

Chapter 1

Background and Overview

Creation of the Governor's Commission on Global Warming

Arkansas Act 696

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

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>.

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...”

GCGW’s Response

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

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.

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 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.

Recent Actions

GHG Reductions Associated With Recent Federal Actions

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. During the GCGW process, sufficient information was identified (e.g., implementation schedules) to estimate GHG emission reductions associated with implementing the Corporate Average Fuel Economy requirements and energy efficiency requirements for new appliances and lighting in Arkansas. The GHG emission reductions projected to be achieved by these actions are shown in Figure 1-1. Table 1-1 provides the numeric estimates underlying Figure 1-1. 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 the 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 residential, commercial, and industrial (RCI) sector policy recommendations, especially RCI-2b, RCI-3a, RCI-3b, RCI-4a, and RCI-4b.

Recent State Actions

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 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.

Figure 1-1. Estimated emission reductions associated with the effect of recent federal actions in Arkansas (consumption-basis, gross emissions)

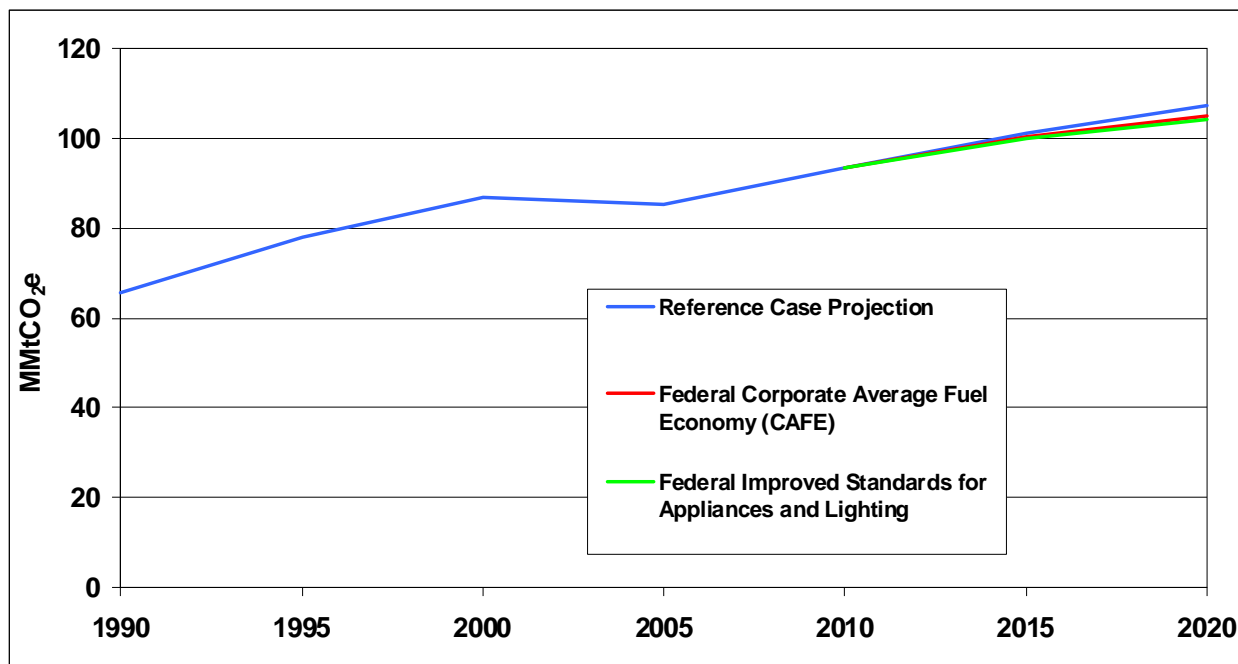


Table 1-1. Estimated emission reductions associated with the effect of recent federal actions in Arkansas (consumption-basis, gross emissions)

Sector / Recent Action	GHG Reductions		GHG Emissions (MMtCO ₂ e)	
	(MMtCO ₂ e)		Business as Usual	With Recent Actions
	2012	2020	2020	2020
Residential, Commercial and Industrial (RCI)				
Energy Efficiency Requirements for New Appliances and Lighting	0.34	0.89	18.1	17.2
Transportation and Land Use (TLU)				
Corporate Average Fuel Economy (CAFE) Requirements	1.02	3.26	31.1	27.8
Total (RCI + TLU Sectors)	1.35	4.14	49.2	45.0
Total (All Sectors)	—	—	114.2	110.1

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent.

The GCGW Process

The GCGW began its deliberative process at its third meeting on February 7, 2008, and met a total of nine times, with the final decisional meeting held on September 25, 2008, followed by a conference call for review of this report. In all, more than 75 meetings and teleconferences of the GCGW and the five supporting TWGs were held to identify and analyze various potential policy actions in advance of the GCGW's September 25, 2008, final decisional meeting.

The five TWGs considered information and potential recommendations in the following sectors:

- Residential, Commercial, and Industrial (RCI);
- Energy Supply (ES);
- Transportation and Land Use (TLU);
- Agriculture, Forestry, and Waste Management (AFW); and
- Cross-Cutting Issues (CC) (i.e., issues that cut across the above sectors).

The Center for Climate Strategies (CCS) provided facilitation and technical assistance to the GCGW and each of the TWGs, based on a detailed proposal approved by the GCGW. The TWGs consisted of only GCGW members; however, the Commission established and appointed an Advisory Body composed of the directors of the following state agencies: Agriculture Department, Department of Environmental Quality, Forestry Commission, Highway and Transportation Department, Natural Resources Commission, Public Service Commission, State Game and Fish Commission, Department of Economic Development, Department of Parks and Tourism, and Oil and Gas Commission. Advisory Body members were assigned to each TWG to assist in responding to questions and providing technical information as requested by the GCGW members (see Appendix C for a listing of the TWG and Advisory Body members of each TWG). Members of the public were invited to observe and provide input at all meetings of the GCGW and TWGs. The TWGs served as advisers to the GCGW and helped generate initial recommendations on Arkansas-specific policy options to be added to the catalog of existing states actions; priority policy recommendations for analysis; draft proposals on the design characteristics and quantification of the proposed policy recommendations; specifications and assistance for analysis of draft policy options (including best available data sources, methods and assumptions); and other key elements of policy option proposals, including related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus. Where members of a TWG did not fully agree on recommendations to the GCGW, the summary of their efforts was reported to the GCGW as a part of its consideration and actions. The GCGW then made its decisions after reviewing the TWGs' proposals, including modifications as deemed appropriate in their judgment.

The GCGW process employed a model of informed self-determination through a facilitated, stepwise, fact-based, and consensus-building approach. With oversight by the Arkansas Governor's Office, the process was conducted by CCS, an independent, expert facilitation and technical analysis team. It was based on procedures that CCS has used in a number of other state climate change planning initiatives since 2000, but was adapted specifically for Arkansas. The GCGW process sought but did not mandate consensus, and it explicitly documented the level of GCGW support for policies and key findings through a voting process established in advance, including barriers to full consensus where they existed on final consideration of proposed actions.

The 54 policy recommendations (out of more than 300 potential options considered) adopted by the GCGW and presented in this report were developed through a stepwise approach that included: (1) expanding a list existing states actions to include additional Arkansas-specific actions; (2) developing a set of "priority for analysis" options for further development; (3) fleshing these proposals out for full analysis by development of "straw proposals" for level of

effort, timing and parties involved in implementation; (4) developing and applying a common framework of analysis for options, including sector specific guidance and detailed specifications for options that include data sources, methods and key assumptions; (5) reviewing results of analysis and modifying proposals as needed to address potential barriers to consensus; (6) finalizing design and analysis of options to remove barriers to final agreement; and (7) developing other key elements of policy proposals such as implementation mechanisms, co-benefits, and feasibility considerations. At the final three meetings of the process, policy recommendations with at least majority support (defined as less than half of those present objecting) from GCGW members present were adopted by the GCGW and included in this report. The TWGs' recommendations to the GCGW were documented and presented to the GCGW at each GCGW meeting. All of the GCGW and TWG meetings were open to the public, and all materials for and summaries of the GCGW and TWG meetings were posted on the GCGW Web site (www.arclimatechange.us). A detailed description of the deliberative process is included in Appendix B.

Analysis of Policy Recommendations

With CCS providing facilitation and technical analysis, the five TWGs submitted recommendations for policies for GCGW consideration using a “policy option template” conveying the following key information:

- Policy Description
- Policy Design (Goals, Timing, Parties Involved)
- Implementation Mechanisms
- Related Policies/Programs in Place
- Type(s) of GHG Reductions
- Estimated GHG Reductions and Net Costs or Cost Savings
- Key Uncertainties
- Additional Benefits and Costs
- Feasibility Issues
- Status of Group Approval
- Level of Group Support
- Barriers to Consensus

In its deliberations, the GCGW reviewed, modified, and reached group agreement on various policy recommendations. The final versions for each sector, conforming to the policy option templates, appear in Appendices F through J and constitute the most detailed record of decisions of the GCGW. Appendix E describes the methods used for quantification of the 31 policy recommendations that were analyzed quantitatively. The quantitative analysis produced estimates of the GHG emission reductions and direct net costs (or cost savings) of implementation of various policies, in terms of both a net present value from 2009 to 2025 and a dollars-per-ton cost (i.e., cost-effectiveness). The key methods are summarized below.

Estimates of GHG Reductions: Using the projection of future GHG emissions (see below) as a starting point, 31 policy recommendations were analyzed by CCS to estimate GHG reductions attributable to each policy in the individual years of 2015 and 2025 and cumulative reductions over the period 2009–2025. The estimates were prepared in accordance with guidance by the

appropriate TWG and the GCGW, which later reviewed the estimates and, in some cases, directed that they be revised with respect to such elements as goals, data sources, assumptions, sensitivity analysis, and methodology. Many policies were estimated to affect the quantity or type of fossil fuel combusted; others affected methane or CO₂ sequestered. Among the many assumptions involved in this task was selection of the appropriate GHG accounting framework—namely, the choice between taking a “production-based” approach versus a “consumption-based” approach to various sectors of the economy.³

Estimates of Costs/Cost Savings: The analyses of 29 policy recommendations included estimates of the direct cost of those policies, in terms of both net costs or cost savings during 2009–2025 and a dollars-per-ton cost (i.e., cost-effectiveness). (The other two policy recommendations that were analyzed with respect to their GHG reductions were such that their costs or cost savings could not be readily estimated.) Following is a brief summary of the approach used to estimate the costs or cost savings associated with the policy recommendations:

- *Discounted and annualized costs or cost savings*—Standard approaches were taken here. The net present value of costs or cost savings was calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as an annualized cost per ton, dividing the present value cost or savings by the cumulative GHG reduction measured in tons. As was the case with GHG reductions, the period 2009–2025 was analyzed.
- *Cost savings*— Total net costs or savings were estimated through comparison of monetized costs and savings of policy implementation over time, using discounting. These net costs could be positive or negative; negative costs indicated that the policy saved money or produced “cost savings.” Many policies were estimated to create net financial cost savings (typically through fuel savings and electricity savings associated with new policy actions).
- *Direct vs. indirect effects*—Estimates of costs and cost savings were based on “direct effects” (i.e., those borne by the entities implementing the policy).⁴ Implementing entities could be individuals, companies, and/or government agencies. In contrast, conventional cost-benefit analysis takes the “societal perspective” and tallies every conceivable impact on every entity in society (and quantifies these wherever possible).

³ A production-based approach estimates GHG emissions associated with goods and services produced within the state, and a consumption-based approach estimates GHG emissions associated with goods and services consumed within the state. In some sectors of the economy, these two approaches may not result in significantly different numbers. However, the power sector is notable, in that it is responsible for large quantities of GHG emissions, and states often produce more or less electricity than they consume (with the remainder attributable to power exports or imports). From 1990 to 1999 and from 2001 to 2004, Arkansas was a net exporter of electricity, meaning that Arkansas power plants produced more electricity than it consumed. In 2000 and 2005, Arkansas was a net importer of electricity. Based on the approval of the GCGW, the final reference case forecast assumes that Arkansas is self-sufficient in electricity production, and that there will be no net imports over the revised forecast period (2006–2025). For the purpose of estimating emissions, natural gas-fired generation is assumed to fill any gaps in the supply of electricity to meet Arkansas demand during the forecast period. Thus, for the forecast, production- and consumption-based emissions are the same.

⁴ “Additional benefits and costs” were defined as those borne by entities other than those implementing the policy recommendation. These indirect effects were quantified on a case-by-case basis, depending on magnitude, importance, need, and availability of data.

Additional Costs and Benefits: The GCGW recommendations were guided by four decision criteria that included GHG reductions and monetized costs and cost savings of various policies, as well as other potential co-benefits and costs (e.g., social, economic, and environmental) and feasibility considerations. The TWGs were asked to examine the latter two in qualitative terms where deemed important and quantify them on a case-by-case basis, as needed, depending on need and where data were readily available.

Implementation Mechanisms: The analysis for each recommendation (see Appendices F through J) of the GCGW includes guidance on the policy instruments or “mechanisms” that were prescribed or assumed for the policy action. This includes a range of potential mechanisms including, for instance, funding incentives, codes and standards, voluntary and negotiated agreements, market based instruments, information and education, reporting and disclosure, and other instruments. In some cases, the recommended instruments are precise. In other cases, they are more general and envision further work to develop concrete programs and steps to achieve the goals recommended by the GCGW.

Arkansas GHG Emissions Inventory and Reference Case Projections

In May 2008, 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.⁵ The GCGW and TWGs reviewed, discussed, and evaluated the draft inventory and projections methodologies, as well as alternative data and approaches for improving the draft inventory and projections. The inventory and reference case projections were revised to address the comments approved by the GCGW, and were subsequently approved by the GCGW at its 10th meeting on September 25, 2008.⁶

The inventory and reference case projections included detailed coverage of all economic sectors and GHGs in Arkansas, including future emission trends and assessment issues related to energy, the economy, and population growth. The assessment included estimates of total statewide “gross emissions” (leaving aside carbon sequestration⁷) on a production basis for all sources and on a consumption basis for the electricity sector. (See prior discussion under “Analysis of Policy Recommendations” in this chapter for an explanation of the production versus consumption approach.) Further discussion of the issues involved in developing the inventory and reference case projections is summarized in Chapter 2 (Inventory and Forecast of GHG Emissions) and discussed in detail in the final report for the inventory and reference case projections.

⁵ 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. Available at: http://www.arclimatechange.us/Inventory_Forecast_Report.cfm.

⁶ Center for Climate Strategies. *Final Arkansas Greenhouse Gas Inventory and Reference Case Projections, 1990–2025*. Prepared for the Arkansas Governor’s Commission on Global Warming. October 2008. Available at: http://www.arclimatechange.us/Inventory_Forecast_Report.cfm.

⁷ Sequestration refers to the storing of carbon in mines, brine strata, oceans, plants, and soil. As trees and other plants grow, they remove CO₂ (the principal GHG) from the atmosphere, transforming the carbon through photosynthesis into cellulose, starch, and sugars, thus sequestering it in their structures and roots. The oxygen is released back into the atmosphere. Arkansas’ forests and agricultural lands are capable of sequestering much CO₂, as described in Chapter 7 (Agriculture, Forestry, and Waste Management).

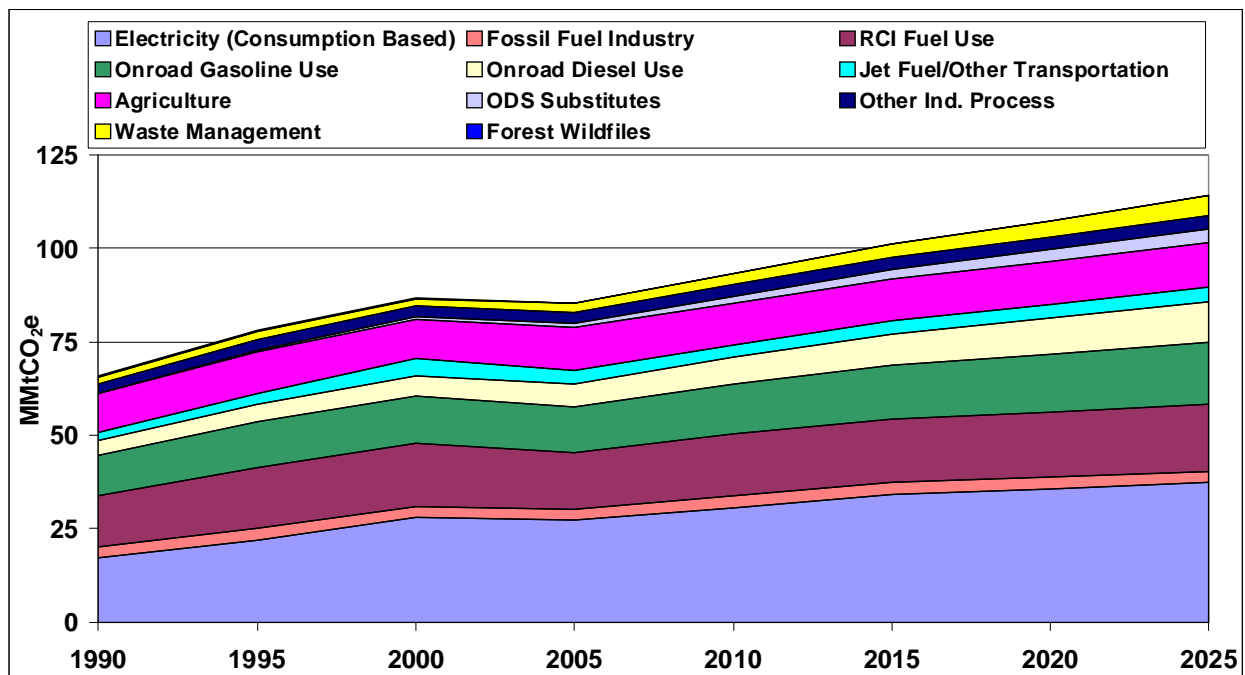
The inventory and reference case projections revealed substantial emission growth rates and related mitigation challenges. Figure 1-2 shows the reference case projections for Arkansas' gross GHG emissions as rising fairly steeply to 114 MMtCO₂e by 2025, growing by 74% over 1990 levels. Figure 1-2 also provides the sectoral breakdown of projected GHG emissions.

The inventory and reference case projections of Arkansas' GHG emissions provided the following critical findings:

- As is common in many states, the electricity and transportation sectors have the largest emissions, and their emissions are expected to continue to grow faster than in other sectors.
- From 2005 to 2025, emissions associated with electricity generation to meet both in-state and out-of-state demand are projected to be the largest contributor to future emissions growth, followed by emissions associated with the transportation sector. Other sources of emissions growth include the RCI fuel use sectors, the transmission and distribution of natural gas, and the increasing use of hydrofluorocarbons and perfluorocarbons as substitutes for ozone-depleting substances in refrigeration, air conditioning, and other applications.

While Arkansas' estimated emissions growth rate presents challenges, it also provides major opportunities. Key choices regarding technologies and infrastructure can have a significant impact on emissions growth in Arkansas. The GCGW's recommendations document the opportunities for the state to reduce its GHG emissions, while continuing its strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels.

Figure 1-2. 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 residential, commercial, and industrial sectors; ODS = ozone-depleting substance; Ind. = industrial.

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 of this report, which contain detailed accounts of the GCGW's recommendations.

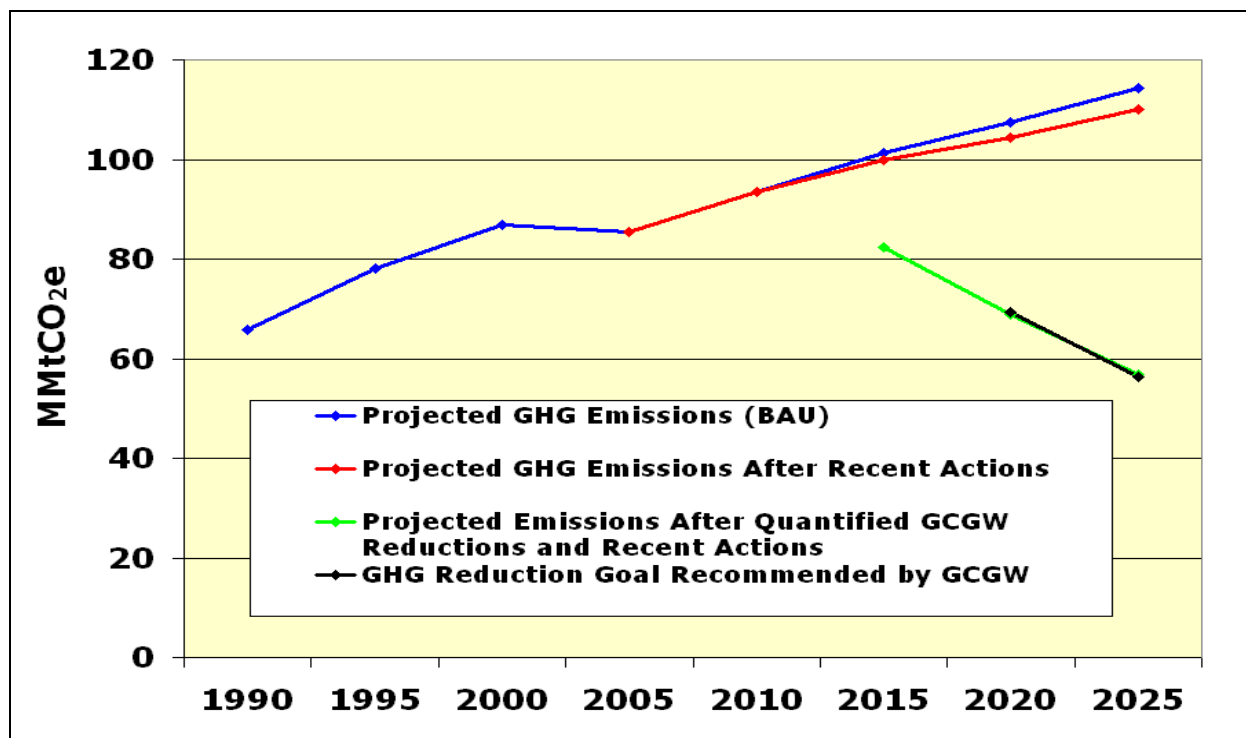
A total of 31 of the 54 policy recommendations were analyzed quantitatively to estimate their effects on emissions. Of these 31 analyzed for their emission reductions, 29 were analyzed quantitatively to estimate their costs or cost savings. The 31 recommendations for which emission reductions were quantified were estimated to have a cumulative effect of reducing emissions by about 17.6 MMtCO_{2e} in 2015, 35.5 MMtCO_{2e} in 2020, and 53.3 MMtCO_{2e} in 2025.

Figure 1-3 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 1-2 provides the numeric estimates underlying Figure 1-3. In Figure 1-3:

- 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.

For the policies recommended by the GCGW to yield the levels of estimated emission reductions shown in Table 1-3, they must be implemented in a timely, aggressive, and thorough manner.

Figure 1-3. 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 1-2. 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, especially RCI-2b, RCI-3a, RCI-3b, RCI-4a, and RCI-4b.

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

Table 1-3. 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.

Table 1-4. 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 1-4 (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	\$6,228	\$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	

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 1-4 (continued). Transportation and Land Use 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			
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	<i>Not Quantified</i>		
	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 1-4 (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 1-4 (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).

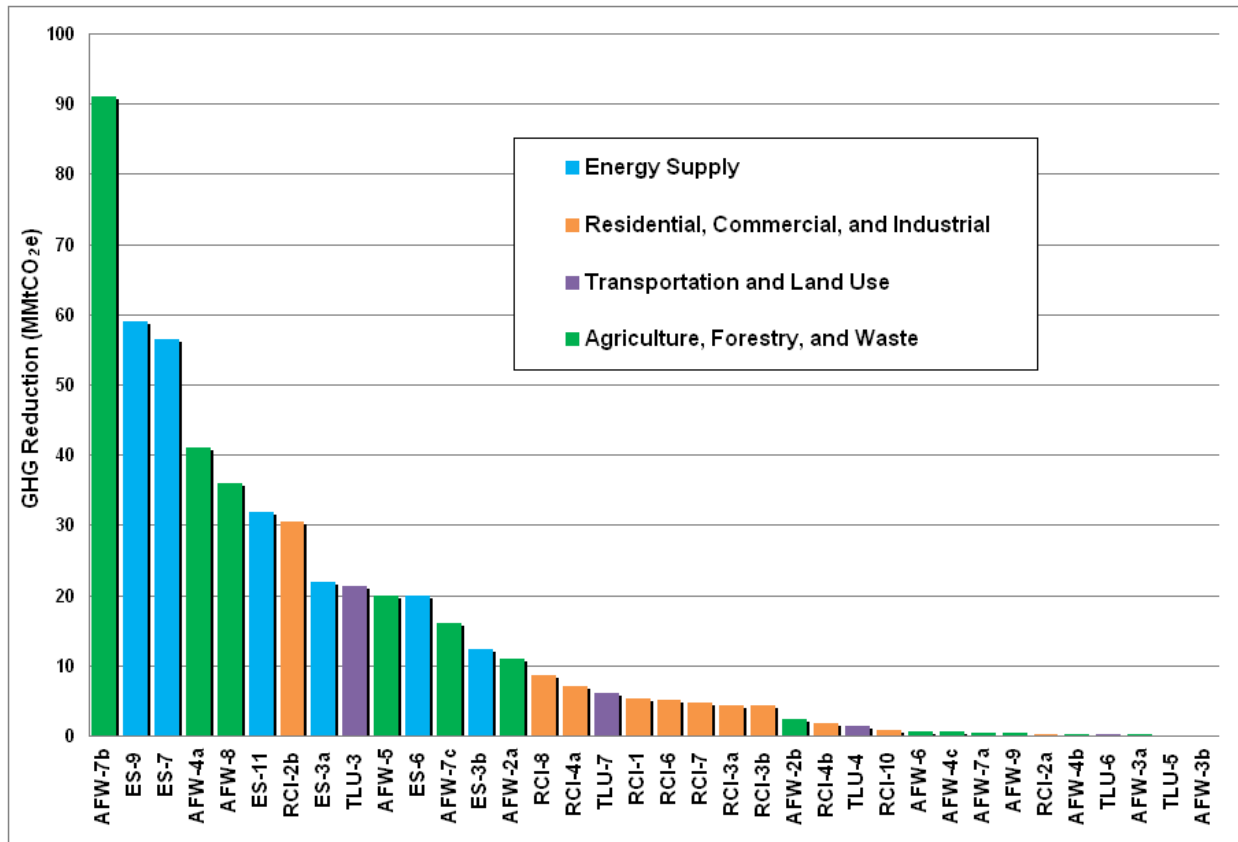
† The GCGW approved this option at Meeting #10 (September 25, 2008); 21 members present and voting (none by phone).

Perspectives on Policy Recommendations

As explained above, the GCGW considered the estimates of the GHG reductions that could be achieved by 31 of its recommendations, and the costs (or cost savings) of 29 of those 31. Figure 1-4 presents the estimated tons of GHG emission reductions for each policy recommendation for which estimates were quantified, expressed as a cumulative figure for the period 2009–2025. In addition to the imprecision in GHG reductions achieved by each policy recommendation, there are uncertainties about the exact cost (or cost savings) per ton of reduction achieved. Figure 1-5 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, expressed as a cumulative figure for the period 2009–2025. 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.

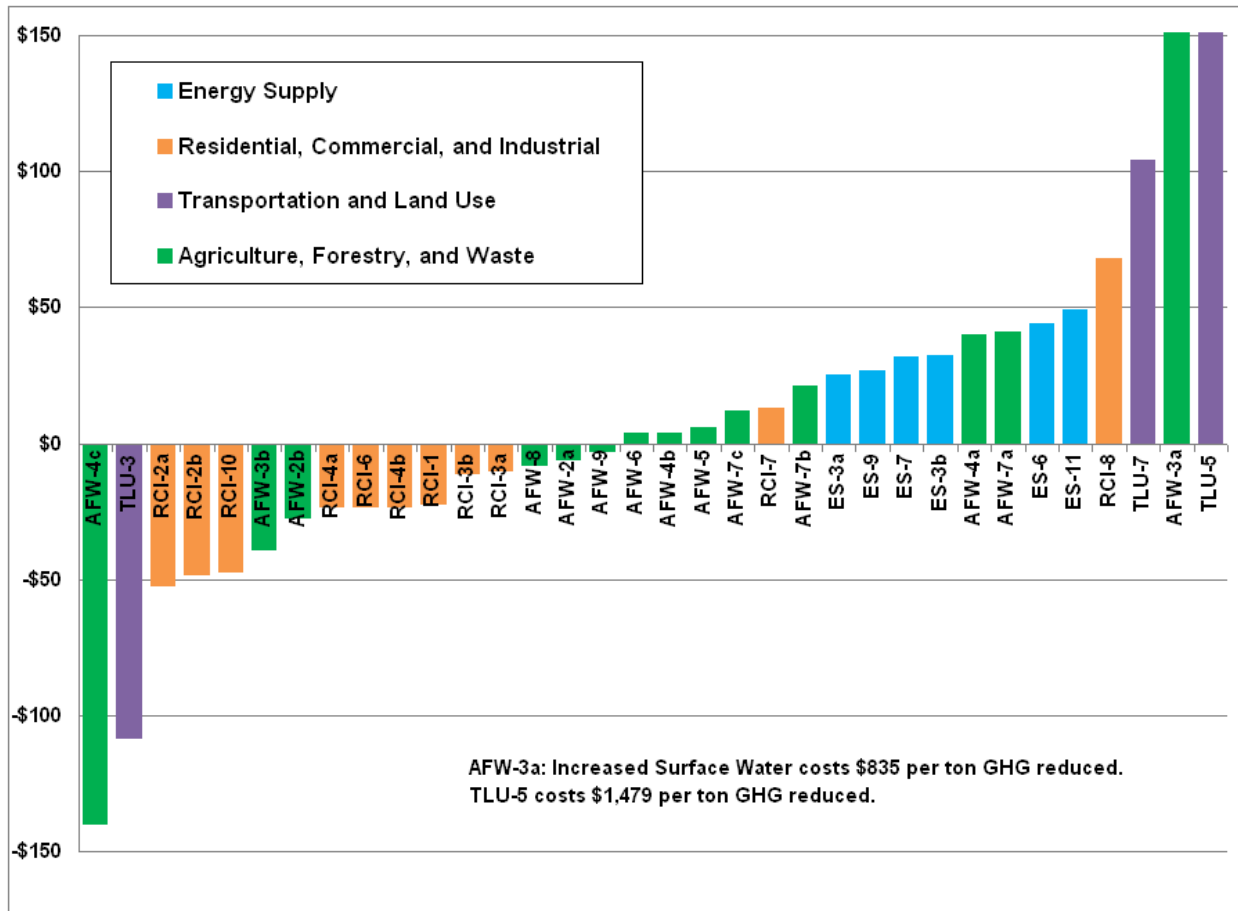
Figure 1-6 presents a stepwise marginal cost curve for Arkansas. The horizontal axis represents the percentage of GHG emissions reduction in 2025 for each option relative to the business as usual (BAU) forecast. The vertical axis represents the marginal cost of mitigation (expressed as the cost-effectiveness 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.

Figure 1-4. GCGW policy recommendations ranked by cumulative (2009–2025) GHG reduction potential



GHG = greenhouse gas; MMtCO₂e = 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.

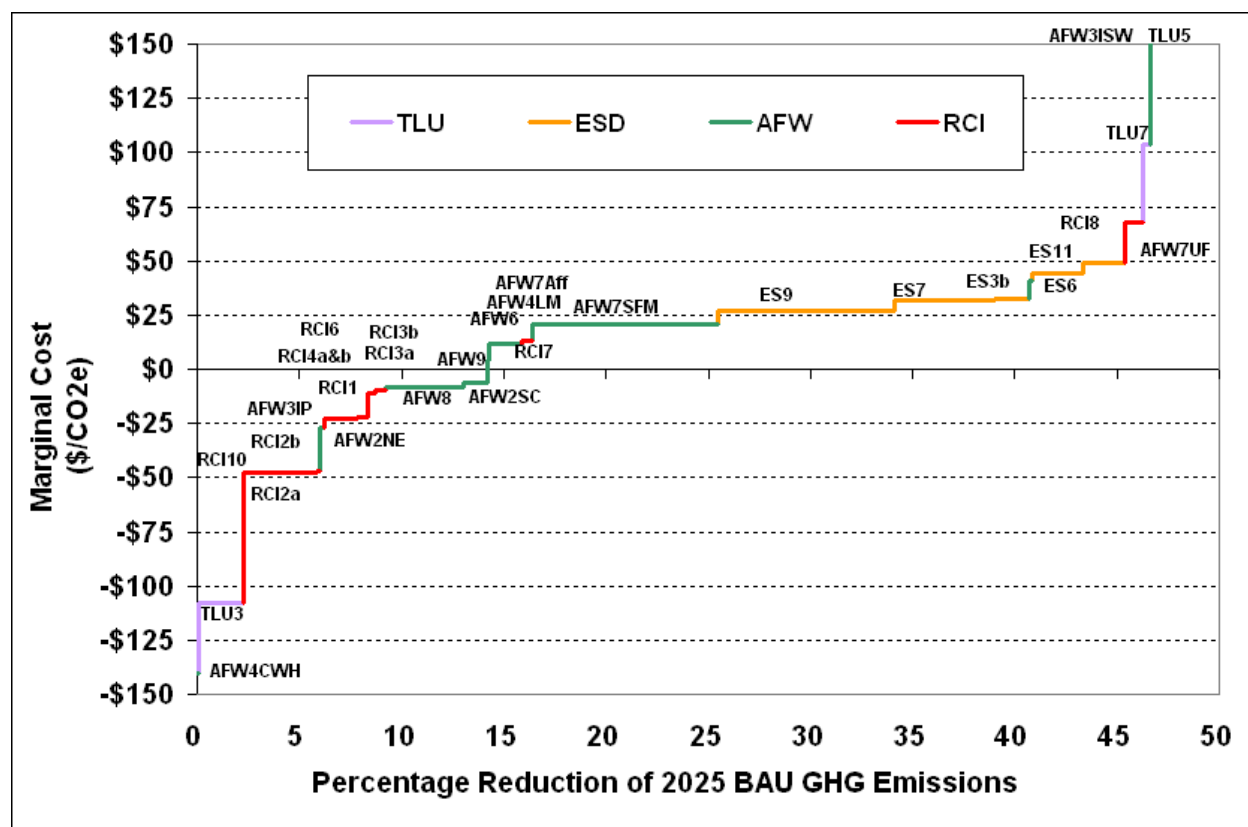
Figure 1-5. GCGW policy recommendations ranked by cumulative (2009–2025) net cost/cost savings per ton of GHG removed



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 1-6. 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 that 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 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.