission provided data for the investor-owned utilities.

- For purpose of this analysis, the data is aggregated assuming that the peak demand for these different utilities coincides in time. In reality, peak demand for different systems does not necessarily occur on the same day of the summer. However, the data that would be required to analyze peak demand and capacity in finer time gradations is not available.
- The data that is provided is estimated on a system-wide basis and includes both Missouri and non-Missouri resources and customers for the utilities that operate in more than one state. This includes three of the investor-owned utilities (AmerenUE, Empire and KCPL) as well as AECI, which serves several electric distribution cooperatives in southern Iowa and northeast Oklahoma.
- Utility projections of peak demand rely on models that take economic variables into account and therefore are subject to the uncertainty inherent in economic forecasting.

Appendix B

State Government Facility and Fleet Efficiency Statutes

Energy Efficiency in State Facilities
State law passed in 1993 (RSMo 8.800-8.851)
Rule (10 CSR 140-7.010 – State Building Minimum Energy Efficiency Standards; effective February 25, 1996).

This statute was established to increase the energy efficiency of state and other public buildings. Specific provisions include:

- Minimum energy efficiency standards to be established for the construction of state buildings or major building renovations;
- Department of Natural Resources is to make energy efficiency practices information available to persons involved in the design, construction, retrofitting and maintenance of public buildings and state buildings;
- Energy efficiency is to be evaluated when buildings are considered for acquisition by the state;
- Office of Administration/Division of Design and Construction, in conjunction with Department of Natural Resources, is to compile data on energy consumption and energy costs for all state buildings to establish a baseline for energy consumption;
- Department of Natural Resources is to analyze all state buildings for energy efficiency, as funds become available;
- The Division of Design and Construction is to recommend energy efficiency projects;
- Department of Natural Resources is to establish a state building energy efficiency rating system; and
- Creates an Interagency Advisory Committee on Energy Cost Reduction and Savings.

State Fleet Energy Efficiency and Alternative Fuels
State law passed in 1991 (RSMo 414.400-414.417, revised 1998)

This statute was established to implement federal requirements to reduce fuel consumption and include alternative fuel vehicles in the state fleet. Specific provisions include:

- Department of Natural Resources, in consultation with the Office of Administration, is to develop and implement a state vehicle fleet program to reduce fuel consumption, improve fleet management and promote the use of alternative fuels;

- Each state agency is to develop and implement a plan for the purposes of reducing vehicle fuel consumption;

- Department of Natural Resources is to develop a motor vehicle alternative fuel use plan and recommend alternative fuels which state agencies and state universities may consider when purchasing vehicles;

- Any state agency that operates a fleet of more than 15 vehicles must acquire alternative fuel vehicles. The 1998 amendments specify that at least 50 percent of the non-exempt state vehicles purchased after July 1, 1998 be capable of operating on alternative fuels.

- The 1998 amendments revise the cap on incremental life-cycle costs of alternatively-fueled vehicles from the previous limit of 5 percent to 10 percent over that of traditionally fueled vehicles. In air pollution non-attainment areas the incremental cost cap is up to 17 percent higher.

Appendix C

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Missouri Department of Natural Resources
Energy Center

MISSOURI ENERGY BULLETIN

March 6, 2003

The Missouri Energy Bulletin is distributed twice a month by the Missouri Department of Natural Resources Energy Center. The Energy Bulletin is a public resource that is made available to state government decision-makers, to any other interested individual upon request and on-line at the Energy Center Internet site.

The Department of Natural Resources, Energy Center thanks each of the following in helping to provide accurate, timely data on fuel supplies and prices: the U.S. Department of Energy's (USDOE) Energy Information Administration (EIA) and Chicago Regional Office; the National Association of State Energy Officials (NASEO); the Missouri Propane Gas Association (MPGA) and the Propane Education and Research Council (MoPERC); the St. Louis AAA Auto Club; regional state energy offices; and, Missouri's energy retailers.

The Energy Center collects transportation and propane heating fuel prices from various retail providers located throughout the state. To preserve confidentiality, price data are averaged and reported by region. Unless otherwise noted, energy prices and supplies shown throughout this bulletin are from Mar. 3, 2003. Also shown are energy data from a month ago, Feb. 3, 2003, and from a year ago, Mar. 4, 2002.

Heating Fuels

Heating fuels tracked in the Missouri Energy Bulletin include natural gas, propane and residential heating oil. All heating fuel prices and supplies reported in the bulletin from October through March are updated in every new release of the bulletin. From April through September, propane and heating oil prices and supplies are either not available or revised once a month.

Natural Gas

- The spot price for natural gas at the Henry Hub, throughout this last month, increased by 2.98 dollars per MMBtu (52 percent) moving from 5.75 to 8.72 dollars per MMBtu. Throughout this last year, the price paid increased by 6.07 dollars per MMBtu moving from 2.65 to 8.72 dollars per MMBtu, an increase of 229 percent. (Source: *Wall Street Journal*, Mar. 5, 2003)

- The near-month contract settlement price paid for natural gas futures at the NYMEX, throughout this last month (Jan. 29 to Feb. 26), increased by 3.47 dollar per MMBtu (61 percent) moving from 5.66 to 9.13 dollars per MMBtu. Throughout this last year (Mar. 1, 2002 to Feb. 26, 2003), the price paid increased by 6.77 dollars per MMBtu moving from 2.36 to 9.13 dollars per MMBtu, an increase of 287 percent.

- At the Henry Hub, the spot price declined a cumulative 75 cents to end trading on March 5 at $7.81 per MMBtu. Daily changes were relatively large at Northeast locations, where price drops on March 4 and price increases on March 5 were mostly over $2 per MMBtu.

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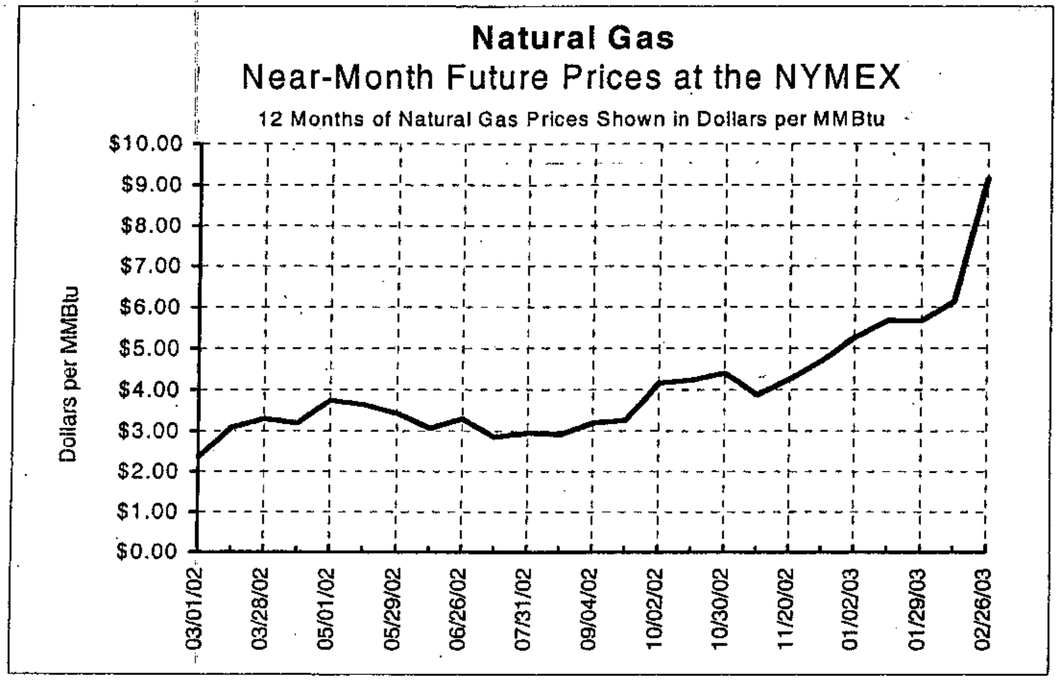
Web Address: www.dnr.state.mo.us/energy/transportation/fb.htm



- Due largely to colder than normal weather, working gas in storage was 838 Bcf as of February 28, according to EIA's *Weekly Natural Gas Storage Report*. This is almost 42% below the prior 5-year average.

- As of March 6, spot prices have begun to retreat from the record-high levels of the previous week, as concerns about supply adequacy for the rest of the heating season seemed to ease, aided somewhat by a minor warming trend in some parts of the country. (U.S. DOE EIA)

- Compared to 2001-2002 levels, natural gas prices are higher in the 2002-03 heating season because prices bottomed out in the summer and fall of 2001 from several factors -- increased production capacity that reached a record-setting peak of 1,068 rigs during the week ended July 13, 2001; lower gas demand from the economic downturn magnified by Sept. 11; an easing of petroleum prices; and more natural gas in storage at that time.

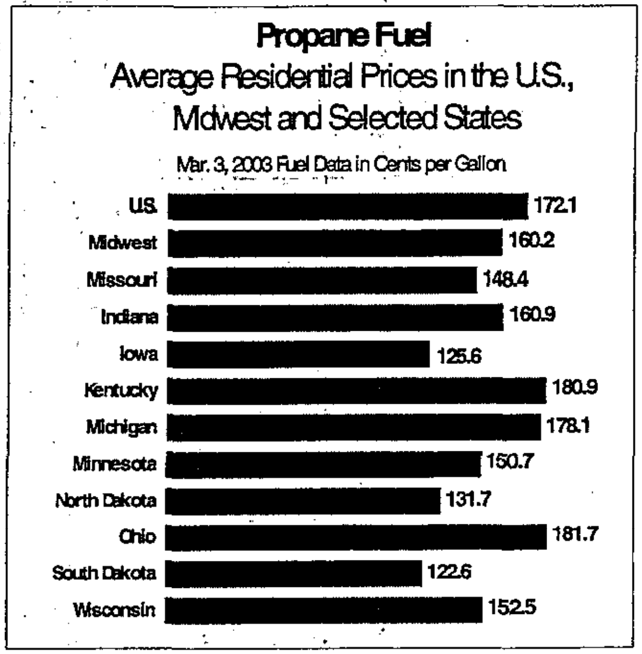
Propane

- The average price paid for residential propane in **Missouri**, throughout this last month, increased by 29.2 cents per gallon (24 percent) moving from 119.2 to 148.4 cents per gallon. Throughout this last year, the price paid for propane increased by 54.4 cents per gallon moving from 94.0 to 148.4 cents per gallon, an increase of 58 percent.

- The average price paid for residential propane in the **United States**, throughout this last month, increased by 28.3 cents per gallon (20 percent) moving from 143.8 to 172.1 cents per gallon. Throughout this last year, the price paid increased by 59.7 cents per gallon, an increase of 53 percent.

- Propane stocks in the **United States**, throughout this last month (Jan. 31 to Feb. 28), were down by 11.4 million barrels moving from 32.3 to 21.0 million barrels, a decrease of 35 percent. In the **Midwest**, stocks were down by 5.5 million barrels (43 percent) moving from 12.9 to 7.3 million barrels.

- Propane stocks in the **United States**, throughout this last year (Mar. 1, 2002 to Feb. 28, 2003), were down by 21.7 million barrels (51 percent) moving from 42.6 to 21.0 million barrels. In the **Midwest**, stocks were down by 10.7 million barrels moving from 18.0 to 7.3 million barrels, a decrease of 59 percent.



- U.S. inventories of propane fell a relatively modest 2.0 million barrels last week, ending the week of February 28, 2003 at an estimated 21.0 million barrels. Following a period of sharp declines since the first wave of Arctic temperatures swept the nation, U.S. inventories last week posted the smallest weekly decline since the week ending January 3, 2003.

Residential Heating Oil

- The average price paid for residential heating oil in the **Midwest**, throughout this last year, increased by 56.7 cents per gallon. In the **United States**, the average price paid increased by 67.4 cents per gallon (58 percent) moving from 116.1 to 183.5 cents per gallon.

- Residential heating oil stocks in the **Midwest**, throughout this last month (Jan. 31 to Feb. 28), were up by 0.3 million barrels (4 percent) moving from 6.7 to 7.0 million barrels. In the **United States**, stocks were down by 6.9 million barrels (16 percent) moving from 42.5 to 35.6 million barrels.

- Residential heating oil stocks in the **Midwest**, throughout this last year (Mar. 1, 2002 to Feb. 28, 2003), were down by 1.3 million barrels (16 percent) moving from 8.3 to 7.0 million barrels. In the **United States**, stocks were down by 16.6 million barrels (32 percent) moving from 52.2 to 35.6 million barrels.

- Frigid weather spilled over from January into February with combined temperatures in the New England and Middle Atlantic regions (the largest users of heating oil) being reported at about 7 percent below normal during February, only slightly below the nearly 8 percent colder-than-normal-level reported during January 2003.

- For the week ending February 28, USDOE shows distillate fuel inventories fell by 2.6 million barrels, with most of the decline in low-sulfur distillate fuel (diesel fuel). Comparing the latest weekly data to monthly data for previous years, total distillate fuel inventories at the end of February are at the lowest level for this time of year since 1963. During the past eight weeks, DOE has distillate inventories losing 35.8 million barrels. U.S. distillate inventories currently stand at a 35.7 million bbl year-to-year deficit (Source: USDOE, March 5, 2003)

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Web Address: www.dnr.state.mo.us/de/transportation/fb.htm

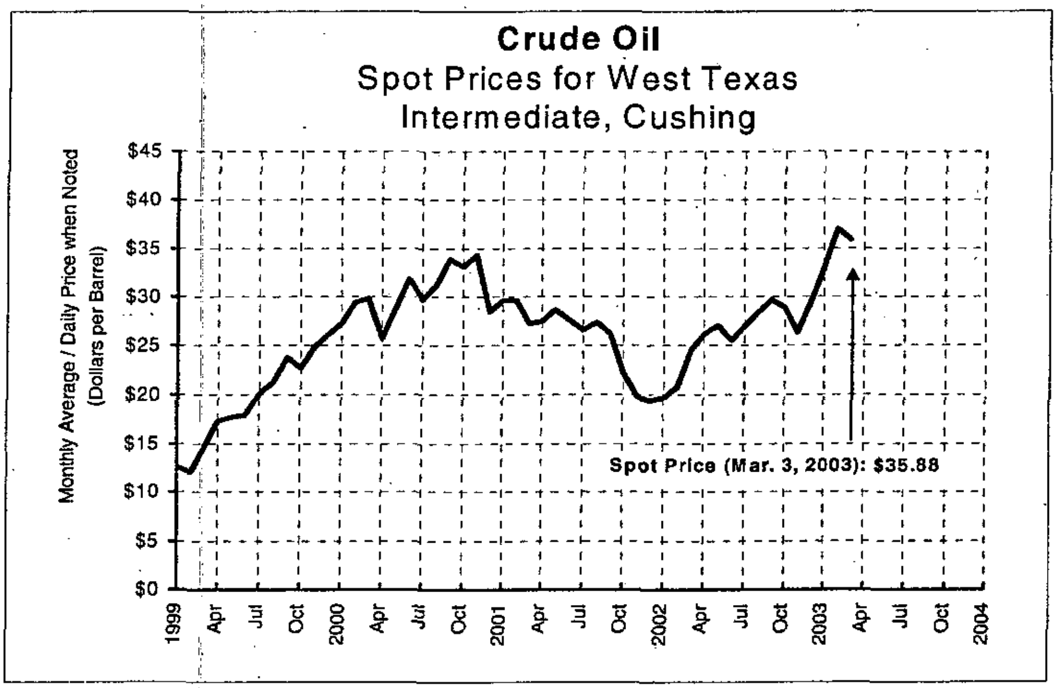
Coal

- Coal-fired electric power plants located in Missouri produced 84 percent of all electric power used throughout the state in 2001. Of all coal delivered to Missouri during 2000, about 96 percent came from Wyoming.

- The monthly average price paid for Wyoming, Powder River coal, throughout this last month (Jan. to Feb.), decreased by 0.03 dollars (1 percent) moving from 5.71 to 5.68 dollars per ton. Throughout this last year (Feb. 2002 to Feb. 2003), the average price paid decreased by 0.43 dollars moving from 6.11 to 5.68 dollars per ton, a decrease of 7 percent. (Source: *Wyoming Insight*, Feb. 21, 2003)

Crude Oil

- The spot price of crude oil (West Texas Intermediate - Cushing), throughout this last month, increased by 3.10 dollars per barrel (9 percent) moving from 32.78 to 35.88 dollars per barrel. Throughout this last year, the spot price increased by 13.40 dollars per barrel moving from 22.48 to 35.88 dollars per barrel, an increase of 60 percent. (Source: *Wall Street Journal*, Mar. 4, 2003)



- Crude oil prices continued to increase through the week ending February 28. NYMEX settling prices continued above $35 dollars per barrel and hit intraday trading levels near $40 due to low U.S. supplies of crude oil and concerns surrounding military action against Iraq. (Source: USDOE/EIA, February 28, 2002)

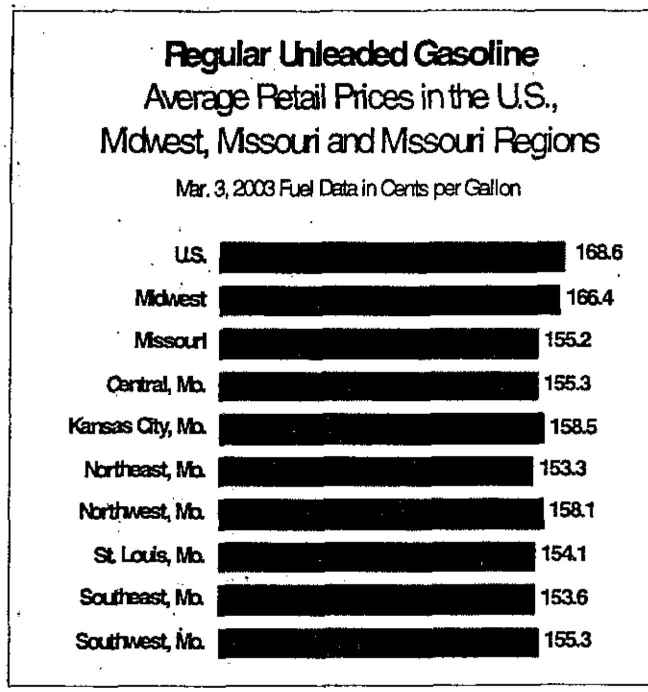
- Preliminary data for last week showed a substantial increase in U.S. crude oil imports from Venezuela, reaching a level much closer to pre-strike levels than in recent weeks. Although crude oil inventories did increase by 1.7 million barrels, that was partly due to a decline in crude oil refinery inputs, which dropped by nearly 300,000 barrels per day last week. Even with a substantial increase in crude oil imports from Venezuela, there was still not enough crude oil in the petroleum system to build both crude oil inventories, as well as product inventories (through an increase in refinery output). (U.S. DOE EIA)

Transportation Fuels

- The average retail price paid for regular unleaded gasoline in **Missouri**, throughout this last month, increased by 9.8 cents per gallon (7 percent) moving from 145.4 to 155.2 cents per gallon. Throughout this last year, the price paid increased by 46.9 cents per gallon moving from 108.3 to 155.2 cents per gallon, an increase of 43 percent.

- The average retail price paid for regular unleaded gasoline in the **United States**, throughout this last month, increased 15.9 cents per gallon (10 percent) moving from 152.7 to 168.6 cents per gallon. Throughout this last year, the price paid increased by 54.2 cents per gallon, an increase of 47 percent.

- The average retail price paid for highway diesel fuel in **Missouri**, throughout this last month, increased by 19.4 cents per gallon (13 percent) moving from 148.7 to 168.1 cents per gallon. Throughout this last year, the price paid increased by 55.8 cents per gallon moving from 112.3 to 168.1 cents per gallon, an increase of 50 percent.

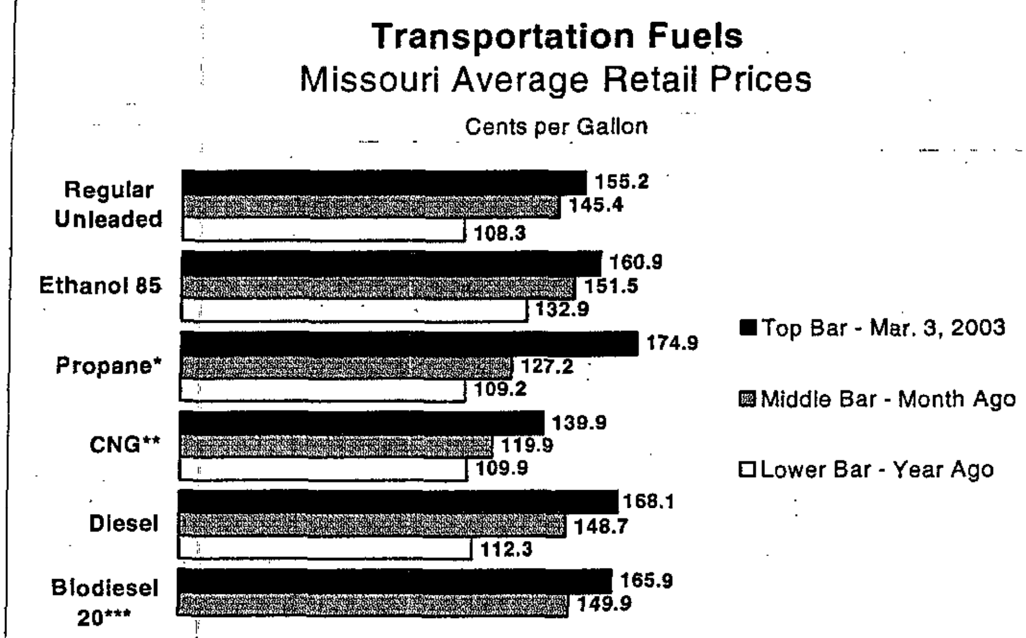


- Total motor gasoline stocks in the **Midwest**, throughout this last month (Jan. 31 to Feb. 28), were down by 0.6 million barrels (1 percent) moving from 50.7 to 50.1 million barrels. In the **United States**, stocks were down by 3.5 million barrels moving from 209.6 to 206.1 million barrels, a decrease of 2 percent.

- Total motor gasoline stocks in the **Midwest**, throughout this last year (Mar. 1, 2002 to Feb. 28, 2003), were down by 4.2 million barrels (8 percent) moving from 54.3 to 50.1 million barrels. In the **United States**, stocks were down by 6.6 million barrels moving from 212.7 to 206.1 million barrels, a decrease of 3 percent.

- Daily production of total finished gasoline in the **Midwest**, throughout the week ending Feb. 28, remained at 1,890,000 barrels. Daily production in the **Gulf Coast** region, a major supply source of gasoline to Missouri, increased from 3,350,000 to 3,360,000 barrels. This compares to year-ago daily production levels of 1,870,000 barrels in the **Midwest** and 3,590,000 barrels in the **Gulf Coast**.

- Implied demand for gasoline for the week ending February 28 jumped more than 491,000 barrels putting total demand at over 8.85 million barrels per day. Strong gasoline demand ahead of the normal seasonal increase, extensive refinery maintenance, and still tight crude oil supply, may be pointing to added price pressure in the months ahead. (U.S. DOE EIA)



* Throughout the nonheating season, propane data is only collected once a month on the first Monday of the month.
** CNG (compressed natural gas) is reported in cents per gasoline gallon equivalence.
*** The regional price of biodiesel 20 has only been tracked at the Missouri Energy Center since Oct. 2002. Therefore, the year ago price can't be shown in the above chart.