

Executive Summary

Background

With the signing of Act 696 of the Arkansas 86th General Assembly (HB2460),¹ Governor Mike Beebe established the Governor's Commission on Global Warming (GCGW). By design the Commission represents a wide diversity of views and perspectives with members coming from business, industry, environmental groups, and academia. Seventeen of the 21 members of the Commission were appointed by the Governor and two members each were appointed by the President Pro Tempore of the Arkansas State Senate and by the Speaker of the Arkansas House of Representatives.

As stated by Act 696, the purpose of the GCGW process is “to place Arkansas in a position to help stabilize global climate, to allow Arkansas to lead the nation in attracting clean and renewable energy industries to the state, and to reduce consumer energy dependence on current carbon-generating technologies and expenditures.” The primary duties outlined in Act 696 task the GCGW to:

1. “Conduct an in-depth examination and evaluation of the issues related to global warming and the potential impacts of global warming on the state, its citizens, its natural resources, and its economy, including without limitation, agriculture, travel and tourism, recreation, insurance, and economic growth and development.”
2. “Based on the commission’s evaluation of the current global warming data, the assessment of global warming mitigation strategies, and the available global warming pollutant reduction strategies, the commission shall set forth
 - a. A global warming pollutant reduction goal; and
 - b. A comprehensive strategic plan for implementation of the global warming pollutant reduction goal.”

Act 696 includes an Emergency Clause, as follows: “It is found and determined by the General Assembly of the State of Arkansas that it is imperative that Arkansas study the scientific data, literature, and research on global warming to determine whether global warming is an immediate threat to the citizens in the State of Arkansas; that the potential impact of global warming on the state and its citizens, its natural resources, and the economy necessitates a thorough review by the state and a strategy to deal with the consequences of global warming; that economic opportunities might arise from an emerging carbon market tailored to reduce carbon emissions; that failure to take necessary steps to prevent, stabilize, or mitigate the effects of global warming will cause irreparable harm to the lives and livelihoods of Arkansans; and that this act is immediately necessary to ensure the welfare and well-being of the citizens of this state. Therefore, an emergency is declared to exist and this act being immediately necessary for the preservation of the public peace, health, and safety...”

¹ State of Arkansas, 86th General Assembly, Regular Session, 2007. “Act 696: An Act to Establish the Governor’s Commission on Global Warming; to Direct the Commission to Study Issues Related to Global Warming and the Emerging Carbon Market; to Establish a Global Warming Pollutant Reduction Goal and Comprehensive Strategic Plan; and for Other Purposes.” Available at: <http://www.arkleg.state.ar.us/ftp/root/acts/2007/public/act696.pdf>.

In fulfillment of the requirements of Act 696, the GCGW provides the following key recommendations and accomplishments:

- Recommendation of a comprehensive set of 54 specific policies to reduce GHG emissions and address climate-, energy-, and commerce-related issues in Arkansas. The GCGW members present and voting approved 28 policy actions unanimously, approved 23 by a super majority (five objections or fewer, including 19 that had only one objection), and approved 3 by a majority (fewer than half object). Explanations of objections are in Appendices F through J of this report, which contain detailed accounts of the GCGW's recommendations.
- Recommendation that Arkansas adopt a statewide, economy-wide global warming pollutant reduction goal to reduce the state's gross greenhouse gas (GHG) emissions below 2000 levels by 20% by 2020, 35% by 2025, and 50% by 2035.² The GCGW based its recommendations on its review of the potential overall emission reduction estimates (as compared to the GHG emissions inventory and forecast) for 31 of 54 policy recommendations for which emission reductions were quantified, and its review of goals and targets adopted by several other states. Of the 54 policy recommendations, 31 were analyzed quantitatively to have a cumulative effect of reducing emissions by about 35.5 million metric tons of carbon dioxide equivalent (MMtCO₂e) in 2020 and 53.3 MMtCO₂e in 2025. Together, if the 31 quantified policy recommendations and the recent federal actions (or their functional equivalent) are successfully implemented, the 2020 emission reduction goal would be achieved and the 2025 GHG emission reduction goal would come very close to being achieved based on results of analysis of GCGW proposals conducted through the GCGW and Technical Work Group (TWG) process. In addition, the GCGW recommends that the state report to the Governor and the state legislature every 2 years on the state's progress toward achieving the statewide GHG reduction goal and identify future actions and resource needs.
- Evaluation of the direct costs and direct cost savings of the policy recommendations in Arkansas. The GCGW analyzed quantitatively the direct costs or cost savings of 29 of its 54 policy recommendations. Although the total net cost associated with the 29 policies analyzed is estimated at about \$3.7 billion between 2009 and 2025, the weighted-average cost-effectiveness of the 29 policies is estimated to be approximately \$8.8/tCO₂e reduced. Many of the policies are estimated to yield significant cost-saving opportunities for Arkansans. Other policies will incur net costs.
- Review, update, and approval of a comprehensive inventory and forecast of GHG emissions in Arkansas for 1990 through 2025. This is the first comprehensive, statewide GHG inventory and forecast that has been developed for Arkansas. It has benefited from the expertise of many GCGW, TWG, and Advisory Body members who provided state-specific data.
- A review of the physical science of climate change and potential implications for the southern United States and developments in U.S. law related to climate change issues. The GCGW held a special evening session at which a member of the Intergovernmental Panel on Climate Change presented the results of that panel's study and of the assessments of impacts

² Year 2000 was selected as the base year for the goals because emissions inventory data are more complete for year 2000 than for previous years.

on the southeastern United States, and an environmental attorney presented the current status of international, federal and state law on the subject and the treatment of science under the law.

Inventory of Arkansas' Greenhouse Gas Emissions

In May 2008, the Center for Climate Strategies (CCS) completed a draft GHG emissions inventory and reference case projection to assist the GCGW and TWGs in understanding past, current, and possible future GHG emissions in Arkansas, and thereby inform the policy development process.³ The preliminary draft was improved by incorporating comments provided by the GCGW and TWGs. As shown in Figure EX-1, the inventory and projections revealed substantial emission growth rates and related mitigation challenges.

Arkansas' GHG emissions are rising faster than those of the nation as a whole. From 1990 to 2005, Arkansas' gross GHG emissions increased by 30%, while national gross emissions rose by 16%.⁴ The state's emissions on a per-capita basis increased by about 10% between 1990 and 2005, while U.S. per-capita emissions declined slightly (2%) over this period. On a per-capita basis, Arkansans emitted about 31 metric tons (t) of gross CO₂e in 2005—higher than the national average of about 24 tCO₂e. The higher per capita emission rates in Arkansas are driven by emissions growth in the electricity supply, transportation, and agricultural sectors (agricultural sector emissions are twice the national average). In both Arkansas and the nation as a whole, economic growth exceeded emissions growth throughout the 1990–2005 period. From 1990 to 2005, emissions per unit of gross product dropped by 26% nationally, and by 23% in Arkansas.⁵ Arkansans' gross GHG emissions are projected to rise fairly steeply to about 114 MMtCO₂e by 2025, or 74% over 1990 levels.

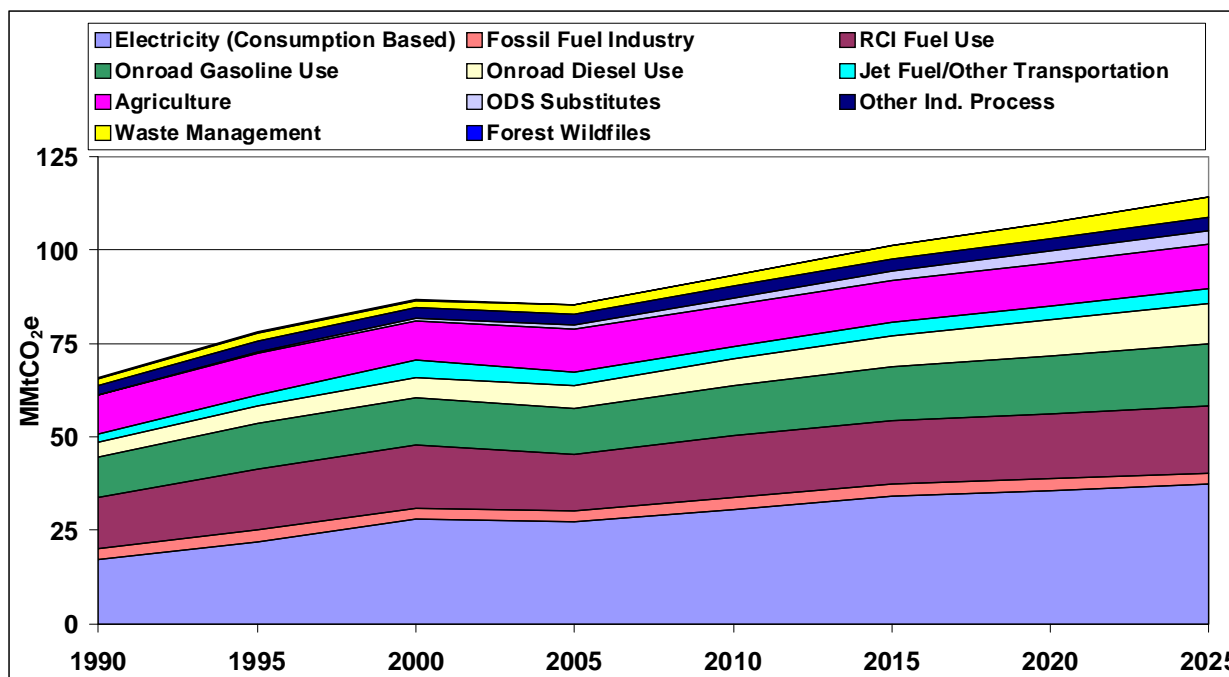
The principal sources of Arkansas' GHG emissions in 2005 are electricity consumption and transportation, accounting for 32% and 26% of Arkansas' gross GHG emissions, respectively, as shown in Figure EX-2. The direct use of fuels—natural gas, oil products, coal, and wood—in the residential, commercial, and industrial (RCI) sectors accounted for another 18% of the state's emissions in 2005.

³ Center for Climate Strategies. *Draft Arkansas Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Arkansas Governor's Commission on Global Warming. May 2008 (http://www.arclimatechange.us/Inventory_Forecast_Report.cfm).

⁴ During this period, population grew by 18% in Arkansas and by 19% nationally. However, Arkansas' economy grew at a faster rate on a per capita basis (up 44% vs. 32% nationally).

⁵ Based on real gross domestic product (millions of chained 2000 dollars) that excludes the effects of inflation. U.S. Department of Commerce, Bureau of Economic Analysis. "Gross Domestic Product by State." Available at: <http://www.bea.gov/regional/gsp/>.

Figure EX-1. Gross GHG emissions by sector, 1990–2025: historical and projected (consumption-based approach) business-as-usual/base case



MMtCO₂e = million metric tons of carbon dioxide equivalent; RCI = direct fuel use in the residential, commercial, and industrial sectors; ODS = ozone depleting substance; Ind. = industrial.

Figure EX-2. Gross GHG emissions by sector, 2005: Arkansas and U.S.

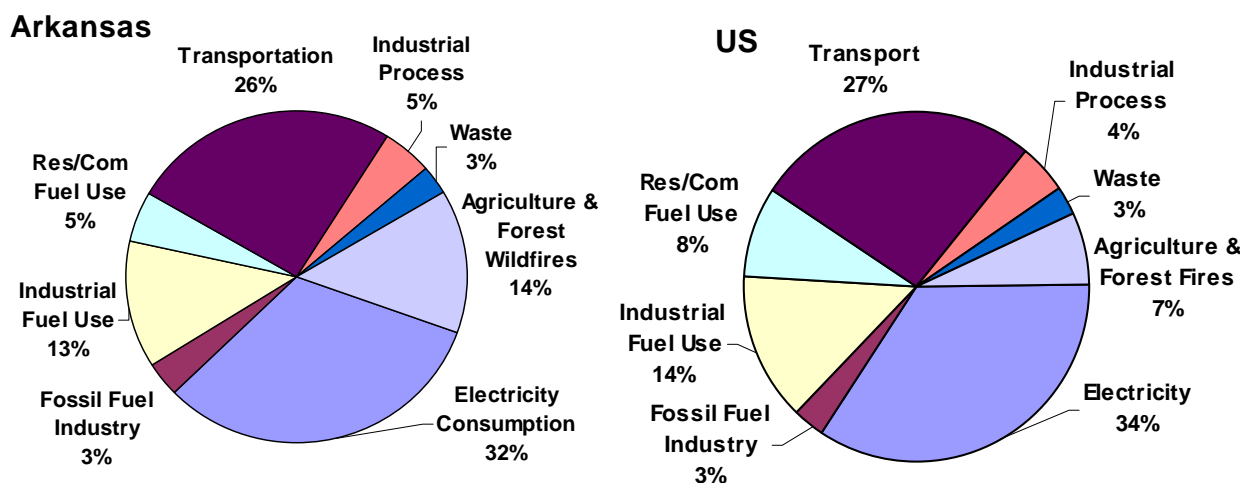


Figure EX-2 shows the agricultural and forest wildfire (including prescribed burning) sectors together accounted for 14% of the gross GHG emissions in Arkansas in 2005. These methane (CH₄) and nitrous oxide (N₂O) emissions primarily come from agricultural soils, rice cultivation, enteric fermentation, and manure management. Industrial process emissions accounted for another 5% of the state’s GHG emissions in 2005, and are rising due to the increasing use of hydrofluorocarbons and perfluorocarbons as substitutes for ozone-depleting

chlorofluorocarbons.⁶ Other industrial process emissions include CO₂ released by cement and lime manufacturing; CO₂ released during soda ash, limestone, and dolomite use; CO₂ released during ammonia, urea, and iron and steel production; N₂O released during nitric acid production; and sulfur hexafluoride released from transformers used in electricity transmission and distribution systems. Also, landfills and wastewater management facilities produce CH₄ and N₂O emissions that accounted for 3% of total gross GHG emissions in Arkansas in 2005. Similarly, emissions associated with the production, processing, transmission, and distribution of fossil fuels accounted for 3% of the gross GHG emissions in 2005.

Forestry emissions refer to the net CO₂ flux⁷ from forested lands in Arkansas, which account for about 56% of the state's land area.⁸ Arkansas' forests are estimated to be net sinks of CO₂ emissions in the state, reducing net GHG emissions by 19 MMtCO₂e in 2005. In addition, estimates of net carbon fluxes from agricultural soil cultivation practices are estimated to be net sinks of CO₂ emissions in Arkansas.

Recent Actions

Just prior to the beginning of the GCGW process, the federal Energy Independence and Security Act of 2007 (EISA) was signed into law in December 2007. This law contains several requirements that will reduce GHG emissions as they are implemented over the next few years. Sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing certain provisions of this law pertaining to increasing corporate average fuel economy for the national on-road vehicle fleet, and energy efficiency requirements for new appliances and lighting. The GHG emission reductions projected to be achieved by these actions when implemented in Arkansas were estimated and included in the baseline of related GCGW policy recommendations. Together, these federal requirements are estimated to reduce gross GHG emissions for all sectors combined in Arkansas by about 3.1 MMtCO₂e (a 2.9% reduction) from the business-as-usual emissions in 2020, and by about 4.1 MMtCO₂e (a 3.6% reduction) from the business-as-usual emissions in 2025. Note, however, that GHG emission reductions associated with EISA's Title IV (Energy Savings in Buildings and Industry) and Title V (Energy Savings in Government and Public Institutions) requirements have not been quantified because of the uncertainties in how they will be implemented. It is expected that these requirements will overlap with some of the RCI policy recommendations, especially RCI-2b, RCI-3a, RCI-3b, RCI-4a, and RCI-4b.

Arkansas has recently embarked on statewide energy efficiency programs in response to concerns about energy costs. Ark. Code Ann. §§23-3-401 *et seq.* authorizes the Arkansas Public

⁶ Chlorofluorocarbons are also potent GHGs; however, they are not included in GHG estimates because of concerns related to implementation of the Montreal Protocol on Substances That Affect the Ozone Layer. See Appendix I in the Final Inventory and Projections report for Arkansas (http://www.arclimatechange.us/Inventory_Forecast_Report.cfm).

⁷ "Flux" refers to both emissions of CO₂ to the atmosphere and removal (sinks) of CO₂ from the atmosphere.

⁸ Total forested acreage in Arkansas is 18.8 million acres. For acreage by forest type, see: Richard A. Birdsey and George M. Lewis. "Carbon in United States Forests and Wood Products, 1987–1997: State-by-State Estimates." Arkansas Estimate for 1987–1997. Available from the U.S. Department of Agriculture, Forest Service, Northern Global Change Research Program, at: <http://www.fs.fed.us/ne/global/pubs/books/epa/states/AR.htm>. The total land area in Arkansas is 33.3 million acres (<http://www.50states.com/arkansas.htm>).

Service Commission (APSC) to develop energy efficiency and conservation programs to address high energy costs. In January 2007, APSC issued its energy efficiency and conservation plan rules. The electric and gas utilities proposed a series of programs in July 2007, and the APSC approved several energy efficiency and conservation programs. The total cost of the initial quick-start programs is approximately \$18,530,924 for the initial 2-year period ending December 31, 2009. Municipal and cooperative electric utilities are also currently pursuing energy efficiency programs.

GCGW Policy Recommendations (Beyond Recent Actions)

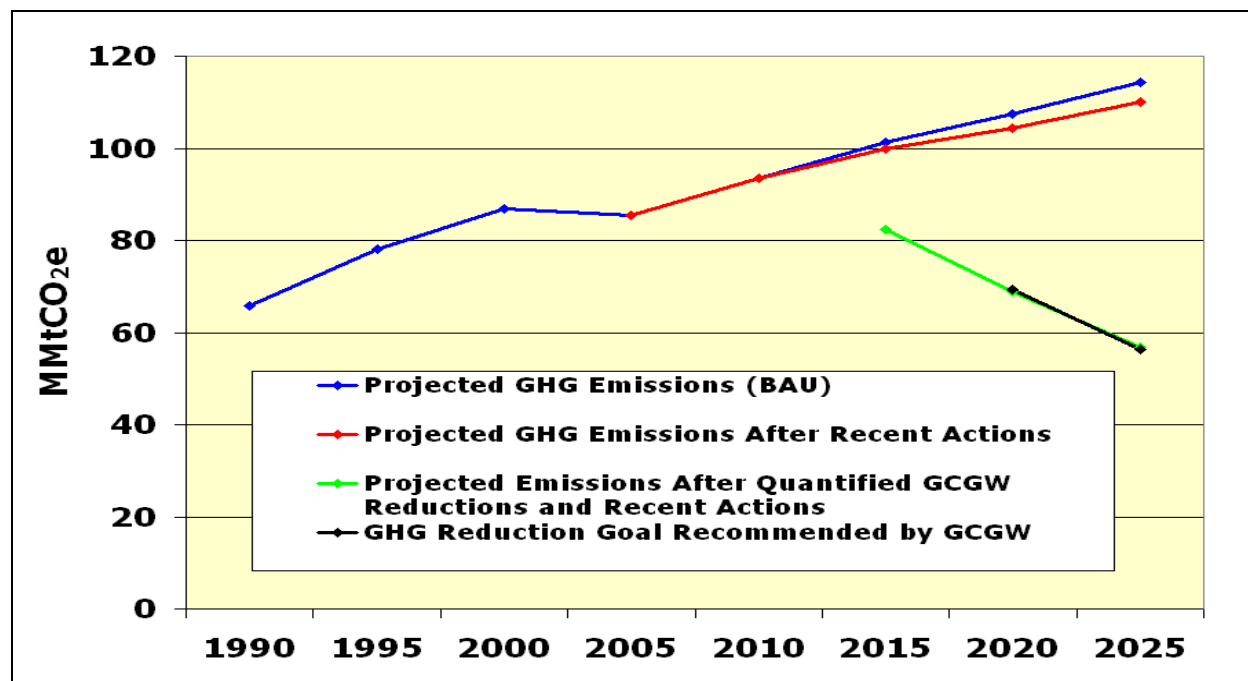
The GCGW recommended 54 policy actions. The GCGW members present and voting approved 28 policy actions unanimously, approved 23 by a super majority (five objections or fewer), and approved 3 by a majority (fewer than half object). Explanations of objections are in Appendices F through J to this report, which contain detailed accounts of the GCGW's recommendations.

A total of 31 of the 54 policy recommendations were analyzed quantitatively to estimate their effects on emissions. Of these 31 analyzed for their emission reductions, 29 were analyzed quantitatively to estimate their costs or cost savings. The 31 recommendations for which emission reductions were quantified were estimated to have a cumulative effect of reducing emissions by about 17.6 MMtCO₂e in 2015, 35.5 MMtCO₂e in 2020, and 53.3 MMtCO₂e in 2025.

Figure EX-3 presents a graphical summary of the potential cumulative emission reductions associated with the recent federal actions and the 31 policy recommendations relative to the business-as-usual reference case projections. Table EX-1 provides the numeric estimates underlying Figure EX-3. In Figure EX-3:

- The blue line shows actual (for 1990, 1995, 2000, and 2005) and projected (for 2010, 2015, 2020, and 2025) levels of Arkansas' gross GHG emissions on a consumption basis. (The consumption-based approach accounts for emissions associated with the generation of electricity in Arkansas to meet the state's demand for electricity)
- The red line shows projected emissions associated with recent federal actions that were analyzed quantitatively.
- The green line shows projected emissions if all of the GCGW's 31 recommendations that were analyzed quantitatively with respect to their GHG reduction potential are implemented successfully and the estimated reductions are fully achieved. (Note that other GCGW recommendations would have the effect of reducing emissions, but those reductions were not analyzed quantitatively, so are not reflected in the green line.)
- The black line shows the projected emission level associated with the GCGW's recommendation for Arkansas to adopt a statewide, economy-wide global warming pollutant reduction goal to reduce the state's gross GHG emissions below 2000 levels by 20% by 2020, 35% by 2025, and 50% by 2035. Together, if the 31 quantified policy recommendations and the recent federal actions (or their equivalent) are successfully implemented, the 2020 emission reduction goal would be achieved and the 2025 GHG emission reduction goal would come very close to being achieved based on results of analysis of GCGW proposals conducted through the GCGW and TWG process.

Figure EX-3. Annual GHG emissions: reference case projections and GCGW recommendations (consumption-basis, gross emissions)



MMtCO₂e = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; GCGW = Governor's Commission on Global Warming.

Table EX-1. Annual emissions: reference case projections and impact of GCGW recommendations (consumption-basis, gross emissions)

Annual Emissions (MMtCO ₂ e)	1990	2000	2005	2010	2015	2020	2025
Projected GHG Emissions	65.8	86.8	85.4	93.5	101.3	107.5	114.2
Reductions From Recent Actions*			0.0	0.1	1.4	3.1	4.1
Projected GHG Emissions After Recent Actions			85.4	93.4	99.9	104.4	110.1
Total GHG Reductions From 31 Analyzed GCGW Recommendations					17.6	35.5	53.3
Projected Annual Emissions After Quantified GCGW Reductions [†]					82.3	68.9	56.8
2020 and 2025 GHG Reduction Goal Recommended by GCGW						69.4	56.4

MMtCO₂e = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; GCGW = Governor's Commission on Global Warming.

* Reductions from recent actions include the Energy Independence and Security Act of 2007, Title III. GHG reductions from Titles IV and V of this Act have not been quantified because of the uncertainties in how they will be implemented. It is expected that Titles IV and V measures will overlap with RCI policies.

[†] Projected annual emissions also include reductions from recent actions.

For the policies recommended by the GCGW to yield the levels of estimated emission reductions shown in Table EX-2, they must be implemented in a timely, aggressive, and thorough manner.

Table EX-2. Summary by sector of estimated impacts of implementing all of the GCGW recommendations (cumulative reductions and costs/savings)

Sector	GHG Reductions (MMtCO ₂ e)			Net Present Value 2009–2025 (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)
	2015	2025	Total 2009–2025		
Residential, Commercial, and Industrial	2.5	9.2	69.8	–\$1,313	–\$19
Energy Supply	6.0	22.6	179.5	\$ 6,228	\$35
Transportation and Land Use	1.3	3.2	28.9	–\$2,244	\$78
Agriculture, Forestry, and Waste Management	7.8	18.3	162.2	\$1,045	\$6.4
Cross-Cutting Issues	Non-quantified, enabling options				
TOTAL (includes all adjustments for overlaps)	17.6	53.3	440.4	\$ 3,717	\$8.8

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent.

The values in this table do not include the effects of recent actions. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the policy recommendations.

Within each sector, values have been adjusted to eliminate double counting for policies or elements of policies that overlap. In addition, values associated with policies or elements of policies within a sector that overlap with policies or elements of policies in another sector have been adjusted to eliminate double counting. Appendix G (for the RCI sectors), Appendix J (for the AFW sectors), and Appendix I (for the TLU sectors) of this report provide documentation of how sector-level emission reductions and costs (or cost savings) were adjusted to eliminate double counting associated with overlaps between policies.

Figure EX-4 presents the estimated tons of reductions for each policy recommendation for which estimates were quantified, expressed as a cumulative figure for the period 2009–2025. Figure EX-5 presents the estimated dollars-per-ton cost (or cost savings, depicted as a negative number) for each policy recommendation for which cost estimates were quantified. This measure is calculated by dividing the net present value of the cost of the policy recommendation by the cumulative GHG reductions, all for the period 2009–2025.

Figure EX-6 presents a stepwise marginal cost curve for Arkansas. The horizontal axis represents the percentage of GHG emissions reduction in 2025 for each option relative to the business as usual (BAU) forecast. The vertical axis represents the marginal cost of mitigation (expressed as the cost-effectiveness of each policy recommendation on a cumulative basis, 2009–2025). In the figure, each horizontal segment represents an individual policy. The width of the segment indicates the GHG emission reduction potential of the option in percentage terms. The height of the segment relative to the x-axis shows the average cost (saving) of reducing one MMtCO₂e of GHG emissions with the application of the option.

Table EX-3. Residential, Commercial, and Industrial Policy Recommendations

No.	Policy Recommendation	GHG Reductions (MMtCO ₂ e)			Net Present Value 2009–2025 (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	Level of Support
		2015	2025	Total 2009–2025			
RCI-1*	Improved Building Codes	0.2	0.6	5.3	–\$118	–\$22	Super Majority (1 objection)
RCI-2a*	Utility and Non-Utility DSM for Peak Use Electricity	0.01	0.02	0.21	–\$11	–\$52	Super Majority (1 objection)
RCI-2b*	Utility and Non-Utility DSM and Energy Efficiency for Electricity	1.1	4.1	30.5	–\$1,450	–\$48	Majority (7 objections)
RCI-3a*	Reduced Energy Use in New and Retrofitted State-Owned Buildings	0.1	0.6	4.3	–\$42	–\$10	Super Majority (1 objection)
RCI-3b*	Reduced Energy Use in State-Owned Buildings	0.2	0.4	4.2	–\$46	–\$11	Super Majority (1 objection)
RCI-4a*	Promotion and Incentives for Improved New Building Design and Construction	0.2	1.1	7.0	–\$160	–\$23	Super Majority (1 objection)
RCI-4b*	Promotion and Incentives for Improved Existing Buildings	0.0	0.3	1.7	–\$39	–\$23	Super Majority (1 objection)
RCI-5*	Education for Consumers, Industry Trades, and Professions	<i>Not Quantified</i>					Unanimous
RCI-6 [†]	Incentives and Funds To Promote Renewable Energy and Energy Efficiency	0.2	0.8	5.1	–\$118	–\$23	Super Majority (1 objection)
RCI-7*	Green Power Purchasing for Consumers	0.2	0.6	4.7	\$61	\$13	Unanimous
RCI-8*	Nonresidential Energy Efficiency	0.4	1.0	8.6	\$583	\$68	Unanimous
RCI-9 [†]	Support for Energy-Efficient Communities, Including Smart Growth	<i>Not Quantified</i>					Unanimous
RCI-10 [†]	Energy-Savings Sales Tax	0.0	0.1	0.7	–\$33	–\$47	Super Majority (1 objection)
	Sector Total After Adjusting for Overlaps	2.55	9.24	69.77	–\$1,313	–\$18.8	
	Reductions From Recent Actions (ESIA Title II requirements for new appliances and lighting)	0.34	0.89	8.02	<i>Not Quantified</i>		
	Sector Total Plus Recent Actions	2.89	10.13	77.79	–\$1,313	–\$18.8	

DSM = demand-side management; EISA = Energy Independence and Security Act of 2007; GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent.

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

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

* The GCGW approved this option at Meeting #9 (September 9, 2008); 18 members present and voting (one by phone).

[†] The GCGW approved this option at Meeting #10 (September 25, 2008); 21 members present and voting (none by phone).

Table EX-3 (continued). Energy Supply Policy Recommendations

No.	Policy Recommendation	GHG Reductions (MMtCO ₂ e)			Net Present Value (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	Level of Support
		2015	2025	Total 2009–2025			
ES-2*	Technology Research & Development	<i>Not Quantified</i>					Unanimous
ES-3 [†]	3a: Renewable Portfolio Standard (RPS)	0.3	3.6	21.9	\$548	\$25.0	Majority (10 objections)
	3b: Renewable Energy Feed-In Tariff (REFIT)	0.2	2.0	12.3	\$399	\$32.5	Super Majority (4 objections)
ES-4 [†]	Grid-Based Renewable Energy Incentives and/or Barrier Removal	<i>Not Quantified</i>					Unanimous
ES-5 [†]	Approaches Benefiting From Regional Application	<i>Not Quantified</i>					Unanimous
ES-6*	Combined Heat and Power	0.6	2.9	20.0	\$886	\$44.3	Unanimous
ES-7 [†]	Geological Underground Sequestration for New Plants	2.9	5.6	56.5	\$1,801	\$31.9	Majority (10 objections)
ES-8 [†]	Transmission System Upgrades	<i>Not Quantified</i>					Unanimous
ES-9*	Nuclear Power	0.0	9.8	58.9	\$1,574	\$26.7	Unanimous
ES-10 [†]	Carbon Tax	<i>Not Quantified</i>					Super Majority (4 objections)
ES-11*	Efficiency Improvements and Repowering of Existing Plants	2.3	2.3	31.8	\$1,568	\$49.3	Unanimous
	Sector Total After Adjusting for Overlaps	6.0	22.6	179.5	\$6228	\$34.7	
	Reductions From Recent Actions	0	0	0	\$0	\$0.0	
	Sector Total Plus Recent Actions	6.0	22.6	179.5	\$6,228	\$34.7	

CCS = carbon capture and storage; GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent.

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

The numbering used to denote the above policy recommendations is for reference purposes only; it does not reflect prioritization among these important policy recommendations. ES-1 (Green Power Purchases and Marketing) was combined with RCI-7 (Green Power Purchasing for Consumers).

* The GCGW approved this option at Meeting #9 (September 9, 2008); 18 members present and voting (one by phone).

[†] The GCGW approved this option at Meeting #10 (September 25, 2008); 21 members present and voting (none by phone).

Table EX-3 (continued). Transportation and Land Use Policy Recommendations

No.	Policy Recommendation	GHG Reductions (MMtCO ₂ e)			Net Present Value 2009–2025 (Million \$)	Cost-Effective-ness (\$/tCO ₂ e)	Level of Support
		2015	2025	Total 2009–2025			
TLU-1*	Study the Feasibility of Plug-In Vehicles	<i>Not Quantified—Qualitative Study Recommendation</i>					Unanimous
TLU-2 [†]	Research and Development of Renewable Transportation Fuels	<i>Incorporated Into Analysis for TLU-3</i>					Super Majority (1 objection)
TLU-3 [†]	Advanced Biofuels Development and Expansion	0.88	2.54	21.26	–\$2,293	–\$108	Super Majority (1 objection)
TLU-4*	Smart Growth, Pedestrian and Bicycle Infrastructure	0.06	0.17	1.39	≤0 (Net Savings)	≤0 (Net Savings)	Unanimous
TLU-5*	Improve and Expand Transit Service and Infrastructure	0.001	0.007	0.03	1.5	\$1,479	Unanimous
TLU-6 [†]	School and University Transportation Bundle	0.006	0.013	0.113	N/A	N/A	Unanimous
TLU-7*	Promote and Facilitate Freight Efficiency	0.33	0.47	6.1	\$48	\$104	Unanimous
TLU-8 [†]	Procurement of Efficient Fleet Vehicles (Passenger and Freight)	<i>State "Lead by Example" Qualitative Recommendation</i>					Unanimous
TLU-9 [†]	Fuel Efficiency: Clean Car Incentive	<i>Not Quantified—Qualitative Study Recommendation</i>					Super Majority (1 objection)
TLU-10*	Public Education	<i>Not Quantified</i>					Unanimous
	Sector Total After Adjusting for Overlaps	1.28	3.2	28.89	–\$2,244	–\$78	
	Reductions From Recent Actions (Federal CAFE Requirements)	1.02	3.26	26.9	Not Quantified		
	Sector Total Plus Recent Actions	2.29	6.45	30.2	–\$2,244	–\$78	

CAFE = corporate average fuel economy; GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable.

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

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

* The GCGW approved this option at Meeting #9 (September 9, 2008); 18 members present and voting (one by phone).

[†] The GCGW approved this option at Meeting #10 (September 25, 2008); 21 members present and voting (none by phone).

Table EX-3 (continued). Agriculture, Forestry, and Waste Management Policy Recommendations

No.	Policy Recommendation		GHG Reductions (MMtCO ₂ e)			Net Present Value 2009–2025 (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	Level of Support
			2015	2025	Total 2009–2025			
AFW-1*	Manure Management		Not quantified					Unanimous
AFW-2†	Promotion of Farming Practices That Achieve GHG Benefits	Soil Carbon	0.5	1.3	11	–\$71	–\$6	Super Majority (1 objection)
		Nutrient Efficiency	0.1	0.3	2.4	–\$66	–\$27	
AFW-3†	Improved Water Management and Use	Increased Surface Water	0.005	0.01	0.10	\$86	\$835	Super Majority (1 objection)
		Improved Purification	0.001	0.001	0.01	–\$0.4	–\$39	
AFW-4†	Expanded Use of Agriculture and Forestry Biomass Feedstocks for Electricity, Heat, or Steam Production	Energy From Biomass	2.1	4.2	41	\$1,637	\$40	Super Majority (1 objection)
		Energy From Livestock Manure and Poultry Litter	0.01	0.02	0.2	\$0.8	\$4	
		Capture of Waste Heat	0.02	0.06	0.50	–\$70	–\$140	
AFW-5†	Expanded Use of Advanced Biofuels		1.4	2.2	20	\$114	\$6	Unanimous
AFW-6†	Expanded Use of Locally Produced Farm and Forest Products		0.03	0.06	0.6	\$2	\$4	Unanimous
AFW-7†	Forest Management and Establishment for Carbon Sequestration	Urban Forestry	0.02	0.1	0.4	\$17	\$41	Unanimous
		Sustainable Forest Management	4.1	10.4	91	\$1,139	\$21	
		Afforestation	0.7	1.8	16	\$201	\$12	
AFW-8†	Advanced Recovery and Recycling		1.5	4.4	36	–\$283	–\$8	Super Majority (1 objection)
AFW-9†	End-of-Use Waste Management Practices		0.02	0.02	0.4	–\$1	–\$3	Super Majority (1 objection)
	Sector Total After Adjusting for Overlaps		7.8	18.3	162.2	\$1,045	\$6.4	
	Reductions From Recent Actions		0.0	0.0	0.0	\$0.0	\$0.0	
	Sector Total Plus Recent Actions		7.8	18.3	162.2	\$1,045	\$6.4	

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent.

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

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

* The GCGW approved this option at Meeting #8 (July 31, 2008); 19 members present and voting (two by phone).

† The GCGW approved this option at Meeting #9 (September 9, 2008); 18 members present and voting (one by phone).

Table EX-3 (continued). Cross-Cutting Issues Policy Recommendations

No.	Policy Recommendation	GHG Reductions (MMtCO ₂ e)			Net Present Value 2009–2025 (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	Level of Support
		2015	2025	Total 2009–2025			
CC-1 [†]	Greenhouse Gas Inventories and Forecasts	<i>Not Quantified</i>					Unanimous
CC-2 [‡]	State Greenhouse Gas Reporting and Registry	<i>Not Quantified</i>					Unanimous
CC-3 [‡]	Statewide Greenhouse Gas Reduction Goals or Targets	<i>Not Quantified</i>					Super Majority (3 objections)
CC-4*	The State's Own Greenhouse Gas Emissions (Lead by Example)	<i>Not Quantified</i>					Unanimous
CC-5*	Comprehensive Local Government Climate Action Plans	<i>Not Quantified</i>					Super Majority (1 objection)
CC-6*	State Climate Public Education and Outreach	<i>Not Quantified</i>					Super Majority (1 objection)
CC-7 [‡]	Optimizing Best Scale of Reduction Policies	<i>Not Quantified</i>					Unanimous
CC-8 [†]	Creative Financial Mechanisms	<i>Not Quantified</i>					Super Majority (1 objection)
CC-9*	Adaptation and Vulnerability	<i>Not Quantified</i>					Super Majority (1 objection)
CC-10 [†]	Climate Change-Related Economic Development	<i>Not Quantified</i>					Unanimous
CC-11 [†]	Regulatory Realignment in Government To Encourage Constructive Climate Action	<i>Not Quantified</i>					Super Majority (2 objections)

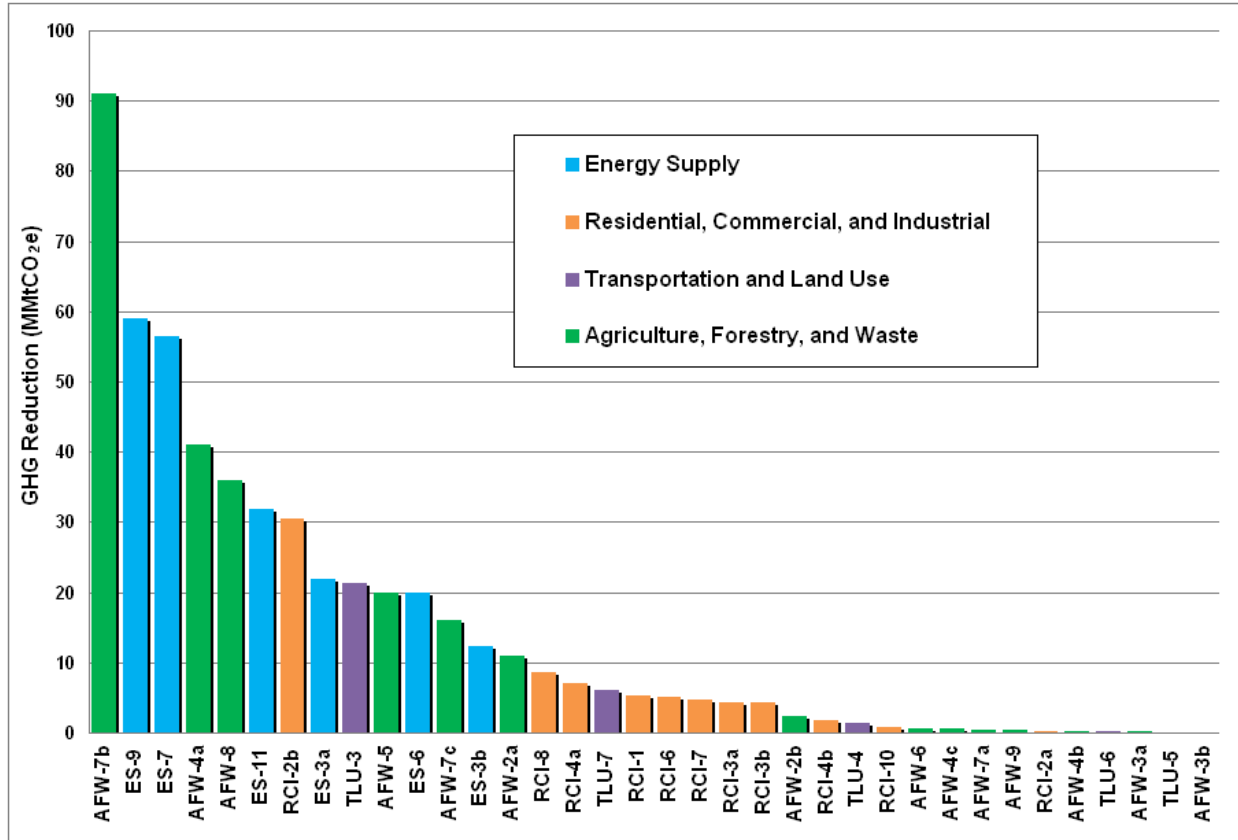
GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent.

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

* The GCGW approved this option at Meeting #8 (July 31, 2008); 19 members present and voting (two by phone).

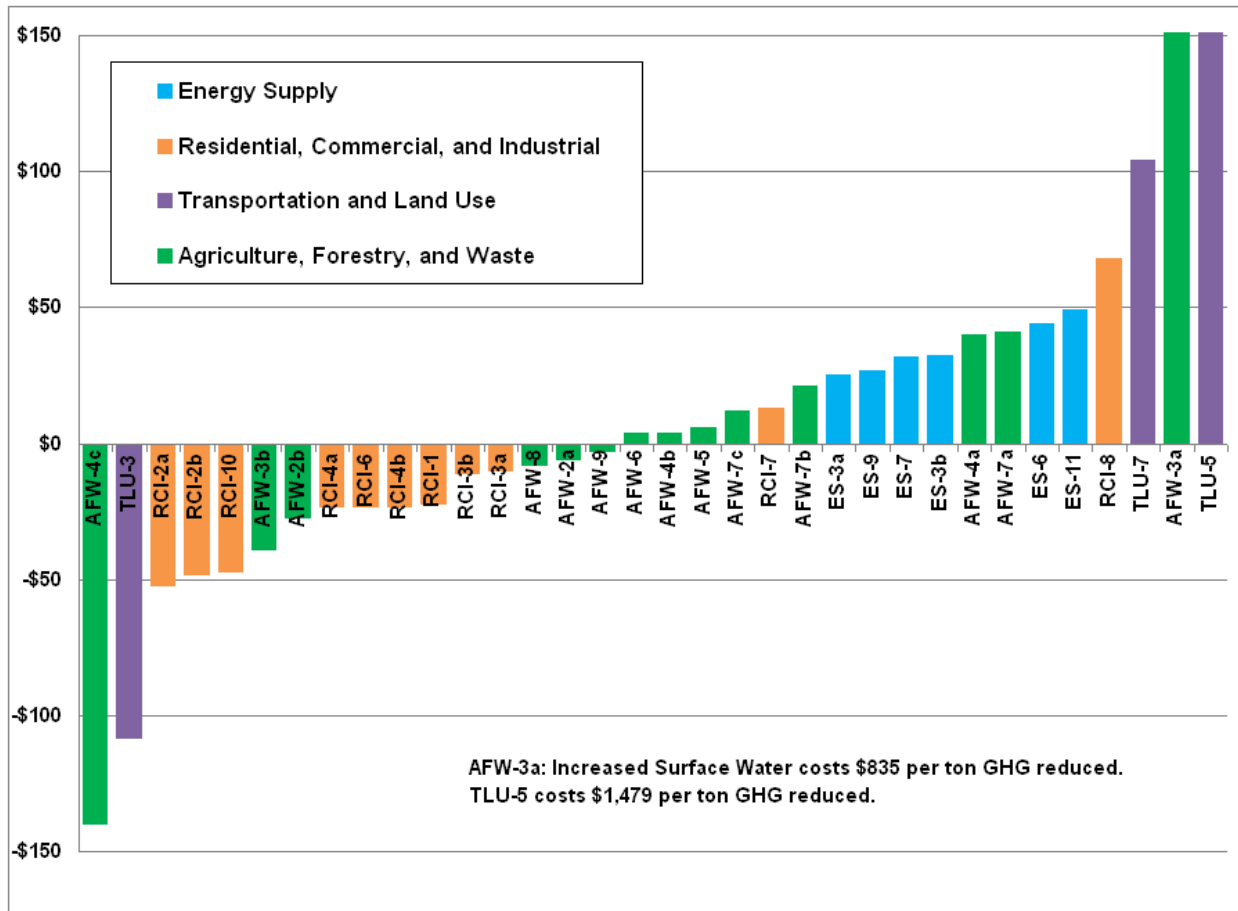
† The GCGW approved this option at Meeting #10 (September 25, 2008); 21 members present and voting (none by phone).

Figure EX-4. GCGW policy recommendations ranked by cumulative (2009–2025) GHG reduction potential



GHG = greenhouse gas; MMtCO_{2e} = million metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; RCI = Residential, Commercial, and Industrial; TLU = Transportation and Land Use; ES = Energy Supply.

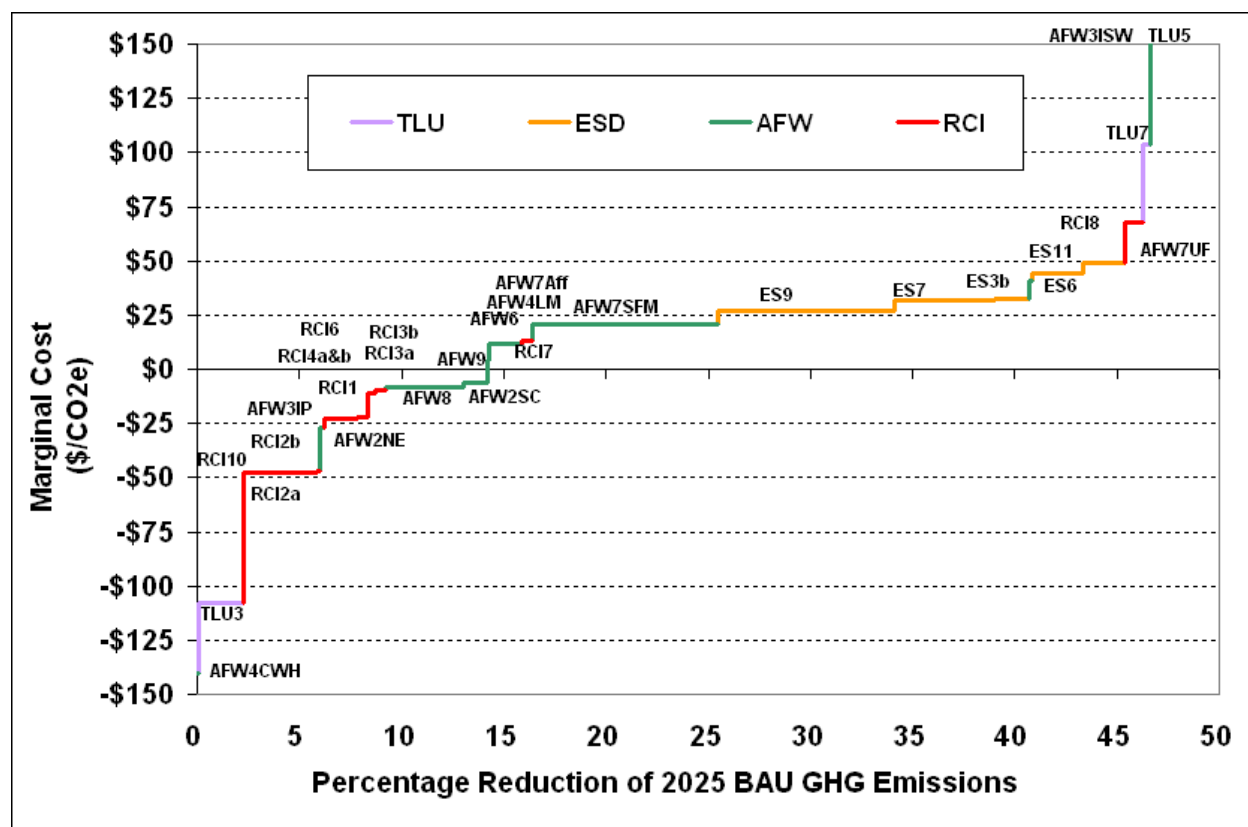
Figure EX-5. GCGW policy recommendations ranked by cumulative (2009–2025) net cost/cost savings per ton of GHG removed



GHG = greenhouse gas; RCI = Residential, Commercial, and Industrial; TLU = Transportation and Land Use; ES = Energy Supply; AFW = Agriculture, Forestry, and Waste Management.

Negative values represent net cost savings and positive values represent net costs associated with the policy recommendation.

Figure EX-6. Stepwise marginal cost curve for Arkansas, 2025



BAU = business as usual; GHG = greenhouse gas; tCO₂e = metric tons of carbon dioxide equivalent; AFW = Agriculture, Forestry, and Waste Management; RCI = Residential, Commercial, and Industrial; TLU = Transportation and Land Use; ES = Energy Supply.

Negative values represent net cost savings and positive values represent net costs associated with the policy recommendation.

Note: Results have been adjusted to remove overlaps between policies. AFW 3a and TLU 5 are not shown due to scale effects. AFW 3a costs \$835 per ton CO₂e reduced, and TLU 5 costs \$1,479/ton.

Summary of Current Scientific Literature on Causes and Impacts of Global Warming

All panels of scientists who have reviewed the science of climate change have concluded that there is a 90 to 95% probability that human activities have increased amounts of important GHGs (primarily CO₂, CH₄, N₂O, and fluorocarbons) in the atmosphere to levels not seen in all of prior human experience, and likely not seen for 3 million years. *See, Fourth Report of the Intergovernmental Panel on Climate Change (IPCC) (2007) and in at least three reports of the National Research Council of the National Academy of Sciences (NAS/NRC), Climate Change Science: An Analysis of Some Key Questions (2001) (“Climate Change Science”), NAS/NRC, Surface Temperature Reconstructions for the Last 2,000 Years (2006); NAS/NRC, Abrupt Climate Change: Inevitable Surprises (2002).* These findings are also reflected in the summary of science prepared by the U.S. Environmental Protection Agency (U.S. EPA) in the Advance Notice of Proposed Rulemaking, *Regulating Greenhouse Gas Emissions Under the Clean Air Act*, 73 Fed. Reg. 44354 (July 30, 2008). Scientists have already observed increased temperatures

and a variety of related effects and, because GHGs have very long residence times in the atmosphere, if no action is taken to restrict emissions, impacts are likely to increase dramatically.

There are a variety of impacts that are expected to affect Arkansas. These include increases in severe weather events and drought, which, in turn, can be expected to adversely affect agriculture. Floods are expected to increase in frequency with related expansion of floodplains and flood damage. Sea level rise will inundate some nearby coastal areas, and related salt-water intrusion, coupled with increased drought stress may impact water supplies. In areas dependent on snow pack, such as the western United States, water supplies will be more severely affected. Ecosystems and sensitive species could be disrupted as climatic zones move north. Tropical diseases and insects will move north. Heat-related deaths will increase, although cold-related deaths will decrease. Climate change impacts in volatile regions of the world could destabilize these areas and pose a national security threat. There is also a possibility of sudden and dramatic climate change that cannot be predicted, but would have far greater and adverse impacts.

Although there are books and articles in the popular press that raise questions about climate change, none have been scientifically peer reviewed. The body of literature that has undergone peer review is virtually unanimous in concluding that human activities have affected climate and that the effects will increase if anthropogenic GHG emissions are not reduced. None of the skeptics will say to a reasonable degree of scientific certainty that emissions of GHGs will not have adverse impacts. The applicable legal standards require action if adverse impacts can be reasonably anticipated. See 42 U.S.C. §§ 7408(a)(1) (“air pollution which may reasonably be anticipated to endanger public health or welfare”), 7411(b)(1)(A) (same), 7521(a)(1) (same), 7547(a)(1)(same), 7571(a)(2)(A)(same); see also United Nations Framework Convention on Climate Change, art. 3, §3.