Missouri Weatherization Assistance Program, 2003

Eligible Energy Efficiency Measures

Air leakage reduction
Attic insulation
Foundation insulation
- sillbox insulation
- foundation insulation
- floor insulation

Wall insulation
Duct insulation
Storm windows
Window replacement
Door replacement
Heating System
- repairs
- clean and tune
- venting repairs
- replacement*: these will be limited to natural gas, propane, and oil-fired systems.

Water heater tank insulation
Water heater pipe insulation
Low flow showerheads
Water heater replacement
Repair measures
- minor drywall
- minor roof
- minor electrical
- minor moisture

Moisture barrier

* Electric heating systems are normally not eligible for replacement. Program guidance from DOE discourages this practice. Repairs to these systems can be made under incidental repairs and replacement can be made on site-specific situations.

December 2, 2003

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STANDARD PROCEDURES FOR METEOROLOGICAL MEASUREMENTS AT A POTENTIAL WIND TURBINE SITE

Prepared by:

Siting Subcommittee
Standards Program
American Wind Energy Association
122 C Street, NW, Fourth Floor
Washington, DC 20001 USA
Cooperative Agreement DE-FC01-80CH10302

AMERICAN WIND ENERGY ASSOCIATION STANDARDS

The designation *American Wind Energy Association (AWEA) Standard* implies a consensus of those substantially concerned with its scope and provisions. An AWEA Standard is intended as a guide to aid the manufacturer, the user and the general public. The existence of an AWEA Standard does not in any respect preclude anyone, whether he or she has approved the Standard or not, from manufacturing, marketing, purchasing or using products, processes, or procedures not conforming to the Standard. AWEA Standards are subject to periodic review and users are cautioned to obtain the latest edition.

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FOREWORD

This foreword is included for informational purposes and is not part of *Standard Procedures for Meteorological Measurements at a Potential Wind Turbine Site, AWEA 8.1 - 1986.*

This standard is one in a series of standard documents being prepared by the American Wind Energy Association (AWEA) to facilitate uniform practices and communication in the technology of wind energy conversion. To continue to be of service to those organizations and individuals who use it, this document should not be static -- especially in view of the rapid evolution of wind energy technology. Suggestions for improvement will be welcomed by the Association. Address all correspondence to AWEA Standards Program, 122 C Street, NW, Fourth Floor, Washington, DC, 20001, USA.

AWEA 8.1 - 1986 was developed by the Siting Subcommittee of the AWEA Standards Program. The purpose of this subcommittee has been, and continues to be, to develop criteria for the design of wind energy conversion systems (WECS).

This document was prepared for submittal to the AWEA membership under the overall guidance of the AWEA Standards Coordinating Committee which was constituted as follows at the time of this submittal:

Robert W. Baker	US Windpower
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Paul Bergman	Massachusetts Energy Office
Dr. Edwin X. Berry	Atmospheric Research & Technology Institute
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William A. Turner	Harriman Associates
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Bob Zickerfoose	Alternative Energy Corp.

1.0 Scope

This document provides procedures and methods for obtaining meteorological measurements at a site that has been proposed for wind energy use. Standards are provided for meteorological measurement systems and installation, operation, and calibration of equipment. Guidelines for sampling strategies, data processing and site evaluation practices are given in the appendices.

General wind turbine siting guidelines are not included here. References presenting this topic are given in "Applicable Documents".

This document does not cover standards for interpolating nearby data to the site, or for extrapolating short-term data into a long-term climatology. Numerical schemes for vertical extrapolation of data are also excluded. However, guidelines for obtaining the most representative measurements for the site and for recording these measurements during selected periods of the year to obtain annual estimates are given in Appendix C.

For the purposes of this document, wind energy utilization is defined as the use of single units or arrays of multiple units of wind turbines of any size greater than 1 kW for purposes of generating electricity. Although many of the guidelines in this document are applicable for all types of wind energy utilization, this document emphasizes procedures for commercial wind energy projects.

2.0 Applicable Documents

2.1 AWEA Terminology Standard AWEA 5.1 - 1985

2.2 Hiester, T. R. and W. T. Pennell, 1981. The Meteorological Aspects of Siting Large Wind Turbines. PNL-2522, Pacific Northwest Laboratory, Richland, Washington.

2.3 Wegley, H. L., et al. 1980. A Siting Handbook for Small Wind Energy Conversion Systems. PNL-2521 Rev. 1, Pacific Northwest Laboratory, Richland, Washington.

2.4 Pennell, W. T. 1983. Siting Guidelines for Utility Application of Wind Turbines. AP-2795, Research Project 1520-1. Electric Power Research Institute, Palo Alto, California.

3.0 Significance and Use

This document provides standard procedures for obtaining reliable, calibrated, and representative meteorological data from a site proposed for wind energy use. Adherence to this program will provide comparability of measurements among different sites and ensure that the data values are real and traceable to standards established by the National Bureau of Standards. The data base developed from this measurement program will enable the user to:

- Estimate energy production of wind systems over diurnal and monthly cycles from the installed equipment.
- Identify potential turbulence and/or site-specific wind characteristics wind turbines might encounter.
- Estimate on-peak, mid-peak, and off-peak energy production from the wind turbine site.

4.0 Description of Components of Wind Measurement Systems

4.1 Wind Sensors

Wind sensors measure the wind speed and direction. The most common type of sensors for measuring the horizontal wind speed component are cup or propeller anemometers. A wind vane is used to measure wind direction. Propeller anemometers also are used to measure the wind components in three orthogonal directions. These "uvw" anemometers can provide a measure of the vertical component of the wind.

4.1.1 Anemometer

A cup anemometer and wind vane could be independent sensors separated by a few feet, or the cup and vane could be mounted on the same vertical axis. When propellers and vanes are used, the propeller is attached to the vane. Because in this case the two sensors are not totally independent, structural or mechanical failure of the vane can cause erroneous wind speed data. Also, there may be errors introduced by the vane's response to wind direction, as opposed to cups that are essentially non-directional.

The rotation of anemometers is used to generate a signal that is proportional to wind speed. In most cases, the signal is electrical, although some anemometers produce mechanical signals. These signals may be continuous or intermittent. Continuous signals permit the wind speed to be determined at any instant. Intermittent signals can only be used to determine the average wind speed during a specific interval, depending on sampling rate.

Note: An example of a continuous signal would be the output of a small DC generator. If an anemometer is connected to a DC generator, the output of the generator can be displayed using a voltmeter or ammeter. The needle of the voltmeter will rise and fall with each wind gust, and the average wind speed is reflected by the average position of the needle. An example of an intermittent signal would be a flashing light. An anemometer can be connected to the light switch so that the number of light flashes over a predetermined time period equals the average wind speed. No information would be available on the speed during gusts during that period. Other methods of obtaining intermittent signals include use of reed switches or photocell light-choppers.

4.1.2 Wind Vanes

Wind vanes produce continuous signals; however, there are two types of signals. One type relates the signals to discrete direction sectors (i. e., north, northwest, etc.). As long as the wind continues within the sector, the signal remains constant even though there may be small direction fluctuations. The other type relates the signal to the instantaneous wind direction.

4.2 Signal Conditioners

Signal conditioners can supply power to sensors when required, and receive the signal from the sensor and convert it to a form that can be used by a recorder or display. Signal conditioning equipment is often included in the recorder or display equipment.

4.3 Displays

4.3.1 Dials

The information is read directly by needles or pointers.

4.3.2 Digital Displays

Information is presented directly by numerals and letters.

4.4 Recorders

4.4.1 Electromechanical Counters

Electromechanical counters record only the total amount of wind passing the sensor over a specified time interval. To estimate wind speed for electromechanical counters, it is necessary to determine elapsed time and divide the total amount of wind passing the sensor by the elapsed time. For example:

Average wind speed (mph) = miles of wind passage/elapsed time (hours)

4.4.2 Electronic Storage Data Loggers

In their simplest form, electronic data loggers can combine a number of accumulated signals, each with certain wind data. At the end of the observation period, the contents of the accumulators can provide a variety of statistics on wind, such as wind speed frequency distributions or sequential wind speed averages representative of predetermined time intervals. More complex data loggers may be used to record wind speed by direction and/or time of day. Data loggers that perform electronic calculations using the input signals and then record the results of the calculations are called "smart" data loggers.

4.4.3 Chart Recorders

In a chart recorder, the signal from the sensor moves a pen or other marking device back and forth across a piece of paper, which is typically moving at speeds between 2 and 15 centimeters (1 and 6 inches) per hour. The trace is a continuous wind record in which time of occurrence is determined by position along the chart.

4.4.4 Magnetic Tape or Solid State Recorders

Recorders can be used to record time sequential raw data or to record data that have been processed by the data logger. In the second case, a large part of the data analysis may be completed before recording. This preprocessing reduces the amount of data stored on the tapes, but may limit the flexibility of further data analysis, because the raw "time sequential" data have been lost. On the other hand, if the system only records the raw data, the sampling frequency must be high enough to ensure that sufficient samples are recorded for statistical analysis.

4.5 Wind Measurement Data Systems

Wind measurement data systems are defined on the basis of data storage capability as shown in Table 1.

Class I Systems: These systems do not have any data storage capability. If data are to be collected, an observer must monitor the system and manually record the data.

Class II Systems: These systems characterize the wind with a single number. Wind-run odometers are examples of these systems. Other instruments in this class record available energy in the wind (proportional to the sum of the cubes of instantaneous wind speed samples) or extractable energy (assuming a wind turbine's cut-in, rated, and cutout wind speeds are known). The time between readings of these instruments must be known to use the results.

Class III Systems: These systems store data in a sequential or accumulated form that retains information about the individual wind observations, including date and time. As a result, Class III systems record, store, and accumulate more data than the other systems. The data from these systems can be summarized in more than one form for analysis. As long as the recorded data are not lost, flexibility in analysis is retained, even after data collection is completed. Data collected by these systems can be used even if the details of data analysis were not determined before the data collection.

These systems are suitable for many wind turbine siting applications and provide more information on wind characteristics than Class II systems. Class III systems are particularly useful if diurnal load matching is important, because the data can be organized by time of day. Many of these systems are designed for unattended operation in remote locations and contain their own power sources.

The summary and analysis of data from Class III systems require the handling of large quantities of data. These systems generally require more attention to maintain the same levels of data recovery as Class I and II systems. However, because of the continuous nature of the data record obtained from these systems, software programs can be designed to obtain summaries of wind statistics over any time period desired. Many Class III systems have internal programs that summarize the data in various ways before recording them.

TABLE 1

DESCRIPTION OF THREE MAJOR CLASSES OF WIND MEASUREMENT SYSTEMS

Class	Storage Capability	Recording Medium	Primary Application	Comments
I	None	Manual records by observer	Real time, instantaneous data	Lowest cost,but human factor could introduce bias error
II	Single register	Counter or Electronic	Weekly, monthly averages	Minimum system for average speed or annual energy output
III	Multiple register, processed and sequential	Magnetic tape/ solid state/ strip chart	Summarized bin data, detailed statistical data analysis	Raw data retained for further processing;some internal processing;data storage dependent on sophistication of processing and logging systems.

5.0 Minimum Requirements for Standard Site Measurement Procedures

5.1 Data Use

Illustrations of different measurement strategies that can be used for various machine evaluations are shown in Appendix A.

5.2 Minimum Data Requirements

Data shall cover the wind speed range from 0 to 45 m/s (0 to 100 mph). In the wind speed range of 4.5 to 20 m/s (10 to 45 mph), resolution of the data shall be at a minimum of 0.5 m/s (1 mph). Data shall be recorded on a continuous basis for at least one year, even if wind turbines are installed before that period. During that year, a valid data recovery goal of at least 90% shall be established.

For the purposes of this document, "valid data" are measured data that are representative of the unknown quantities within the calibration tolerances of the instrumentation used and that would be confirmed by redundant measurements.

5.3 Maximum Wind Measurement System Inaccuracy

The wind measurement system consists of two primary subsystems: The physical subsystem (anemometer and wind vane sensors) and the electronic subsystem (signal conditioning, recording devices, and all cabling and connectors). The overall maximum wind speed system inaccuracy shall be +-2% of the true wind speed. The maximum wind direction system inaccuracy shall be +-5 degrees. These system inaccuracies shall apply over the temperature range specified by the manufacturer.

5.3.1 Physical Subsystem Measurement Inaccuracy

Under steady airflow conditions in a wind tunnel the physical subsystem contribution to the maximum wind speed inaccuracy shall be +-2% of the true wind speed for the range of 4.5 to 27 m/s (10 to 60 mph).

Note: Under normal use in the atmosphere, the inaccuracy of cup and propeller anemometers has not been documented, but may be greater than wind tunnel inaccuracies due to unsteady wind effects.

The physical subsystem contribution to the maximum wind direction inaccuracy shall be +-5 degrees of the true wind direction for the range of 4.5 to 27 m/s (10 to 60 mph) over the active part of the sensor. The sensors shall have a "dead band" (in which no measurement is possible) of less than 10 degrees.

5.3.2 Electronic Subsystem Measurement Uncertainty

The electronic subsystem contribution to the inaccuracy of wind speed and wind direction measurements shall be negligible for the range of 4.5 to 27 m/s (10 to 60 mph).

Note: Should the electronic subsystem measurement inaccuracy be significant, the total system measurement inaccuracy shall still be less than +-2% for wind speed and +-5 degrees for wind direction.

5.4 System Reliability

In assessing system reliability, data losses can result from malfunctions of sensors, processors, and data recorders. As a result, the data collection program shall incorporate the quality assurance procedures specified in Section 7 of this document.

Missing data records shall be clearly marked. Data processing procedures shall be established that ensure that missing data are not factored into statistical averages.

Note: In some cases, missing data gaps need to be filled so that a complete data set is available. Procedures for filling missing data are beyond the scope of this document.

6.0 Installation of Measurement Systems

6.1 Wind Energy Site Characteristics

Before selecting a site for wind energy measurements, and ultimately for wind energy use, consideration shall be given to local topography and obstructions, and preferred locations that may experience wind enhancement. References are given in the Applicable Documents section that provide detailed guidance on the siting of wind turbines incorporating these considerations.

6.2 Representativeness of Measurement System Locations

Measurements shall be taken as close to the intended turbine location as possible and at the anticipated hub height (or, for a vertical-axis machine, the equator height) of the rotor. At a minimum, the anemometer shall be at a height of at least 33 feet (10 meters).

To ensure representativeness of the planned wind turbine site, anemometers installed for site evaluation purposes shall be in exposures similar to the turbines. For example, if turbines are to be sited along a ridge crest, the anemometer shall be installed on the same crest. Use of isolated hills for anemometers, when the turbines are subsequently installed in lower terrain, often leads to unrepresentative measurements. Measurements shall be taken in an open area, free of heavy vegetation and structures. If sensors must be located near an obstruction, the location shall be a horizontal distance at least ten times the height of the obstruction.

Rooftop locations shall not be used for wind measurement systems unless the generator will also be on top of the roof at nearly the same height as the anemometer.

For large machine installations, or for multiple installations, or for complex terrain areas, more than one measurement location and/or level may be necessary. Due to the change of wind speed with height that normally occurs in the atmosphere, and the fluctuation of the magnitude of this change with time, anemometer heights must be at the turbine hub or equator height to avoid the introduction of uncertainties in the representativeness of the measurements due to this phenomenon. Multiple levels of measurements are beneficial when the exact hub height of the turbine is not known, or if the turbine height must be optimized.

6.3 Installation and Calibration of Wind Measuring Systems

6.3.1 Inspecting the Equipment

Before they are installed, measurement systems shall be given a functional check and calibration.

Signal conditioning and recording/display equipment shall be checked by putting simulated signals corresponding to sensor outputs for known wind speeds or directions into the signal conditioning equipment and comparing the recording/display equipment's outputs to the known speeds or directions. The check shall be performed for signals representing zero, as well as three or four additional wind speeds (e. g., 10, 20, and 30 mph), and four wind directions (0, 90, 180, and 270 degrees).

Note: When appropriate, torque watch values can be used to measure the starting speed of a sensor for comparison with manufacturers' specifications, if available. A torque watch is a device that is used to measure the amount of drag of the rotating shaft of the anemometer.

The chart speed of strip chart recorders shall be verified to be within manufacturer's specifications by running the recorder a minimum of one hour, and then measuring the amount of chart travel.

6.3.2 Installation

To avoid the effect of towers and cross-arms on sensors, the sensors shall be mounted on a mast above their support. Wind sensors shall be placed at a distance at least three structure diameters from lattice-type towers and at least six structure diameters from solid towers. Sensors shall be oriented into the prevailing wind direction.

The supporting structure shall be designed to withstand the wind loading expected for the site (structural standards for this loading are available from tower manufacturers). The structure shall be free of vibration and motion induced by the wind. The structure shall include lightning protection equipment to protect the sensors and data logging equipment. The structure shall be adequately secured against vandalism, unauthorized tower climbing, and other hazards. All necessary warning signs and ownership tags shall be clearly visible. If the supporting structure is 60 meters (200 feet) or higher, or is near an airport, proper FAA permits shall be obtained, and the tower shall be lighted according to regulations.

The anemometer and wind vane shall be aligned to assure that the appropriate axes are vertical (cup anemometers) and/or horizontal (propeller anemometers and wind vanes).

The wind vane shall be aligned by one of the following methods: 1) Drive a surveyor-type stake into the ground about 60 meters (200 feet) from the sensor toward true north and visibly align the "north" mark on the sensor to the stake; 2) Identify an existing landmark at the true north or other known direction position from the sensor and align according to 1); or 3) Use a compass to align the "north" mark to magnetic north then adjust the sensor's alignment for magnetic deviation. Before installation, sensor north shall be aligned with the supporting cross arm, since the cross arm is easier to line up with the reference point.

6.4 Operating the Equipment for Site Evaluation

A sampling strategy for site evaluation for a wind turbine or wind turbine array shall be designed to incorporate information on the turbulence characteristics of the site, fluctuations in winds that affect turbine operating strategies, the diurnal and seasonal variability, and the interannual variability of the winds. Examples of data analysis and reporting procedures may be found in Appendix A.

7.0 Standard Operating Procedures

The successful completion of a field monitoring program depends on the adherence to a set of Standard Operating Procedures. These procedures define all necessary steps to perform system calibrations, document site visits, identify and correct system problems, and provide for proper record keeping of all the steps involved from collecting data to summarizing the results with the assurance that the results are accurate and traceable to known standards. The Standard Operating Procedures shall include, at a minimum, procedures for the following activities.

7.1 Site Visits

At a minimum, the following steps shall be taken during each routine site visit:

- Record the date and time.
- Visually inspect the sensors, and document (and correct, if possible) any irregularities.
- Visually inspect the sensor support, including guy wire tensions, trueness of the support in the vertical, and condition of grounding system. Correct as needed.
- Check the power source or batteries. Replace batteries on a scheduled or as needed basis and document changes.
- Check the recorder or data logger operation according to manufacturer's specifications.
- Where appropriate, check "0" and "full scale" spans on signal conditioning equipment, and adjust where necessary. Document "as arrived" and "as left" conditions.
- Annotate the recording medium to identify the in formation recorded, the date and time that data recording started, and the time that it was completed.
- Document any actions taken during emergency or routine visits. The person performing the site visit shall be identified in the log each time.

7.2 Record Keeping Procedures

A record shall be kept for descriptions of the status of the instrument system. This record shall include the manufacturer and model number, and serial numbers of all pieces of equipment. References to the equipment shall always include the serial number.

7.2.1 Site Inspections

Each site inspection shall be documented in the record. This documentation shall include the pertinent features of the inspection procedures listed in Section 7.1. Where corrective action was required, this shall be noted in the record, and the date of the action shall be documented if different from the date of the inspection.

7.2.2 Instrument Inspection

The record shall contain a complete history of the instruments used in a measurement program from the time the instruments are received until the program is completed. Initial entries shall describe the instruments, the pre- installation inspection and calibration, the measurement site, the installation, and any recalibrations. Sufficient information shall be contained so that the measurement program could be reconstructed at a later date.

All records shall be initialed by the person making the entry. The initials shall be correlated to individuals.

7.3 Sensor Calibrations

Sensor calibrations shall be done with equipment traceable to National Bureau of Standards. Calibration reports shall be factored into any post-processing of data.

7.3.1 Field Calibrations

Instruments and recorders that can be field calibrated shall be calibrated to manufacturers' specifications at least twice a year. This calibration shall consist of an electronics check of the signal conditioning and recording equipment.

Note: Adequate steps shall be taken to assure that the bearings and DC generators have not deteriorated to the point of affecting the sensor calibration. Consequently, the Standard Operating Procedures shall include provisions for checking and replacing the sensors at appropriate intervals..

7.3.2 Laboratory Calibrations

Sensors shall be removed and tested in the laboratory on a regularly scheduled interval. Sensors shall be refurbished with new bearings and/or other parts as needed. Sensors shall be recalibrated by appropriate measures to ensure that the equipment is operating within the manufacturer's specifications.

Appendix A

EXAMPLES OF DATA ANALYSIS AND REPORTING PROCEDURES

A.1 Data Analysis

A wide range of sampling strategies and data processing procedures is available depending on the kind of recording equipment used in the collection program. Data logger sampling frequencies and averaging times are partially determined by the wind turbine application and utility purchase rate structure. As a result, advance planning should be done to determine the most appropriate and useful strategy.

For Class III systems, data should be sampled approximately once every one to three seconds, averaged over a period not to exceed one hour, and then stored in bins to obtain a variety of information. Also included in this sampling strategy should be a calculation of turbulence over the averaging period, as defined in AWEA's Terminology Standard. A Class III system should record the following information:

- The mean wind speed and direction.
- Turbulence data.

Software may be required to produce the type of information listed for Class III systems. For most Class III systems currently available, this type of sampling strategy should allow for approximately one month of data collection before the recording medium needs to be refreshed or replaced from the system. From this basic sampling and recording strategy, summarized output of Class III systems should be as follows:

- Mean wind speed for each recording period not to exceed one hour.
- A wind speed frequency histogram in 1 m/s (2 mph) speed intervals.
- A joint distribution of wind speed and direction in 2 m/s (5 mph) speed intervals and 22.5-degree direction intervals.
- A joint distribution of wind speed versus time of day in 2 m/s (5 mph) speed intervals and time intervals not to exceed 3 hours.
- A joint distribution of wind direction versus time of day in 22.5-degree intervals and 3-hour time intervals.
- Information about turbulence.
- Maximum peak gust and sustained (based on averaging interval) wind speeds.

A.2 Data Reporting Formats

Table A-1 summarizes information that should be reported on a routine (preferably monthly) basis for the various classes of data measurement systems.

TABLE A-1

ROUTINE (PREFERABLY MONTHLY) REPORTING RECOMMENDATIONS FOR VARIOUS CLASSES OF INSTRUMENTATION SYSTEMS

	Class I	Class II	Class III
Monthly/annual mean wind speed		X	X
Wind speed frequency distribution and cumulative frequency distribution			X
Wind direction frequency distribution			X
Mean speed/direction by time of day			X (not more than 1/4 day increments)
Vertical shear of speed by direction and time of day*			X
Turbulence			X
Maximum gusts		X	X

* Requires at least two levels of instrumentation on tower

Appendix B

EXAMPLE PROCEDURES FOR ENHANCING DATA REPRESENTATIVENESS AT A SITE

B.1 Extrapolating On-Site Data to Long-Term Statistics

It is obviously impractical to sample at a proposed wind turbine site long enough to obtain information on interannual variability, and perhaps even seasonal variability. Wind measurement strategies, based on the known statistical characteristics of high-wind sites, have been developed, and are recommended here to obtain information on the likely long-term variability of a site.

For a single season or year of measurements at the wind turbine site, the long-term wind speed for the corresponding season, or the long-term annual wind speed for a single year of measurements, will be within +-10% of the single season or year observation with about 90% confidence (References 1, 2, and 3).

When a nearby long-term reference station is available, and the diurnal and seasonal wind patterns at the reference station and measurement station are similar, the short-term site data can be adjusted to the climatological station using the following relationship:

If a number of different sites in a wind turbine array are to be monitored, an intermittent measurement strategy can be used at each site to maximize instrument usage (Reference 3).. Based on results quoted in (3) it is recommended that at least two to three months of intermittent measurements be made at each location for a period of at least three years. This will provide a data set that will give at least the same, if not higher, confidence of the long-term estimate at all sites than one year of continuous measurements at each site.

B.2 Special Measurements for Site Evaluation

B.2.1 Turbulence Measurements

For site evaluation for large wind turbines or wind turbine arrays, special turbulence measurements may be desirable to determine more precisely the types of loads wind machines might experience at the site. It is recommended that a special measurement program using high quality, sensitive wind sensors and sophisticated data loggers be undertaken for short periods of time. Detailed descriptions of these programs is beyond the scope of this document.

B.2.2 Kite Anemometer Measurements

Kite anemometers can be used in the site evaluation process to obtain information on the spatial representativeness of the measurement station(s) installed at the site. For these studies, it is recommended that kite anemometer studies be made at different times on each of 2 to 3 days per month, three to four times per year. The studies should involve at least two kites, which are first flown together to obtain a relative comparison on the readout of each. Then one kite is flown continuously, close to the measurement station and at the same height as the anemometer of the measurement station, while the other is flown at the same height at several pre-determined locations around the site. These locations should be representative of the locations where wind turbines would be installed. At each location, at least three 10-minute measurement periods are recommended, with a 3- to 5-minute break between each period. During each measurement period, readings approximately every 15 seconds should be taken. At the conclusion of the measurements, all values within each 10-minute measurement period should be averaged and compared with the "control" kite anemometer.

A kite anemometer can also be used to estimate the vertical variation of the wind speed at the measurement station, and at any location within the site. These measurements should also be done for several hours on 2 to 3 days per month, 3 to 4 months per year, using the same sampling strategy as before. A "control" kite at the measurement station is recommended for this practice as well.

References for Appendix B

1. Corotis, R. B., et al., 1977: "Variance Analysis of Wind Characteristics for Energy Conversion." Journal of Applied Meteorology 16:1149-1157.

2. Justus, C. G., et. al., 1979: "Interannual and Month-to-Month Variations of Wind Speed." Journal of Applied Meteorology 18:913-920.

3. Ramsdell, J. V., et. al., 1980. Measurement Strategies for Estimating Long-Term Average Wind Speeds. PNL-3448, Pacific Northwest Laboratory, Richland, Washington.

U.S. Census Bureau

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data

NOTE: Data based on a sample except in P3, P4, H3, and H4. For information on confidentiality protection, sampling error, nonsampling error, and definitions see http://factfinder.census.gov/home/en/datanotes/expsf3.htm.

	Missouri	Adair County, Missouri	Andrew County, Missouri	Atchison County, Missouri	Audrain County, Missouri	Barry County, Missouri	Barton County, Missouri	Bates County, Missouri	Benton County, Missouri	Bollinger County, Missouri
Total:	2,197,214	9,645	6,249	2,736	9,872	13,371	4,908	6,521	7,444	4,589
Under 1.50: 20.86%	458,416	3,451	1,123	658	2,262	3,911	1,454	1,769	2,157	1,407
Family households:	234,777	1,119	585	340	1,280	2,348	832	987	1,132	846
Married-couple family	112,063	659	349	229	741	1,537	573	628	740	585
Other family:	122,714	460	236	111	539	811	259	359	392	261
Male householder, no wife present	21,346	103	43	22	94	259	47	86	101	39
Female householder, no husband present	101,368	357	193	89	445	552	212	273	291	222
Nonfamily households:	223,639	2,332	538	318	982	1,563	622	782	1,025	561
Male householder	84,859	1,089	187	94	273	647	205	253	407	175
Female householder	138,780	1,243	351	224	709	916	417	529	618	386
1.50 and over:	1,738,798	6,194	5,126	2,078	7,610	9,460	3,454	4,752	5,287	3,182
Family households:	1,251,769	4,284	4,042	1,450	5,561	7,353	2,634	3,617	4,077	2,645
Married-couple family	1,045,487	3,818	3,562	1,278	4,804	6,503	2,278	3,282	3,740	2,406
Other family:	206,282	466	480	172	757	850	356	335	337	239
Male householder, no wife present	59,767	119	172	92	305	309	123	134	104	74
Female householder, no husband present	146,515	347	308	80	452	541	233	201	233	165
Nonfamily households:	487,029	1,910	1,084	628	2,049	2,107	820	1,135	1,210	537
Male householder	233,213	826	589	298	881	1,089	397	597	662	290
Female householder	253,816	1,084	495	330	1,168	1,018	423	538	548	247

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data

NOTE: Data based on a sample except in P3, P4, H3, and H4. For information on confidentiality protection, *sampling error, nonsampling error, and definitions* see http://factfinder.census.gov/home/en/datanotes/expsf3.htm.

	Boone County, Missouri	Buchanan County, Missouri	Butler County, Missouri	Caldwell County, Missouri	Callaway County, Missouri	Camden County, Missouri	Cape Girardeau County, Missouri	Carroll County, Missouri	Carter County, Missouri	Cass County, Missouri
Total:	53,106	33,592	16,737	3,522	14,449	15,740	27,031	4,169	2,377	30,236
Under 1.50:	12,693	7,920	5,548	883	2,556	3,081	5,947	1,067	952	3,560
Family households:	4,429	3,793	2,922	479	1,393	1,770	2,500	521	565	1,981
Married-couple family	1,821	1,719	1,607	291	627	1,118	1,282	399	382	1,053
Other family:	2,608	2,074	1,315	188	766	652	1,218	122	183	928
Male householder, no wife present	471	300	271	33	162	184	192	20	57	149
Female householder, no husband present	2,137	1,774	1,044	155	604	468	1,026	102	126	779
Nonfamily households:	8,264	4,127	2,626	404	1,163	1,311	3,447	546	387	1,579
Male householder	4,040	1,525	965	148	456	580	1,193	165	155	525
Female householder	4,224	2,602	1,661	256	707	731	2,254	381	232	1,054
1.50 and over:	40,413	25,672	11,189	2,639	11,893	12,659	21,084	3,102	1,425	26,676
Family households:	27,236	18,299	8,473	2,026	9,023	9,533	15,569	2,358	1,101	21,115
Married-couple family	22,841	15,212	7,340	1,793	7,777	8,662	13,498	2,113	966	18,422
Other family:	4,395	3,087	1,133	233	1,246	871	2,071	245	135	2,693
Male householder, no wife present	1,207	916	268	96	417	321	558	73	50	903
Female householder, no husband present	3,188	2,171	865	137	829	550	1,513	172	85	1,790
Nonfamily households:	13,177	7,373	2,716	613	2,870	3,126	5,515	744	324	5,561
Male householder	6,396	3,468	1,209	342	1,440	1,643	2,554	324	166	2,749
Female householder	6,781	3,905	1,507	271	1,430	1,483	2,961	420	158	2,812

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data

NOTE: Data based on a sample except in P3, P4, H3, and H4. For information on confidentiality protection, sampling error, nonsampling error, and definitions see http://factfinder.census.gov/home/en/datanotes/expsf3.htm.

	Cedar County, Missouri	Chariton County, Missouri	Christian County, Missouri	Clark County, Missouri	Clay County, Missouri	Clinton County, Missouri	Cole County, Missouri	Cooper County, Missouri	Crawford County, Missouri	Dade County, Missouri
Total:	5,664	3,462	20,473	2,967	72,613	7,170	27,064	5,943	8,870	3,222
Under 1.50:	1,793	886	3,821	742	7,832	1,206	4,243	1,230	2,521	851
Family households:	851	437	2,352	391	3,836	667	1,980	631	1,424	457
Married-couple family	614	309	1,368	286	1,715	389	793	373	881	266
Other family:	237	128	984	105	2,121	278	1,187	258	543	191
Male householder, no wife present	64	22	126	28	436	66	183	79	100	71
Female householder, no husband present	173	106	858	77	1,685	212	1,004	179	443	120
Nonfamily households:	942	449	1,469	351	3,996	539	2,263	599	1,097	394
Male householder	385	164	461	140	1,324	180	939	167	415	141
Female householder	557	285	1,008	211	2,672	359	1,324	432	682	253
1.50 and over:	3,871	2,576	16,652	2,225	64,781	5,964	22,821	4,713	6,349	2,371
Family households:	3,050	1,921	13,541	1,705	46,623	4,674	16,010	3,529	4,978	1,832
Married-couple family	2,778	1,736	12,104	1,520	39,040	4,131	13,734	3,085	4,541	1,648
Other family:	272	185	1,437	185	7,583	543	2,276	444	437	184
Male householder, no wife present	70	63	502	79	2,203	187	712	154	165	62
Female householder, no husband present	202	122	935	106	5,380	356	1,564	290	272	122
Nonfamily households:	821	655	3,111	520	18,158	1,290	6,811	1,184	1,371	539
Male householder	355	281	1,417	234	8,951	616	2,980	581	712	278
Female householder	466	374	1,694	286	9,207	674	3,831	603	659	261

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
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NOTE: Data based on a sample except in P3, P4, H3, and H4. For information on confidentiality protection, sampling error, nonsampling error, and definitions see http://factfinder.census.gov/home/en/datanotes/expsf3.htm.

	Dallas County, Missouri	Daviess County, Missouri	DeKalb County, Missouri	Dent County, Missouri	Douglas County, Missouri	Dunklin County, Missouri	Franklin County, Missouri	Gasconade County, Missouri	Gentry County, Missouri	Greene County, Missouri
Total:	6,063	3,184	3,553	6,017	5,214	13,414	35,081	6,188	2,745	98,003
Under 1.50:	1,933	824	887	1,877	1,785	5,253	5,268	1,303	721	22,460
Family households:	1,149	476	412	1,043	982	2,960	2,633	631	391	9,610
Married-couple family	743	343	291	706	692	1,613	1,328	376	276	4,464
Other family:	406	133	121	337	290	1,347	1,305	255	115	5,146
Male householder, no wife present	60	17	16	81	67	227	323	52	30	1,034
Female householder, no husband present	346	116	105	256	223	1,120	982	203	85	4,112
Nonfamily households:	784	348	475	834	803	2,293	2,635	672	330	12,850
Male householder	291	75	165	283	307	686	844	211	114	5,217
Female householder	493	273	310	551	496	1,607	1,791	461	216	7,633
1.50 and over:	4,130	2,360	2,666	4,140	3,429	8,161	29,813	4,885	2,024	75,543
Family households:	3,301	1,797	2,074	3,271	2,723	6,274	23,294	3,695	1,515	52,537
Married-couple family	3,026	1,629	1,856	2,895	2,490	5,442	20,153	3,296	1,378	44,650
Other family:	275	168	218	376	233	832	3,141	399	137	7,887
Male householder, no wife present	145	73	79	118	91	229	1,149	145	42	2,348
Female householder, no husband present	130	95	139	258	142	603	1,992	254	95	5,539
Nonfamily households:	829	563	592	869	706	1,887	6,519	1,190	509	23,006
Male householder	437	296	276	382	377	854	3,610	613	194	10,642
Female householder	392	267	316	487	329	1,033	2,909	577	315	12,364

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households

Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data

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	Grundy County, Missouri	Harrison County, Missouri	Henry County, Missouri	Hickory County, Missouri	Holt County, Missouri	Howard County, Missouri	Howell County, Missouri	Iron County, Missouri	Jackson County, Missouri	Jasper County, Missouri
Total:	4,395	3,683	9,192	3,947	2,236	3,838	14,805	4,209	266,501	41,471
Under 1.50:	1,337	1,128	2,444	1,209	612	937	5,254	1,389	51,955	10,988
Family households:	689	576	1,345	659	333	486	3,055	804	25,673	5,695
Married-couple family	405	401	759	513	225	276	2,051	487	8,360	2,817
Other family:	284	175	586	146	108	210	1,004	317	17,313	2,878
Male householder, no wife present	61	42	130	19	32	47	237	69	2,757	467
Female householder, no husband present	223	133	456	127	76	163	767	248	14,556	2,411
Nonfamily households:	648	552	1,099	550	279	451	2,199	585	26,282	5,293
Male householder	196	212	405	232	104	158	726	220	10,919	1,879
Female householder	452	340	694	318	175	293	1,473	365	15,363	3,414
1.50 and over:	3,058	2,555	6,748	2,738	1,624	2,901	9,551	2,820	214,546	30,483
Family households:	2,221	1,982	5,000	2,101	1,185	2,171	7,658	2,174	141,676	22,402
Married-couple family	2,016	1,754	4,374	1,939	1,041	1,876	6,859	1,964	108,967	19,168
Other family:	205	228	626	162	144	295	799	210	32,709	3,234
Male householder, no wife present	80	94	252	66	52	98	242	84	8,832	950
Female householder, no husband present	125	134	374	96	92	197	557	126	23,877	2,284
Nonfamily households:	837	573	1,748	637	439	730	1,893	646	72,870	8,081
Male householder	414	238	918	308	230	372	950	320	34,752	3,901
Female householder	423	335	830	329	209	358	943	326	38,118	4,180

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
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	Jefferson County, Missouri	Johnson County, Missouri	Knox County, Missouri	Laclede County, Missouri	Lafayette County, Missouri	Lawrence County, Missouri	Lewis County, Missouri	Lincoln County, Missouri	Linn County, Missouri	Livingston County, Missouri
Total:	71,567	17,390	1,794	12,809	12,584	13,612	3,965	13,882	5,741	5,796
Under 1.50:	9,653	4,523	576	3,763	2,377	3,712	1,055	2,364	1,633	1,484
Family households:	5,444	2,149	304	2,205	1,257	2,138	584	1,393	865	662
Married-couple family	2,630	1,270	228	1,451	610	1,281	362	771	529	351
Other family:	2,814	879	76	754	647	857	222	622	336	311
Male householder, no wife present	605	209	21	160	109	152	52	98	74	49
Female householder, no husband present	2,209	670	55	594	538	705	170	524	262	262
Nonfamily households:	4,209	2,374	272	1,558	1,120	1,574	471	971	768	822
Male householder	1,447	1,095	88	522	359	615	166	380	240	210
Female householder	2,762	1,279	184	1,036	761	959	305	591	528	612
1.50 and over:	61,914	12,867	1,218	9,046	10,207	9,900	2,910	11,518	4,108	4,312
Family households:	49,445	9,698	917	7,077	7,856	7,776	2,139	9,203	2,962	3,205
Married-couple family	41,492	8,603	818	6,303	6,886	6,907	1,885	7,890	2,564	2,858
Other family:	7,953	1,095	99	774	970	869	254	1,313	398	347
Male householder, no wife present	2,835	455	41	273	311	263	116	479	147	113
Female householder, no husband present	5,118	640	58	501	659	606	138	834	251	234
Nonfamily households:	12,469	3,169	301	1,969	2,351	2,124	771	2,315	1,146	1,107
Male householder	7,349	1,674	134	1,028	1,220	1,069	370	1,359	502	512
Female householder	5,120	1,495	167	941	1,131	1,055	401	956	644	595

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
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	McDonald County, Missouri	Macon County, Missouri	Madison County, Missouri	Maries County, Missouri	Marion County, Missouri	Mercer County, Missouri	Miller County, Missouri	Mississippi County, Missouri	Moniteau County, Missouri	Monroe County, Missouri
Total:	8,133	6,494	4,711	3,536	11,064	1,601	9,288	5,379	5,264	3,640
Under 1.50:	2,802	1,692	1,631	883	2,733	431	2,476	2,227	1,034	918
Family households:	1,705	762	902	487	1,445	238	1,337	1,228	547	431
Married-couple family	976	457	567	327	759	158	744	461	310	297
Other family:	729	305	335	160	686	80	593	767	237	134
Male householder, no wife present	209	73	59	36	124	23	74	82	71	20
Female householder, no husband present	520	232	276	124	562	57	519	685	166	114
Nonfamily households:	1,097	930	729	396	1,288	193	1,139	999	487	487
Male householder	518	343	208	146	366	70	410	341	186	190
Female householder	579	587	521	250	922	123	729	658	301	297
1.50 and over:	5,331	4,802	3,080	2,653	8,331	1,170	6,812	3,152	4,230	2,722
Family households:	4,189	3,594	2,398	2,056	6,131	857	5,113	2,488	3,185	2,123
Married-couple family	3,645	3,095	2,155	1,834	5,412	783	4,430	2,114	2,809	1,846
Other family:	544	499	243	222	719	74	683	374	376	277
Male householder, no wife present	239	196	85	81	200	26	238	136	139	92
Female householder, no husband present	305	303	158	141	519	48	445	238	237	185
Nonfamily households:	1,142	1,208	682	597	2,200	313	1,699	664	1,045	599
Male householder	658	576	373	351	994	138	912	311	461	314
Female householder	484	632	309	246	1,206	175	787	353	584	285

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	Montgomery County, Missouri	Morgan County, Missouri	New Madrid County, Missouri	Newton County, Missouri	Nodaway County, Missouri	Oregon County, Missouri	Osage County, Missouri	Ozark County, Missouri	Pemiscot County, Missouri	Perry County, Missouri
Total:	4,782	7,847	7,831	20,163	8,164	4,269	4,956	3,987	7,906	6,929
Under 1.50:	1,159	2,113	2,701	4,578	2,319	1,756	913	1,391	3,514	1,434
Family households:	623	1,165	1,588	2,534	737	1,007	410	840	2,061	661
Married-couple family	348	804	759	1,640	426	677	243	633	814	419
Other family:	275	361	829	894	311	330	167	207	1,247	242
Male householder, no wife present	62	73	87	222	69	77	30	76	187	55
Female householder, no husband present	213	288	742	672	242	253	137	131	1,060	187
Nonfamily households:	536	948	1,113	2,044	1,582	749	503	551	1,453	773
Male householder	170	400	449	736	655	301	221	238	575	297
Female householder	366	548	664	1,308	927	448	282	313	878	476
1.50 and over:	3,623	5,734	5,130	15,585	5,845	2,513	4,043	2,596	4,392	5,495
Family households:	2,736	4,407	3,937	12,245	4,164	2,016	3,202	2,080	3,304	4,292
Married-couple family	2,355	4,023	3,354	10,855	3,713	1,826	2,866	1,869	2,735	3,780
Other family:	381	384	583	1,390	451	190	336	211	569	512
Male householder, no wife present	139	155	166	473	190	68	143	70	177	183
Female householder, no husband present	242	229	417	917	261	122	193	141	392	329
Nonfamily households:	887	1,327	1,193	3,340	1,681	497	841	516	1,088	1,203
Male householder	496	691	548	1,706	857	252	480	290	514	672
Female householder	391	636	645	1,634	824	245	361	226	574	531

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	Pettis County, Missouri	Phelps County, Missouri	Pike County, Missouri	Platte County, Missouri	Polk County, Missouri	Pulaski County, Missouri	Putnam County, Missouri	Ralls County, Missouri	Randolph County, Missouri	Ray County, Missouri
Total:	15,616	15,677	6,417	29,317	9,899	13,456	2,240	3,725	9,217	8,725
Under 1.50:	3,591	4,631	1,746	2,788	2,877	2,943	690	759	2,371	1,394
Family households:	2,016	2,136	943	1,283	1,546	1,795	375	418	1,209	791
Married-couple family	1,069	1,148	578	541	1,048	1,034	258	309	635	432
Other family:	947	988	365	742	498	761	117	109	574	359
Male householder, no wife present	144	221	99	180	107	131	30	15	131	73
Female householder, no husband present	803	767	266	562	391	630	87	94	443	286
Nonfamily households:	1,575	2,495	803	1,505	1,331	1,148	315	341	1,162	603
Male householder	570	1,245	346	533	441	409	90	95	397	166
Female householder	1,005	1,250	457	972	890	739	225	246	765	437
1.50 and over:	12,025	11,046	4,671	26,529	7,022	10,513	1,550	2,966	6,846	7,331
Family households:	8,697	8,158	3,498	19,142	5,644	8,242	1,151	2,367	5,074	5,737
Married-couple family	7,369	7,280	3,002	16,248	5,069	7,342	1,067	2,172	4,335	5,145
Other family:	1,328	878	496	2,894	575	900	84	195	739	592
Male householder, no wife present	424	259	184	916	226	316	36	96	247	223
Female householder, no husband present	904	619	312	1,978	349	584	48	99	492	369
Nonfamily households:	3,328	2,888	1,173	7,387	1,378	2,271	399	599	1,772	1,594
Male householder	1,597	1,453	640	3,805	607	1,288	221	353	914	866
Female householder	1,731	1,435	533	3,582	771	983	178	246	858	728

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	Reynolds County, *Missouri*	Ripley County, *Missouri*	St. Charles County, Missouri	St. Clair County, Missouri	Ste. Genevieve County, Missouri	St. Francois County, Missouri	St. Louis County, Missouri	Saline County, Missouri	Schuyler County, Missouri	Scotland County, Missouri
Total:	2,735	5,438	101,826	4,031	6,602	20,788	404,607	8,984	1,725	1,895
Under 1.50:	978	2,300	7,936	1,386	1,075	5,745	48,779	2,143	499	605
Family households:	537	1,352	4,297	785	597	3,000	24,268	1,163	251	344
Married-couple family	378	933	1,678	503	350	1,552	8,273	572	199	240
Other family:	159	419	2,619	282	247	1,448	15,995	591	52	104
Male householder, no wife present	33	77	386	57	19	346	2,216	164	8	21
Female householder, no husband present	126	342	2,233	225	228	1,102	13,779	427	44	83
Nonfamily households:	441	948	3,639	601	478	2,745	24,511	980	248	261
Male householder	209	406	1,116	214	129	934	8,061	372	91	92
Female householder	232	542	2,523	387	349	1,811	16,450	608	157	169
1.50 and over:	1,757	3,138	93,890	2,645	5,527	15,043	355,828	6,841	1,226	1,290
Family households:	1,407	2,534	73,156	2,004	4,352	11,822	248,251	4,822	943	974
Married-couple family	1,272	2,282	63,686	1,816	3,842	10,083	200,714	4,112	831	899
Other family:	135	252	9,470	188	510	1,739	47,537	710	112	75
Male householder, no wife present	57	91	3,011	88	172	628	10,864	226	35	35
Female householder, no husband present	78	161	6,459	100	338	1,111	36,673	484	77	40
Nonfamily households:	350	604	20,734	641	1,175	3,221	107,577	2,019	283	316
Male householder	196	321	10,532	326	687	1,576	46,030	966	136	114
Female householder	154	283	10,202	315	488	1,645	61,547	1,053	147	202

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P93. RATIO OF INCOME IN 1999 TO POVERTY LEVEL BY HOUSEHOLD TYPE [19] - Universe: Households
Data Set: Census 2000 Summary File 3 (SF 3) - Sample Data

NOTE: Data based on a sample except in P3, P4, H3, and H4. For information on confidentiality protection, sampling error, nonsampling error, and definitions see http://factfinder.census.gov/home/en/datanotes/expsf3.htm.

	Scott County, Missouri	Shannon County, Missouri	Shelby County, Missouri	Stoddard County, Missouri	Stone County, Missouri	Sullivan County, Missouri	Taney County, Missouri	Texas County, Missouri	Vernon County, Missouri	Warren County, Missouri
Total:	15,689	3,329	2,754	12,047	11,824	2,921	16,175	9,379	8,018	9,210
Under 1.50:	4,549	1,446	773	3,907	2,787	951	4,006	3,338	2,283	1,639
Family households:	2,548	907	436	2,132	1,592	462	2,179	2,006	1,188	845
Married-couple family	1,135	654	318	1,316	1,027	294	1,326	1,296	654	420
Other family:	1,413	253	118	816	565	168	853	710	534	425
Male householder, no wife present	208	54	32	176	126	33	220	185	85	73
Female householder, no husband present	1,205	199	86	640	439	135	633	525	449	352
Nonfamily households:	2,001	539	337	1,775	1,195	489	1,827	1,332	1,095	794
Male householder	644	193	127	627	468	186	732	472	467	233
Female householder	1,357	346	210	1,148	727	303	1,095	860	628	561
1.50 and over:	11,140	1,883	1,981	8,140	9,037	1,970	12,169	6,041	5,735	7,571
Family households:	8,814	1,481	1,431	6,353	7,266	1,508	8,917	4,694	4,303	6,053
Married-couple family	7,561	1,314	1,298	5,683	6,636	1,272	7,942	4,209	3,798	5,368
Other family:	1,253	167	133	670	630	236	975	485	505	685
Male householder, no wife present	368	73	37	232	226	104	323	192	172	275
Female householder, no husband present	885	94	96	438	404	132	652	293	333	410
Nonfamily households:	2,326	402	550	1,787	1,771	462	3,252	1,347	1,432	1,518
Male householder	940	192	229	875	901	249	1,447	637	672	897
Female householder	1,386	210	321	912	870	213	1,805	710	760	621

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	Washington County, Missouri	Wayne County, Missouri	Webster County, Missouri	Worth County, Missouri	Wright County, Missouri	St. Louis city, Missouri
Total:	8,376	5,540	11,080	1,007	7,094	147,286
Under 1.50:	2,935	2,022	2,802	318	2,735	49,756
Family households:	1,824	1,157	1,723	158	1,620	24,735
Married-couple family	1,125	690	1,275	113	1,080	5,848
Other family:	699	467	448	45	540	18,887
Male householder, no wife present	145	134	126	10	135	2,332
Female householder, no husband present	554	333	322	35	405	16,555
Nonfamily households:	1,111	865	1,079	160	1,115	25,021
Male householder	499	313	433	58	330	10,577
Female householder	612	552	646	102	785	14,444
1.50 and over:	5,441	3,518	8,278	689	4,359	97,530
Family households:	4,422	2,688	6,742	520	3,448	53,049
Married-couple family	3,851	2,437	5,973	466	3,081	32,942
Other family:	571	251	769	54	367	20,107
Male householder, no wife present	237	94	278	16	129	5,041
Female householder, no husband present	334	157	491	38	238	15,066
Nonfamily households:	1,019	830	1,536	169	911	44,481
Male householder	528	439	791	88	484	21,996
Female householder	491	391	745	81	427	22,485

U.S. Census Bureau
Census 2000

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STRUCTURING A PUBLIC PURPOSE "DISTRIBUTION FEE" FOR MISSOURI

Prepared For:

Division of Energy
Department of Natural Resources
State of Missouri
Jefferson City, MO

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In 1997, Colton undertook electric restructuring research for Oak Ridge National Laboratory. His Oak Ridge research was published as the paper *The Obligation to Serve and a Competitive Electric Industry*.

In addition, Colton has authored four books on low-income energy policy, including *On the Brink of Disaster: A State-by-State Analysis of Low-Income Natural Gas Winter Heating Bills*; *The Other Part of the Year: Low-Income Households and Their Need for Cooling: A State-by-State Analysis of Low-Income Summer Electric Bills*; *Energy Efficiency and the Low-Income Consumer: Planning, Designing and Financing*; and *Funding Fuel Assistance: State and Local Strategies to Help Pay Low-Income Home Energy Bills*.

Each of these publications is available from FSC Publications, 34 Warwick Road, Belmont, MA, 02178.

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INTRODUCTION

This report considers a public purpose distribution fee for the State of Missouri. Prepared at the request of the Missouri Department of Natural Resources, the research presents a detailed analysis, using Missouri-specific data, of a charge through which the State may generate revenues for:

- o residential energy efficiency efforts generally;[1] and
- o cost-effective energy affordability assistance, including both cash assistance and low-income energy efficiency investments.

The discussion below will concentrate on documenting: (1) the need for a public purpose distribution fee in the State of Missouri; and (2) the rate implications of various scenarios through which distribution fee revenues might be generated. The discussion is not intended to address the broader issues of how activities such as research and development (R&D) and other "public purposes" might be funded in a restructured electric industry.

Clearly, subsumed within these broader issues are other important discussions. How can a distribution fee be made competitively neutral? On what basis should a distribution fee be imposed? These other issues are considered in the text below. Tables setting forth the data discussed in the text are included in Appendix A.

The Distinction Between Types of Fees Arising in "Restructuring"

One condition that many states are placing on "restructuring" the electric industry today involves the imposition of a "system benefits charge" or a "distribution fee." Different fees have been proposed under different names. While they may seem quite similar, in fact, they serve quite different purposes and are based upon different policy justifications.

On the one hand, there are charges called "system benefits charges." A system benefits charge is designed to fund certain "public benefits" that are placed at risk of being "stranded" in a more competitive industry. These benefits include, but are not limited to, assistance for low-income consumers, renewable energy, research and development, energy efficiency, and the like. On the other hand, there are broader "distribution fees." These fees recognize a need for energy efficiency investments and low-income assistance beyond that currently offered by the electric industry. From the low-income perspective, these fees are predicated upon the observation that a move from a monopoly-regulated to a competitive, market-driven industry fundamentally changes the risks to which low-income consumers are subjected. Whether or not the industry has previously provided "benefits" that may be "stranded" is not the issue. From an energy efficiency perspective, these fees are predicated on the observation that a move to a market-

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[1] Throughout this discussion, the term "energy efficiency" or "energy efficiency investment" is intended to incorporate investments in renewable energy as well.

driven industry places the energy efficiency industry at risk of being stymied by past market failures that have still not been remedied.

These fees further recognize that "restructuring" (with competition being increasingly relied upon to replace direct regulation) is coming not only to the electric industry but to the natural gas industry as well. A distribution fee tends to be placed on a broader range of fuel sources than the electric-only system benefits charge. It is intended to represent a device to preserve public programs that may not be recognized by a competitive market more than a means simply to continue the status quo. It is for this reason that the discussion below focuses not simply on what programs currently exist in Missouri, but rather on what the need is for: (1) residential energy efficiency investments generally, and (b) cost-effective affordability assistance.

THE NEED FOR A PUBLIC PURPOSE DISTRIBUTION FEE IN MISSOURI

Given this introduction, the analysis below turns its attention to a consideration of the need for a public purpose distribution fee in Missouri. The need for residential energy efficiency generally is considered first. The need for bill affordability assistance is considered next.

Residential Energy Efficiency Investments

A Missouri distribution fee should help fund investments in energy efficiency for residential consumers generally. Without such funding, the state loses substantial opportunities to contribute to cleaner air, a healthier economy, more affordable housing, and a host of other impacts that benefit all Missouri residents. A need exists for energy efficiency investments for both heating and non-heating residential energy.

The Need for Residential Energy Efficiency Investments

Investments in residential energy efficiency help deliver efficient end-uses to consumers. Energy efficiency recognizes the truism that Missouri households do not seek to consume energy. Instead, what they seek is to have light, hot water and space heating. If these end uses can be delivered using less energy, the needs of Missouri consumers will have been satisfied.

Residential Heating Consumption: It is difficult, if not impossible, to perform a complete inventory of energy inefficient homes in Missouri. To do so is not the purpose of this analysis. It *is* possible, however, to determine whether there is a significant, or an insignificant, number of homes that may even *potentially* benefit from the installation of energy efficiency improvements for home heating purposes. Surrogates for energy inefficiency are used, which include: (1) the age of the home; (2) the presence of physical problems with the home; and (3) the affordability of total shelter costs (which include the costs of all utilities except telephones). For purposes of analysis here, a non-low-income home involves any consumer living above 80 percent of median income as defined by the U.S. Department of Housing and Urban Development (HUD).

HUD data shows that roughly one-in-six Missouri units of housing that are affordable to households living above 80 percent of median income were constructed before 1940. Moreover, of the total of roughly 550,000 units affordable at that income level, nearly 90,000 have some type of "physical problem" under HUD's definitions. Finally, nearly 55,000 households living above 80% of median income pay more than 30 percent of their income for shelter costs; roughly 5,000 pay more than 50 percent. This data is set forth in Table 1 (pages 1 - 3 respectively).[12]

<u>Residential Non-Heating Consumption</u>: Focusing attention only on heating bills generally results in inadequate attention being devoted to the impacts of *electric* policy on residential consumers. This focus is misplaced. As shown in Table 2, electric *non*-heating consumption represents roughly 45 percent of residential usage and nearly 70 percent of residential bills. What happens to the price of electricity is thus important to residential consumers. An energy efficiency policy focused exclusively on home heating would address less than half of the energy dollars consumed in the state of Missouri.

<u>Solar Hot Water and Domestic Space Heating</u>: In addition to considering space heating and non-space heating separately, energy efficiency programs should consider the potential for investing in renewable energy for Missouri consumers. There is little question but that electricity is one of most expensive fuels to use for space heating and domestic hot water heating in the State of Missouri. According to 1995 Department of Energy (Energy Information Administration) data, the 1993 price of electricity in Missouri --the last year for which data is available-- was roughly $21.29/mmBtu. In contrast, the 1993 price for natural gas was $5.35/mmBtu and the price for LPG was $7.29/mmBtu.

Despite these relatively high prices, a substantial number of Missouri households use electricity for space and domestic hot water heating while a negligible number of consumers rely upon distributed technologies such as solar. On the one hand, as of the time of the 1990 Census, nearly one-in-five (18%) of all Missouri consumers use electricity for space heating. On the other hand, only three-hundredths of one percent (520) used solar energy for space heating.

Statewide figures are not available for fuel use for hot water. Regional data from the U.S. Department of Energy's *Residential Energy Consumption Survey* indicates that for the Census division of which Missouri is a part (West North Central), one-in-four (24.6%) of all households use electricity for their domestic hot water heating.

Without quantifying precisely how big the potential for increased penetrations of solar space and domestic water heating, it is possible to conclude that the market has barely been tapped. There is substantial potential for an expansion of distributed technologies in Missouri.

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[12] All Tables are set forth in Appendix A.

Advantages to Residential Energy Efficiency Investments

Funding residential energy efficiency investments in the State of Missouri will generate substantial benefits for all sectors of the state. In addition to generating environmental benefits such as cleaner air and water, energy efficiency will promote economic development, increase housing affordability, and reduce the risk of insurable events.

Well designed energy efficiency programs have been shown to produce substantial economic benefits for local and state economies. Electric and gas utilities are poor performers in terms of their ratios of: (1) in-state jobs to sales, and (2) sales to in-state income generation. By comparison, the industry that does most of the home energy efficiency work --the maintenance and repair construction industry-- has almost four times the jobs-to-sales ratio of the utility industry, and a 20 percent higher ratio of in-state income generation per dollar of sales. In addition, energy efficiency programs produce additional economic benefits in terms of jobs in proportion to the extent that they are designed to be cost effective.[3] It is not surprising that the *Missouri Statewide Energy Study* concluded that energy efficiency would "sustain more employment opportunities than either the continued current level of energy use or the development of new energy supplies."[4]

In addition to these economic impacts, state investment in energy efficiency tends to protect households against "insurable events." In August, 1996, Lawrence Berkeley Laboratory released findings showing that energy efficiency investments in housing often lead to the correction of conditions that place buildings at risk. Such conditions include fire, carbon monoxide poisoning, and the like.[5]

Finally, energy efficiency investments can promote the affordability of homeownership in Missouri. A study of how energy efficiency investments affect the affordability of first time home ownership[6] found that, in the Census Division of which Missouri is a part, a $3,000

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[3] Thus, for example, if an energy efficiency measure has a cost/benefit ratio of 1.10, it returns $110 of benefits for every $100 of expenditures. Additional economic activity and jobs will be associated not only with the $100 of expenditures, but with the $10 savings as well.

[4] *Missouri Statewide Energy Study -- Volume 1: Summary Report*, Environmental Improvement and Energy Resource Authority, Jefferson City, MO, 1992, page I-9.

[5] Evan Mills (1996). *Energy Efficiency: No-Regrets Climate Change Insurance for the Insurance Industry*, Lawrence Berkeley Laboratory: Berkeley, CA. Available at: http:\\eande.lbl.gov\CBS\reports.html. A review of the full complement of Lawrence Berkeley Laboratory, Center for Building Science, initiatives on *Energy Efficiency as an Insurance Loss-Prevention Strategy*, can be found at: http:\\eande.lbl.gov\CBS\Climate-Insurance\ci.html.

[6] Roger Colton (November 1996). *Energy Efficiency as a Credit Enhancement: Public Utilities and the Affordability of First-Time Homeownership*, Fisher, Sheehan and Colton, Public Finance and General Economics: Belmont, MA.

energy efficiency investment made at the time of home purchase, financed at nine percent interest, would yield an effective reduction in the price of the home of 6.0%,[17] and an effective interest rate discount of 0.48%.[18]

As can be concluded, there is a significant potential for investment in energy efficiency and renewable energy in Missouri. In addition, the benefits from making these investments are great.

THE NEED FOR COST-EFFECTIVE ENERGY AFFORDABILITY ASSISTANCE

A Missouri distribution fee seeking to provide cost-effective energy affordability assistance should seek to meet two needs: (1) the need for cash fuel assistance; and (2) the need for energy efficiency improvements. Both of these needs will be considered below.

The Need for Cash Fuel Assistance

Missouri has a significant number of low-income households, most of whom experience unaffordable home energy burdens. A home energy burden is the home energy bill as a percentage of income. In determining the need for fuel assistance, it is appropriate to look at low-income energy burdens. This is the approach now incorporated into the federal statute creating the Low-Income Home Energy Assistance Program (LIHEAP). That statute mandates that LIHEAP benefits be targeted to households who have the lowest incomes and the highest bills in relation to income taking into account household size. Moreover, in 1994, Congress described "highest home energy needs" as taking into consideration energy burdens and defined "energy burden" as "the expenditures of the household for home energy divided by the income of the household."

A consideration of home energy burdens should focus on *total* home energy bills for low-income households. While public policy traditionally has focused attention on home *heating* needs, this policy is too narrow. Instead, two aspects of home energy should be considered: (1) home heating on the one hand; and (2) home electric usage (including home cooling) on the other hand. National figures, as well as state-specific studies by FSC, find that while low-income heating *consumption* is greater than non-heating consumption, low-income heating *bills* represent

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17 For the average sales price of a home supported by the state's first time homebuyer program, in order to generate the same dollar savings as a $3,000 investment in energy efficiency, financed at nine percent interest, the original sales price of the home would need to be six percent lower.

18 In order to generate the same dollar savings as the energy efficiency investment, in other words, the interest rate charged on the home mortgage would need to be reduced by 0.48%.

a smaller percentage of total low-income energy bills.[9] Any determination of the need for cash assistance should take both heating and non-heating bills into account.

Home Heating Bills in Missouri

Winter home heating bills in Missouri impose unaffordable burdens on low-income households. Several populations will be used for purposes of demonstrating this conclusion: (a) households who receive LIHEAP benefits; (b) households who receive benefits through Aid to Families with Dependent Children (AFDC);[10] (c) households who receive Supplemental Security Income (SSI); and (d) households who receive Social Security (retired widows and widowers).[11]

As Table 3 demonstrates, each of these populations of households experiences a winter home heating burden --these figures do not include winter non-heat electric burdens-- which are beyond "affordable" levels. LIHEAP and AFDC recipients both experience winter home heating burdens of from 15 to 25 percent of income. Social Security recipients have burdens which are marginally lower.

These home heating burdens can be compared to the "shelter" burdens which the U.S. Department of Housing and Urban Development (HUD) has defined to be "affordable." According to HUD, if a household faces a *shelter* burden exceeding 30 percent of income, that household is over-extended. Shelter burdens include rent/mortgage payments plus all utility payments other than telephone.[12] A household that is paying 20 or 25 percent of its income simply toward home heating --again, not taking into account electricity as well-- will not be able to fall below this 30 percent limit.

The significance of the home heating burdens imposed on low-income households is even more apparent when one considers the full range of incomes at which low-income residents of Missouri live. Most households who qualify for LIHEAP in Missouri by living at or below 150 percent of Poverty live *below* the ceiling rather than *at* the ceiling. Table 4 sets forth the actual distribution of winter heating burdens for Missouri LIHEAP recipients. While it is a simple matter of arithmetic that energy burdens as a percentage of income will increase as dollar incomes decrease, the *magnitude* of the burden at the lower income levels is nonetheless

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[9] *See e.g.*, Roger Colton, Michael Sheehan, *et al.* (1995). ***An Assessment of Low-Income Energy Needs in Washington State***, Fisher, Sheehan & Colton, Public Finance and General Economics: Scappoose, OR; Roger Colton (1996). ***Home Energy Assistance Review and Reform in Colorado***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[10] AFDC is what most people think of as "welfare." Under recent Congressional welfare reforms, the program is now called TANF (Temporary Aid to Needy Families).

[11] Thus, not included in Social Security are disability recipients.

[12] Hence, for example, the utility payments would include home heating, electricity, water/sewer, and garbage and/or trash pick-up where appropriate.

stunning. As Table 4 shows, a household with an annual income of $0 to $2000 will have winter heating burdens[13] of nearly 85 percent; households living with annual incomes of $2000 to $4000 will have winter heating burdens of nearly 30 percent; and households living with annual incomes of $4000 to $6000 will have winter heating burdens of more than 16 percent.

The number of households with these extremely low levels of annual incomes (and thus high heating burdens) is not small. Table 5 shows that amongst the roughly 125,000 Missouri LIHEAP participants, more than 71,000 (roughly 60 percent) live with incomes of less than $6,000.

Non-Heating Home Energy Bills in Missouri

Non-heat electric bills can be just as unaffordable to low-income households as winter heating bills are. As Table 6 shows, non-heating electric bills (500 kWh/month) for Missouri's six largest electric companies impose burdens as a percentage of income ranging from 10 percent to 20 percent of income for public assistance recipients.[14]

The conclusions from this data are several fold *vis a vis* a distribution fee for Missouri. The need for cash fuel assistance is great in Missouri, both in terms of dollars and in terms of the number of households in need. Second, with many of these households, the need for cash assistance cannot be alleviated through reduced bills generated by improvements in energy efficiency. No matter how low the bills go for these households, they will be unaffordable. Third, given the income of these households, virtually *any* energy bill will impose unaffordable burdens. Fourth, the energy problems of these households are not household budgeting problems. There is, instead, an absolute mismatch between household resources and expenses. Finally, given the energy burdens facing low-income households, there will be an inevitable need for a crisis intervention fund to prevent the loss of service due to inability-to-pay.

The Need for Low-Income Energy Efficiency Assistance

In addition to the need for cash fuel assistance to be funded through a distribution fee, a significant number of low-income households in Missouri are in need of energy efficiency improvements. It is difficult, if not impossible, to quantify the precise number of low-income units in Missouri that are in need of energy efficiency improvements. Some rough estimates can

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[13] Remember, these do *not* include electric bills in addition to heating bills. Taking electric bills into account would drive burdens even higher.

[14] Again, according to HUD, if total shelter costs exceed 30 percent, a household is financially overextended.

be made, however. In 1995, there were roughly 450,000 low-income households in Missouri.[15] According to state Weatherization Assistance Program (WAP) officials, Missouri has weatherized roughly 31,000 homes from 1989 through 1997.[16] Due to decreased funding levels, however, the number of units per year has dropped in recent years. In fact, all weatherization production funded through non-DOE dollars was eliminated in Fiscal Year 1995. By Fiscal Year 1996, the number of low-income units weatherized each year in Missouri had dropped to only 40 percent of its 1989 level (2,593 / 6,040 = 42.9%).

Low-Income Units Weatherized in Missouri:
Total and DOE-Funded

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Total /a/	6,040	3,693	4,051	4,744	2,738	2,615	2,894	2,593	1,346
DOE	2,334	1,223	2,298	2,765	2,238	2,322	2,894	2,593	1,346 /b/

NOTES:

/a/ These totals do not include dollars that did not come through the state weatherization program.
/b/ Some quarterly data missing.

In addition to units weatherized through WAP, there will be some low-income households who live in homes that are newly constructed. Even though Missouri has no state building code, and state analysis of new construction has found substantial energy savings to be found in this new construction,[17] for ease of analysis here, these homes are excluded from the calculation of homes in need of weatherization. Assuming no unduplicated fully weatherized homes treated by utilities in that time, roughly 420,000 low-income housing units remain to be weatherized in Missouri.[18]

\15\ This is a calculated number. In 1990, there were roughly 435,000 households at or below 150% of the federal poverty level in Missouri. According to HUD, Missouri experiences roughly 20,000 new housing units per year authorized by building permits, of which approximately 15 percent (3,000/year) are likely to be inhabited by low-income households. There will be some duplicated households here, since some of the inhabitants of the new housing will come from the 435,000 existing low-income households. Nonetheless, a rough estimate equal to 435,000 + (3,000/year x 6 years) = 453,000 (rounded to 450,000) seems appropriate.

\16\ Due to changes in technology and program requirements, homes weatherized prior to 1988 are assumed to be in need of re-weatherization. Homes weatherized with funds that were not administered by the state weatherization program are not included in these figures.

\17\ Economic Research Associates. (December 1995). *A Reevaluation of Economic Opportunities through Missouri Building Codes and Energy Efficiency Improvements*, Missouri Division of Energy, Missouri Department of Natural Resources.

\18\ This is calculated as follows: 450,000 minus 31,000 weatherized homes. This yields roughly 420,000 units.

If WAP production levels continue at roughly 2,500 units per year, if no weatherized house ever needs to be re-weatherized,[19] and if no expansion in Missouri's low-income population occurs, these un-weatherized homes will all be treated with energy efficiency improvements by the year 2165, roughly 168 years. Clearly, an additional source of low-income energy efficiency funding is needed.

Age of Low-Income Housing Units in Missouri

Two additional ways exist to develop a surrogate for energy efficiency needs in low-income housing in Missouri. While, as mentioned above, no direct measurement exists of the number of energy *in*efficient low-income housing units in Missouri, some correlation can be drawn between energy inefficiency and the age of housing units. Table 7 sets out the number of Missouri households, at different levels of "being poor," distributed by the age of the housing units in which they live. As can be seen, while it is impossible to conclude with any specificity the actual *extent* of energy inefficiency, it *is* possible to see the potential that hundreds of thousands of low-income Missouri households live in old, and presumptively energy inefficient, housing units. Roughly 210,000 households living at or below 50 percent of median income live in housing that was constructed before 1940. Roughly 315,000 households living at or below 80 percent of median income live in housing that was constructed before 1940, more than 55 years ago.

Moreover, these figures do not refer to all housing units, but rather simply to housing units that are affordable (i.e., yield total shelter burdens at or below 30 percent of income) at those income levels.

Affordability of Housing Units

A different surrogate to be used to identify the need for energy efficiency improvements involves shelter burden. The starting point again is HUD's rule that a household which devotes in excess of 30 percent of income toward shelter costs is over-extended.[20] Table 8 presents the number of Missouri households who are called upon to pay either more than 30 percent of their income or more than 50 percent of their income toward their shelter costs. As this Table shows, more than 350,000 Missouri households living at or below 80 percent of median income pay more than 30 percent of their income, and nearly 160,000 households at those income levels pay more than 50 percent of their income toward their total shelter costs.

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[19] This is a clearly unreasonable assumption. Not only will technologies improve and the process of weatherization become more sophisticated, the existing weatherization measures will ultimately reach the end of their useful lives and need to be replaced as well.

[20] As discussed above, shelter costs include rent/mortgage payments plus all utilities except telephone service.

Given the discussion above as to home energy burdens, it is clear that home energy bills contribute to the lack of shelter affordability. A review of monthly Fair Market Rents (FMRs),[21] and the extent to which utility bills contribute to those monthly shelter costs, is set forth in Table 9.[22] This Table shows utility bills in relation to total shelter costs in the two major Missouri cities for which data is available. These bills represent roughly 35 to 40 percent of total shelter costs. In contrast, Fannie Mae[23] has reported that utility bills should represent no more than 20 percent of total shelter costs. To the extent that energy efficiency can reduce these bills, overall shelter affordability will improve.

Finally, Table 10 presents the number of Missouri units that are "affordable" but which have some type of physical problem associated with them. As can be seen, more than one-in-four affordable units for Missouri households at 0 - 30 percent of median income (26%), three-in-ten affordable units for Missouri households at 31 - 50 percent of median income (30%), and one-in-four affordable units for Missouri households at 51 - 80 percent of median income (23%) have some type of physical problem. If one engages in the assumption that households with "physical problems" are likely to have energy efficiency problems as well, the extent of the acute need for low-income energy efficiency improvements in Missouri is evident.

Again, these households do not refer to all housing units, but rather simply to housing units that are affordable (*i.e.*, yield total shelter burdens at or below 30 percent of income) at those income levels.

Utility Benefits from Low-Income Energy Efficiency

In addition to looking at energy efficiency from the household perspective, it is beneficial to examine the benefits of a low-income energy efficiency program from the perspective of energy service providers. Extensive research has found that low-income energy efficiency programs result in substantial non-energy savings to utilities. These non-energy savings include reductions in working capital expense, uncollectible accounts, credit and collection expenses, and the like.[24] The results of one of the most recent studies are summarized in Table 11. Table 11

\21\ FMRs concededly do not include mortgage payments. FMRs set by HUD are based on area rents at the 40th percentile.

\22\ Roger Colton (1994). ***The Role of Utility Costs in Setting Fair Market Rents For Section 8 Housing***, presented in, *Section 8 Housing Assistance Payments Program--Fair Market Rent (FMR) Schedules for Use in the Rental Certificate Programs, Loan Management and Property Disposition Programs, Moderate Rehabilitation Program and Rental Voucher Program*, HUD Docket No. N-94-3754 (October 1994) (presented on behalf of ten Legal Services Corporation offices) (looking at data from 100 cities in 38 states and the District of Columbia).

\23\ The Federal National Mortgage Association (FNMA).

\24\ Roger Colton (1995). ***Energy Efficiency and the Low-Income Consumer: Planning, Designing and Financing***, at Chapter 7, Fisher, Sheehan & Colton. Public Finance and General Economics: Belmont, MA (summarizing existing utility research examining non-energy benefits).

shows the results of the Pennsylvania Low-Income Usage Reduction Program (LIURP) for all Pennsylvania utilities. The Table presents pre-treatment and post-treatment payment patterns for the low-income households to whom energy efficiency was delivered. A payment of less than 100 percent means that the low-income household was not even paying the current month's utility bill. In contrast, a payment *exceeding* 100 percent means that the low-income household was not only paying the current bill, but was paying off its arrears as well.

As Table 11 shows, for every Pennsylvania utility but one, the delivery of energy efficiency substantially improves the payment patterns of the treated low-income households. Indeed, the general impact of the delivery of energy efficiency was a *substantial* increase in the payment coverage of the household energy bill. In most cases the low-income household moved from a situation where that customer was falling further and further behind by failing to pay the current bill to a situation where the household was paying the entire current bill and beginning to retire the arrears.

Summary

A distribution fee is necessary to fund two types of programs in Missouri. First, there is a need for residential energy efficiency initiatives, including distributed technologies. Not only will these energy efficiency investments reduce energy waste and help clean-up the environment, they will generate economic benefits and promote affordable homeownership as well. Second, there is a need to provide cost-effective energy affordability assistance. This assistance will include the provision of cash assistance as well as the provision of low-income energy efficiency investments.

THE COST OF A PUBLIC PURPOSE DISTRIBUTION FEE IN MISSOURI

Having documented the need for a "distribution fee" in Missouri, the next question to be addressed is the cost which creating such a charge would impose on Missouri ratepayers. Three different sets of assumptions are used in the Tables below. Tables 12 and 13 are based on the assumption that a "distribution fee" is imposed on end-use consumption involving electricity and natural gas. Table 14 is based on the assumption that a distribution fee is imposed only on end-use consumption involving electricity. Finally, Tables 15 and 16 are based on the assumption that a "distribution fee" is based on all fuels. In each of these three sets of assumptions, the impacts are assessed of levying a distribution fee: (1) on residential consumption alone, and (2) on residential, commercial and industrial consumption combined.

Overview of the Alternative Scenarios

Tables 12, 13, 15 and 16 below are each set forth in four parts. The four parts assume differing levels of funding. Tables 12 through 16 begin with a base case funding scenario of roughly $80 million. In addition to this base case scenario, alternative funding levels of $100, $120 million, and $160 million are considered. Table 14, the Table which includes the electric-only analysis, has a fifth part that examines a $40 million funding scenario. More particularly:

- o Table 12 assumes that an electric/natural gas distribution fee in Missouri is imposed only on residential ratepayers.

- o Table 13 assumes that, in the alternative, an electric/natural gas distribution fee in Missouri is imposed on all end-use consumption for industrial, commercial and residential customers.

- o Table 14 assumes that an electric-only distribution fee is imposed in Missouri. The Table considers a charge on residential consumption alone as well as a charge on all end-use electric consumption for industrial, commercial and residential customers.

- o Table 15 assumes that a distribution fee in Missouri is imposed on residential consumption for all fuels.

- o Table 16 assumes that a distribution fee in Missouri is imposed on all fuels for residential, commercial and industrial customers.

The Tables are intended to generate three pieces of data on a state-specific basis for Missouri: (a) the per unit of energy cost of a distribution fee of the specified amounts for each fuel type; (b) the *total* cost allocated to each fuel type arising out of a distribution fee of the specified amounts; and (c) the difference caused by allocating program costs only to residential versus allocating program costs to aggregate residential, commercial and industrial end-use.

The Basis of the Funding Levels

Four funding levels are considered in this analysis. A scenario based on 100 percent of the LIHEAP/WAP appropriation is used as the base case. Two specific program elements, however, are included in the distribution fee which makes reliance on this federal low-income assistance program inappropriate as the exclusive funding touchstone:

- o Non-low-income residential energy efficiency program are recommended to be funded through the distribution fee; and

- o Non-heating bill affordability assistance is recommended to be funded through the distribution fee.

To test the impacts of increasing dollars to fund these additional program components,[25] three additional scenarios were added. Because the ability to deliver energy efficiency is limited by

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\25\ In contrast, the electric-only analysis adds a fifth scenario to provide a basis for evaluating the impacts should the assistance provided through an electric-only distribution fee be scaled back to reflect a decision to limit the use of the funds only to electric energy efficiency measures or electric bill affordability assistance.

the capacity of the existing network of weatherization service providers, it was deemed appropriate to use multipliers of the LIHEAP/WAP appropriation as the means to test the rate impact of different levels of a distribution fee.[26] The use of LIHEAP/WAP as the basis from which to make funding estimates should not detract from the observation that, as explained in detail above, the wires charge revenue considered in this report is to be used for the following three purposes:

- o Residential energy efficiency generally, including renewable energy strategies;
- o Cost-effective bill affordability programs, including efforts directed toward both heating and non-heating bill components; and
- o Low-income energy efficiency.

Methodology

The methodology employed in Tables 12 through 16 begins by estimating the funds desired to be generated through the distribution fee. The estimates flow from employing the LIHEAP/WAP multiplier described above.[27]

The funds estimated through these various scenarios are then distributed via an allocator. In the scenario where the funds are distributed solely to the residential class, the funds are divided by the total number of mmBtu consumed by the residential customer class in Missouri to derive a cost per Btu. That cost per Btu is then multiplied by the Btu's per unit of fuel to derive a per unit of fuel cost (*e.g.*, cost per MCF, cost per kWh). The cost per Btu is further multiplied by the number of Btu consumed within each fuel class at the end-use level to determine the total dollars to be derived from each fuel source. The effect of this methodology is to assign a responsibility to each fuel source equal to the proportion of end use residential energy supplied by that fuel source on a per Btu basis.

The same process is used for the section that distributes the cost over all residential, commercial and industrial end-use consumption. The total dollars desired are divided by the total end use consumption from those three customer classes. The per Btu cost is then multiplied by the number of Btu in each type of fuel unit to derive a per unit of fuel cost, and multiplied by the

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[26] Given the spread between the high and low dollar figure studied, clearly no funding *recommendation* is being made by this report. Instead, the purpose of the report is to consider the rate impacts assuming different levels of funding. The purpose is present illustrations of potential high, low and intermediate funding levels.

[27] The 1986 LIHEAP appropriations was the highest appropriation for the nation as a whole. In 1986, Missouri received $89,335,293 in LIHEAP funds. U.S. Department of Health and Human Services, ***Low Income Home Energy Assistance Program, Report to Congress for Fiscal Year 1986***, at Table C-4, page 67 (July 1987). The highest Missouri WAP appropriation occurred in 1996, when Missouri received $5.778 million. (Correspondence, Missouri Department of Natural Resources to FSC).

total number of Btu consumed at the end use level to derive the total contribution which each fuel type would make to the bottom line. This results in an allocation based not on the proportion of end use fuel type within only the residential class, but by the proportion of end use fuel type within all customer classes combined.

The $80 million scenario is set forth in Tables 12A, 13A, 14A, 15A and 16A; the $100 million scenario is set forth in Tables 12B, 13B, 14B, 15B and 16B; the $120 million scenario is set forth in Tables 12C, 13C, 14C, 15C and 16C; and the $160 million scenario is set forth in Tables 12D, 13D, 14D, 15D and 16D. Table 14E reflects the electric-only $40 million scenario.[28]

Results

Allocating Costs Only to Residential Natural Gas and Electric Customers

A distribution fee designed to generate $80 million[29] imposed only on the residential natural gas and electric customer class would result in a price increase of the following for natural gas and electric users in Missouri:

- o roughly 3.9 cents per CCF for natural gas users. Assuming a consumption of roughly 1,100 CCF per year, this results in an annual bill increase of roughly $43, or about $3.60 per month.

- o roughly 13.2 one-hundredths of a cent per kWh for electricity users. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of $12, or about 98 cents per month.

In contrast, a distribution fee designed to generate $160 million[30] imposed only on the residential class would result in a price increase of the following for natural gas and electricity in Missouri:

- o roughly 7.8 cents per CCF for natural gas users. Again, assuming an annual consumption of roughly 1,100 CCF, this results in an annual bill increase of roughly $86, or about $7.10 per month.

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[28] There is no corresponding Table E in other sets of Tables.

[29] For all of the reasons outlined in the text above, the $80 million is calculated as 100 percent of the highest historical LIHEAP/WAP appropriations in Missouri (1997S).

[30] For all of the reasons outlined in the text above, the $160 million is calculated as 200 percent of the highest historical LIHEAP/WAP appropriations in Missouri (1997S).

o roughly 2.6 tenths of a cent per kWh for electricity. Again, assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about $23.40, or roughly $1.95 a month.

Clearly, the costs of generating $100 and $120 million[31] from the residential class alone fall somewhere in between. The precise costs for these two scenarios are set forth in Tables 12B and 12C respectively.

Allocating Costs to Residential, Commercial and Industrial Natural Gas and Electric Customers

A distribution fee designed to generate $80 million imposed on the combined residential, commercial and industrial customer base would result in a price increase of the following for natural gas and electric residential fuel users in Missouri:

o roughly 1.7 cents per CCF for natural gas users. Assuming a consumption of roughly 1,100 CCF per year, this results in an annual bill increase of roughly $19, or about $1.60 per month for the average residential consumer.

o roughly 5.8 one-hundredths of a cent per kWh for electricity users. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of $4.50, or about 38 cents per month for the average residential customer.

In contrast, a distribution fee designed to generate $160 million imposed on the combined residential, industrial and commercial classes would result in a price increase of the following for residential natural gas and electricity users in Missouri:

o roughly 3.4 cents per CCF for natural gas users. Assuming an annual consumption of roughly 1,100 CCF, this results in an annual bill increase of roughly $38, or about $3.15 per month for the average residential customer.

o roughly 11.7 hundredths of a cent per kWh for electricity. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about $9.90, or just over 80 cents a month for the average residential consumer.

Clearly, the costs of generating $100 and $120 million from the combined residential, commercial and industrial classes fall somewhere in between. The precise costs for these latter two scenarios are set forth in Tables 13B and 13C respectively.

\31\ These are the 125% and 150% scenarios respectively.

Allocating Costs only to Electric Consumption

A distribution fee designed to generate $80 million imposed only on electric consumption would result in a price increase of the following for residential electric users in Missouri:

- o roughly 1.3 tenths of one cent per kWh if spread over all electric classes (residential, commercial, industrial). Assuming an annual consumption of roughly 9000 kWh, this results in an annual bill increase of roughly $11.70, or about 98 cents per month.

- o roughly 3.3 tenths of a cent per kWh if spread over only residential consumption. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of $29.70 or about $2.50 per month.

In contrast, a distribution fee designed to generate $160 million imposed only on electric consumption would result in a price increase of the following for residential electric users in Missouri:

- o roughly 2.7 tenths of one cent per kWh if spread over all electric classes (residential, commercial, industrial). Assuming an annual consumption of roughly 9000 kWh, this results in an annual bill increase of roughly $23.40, or about $1.95 per month.

- o roughly 6.6 tenths of a cent per kWh for electricity. Again, assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about $59.40, or roughly $4.95 a month.

Clearly, the costs of generating $100 and $120 million from electricity consumption alone fall somewhere in between. The precise costs for these two scenarios are set forth in Tables 14B and 14C respectively.

In addition, this analysis examines the impact of generating only $40 million. A distribution fee designed to generate $40 million imposed only on electric consumption would result in a price increase of the following for residential electric users in Missouri:

- o roughly 6.7 one-hundredths of one cent per kWh if spread over all electric classes (residential, commercial, industrial). Assuming a consumption of roughly 9000 kWh per year, this results in an annual bill increase of roughly $5.40, or about 45 cents per month.

- o roughly 17 one-hundredths of a cent per kWh if spread over only residential consumption. Again, assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about $14.40, of roughly $1.20 a month.

This analysis is set forth in Table 14E. This Table considers costs for a residential only scenario as well as for a scenario involving combined residential, industrial and commercial consumption.

Allocating Costs Only to Residential Customers: All Fuels

A distribution fee designed to generate $80 million imposed only on the residential customer class (all fuels) would result in a price increase of the following for natural gas and electric users in Missouri:

- o roughly 3.5 cents per CCF for natural gas users. Assuming a consumption of roughly 1,100 CCF per year, this results in an annual bill increase of roughly $38.50, or about $2.30 per month.

- o roughly 11 one-hundredths of a cent per kWh for electricity users. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of $9.90, or about 85 cents per month.

In contrast, a distribution fee designed to generate $160 million imposed only on the residential class (all fuels) would result in a price increase of the following for natural gas and electricity in Missouri:

- o roughly 7.0 cents per CCF for natural gas users. Again, assuming an annual consumption of roughly 1,100 CCF, this results in an annual bill increase of roughly $77, or about $6.40 per month.

- o roughly 24 one-hundredths of a cent per kWh for electricity. Again, assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about $20.70, or roughly $1.75 a month.

Clearly, the costs of generating $100 and $120 million from the residential class alone fall somewhere in between. The precise costs for these two scenarios are set forth in Tables 15B and 15C respectively.

Allocating Costs to Residential, Commercial and Industrial Customers: All Fuels

A distribution fee designed to generate $80 million imposed on the combined residential, commercial and industrial customer base (all fuels) would result in a price increase of the following for natural gas and electric residential fuel users in Missouri:[32]

\32\ Price impacts for bulk fuels are set forth in the corresponding Tables below.

- roughly 1.5 cents per CCF for natural gas users. Assuming a consumption of roughly 1,100 CCF per year, this results in an annual bill increase of roughly \$16.60 or about \$1.40 per month for the average residential consumer.

- roughly 5.1 one-hundredths of a cent per kWh for electricity users. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of \$4.50, or about 40 cents per month for the average residential customer.

In contrast, a distribution fee designed to generate \$160 million imposed on the combined residential, industrial and commercial classes would result in a price increase of the following for residential natural gas and electricity users in Missouri:

- roughly 3.0 cents per CCF for natural gas users. Assuming an annual consumption of roughly 1,100 CCF, this results in an annual bill increase of roughly \$33, or about \$2.80 per month for the average residential customer.

- roughly one tenth of a cent per kWh for electricity. Assuming a consumption of 9,000 kWh per year, this results in an annual bill increase of about \$9.00, or roughly 75 cents a month for the average residential consumer.

Clearly, the costs of generating \$100 and \$120 million from the combined residential, commercial and industrial classes fall somewhere in between. The precise costs for these latter two scenarios are set forth in Tables 16B and 16C respectively.

A Proposed Structure for a Missouri Distribution Fee

A proposed structure for a Missouri distribution fee should address four issues:

(1) What benefits should the distribution fee pay for;

(2) Who should bear the cost of the distribution fee;

(3) What should the value of the distribution fee be; and

(4) How can the distribution fee be made immune to bypass.

What Initiatives Should the Distribution Fee Pay For

For all of the reasons discussed in the first section of this paper, a distribution fee should be developed to pay for residential energy efficiency as well as cost-effective bill affordability programs. Residential energy efficiency should include renewable energy strategies. Cost-effective bill affordability measures should include: (a) low-income basic cash fuel assistance; (b) low-income crisis intervention assistance; and (c) low-income energy efficiency programs.

Energy efficiency programs should include not only direct investment programs involving partnerships with local Community Action Agencies (or other WAP sub-grantees),[33] they should include innovative partnerships involving housing,[34] financial institutions,[35] community development financial institutions,[36] and other public and private housing programs.[37]

Deciding on the Level of Distribution Fee Revenues

The value of the distribution fee to be collected should be based on the total amount of funds desired by the state. The cost per Btu, and thus the per unit of energy charge, should flow from this broader decision. Hence, for example, the state should decide whether it wishes to generate funding at the $80, $100, $120, or $160 million levels, rather than deciding whether to increase rates by 0.5%, 1.0%, 1.5% or some other factor. One difficulty with increasing rates by a uniform percentage is the inherent unfairness of the distribution of the levy. As shown by the Tables discussed above, a one percent increase in natural gas rates is not equal in burden to a one percent increase in electric rates on a per unit of energy basis. Moreover, it seems most reasonable to decide what end result is desired before addressing the mechanism (*i.e.*, the per unit of energy charge) to be used to achieve that result. This is not to say, of course, that the final dollar figure desired should not always be tempered by the impact which such fundraising has on rates. It is merely to state that the state should have an end-in-view as to total dollars desired before beginning the cost allocation process.

The value of a state's distribution fee depends upon several underlying decisions. The first issue was addressed above. The distribution fee should be sufficient to generate funds for residential energy efficiency generally (including distributed technologies) as well as cost-effective bill

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[33] *See e.g.*, Roger Colton (1994). ***Energy Efficiency and the Low-Income Consumer: Planning, Designing and Financing***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA; Roger Colton (1994). ***Securitizing Utility Avoided Costs: Creating an Energy Efficiency "Product" for Private Investment in WAP***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[34] *See e.g.*, Roger Colton (1995). ***Funding Minority and Low-Income Energy Efficiency Programs in a Competitive Electric Industry***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[35] *See e.g.*, Roger Colton (1995). ***Energy Efficiency as a Credit Enhancement: Public Utilities and the Affordability of First-Time Homeownership***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[36] *See e.g.*, Roger Colton and M.Sheehan (1994). ***"Linked Deposits" as a Utility Investment in Energy Efficiency for Low-Income Housing***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

[37] *See e.g.*, Roger Colton (1996). ***Changing Paradigms for Delivering Energy Efficiency to the Low-Income Consumer by Competitive Utilities: The Need for a Shelter-Based Approach***, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA.

affordability programs. Both initiatives should be directed toward heating and non-heating energy use.

The Level of Energy Efficiency Revenues

The energy efficiency program funded through a distribution fee should involve both adequate scope and funding. Adequate "scope" of the energy efficiency program means that the state should seek to serve a wide-range of constituencies. Adequate "funding" means that the energy efficiency budget should increase until the program exhausts the available cost-effective measures, or until it exhausts the institutional capacity to deliver cost-effective measures, whichever comes first.

Determining the funding of energy efficiency programs (including solar investments) presents somewhat of a problem. While, in theory, a program should continue to fund energy efficiency measures until the marginal costs of those measures equal the marginal benefits, in reality, no such "full" funding is ever provided. In light of this, there seems to be no principled basis upon which to set an energy efficiency budget. Why should the State of Missouri, in other words, spend $8.0 million a year and not $9.0 million? Why should the State serve 5,000 households rather than 6,000 households?

One principle does seem appropriate to guide energy efficiency funding decisions. The extent of energy efficiency funding should be sufficient to ensure that there are no lost opportunities in any given year. Lost opportunities arise when the accomplishment of some given task precludes the future accomplishment of additional work at that same dwelling. Some of the lost opportunities involved with existing programs include:

> **<u>WAP weatherization</u>:** To the extent that WAP invests $1,800 in a home that has the potential for $3,000 of cost-effective conservation, there is a lost opportunity. It is highly unlikely that the home will be revisited to subsequently "finish" the remaining $1,200 of conservation improvements. Moreover, federal regulations generally prohibit WAP from retrofitting a home in which WAP dollars have previously been invested.
>
> **<u>Housing developments</u>:** Decisions made by housing developers represent decisions that will hold for the useful life of the measures. Accordingly, if a developer installs a relatively inefficient furnace or hot water heater, or fails to install the most cost-effective level of insulation, it is not likely that the state or a utility will soon revisit that home to install more energy efficient measures. The opportunity to install high efficiency measures is lost at the time of the developer's initial decision.
>
> **<u>Unused institutional capacity</u>:** Assume the institutional capacity of energy efficiency service providers is 8,000 homes per year in Missouri. These service providers might include local contractors, CAAs, CDCs and other profit or non-profit institutions. If the combined budget of energy efficiency programs funds only 6,000 homes a year, there is a lost opportunity to increase the energy efficiency in 2,000 homes. By assumption,

the maximum capacity is 8,000 homes per year. That capacity thus cannot be pushed to 10,000 for a year to "make-up" the earlier lost opportunity.

The institutional capacity for delivering energy efficiency, of course, should include the capacity of the state's utilities in addition to the private non-utility contractors.

As can be seen, one component of an energy efficiency program funded through a distribution fee is a periodic inventory of the institutional capacity to deliver energy efficiency measures. The inventory should cover the planning period of the entity administering the distribution fee funds. If that entity develops three year energy efficiency plans, in other words, its inventory should include the existing and projected capacity to deliver energy efficiency services over that three year period. The budget for energy efficiency should thus be sufficient to fund full utilization of the inventoried capacity.[138]

In sum, the upper limit on the budget for delivering energy efficiency measures through a Missouri distribution fee should be the point at which the marginal costs of such measures equal the marginal benefits. In reality, however, energy efficiency programs rarely, if ever, spend to the margin. A substitute principle thus needs to be developed as a decision rule for the extent of energy efficiency funding. The proposed decision rule is that funding through the distribution fee[139] should be of sufficient magnitude to ensure that there is no unused institutional capacity to deliver cost-effective energy efficiency services.

The Level of Bill Affordability Revenues

The amount of money needed to provide cost-effective bill affordability assistance should consider the need for basic cash fuel assistance grants, as well as crisis intervention. The necessary level of revenue depends upon four factors:

- o **Defining the "energy bill" to be covered:** For all of the reasons outlined in the first section of this paper, a distribution fee should address both heating and non-heating components of low-income bills. This focus supplants and replaces the current focus on heating bills with a new focus on total home energy bills (excluding transportation).

- o **Defining "low-income"**: The state must next define what it means by "low-income." Historically, the cap for LIHEAP participation has been established by federal statute as being either 150 percent of the federal Poverty Level *or* 60 percent of median income, at the state's discretion. In contrast, most HUD

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[138] The entity which administers the distribution fee then needs to make commitments to fully fund the institutional capacity over an announced time frame. This type of commitment is necessary for energy efficiency service providers to plan and develop their own capacity.

[139] Combined with WAP and other sources of revenues.

programs define "low-income" as extending up to 80 percent of median income. Table 17 below presents statewide figures on how this decision affects the number of families[40] deemed to be "low-income" in Missouri. Based on the historical inadequacy of 150 percent of Poverty as an indicator of inability-to-pay,[41] the definition of "low-income" should be set at 200 percent of the federal Poverty Level.

- **Making assumptions as to participation levels:** The third factor that affects a determination of how much money to raise through a distribution fee involves the participation rate from amongst the eligible population. Nationwide, LIHEAP participation rates range from roughly 20 percent to roughly 40 percent of the eligible population. An assumed participation rate of 30 to 35 percent in low-income fuel assistance programs funded through a Missouri distribution fee would not be unreasonable.

- **Targeting assistance:** The final factor that affects how much money to raise through a distribution fee in Missouri involves the decision rule for targeting assistance. The most commonly used benchmark is to establish lowering low-income energy burdens (*i.e.*, energy bills as a percent of income) to the total population average as the "ideal." This goal, however, often involves expenditures beyond a magnitude that would be politically acceptable. Lowering total energy burdens to a range of 10 - 12 percent allows for reasonable success in making payments by low-income households while staying within reasonable budgetary constraints.[42]

As part of the decision on how much money to raise through a distribution fee, it would be appropriate, also, to establish a cap on administrative expenses for both the fuel assistance and energy efficiency components of the program. A cap based on existing LIHEAP statutory restrictions (10 percent) is not unreasonable.

\40\ "Families" and "households" are not synonymous.

\41\ While not having space to document the discussions in the literature, it should be noted that 150 percent of Poverty does not reach many of the "working poor" who do not qualify for public assistance, but who nonetheless lack the financial ability to pay ongoing household expenses. In addition, many Social Security recipients also fall over (not far over, but nevertheless over) the 150 percent of Poverty Level ceiling.

\42\ It would be reasonable, also, to vary the target energy burden by household size. Ten percent of income is more important to a household with eight persons than it is to a household with two persons. Thus, a matrix that sets the payment level for households at or below 50% of Poverty at 5%, for households at 50 - 99% of Poverty at 7%, and for households at 100% or more of Poverty at 9%, may well be reasonable.

How to Make the Distribution Fee Immune to Bypass

The recommendation inherent in this analysis is that a distribution fee be imposed "at the meter." This recommendation stands in contrast to some recommendations that propose to impose the distribution fee at the provider level. The primary goal of such proposals, it appears, is to try to force responsibility for some portion of the distribution fee back on the shareholders, as competitive energy providers choose not to pass on the charge in retail rates. That goal, standing alone, represents an insufficient reason to impose a distribution fee at the provider level.

Moreover, full responsibility for a distribution fee should not be subject to bypass, in whole or in part, by a customer switching fuels. For this reason, the distribution fee should not be imposed on a flat percentage of revenue (or a flat per unit of energy charge) basis. As the Tables discussed above show, imposing the distribution fee on a per Btu basis is not only "equitable" in that it assigns cost responsibility based on the proportion of fuel consumed, it creates the situation where a customer switching from one fuel to another does not change the proportionate responsibility he or she bears as a user of that fuel.

Proposals for a flat per customer charge are somewhat summarily rejected. Under such a scheme, each unit in a 50-unit multi-family building that is individually metered (50 customers) would pay the same distribution fee as the entire 50-unit building which is master-metered (one customer). There is little equity in such a proposal.

How to Make the Distribution Fee Competitively Neutral

The proposed distribution fee for Missouri is competitively neutral. In this sense, the term "competitively neutral" means that the imposition of the distribution fee does not change the competitive position of fuels that would otherwise exist in the absence of such a charge. This competitive neutrality is enforced by imposing the distribution fee on a per Btu basis. As a result, there is no greater or lesser incentive to purchase one fuel rather than another because of the distribution fee. Nor is there any incentive to purchase from one supplier rather than another (within the same fuel type) as a result of the distribution fee.

Creation of a State Leveraging Incentive Fund

As part of the process of establishing a distribution fee, the state legislature should create and fund a state leveraging incentive fund akin to the LIHEAP leveraging incentive fund created at the national level. This incentive fund would encourage local communities to bring local resources to bear on energy efficiency and energy affordability issues. Whether through energy efficiency programs through volunteer house repairs,[43] crisis assistance initiatives such as

[43] The "Florida Fix" program coordinated and promoted by the Florida Housing Coalition (Tallahassee) is an excellent example of such a volunteer partnership. Florida Fix involves local groups of volunteers working to repair low-income housing.

utility fuel funds, or some other mechanisms), the state should commit to encouraging (and rewarding) local initiatives.[44]

SUMMARY AND CONCLUSIONS

For all of the reasons outlined in this paper, a distribution fee is a necessary and appropriate public policy in Missouri. A summary of the various decisions that might comprise the design of a Missouri distribution fee is set forth in Appendix C below.

\44\ A broad ranging discussion of state and local fundraising initiatives can be found at Roger Colton (1996). *Funding Fuel Assistance: State and Local Strategies to Help Pay Low-Income Home Energy Bills*, Fisher, Sheehan & Colton, Public Finance and General Economics: Belmont, MA. A listing of the programs described in that publication is attached as Appendix B.

TABLE 1 (PAGE 1 OF 3) UNITS OF HOUSING AFFORDABLE AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME (HAMFI) BY YEAR OF CONSTRUCTION			
Year of Construction	81%+ Median Income		
	Renter	Owner	Total
Before 1940	24,157	65,411	89,568
1940 - 1949	1,578	24,910	26,488
1950 - 1959	2,574	54,978	57,552
1960 - 1979	13,483	224,640	238,123
1980 - 1990	12,560	137,638	150,198
SOURCE: CHAS Data Base: HUD: 1990.			

TABLE 1 (PAGE 2 OF 3)
MISSOURI HOUSING AFFORDABILITY AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME

Income Range	*Housing Burden > 30%*			Housing Burden > 50%		
	Renter	Owner	Total	Renter	Owner	Total
81 - 95% HAMFI	3,550	14,378	17,928	268	1,765	2,033
95% + HAMFI	2,673	33,741	36,414	174	2,996	3,170

Source: CHAS Data Base: HUD: 1990.

TABLE 1 (PAGE 3 OF 3)
UNITS OF HOUSING AFFORDABLE AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME
WITH PHYSICAL PROBLEMS

	81%+ HAMFI		
	Renter	Owner	Total
Total Units	34,352	507,397	541,749
Units With Physical Problems	15,962	73,682	89,644

Source: CHAS Data Base: HUD: 1990

TABLE 2
HEATING USAGE AS PERCENT OF TOTAL HOME ENERGY USAGE AND
HEATING BILLS AS PERCENTAGE OF TOTAL HOME ENERGY BILLS
NATIONAL DATA

	Usage (mmBtu)			Bills ($$$)		
	Total	Heating	Percent	Total	Heating	Percent
All Households	103.9	56.5	54.4%	$1,255	$406	32.4%
Low-Income Households	90.9	50.6	55.7%	$1,062	$364	34.3%
LIHEAP Recipients	98.7	59.9	60.7%	$1,067	$412	38.6%

SOURCE:

Low-Income Home Energy Assistance Program Report to Congress for FY 1993, at 17 and 20 (Oct. 1994).

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TABLE 3
AVERAGE WINTER NATURAL GAS HEATING BURDENS
VARIOUS MISSOURI LOW-INCOME POPULATIONS

	Average Winter Income	Average Winter Gas Bill	Bill as Income Percent
LIHEAP Recipients	$1,537	$210.94	13.7%
AFDC Recipients	$ 826	$210.94	24.1%
SSI Recipients	$1,221	$210.94	17.3%
Social Security:	$1,767	$210.94	11.9%

SOURCE:

R.Colton and M.Sheehan (1995). ***On the Brink of Disaster: A State-by-State Analysis of Natural Gas Winter Home Heating Bills***.

Appendix A:
Missouri Distribution fee Data and Tables

Table 4
Winter Gas Bill As Percentage of Income:
LIHEAP Recipients By Income Range

	AVERAGE WINTER NATURAL GAS BILL	INCOME $0-1,999	INCOME $2-3,999	INCOME $4-5,999	INCOME $6-7,999	INCOME $8-9,999	INCOME $10-11,999	INCOME $12-14,999	INCOME $15,000+
Missouri	$210.94	84.4%	28.1%	16.9%	12.1%	9.4%	7.7%	6.3%	5.6%

SOURCE:

R.Colton and M.Sheehan (1995). ***On the Brink of Disaster: A State-by-State Analysis of Natural Gas Winter Home Heating Bills.***

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TABLE 5
NUMBER OF LIHEAP RECIPIENTS BY INCOME RANGE

	TOTAL STATE LIHEAP RECIPIENTS	INCOME $0-1,999	INCOME $2-3,999	INCOME $4-5,999	INCOME $6,-7,999	INCOME $8-9,999	INCOME $10-11,999	INCOME $12-14,999	INCOME $15,000+
Missouri	124,360	8,083	19,276	43,899	24,375	14,674	7,213	4,874	1,990

SOURCE:

R Colton and M.Sheehan (1995). ***On the Brink of Disaster: A State-by-State Analysis of Natural Gas Winter Home Heating Bills.***

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TABLE 6
UTILITY-BY-UTILITY NON-HEATING ELECTRIC BILL (500 KWH)
AS PERCENT OF INCOME, PUBLIC ASSISTANCE RECIPIENTS

State	Utility	Largest City Served	Typical Non-Htg Electric Bill (500 kWh)	Avg Public Assistance Income	Avg Non-Htg Electric Bill as Pct of Income	No. of Public Assistance HHs in Largest Community
Missouri	Citizens Electric Corp.	Perryville	$143.46	$703	20.4%	188
	Empire District Electric	Joplin	$105.60	$808	13.1%	1,812
	Kansas City Power and Light	Kansas City	$148.53	$824	18.0%	13,931
	Missouri Public Service	Raytown	$137.50	$1,434	9.6%	441
	St. Joseph Light & Power	St. Joseph	$102.93	$804	12.8%	2,286
	Union Electric	St. Louis	$151.47	$856	17.7%	22,417

SOURCE:

R.Colton, *The Other Part of the Year: Low-Income Households and their Need for Cooling, A State-by-State Analysis of Low-Income Summer Electric Bills* (1995).

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 7
UNITS OF HOUSING AFFORDABLE AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME (HAMFI)
BY YEAR OF CONSTRUCTION

Year of Construction	0 - 30% Median Income			31 - 50% Median Income			51 - 80% Median Income		
	Renter	Owner	Total	Renter	Owner	Total	Renter	Owner	Total
Before 1940	28,803	55,378	84,181	55,662	67,488	123,150	37,384	70,482	107,866
1940 - 1949	9,617	16,453	26,070	22,523	31,702	54,225	18,759	39,198	57,957
1950 - 1959	13,372	18,205	31,577	27,274	48,221	75,495	29,391	93,814	123,205
1960 - 1979	45,276	63,937	109,213	75,564	61,245	136,809	1-5,580	179,985	164,405
1980 - 1990	18,921	28,416	47,337	27,185	18,142	45,327	62,760	48,311	111,071

Source: CHAS Data Base: HUD: 1990

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TABLE 8
MISSOURI HOUSING AFFORDABILITY AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME

Income Range	Housing Burden > 30%			Housing Burden > 50%		
	Renter	Owner	Total	Renter	Owner	Total
0 - 30% HAMFI	101,021	63,640	164,661	76,075	38,030	114,105
31 - 50% HAMFI	65,458	41,996	107,454	16,624	14,301	30,925
51 - 80% HAMFI	34,883	44,501	79,384	2,410	8,093	10,503

Source: CHAS Data Base: HUD: 1990

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 9
CONTRIBUTION OF UTILITY COSTS TO TOTAL SHELTER COSTS: SELECTED MISSOURI CITIES

State	City	FMR /a/	Monthly Winter Utility Bills for Selected Missouri Cities			Monthly Winter Utility Bill /b/	Percent of FMR Devoted to Utilities
			Natural Gas	Electricity	Water/Sewer		
Missouri	Kansas City	$489	$79	$60	$24	$163	33%
Missouri	St. Louis	$476	$98	$50	$26	$174	37%

SOURCE:

R.Colton (1994). ***The Role of Utility Costs in Setting Fair Market Rents For Section 8 Housing***, presented in, *Section 8 Housing Assistance Payments Program--Fair Market Rent (FMR) Schedules for Use in the Rental Certificate Programs, Loan Management and Property Disposition Programs, Moderate Rehabilitation Program and Rental Voucher Program*, HUD Docket No. N-94-3754.

NOTES:

/a/ Fair Market Rents (FMRs) include contract rent plus all utilities. Determined and published by HUD on annual basis.
/b/ May have minor differences from sum of individual columns due to rounding.

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 10
UNITS OF HOUSING AFFORDABLE AT DIFFERENT LEVELS OF HUD-ADJUSTED MEDIAN FAMILY INCOME
WITH PHYSICAL PROBLEMS

	0 - 30% HAMFI			31 - 50% HAMFI			51 - 80% HAMFI		
	Renter	Owner	Total	Renter	Owner	Total	Renter	Owner	Total
Total Units	116,069	182,757	298,826	208,208	226,769	434,977	253,844	431,810	685,654
Units With Physical Problems	31,837	44,957	76,794	88,918	42,683	131,601	97,868	62,084	159,952

Source: CHAS Data Base: HUD: 1990

TABLE 11 BILL PAYMENT IMPACT FOR CUSTOMERS WITH ARREARAGES: LIURP: PENNSYLVANIA						
	Heating Jobs		Water Heating Jobs		Baseload Jobs	
1992 LIURP	Percent of Bill Paid Pre-Period	Percent of Bill Paid Post-Period	Percent of Bill Paid Pre-Period	Percent of Bill Paid Post-Period	Percent of Bill Paid Pre-Period	Percent of Bill Paid Post-Period
Duquesne	Not Applicable		91%	100%	78%	106%
Met Ed	78%	107%	79%	107%		
Pennelec	92%	95%	96%	99%		
Penn Power	Not Applicable		95%	93%		
PP&L	51%	95%	55%	105%		
PECO Electric	74%	118%	78%	109%		
UGI Electric	95%	105%	Not Applicable			
West Penn	126%	102%	129%	106%		
Columbia Gas	69%	133%				
Equitable	Not Applicable					
NFG	96%	125%				
PECO Gas	68%	133%				
PG&W	96%	106%				
Peoples	99%	106%				
T.W. Phillips	Not Available					
UGI Gas	89%	115%				
SOURCE: Pennsylvania PUC Evaluation of 1992 LIURP Program Results (1995).						

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 12A
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $80 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$47,829,385	$31,847,465	$79,676,850
Price per Fuel Unit /a/	$0.38886	$0.00132	
Average Annual Residential Bill Impact /b/	$42.77	$11.70	
Average Monthly Residential Bill Impact	$3.56	$0.98	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 12B
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $100 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$59,786,731	$39,809,332	$99,596,063
Price per Fuel Unit /a/	$0.48607	$0.00165	
Average Annual Residential Bill Impact /b/	$53.46	$14.40	
Average Monthly Residential Bill Impact	$4.46	$1.20	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 12C
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $120 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$71,744,077	$47,771,198	$119,515,275
Price per Fuel Unit /a/	$0.58329	$0.00199	
Average Annual Residential Bill Impact /b/	$64.15	$17.10	
Average Monthly Residential Bill Impact	$5.35	$1.43	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

Appendix A:
Missouri Distribution Fee Data and Tables

Table 12D
Charge Needed on Missouri Residential Consumption
To Generate $160 Million

	Natural Gas	Electricity	Total
Total Dollars	$95,658,769	$63,694,931	$159,353,700
Price per Fuel Unit /a/	$0.77771	$0.00265	
Average Annual Residential Bill Impact /b/	$85.55	$23.40	
Average Monthly Residential Bill Impact	$7.13	$1.95	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 13A
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $80 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$44,827,856	$34,848,994	$79,676,850
Price per Fuel Unit /a/	$0.17175	$0.00058	
Average Annual Residential Bill Impact /b/	$18.89	$4.50	
Average Annual Residential Bill Impact	$1.57	$0.38	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

Appendix A:
Missouri Distribution Fee Data and Tables

Table 13B Charge Needed on Missouri Residential Consumption To Generate $100 Million			
	Natural Gas	Electricity	Total
Total Dollars	$56,034,820	$43,561,242	$99,596,062
Price per Fuel Unit /a/	$0.21469	$0.00073	
Average Annual Residential Bill Impact /b/	$23.61	$6.30	
Average Monthly Residential Bill Impact	$1.97	$0.53	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 13C
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $120 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$67,241,784	$52;273,491	$119,515,275
Price per Fuel Unit /a/	$0.25763	$0.00088	
Average Annual Residential Bill Impact /b/	$28.34	$7.20	
Average Monthly Residential Bill Impact	$2.36	$0.60	

NOTES:

/a/ Fuel unit: electricity = Kwh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A: MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 13D
CHARGE NEEDED ON MISSOURI RESIDENTIAL CONSUMPTION
TO GENERATE $160 MILLION

	Natural Gas	Electricity	Total
Total Dollars	$89,655,712	$69,697,988	$159,353,700
Price per Fuel Unit /a/	$0.34351	$0.00117	
Average Annual Residential Bill Impact /b/	$37.79	$9.90	
Average Monthly Residential Bill Impact	$3.15	$0.83	

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 14A
CHARGE NEEDED ON MISSOURI ELECTRIC CONSUMPTION
TO GENERATE $80 MILLION

	All Classes	Residential Only
Total Dollars	$79,676,850	$79,676,850
Price per Fuel Unit /a/	$0.00133	$0.00331
Average Annual Residential Bill Impact /b/	$11.70	$29.70
Average Monthly Residential Bill Impact	$0.98	$2.48

NOTES:

/a/ Fuel units: electricity = kWh.
/b/ Assumed annual electric consumption: 9,000 kWh.

TABLE 14B
CHARGE NEEDED ON MISSOURI ELECTRIC CONSUMPTION
TO GENERATE $100 MILLION

	All Classes	Residential Only
Total Dollars	$99,596,063	$99,596,063
Price per Fuel Unit /a/	$0.00167	$0.00414
Average Annual Residential Bill Impact /b/	$14.40	$36.90
Average Monthly Residential Bill Impact	$1.20	$3.08

NOTES:

/a/ Fuel units: electricity = kWh.
/b/ Assumed annual electric consumption: 9,000 kWh.

TABLE 14C CHARGE NEEDED ON MISSOURI ELECTRIC CONSUMPTION TO GENERATE $120 MILLION		
	All Classes	Residential Only
Total Dollars	$119,515,275	$119,515,275
Price per Fuel Unit /a/	$0.00200	$0.00497
Average Annual Residential Bill Impact /b/	$18.00	$44.10
Average Monthly Residential Bill Impact	$1.50	$3.68

NOTES:

/a/ Fuel units: electricity = kWh.
/b/ Assumed annual electric consumption: 9,000 kWh.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 14D CHARGE NEEDED ON MISSOURI ELECTRIC CONSUMPTION TO GENERATE $160 MILLION		
	All Classes	Residential Only
Total Dollars	$159,353,700	$159,353,700
Price per Fuel Unit /a/	$0.00267	$0.00662
Average Annual Residential Bill Impact /b/	$23.40	$59.40
Average Monthly Residential Bill Impact	$1.95	$4.95

NOTES:

/a/ Fuel units: electricity = kWh.
/b/ Assumed annual electric consumption: 9,000 kWh.

Appendix A:
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Table 14E Charge Needed on Missouri Electric Consumption To Generate $40 Million		
	All Classes	Residential Only
Total Dollars	$39,838,425	$39,838,425
Price per Fuel Unit /a/	$0.00067	$0.00166
Average Annual Residential Bill Impact /b/	$5.40	$14.40
Average Monthly Residential Bill Impact	$0.45	$1.20

NOTES:

/a/ Fuel units: electricity = kWh.
/b/ Assumed annual electric consumption: 9,000 kWh.

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MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 15A
CHARGE NEEDED ON ALL RESIDENTIAL CONSUMPTION IN MISSOURI
TO GENERATE $80 MILLION

	Natural Gas	Electric	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$42,975,309	$28,615,352	$731,940	$34,854	$7,319,396	$79,676,850
Price per Fuel Unit /a/	$0.34939	$0.00119	$0.04937	$0.03458	$0.03020	
Average Annual Residential Bill Impact /b/	$38.42	$9.90				
Average Monthly Residential Bill Impact	$3.20	$0.83				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 15B CHARGE NEEDED ON ALL RESIDENTIAL CONSUMPTION IN MISSOURI TO GENERATE $100 MILLION						
	Natural Gas	Electric	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$53,719,136	$35,769,190	$914,924	$43,568	$9,149,245	$99,596,063
Price per Fuel Unit /a/	$0.43674	$0.00149	$0.06171	$0.04322	$0.03775	
Average Annual Residential Bill Impact /b/	$48.04	$12.60				
Average Monthly Residential Bill Impact	$4.00	$1.05				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 15C
CHARGE NEEDED ON ALL RESIDENTIAL CONSUMPTION IN MISSOURI
TO GENERATE $120 MILLION

	Natural Gas	Electric	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$64,462,963	$42,923,027	$1,097,909	$52,281	$10,979,094	$119,515,275
Price per Fuel Unit /a/	$0.52409	$0.00178	$0.07403	$0.05187	$0.04530	
Average Annual Residential Bill Impact /b/	$57.64	$15.30				
Average Monthly Residential Bill Impact	$4.80	$1.28				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 15D
CHARGE NEEDED ON ALL RESIDENTIAL CONSUMPTION IN MISSOURI
TO GENERATE $160 MILLION

	Natural Gas	Electricity	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$85,950,618	$57,230,703	$1,463,879	$69,709	$14,638,791	$159,353,700
Price per Fuel Unit /a/	$0.69879	$0.00238	$0.09874	$0.06916	$0.06040	
Average Annual Residential Bill Impact /b/	$76.86	$20.70				
Average Monthly Residential Bill Impact	$6.41	$1.73				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 16A
CHARGE NEEDED ON ALL CUSTOMER CLASS CONSUMPTION IN MISSOURI
TO GENERATE $80 MILLION

	Natural Gas	Electricity	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$39,469,202	$30,683,198	$4,430,678	$45,211	$5,048,582	$79,626,850
Price per Fuel Unit /a/	$0.15122	$0.00051	$0.02098	$0.02243	$0.01306	
Average Annual Residential Bill Impact /b/	$16.63	$4.50				
Average Monthly Residential Bill Impact	$1.39	$0.38				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 16B
CHARGE NEEDED ON ALL CUSTOMER CLASS CONSUMPTION IN MISSOURI
TO GENERATE $100 MILLION

	Natural Gas	Electricity	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$49,305,542	$38,329,929	$5,534,872	$56,478	$6,306,742	$99,533,563
Price per Fuel Unit /a/	$0.18891	$0.00064	$0.02620	$0.02802	$0.01631	
Average Annual Residential Bill Impact /b/	$20.78	$5.40				
Average Monthly Residential Bill Impact	$1.73	$0.45				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 16C
CHARGE NEEDED ON ALL CUSTOMER CLASS CONSUMPTION IN MISSOURI
TO GENERATE $120 MILLION

	Natural Gas	Electric	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$59,166,650	$45,995,914	$6,641,846	$67,774	$7,568,090	$119,440,275
Price per Fuel Unit /a/	$0.22669	$0.00077	$0.03145	$0.03362	$0.01958	
Average Annual Residential Bill Impact /b/	$24.93	$6.30				
Average Monthly Residential Bill Impact	$2.08	$0.53				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

TABLE 16D
CHARGE NEEDED ON ALL CUSTOMER CLASS CONSUMPTION IN MISSOURI
TO GENERATE $160 MILLION

	Natural Gas	Electric	Fuel Oil	Kerosene	LPG	Total
Total Dollars	$78,938,404	$61,366,396	$8,861,356	$90,422	$10,097,123	$159,353,700
Price per Fuel Unit /a/	$0.30245	$0.00103	$0.01495	$0.04485	$0.02612	
Average Annual Residential Bill Impact /b/	$33.26	$9.00				
Average Monthly Residential Bill Impact	$2.77	$0.75				

NOTES:

/a/ Fuel unit: electricity = kWh. natural gas = mcf. fuel oil, kerosene, LPG = gallons.
/b/ Assumed annual electric consumption: 9,000 kWh. Assumed annual natural gas consumption: 1,100 therms.

APPENDIX A:
MISSOURI DISTRIBUTION FEE DATA AND TABLES

TABLE 17 NUMBER OF LOW-INCOME HOUSEHOLDS IN MISSOURI AT DIFFERENT MEASURES OF "LOW-INCOME"					
Number of Families					
Percent of federal Poverty Level /a/			Percent of Median Income /b/		
0 - 100%	0 - 150%	0 - 200%	0 - 30%	0 - 50%	0 - 80%
254,052	531,809	630,233	237,752	464,629	813,121

APPENDIX B:
SUMMARY OF FUNDRAISING INITIATIVES DISCUSSED IN *FUNDING FUEL ASSISTANCE: STATE AND LOCAL STRATEGIES TO HELP PAY LOW-INCOME HOME ENERGY BILLS*

Table of Program Suggestions

1. Utility bill checkoffs for fuel funds
2. Electronic funds transfer (EFT) billing
3. Early payment agreements
4. Contributions of utility refunds
5. Recapture of unclaimed deposits
6. Recapture of unclaimed utility refunds
7. Ratepayer assistance trust fund
8. Franchise fees--rental payments
9. Rate discounts
10. "One Church--One Family"
11. Contributions in lieu of taxes
12. Universal Service Fund
13. Earned Income Tax Credit promotion
14. State Earned Income Tax Credit

APPENDIX B:
SUMMARY OF FUNDRAISING INITIATIVES DISCUSSED IN *FUNDING FUEL ASSISTANCE: STATE AND LOCAL STRATEGIES TO HELP PAY LOW-INCOME HOME ENERGY BILLS*

15. Promotion of circuit breaker property tax relief
16. State tax credits
17. Sales tax relief on home energy
18. Title IV-A: Emergency Assistance/Special Needs
19. Utility allowances in assisted housing: annual
20. Utility allowances in assisted housing: monthly
21. Bulk fuels: cash prices
22. Bulk fuels: across-the-board discount
23. Bulk fuels: margin over rack program
24. Bulk fuels: summer fill program
25. Bulk fuels: winter shutoff protections

Appendix C:
Summary of Recommendations
Structure of Distribution Fee in Missouri

1. **A distribution fee should fund three initiatives.**

    a. Low-income cash fuel assistance.

    b. Low-income energy efficiency assistance.

    c. Non-low-income energy efficiency, including investments in distributed technologies such as solar space and water heating.

2. **Who pays for the distribution fee.**

    a. All customer classes (residential, industrial, commercial) should pay the distribution fee.

    b. The "distribution fee" should be imposed on all fuel sources.

        i. Natural gas, electricity, propane, fuel oil, propane.

        ii. The responsibility should be apportioned in proportion to usage of each fuel.

3. **The value of a distribution fee should consider three factors.**

    a. A "distribution fee" should include a component for both:

        i. Low-income fuel assistance

            (1) Define who is poor;

            (2) Determine percent who will participate;

            (3) Targeting assistance: affordable percentage of income.

        ii. Non-low-income energy efficiency, including solar investments.

            (1) Exhaust the institutional capacity;

            (2) Eliminate lost opportunities.

b. A "distribution fee" should fund assistance directed toward total home energy bills, including non-heat electric, not simply home heating.

c. There should be an administrative dollar cap.

4. HOW TO MAKE THE DISTRIBUTION FEE NON-BYPASSABLE.

a. The distribution fee should be imposed "at the meter," not at the provider level.

b. The charge should be calculated on a per Btu basis.

i. Not a flat percentage basis.

ii. Not on a flat per customer basis.

5. MISCELLANEOUS "OTHER" ISSUES.

a. There should be a state-funded leveraging incentive fund.

i. Akin to federal LIHEAP leveraging incentive fund.