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Residential, Commercial, and Industrial (RCI) Technical Work Group

Summary List of Priority Policy Options for Analysis

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Status
		2015	2025	Total 2009–2025			
RCI-1	Improved Building Codes	0.2	1.0	7.6	–$165	–$22	Pending
RCI-2a	Utility and Non-Utility DSM for Peak Use Electricity	0.0	0.5	2.6	–$97	–$37	Pending
RCI-2b	Utility and Non-Utility DSM and Energy Efficiency for Electricity	1.2	4.5	34.1	–$1,619	–$47	Pending
RCI-3a	Reduced Energy Use in New and Retrofitted State-Owned Buildings	0.1	0.6	4.4	$17	$4	Pending
RCI-3b	Reduced Energy Use in State-Owned Buildings	0.2	0.4	4.2	$11	$3	Pending
RCI-4a	Promotion and Incentives for Improved New Building Design and Construction	0.5	1.5	11.7	–$278	–$24	Pending
RCI-4b	Promotion and Incentives for Improved Existing Buildings	0.1	0.5	3.3	–$75	–$23	Pending
RCI-5	Education for Consumers, Industry Trades, and Professions	*Not Quantified*					Pending
RCI-6	Incentives and Funds To Promote Renewable Energy and Energy Efficiency	0.2	1.0	6.8	–$156	–$23	Pending
RCI-7	Green Power Purchasing for Consumers	0.2	0.6	4.8	$241	$50	Pending
RCI-8	Nonresidential Energy Efficiency	0.4	1.0	8.6	$583	$68	Pending
RCI-9	Support for Energy-Efficient Communities, Including Smart Growth	TBD	TBD	TBD	TBD	TBD	Pending
RCI-10	Energy-Savings Sales Tax	0.0	0.2	1.1	–$51	–$47	Pending
	Sector Total After Adjusting for Overlaps	**3.10**	**11.33**	**85.79**	**–$1,510.05**	**–$17.60**	
	Reductions From Recent Actions (ESIA Title II requirements for new appliances and lighting)	**0.34**	**0.89**	**8.05**	**Not quantified**		
	Sector Total Plus Recent Actions	**3.44**	**12.21**	**93.84**	**–$1,510.05**	**–$16.10**	

DSM = demand-side management; EISA = Energy Independence and Security Act of 2007; GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; TBD = to be determined.

Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings.

The numbering used to denote the above pending priority policy options is for reference purposes only; it does not reflect prioritization among these important draft policy options.

Draft Overlap Discussion

The Governor's Commission on Global Warming (GCGW) and the Residential, Commercial, and Industrial (RCI) Technical Work Group have developed 10 policy options to reduce the emissions of greenhouse gases (GHGs) in the RCI sector. In addition to estimating the impacts of each individual policy recommendation, the combined impacts of the policy recommendations in each sector were estimated, assuming that all were implemented together. This involved eliminating any overlaps in coverage that would occur to avoid double counting of impacts. Also, some of the policy recommendations in one sector overlapped with those in another sector; therefore, these overlaps were identified, and the impact analysis was adjusted to eliminate double counting of impacts associated with these intersectoral overlaps. The following section identifies where these overlaps occurred and explains the methods used to adjust the impacts analysis to avoid double counting of impacts.

Method for Analyzing RCI Cumulative Impacts

To assess the cumulative emission reductions for the policies in the RCI sector, it is necessary to consider any overlaps among the policies that affect similar types of energy use. Specifically, some policies (such as RCI-3) are defined by their goals for reducing energy use, while others (such as RCI-1 and RCI-2) are defined by addressing a specific type of energy use. In these cases, it is important to consider whether addressing the specific energy use would add to the overall reductions, or would just be subsumed into the more general reduction goal. To address this issue, policies were compared in terms of the type of energy use they target and the energy reduction strategies they implement. Overlaps were identified and quantified by sector (RCI or government/institutional), type of energy use targeted (water heating, space heating, etc.), and measure (e.g., solar hot water). If a policy's impact by sector and type of energy use was less than the impact from an overlapping policy for that same sector and type of energy use, it was excluded from the cumulative analysis.

RCI-1 (Improved Building Codes) doesn't overlap with RCI-2b, at least in theory, because RCI-2b either should be applied to existing demand or would be for energy efficiency improvements beyond new codes. There are no overlaps for this option.

RCI-2a (Utility and Non-Utility DSM for Peak Use Electricity) quantifies the reduced use of electricity due to more rational pricing mechanisms, such as real-time pricing. Higher prices result in lower energy use overall. The quantification of this option explicitly excludes conservation measures, such as high-efficiency air conditioners and chillers, which are included in RCI-1. This option does not overlap with any other options.

RCI-2b (Utility and Non-Utility DSM and Energy Efficiency for Electricity) is the "headline" energy efficiency policy option that potentially subsumes other policy options.

RCI-3a and RCI-3b (Reduced Energy Use in New and Retrofitted [3a] and Existing [3b] State-Owned Buildings) typically show little overlap with utility programmatic investments and are additional to code improvements. These options do not overlap with any other options.

RCI-4a and RCI-4b (Promotion and Incentives for Improved New [4a] and Existing [4b] Building Design and Construction) are improvements "beyond code" only for new buildings and for major retrofits. These options were quantified so that the energy efficiency measures deployed were additional to the more generation energy efficiency measures under RCI-2b. There are no overlaps for these options.

RCI-6 (Incentives and Funds To Promote Renewable Energy and Energy Efficiency) provides additional energy efficiency funding and implementation mechanisms for low-income residential customers. Well-designed utility and non-utility energy efficiency/demand-side management programs will target these populations, but not at the level identified under this policy option. RCI-6 is assumed to overlap 50% with RCI-2b.

RCI-7 (Green Power Purchasing for Consumers) voluntary purchasing programs in the residential sector do not overlap with other RCI options, nor with Energy Supply options, because green power purchasing is a voluntary, demand-side measure in contrast to the regulatory, supply-side renewable portfolio standard promulgated under ES-3a and/or 3b This option is assumed to not overlap with any other energy sector options. However, the biomass generation resulting from this option partially overlaps with AFW-4 (Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production) and is adjusted for this overlap in the AFW totals.

RCI-8 (Nonresidential Energy Efficiency) is a combined heat and power option that is unique to the RCI sector and is not analyzed in the Energy Supply TWG. This option is assumed to not overlap with any other energy sector options. However, the biomass generation resulting from this option partially overlaps with AFW-4 (Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production) and is adjusted for this overlap in the AFW totals.

RCI-10 (Energy-Savings Sales Tax) reduces prices for energy-efficient goods and increases the demand for these items that would have not occurred otherwise. There are no overlaps for this option.

RCI-1. Improved Building Codes

Policy Description

This policy option enforces existing building codes and strengthens and streamlines the building codes process to increase energy efficiency (reduce energy consumption) for RCI buildings.

According to the U.S. Department of Energy (DOE), almost half of GHG emissions are associated with the construction and operation of buildings. Building energy codes specify minimum energy efficiency requirements for new buildings or for existing buildings undergoing a major renovation. Given the long lifetime of most buildings, amending state and/or local building codes to include minimum energy efficiency requirements and periodically updating energy efficiency codes could provide long-term GHG savings.

Also, the state can improve codes that are not limited to heating, ventilation, and air conditioning (HVAC) systems, including daylighting design to reduce lighting needs, electric lighting design, building envelope design, and integrated building design strategies.

In Arkansas, residential structures account for 60% of building energy use, with commercial structures accounting for the remaining 40%. Emphasis on improving and enforcing residential codes holds a large potential for reducing GHG emissions.

Policy Design

Goals:

- Expand education about and enforcement of existing building codes (nonquantifiable).
- Follow national codes without amendments in Arkansas, and update Arkansas codes in concert with the timing of the national codes.
- Achieve a 10% improvement in energy efficiency through educational programs for building inspectors and other building industry professionals to ensure that the new codes are implemented and enforced.

Timing:

- Expand education and enforcement efforts for existing code requirements immediately.
- Align with code review cycles and streamline the Arkansas review process by the end of 2009.
- Coordinate education and enforcement initiatives with new code review cycles.

Implementing Parties: Homeowners, building owners, builders, contractors, developers (new construction and existing buildings).

Other: None noted.

Implementation Mechanisms

None currently identified.

Related Policies/Programs in Place

- Arkansas Energy Code:
  - Residential—2003 International Energy Conservation Code (IECC), with Arkansas supplements and amendments to the 2003 IECC.
  - Commercial—2003 IECC (including ASHRAE/IESNA [American Society of Heating, Refrigerating and Air-Conditioning Engineers/Illuminating Engineering Society of North America] 90.1-2001), with Arkansas supplements and amendments to the 2003 IECC.
  - No set code review cycle.
  - Last effective date, October 1, 2004.
- National Energy Code:
  - Residential—2006 IECC.
  - Commercial—2006 IECC (including ASHRAE/IESNA 90.1-2001), with Arkansas supplements and amendments to the 2003 IECC.
  - 3-year code review cycle with yearly supplements.

Type(s) of GHG Reductions

Carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 1. Estimated GHG reductions and costs of or cost savings from RCI-1

Quantification Factors	2015	2025	Units
GHG emission reductions	0.24	0.65	$MMtCO_2e$
Net present value	$30.2	–$125.7	$ Million
Cumulative GHG reductions	1.01	5.64	$MMtCO_2e$
Cost-effectiveness	–$29.95	–$22.31	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources:

A. Energy Consumption by Sector (Billions of British thermal units [BBtu])

Historical energy consumption in the state, by sector, is taken from the DOE Energy Information Administration (EIA) State Energy Data System, available at: http://www.eia.doe.gov/emeu/states/_seds.html. To calculate future projected energy consumption through 2030, growth factors were applied to the historical 2005 data. The growth factors are based on a combination of two parameters:

- *Growth Within the RCI Sectors*—Growth factors for the residential sector are based on projected population growth. Population figures are from the University of Arkansas Center for Business and Economic Research Population Projections for 2001 to 2004 (http://cber.uark.edu/default.asp?show=population), and the Time Series Extrapolations for 2005 to 2030 (http://www.aiea.ualr.edu/research/demographic/population/default.html). Growth in the commercial sector is based on nonmanufacturing employment growth projections, and industrial growth is based on manufacturing employment. Employment projections were taken from the Arkansas Department of Workforce Service's long-term industry employment projections (http://www.discoverarkansas.net/?PageID=156), with estimated 2004 employment and 2014 projected employment figures for the manufacturing and nonmanufacturing sectors.
- *Growth in Electricity Sales*—This factor was calculated based on historical retail sales from 1990 to 2005, obtained from the EIA state electricity profile, in gigawatt-hours (GWh), available from Table 8 at: http://www.eia.doe.gov/cneaf/electricity/st_profiles/arkansas.html.

B. Baseline Power Station Electricity Generation (GWh) and Fuel Use (BBtu)

Gross generation for 2005 was obtained from the EIA databases (EIA-906 and EIA-920) on fuel stocks at all electric power sector generating facilities, broken down by fuel type (http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html). Data for later years were projected from the 2005 figure, based on projections of growth in generation for the Southwest Power Pool (SPP) region and the Southeastern Reliability Council (SERC) region. EIA assumes that Arkansas is located partly (85%) in the SERC region and partly (15%) in the SPP region. The projected regional consumption and generation data are from the EIA *Annual Energy Outlook 2008* (AEO2008) and can be accessed by downloading the "Electric Generation & Renewable Resource" file at http://www.eia.doe.gov/oiaf/aeo/supplement/index.html. On-site use was subtracted from all generation figures. The analysis is based on *consumption-based* generation, meaning it is based on the electricity sources that deliver electricity to consumers *in state*; therefore, the generation of electricity that is exported is not considered.

C. Costs Associated With Electricity Generation

The costs in the United States to produce electricity using different types of technologies are from the AEO2007, which used the EIA National Energy Modeling System. Capital costs and fixed and variable operations and maintenance costs are from Table 39 in the Electricity Market Module, available at: http://www.eia.doe.gov/oiaf/archive/aeo07/assumption/index.html. Prices for delivered fuel (in 2005$/million [MM] Btu) are provided in the EIA Supplemental Tables to the AEO2007 by region, with projections through 2030. (Download "Consumption & Prices by Sector & Census Division" at: http://www.eia.doe.gov/oiaf/aeo/supplement/; fuel prices by region begin with Table 11.) Transmission costs are added to the total as a constant $80/kilowatt (kW).

Quantification Methods

A. Heat Rates (Btu/kilowatt-hour [kWh])

Heat rates indicate how much fuel is used (Btu) to generate a given amount of electricity (kWh). They vary greatly, depending on the type of power stations and the fuel used. Heat rates are used to convert figures for electricity into figures for fuel use so the amount of fuel used can then be

converted into GHG emissions using the appropriate GHG emission factors. Heat rates for 2005 for each type of generation and fuel were calculated from 2005 fuel use (in BBtu) divided by 2005 generation (GWh). Projections for 2006 and beyond are based on annual combustion efficiency growth rates for the Mid-Atlantic Area Power Pool region. Combustion efficiency for a given year is calculated for each fuel type as the fuel use (in quadrillion Btu) divided by the electricity generated (in billion kWh), and the combustion efficiency growth rate applied to this value is based on the change in combustion efficiency from the previous year.

B. GHG Emissions Associated With End-Use Consumption (by Sector)

Historical CO_2 data by sector (and further broken down by fuel type) were calculated by two U.S. Environmental Protection Agency (EPA) State Greenhouse Gas Inventory Tool (SIT) software modules: the Fossil Fuel Combustion Module and—for emissions from industrial sources—the SIT module for industry. CH_4 and N_2O emissions were calculated by the Stationary Combustion Module and—for emissions from industrial sources—the SIT module for industry.

Projected emissions through 2030 were based on the 2005 data, with growth factors compounded from year to year, as discussed above in section A of the Data Sources section for energy consumption.

C. GHG Emissions Associated With Electricity Generation From Different Technologies and Fuels

The projected data for each GHG were calculated for each fuel and generation type (e.g., non-lignite coal in a steam plant) as a direct product of the projected generation data (in GWh) described above in section B. Metric tons (t) of CO_2 are calculated from generation as:

$$tCO_2 = GWh * (Btu/kWh) * (tCO_2/MMBtu) * (\% \text{ of that fuel in the fuel mix})$$

where (Btu/kWh) is the heat rate and (tCO_2/million [MM] Btu) is the CO_2 emission factor. The calculation is similar for CH_4 and N_2O, which are then converted to CO_2 equivalents (CO_2e) using global warming potentials of 21 for CH_4 and 310 for N_2O. The emission factors used for each GHG were the same as those used in the EPA SIT software modules.

Key Assumptions:

- The rate at which cash flows are discounted is 5%.
- Net present value (NPV) is calculated in 2005 dollars.
- The NPV base year is 2009.
- Transmission and distribution (T&D) losses are 8.1%.[1]
- Manufactured housing is not included in the building code improvement quantification.
- Renovated commercial space is 30% of new building construction. Renovated residential space does not fall under code improvements.

[1] U.S. Department of Energy, Energy Information Administration. State Electricity Profiles 2006. Data for Arkansas. Available at: http://www.eia.doe.gov/cneaf/electricity/st_profiles/arkansas.html.

- The new building construction rate is 1.3%/year for the residential sector,[2] and 2.0%/year for the commercial sector.[3]
- The 2008 avoided delivered electricity cost ($2005) is $58.28/megawatt-hour (MWh) The 2008 avoided peak delivered electricity cost is estimated at $74.02/MWh.[4] The 2008 avoided natural gas cost ($2005) is $7.28/MMBtu.[5]
- The levelized capital cost of electricity energy efficiency ($2005) is $34.10/MWh.[6] This includes utility fixed costs of marketing, evaluation, and administration, which add an estimate 24% to the capital costs listed in Quantec et al. (2008).[7] This figure represents the total utility and participant costs that are typically figured into a total resource cost measure.
- The levelized cost of natural gas efficiency ($2005) is $5.10/MMBtu.[8] This includes utility fixed costs of marketing, evaluation, and administration, which add 24% to capital costs. This figure represents the total utility and participant costs that are typically figured into a total resource cost measure.
- T&D electricity losses are estimated at 8.1%, which is an average of 2005 and 2006 estimated losses/retail sales.[9]
- The annual average (geometric) growth rate for 2008–2030 for population and residential and commercial buildings is 0.64%.[10]
- CO_2 emission reductions due to reduced electricity use occur at the annual average CO_2 intensity (tCO_2e/MWh) for total Arkansas electricity generation over the planning period.

Key Uncertainties

None currently identified.

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[2] Based on U.S. Census Bureau data for new housing starts in Arkansas in 2005. Available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt.

[3] Forecasted annual change in commercial floor space of 2.0% in West South Central, from AEO2005 output files. (Not available online.)

[4] Entergy Arkansas, Inc. Docket No. 81-071-F. Public Utility Regulatory Policies Act - Section 210. Filed on June 30, 2008. Available at: http://www.apscservices.info/pdf/81/81-071-f_319_1.pdf. The avoided cost is the average of all periods. The avoided peak cost is the average of summer and winter peaks.

[5] U.S. Department of Energy, Energy Information Administration. "Natural Gas Prices." January 2008 Arkansas City Gate Price. Available at: http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_SAR_m.htm.

[6] Quantec LLC, Summit Blue Consulting, Nextant, Inc., A-TEC Energy Corporation, and Britt/Makela Group. *Assessment of Energy and Capacity Savings Potential in Iowa: Final Report*, vol. I. Prepared for the Iowa Utility Association. February 2008. (Not available online.)

[7] Ibid.

[8] Ibid.

[9] U.S. Department of Energy, Energy Information Administration. "Arkansas Electricity Profile." DOE/EIA-0348. 2006. Available at: http://www.eia.doe.gov/cneaf/electricity/st_profiles/arkansas.html.

[10] U.S. Census Bureau. "State Population Estimates—Characteristics." Table 1: Estimates of the Population by Selected Age Groups for the United States and Puerto Rico: July 1, 2007 (SC-EST2007-01). Available at: http://www.census.gov/popest/states/asrh/SC-EST2007-01.html.

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar photovoltaic (PV) panels, LED (light-emitting diode) lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-2a. Utility and Non-Utility DSM for Peak-Use Electricity

Policy Description

Demand-side management (DSM) is a policy approach that requires actions that influence both the quantity and the patterns of energy consumed by end users. This policy option focuses on increasing investment in electricity DSM programs. The goals may be accomplished through programs run by utilities or others, energy efficiency funds, and/or energy efficiency goals. These strategies are typically termed DSM activities, and may be designed to work in tandem with other strategies that can also encourage efficiency gains.

Natural gas utilities have experienced declines in sales to consumers over the last 10 years. Because of this, the RCI TWG has decided that it is not necessary to impose a state goal for utilizing DSM programs to reduce consumption of natural gas. However, the GCGW envisions increased direct natural gas use, and carbon pricing and other national market factors may also increase gas use in the future. While promoting direct natural gas use where it accomplishes energy efficiency and climate change goals, Arkansas should take advantage of any additional opportunities to promote increased efficiency in the use of natural gas.

GHGs from peak electricity DSM can be reduced from two sources. The first is the reduction of absolute levels of energy use by consumers due to higher prices. Real-time pricing and smart metering give consumers information about their energy use that enables them to better rationalize their use. Time-of-use pricing or other schemes to reflect rational pricing that result in price increases during peak periods potentially reduces demand by the estimated price elasticity of demand, typically –0.20% to –0.50% (US EIA, 2003) so that a 10% increase in prices would lead to a 2%–5% reduction in demand. In a survey of experience with smart metering, Owen and Ward (2006) find energy savings of 0%–10%. Peak avoided costs in 2008 are an average of 74% higher than nonpeak avoided costs, so the demand reductions could be larger, but this price differential would limit voluntary adoption of the program without regulatory encouragement.

The other source of GHG reductions from policies to reduce peak demand is energy efficiency measures that reduce demand during peak periods, such as high-efficiency air conditioners and chillers. Included in the existing DSM measures in RCI-2b, these measures also reduce new generation capacity investments, a factor that is not quantified for GHG reductions. The GHG impacts of other types of rate structures are more difficult to quantify. Curtailment programs that allow loads to be shifted during peak periods might result in different emission profiles as these loads move from peak to shoulder or baseload periods. Overall CO_2 savings from these programs are also difficult to quantify. (This element of this option is not quantified.)

Policy Design

Goals: Implement energy efficiency programs and DSM to reduce growth in electric peak demand by 5% per year by 2010 and by 10% per year by 2015.

Timing: See above.

Implementing Parties: All electric utilities (public and private), municipal electric systems, electric cooperatives, regulators, and customers (all sectors).

Other: None noted.

Implementation Mechanisms

Statewide expansion of energy efficiency programs.

Related Policies/Programs in Place

There are currently no regulatory requirements for municipally owned electric systems and electric cooperatives to offer energy efficiency programs to their customers, although this could change in the next several years.

The current rate design for electric and gas utilities links a significant amount of the utilities' revenues to the amount of electricity or natural gas sold. Consequently, the utilities' revenues may be reduced with the introduction of energy efficiency programs, conservation programs, and DSM programs that reduce the amount of electricity or natural gas sold. To encourage the utilities to offer and promote these programs, the Arkansas Public Service Commission (APSC) should adopt rate designs and cost recovery mechanisms that are necessary and in the public interest, to decouple the recovery of the utilities' revenues from the amount of electricity or natural gas sold. Further, the APSC should identify appropriate incentives that are necessary and in the public interest, to further encourage the utilities to offer energy efficiency, conservation, and DSM programs.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 2. Estimated GHG reductions and costs of or cost savings from RCI-2a

Quantification Factors	2015	2025	Units
GHG emission reductions	0.05	0.49	$MMtCO_2e$
Net present value	–$6.3	–$97.3	$ Million
Cumulative GHG reductions	0.11	2.61	$MMtCO_2e$
Cost-effectiveness	–$56.29	–$37.36	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

- Gill Owen and Judith Ward. *Smart Meters: Commercial, Regulatory and Policy Drivers*. Appendix 2. Sustainability First. March 2006. Available at: http://www.sustainabilityfirst.org.uk/docs/smartmeterspdfappendices.pdf.

- U.S. Department of Energy, Energy Information Administration. "Price Responsiveness in the AEO2003 NEMS Residential and Commercial Buildings Sector Models." 2003. Available at: http://www.eia.doe.gov/oiaf/analysispaper/elasticity/

Quantification Methods: See RCI-1.

Key Assumptions:

- Demand response measures reduce electricity demand by 5%. This number is a midpoint from the survey in Owen and Ward (2006), which finds that energy savings from smart meters vary from 0% to 10%. This is consistent with what price elasticity of demand would predict. If peak price tariffs are 10%–20% higher than nonpeak tariffs, then demand reductions would range from 2.5% to 10% using price elasticities of_–20% to_–5% (EIA, 2003).
- The installation of demand response measures increases from 2% of total sales customers in the beginning of the program to 60% by 2025 as the program gets implemented.
- RCI customers all implement the program at the same rate.
- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- Peak load hours are 44% of total hours.
- T&D losses are estimated at 8.1%.
- Peak DSM displaces 100% natural gas generation (TWG assumption).
- CO_2 reductions and electricity savings from investments in measures to reduce peak demand, such as high efficiency air conditioners and chillers, are not quantified under this option, as they are included in RCI-2b.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

T&D losses are typically greater during peak hours than during nonpeak hours. This analysis uses average T&D losses, so emission reductions might be modestly understated.

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-2b. Utility and Non-Utility DSM and Energy Efficiency for Electricity

Policy Description

DSM is a policy approach that requires actions that influence both the quantity and the patterns of energy consumed by end users. This policy option focuses on increasing investment in electricity DSM programs. The goals may be accomplished through programs run by utilities or others, energy efficiency funds, and/or energy efficiency goals. These strategies are typically termed DSM activities, and may be designed to work in tandem with other strategies that can also encourage efficiency gains.

Natural gas utilities have experienced declines in sales to consumers over the last 10 years. Because of this, the TWG has decided that it is not necessary to impose a state goal for utilizing DSM programs to reduce consumption of natural gas. However, the GCGW envisions increased direct natural gas use, and carbon pricing and other national market factors may increase gas use in the future as well. While promoting direct natural gas use where it accomplishes energy efficiency and climate change goals, Arkansas should take advantage of any additional opportunities to promote increased efficiency in the use of natural gas.

Policy Design

Goals:

- Implement an aggressive goal for energy efficiency and other DSM programs that eliminates electric utility demand growth over a realistic phase-in period. At this time and for the GCGW's purposes, average electricity demand growth is projected to be 1.4% through 2030. Therefore, energy efficiency and DSM programs that deliver demand reductions of 1.4% of total sales (based on a prior 3-year running average) would be phased in through 2015. Thereafter, energy efficiency and DSM programs delivering demand reductions equal to 1.4% of total electricity sales would be continued, unless a comprehensive assessment of potential efficiency gains in Arkansas and best practices nationwide indicates that greater gains are possible.
- Implement energy efficiency programs and DSM to reduce growth in total electricity demand so that annual electricity load growth is equal to 0% by 2015, when all new electricity use is met with DSM and energy efficiency investments.

Timing: Interim targets are to be linear reductions of projected load growth beginning in 2010. Approximately 16% of load growth will by met in each year with new energy efficiency investments during 2010–2015: 16% in 2010, 32% in 2011, 48% in 2012, 64% in 2013, 80% in 2014, and 100% by 2015.

Implementing Parties: All electric utilities (public and private), municipal electric systems, electric cooperatives, regulators, and customers (all sectors).

Other: None noted.

Implementation Mechanisms

In 2009, Arkansas should engage expert assistance in providing an in-depth, comprehensive, state-specific energy efficiency analysis that outlines the potential to cost-effectively meet future energy utility demand through efficiency, DSM, and renewable energy (Maryland and Florida recently made such analyses the basis for energy policy planning). That in-depth study should quantify, among other things, the climate change emission reductions below baseline that would result from achieving that potential, and should become a basis for DSM program implementation.

Related Policies/Programs in Place

The current rate design for electric and gas utilities links a significant amount of the utilities' revenues to the amount of electricity or natural gas sold. Consequently, the utilities' revenues may be reduced with the introduction of energy efficiency, conservation, and DSM programs that reduce the amount of electricity or natural gas sold. To encourage the utilities to offer and promote these programs, the APSC should adopt rate designs and cost recovery mechanisms that are necessary and in the public interest, to decouple the recovery of the utilities' revenues from the amount of electricity or natural gas sold. Further, the APSC should identify appropriate incentives that are necessary and in the public interest, to further encourage the utilities to offer energy efficiency, conservation, and DSM programs.

There are currently no regulatory requirements for municipally owned electric systems and electric cooperatives to offer energy efficiency programs to their customers, although this could change in the next several years.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 3. Estimated GHG reductions and costs of or cost savings from RCI-2b

Quantification Factors	2015	2025	Units
GHG emission reductions	1.22	4.52	$MMtCO_2e$
Net present value	–$176.8	$1,618.6	$ Million
Cumulative GHG reductions	1.22	34.09	$MMtCO_2e$
Cost-effectiveness	–$46.55	–$47.48	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Quantification Methods: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- T&D losses are estimated at 8.1%.
- CO_2 emission reductions due to reduced electricity use occur at the annual average CO_2 intensity (tCO_2e/MWh) for total Arkansas electricity generation over the planning period.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-3a. Reduced Energy Use in New and Retrofitted State-Owned Buildings: Government "Lead by Example"

Policy Description

Government-led, or "lead by example," initiatives help state and local governments achieve substantial energy cost savings, while promoting the adoption of clean energy technologies for significant GHG emission reductions in new and existing state and local government buildings. The proposed policy provides energy efficiency targets that are much higher than code standards. This option sets energy efficiency goals for new construction and major renovations.

Policy Design

Goals:

- Require that all new state buildings (buildings that utilize a minimum of 20% of state funds), developments, and major renovations be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% less energy use than the ASHRAE 90.1-2004 energy standard. Special-use facilities, such as state laboratories, can receive an exemption from this rule, as determined by the Arkansas Energy Office (AEO).
- Increase the fossil fuel reduction standard for all new buildings to:
  - 60% reduction in 2012,
  - 70% in 2017,
  - 80% in 2020,
  - 90% in 2025, and
  - Carbon-neutral in 2030 (using no GHG-emitting energy to operate).
- For verification of energy efficiency performance, require state-funded buildings to be certified by the Leadership in Energy and Environmental Design™ (LEED) certification standards.
  - Buildings can also be verified through Green Globes for New Construction (with independent third-party verification), or other similarly stringent, national, third-party-verified green building certification system .

Timing: Beginning in 2009.

Implementing Parties: State government agencies, local governments, schools, and universities.

Other: None noted.

Implementation Mechanisms

The state should include full life-cycle cost accounting for all its procurement. ENERGY STAR-rated appliances are to be a minimum acceptable level of energy efficiency for procurement where applicable.

New Buildings:

- State building procurement regulations that include energy requirements for the respective year.
- Database of new building performance that includes pertinent building metrics (energy savings, GHG emission reductions, operational savings, return on investment).

Major Renovations:

- Implementation of energy conservation measures to reduce energy use within state-funded buildings.
- A retained savings policy, whereby agencies can retain funds saved by improving energy efficiency to additional energy efficiency investments.

Certification System:

- AEO can determine which certification systems would be appropriate for energy efficiency validation.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 4. Estimated GHG reductions and costs of or cost savings from RCI-3a

Quantification Factors	2015	2025	Units
GHG emission reductions	0.10	0.64	$MMtCO_2e$
Net present value	–$12.5	$17.0	$ Million
Cumulative GHG reductions	0.38	4.36	$MMtCO_2e$
Cost-effectiveness	–$32.69	$3.90	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- 90% of new and retrofitted buildings comply with the policy; the remaining 10% that don't comply are 20% less energy efficient than the policy calls for.

- The state begins to purchase renewable energy for the fossil fuel reduction targets when all energy efficiency gains are assumed to be made, which is estimated at a 70% reduction from current efficiency levels.
- The growth rate for new government buildings is 2% per year, which is the growth rate in new commercial buildings.
- For every square foot of new government buildings, 30% of equivalent square footage is retrofitted each year.

Quantification Methods: See RCI-1.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

Maintenance and operation costs should be considered in life-cycle cost accounting for high-efficiency buildings.

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-3b. Reduced Energy Use in Existing State-Owned Buildings: Government "Lead by Example"

Policy Description

Government-led, or "lead by example," initiatives help state and local governments achieve substantial energy cost savings, while promoting the adoption of clean energy technologies for significant GHG emission reductions in existing state and local government buildings. The proposed policy provides energy efficiency targets for existing buildings that are much higher than code standards.

The Arkansas state government is a significant consumer of energy. The state owns or leases approximately 29.45 million square feet of building space, and pre-K through 12 schools account for an additional 85 million square feet. Additional local government buildings are not in this inventory, such as courthouses, city halls, and other facilities.

Arkansas' public school buildings are in need of approximately $1.6 trillion of repairs and improvements that "Impact Functioning of School, i.e., Mechanical, Electrical, HVAC." These needs are opportunities for installing more energy-efficient equipment.[11]

Policy Design

- **Goals:** Set a state goal to reduce by 2030, from a 2009 baseline, a minimum of 30% of electricity consumed by existing state and local facilities, schools, and universities. Require that 20% of the square footage of the existing state building stock (buildings that utilize a minimum of 20% of state funds) achieve 7 points (approximately 30% energy savings) per the full requirements of the LEED for Existing Buildings, Energy and Atmosphere Credit 1 by 2012. A similarly stringent, third-party-verified green building certification system for commercial buildings may also be used.
- Require the total square footage of buildings that meet the efficiency standard for existing buildings to be increased as follows:
  - 40% in 2014,
  - 60% in 2016,
  - 80% in 2018, and
  - 100% in 2020. By this date, the entire state existing building stock will have received efficiency investments to reach the 30% improvement target.
- Adjust the improvement targets and execute programs to achieve additional savings in 2020–2030.

[11] Task Force to Joint Committee on Educational Facilities. *Arkansas Statewide Educational Facilities Assessment—2004. Final Report to the Joint Committee on Educational Facilities.* November 30, 2004, p. 20. Available at: http://www.arkleg.state.ar.us/data/education/statereport.pdf.

- Create a program to audit energy use, with a goal of at least 20% of all buildings being audited annually, and require state and local governments to submit annual energy plans to the state.
- Set a statewide goal that by 2025, a minimum of 15% of energy consumed by state and local government buildings will come from renewable in-state energy sources. This policy will allow the state to "lead by design," and will create an established market for green power generators.

Timing: Beginning in 2010.

Implementing Parties: State government agencies, local governments, schools, and universities.

Other: None noted.

Implementation Mechanisms

- Establish a Sustainability Coordinator function that will define the current performance of existing building stock, set priorities, and define energy efficiency programs. Utilize LEED or a similarly stringent rating system to verify and certify performance.
- Implement a retained savings policy, whereby agencies can retain a portion of funds saved by improving energy efficiency and apply them to additional energy efficiency investments.

State Audits

Audits of energy use and associated GHG emissions by state agencies are vital for establishing baseline levels needed to set achievable goals for reducing emissions. It will be important to audit both state agency facilities and activities in order to fully assess and mitigate each agency's carbon footprint. It will also be important for state agencies to audit energy use and GHG emissions annually for tracking progress toward meeting GHG reduction goals. In so doing, the GCGW recommends that state agencies consider a phased approach by assessing energy use and associated emissions first for state facilities and then for state activities.

- *State Facilities*—Since facilities are stable and stationary entities. Protocols for auditing energy use and emissions should be fairly routine to implement annually and would assist the agencies in developing experience that can be applied to assess energy use associated with their activities.
- *State Activities*—Development and implementation of protocols to assess energy and interior and exterior water use and emissions associated with state agency activities may be more difficult, because activities vary depending on the mission of each agency, and are likely to change frequently, even within an agency. Nevertheless, an analysis of energy use and emissions associated with agency activities is necessary to develop plans to mitigate GHG emissions and demonstrate progress toward meeting GHG emission reduction goals.

In addition, the state should consider a phased approach, starting with the larger state government agencies first, to develop protocols and experience that can then be used to assist smaller agencies and the university system. Such an approach should be designed to leverage

experience and assessment tools that can be used by other entities (e.g., school districts) to foster consistency in developing and implementing audit protocols on a routine basis.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 5. Estimated GHG reductions and costs of or cost savings from RCI-3b

Quantification Factors	2015	2025	Units
GHG emission reductions	0.10	0.64	$MMtCO_2e$
Net present value	$1.5	$11.0	$ Million
Cumulative GHG reductions	0.72	4.23	$MMtCO_2e$
Cost-effectiveness	$2.01	$2.59	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Quantification Methods: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy see RCI-1
- Arkansas state and local governments occupy 15.6% of commercial floor space in the state.
- All government buildings are commercial buildings.
- Renewable energy consisting of 80% wind and 20% biomass meets 25% of government electricity consumption in 2025.
- The state begins to purchase renewable energy for the fossil fuel reduction targets when all energy efficiency gains are assumed to be made, which is estimated at a 70% reduction from current efficiency levels.
- 90% of retrofitted buildings comply with the policy; the remaining 10% that don't comply are 20% less energy efficient than the policy calls for.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-4a. Promotion and Incentives for Improved New Building Design and Construction

Policy Description

Almost half of all GHG emissions in the United States are associated with RCI buildings and the energy associated with building materials. Improving the energy efficiency design and construction of buildings will have an immediate and ongoing impact on GHG reduction.

This policy provides incentives and targets to induce the owners and developers of new buildings to improve the efficiency with which energy and other resources are used in those buildings, along with provisions for raising targets periodically and providing resources to building industry professionals to help achieve the desired building performance. This policy can include elements to encourage the improvement and review of energy use goals over time, and to encourage flexibility in contracting arrangements to encourage integrated energy- and resource-efficient design, construction, and renovation. Incentives could include low-cost loans for investments in energy efficiency, tax credits, and feebates. The use of third-party rating systems will reduce the requirement for significant oversight and enforcement by state organizations.

Policy Design

Goals:

- Provide tiered incentives for energy efficiency in new buildings that achieve at least a 20% reduction in energy use relative to the ASHRAE 90.1-2004 energy standard for commercial buildings, and the 2004 Arkansas Energy Code for residential buildings through certification in one of the following rating systems:
  - LEED (New Construction, Core & Shell, Commercial Interiors, Homes, or other appropriate version),
  - Green Globes New Construction, or
  - Similarly stringent, third-party-verified green building certification system for commercial or residential buildings.
- Make the incentives for this program commensurate with the energy efficiency threshold achieved. Tier the thresholds as follows:
  - 20%
  - 25%
  - 30%
  - 30% and above
- Increase the benchmark minimum efficiency standard for existing buildings as follows:
  - 20% in 2014
  - 25% in 2016
  - 30% in 2018
  - 35% in 2020

- Require participating organizations or individuals to provide feedback on the costs and actual performance of energy efficiency improvements, and annual GHG reduction levels in new construction as compared to the Arkansas Energy Code.

Timing: Develop legislation in 2009; make incentives available in 2010; begin compliance in 2011.

Implementing Parties: All builders, building material suppliers, recycled building material sellers, and home improvement stores.

Other: None noted.

Implementation Mechanisms

- A reference guide for defining the appropriate rating systems and verification requirements;
- Initial building audits of energy performance and operations of state buildings to define initial priorities;
- Low-cost loans for improving energy efficiency in residential buildings, including a weatherization program;
- A retained savings policy, whereby agencies can retain funds saved by improving energy efficiency and apply them to additional energy efficiency investments;
- Low-interest loans to fund energy efficiency retrofits for commercial and industrial buildings;
- Tax credits for energy-efficient residential, commercial, and industrial buildings; and
- A feebate program that allows for a self-funded financial mechanism.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 6. Estimated GHG reductions and costs of or cost savings from RCI-4a

Quantification Factors	2015	2025	Units
GHG emission reductions	0.46	1.51	$MMtCO_2e$
Net present value	–$50.0	–$277.6	$ Million
Cumulative GHG reductions	1.50	11.74	$MMtCO_2e$
Cost-effectiveness	–$33.23	–$23.66	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Quantification Methods: See RCI-1.

Key Assumptions:

- Baseline electricity use by sector that falls under RCI-4a (GWh):
  - Residential sector—51% (all end uses except refrigerators and 50% of appliances and lighting);[12]
  - Commercial sector—74% (all end uses except office equipment); and[13]
  - Industrial sector—14% (used for HVAC, lighting, and "other facility support," including natural gas used in the South Census region).[14]
- New building construction rate/year:
  - Residential sector—1.3%;[15]
  - Commercial sector—2.0%; and[16]
  - Industrial sector—0.4%.[17]
- Estimated based on relative use of electricity and gas by sector (ratio of electricity savings to gas savings: BBtu/GWh):
  - Residential sector—101.4%;[18]
  - Commercial sector—63.5%; and[19]

[12] U.S. Department of Energy, Energy Information Administration. "Residential Energy Consumption Survey 2001 Consumption and Expenditure Data Tables." Available at: http://www.eia.doe.gov/emeu/recs/recs2001/detailcetbls.html - space.

[13] U.S. Department of Energy, Energy Information Administration. "2003 Commercial Buildings Energy Consumption Survey Detailed Tables." Table C1: Total Energy Consumption by Major Fuel for Non-Mall Buildings. December 2006. Available at: http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html - consumexpen03.

[14] U.S. Department of Energy, Energy Information Administration. (2001). "2002 Manufacturing Energy Consumption Survey." Table 5.8: End Uses of Fuel Consumption, 2002. Form EIA-846. Available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table5.8_02.pdf.

[15] U.S. Census Bureau. Table 2u: New Privately Owned Housing Units Authorized Unadjusted Units for Regions, Divisions, and States. December 2005. Available at: http://www.census.gov/const/C40/Table2/t2yu200512.txt.

[16] Forecasted annual change in commercial floor space of 2.0% in West South Central from AEO2005 output files.

[17] Forecasted annual change in industrial electricity consumption from the Arkansas inventory and forecast, reduced by 25% for improvements in energy intensity per square foot (estimate).

[18] Based on the ratio of natural gas fuel use to site electricity use for residential buildings in Arkansas' climate zone. Source: U.S. Department of Energy, Energy Information Administration. "2001 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables." Table CE1-1c: Total Energy Consumption in U.S. Households by Climate Zone. Available at: http://www.eia.doe.gov/emeu/recs/recs2001/ce_pdf/enduse/ce1-1c_climate2001.pdf.

[19] Based on the ratio of natural gas fuel use to site electricity use for commercial buildings nationwide. Source: U.S. Department of Energy, Energy Information Administration. "2003 Commercial Buildings Energy Consumption Survey Detailed Tables." Available at: http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html - consumexpen03.

  - Industrial sector—82.0%.[20]

- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- 90% of new buildings comply with the policy; the remaining 10% that don't comply are 20% less energy efficient than the policy calls for.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

Wood products contain much less embodied energy than other building materials and, unlike other building materials, function as long-term sequesters of carbon. Additionally, wood products sourced locally have more energy and carbon advantages compared to products transported from distant sources. For example, a lumber-framed wall or floor system requires just 40% of the fossil fuel energy needed to manufacture a concrete wall or floor system and only 20% of the fossil fuel energy need to manufacture a steel wall or floor.[21]

The quantification of costs and benefits of energy efficiency only includes technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Operation and maintenance costs should be considered in life-cycle cost accounting for high-efficiency buildings.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

[20] Gas facility support divided by electricity facility support (in BBTU) in the South Census Region. Source: U.S. Department of Energy, Energy Information Administration. "2002 Energy Consumption by Manufacturers—Data Tables." Table 5.7: Energy Consumed as a Fuel by End Use—By Region With Total Consumption of Electricity. March 8, 2005. Available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html.

[21] J. Boyer, S. Bratkovich, A. Lindburg, and K. Fernholz. Wood Products and Carbon Protocols: Carbon Storage and Low Energy Intensity Should be Considered. Dovetail Partners, Inc. April 28, 2008. Available at: http://www.dovetailinc.org/reportView.php?action=displayReport&reportID=92.

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-4b. Promotion and Incentives for Improved Existing Building Design and Construction

Policy Description

Almost half of all GHG emissions in the United States are associated with RCI buildings and the energy associated with building materials. Improving the energy efficiency design of buildings will have an immediate and ongoing impact on GHG reduction.

This policy provides incentives and targets to induce the owners and developers of existing buildings to improve the efficiency with which energy and other resources are used in those buildings, along with provisions for raising targets periodically and providing resources to building industry professionals to help achieve the desired building performance. This policy can include elements to encourage the improvement and review of energy use goals over time, and to encourage flexibility in contracting arrangements to promote integrated energy- and resource-efficient design, energy demand reduction, and practices that maintain optimal energy use. Incentives could include low-cost loans for investments in energy efficiency, tax credits, and feebates.

Policy Design

Goals:

- Measure the performance of energy efficiency improvements in existing buildings against a regional average of similar building types.
- Provide tiered incentives for energy efficiency in existing buildings that achieve at least a 15% reduction in energy use versus the regional average for similar buildings through certification in one of the following rating systems:
  - LEED for Existing Buildings or
  - Similarly stringent, third-party-verified green building certification system for commercial or residential buildings.
- Make the incentives for this program commensurate with the energy efficiency threshold achieved. Tier the thresholds as follows:
  - 15%
  - 20%
  - 25%
  - 30% and above
- Increase the benchmark minimum efficiency standard for existing buildings as follows:
  - 20% in 2014
  - 25% in 2016
  - 30% in 2018
  - 35% in 2020

- Require participating organizations or individuals to provide feedback on the costs and actual performance of energy efficiency improvements, and annual GHG reduction levels in new construction against the benchmark.
- Offer low-cost loans or incentives to consumers for weatherization programs, including weatherstripping and insulation improvements.

Timing: Develop legislation in 2009; make incentive measures available in 2010; begin program in 2011.

Implementing Parties: All builders, building material suppliers, recycled building material sellers, and home improvement stores. The aforementioned should be considered for both private and pubic construction projects.

Other: None noted.

Implementation Mechanisms

LEED, or equivalent rating system, will be used to define the benchmark and actual energy savings achieved. Relevant implementation mechanisms may include:

- Retro-commissioning of existing building;.
- Audits of energy performance and operations by state and other government buildings;
- Implementation of design features to reduce energy use within state-funded buildings, through incorporation of proven planning guides and regulations;
- Financial and technical assistance for implementation of energy-saving programs in existing buildings, and a requirement that all state-owned buildings implement an energy management program;
- Low-interest loans to fund energy efficiency retrofits for commercial and industrial buildings; and
- Tax credits for energy-efficient RCI buildings. Funding for education programs could come from a variety of sources, including professional associations, matching grants from federal agencies, regional market energy efficiency organizations, and energy efficiency from utilities and non-utilities, among others.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 7. Estimated GHG reductions and costs of or cost savings from RCI-4b

Quantification Factors	2015	2025	Units
GHG emission reductions	0.09	0.51	$MMtCO_2e$
Net present value	–$9.1	–$74.9	$ Million
Cumulative GHG reductions	0.27	3.30	$MMtCO_2e$
Cost-effectiveness	–$33.31	–$22.66	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Quantification Methods: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy see RCI-1
- 90% of retrofitted buildings comply with the policy; the remaining 10% that don't comply are 20% less energy efficient than the policy calls for.
- This policy only applies to major retrofits of existing buildings. The rate of major retrofits is assumed to be 30% of the following new building construction rates/year:
  - Residential sector—1.3%;
  - Commercial sector—2.0%; and
  - Industrial sector—0.4%.
- Baseline electricity use by sector that falls under RCI-4b (GWh):
  - Residential sector—51% (all end uses, except refrigerators, and 50% of appliances and lighting);
  - Commercial sector—74% (all end uses except office equipment); and
  - Industrial sector—14% (used for HVAC, lighting, and "other facility support," including natural gas used for the South Census region).
- Estimated based on relative usage of electricity and gas by sector. Ratio of electricity savings to gas savings (BBtu/GWh):
  - Residential sector—101.4%;
  - Commercial sector—63.5%; and
  - Industrial sector—82.0%.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

Wood products contain much less embodied energy than other building materials and, unlike other building materials, function as long-term sequesters of carbon. Additionally, wood products sourced locally have more energy and carbon advantages compared to products transported from distant sources. For example, a lumber-framed wall or floor system requires just 40% of the fossil fuel energy needed to manufacture a concrete wall or floor system and only 20% of the fossil fuel energy need to manufacture a steel wall or floor.[22]

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis. Operation and maintenance costs should be considered in life-cycle cost accounting for high-efficiency buildings.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

[22] J. Boyer, S. Bratkovich, A. Lindburg, and K. Fernholz. *Wood Products and Carbon Protocols: Carbon Storage and Low Energy Intensity Should be Considered*. Dovetail Partners, Inc. April 28, 2008. Available at: http://www.dovetailinc.org/reportView.php?action=displayReport&reportID=92.

RCI-5. Education for Consumers, Industry Trades, and Professions

Policy Description

Education under this option falls under two broad categories:

- Consumer awareness education on how consumers can reduce GHG emissions, and
- Technical education for builders and contractors on the specific methods they can incorporate to reduce GHG emissions at every stage of construction.

The ultimate effectiveness of emission reduction activities in many cases depends on providing information and education to consumers regarding the energy and GHG emission implications of their choices. Public education and outreach is vital to fostering a broad awareness of climate change issues and effects (including co-benefits, such as clean air and public health) among the state's citizens. Such awareness is necessary to engage citizens in actions to reduce GHG emissions in their personal and professional lives.

This option also addresses education and outreach programs for building professionals to encourage incorporation of energy efficiency and GHG emission reduction considerations, such as programs to train builders and contractors.

Education and training should also be made available to builders and contractors and others for retrofitting existing buildings.

Policy Design

Goals: Develop consumer and technical/professional education courses and outreach programs for GHG emission reductions to increase the number of professionals trained in energy efficiency.

Timing: By 2010, put the education/training option in place and begin outreach programs.

Implementing Parties: Consumers, retailers, manufacturers, technicians, and professionals in building and related trades, code enforcement agencies, K-12 public schools, community colleges, universities, Arkansas Department of Education.

Other: None noted.

Implementation Mechanisms

Funding for education programs could come from a variety of sources, including professional associations, matching grants from federal agencies, regional market energy efficiency organizations, and energy efficiency from utilities and non-utilities, among others.

Related Policies/Programs in Place

None currently identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Not quantifiable.

Data Sources: Not applicable.

Quantification Methods: Not quantifiable.

Key Assumptions: Not applicable.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

None currently identified.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-6. Incentives and Funds To Promote Renewable Energy and Energy Efficiency

Policy Description

This policy option refers to financial mechanisms for energy efficiency that could increase program participation and investment by providing incentives to a variety of customer classes to improve the energy performance of buildings, equipment, and residences. These incentives could be targeted to residential customers, small businesses, and low-income consumers, as well as to other customer classes, including larger businesses and the industrial sector.

A public benefits charge (sometimes called a systems benefits charge) is a fee attributed to utility customers based on their use of energy in a given time period. With deregulation in many states, the public utility commissions often lost the ability to require electric utilities to implement efficiency programs. The result in many states was the development of the public benefits charge, which is a non-bypassable charge on electric bills. The funds collected are then provided to a third party to provide energy efficiency programming, or can support implementation of a revolving-loan payment, establishment of a micro-loan program, and tax incentives. Energy audits should be included to aid in assessing needs and tracking progress toward improvement.

At least 33% of Arkansas' population has an income of less than $30,000/year, and they spend 20%–30% of their income on utility bills. There are currently not enough weatherization or energy conservation programs in place to reduce the economic burden on this population or to have a scalable impact on mitigating the GHG emissions produced by these homes. Providing traditional financing options for low-income homeowners will not meet their needs or achieve any meaningful scale.

The need exists for identifying these homeowners, educating them about and the opportunity for energy audits, and financing the implementation of energy-efficient measures with a shared savings approach. There would be multiple benefits to develop an employer-driven, local economic impact initiative that reaches out to employees (scalable), connecting them to trained energy auditors (provided by public benefit funds), and to create a Program-Related Investment (PRI) fund (revolving energy fund) to finance moderate energy efficiency measures for employees (builds employee retention and adds benefits.) The resulting energy savings would be split between the employee's monthly payroll deduction (paid into the PRI) and the employee, manifested in the lower utility bill. Employers would be provided the incentive to create the PRI with either a state tax credit or the right to "bank" or capture the aggregated annual CO_2 savings from their employees.

Manufactured (mobile) homes account for approximately 27% of residential structures in Arkansas. Mobile homes and temporary dwellings (hunting camps, boat houses) are exempt from compliance with the Arkansas Energy Code and fall under U.S. Department of Housing and Urban Development (HUD) regulation. These homes are factory-made and can more easily implement efficiency improvements. ENERGY STAR has a program for energy-efficient manufactured homes.

In Schweitzer et al's (2003) review of 20 major energy audits, the audits accounted for less than 4% of program spending on conservation, yet resulted in an estimated 18% of cost and energy savings. Audits are one of the lowest-cost conservation measures available to utilities and non-utility programs and form a core element of DSM programs.

Policy Design

Goals: *[Draft language, not finalized by TWG]*

Low-Income Pilot Program

- Fund a Low-Income Pilot Program in rural Arkansas counties that targets weatherization of the of the counties' low-income population, working with the local economic development office, Arkansas community action agencies, industries, and manufacturers.
- Beginning year one of the program, double the estimated 1,200 homes a year that are currently receiving weatherization assistance to 2,400 homes. Each year for the next 5 years, increase the number of homes receiving weatherization by 2,400, until by 2015 14,000 homes are being retrofitted annually.
- Ultimately, target 90% of the low-income homeowner population (approximately 178,000 residences in 2008) that are eligible for federal weatherization assistance.
- Expand available funding per residence from the current level (approximately $2,800) to be able to upgrade major appliances, such as furnaces.
- Target energy efficiency improvements of 40% per upgraded residence.
- Increase these targets annually until the low-income target is achieved, and then target weatherization in homes that are above the federal weatherization eligibility level.

Manufactured Housing

- Require that the incentive program for manufactured housing purchased in or shipped to Arkansas be ENERGY STAR-qualified or have other equivalent energy-efficient, third-party certification.
- Ensure that these units are at least 30% more energy efficient than comparable available manufactured housing.
- Through the incentives, increase the penetration of energy-efficient manufactured housing to 75% of new manufactured housing sales by 2025.

Other

- Add a minimum of 75–100 new certified auditors, which are green collar jobs.
- Expand energy audit programs for all sectors, and increase them annually until 100% saturation is achieved.

Timing:

Low-Income Pilot Program

- 2009–10—Launch a Low-Income Pilot Program in select rural counties through a public-private partnership with the Arkansas Chapter of the U.S. Green Building Council.
- 2009–10—Build the state's capacity of certified energy auditors/raters; identify and prequalify subcontractors statewide.
- July 2010—Fund a program manager and adequate staff to begin statewide implementation of the goal 2,400 homes.
- 2010 and beyond—Increase funding to meet annual targets.

Manufactured Homes

- Begin in 2010 an incentive program for ENERGY STAR-Qualified Manufactured Housing or other equivalent efficient third-party certification.

Other

- Expand energy audit programs by 2010. Make the annual increase 10% of the audited stock.

Implementing Parties: Commercial and industrial energy users in the private and public sectors (including those responsible for mixed-use projects), nongovernmental organizations, public agencies, utilities, building design and construction professionals, and lenders.

Other: TBD – [as needed and approved by the TWG]

Implementation Mechanisms

Offer low-cost loans or incentives to consumers for weatherization programs, including weatherstripping and insulation improvements. These could include “weatherization kits” like those being offered to low-income residents in Chicago to improve their building energy efficiency and reduce energy expenditures.

Related Policies/Programs in Place

The current rate design for electric and gas utilities links a significant amount of the utilities' revenues to the amount of electricity or natural gas sold. Consequently, the utilities' revenues may be reduced with the introduction of energy efficiency, conservation, and DSM programs that reduce the amount of electricity or natural gas sold. To encourage the utilities to offer and promote these programs, the APSC should adopt rate designs and cost recovery mechanisms that are necessary and in the public interest, to decouple the recovery of the utilities' revenues from the amount of electricity or natural gas sold. Further, the APSC should identify appropriate incentives that are necessary and in the public interest, to further encourage the utilities to offer energy efficiency, conservation, and DSM programs.

- Federal Weatherization Program.
- HUD Code for Manufactured Homes. HUD 1976 Federal Manufactured Home Construction and Safety Standards Acts, commonly known as the "HUD Code."

- ENERGY STAR-Qualified Manufactured Homes.

Type(s) of GHG Reductions

TBD – [as approved by the TWG]

Estimated GHG Reductions and Costs or Cost Savings

Table 8. Estimated GHG reductions and costs of or cost savings from RCI-6

Quantification Factors	2015	2025	Units
GHG emission reductions	0.20	1.02	$MMtCO_2e$
Net present value	–$20.1	–$156.2	$ Million
Cumulative GHG reductions	0.60	6.81	$MMtCO_2e$
Cost-effectiveness	–$33.62	–$22.95	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

- U.S. Department of Energy, Energy Information Administration. "2001 Residential Energy Consumption Survey: Household Energy Consumption and Expenditures Tables." Table CE1-3c: Total Energy Consumption in U.S. Households by Household Income, 2001." Available at: http://www.eia.doe.gov/emeu/recs/recs2001/ce_pdf/enduse/ce1-3c_hhincome2001.pdf.
- Martin Schweitzer, Donald W. Jones, Linda G. Berry, and Bruce E. Tonn. *Estimating Energy and Cost Savings and Emissions Reductions for the State Energy Program Based on Enumeration Indicators Data*. ORNL/CON-487. Oak Ridge National Laboratory. January 2003. Available at: http://www.ornl.gov/~webworks/cppr/y2001/rpt/116341.pdf.

Quantification Methods: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy. see RCI-1.
- Federally eligible housing units eligible for the green loan package consumed an average of 9800 KWh/year in 2010 and grows at 1.1%/year.
- The costs and benefits of expanding energy audits are not quantified.
- Households eligible for federal assistance grow at 1.3%/year.

Key Uncertainties

TBD – [as needed and approved by the TWG]

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Statewide increases in the green renovation construction market lead to increased economic development.

Feasibility Issues

TBD – [as needed and approved by the TWG]

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-7. Green Power Purchasing for Consumers

Policy Description

Green power purchasing refers to a variety of consumer-driven strategies to increase the production and delivery of low-GHG power sources beyond levels achieved through RPS and other mandatory programs. These sources include solar, wind, geothermal, biogas, biomass, and low-impact hydroelectric. Green power purchasing programs provide consumers with information about alternative green sources of energy they can select, rather than the traditional, more carbon-intensive sources.

As of April 2008, the leading green power program in the country had a customer participation rate of over 20%, but green power accounted for 4.6% of its load (NREL, 2008). This implies that participating customers were purchasing green power for less than 25% of their total electricity consumption, or else only small electricity users were participating. Therefore, this policy not only provides incentives participation, but also encourages large-scale purchases so that customers may use green power to offset their entire electricity consumption.

Policy Design

Goals:

- By 2025, the residential participation rate for green power purchasing programs is 25%, and these participants purchase an average of 25% of their total electricity use from renewable resources.
- Develop a mechanism that strongly encourages utilities purchasing this power to develop green power in Arkansas.

Timing: Consumers participate in green power purchasing programs beginning in 2010, achieving the 25% goal linearly by 2025.

Implementing Parties: State facilities, electric utilities, renewable energy producers, electricity consumers, and buyers of energy-using appliances and equipment.

Other: None noted.

Implementation Mechanisms

Arkansas will implement programs to provide consumers the option to purchase green power.

According to Bird et al (2007), the premium paid by consumers for green power declined from $34.80/MWh to $21.20/MWh between 2000 and 2006. The green power premium estimated under this policy for Arkansas is closer to $38, which will require aggressive marketing programs to reach the program target.

Related Policies/Programs in Place

None identified.

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 9. Estimated GHG reductions and costs of or cost savings from RCI-7

Quantification Factors	2015	2025	Units
GHG emission reductions	0.19	0.60	$MMtCO_2e$
Net present value	$12.1	$241.1	$ Million
Cumulative GHG reductions	0.75	4.83	$MMtCO_2e$
Cost-effectiveness	$16.23	$49.98	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

- Lori Bird, Leila Dagher, and Blair Swezey. *Green Power Marketing in the United States: A Status Report,* (Tenth Edition). National Renewable Energy Laboratory. Technical Report NREL/TP-670-42502. December 2007. Available at:. http://www.eere.energy.gov/greenpower/resources/pdfs/42502.pdf.
- National Renewable Energy Laboratory. "NREL Highlights Leading Utility Green Power Programs: Pricing Programs Give Consumers Clean Power Choices." April 22, 2008. Available at: http://www.nrel.gov/news/press/2008/348.html.

Quantification Methods: See RCI-1.

Key Assumptions:

- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- Green power purchasing starts at 1.2% in 2010 and rises linearly each year to meet the target of 25% by 2025.
- All electricity consumers purchase green power equal to 25% of their electricity needs
- The renewable energy mix supplied to the program is 75% wind, 15% biomass, 5% hydro, and 5% municipal solid waste or landfill gas.

Key Uncertainties

None currently identified.

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-8. Nonresidential Energy Efficiency

Policy Description

This policy option removes regulatory impediments and modifies utility rates to remove financial barriers to combined heat and power (CHP). CHP refers to any system that simultaneously or sequentially generates electric energy and utilizes the thermal energy that is normally wasted. The recovered thermal energy can be used for industrial process steam, space and water heating, air conditioning, water cooling, product drying, or nearly any other thermal energy need in the commercial and industrial sectors. The end result is significantly increased efficiency over generating electric and thermal energy separately. In fact, many CHP systems are capable of an overall efficiency of over 80%—double that of conventional systems. Another significant advantage is the reduced T&D losses associated with centralized power generation.

There are significant opportunities for CHP plants in Arkansas. Fully 47% of industrial natural gas use in the South Census region is used for process heating or cooling that might be suitable for CHP (U.S. DOE/EIA, 2002).

Industrial and commercial facilities served by 480-volt, three-phase power from a utility typically use dry-type transformers to distribute power internally at lower voltages, such as for lighting and plug power. Efficient transformers are able to reduce T&D losses throughout the period of use. When combined with incentives, the electricity saved by such energy-efficient transformers typically has a 3-year payback period. The Energy Policy Act of 2005 set a standard for National Electrical Manufacturing Association (NEMA) TP-1 low-voltage distributors, effective 2007. Standards for medium- and high-voltage distributors have been ruled to have no significant impact on the environment.[23] While federal standards have increased the efficiency of transformers, the RCI TWG recommends that Arkansas consider adopting incentives to encourage transformers that can efficiently handle nonlinear (variable) loads from digital equipment and lighting. The RCI TWG has not quantified the costs and benefits from such an incentive policy.

Policy Design

Goals:

- Install additional CHP and waste heat recovery technical potential on 25% of new boiler installations of a minimum size rating consistent with a reasonable payout in the state.
- Encourage efficient transformers where options for improved energy efficiency are available.

Timing: Achieve goals by 2010.

Implementing Parties: APSC.

[23] U.S. Environmental Protection Agency, "Finding of No Significant Impact: Energy Conservation Program for Commercial Equipment, Distribution Transformers." *Federal Register* November 9, 2007;72(217):63563-63564. Available at: http://www.epa.gov/fedrgstr/EPA-AIR/2007/November/Day-09/a22004.htm.

Other: None noted.

Implementation Mechanisms

None currently identified.

Related Policies/Programs in Place

The EPA Combined Heat and Power Partnership is a voluntary program seeking to reduce the environmental impact of power generation by promoting the use of CHP. The partnership works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits.[24]

Type(s) of GHG Reductions

CO_2, CH_4, and N_2O emissions are reduced by avoided electricity generation from fossil fuel sources.

Estimated GHG Reductions and Costs or Cost Savings

Table 10. Estimated GHG reductions and costs of or cost savings from RCI-8

Quantification Factors	2015	2025	Units
GHG emission reductions	0.43	0.95	$MMtCO_2e$
Net present value (2009–2025)	$106	$583	$ Million
Cumulative GHG reductions (2008–2025)	1.51	8.56	$MMtCO_2e$
Cost-effectiveness	$70.10	$68.09	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources:

- Bruce Hedman. "CHP Market Review." Presented at Southeast Planning Session on July 6, 2005. Available at: http://www.chpcenterse.org/pdfs/EEA-Southeast_Planning_session_7-6-05.pdf.
- U.S. Environmental Protection Agency, Combined Heat and Power Partnership. *Catalog of CHP Technologies*. Introduction, p. 7. Available at: http://www.epa.gov/CHP/basic/catalog.html.
- Kim Crossman. "Woody Biomass to CHP—Characteristics, Costs, and Performance of Commercially Available Technologies." Presented to the Society of American Foresters on October 26, 2007. Available at: www.fpl.fs.fed.us/tmu/2007safconvention/2007safconvention--crossman.pptwww.fpl.fs.fed.us/tmu/2007safconvention/2007safconvention--crossman.ppt.

[24] U.S. Environmental Protection Agency. Combined Heat and Power Partnership. Available at: http://www.epa.gov/chp/.

- U.S. Department of Energy, Energy Information Administration. U.S. Department of Energy, Energy Information Administration. *Assumptions to the Annual Energy Outlook 2008: With Projections for 2030*. Table 4: Growth Rates for Total Energy Use by Sector. DOE/EIA-0554(2008). June 2008. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/.
- U.S. Department of Energy, Energy Information Administration. "2002 Energy Consumption by Manufacturers—Data Tables." Table 5.7—End Uses of Fuel Consumption, March 8, 2005. Available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html.

Quantification Methods: See RCI-1.

Key Assumptions:

- Technical potential for CHP in Arkansas in 2005 is 660 MW for commercial and 1120 MW for industrial facilities. This serves as an estimate for CHP retrofit capacity, which is implemented linearly for 15 years.
- Each year, 25% of new thermal demand is installed with CHP.
- The avoided CO_2 emissions are assumed to be Arkansas average emission intensities over the 2010–2025 period, estimated at 0.58 tCO_2/MWh in 2009.
- The fuel for new commercial CHP is 100% gas; for new industrial and advanced biofuel refineries, the fuel is 33% coal, 33% gas, and 33% biomass.
- The program deploys only 30% of estimated technical CHP potential for commercial, industrial, and advanced biofuel refineries in the state over the life of the program.
- T&D losses are be 8.1%.[25]
- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.
- Avoided capacity charges for commercial CHP are: ancillary service charge—$0.28/kW/month; facility capacity – distribution—$1.65/kW/ month; on-peak demand charge—$1.90/kW/month; system usage charge—$0.35/kWh.
- New commercial and industrial CHP grows at 1.4% and 1.5%, respectively, over the 2006–2020 period.[26]
- Biofuels processing CHP supply is derived from the assumption that biofuel produced in the state will be 15% of total transportation fuel by 2025, and that waste heat will be captured in 25% of these sites to generate electricity.

[25] U.S. Department of Energy, Energy Information Administration. "Arkansas Electricity Profile." DOE/EIA-0348. 2006. Available at: http://www.eia.doe.gov/cneaf/electricity/st_profiles/arkansas.html.

[26] U.S. Department of Energy, Energy Information Administration. U.S. Department of Energy, Energy Information Administration. *Assumptions to the Annual Energy Outlook 2008: With Projections for 2030*. Table 4: Growth Rates for Total Energy Use by Sector. DOE/EIA-0554(2008). June 2008. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/.

Key Uncertainties

Estimating the costs of combined heat and power into the distant future is tentative because cost estimates are highly sensitive to natural gas prices, the cost of avoided power, and the assumption about the CO_2 intensity of displaced electricity.

Additional Benefits and Costs

This analysis does not consider CHP benefits from avoided costs of backup power systems.

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

None currently identified.

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-9. Support for Energy-Efficient Communities, Including Smart Growth

Policy Description

Smart growth dictates how the state will invest its money in community development, either by regulating local land-use decisions or by providing incentives to influence those decisions. Existing building and zoning codes often work against smart growth development. In the context of GHG emissions, smart growth policies can serve to revitalize and reuse commercial sites and will help preserve critical natural resources and farmland.

Improved community planning aims to create communities that are, among other attributes, livable, designed for reduced use of energy both within homes and businesses and in the transport sector, and have a reduced environmental impact relative to typical developments. Variants on the smart growth concept exist, but many call for clustering living units with easy access (often walking distance) to shops, schools, and entertainment and recreational facilities; incorporating elements of energy-efficient design and renewable energy in buildings; sharing energy facilities between buildings (for example, district heating systems); and preserving open spaces.

These two concepts—improved building energy performance and community planning—offer significant synergies for Arkansas. This policy suggests a combination of incentives and targets to induce the owners and developers of buildings and the communities in which they are located to produce and operate buildings and communities that produce markedly lower GHG emissions than existing buildings and communities.

Policy Design

Goals:

- By 2009, provide resources for local jurisdictions to examine and rewrite their outdated state and local codes to accommodate for smart growth initiatives in community planning and development. Implementing smart growth policies is expected to reduce (per-unit) energy consumption, GHC emissions, infrastructure costs, and new construction by 30% by 2030.
- Design all new buildings, developments, and major renovations to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional average for that building type based on EIA Commercial Buildings Energy Consumption Survey data.
- At a minimum, renovate an equal amount of existing building area annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional average for that building type.
- Increase the fossil fuel reduction standard for all new buildings to:
    - 60% in 2010
    - 70% in 2015
    - 80% in 2020
    - 90% in 2025

- Achieve carbon-neutral buildings in 2030 (using no fossil fuel GHG-emitting energy to operate). Implementing innovative sustainable design strategies, generating on-site renewable power, and/or purchasing renewable energy and/or certified renewable energy credits may accomplish these targets.
- Identify the link between GHG reductions and land-use planning decisions, as well as the reduction potential and targets for Arkansas.
- Create incentives to encourage smart growth by meeting Built Green Community certification or the LEED-ND (LEED for Neighborhood Development) gold level, with minimum energy and location criteria. Encourage compact and transit-oriented, mixed-use development within urban growth areas that results in reduced vehicle miles traveled and GHG emissions and encourages walking and biking.
- Improve planning to reduce sprawl modeled after the "California Communities Climate Action Plan."
- Implement executive, legislative, and administrative changes to enhance integrated design of communities, energy systems, and transport systems.
- Promote consideration of location as part of a building's GHG footprint.
- Support growth of local agricultural food production and community-supported agriculture programs. Require that a percentage of all state-funded food be sourced within 100 miles of the user.
- Limit sprawl by enabling transfer of development rights.

Timing: See above.

Implementing Parties: TBD – [as approved by the TWG]

Other: TBD – [as needed and approved by the TWG]

Implementation Mechanisms

Encourage firms to adopt policies for telecommuting and 4-day work weeks to reduce transportation-related CO_2 emissions.

Related Policies/Programs in Place

TBD – [as needed and approved by the TWG]

Type(s) of GHG Reductions

TBD – [as approved by the TWG]

Estimated GHG Reductions and Costs or Cost Savings

Table 11. Estimated GHG reductions and costs of or cost savings from RCI-9

Policy No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2009–2025			
RCI-9	Support for Energy-Efficient Communities, Including Smart Growth	*Not Yet Quantified*					Pending

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources: See RCI-1.

Quantification Methods: See RCI-1.

Key Assumptions: [TBD, as approved by the TWG]

Key Uncertainties

TBD – [as needed and approved by the TWG]

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

TBD – [as needed and approved by the TWG]

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]

RCI-10. Energy-Savings Sales Tax

Policy Description

This policy option refers to a sales tax exemption for energy-efficient products, such as compact fluorescent light bulbs; geothermal heat pumps; highly efficient (> 14.4 SEER [seasonal energy efficiency ratio]) heat pump systems (auxiliary heat may be supplied by electricity or natural gas); and ENERGY STAR-certified water heaters, refrigerators and freezers, clothes washers and dryers, and dishwashers. Establishing a market signal that rewards lower-carbon purchase decision making provides consumers an incentive to improve their energy efficiency and reduce their adverse impacts on climate.

The list of energy efficiency measures that this option applies to contains the same measures that utility energy efficiency programs typically pursue. Utility programs assume that the participant pays some portion (usually ~25%) of the capital costs of the efficiency measure. Thus, this option reduces the purchase price (capital cost) of energy efficiency goods by consumers by the amount of the sales tax. However, the state then pays these costs, rather than consumers.

The effect of the sales tax exemption on the purchase of energy-efficient products is a function of the price elasticity of demand. As the price of the efficient products decreases, the demand for these products increases. Price elasticity of demand for electricity in the short run is close to –0.20% and in the long run is closer to –0.50% (US EIA, 2003). If the policy eliminates all taxes (estimated at 8.72%), this would lead to a 2%–5% increase in demand.

Policy Design

Goals: Implement a sales tax exemption on compact fluorescent light bulbs; geothermal heat pumps; highly efficient heat pump systems; and ENERGY STAR-certified water heaters, refrigerators and freezers, clothes washers and dryers, and dishwashers.

Timing: Implement the sales tax exemption by 2010.

Implementing Parties: Retail business and consumers.

Other: TBD – [as needed and approved by the TWG]

Implementation Mechanisms

Tax exemptions would need to be approved by the appropriate jurisdictions, and tax relief mechanisms at the point of sale would need to be developed.

Related Policies/Programs in Place

Act 120 of 1st Extraordinary Session of 1983 exempts Gross Receipts Tax and Other State Excise Tax on the first 500 kWh of electricity per month for low- and moderate-income residential customers. (No Web link available.)

Type(s) of GHG Reductions

TBD – [as approved by the TWG]

Estimated GHG Reductions and Costs or Cost Savings

Table 12. Estimated GHG reductions and costs of or cost savings from RCI-10

Quantification Factors	2015	2025	Units
GHG emission reductions	0.02	0.12	$MMtCO_2e$
Net present value	–$1.12	–$13.5 to –$15.2	$ Million
Cumulative GHG reductions	0.02	0.72	$MMtCO_2e$
Cost-effectiveness	–$22.72 to –$23.60	–$18.80 to –$21.14	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources:

- Arkansas Department of Finance and Administration, Office of Excise Tax Administration. "Sales Tax Rates." Available at: http://www.state.ar.us/dfa/excise_tax_v2/et_su_rates_state.html excel file city_county_list_07_2008.xls.
- U.S. Department of Energy, Energy Information Administration. "Price Responsiveness in the AEO2003 NEMS Residential and Commercial Buildings Sector Models." 2003. Available at: http://www.eia.doe.gov/oiaf/analysispaper/elasticity/.

Quantification Methods: See RCI-1.

Key Assumptions:

- This option reduces consumer costs of energy efficiency measures and thus increases deployment. The assumed increase in deployment is a linear function of the estimated tax level. Low tax levels are expected to have little impact on purchasing decisions. High taxes and subsequent tax holidays will have a greater impact on consumers' buying energy-efficient equipment.
- The assumed state tax is 6%, the unweighted average city tax is 1.35%, and the unweighted average county tax is 1.37, for a total tax rate of 8.72%.
- Energy efficiency deployment under RCI-2b is used for baseline demand. RCI-10 leads to additional energy efficiency deployment, due to reduced participant capital costs. By 2025, this policy results in a cumulative reduction of 0.6% of annual sales.
- The price elasticity of demand for energy-efficient products is the same as the estimated price elasticity of demand for electricity in EIA (2003). The short-run price elasticity of demand for energy-efficient products begins at –0.2% in 2010 and increases linearly to the long-run elasticity of –0.5% in 2025.
- For levelized costs of energy efficiency measures and avoided costs of energy, see RCI-1.

Key Uncertainties

TBD – [as needed and approved by the TWG]

Additional Benefits and Costs

The quantification of costs and benefits of energy efficiency only include technologies that are currently commercialized. New technologies, such as building integrated solar PV panels, LED lighting, etc, that might lead to additional CO_2 reductions at a reduced cost, are not included in the cost analysis.

Feasibility Issues

TBD – [as needed and approved by the TWG]

Status of Group Approval

Pending – [until GCGW moves to final agreement at meeting #9 or #10]

Level of Group Support

TBD – [blank until GCGW meeting #9 or #10]

Barriers to Consensus

TBD – [blank until final vote by the GCGW]