Appendix I
Transportation and Land Use Sectors
Policy Recommendations

Summary List of Policy Recommendations

No.	Policy Recommendation	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2025 (Million $)	Cost-Effectiveness ($/tCO_2e$)	Level of Support
		2015	2025	Total 2009–2025			
TLU-1*	Study the Feasibility of Plug-In Vehicles	*Not Quantified—Qualitative Study Recommendation*					Unanimous
TLU-2†	Research and Development of Renewable Transportation Fuels	*Incorporated Into Analysis for TLU-3*					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)	*State "Lead by Example" Qualitative Recommendation*					Unanimous
TLU-9†	Fuel Efficiency: Clean Car Incentive	*Not Quantified—Qualitative Study Recommendation*					Super Majority (1 objection)
TLU-10*	Public Education	*Not Quantified*					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; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = 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).

Overlap Discussion:

The amount of greenhouse gas (GHG) emissions reduced and the costs of a policy recommendation within the Transportation and Land Use (TLU) sectors overlap with some of the quantified benefits and costs of policy recommendations within other sectors. Where this overlap has been determined to exist, the sector totals have been adjusted and each instance is outlined below. Overlaps between recommendations within TLU have been accounted for within the goal-setting process.

TLU-2 (Research and Development of Renewable Transportation Fuels) and TLU-3 (Advanced Biofuels Development and Expansion) overlap with AFW-5 (Expanded Use of Liquid Biofuels). This overlap was determined to be a partial overlap for the years 2010 to 2015 and a full overlap for years after 2015. The policy overlap for both time periods has been accounted for by adjusting the emission reductions and costs for AFW-5 by the proportion determined to be included under the TLU analysis to avoid double counting.

Smart growth, transit, school siting, and school access are all closely related and interact directly with one another. Because of this close interaction, three policy recommendations, TLU-4 (Smart Growth, Pedestrian and Bicycle Infrastructure), TLU-5 (Improve and Expand Transit Service and Infrastructure), and TLU-6 (School and University Transportation Bundle) all overlap to some extent with one another as each of these policy recommendations is complimentary of one another. The complimentary nature of these policies did not, however, impact their quantification. Each of these policies has been independently quantified for both emissions reductions and costs.

To account for their complimentary nature, these three policy recommendations each identify policies which would enhance their viability. TLU-4 specifically mentions the use of transit and transit oriented development as part of the vehicle miles traveled (VMT) reduction associated with this policy recommendation, all of which is further discussed in TLU-5. TLU-5, discusses the need to have appropriate land use policies in place for the success of transit, including utilizing transit in higher density areas and the ability for municipalities to use eminent domain to purchase the land necessary to develop transit and rail corridors, all of which could be associated with the Smart Growth measures in TLU-4. TLU-6 discusses land use policies necessary to be associated with school siting and the development of both pedestrian and bicycling infrastructure (mentioned in TLU-4) as part of the safe routes to school program as a method of reducing VMT. Although these three policies overlap concerning their implementation and that each one would benefit from the implementation of the other, all of their emissions reductions and costs were quantified separately and no overlap was identified as each of these policies could be implemented separately.

No reductions from recent actions as identified in the policy recommendations have been made to the TLU sector totals.

TLU-1. Study the Feasibility of Plug-In Electric Vehicles

Policy Description

Increasing the contribution of motor vehicles that are "plugged in" to the electrical grid may reduce GHG emissions in Arkansas, depending on the degree to which power generation in the state relies on fossil fuels and renewable fuels now and in the future. The goal of this policy recommendation is to study a set of actions that would further evaluate the benefits and feasibility of plug-in hybrid electric vehicles (PHEVs), accelerate the deployment of a commercially viable technology, remove barriers to more rapid adoption, create initial incentives, and provide for the integration of PHEVs with other systems, including the power supply and transportation systems.

Policy Design

Undertake a study that will review relevant completed, ongoing, and forthcoming studies, including the 3-year national study (begun in 2007 and expected to be completed by 2010) by the Electric Power Research Institute (EPRI), Ford Motor Company, and Southern California Edison (SCE), which will develop and evaluate technical approaches for integrating PHEVs into the nation's electric grid system.[1] Following the review of the relevant studies, assess the potential effectiveness of implementing some or all of the items noted in the Implementation Mechanisms section that follows.

Goals: Undertake a study that reviews relevant research, including the 3-year national study by EPRI, Ford, and SCE. Thereafter, assess the effectiveness of the additional goals, actions, and implementation timetables for other policy design options listed above.

Timing: As indicated above for each individual activity.

Parties Involved: Auto users, power utilities, auto dealers, others.

Implementation Mechanisms

- Assess the impacts of plug-in electric fleets on the state's power infrastructure at various levels of market penetration, and identify technology and system requirements to maximize use of off-peak and underutilized power resources. Engage power utilities as partners in the study, and consider the future sources of power generation and their current and future impacts on GHG emissions from PHEVs. Since automakers are preparing to introduce PHEVs by 2010, and since it will be advantageous for car owners to plug in at night, utility companies should be encouraged, and compensated for, installing "smart meters" allowing time-of-day pricing for plug-in vehicles.

[1] Ford Motor Company. "EPRI Joins Ford-SCE Analysis of Plug-In Hybrids on Grid." March 27, 2008. Available at http://www.ford.com/about-ford/news-announcements/press-releases/press-releases-detail/pr-epri-joins-fordsce-analysis-of-27955.

- Provide funding for state and local government fleet conversions of standard hybrids to PHEVs. In the future, set a goal for a certain number of conversions, and allocate funding to reach that goal. Require that these vehicles be grid-aware, and include funding for equipment to accomplish this task.
- In the future, provide funding for school districts to acquire plug-in electric hybrid school buses.
- Commit the Arkansas state government to purchase PHEVs as they become commercially available, allowing purchase at a price premium to reflect taking into account carbon-reduction benefits and reductions in state expenditures on imported fuels.
- Direct the state to provide rate recovery for utility research and development (R&D) investments in pilot tests of vehicle-to-grid systems.
- Fund the study of an assessment of electric vehicle charging needs in state parking facilities.
- Develop and fund at least one vehicle-to-grid pilot involving a fleet of public plug-ins parked in a state garage.
- Fund a study by the state to identify Arkansas companies and economic sectors with potential vehicle electrification markets, and develop a strategy to help Arkansas companies' position themselves for success in those markets.

Related Policies/Programs in Place

As described in the above implementation section. No other related programs identified at this time.

Type(s) of GHG Reductions

Since this policy calls for a study, this policy is not quantified at this time. Following the completion of the study, it is expected that better information will be available in order to provide quantitative estimates of the potential impact of PHEVs on Arkansas.

Estimated GHG Reductions and Costs or Cost Savings

Not quantified at this time, since results will likely be available following completion of the proposed study.

Key Uncertainties

The basic question as to whether motor vehicles powered by the electrical grid in Arkansas will produce more or less GHG emissions on a life-cycle per-mile basis is unanswered. The study is being recommended to provide information in an attempt to answer this question.

Additional Benefits and Costs

To be identified during the course of the study.

Feasibility Issues

The feasibility and effectiveness of the proposed implementation actions will be assessed as part of the study process.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-2. Research and Development of Renewable Transportation Fuels

Policy Description

This policy recommendation indicates support to assist in the development of low-carbon fuels that are not yet commercially available in Arkansas, such as cellulosic ethanol. It will also attempt to identify potential funding sources to conduct analyses to identify which renewable fuels will provide the best options for Arkansas and its constituent regions and cities.

General support for research and development of advanced biofuels at the state's research facilities, primarily the Arkansas State University System, is to be encouraged, and external sources of research support should be identified.

Policy Design

Among other leading research institutions in Arkansas, the University of Arkansas' Division of Agriculture has expanded its involvement in research and education on biomass issues, especially biofuels. New faculty members have been hired, and others have redirected their efforts (e.g., plant breeding for alternative feedstock opportunities). The division dedicated the recent higher education bond monies for capital improvements for new construction and renovation of the Rice Research and Extension Center at Stuttgart. Two laboratories in that facility have been designated as field biofuel laboratories. New resources are needed to expand both the research and the agricultural extension output in these areas. Additional capacity is needed to work on by-products and co-products (e.g., increased uses for glycerin, a by-product of biodiesel production), new feedstocks, application of cellulosic technologies, marketing strategies, and policy information support systems. Financial support is needed for field stations to adapt to these changing crops in their research and education systems.

Goals: The goal of the policy should be to support R&D of renewable transportation fuels in order to increase the capacity of the state university system to develop and produce such fuels cost-effectively.

Timing: Legislation to be passed in the 2009 Regular Session, with funds to be available in fiscal year (FY) 2009–2010.

Parties Involved: State of Arkansas, University of Arkansas Division of Agriculture, other state research institutions.

Implementation Mechanisms

This policy will provide funding to promote in-state R&D related to biofuel/biodiesel production, such as investigating the production of biofuels from Arkansas-based biomass feedstocks (e.g., residues or by-products) from agricultural production (crop residues, chicken fat, beef tallow), agricultural processing, forest or wood resources or production processes (material not being utilized by pulp mill plants), or other cellulosic crops (e.g., switchgrass). It could also include the reuse of food oils for use as biodiesel, possibly encouraging the production of “homemade” biofuels (for example, by farmers for their farm equipment).[2] Such research could be linked to life-cycle analyses of feedstock production and conversion.

The state should consider providing continuing annual funding for program enhancement for biofuels and other biomass.

Related Policies/Programs in Place

Arkansas State University has established a Center of Excellence on BioFuels and BioBased Products. One research project is designed to develop an inexpensive supply of enzymes for cellulosic biomass conversion. In addition, the environmental sustainability of various potential energy crop systems will be evaluated based on soil quality, water quality, and water use in addition to crop and fuel yields from the management of these energy crops. A third area will be testing spark-ignition and compression-ignition engine categories to determine the impact on emissions and engine performance when fueled by specific alternative fuels. We are investigating the fuel production comparisons that suggest that algae have the potential to produce up to 100,000 liters (L) of oil/hectare (ha), nearly 17 times the level of the highest terrestrial crop, oil palm.[3] Finally, we are investigating valuable new bio-based products from protein and carbohydrate components present in low-value plant processing residues, such as algae, rice bran, or other residues generated from the emerging Mid-South bioenergy industry.

Type(s) of GHG Reductions

Second-generation biofuels have the potential to significantly reduce carbon dioxide (CO_2) and other GHG emissions in comparison to existing petroleum-based fuels.

Estimated GHG Reductions and Costs or Cost Savings

Quantified as part of the analysis for TLU-3, Advanced Biofuels Development and Expansion.

Data Sources: Please see analysis for TLU-3.

Quantification Methods: Please see analysis for TLU-3.

Key Assumptions: Please see analysis for TLU-3.

Key Uncertainties

Universities are well suited for R&D activities; outcomes and timeframes can be uncertain.

Additional Benefits and Costs

R&D often has benefits that are difficult to predict before undertaking the R&D.

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[2] The Council for Agricultural Science and Technology (CAST) has published a map showing the leading candidates for lignocellulose-based biofuel feedstocks. See CAST, *Biofuel Feedstocks: The Risk of Future Invasions*. CAST Commentary QTA 2007-1. Ames, IA, 2007. Available at: http://www.cast-science.org/websiteUploads/publicationPDFs/Biofuels%20Commentary%20Web%20version%20with%20color%20%207927146.pdf.

[3] See "Oil From Algae!" Available at: http://www.oilgae.com.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Super Majority (one objection).

Barriers to Consensus

A member objected because the cost of this recommendation was included in the cost for TLU-3, and the member does not believe TLU-2 and TLU-3 will result in net cost savings.

TLU 3. Advanced Biofuels Development and Expansion

Policy Description

Arkansas should adopt standards that require a certain amount or percentage of transportation motor fuels, as measured by volume, to be sold in the state to be advanced biofuels.[4] The goals for the amounts or percentages to be sold should gradually increase over time, as in-state and out-of-state supply and production capacities increase. The state should also help facilitate the transition to advanced biofuels by regulating quality standards for fuel blends.

According to H.R. 6, the Energy Independence and Security Act of 2007, the term "advanced biofuel" means renewable fuel, other than ethanol derived from corn starch, which has life-cycle GHG emissions that are at least 50% less than baseline life-cycle GHG emissions. "Baseline life-cycle GHG emissions" means the average life-cycle GHG emissions for gasoline or diesel.

The types of fuels eligible for consideration as "advanced biofuels" may include any of the following: ethanol derived from cellulose, hemicellulose, or lignicellulose; ethanol derived from sugar or starch (other than corn starch); ethanol derived from waste material, including crop residue, other vegetative waste material, animal waste, and food and yard waste; biomass-based diesel; biogas (including landfill gas and sewage waste treatment gas) produced through the conversion of organic matter from renewable biomass; butanol or other alcohols produced through the conversion of organic matter from renewable biomass; and other fuel derived from cellulosic biomass. Advanced biofuels also include fuels derived from biomass, such as algae. Biomass-based diesel fuel also includes bio-based lipids harvested from feedstocks, such as algae and biogass.

Policy Design

Arkansas should encourage state and national fuel industries to reach for specific goals, as measured by specific volume amounts or percentages of advanced biofuels, which would produce fewer GHG emissions when considered on a per-volume and/or per-energy-unit basis. The state should encourage industry and research universities to work together to create an Arkansas Alternative Energy Institute.

The state does not wish to encourage the conversion of any human food sources, such as corn, to alternative fuels, because this is likely to increase the price of food. The Governor's Commission on Global Warming (GCGW) also does not wish to encourage the production of alternative fuels that would lead to higher GHG emissions than are produced from petroleum-based fuels. As a result, the state is supportive of development of advanced biofuels, as listed above under the Policy Description.

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[4] A definition of "advanced biofuels" can be found in Section 201 of the text of federal legislation "H.R.6: Energy Independence and Security Act of 2007." The text of the legislation can be found online at: http://thomas.loc.gov/.

Goals:

- Increase the use of advanced biofuels that emit less GHG emissions in automobiles and other on-road transportation vehicles to the level of at least 3% of the total consumed by 2015.

Timing:

By 2012, an appropriate state agency will:

- Develop incentives for industry to produce advanced biofuels that reduce GHG emissions.
- Develop an industry/research university institute that will continually work toward commercially available solutions for advanced biofuels.

By 2015, the state or appropriate agency will:

- Reduce GHG vehicle emissions by converting to fuels that burn much more efficiently, with the goal of advanced biofuels comprising 3% of the statewide use of fuels by 2015.
- Work with the Arkansas Alternative Energy Institute to promote biofuel production to aid in control of GHG emissions and to promote state industries that will provide "green" jobs for Arkansas workers.
- Establish legislation to set standards for biofuel production that meets federal and state regulations for GHG emission levels.

Parties Involved: Arkansas Departments of Natural Resources, Highway and Transportation, Agriculture, Economic Development, Labor, Forestry, and Energy.

Table I-1 shows life cycle ("well-to-wheels") GHG impacts of various biofuel options.

Table I-1. Estimated alternative fuels impacts on GHG emissions

Fuel/Technology	Blend	Feedstock	Reduction (GHGs per mile)*
Ethanol	E10	Corn	1.4%
Ethanol	E10	Cellulosic	7.4%
Ethanol	E85	Corn	15.9%
Ethanol	E85	Cellulosic	83.8%
Biodiesel	B20	Soy	17.7%

* Ethanol reductions estimated relative to gasoline; biodiesel reductions estimated relative to diesel fuel. Actual reductions depend on many factors in the production, distribution, and use of fuels.
Source: Argonne National Laboratory. GREET model version 1.8 outputs.

Implementation Mechanisms

To aid in biofuel development, state money could be used to establish partnerships with state and national laboratories that have already worked on some of the issues of biofuel conversion. This would bring knowledge of established production/conversion protocols into the state and develop processing parameters for Arkansas-specific feedstocks.

The state could incentivize the development of in-state industries and businesses that produce and distribute alternative fuels:

- Arkansas should provide incentives to private industries to establish alternative-fuel infrastructure that could aid in the promotion of alternative-fuel use.
- The expense of equipment and installation may be offset by the increasing use of these alternative fuels.
- The biofuel production plants should optimally be situated within a radius of their feedstocks as feasible, with use of both rail and truck as appropriate, and with a focus on minimizing the energy used to distribute the fuel.
- The distributors of alternative fuels should be in convenient locations to be able to offer fuels at competitive prices.

Related Policies/Programs in Place

Federal Energy Independence and Security Act (EISA) of 2007: Fuel suppliers must increase the amount of renewable fuel blended into transportation fuels annually, to reach a level of 36 billion gallons in 2022.

Type(s) of GHG Reductions

CO_2 and other GHG emissions from the combustion of surface transportation fuels.

Estimated GHG Reductions and Costs or Cost Savings

Table I-2. Estimated GHG reductions and costs of or cost savings from TLU-3

Quantification Factors	2015	2025	Units
GHG emission savings	0.88	2.54	$MMtCO_2e$
Net present value (2009–2025)	N/A	–$2,293	Million $
Cumulative reductions (2009–2025)	N/A	21.26	$MMtCO_2e$
Cost-effectiveness	N/A	–$108	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable.

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

Table I-3. Estimated GHG reductions and costs or cost savings from current federal law

Quantification Factors	2015	2025	Units
GHG emission savings	0.70	2.07	$MMtCO_2e$
Net present value (2009–2025)	N/A	–$2,472	Million $
Cumulative reductions (2009–2025)	N/A	17.31	$MMtCO_2e$
Cost-effectiveness	N/A	–$143	$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable; analysis scenario based on Federal Renewable Fuels Standard.

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

This analysis assumes a "fuel-neutral," low-carbon fuels policy requiring increased use of biofuels that could be met by a variety of scenarios. A sample scenario is assessed that would achieve the stated goal for overall increase in advanced biofuels use to 3% of total transportation fuel consumed in Arkansas.

Data Sources:

- *Life-cycle impacts of biofuels*—Argonne National Laboratory. "The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) Model," version 1.8. Available at: http://www.transportation.anl.gov/software/GREET/.
- *Fuel economy and gasoline and ethanol prices*—U.S. Department of Energy, Energy Information Administration. *Annual Energy Outlook 2008: With Projections for 2030 (Revised Early Release).* DOE/EIA-0383(2008). March 2008. Available at: http://www.eia.doe.gov/oiaf/aeo.
- *Price of biodiesel relative to conventional diesel*—U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. *Clean Cities Alternative Fuel Price Report*, January 2008. Available at: http://www.eere.energy.gov/afdc/price_report.html.

Quantification Methods:

The estimate of GHG emission reductions from this policy is based upon an increase of alternative-fuel use to 14% of all on-road fuels in the state by 2015 and 25% by 2025. A ramp-up period is estimated so that alternative-fuel use would increase steadily on a yearly basis between 2010 and 2025.

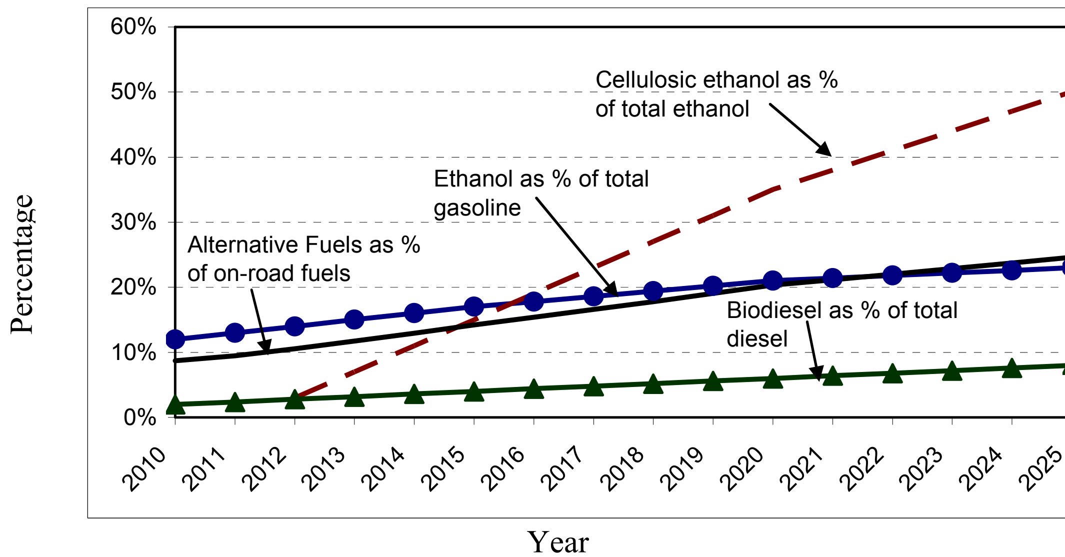
To estimate the likely ramp-up in alternative-fuel use needed to meet the policy, a potential scenario was developed for analysis. This scenario is intended to reflect requirements under current federal law (per the Renewable Fuel Standard), with additional emphasis on advanced biofuels (represented in this scenario by cellulosic ethanol and biodiesel). In the scenario, by 2025, ethanol sales in Arkansas would represent 23% of gasoline sales, with 18% of the ethanol used in flex-fuel vehicles (E85) and the remainder used in conventional vehicles operating on E10. For analysis purposes, ethanol was assumed to be used in the form of either E10 or E85. In reality, flex-fuel vehicles will be able to operate on any blend of ethanol up to 85%. The analysis assumptions are intended to reflect that range of blends. In addition, 100% of ethanol is assumed to come from corn feedstocks in 2010. Starting in 2012, it is assumed that cellulosic ethanol would begin to make up a significant portion of the ethanol market, ramping up to 50% of ethanol by 2025. Biodiesel (from soy) is assumed to make up 8% of total Arkansas diesel sales by 2025. The cumulative effect of this increase in biofuels would be that alternative fuels would make up 14%, and advanced biofuels would make up 3% of on-road fuels used in Arkansas by 2015, while alternative fuels would make up 25% and advanced biofuels would make up 10% by 2025. Table I-3 shows the assumptions used for this scenario.

Table I-4. Analysis scenario assumptions

Time Period	E85 Ethanol Market Share	E10 Ethanol Market Share	% Ethanol in Gasoline	Ethanol Feedstocks		% Biodiesel in Diesel	% Alternative Fuels	% Advanced Biofuels
				% Corn	% Cellulosic			
2010	3%	97%	12%	100%	0%	2%	9%	1%
2015	10%	90%	17%	85%	15%	4%	14%	3%
2020	15%	85%	21%	65%	35%	6%	20%	7%
2025	18%	82%	23%	50%	50%	8%	25%	10%

Figure I-1 illustrates the assumed blends of ethanol and biodiesel as percentages of gasoline and diesel, respectively, cellulosic ethanol as a percentage of total ethanol, and the percentage of total on-road transportation fuels displaced by alternative fuels.

Figure I-1. Analysis scenario illustration



Cost is calculated as the incremental cost of biofuels per gallon of gasoline equivalent (for ethanol) or diesel equivalent (for biodiesel), multiplied by total consumption of each fuel. Ethanol and gasoline prices in future years are drawn from the Energy Information Administration's (EIA's) *Annual Energy Outlook 2008* (AEO2008). Based on January 2008 information from the U.S. Department Energy's (DOE's) *Clean Cities Alternative Fuels Price Report*, the difference in the average price of biodiesel compared to conventional diesel in the Gulf Coast region is approximately $0.11/gallon (less for biodiesel). Note that the cost calculation does not include federal subsidies in the form of tax credits for ethanol or biodiesel. In addition, costs related to any vehicle upgrades (e.g., flex-fuel vehicles that can operate on ethanol blends up to E85) are not included.

Key Assumptions:

- Program starts in 2010, the first year of emission reduction.
- Program reaches the goal of advanced biofuels as at least 3% of total fuels consumed in Arkansas by 2015.
- Program applies to all on-road vehicles, “replacing” or (displacing) current gasoline and diesel fuel.
- Baseline scenario accounts for:
  - 0% ethanol existing market share and
  - 0% existing biodiesel market share.

Key Uncertainties

Cellulosic ethanol is assumed to be a significant component of this policy. The timeline for availability of cellulosic ethanol on a large scale is unknown, although production facilities are beginning to come on line as of the date of this analysis. Another unknown is the price difference between cellulosic and corn-based ethanol.

The price differential between biodiesel and diesel is extremely dynamic. The results of the cost component of this analysis could vary, depending on future changes in that price differential.

Also, to achieve the goals, transportation fuel providers would need to undertake changes in their production and distribution methods. Because the policy does not prescribe particular technology pathways, there is uncertainty surrounding which fuels and technologies fuel providers will use to meet the standard. The program assumes that providers will use the most cost-effective options to meet the standard, but compliance costs are unknown at this time.

Additional Benefits and Costs

It is generally agreed that increased domestic production of advanced transportation biofuels will reduce the need to import petroleum-based motor fuels and crude oil from other countries.

Feasibility Issues

Please see the Key Uncertainties section.

Status of Group Approval

Complete.

Level of Group Support

Super Majority (one objection).

Barriers to Consensus

One member does not believe this policy recommendation will result in net cost savings.

TLU-4. Smart Growth, Pedestrian and Bicycle Infrastructure

Policy Description

This policy recommendation calls for incentives and programs to encourage smart growth, including enhancing the pedestrian and bicycle infrastructure. Current land-use development practices increase vehicle travel by dispersing destinations, which separates activities and favors automobile travel over alternative modes. "Smart growth" planning by local, regional, and state governments refers to development that reduces sprawl and maximizes environmental, fiscal, and economic resources. It incorporates such planning tools as mixed use, open-space protections, downtown revitalization, "greyfield" redevelopment,[5] infill development, transit-oriented development, and pedestrian and bicycle infrastructure. It seeks to preserve open, recreational, and agricultural spaces and to prevent sprawl, especially on the periphery of urban areas where sprawling development may otherwise occur.

It is difficult to envision a solution to either global warming or energy security issues that does not involve slowing the growth of transportation emissions. To date, the national discussion of climate and energy initiatives has focused on technological solutions—namely, developing more fuel-efficient vehicles or lower-carbon fuels. Experts recognize, however, that all such technological solutions will be overwhelmed by the continued growth in automobile travel, thanks to our increasingly spread-out, car-dependent development patterns. During 1982–2002, these land-intensive development patterns caused development acreage to increase at twice the rate of population growth. This in turn caused per-capita vehicle miles traveled (VMT) to increase three times faster than America's population growth over that same period. It's no accident that VMT is increasing as the country continues to build and develop more areas where residents have no realistic choice but to drive long distances each day to meet their daily needs. A 2002 study by Smart Growth America found that the degree of sprawl was the most significant cause of a high VMT rate.[6]

The good news is that we can make enormous progress simply by shaping future building to create communities where people can accomplish more by driving less. Numerous studies demonstrate that when people are given the option to live in a less automobile-dependent place, they drive less. According to the report *Growing Cooler: The Evidence on Urban Development and Climate Change,* residents of more compact neighborhoods drive 20%-40% less on average, saving oil and reducing GHG emissions.[7] If we combine compact neighborhoods with increased investment in public transit of all shapes and sizes (TLU-6, School and University Transportation Bundle), the resulting synergies can reduce dangerous emissions enormously.

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[5] Greyfields are underutilized land in the form of parking lots, declining strip malls, and vacant parcels.

[6] Smart Growth America. "Energy and Climate." Available at: http://www.smartgrowthamerica.org/climate.html.

[7] Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen. *Growing Cooler: The Evidence on Urban Development and Climate Change,* Washington, DC: Urban Land Institute, 2008. Available at: http://www.smartgrowthamerica.org/gcindex.html.

Policy Design

Arkansas should allow, encourage, facilitate, and undertake a set of smart growth activities related to the following initiatives:

- Downtown and neighborhood revitalization,
- Greyfield redevelopment,
- Infill development,
- Transit-oriented development (TOD),
- Sprawl reduction,
- Bike and pedestrian infrastructure,
- Incentives for urban school districts,
- Highway access management and corridor maintenance, and
- Smart growth planning, modeling, and tools.

Goals: Overall goals for the set of activities would be the following:

- By 2010, 35% of new development and redevelopment will occur in higher-density tracts (> 2,000 people per square mile), compared to only 10% under the business as usual (BAU) scenario.
- By 2010, begin providing economic development incentives and liberalized zoning and permitting processes (parking requirements, density restrictions, mixed-use restrictions, etc.) to encourage investment in central business districts.
- By 2010, begin providing economic incentives, liberalized zoning and land-use restrictions, and streamlined permitting processes to encourage brownfield redevelopment, infill development, and TOD.
- By 2010, develop and adopt a comprehensive plan to preserve open space on the edges of urban areas where sprawling development may otherwise occur, and to encourage regional cooperation in reducing sprawl.
- By 2010, develop a program for information dissemination and technical assistance to facilitate the adoption of smart growth planning processes, models, and tools by local and regional jurisdictions.
- By 2015, require "complete streets" policies, providing for systematic adoption of sidewalks and bikeways.

Timing: See above, with most strategies to be implemented by 2010.

Parties Involved: State government, local government, city planners from around the state (including, specifically, the city planners in Fayetteville), individual property owners, and investors.

Implementation Mechanisms

Downtown and Neighborhood Revitalization

Many U.S. towns and cities are crowded during business days, but are deserted by night and on weekends because few people live there. Some cities have begun turning this problem around by revitalizing their downtowns and centrally located neighborhoods. Downtown revitalization can be profitable (by reusing existing infrastructure), can provide a better quality of life (by centralizing entertainment and retail, providing a critical mass for success), and can improve the environment (by reducing VMT, providing sufficient density for walking, bicycling, and transit, reducing sprawling-edge development, and preserving greenfields).

Arkansas should provide economic development incentives and liberalized zoning and permitting processes (parking requirements, density restrictions, mixed-use restrictions, etc.) to encourage investment in central business districts and neighborhoods. The state could provide tax incentives for property owners to do historic preservation and restoration on buildings located in historic downtowns. (Arkansas is one of the few states lacking a personal income tax incentive for historic preservation.) State agencies should lead by example and locate offices and services in downtowns and centrally located neighborhoods. Main Street Arkansas is a state program that assists downtowns in their revitalization efforts and provides training and support to 30 participating communities. A major principle of sustainable building practices is to rehabilitate, refurbish, remodel, or convert existing structures.

Greyfield Redevelopment

"Infill" development of all sorts reduces sprawl and VMT. Many of Arkansas' urban areas have a large percentage of greyfields. Redeveloping greyfields has the additional advantage of improving the quality of life in city centers, which increases the number of downtown residents, workers, and visitors. Arkansas should provide economic incentives, liberalized zoning and land-use restrictions, and streamlined permitting processes to encourage greyfield redevelopment. This can be a key factor in urban revitalization by providing new centrally located areas for residential, commercial, or mixed-use development. It also reduces average trip distances, and encourages walking, bicycling, and public transit.

Infill Development

Development of vacant or underused parcels of land within existing developed areas reduces average trip distances and saves public funds by taking advantage of existing infrastructure and public utilities. By increasing the local population density, it also encourages walking, bicycling, and public transit. Arkansas should provide economic incentives, liberalized zoning and land-use restrictions, and streamlined permitting processes to encourage infill development. Toward this end, Arkansas should pass Transfer of Development Rights (TDR) enabling legislation, so that cities can preserve high-value agricultural land and natural resources by transferring development rights to designated infill areas and allow market forces to determine the price of development credits (additional units per acre).[8]

Additionally, enabling cities to adopt tiered impact fees, especially with regard to roads, would help guide development to appropriate infill locations. Tiered impact fees charge less for developments located near the core of the city and more for developments located on the urban fringe. The lack of county zoning in most of Arkansas severely limits the ability for cities to discourage sprawl. Development often happens just over the line, resulting in leap-frog development patterns and an increased tax burden for providing urban services, such as fire and police protection. A major initiative should be made to bring planning and zoning to all counties having significant urban centers.

Transit-Oriented Development

Transit-Oriented Development (TOD) is the creation of compact, mixed-use commercial or residential communities designed to maximize access to public transit (see TLU-6), while also creating a community attractive to pedestrians and bicyclists. TOD thus reduces VMT and the associated GHG emissions. Arkansas should provide economic incentives, liberalized zoning and land-use restrictions, and streamlined permitting processes to encourage TOD. Regional Mobility Authorities throughout Arkansas should devote at least 20% of their funds to mass transit options to facilitate this mechanism.

Reducing Sprawl

For smart growth policies to be truly effective, the efforts must be regional or, better yet, statewide. If all municipalities in an area are not practicing smart growth, development may gravitate to greenfields at the edges of cities or between cities, resulting in sprawl. Arkansas should adopt a comprehensive plan to preserve open space on the edges of urban areas where sprawling development may otherwise occur, and to encourage regional cooperation in reducing sprawl. One approach would be to encourage "green zones" at the edges of cities that would be permanently zoned for agricultural use only, and off limits to developers.[9] Also, the state should provide for TDR programs, discussed above.

Bike and Pedestrian Infrastructure

Smart growth aims to encourage alternative (non-automobile) transportation modes, especially walking and bicycling. Arkansas towns, cities, and counties should improve and construct sidewalks and bikeways, and the state should provide economic incentives to encourage such infrastructure development. This is particularly true in commercial areas without adequate

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[8] TDR is a voluntary, market-based implementation process by which the development rights of a landowner in the area to be protected (the "sending" zone) are transferred to an appropriate, community-designated area (the "receiving" zone). The sending zone is placed in a permanent conservation easement, such as a land bank, and the receiving zone is granted an increase in land-use intensity, such as density bonuses or increases in building height. Since this process does not require local governments to purchase any lands, and since concentrated development in the receiving zone saves money on municipal services, very little public funding is required. At least 23 states have adopted TDR enabling legislation.

[9] For further discussion, see Smart Growth America. "Open Space & Farmland." Available at: http://www.smartgrowthamerica.org/openspace.html.

sidewalks and in residential and other areas where pedestrian and bicycle safety is a concern. The attraction of bicycling and walking is greatly enhanced by facilities that are safe and that also "feel" safe to bicyclers and walkers.

Bikeways can take the form of designated bike lanes on shared streets, or of trails that are separated from roadways, except at crossings. The former are typically four or more feet wide. Separate bike trails are usually designed as multi-use trails that also serve joggers, strollers, skaters, etc. Bikeways are not just for recreational use; they also serve commuters, shoppers, school children, and others. Indeed, real reductions in automobile VMT can occur by using bikeways for transportation. For example, in Scandinavian countries, despite the cold weather, 30% of all commuters commute by bicycle. Other infrastructure improvements could include bicycle parking and shower or locker amenities at places of employment. Cities, regional jurisdictions, and universities can institute "free bicycles" programs, as is done in many U.S. and European cities.

Arkansas should require "complete streets" policies, providing for systematic adoption of sidewalks and bikeways to help achieve these goals. All state road projects should include infrastructure to accommodate bikes and pedestrians as a complete street model. At the local level, cities should also be encouraged to create complete streets and adopt trail and on-street bikeway master plans. These master plans should be recognized and included in the planning of all state and city improvement projects. Grant funding should be increased and made available to communities for the construction of multi-use trails and on-street bike facilities. Legislation should be created to allow road turn-back funds to be used for alternative transportation projects. Arkansas should also encourage property owners to donate necessary portions of property for multi-use trails through tax incentives or other benefits. New residential and commercial developments should be required to dedicate rights of way for multi-use trails when identified on the trail master plans. Riparian corridors should be identified for multi-use trails and protected as an enduring green network through their communities.

Incentives for Urban School Districts

Arkansas should provide incentives for school districts to develop new facilities within existing urban cores. Locating new school facilities on the urban fringe encourages sprawl and VMT. A first step would be to remove the excessive acreage requirement that the state mandates for locating new schools (80–100 acres). Rehabilitation and adaptive reuse of existing facilities should be the first option when school expansion is necessary. The Arkansas Department of Education needs to revisit its long-range planning and goals in order to place higher priorities on issues related to sustainability and reasonable location requirements. The placement of school facilities has broad and often drastic effects on how communities grow and evolve. Auto-dependent models of developing schools will quickly fade as the era of cheap energy comes to a close. An emphasis on central location and the ability for alternative transportation options should have significant weight when making policy decisions regarding school locations. Forward-thinking, yet common-sense, approaches are necessary to implement this policy.

Highway Access Management and Corridor Maintenance

The Arkansas State Highway and Transportation Department should adopt access management standards to apply to all Arkansas road projects. Adequate prior transportation planning reduces the number of access/conflict points along state highways and municipal arterial roads and ensures that future roadway capacity is not significantly diminished over time. Arkansas should promote the development of "complete, compact, and connected" neighborhoods through the adoption of smart growth policies. Cul-de-sac subdivisions should be discouraged because of the increased VMT associated with them. Arkansas could significantly reduce GHGs and the maintenance cost of mowing highways by funding a wildflower and native plant corridor program modeled after the program that exists in Texas.

Smart Growth Planning, Modeling, and Tools

Arkansas should provide state funding, information dissemination, and technical assistance to facilitate the adoption of smart growth planning processes, models, and tools by local and regional jurisdictions. A smart growth toolkit should be developed and distributed to all cities and counties.

Related Policies/Programs in Place

As described above.

Type(s) of GHG Reductions

Transportation sector surface transportation fuels produce CO_2 (which accounts for approximately 96% of transportation GHG emissions) and other GHG emissions (methane [CH_4], nitrous oxide [N_2O], and hydrofluorocarbons).

Estimated GHG Reductions and Costs or Cost Savings

This analysis considers potential GHG reductions from reductions in VMT for personal (non-truck) travel, as a result of a shift toward more compact development patterns following smart growth principles. The analysis relies on estimates of per-capita VMT by census tract population density range, as developed by Steve Polzin, Director of the Center for Urban Transportation Research (CUTR) Mobility Program for the CUTR VMT forecasting model. The CUTR model is based on analysis of the U.S. Department of Transportation's 2001 National Household Travel Survey data.[10] The model provides estimates of per-capita VMT by state for five density ranges. It is currently set up for years 2005, 2035, and 2055; for this analysis, results were interpolated for Center for Climate Studies (CCS) analysis years.

The observed relationship between per-capita VMT and population density serves as a proxy for the effects of smart growth development, as described above. Higher levels of population density are associated with overall shorter trips, because destinations are closer together. In addition, areas with higher population densities are more likely to have pedestrian-friendly design (walkability, mixed use, etc.) and to support transit service. It is difficult to separate out the individual effects of the various smart growth strategies at this aggregate level of analysis, but the analysis provides an indicator of what can be achieved through a combined set of smart growth policies.

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[10] P.S. Hu and T.R. Reuscher. *Summary of Travel Trends: 2001 National Household Travel Survey*. Prepared for the U.S. Department of Transportation Federal Highway Administration. December 2004. Available at: http://nhts.ornl.gov/2001/pub/STT.pdf.

Table I-5. Estimated GHG reductions and costs of or cost savings from TLU-4

Quantification Factors	2015	2025	Units
GHG emission savings	0.06	0.17	$MMtCO_2e$
Net present value (2009–2025)	N/A	≤ 0 (Net savings)	Million $
Cumulative reductions (2009–2025)	N/A	1.39	$MMtCO_2e$
Cost-effectiveness	N/A	< 0 (Net savings)	$\$/tCO_2e$

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable.

Data Sources:

- Total population and population density by census tracts in Arkansas and other states, 1990 and 2000.
- Per-capita VMT by census tract population density in Arkansas, from CUTR VMT forecasting model.
- Forecast statewide population growth. U.S. Bureau of the Census, Population Division. Arkansas Population Projections: 1995 to 2025. Available at: http://www.census.gov/population/projections/state/9525rank/arprsrel.txt / Campbell, Paul. "Population Projections by States, 1995–2025." Current Population Reports. P25-1131.U.S. Department of Commerce, Census Bureau. May 1997. Available at: http://www.census.gov/prod/2/pop/p25/p25-1131.pdf

Quantification Methods:

The specific method used to estimate GHG benefits of smart growth strategies is as follows:

- Total population in 2000 was identified by five census tract density ranges, as identified in the CUTR model (< 500, 500–1,999, 2000–3,999, 4,000–9,999, and 10,000 or more people per square mile) for metropolitan versus nonmetropolitan areas.
- The change in population from 1990 to 2000, and associated share of change by density range, was identified from census data.
- Statewide population by tract density range for 2010 (to use as the base year when policy changes are proposed to begin) was estimated by taking state population forecasts for 2010, and allocating 2000–2010 growth to tract density range in the same proportion as 1990–2000 growth.
- For the baseline (BAU) scenario, new population growth between 2010 and 2025 (as determined from state forecasts developed for the CCS baseline) was allocated to tract density ranges based on the share of growth in the 1990–2000 time frame. Total statewide growth is forecast at 363,000 people, or 13%. The proportion of existing housing stock (population) that would be redeveloped over this time frame was estimated at 9%, representing a rate of 6% per decade between 2010 and 2025. Two-thirds of this

redevelopment is assumed to occur in place, and one-third is redeveloped elsewhere, with this redevelopment allocated to tract density ranges based on the 1990–2000 share of population growth. (The 6% and two-thirds figures come from the 2007 *Growing Cooler* report's Section 1.7.3, citing analysis of census data by Nelson [2006].)

- For the Climate Action scenario, a significant shift in the proportion of new development and relocated redevelopment was assumed to take place, with higher-density tracts (> 2,000 people per square mile) receiving 35% of new development under this scenario, compared to only 10% under the BAU scenario. Total population by tract density under this scenario was then calculated. This relatively conservative reallocation scenario reflects the largely rural and small-city nature of population growth in Arkansas, based on analysis of census data from 1990 and 2000 showing that most (two-thirds) of the growth occurred in non-metropolitan areas, while most of the remainder occurred in smaller metropolitan areas. The analysis assumes that rural growth would occur in a more clustered pattern, with shifts in population from the lowest density range (fewer than 500 people per square mile, typical of rural tracts) to the second lowest density range (500–1,999 people per square mile, typical of smaller cities/towns), and that metropolitan growth would shift more toward the third and fourth density ranges (2,000–9,999 people per square mile), representing an increase in higher-density infill and redevelopment.

- Total personal-travel VMT was calculated under the BAU and Climate Action scenarios, based on VMT per capita (from the CUTR model) and total 2025 population by tract density range, and the percentage reduction in personal-travel VMT was calculated.

- The percentage reduction in VMT was adjusted by 90%, to estimate the percentage reduction in GHG emissions. This factor is the same as used in the *Growing Cooler* report, to account for the fact that higher-density areas may experience somewhat lower travel speeds and, therefore, slightly reduced fuel economy.[11]

- BAU GHG emissions in 2025 for passenger travel were estimated as those from all light-duty VMT. To estimate cumulative emission reductions over the 2010–2025 period, a linear ramp-up of benefits was assumed over this time frame.

Key Assumptions:

- The fraction of new population growth and redevelopment by census tract density, under the BAU scenario.

- The assumed shift in the fraction of new population growth and redevelopment from lower-density to higher-density census tracts, under the Climate Action versus the BAU scenario.

- The percentage of residential building stock redeveloped (off site) over the analysis time frame.

[11] Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen. *Growing Cooler: The Evidence on Urban Development and Climate Change,* Washington, DC: Urban Land Institute, 2008. Available at: http://www.smartgrowthamerica.org/gcindex.html.

Corroborating Methodologies:

This methodology is consistent with another methodology that was tested, based on the parameters assumed in the *Growing Cooler* report estimate of CO_2 reductions in 2050. The methodology was adapted to 2025 conditions, and some adjustments were made for Arkansas-specific data where available, including population growth and proportion of VMT in urban areas. The previous methodology used a number of factors from the *Growing Cooler* report. The primary differences are that *Growing Cooler* assumes a 30% reduction in VMT for "compact development" (rather than the VMT levels by census tract density range); includes a blanket assumption of 60% of new (urban) growth reallocated to "compact development"; and does not assign any VMT reduction to growth in rural areas. The methodology produces a result similar to that of the original analysis, projecting a GHG reduction of 1% for passenger travel, compared to the 2025 BAU scenario, or a savings of 0.15 million metric tons of carbon dioxide equivalent ($MMtCO_2e$) in 2025, compared to 0.17 in the methodology above that was utilized.

Key Uncertainties

Smart growth depends upon the decisions of many individual property and business owners, as well as the efficacy of incentives and other programs.

Additional Benefits and Costs

Smart growth generally has very low direct costs to implement, comprised of the governmental costs of altering regulations and zoning and providing education and technical assistance. Tax incentives are an income transfer that results in a public-sector cost but offsetting developer revenue. As most smart growth policies (e.g., allowing higher density and mixed use, reducing parking requirements) are deregulatory in nature, they are opening the development market and have significant indirect as well as direct benefits. An exception is growth boundaries, which restrict the land-use market and have an indirect cost.

Alternative patterns of development have a large number of additional impacts that may provide both benefits and costs. Smart growth provides a range of co-benefits that are well documented in other places. Prominent among these is the reduced cost of providing utilities and infrastructure, as smart growth makes better use of existing facilities and infrastructure and, on average, has lower demand. Improved air quality, public health (e.g., due to walking), and quality of life are also notable co-benefits.

Feasibility Issues

Smart growth policies are being considered and implemented around the country in a wide range of communities. Because most policies are deregulatory in nature, this significantly lowers political barriers. Much of the timing, feasibility, effectiveness and impacts of smart growth measures involve building development and population growth depending upon business and economic cycles.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-5. Improve and Expand Transit Service and Infrastructure

Policy Description

Improvements to existing transit service and expansion of transit routes can shift passenger transportation from single-occupant vehicles to public transit, thereby reducing GHG emissions. This mitigation recommendation involves a number of actions to be undertaken by state and local governments and transit agencies.

Policy Design

Goals:

- Reduce light-duty vehicle (LDV) total VMT in urban areas from 2008 baseline growth by 1% per year starting in 2010 until 2025.
- Increase investment in transit service and infrastructure by 2015.

Timing: As described above.

Parties Involved: State and local governments and transit agencies.

Implementation Mechanisms

The state should implement transit investments that encourage greater use of public transportation, such as the following:

- Improve service frequency on selected existing intra- and intercity transit routes (selected routes would emphasize those for which the measure would generate the greatest additional ridership or cost-effectiveness).
- Support and encourage improvements in intra- and intercity bus service.
- Reduce travel times on selected existing transit routes (signal prioritization, exclusive lanes, etc.).
- Improve the quality of service on selected existing transit routes (safety, cleanliness, improvements to shelters/stations).
- Provide financing, regulatory relief, and the use of eminent domain to develop and expand transit service and infrastructure (commuter rail, light rail, bus). In particular, the state should dedicate funding for the planning and development of commuter/light rail systems, especially in locations having higher population densities and other characteristics conducive to successful systems. The first project of this nature could be a case study for the rest of the state. Where such rail corridors are studied, municipalities in the affected corridor should begin to address zoning issues around likely future transit stops in order to promote increased residential and commercial densities. In addition, Regional Mobility Authorities throughout

Arkansas should always include mass transit options in their considerations and should devote 5%–50% of their funding to mass transit options.

- Offer incentives to potential passengers, and provide loans and/or subsidies to operators (public or private) to offer improved and less expensive intercity bus service.
- Provide financing, regulatory relief, and the use of eminent domain to develop, publicly or privately, a high-speed intercity passenger rail system serving major urban areas. Provide additional financial assistance to improve services already provided by Amtrak on other routes.

Related Policies/Programs in Place

- Arkansas State Highway and Transportation Department, *Arkansas Statewide Long-Range Intermodal Transportation Plan: 2007 Update*, available at: http://www.arkansashighways.com/planning/F%20&%20E/Final%202007%20Statewide%20Long%20Range%20Plan.pdf.
- Regional long-range transportation plans, including the possibility of passenger rail in northwest Arkansas.

Type(s) of GHG Reductions

Transportation sector surface transportation fuels produce CO_2 (which accounts for approximately 96% of transportation GHG emissions) and other GHG emissions (CH_4, N_2O, and hydrofluorocarbons).

Estimated GHG Reductions and Costs or Cost Savings

This analysis examines the reductions in GHGs possible from a shift from personal motor vehicles to transit, which typically emit fewer GHGs per passenger mile. The calculation of GHG reductions must account both for the reduction in the number of private vehicle miles, but also for the partly offsetting increase in transit VMT. In addition to these direct reductions from individuals' shift of modes, two more long-term, indirect effects will be estimated. The shifting of trips from personal vehicles to transit can reduce the number of vehicles on the road, and thus the amount of congestion in urban areas. Reducing congestion improves traffic flow and improves actual average vehicle fuel economy. Studies have also demonstrated that increased transit service can help shape land-use patterns, enabling densities and proximity to the center of urban areas, and resulting in reduced VMT by those living in transit corridors, even if they never use public transit.

Table I-6. Estimated GHG reductions and costs of or cost savings from TLU-5

Quantification Factors	2015	2025	Units
GHG emission savings	0.001	0.007	$MMtCO_2e$
Net present value (2009–2025)	$4.0	$1.5	Million $
Cumulative reductions (2009-2025)	0.001	0.03	$MMtCO_2e$
Cost-effectiveness	$3,980	$1,479	$/MtCO_2e$

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

Data Sources:

- The National Transit Database[12] was used to derive (1) current and historical transit ridership, by mode type (urban/rural, bus or paratransit; (2) operating cost per passenger and per passenger-mile, by mode type (urban/rural, bus or paratransit); and (3) revenue per passenger and per passenger-mile, by mode type (urban/rural, bus or paratransit).
- Linda Bailey, P.L. Mokhtarian, and Andrew Little. The Broader Connection Between Public Transportation, Energy Conservation and Greenhouse Gas Reduction. Produced by ICF International for the American Public Transportation Association. February 2008. Available at: http://www.apta.com/research/info/online/documents/land_use.pdf.
- Texas Transportation Institute. *2007 Annual Urban Mobility Report*. Quantification Methods. Available at: http://mobility.tamu.edu/ums/.

Direct quantification was undertaken for improvements in service frequency, travel time reductions, and the introduction of new and expansion of existing routes and services. These were applied to intra- and inter-city bus, vanpools, and rail services. Selected routes were assumed to emphasize those for which the measure would generate the greatest additional ridership or cost-effectiveness.

Travel time improvements provide a well-documented means of improving transit service and ridership. There is a direct benefit to riders as the improved service reduces the "generalized cost" (time cost plus financial cost) of their trip. In addition to co-benefits in improving service frequency, there is about a –0.4 elasticity for transit travel time.

Service frequency increases ridership from existing riders and attracts new riders. As waiting time between vehicles has been shown to be valued about two times more on average than actual travel time, this mechanism can prove very effective. There is a reported –0.5 elasticity for service frequency alone (time between buses), while the aggregate impacts for service improvements in time between vehicles and travel time have shown an elasticity of between –0.6 and –1.0, incorporating the time and frequency impacts of aggregate increases in service miles provided. An aggregate elasticity of -0.9 was applied to the total increase in vehicle revenue service miles to capture both factors together and reflect that the focus would be on the most effective implementation locations.

For service expansions and introduction, both the literature and a first-order statistical analysis show a long-run elasticity for service expansion of between –0.6 and –1.0. As above, an aggregate elasticity of -0.9 was applied to the total increase in vehicle revenue service miles to capture both factors together and reflect that the focus would be on the most effective implementation locations.

Estimates for the effects of new light rail and commuter rail services were based upon aggregate information from projects in similar urban areas in other states due to the lack of historical data in Arkansas.

[12] U.S. Department of Transportation, Federal Transit Administration. "National Transit Database." 2006. Available at: http://www.ntdprogram.gov/ntdprogram/.

Congestion reduction benefits from transit were represented by using a factor of 0.00822 private vehicle gallons saved per passenger-mile of transit ridership based on the Texas Transportation Institute's *2007 Annual Urban Mobility Report*.[13]

Synergies with land-use development were represented as equaling a reduction in VMT equal to one-quarter of the direct reduction from transit ridership 10 years prior, based on an adjustment of ICF's *The Broader Connection Between Public Transportation, Energy Conservation and Greenhouse Gas Reduction* very long-term factor, reduced to represent the actual pace of development.[14]

Key Assumptions:

- Transit services can be expanded and introduced at the same average operating cost as current services.
- New or improved services will attract ridership in a manner consistent with service improvements in other similar areas of the country (i.e., the Arkansas transit market is not at saturation). Current fuel price increases provide a strong argument for this assumption.

Key Uncertainties

As described above. The timing for availability of additional transit service depends upon the availability of funding and program implementation.

Additional Benefits and Costs

Transit services have a large number of additional impacts, which provide additional benefits. Transit service provides mobility, accessibility, and safety benefits that are not included in the analysis above. Important other co-benefits include improved air quality, public health (e.g., due to walking), and quality of life. Transit benefits in reducing congestion and facilitating land-use patterns, such as transit-oriented development and smart growth, are very significant and, as noted, are partly reflected in the analysis above.

Feasibility Issues

Implementation of additional transit service depends upon availability of funding. The use of eminent domain for the use of new rail right of ways may also impact feasibility.

Status of Group Approval

Complete.

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[13] Texas Transportation Institute. *2007 Annual Urban Mobility Report*. Quantification Methods. Available at: http://mobility.tamu.edu/ums/.

[14] Linda Bailey, P.L. Mokhtarian, and Andrew Little. *The Broader Connection Between Public Transportation, Energy Conservation and Greenhouse Gas Reduction*. Produced by ICF International for the American Public Transportation Association. February 2008. Available at: http://www.apta.com/research/info/online/documents/land_use.pdf.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-6. School and University Transportation Bundle

Policy Description

In 1969, approximately 50% of students walked or biked to school; by 2001 this number was less than 16%. These numbers indicate our growing dependence on the combustion engine and specifically on automotive travel. The reasons behind this drastic decrease in the number of students walking or riding their bikes to school are many, but include the growing distance of students' homes from their schools and an unsafe travel environment, including major road crossings and the lack of access to sidewalks or multi-use paths. The use of passenger vehicles to transport students to and from schools, colleges, and universities burns a significant amount of fossil fuel, which not only releases GHGs into the atmosphere, but also teaches students to travel by car, instead of utilizing healthier alternatives, such as walking, bicycling, riding the bus, or carpooling. Schools, colleges, and universities are well positioned to effect the changes in transportation habits that Arkansas needs if it is to reduce automobile use.

An October 2003 study by the U.S. Environmental Protection Agency (EPA) examined the relationship between school location, the built environment around schools, mode choices for trips to school, and the impacts these choices had an air emissions. The study found that school proximity matters to students, as students with shorter walk and bike times to and from school were more likely to walk and bike. Additionally, students traveling through higher-quality built environments were also more likely to bicycle and walk. And finally, because of these travel behavior choices, centrally located schools that can be reached by walking and bicycling served to reduce air emissions and demonstrated better air quality within the immediate vicinity surrounding the school.[15]

Policy Design

This policy focuses on encouraging the reduction of transportation sector GHG emissions when transporting students to schools, colleges, and universities.

Goals:

- By 2010, colleges and universities will study and report on the environmental impacts, the health and financial costs, and other costs and benefits associated with reduction of student VMT.
- By 2012, K-12 schools should consider establishing programs, such as ride sharing and ride-sharing clearinghouses; supervised walking to school, including "walking school buses" and safe routes to schools; and bicycling and mobility education programs that teach students about the health and environmental benefits of using alternative transportation. Additionally, these programs should present these alternatives in a manner that students should relate to in an effort to make it "cool" to walk, bicycle, carpool, or ride the bus.

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[15] U.S. Environmental Protection Agency. *Travel and Environmental Implications of School Siting*. EPA 231-R-03-004. October, 2003. Available at: http://www.smartgrowth.umd.edu/pdf/SchoolLocationReport.pdf.

- By 2012, K-12 schools should consider developing a program to teach students about the consequences automobile overuse has on both the environment and on their own personal health as well as other potential consequences of automobile overuse.
- By 2012, high schools should consider establishing programs to reduce or abolish student parking.
- By 2012, colleges and universities should consider establishing more comprehensive commuting programs that may include options, such as free bus programs, expanded bicycle storage, free student bicycles, carpooling programs, and abundant multifamily housing on or near campus, that also provide nearby access to such services as food, drugstore, etc.
- By 2012, through a combination of all of these programs, schools, colleges, and universities should consider reducing the total VMT transporting students by 5%
- By 2015, through a combination of all of these programs, schools, colleges, and universities should consider reducing the total VMT transporting students by 10%.
- By 2025, through a combination of all of these programs, schools, colleges, and universities should consider reducing the total VMT transporting students by 10%.

Timing: As described above.

Parties Involved: State of Arkansas, local school districts, parents, students.

Implementation Mechanisms

- K-12 schools will establish alternative transportation programs by 2012, such as ride sharing and ride-sharing clearinghouses; supervised walking to school, including "walking school buses" and safe routes to schools; and bicycling and mobility education programs that teach students about the health and environmental benefits of using alternative transportation. Additionally, these programs will present these alternatives in a manner that students will relate to in an effort to make it “cool” to walk, bicycle, or ride the bus, not only to school, but also in their daily lives.
- Arkansas schools will work with the federal "Safe Routes to School" program, which provides money for local sidewalks and crosswalks to develop safe routes to school.[16]
- Schools will examine their bus routes to determine the most efficient routes to take and will examine the potential for eliminating stops and having children walk farther to reach the bus. Having children walk just five to ten more minutes to a bus stop could save each district substantial sums of money while significantly reducing VMT by district buses.
- Education programs aimed at addressing the potential risks posed by having students walking or riding their bikes to school will be implemented for both parents and students. These

[16] U.S. Department of Transportation, Federal Highway Administration. "Safe Routes to School." Available at: http://safety.fhwa.dot.gov/saferoutes/.

programs will identify how the routes to school are designed for safety, provide perspectives on risk, identify how the routes will be made both visible and accessible, and provide information and training on the use of safety equipment and how to appropriately dress for walking and cycling in various weather conditions.

- K-12 is a critical time to teach children the environmental, health, and other consequences of automobile overuse. K-12 should make lessons about the environment—why we need it, how to preserve it, how we affect it, etc.—a routine part of all courses in health, biology, physical science, and environmental science curricula.

Implementation Mechanisms to Consider:

- Suggest that all streets near any K-12 school or university have sidewalks for pedestrian use.
- Suggest that all K-12 schools, colleges, and universities have bicycle access either via multi-use paths or through bike lanes on the surrounding street.
- Suggest that all K-12 schools, colleges, and universities have bicycle parking conveniently located near the entrances to buildings and in well-lit areas.
- Raise the legal age for receiving a driver's permit to 16, and raise the legal age for receiving a driver's license to 17. This would help to increase safety on the roads as well as serve to reduce GHG emissions by having fewer drivers at the high school level.
- Suggest that state high schools reduce the size of their parking lots to encourage carpooling and the use of other alternative transportation, including walking, cycling, and using public or school-provided transportation. The parking that is available should be neither free nor subsidized; rather, it should reflect the true cost of the lot and land. Schools can restrict student parking to seniors or outstanding students.
- Suggest that Arkansas colleges and universities require first-year, or first- and second-year, students to live on campus, and to store their cars in distant lots for out-of-town travel.
- Revise Arkansas' minimum acreage planning requirements for schools, so that they favor small, centrally located schools that encourage the use of walking and biking, while minimizing driving distances.
- Suggest that the energy required for transporting students to and from a K-12 school, college, or university is considered as a component when calculating a school building's energy ratings.
- Encourage colleges and universities to establish free bus programs for students, bicycle storage facilities, free student bicycles, and/or abundant multifamily housing on or near campus with services (food, drugstore, etc.) nearby.
- Encourage interviews with state officials or compare with peer states to estimate the number of students driving to school to develop an estimate of the number of parking spaces that can be eliminated.

- Encourage "ride matching" by examining the U.S. Department of Transportation National Household Travel Survey (NHTS) data to determine average vehicle occupancy for current school trips (e.g., siblings, current ride sharing) and estimating what additional penetration may be available for vehicles not fully occupied.

Related Policies/Programs in Place

Arkansas Safe Routes to School Program. Available at: http://www.arkansashighways.com/planning/safe%20routes/index.htm.

The Active and Safe Routes To School program in Toronto, Ontario, launched a "No Idling" at schools campaign across Ontario. The program determined that an idling engine uses 3.5 liters of gasoline per hour, and that 12% of urban smog is attributable to idling vehicles. This program resulted in an estimated reduction of 247 hours per day of auto idling resulting in an estimated 210.5 few metric tons of CO_2 emissions.[17]

One year after being implemented at 16 participating schools, Marin Safe Routes To Schools noted that the schools in Marin County, California, experienced a 57% increase in the number of children walking and biking, and a 29% decrease in the number of children being driven in a car.[18]

Type(s) of GHG Reductions

Reduced GHG emissions from reduction in combustion of transportation fuels, including CO_2.

Estimated GHG Reductions and Costs or Cost Savings

Emission reductions from these programs were not quantified for Arkansas at this time due to the lack of available data on travel patterns for students to Arkansas schools and post-secondary institutions. While some data, such as modal splits for accessing schools, were located, important elements, such as VMT by personal vehicles and disaggregation by school type and location for all factors were not. The latter is critical to estimation, due to the predominantly rural and smaller town and city population of the state. This demographic characteristic also made it impossible to compare with most existing studies, which include the results from higher-density urban areas.

Qualitatively, emission reductions in the shorter term will come primarily from mode shifting from passenger vehicle travel to ride sharing, walking, and cycling. The more efficient use of district busing may also serve to both reduce GHG emissions and provide a significant cost savings. In the longer term, school siting and sizing will allow greater baseline penetration of each of these modes, increase the feasibility of bus use, and allow for shorter trip distances for all transportation modes.

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[17] U.S. Department of Transportation, National Highway Traffic Safety Administration, Center for Health Training. *Safe Routes to School: Practice and Promise*. Available at: http://www.nhtsa.dot.gov/people/injury/pedbimot/bike/Safe-Routes-2004/images/SafeRoute2Schlo.pdf.

[18] Ibid.

Table I-7. Estimated GHG reductions and costs of or cost savings from TLU-6

Quantification Factors	2015	2025	Units
GHG emission savings	.006	.013	$MMtCO_2e$
Net present value (2009–2025)	N/A	N/A	Million $
Cumulative reductions (2009–2025)	N/A	.113	$MMtCO_2e$
Cost-effectiveness	N/A	N/A	$/$MtCO_2e$

Year	2001	2002	2003	2004	2005	2010	2015	2020	2025
Total Ark Bus VMT	50,128,000	50,955,112	51,782,224	52,609,336	53,436,448	57,572,008	61,707,568	65,843,128	69,978,688
Tonnes CO2eq	94,369	95,926	97,483	99,040	100,597	108,382	116,167	123,952	131,737
% Reduction in VMT						0%	5%	7.50%	10%
VMT Reduction							3,085,378	4,938,235	6,997,869
Revised VMT	n/a	n/a	n/a	n/a	n/a	n/a	58,622,190	60,904,893	62,980,819
Revised CO2 emissions							110,359	114,657	118,564
CO2eq Reduction (Tonnes)							5,808	9,295	13,173

Total CO2eq Reduction (Tonnes) between 2009 and 2025: 113,754

Total VMT Reduction between 2009 and 2025: 60,780,823
at 6.7 mpg that is a savings of 9,071,765 gallons of diesel.
at $4.80 per gallon = $43,544,472 cost savings form reduced VMT

Federal Average Mileage Per Bus: 8,000
By 2015 this policy could result in as many as 385 less buses needed to be in operation
By 2025 this policy could result in as many as 874 less buses needed to be in operation

Note: This policy does not identify the cost of implementation for this program

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent; VMT = vehicle miles traveled; N/A = not applicable.

Quantification Methods:

The quantification for this policy recommendation was based upon Arkansas school buses and VMT reduction goals of 5% by 2015 and 10% by 2025. Emission reductions were quantified by estimating the reduction in VMT and multiplying that number by the amount of emissions per mile.

Total Arkansas school bus VMT for 2015 is expected to be 61,707,568 miles. A 5% reduction in this number would bring the total mileage down to 58,622,190. CO_2 emissions would drop from 116,167 tons down to 110,359 tons, for a savings of 5,808 tons of CO_2 emissions.

For 2025, total Arkansas school bus VMT is expected to increase to 69,978,688, but reaching the 10% VMT reduction goal would drop this number to 62,980,819. CO_2 emissions would fall from 131,737 without VMT reductions to 118,564 upon reaching the goal of a 10% reduction in school bus VMT.

Other programs that are suggested in this policy if implemented could lead to much more significant reductions in CO_2 emissions. However, many of them would need to be implemented on an institution-by-institution basis, and much of the information necessary to accurately calculate these reductions has not been developed.

Estimating that 200,000 passenger vehicle miles are driven annually to transport students to and from schools, colleges, and universities, a reduction of 10% through this policy recommendation, would result in a reduction of 20,000 VMT. If the state average fuel economy at the time this program is implemented (2012) reaches the 2008 CAFE average of 22.5 miles per gallon (mpg), that would equal a savings of 889 gallons of gasoline. EPA estimates that each gallon of gasoline burned results in 19.4 pounds of CO_2 emissions. Therefore, a savings of 889 gallons of gasoline would results in 17,244 pounds of reduced CO_2 emissions.

Percentage improvements/increases in the penetration rate for nonmotorized access will be taken and applied from programs, such as the "walking school bus," the national pedestrian and bicycle clearinghouse, Safe Routes to School, and university student commute trip benefit programs.

Key Assumptions:

- Current mode splits from NHTS will be based on a collection of peer states and assumed to be similar for Arkansas.
- Estimates of the number of available seats for ride sharing will be based on vehicle occupancy and assumptions regarding the vehicle fleet (e.g., minivans).

Data Sources: School enrollment, school size, bus fleet utilization, and mode splits.

Key Uncertainties

As described above.

Additional Benefits and Costs

None noted.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-7. Promote and Facilitate Freight Efficiency

Policy Description

Today, nearly 2 million tractor trailers are registered in the United States. Between 1990 and 2006, total U.S. truck tonnage increased by nearly 40%. By 2018, truck tonnage is estimated to increase by almost 30%, to about 14 billion tons, up from nearly 11 billion tons in 2006. Much of this traffic routes its way through Arkansas. The state should offer incentives to truck carriers that invest in low-emission engines.

Typical switch locomotives idle 75% of the time, accounting for 27% of their total fuel use. Conversion to electrification may be impeded by institutional factors and access—both perceived and actual—to necessary infrastructure. A check of the DOE truck stop electrification site locator shows three facilities within a 100-mile radius of Little Rock.

Technologies to reduce heavy-vehicle idling are readily available and cost-effective for long-haul trucking, and include auxiliary power units and truck stop electrification. According to Argonne National Laboratory, long-haul trucks idle an average of 6 hours per day or 1,830 hours per year, consuming 20 million barrels of diesel fuel. The use of existing technology can reduce fuel use by 90%.[19]

Improving freight efficiency by expanding the use of short-haul rail over trucking alternatives will require a fundamental shift in regulatory oversight of the railroads. This will require the adoption of federal legislation reforming the Surface Transportation Board (STB), reversing anticompetitive practices, and creating an obligation to serve. The combination of mergers, bottleneck rules, paper barriers, and antitrust exemption creates an environment that often eliminates competition and alternatives for small or captive shippers. The state should take an active role in influencing national rail policies that improve railroad infrastructure, increase rail capacity, and improve rail yards to expand intermodal options.

Policy Design

This policy focuses on promoting and facilitating freight efficiency by:

- Improving railroad infrastructure and rail yards;
- Increasing rail and river shipping capacity, which may allow some freight to shift from trucks to either rail or ships;
- Providing economic assistance and regulatory streamlining for the improvement of intermodal rail yards and the relief of rail freight bottlenecks;
- Providing electrification at truck stops to reduce idling;

[19] Argonne National Laboratory. "Reducing Heavy Vehicle Idling." Available at: http://www.transportation.anl.gov/engines/idling.html.

- Supporting and promoting policies and legislation that improve regulatory oversight of the railroad industry;
- Providing plug-in power at port sites to enable vessels to turn off engines and reduce idling; and
- Providing incentives for more efficient trucks.

Goals:

- Reduce diesel truck idling by Class 8 (tractor-trailer) trucks by 80% by 2010 and 100% by 2020.

Timing: As described above.

Parties Involved: Freight movement operators and other stakeholders.

Implementation Mechanisms

As noted above and as follows:

- Restore antitrust laws to the railroads.
- Reform the STB in a manner that reverses anticompetitive rulings, protects the public interest, creates a proactive STB that will investigate unreasonable rail practices, and creates and enforces an obligation-to-serve standard.
- Require timely investments in rail infrastructure, including increased rail capacity and rail yard enhancements to accelerate intermodal transportation and truck to short-haul rail.
- Establish standards for truck stop electrification by August 2009, determining the appropriate technology (such as Idle Aire or Shorepower systems) that will provide an alternative to idling or auxiliary power units; and establish a reasonable conversion period for transient vehicles and Arkansas-based organizations to retrofit and adapt their systems before assessing the need for restrictive ordinances.
- Complete a similar assessment of port facilities and rail-switching yards to determine the costs and benefits by mid-2010.
- Provide incentives to trucking companies that invest in the purchase of low-emission engines and lightweight tractor/trailer combinations.

Related Policies/Programs in Place

EPA provides partnership support to trucking companies through the “Smartway” program.

Type(s) of GHG Reductions

GHG emissions from combustion of transportation fuels include CO_2 predominantly.

Estimated GHG Reductions and Costs or Cost Savings

Table I-8. Estimated GHG reductions and costs of or cost savings from TLU-7

Quantification Factors	2015	2025	Units
GHG emission savings	0.33	0.47	$MMtCO_2e$
Net present value (2009–2025)	N/A	$48	Million $
Cumulative reductions (2009–2025)	N/A	6.1	$MMtCO_2e$
Cost-effectiveness	N/A	$104	$/MtCO_2e

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/tCO_2e = dollars per metric ton of carbon dioxide equivalent; N/A = not applicable.

Quantification Methods:

Estimate the reduction in CO_2 emissions from reduced idling based on estimating the portion of emissions and fuel consumption in the Arkansas inventory that is attributable to Class 8 diesel trucks, estimate the portion of the total fuel consumption that would be consumed during idling, and apply a targeted reduction of 80% to this amount starting in 2008 and a reduction of 100% starting in 2015. The assumptions below were used for this estimation.

Key Assumptions:

- Idle reductions are achieved only by the Class 8 diesel trucks, which idle for an average of 6 hours per day, and consume 0.8–1.2 gallons of diesel per hour during idling.
- Class 8 diesel trucks will reduce idling by 80% by 2010 or 100% by 2020.
- The VMT traveled by long-haul combination tractor-trailers (the vehicles that would conduct the long idling applicable to this analysis) was estimated at 1,841,000 million miles in 2010, increasing to 3,549,000 million miles by 2025.
- Idling was assumed to occur for 6 hours every 500 miles (the approximate average distance a truck would travel between required rest periods).
- The cost analysis will assume a 5-year lifetime for idling technology equipment, applied to 80% of Class 8 vehicles starting in 2008 and 100% of Class 8 vehicles starting in 2015, at a cost of $6,000 per vehicle and a $4.80 per gallon of diesel.
- Program administration costs, enforcement costs, fines, and reduced vehicle maintenance costs will not be factored into the cost analysis.
- Rail investment is assumed to occur over a 10-year period and to be sufficient to achieve a 6% shift in modal choice. An estimate of 250 miles of track upgrade at $4.4 million per mile was used to represent the cost of rail investment (implicitly including rail yard improvements if needed).

- The shift to intermodal rail was assumed to represent a 30% reduction in emissions, accounting for greater rail circuity, switch-yard locomotives, and the necessary truck haul to/from rail yard to final destination.

Key Uncertainties

The ability of trucking companies to invest in new equipment depends upon economic conditions.

Additional Benefits and Costs

Fuel savings are generally recognized as having positive financial impacts upon trucking companies and truck operators. Some of these positive savings may be passed on to consumers of the goods that are being transported.

Feasibility Issues

Some technologies are "off the shelf," while others are not yet widely implemented in the marketplace.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-8. Procurement of Efficient Fleet Vehicles (Passenger and Freight)

Policy Description

Arkansas state and local government agencies should "lead by example" by enacting procurement policies and or joining the EPA's SmartWay program and utilizing the SmartWay Upgrade Kits that result in adoption of lower-emitting vehicle fleets. The three primary components of the SmartWay program are: (1) creating partnerships between shippers, carriers, and program sponsors; (2) reducing all unnecessary engine idling; and (3) increasing the efficiency of LDVs, heavy-duty vehicles (HDVs), rail, and intermodal operations.

This policy recommendation strengthens Arkansas' commitment to reduce GHG emissions through fuel efficiency in vehicles owned by the state, while also encouraging private and public agencies to develop incentive programs that might, for example, help with the initial costs of purchasing such vehicles.

Policy Design

In leading by example, state government will ensure that its own fleet of vehicles meets or exceeds the targets set for the state as a whole, while providing available means for all public and private vehicles to also exceed these standards voluntarily. To the extent possible, the state should be encouraged to purchase domestically produced vehicles when all other vehicle characteristics are comparable.

Goals:

- By 2010, identify barriers to purchasing hybrid vehicles, and research and develop solutions to procure hybrid or other lower-GHG-emitting vehicles in the state.
- By 2010, ensure that the overall state of Arkansas fleet considers the EPA fuel efficiency rating calculated over the life cycle of the vehicles purchased for the fleet.
- By 2015, ensure that low-carbon fuels are purchased for the state motor pool fleet, wherever they are available and if applicable for the vehicle type.
- By 2019, at least 70% of all HDVs and by 2014 at least 90% of all LDVs are "fuel efficient," meeting, on average, a higher mpg rate for the state's HDV and LDV fleets.

Timing: See above.

Parties Involved: Arkansas state and local government agencies, private industries and fleets, trucking industry.

Other: None noted.

Implementation Mechanisms

None noted.

Related Policies/Programs in Place

None noted.

Type(s) of GHG Reductions

None noted.

Estimated GHG Reductions and Costs or Cost Savings

GHGs and fuel costs will be reduced primarily through the purchase of HDVs that are more fuel efficient within their vehicle class, and through better "right-sizing" of the state vehicle fleet, so that vehicles of a heavier class are not purchased and/or utilized when a lighter, more fuel-efficient vehicle would suffice. Care must be taken to account for the fact that the state may dispose of some vehicles before the end of their useful lives. This could imply the pushing of either less or more fuel-efficient vehicles into the non-state-owned vehicle fleet in Arkansas.

Data Sources:

- State HDV fleet composition and utilization.
- Average annual HDV acquisitions.
- State vehicle fleet diesel and biodiesel use.

Quantification Methods:

- Based on the 2010 initiation and 2019 70% goal, penetration of more fuel-efficient HDVs into the state fleet will be calculated, along with the percentage reduction in fuel use.
- Based on the 2015 low-carbon fuel target, an estimate will be made of the potential penetration (accounting for national fuel availability) rate and the GHG benefits (using a life-cycle analysis of fuel emissions) of using biodiesel.

Key Assumptions:

- Fleet turnover and procurement will continue at the same rate as previously. Accelerated procurement rates would be considered to displace less fuel-efficient vehicles into the non-state fleet more rapidly, counteracting some benefits.
- Biodiesel is assumed to be the only low-carbon fuel available by 2015, with the exception of natural gas, which buses may also run on.

Key Uncertainties

None noted.

Additional Benefits and Costs

None noted.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

TLU-9. Fuel Efficiency: Clean Car Incentive

Policy Description

To reduce gasoline consumption and GHG emissions, Arkansas should adopt a "clean car incentive" system. Unlike a tailpipe emissions mandate or mpg mandate, a market-based incentives program would give rebates to Arkansans who purchase new vehicles that reduce oil consumption and GHG emissions by being more fuel efficient. The program would be self-financed by being paid for with disincentives (fees) to those who purchase new vehicles that are less fuel-efficient. The rebates (or fees) would be subtracted from (or added to) the purchase price of the vehicle at the point of sale. The "pivot point"—the mileage standard that divides rebates from fees—would be calculated from recent Arkansas vehicle sales based on the condition that the program be self-financing. To protect light truck (pickup truck) owners, light trucks would be treated as a separate class with their own pivot point. The clean car incentive would apply only once for each vehicle, at the point of sale of new cars, and so would not affect the price of used cars.

This incentive plan, often called a "feebate," has been adopted in various forms by Canada, Austria, Germany, Sweden, Denmark, and France, and is being seriously considered by California, Massachusetts, Vermont, and at least five other states. This plan was endorsed by the U.S. National Research Council in a 2002 study.[20] The Rocky Mountain Institute, a well-known energy analysis organization, makes this plan the centerpiece of its automobile policy recommendations.[21]

Incentive programs of this sort have two kinds of effects: They encourage consumers to purchase more efficient vehicles, and they encourage manufacturers to produce more efficient vehicles that can take advantage of the rebates.

Vehicle incentive programs have the potential to affect consumer behavior in terms of choices of motor vehicles. The uncertainty of these programs is the degree to which they will result in measureable changes in consumer choices and behavior. Most studies to date have indicated that state and local policies in states with small populations of vehicles are likely to have little impact upon the types of vehicles that are offered in the marketplace.[22] It is possible that state and local policies can affect some individual choices, but studies to date (including studies by Oak Ridge

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[20] National Research Council, *Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards*. Washington, DC: National Academy Press, 2002. Available at: http://www.nap.edu/openbook.php?record_id=10172&page=R1.

[21] A.B. Lovins, E.K. Datta, O-E. Bustnes, J.G. Koomey, and N.J. Glasgow. *Winning the Oil Endgame: Innovation for Profits, Jobs, and Security.* Rocky Mountain Institute. 2007. Available at: http://nc.rmi.org/Page.aspx?pid=269&srcid=269.

[22] The 13 states have about one-third of the nation's registered automobiles. Michael Benjamin, Jon Taylor, and Paul Hughes. "California Air Resources Board Technical Assessment: Comparison of Greenhouse Gas Reductions Under CAFE Standards and ARB Regulations Adopted Pursuant to AB1493." January 2, 2008.

National Laboratory)[23,24,25] indicate that the overall effect of these individual choices is small, unless the program is coordinated with other states and thereby has an effect on the range of vehicles offered in the marketplace.

To promote energy efficiency and GHG reductions, Arkansas should study the adoption of a "clean car incentive" system. Unlike a tailpipe emissions mandate or mpg mandate, an incentives program would encourage Arkansans to purchase new vehicles that save social costs (global warming costs) by being more fuel efficient.

Policy Design

Goals and Timing: Have the clean car incentive program in place by 2010. As a plausible goal, increase the percentage of new high-efficiency vehicles (those with gasoline mileages above the initial pivot point) and decrease the percentage of new low-efficiency vehicles by several percentage points (perhaps 10%) by 2015. As another kind of plausible goal, might move the pivot point toward higher gasoline mileage by a few miles per gallon by 2015.

By 2012, the state or appropriate agency will:

- Develop a program to help reduce GHG vehicle emissions by encouraging greater use of vehicles that produce less GHGs.
- Develop incentives and/or disincentives for purchasing new, lower-GHG, more energy-efficient vehicles.

By 2020:

- The majority of vehicles on the road (greater than 50%) will produce less GHG emissions than the average for the U.S. fleet, and will be in compliance with federal and state GHG emission levels.
- The state or appropriate agency will establish legislation to set standards for new vehicles with mandatory manufacture labeling.

Parties Involved: Arkansas Departments of Motor Vehicles and Transportation, American and foreign automobile industries, EPA, Arkansas Energy Office.

Implementation Mechanisms

The program would be self-financed by being paid for with disincentives to those who purchase new vehicles that impose social costs by being less fuel efficient. The incentives (or

[23] California Air Resources Board. Zero Emission Vehicle Incentive Programs. Available at: http://www.arb.ca.gov/msprog/zevprog/zip/zip.htm.

[24] D.L. Greene. TAFV: Alternative Fuels And Vehicles Choice Model Documentation. . Oak Ridge, TN: Oak Ridge National Laboratory, Center for Transportation Analysis, July 2001. Available at: http://www-cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2001_134.pdf.

[25] D.L. Greene and Y. Fan. *Transportation Energy Efficiency Trends, 1972–1992*. Report ORNL-6828. Oak Ridge, TN: Oak Ridge National Laboratory, Center for Transportation Analysis. December 1994. Available at: http://www.osti.gov/bridge/product.biblio.jsp?osti_id=10110523.

disincentives) would be subtracted from (or added to) the purchase price of the vehicle at the point of sale. The "pivot point"—the mileage standard that divides incentives from disincentives—would be calculated from recent Arkansas vehicle sales based on the condition that the program be self-financing. To protect pickup truck owners, light trucks would be treated as a separate class, with their own pivot point between those vehicles that receive rebates and those that pay fees.

Incentives and disincentives should be zero at the pivot point and should rise in proportion to each vehicle's gasoline savings or consumption relative to the pivot point. Studies suggest that this rise should be around $1,000 per 0.01 gallons per mile (gpm); that is, for each 0.01 gpm that a particular vehicle type saves (relative to the pivot point), the owner receives a rebate of $1,000, and similarly for each 0.01 gpm that a particular vehicle consumes (above the pivot point). For example, if the pivot point for all passenger cars is, say, 23 mpg (or 0.043 gpm), then a car getting 18 mpg (0.056 gpm) is 0.013 gpm worse than the pivot point, and so incurs a $1,300 fee. Another car getting 36 mpg (0.028 gpm) is 0.015 gpm better than the pivot point, so it earns a $1,500 rebate. With a $1,000 per 0.01 gpm rise, the maximum incentives and disincentives would run around $2,500.

Because vehicles will (it is hoped) become more efficient, the pivot point will need to be re-adjusted every year to reflect the most recent year's gasoline mileage data. The clean car incentive would apply only once for each vehicle, at the point of sale of new cars, and so would not affect the price of used cars.

Related Policies/Programs in Place

The federal Energy Independence and Security Act requires automakers to increase the average fuel economy of LDVs offered in the marketplace to an equivalent of 35 mpg by 2020.

Type(s) of GHG Reductions

This policy recommendation will assess the potential for GHG reductions from state policies.

Estimated GHG Reductions and Costs or Cost Savings

GHG reductions and costs or cost savings are not estimated, as the results of the study will provide further information about the potential for state action in this area to significantly reduce GHG emissions.

Key Uncertainties

Consumer response to incentive programs varies from region to region.

Additional Benefits and Costs

The use of more fuel-efficient vehicles is recognized as reducing the need for importing petroleum and petroleum products from other countries.

Feasibility Issues

The feasibility of incentive programs, such as that described above, is yet to be determined. Some European nations and Canada have initiated such programs. The analysis should include a review of these programs in other countries.

Status of Group Approval

Complete.

Level of Group Support

Super Majority (one objection).

Barriers to Consensus

One member favors a national program and objected to this recommendation being implemented in just Arkansas.

TLU-10. Public Education

Policy Description

This policy focuses on better informing the public of the measures individuals can take to reduce their transportation-related GHG emissions. Drivers will voluntarily reduce fuel use and GHG emissions from their activities when they have the information necessary to make proper decisions.

The recommendation would involve development and implementation of a curriculum that addresses limiting GHGs in transportation through:

- Education about transportation choices and consequences: low-GHG-emitting vehicles, carpooling, use of alternative fuels, walking, biking, telecommuting, mass transit, safety issues, ride sharing in schools, etc.
- Improved vehicle operation and maintenance: regular vehicle tune-ups, fuel-efficient tires, coolest temperature fueling, tire pressures, engine lubricants, slower acceleration, shifting at lower revolutions per minute, cruise control, turning off vehicles when parked, eliminating "jack-rabbit" starts.
- Education about city planning choices.

The curriculum would be a requirement for all driver training programs and would be distributed through other possible venues as deemed appropriate by the agency(ies) developing the program. This program should include questions pertinent to training included on the written/driving portion of private and commercial driver licensing tests. (Driver training programs in Utah and Arizona currently incorporate this type of curriculum in classroom settings.) In addition, programs that include this curriculum are to be mandated for both state and municipal fleet operators. All GHG-saving application methods included in the curriculum would be enforced at state and municipality fleet levels.

In the interest of time and expense, it is recommended that existing curricula from such entities as DOE or the National Energy Foundation be examined for application and modified as needed.

Policy Design

Goals:

- Reduce transportation GHG emissions through education to promote intelligent transportation purchasing choices and vehicle operation. *[Unable to quantify effects of educational programs at this time.]*
- Begin the consumer information program in 2008, and extend it as resources become available.

Timing:

- By 2010, the state or appropriate agency would develop a marketing program for fuel-efficient replacement tires and energy-efficient driving practices and devices.
- By 2010, the state or appropriate agency would ensure that training be delivered for all state and municipal fleet operators.
- By 2010, private and commercial driver licensing tests would be modified to incorporate information about fuel-saving driving practices.

Parties Involved: Driver training programs; Arkansas Department of Motor Vehicles; state, commercial, and municipal fleets.

Implementation Mechanisms

The Arkansas Department of Education should make science standards part of the curriculum.

Related Policies/Programs in Place

None noted.

Type(s) of GHG Reductions

None noted.

Estimated GHG Reductions and Costs or Cost Savings

The potential GHG reductions from this policy recommendation will not be quantified, since they are associated with other policies that complement public education.

Key Uncertainties

None noted.

Additional Benefits and Costs

None noted.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

None.