CHAPTER 5
TRANSPORTATION SECTOR
CO_2 EMISSION REDUCTION STRATEGY

Key Findings

Figure 5-1

Transportation Sector CO_2 Emission Projections Through 2010

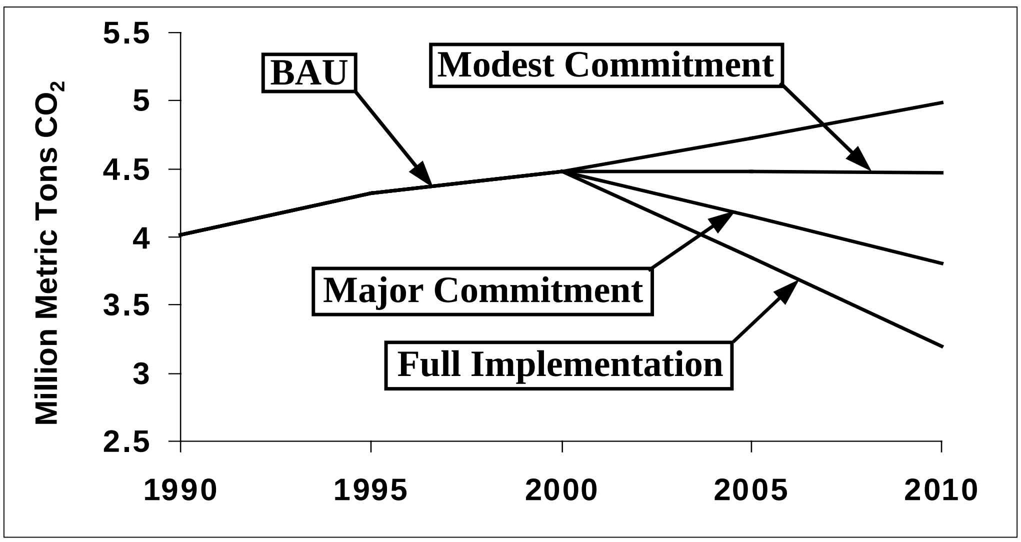

Table 5-1

Summary of Scenario Analyses to Reduce CO_2

in Delaware's Transportation Sector

	Energy Use (trillion BTUs)	GHG emissions ($mmtCO_2$)*
1990	55.59	4.0
2010 BAU	68.61	4.9
Implementation Scenarios		
Modest Commitment (35%)	-	4.4 (10%)
Major Commitment (65%)	-	3.7 (24%)
Full Implementation (100%)	-	3.1 (36%)

* Percentage reductions from forecast emission level are indicated in parenthesis

Carbon dioxide emissions from the transportation sector have accounted for approximately 26 to 30% of Delaware's total CO_2 emissions on a yearly basis since 1985

(EIA, 1997). The existing trend of rising emissions is forecast to continue to 2010 under the BAU scenario. The $EECO_2$ forecast for the Action Plan (see Chapter 1) anticipates more than 20% growth over 1990 levels in energy use and CO_2 emissions for this sector. Three levels of CO_2 mitigation scenarios were developed: the Modest Commitment scenarios, which involves modest technology upgrades and low-cost conservation measures; the Major Commitment scenarios which anticipates higher efficiency technologies penetrating the market, an increase in the pace of diffusion of alternative fuel vehicles (AFVs), and greater use of low-cost conservation measures; and the Full Implementation scenarios, which accelerates market penetration of high-efficiency technology, aggressively markets AFVs and extensively employs low-cost conservation measures. For all three implementation scenarios, it is expected that the State of Delaware will pursue an aggressive program of managed growth strategies that are discussed below. While the Consortium was unable to calculate specific, measurable CO_2 impacts for growth management, it believes that such a program is an essential tool that will be needed to meet the objectives of the Action Plan.

The Modest Commitment scenarios achieve a 10% reduction in CO_2 emissions measured from the BAU benchmark. The Major Commitment scenarios doubles the reduction to 24%, while the Full Implementation scenarios results in a 36% reduction in CO_2 emissions.

Background

In 1995, the transportation sector accounted for 28% of Delaware's total CO_2 emissions, second only to the utility sector (EIA 1997). Almost all greenhouse gas emissions from Delaware's transportation sector are in the form of CO_2. Consequently, CEEP chose to focus on ways to reduce CO_2 emissions from this sector.

Impacting transportation emissions is complex because many different modes of travel spanning a wide range of activities must be considered. Fuels consumed by highway vehicles, boats, airplanes, jets, railroads, and pipelines all contribute to emissions from the sector. However, jet and aviation fuels were excluded from this Action Plan based on a recommendation by USEPA that bunkered fuels should not be included in state emission figures.[1] Of the remaining emission sources, highway vehicles burning motor gasoline and distillate (diesel) fuel account for roughly 85% of CO_2 emissions from the transportation sector on a yearly basis.[2] Highway vehicles include light-duty cars and trucks, heavy-duty vehicles, and motorcycles. This Action Plan focuses specifically on ways to reduce gasoline and diesel fuel consumption, and hence CO_2 emissions, from cars and light-duty trucks (known collectively as light-duty vehicles or LDVs). By themselves, LDVs accounted for 72% of the total CO_2 emissions from the transportation sector in 1990.[3]

Three different tools for reducing CO_2 emissions from highway vehicles are considered in this report – improvements in LDV fuel economy, introduction of compressed natural gas (CNG) vehicles and electric vehicles (EVs), and the use of transportation control measures (TCMs) to reduce vehicle miles traveled (VMTs). Consistent with the modeling approach for other sectors, three implementation scenarios were evaluated: Full Implementation, which results in a 36% reduction in CO_2 emissions from the BAU forecast of 4.9 mmt; the Major Commitment case, which results in a 24% reduction; and the Modest Commitment case which would realize a 10% cut in CO_2 emissions. Although implementing any of these strategies will be challenging, each shows significant potential for reducing CO_2 emissions cost-effectively from the transportation sector. A cost-effectiveness screen of a five-year payback period was used to evaluate CO2 mitigation options for this sector.

Sources and Trends of Emissions

The majority of CO_2 emissions from the transportation sector result from the burning of fossil fuels. The primary fossil fuels burned are motor gasoline, distillate fuel,

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[1] A discussion of bunkered fuels can be found in CEEP's *Delaware Greenhouse Gas Inv*entory (CEEP 1995).
[2] This figure is based on CEEP's calculations of fuel consumption for Delaware vehicles – see Appendix I.
[3] This figure is based on CEEP's calculations of fuel consumption for Delaware vehicles – see Appendix I.

and residual fuel (EIA 1997). The remaining CO_2 emissions derive from the breakdown of lubricants. A small amount of CO_2 is also produced by burning compressed natural gas, liquid petroleum gas and some other alternative fuels, but their portion of total CO_2 emissions is too small to be considered.[4] The relative contributions of the CO_2 sources in 1990 and 1995 are shown in Table 5-2.

Table 5-2

Delaware CO_2 Emissions by Fuel Type from the Transportation Sector

Fuel Type	CO_2 Emissions (metric tons of CO_2)			
	1990		1995	
Distillate	586,663	14.64%	746,135	15.25%
Residual	450,264	11.23%	582,926	12.00%
Motor Gasoline	2,953,805	73.76%	3,518,012	72.40%
Lubricants	14,880	0.37%	16637	0.35%
Total	**4,010,000**	**100%**	**4,860,000**	**100%**

Highway vehicles produce the majority of CO_2 emissions in the transportation sector. In 1990, highway vehicles accounted for 85% of the 4.0 mmtCO_2 emitted by the entire sector. Highway vehicles also accounted for 95% of emissions from gasoline and diesel fuel consumption. In 1996, highway vehicles accounted for 79% of total transportation sector emissions and 90% of gasoline and diesel fuel consumption.[5]

Projections

In 1990, the transportation sector emitted 4.0 million metric tons of carbon dioxide. The BAU forecast for CO_2 emissions in 2010 is 4.9 mmt, an increase of 0.9 mmt (or 22%) from 1990 levels. A 7% reduction from 1990 levels, as per the DCCC emissions reduction goal, yields a target for this sector of 3.7 mmtCO_2. Therefore, a reduction of 1.2 mmt from forecasted 2010 levels (a 24% decline) is required to meet the DCCC goal.

[4] LPG and CNG each count for less than one-tenth of a percent of Delaware's total CO_2 emissions – see the *Delaware Greenhouse Gas Inventory* (CEEP 1995)

[5] The basis for these calculations is described in the methodology section of this chapter.

Increases in Delaware's vehicle miles traveled (VMTs) are fueling the growth in emissions from the transportation sector. VMTs are increasing at a rate much faster than Delaware's population. VMTs increased by 55% during the 1980s, while population increased by only 11% during the same period (DelDOT 1998). Between 1990 and 2010, VMTs are expected to increase by another 43% (DelDOT 1998). Although the rate of VMT increase is expected to slow between now and 2010, the rate of increase is still rapid and will continue to outstrip population growth by a large margin. The rapid growth rate in VMTs reflects two important trends in Delaware; higher proportions of Delawareans are becoming licensed drivers, and those drivers are, on the whole, driving more miles. Sometime after the year 2010, the proportion of licensed drivers in Delaware will stabilize at an upper limit, but VMTs per driver may still increase, if current trends continue.

Increases in the average fuel economy of cars and light-duty trucks during the 1980s and early 1990s partially offset increasing VMTs during the same period. Increasing fuel economy translates into less fuel burned per mile and, hence, less CO_2 emissions per mile traveled. However, the average fuel economy of both cars and trucks stabilized during the 1990s, while VMTs continued to increase (USDOE 1998).[1] Average fuel economy is expected to increase little or not at all in the near future, as corporate average fuel economy (CAFE) standards have leveled off at 27.5 and 20.7 mpg for cars and light-duty trucks, respectively (USDOE 1998). A comparison of CAFE standards with fuel economy for cars and light-duty trucks over the past 15 years is shown in Table 5-3.

[1] Fuel economy rates and the figures for new vehicles sold in Delaware were not obtainable. Therefore, national average fuel economy rates and sales figures were used in lieu of Delaware-specific data. This information was obtained from the U.S. Department of Energy's *Transportation Energy Data Book: Edition 18* (USDOE 1998).

Table 5-3

Average Fuel Economy and CAFE Standards for Cars and Light-Duty Trucks, 1984-1998

	Cars		Light-Duty Trucks	
Model Year	CAFE Standards	Fuel Economy (miles per gallon)	CAFE Standards	Fuel Economy (miles per gallon)
1984	27.0	17.4	20.0	14.0
1985	27.5	17.4	19.5	14.3
1986	26.0	17.4	20.0	14.6
1987	26.0	18.0	20.5	14.9
1988	26.0	18.7	20.5	15.4
1989	26.5	19.0	20.5	16.1
1990	27.5	20.2	20.0	16.1
1991	27.5	21.1	20.2	17.0
1992	27.5	21.0	20.2	17.3
1993	27.5	20.5	20.4	17.4
1994	27.5	20.7	20.5	17.3
1995	27.5	21.1	20.6	17.3
1996	27.5	21.3	20.7	17.3
1997	27.5	N/A	20.7	N/A
1998	27.5	N/A	20.7	N/A

Source: U.S. Department of Energy. (1998) *Transportation Energy Data Book: Edition 18*.

The plateau reached in fuel efficiency, may remain, or even fall, due to the increasing prevalence of sport utility vehicles (SUVs). SUVs are subject to the lower CAFE standard of 20.7 mpg for light-duty trucks. Accordingly, as more SUVs are sold, overall fuel economy for LDVs worsens. Forecasts indicate that light-duty trucks will account for 62% of all light-duty vehicles sold in the U.S. by 2010 (STAPPA/ALAPCO 1998). This is a 105% increase over the proportion of light-duty trucks sold in 1990. An increase in sales of new light-duty trucks by this amount would produce an additional 210,220 mt of CO_2 in 2010 over a comparable baseline that held the proportion of new light-duty trucks sold at 1996 levels. CEEP included an increasing portion of light-duty trucks in its BAU analysis.

Methodology

Three strategies for reducing CO_2 emissions were developed: improvements in fuel economy of cars and light-duty trucks; increased use of alternative fueled vehicles (AFVs); and State and local adoption of menus of transportation control measures, or TCMs, to reduce VMTs. The measures and policies put forth in the Action Plan to reduce CO_2 emissions target only highway vehicles, and specifically, cars and light-duty trucks (both gasoline and diesel powered). Heavy-duty vehicles, such as delivery trucks and tractor-trailers, are not targeted for emission reductions in this Plan, due to data limitations.

In 1996, fuel efficiency for Delaware's automobile fleet was 21.3 mpg, while the light-duty truck fleet averaged 17.3 mpg (USDOE 1998). These figures are based on the most recent national averages published in USDOE's *Transportation Energy Data Book.* As no projections were available for BAU scenario changes in fuel efficiency, a consistent fleet fuel efficiency is assumed throughout the study period. Recent trends in fuel efficiency of new cars and trucks support this assumption.

Two types of AFVs are assessed in the Action Plan analysis: compressed natural gas vehicles (CNGs) and electric vehicles (EVs). CNG vehicles were chosen because of their current and potential market penetration, technological robustness and low CO_2 emissions. A car burning natural gas produces 25% fewer CO_2 emissions per gallon of gasoline equivalent than a conventional car. Furthermore, a variety of natural gas vehicles are currently sold by several domestic manufacturers, and have performance characteristics (e.g. power, acceleration, range, safety features) similar to conventional vehicles.

EVs produce no tailpipe emissions of CO_2. However, lifecycle emissions – those associated with fuel use, production, and distribution – from EVs vary widely. For example, if the electricity for an EV comes from a coal burning power plant, the CO_2 emissions associated with an EV would be higher than those of a car powered by conventional gasoline.[2] However, an EV using renewable energy as its source of electricity would produce a fraction of the lifecycle CO_2 emissions associated with a gasoline powered car. For the purposes of this study, CEEP assumes the electricity used to power EVs would be generated by renewable energy sources such as solar and wind power.

Three AFV scenarios are examined and the target AFV penetrations in each scenario are based on the Energy Policy Act (EPAct) of 1992 mandate for AFVs among fleet vehicles. These scenarios demonstrate potential CO_2 reductions associated with different levels of AFV penetration.

The TCMs chosen for this study will reduce VMTs by considerable amounts, although variations occur in implementation due to local conditions, degree of program implementation, and public behavior. Several studies of the costs and benefits of multiple TCMs have been performed by Harvey and Deakin (1991), Apogee Research (1991), Barton-Aschman (1981), Loudon and Dagang (1992), Cameron (1991), and others. Estimates of energy consumption impacts of TCMs from these studies were generated by investigation and by analytical projections. TCM projections based on these studies are generic, but in practice the response to TCMs may vary from community to community, influenced by economic conditions, existing land uses, and the availability of transportation alternatives.

The studies used by CEEP generally considered each TCM individually, rather than in combination with other TCMs. In reality, the effects of multiple TCMs may be additive, synergistic, redundant, or antagonistic. TCM pricing measures that make driving more costly, for example, tend to increase transit use, carpooling, bicycling, and walking. However, a method for quantitatively valuing these effects was not available for this Action Plan. In lieu of an established methodology, TCM effects were treated as additive. Selecting TCMs whose effects are not redundant strengthened the validity of this assumption.

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[2] A list of lifecycle emissions by fuel type is given in STAPPA/ALAPCO (1998).

All TCMs chosen for this study aim at reducing single occupancy vehicle (SOV) travel and reducing the total amount of VMTs for the State of Delaware. The percent reductions for all VMTs were taken from the available literature. The TCMs selected in the Action Plan reduce VMTs in several ways. Some TCMs encourage carpooling or ridesharing, thereby reducing the amount of SOV travel and VMTs. Other measures encourage the use of alternative modes of travel, such as transit, bicycling, and walking, by either making these measures more attractive or by making automobile travel more expensive. Lastly, some TCMs encourage individuals to reduce their total amount of travel, either through the consolidation of trips or the decision not to make a given trip in the first place.

CEEP used projections of VMTs for all highway vehicles and breakdowns of VMTs by vehicle type to determine the impact of each strategy on gasoline and diesel fuel consumption. CEEP then calculated the corresponding change in CO_2 emissions relative to the entire transportation sector.

Analysis of Options

Three implementation scenarios were investigated: Full Implementation, which seeks to realize 100% of the cost-effective options identified in the Action Plan; the Major Commitment scenario, which endeavors to realize 35% of the cost-effective energy savings identified in the Energy Plan; and the Major Commitment scenario, whose goal is to capture 65% of the full savings potential. Each scenario developed for the transportation the sector uses three basic tools: fuel efficiency improvements, alternative fuel vehicle technology development, and diffusion of transportation control measures. The impact of each scenario is described below.

1. Fuel Efficiency Improvements

Table 5-4

Reductions of CO_2 from Fuel Efficiency Improvements in the Delaware Transportation Sector

Strategies	CO_2 Reduction from 2010 Baseline (metric tons)	Percent Reduction from 2010 Transportation Sector Forecast
Modest Commitment	325,650	6.5%
Major Commitment	769,750	19.5%
Full Implementation	1,101,700	22.4%

Technologies currently exist which could increase the fuel efficiency of cars and light-duty trucks without sacrificing size, features, or performance. However, low gasoline prices and stagnant CAFE standards (set by federal legislation) have created a market where automakers concentrate on increasing performance and amenities, not fuel economy. The introduction of feebate programs (in which consumers receive rebates on the purchase price of vehicles whose MPG ratings are above a specified level above an average rating and pay a fee for those with below average ratings) could create a market-based incentive for automakers to improve the fuel economy of new and existing models. Without feebates or increases in CAFE standards, it is doubtful that automakers will utilize existing technologies to increase fuel economy.

CEEP analyzed three different levels of fuel economy improvements for reducing CO_2 emissions from the transportation sector. The first fuel efficiency improvement strategy, the Modest Commitment case, features a 2-mpg improvement for light-duty cars and trucks by 2010. This strategy would reduce CO_2 emissions in 2010 by 325,650 metric tons, or 6.5% for the entire transportation sector. The second fuel efficiency improvement scenario, the Major Commitment strategy, uses a forecast prepared by the State and Territorial Air Pollution Program Administrators (STAPPA) Association of Local Air Pollution Control Officials (1998). This strategy anticipates a possible fuel efficiency increase among new cars and trucks of 1% per year beginning in the year 2000 (STAPPA/ALAPCO 1998). Using a vehicle turnover rate of 7% for cars and 10% for new trucks,[3] this improvement in new car fuel efficiency yields an increase of 5.9 mpg for Delaware's entire automobile fleet by 2010, and an increase of 3.4 mpg for the light-duty truck fleet. As a result, the Major Commitment strategy for fuel efficiency improvements reduces CO_2 emissions in 2010 by 769,747 metric tons or 19.5%.

The third fuel efficiency improvement case, the Full Implementation strategy, predicts fuel efficiency increases among light-duty vehicles of 1% beginning in the year 2000 and increasing to 3% per year in the year 2005 (STAPPA/ALAPCO 1998). Using the same vehicle turnover rates as in the Major Commitment strategy, fuel efficiency for Delaware's existing car fleet increases 7.7 mpg by 2010, while efficiency for the light-duty truck fleet increases by 6.5 mpg. This strategy reduces CO_2 emissions in 2010 by 1,101,700 mt or 22.4% (as shown above in Table 5-4). This strategy incorporates the high-efficiency case developed by the Interlaboratory Working Group (IWG 1997).

2. Alternative Fuel Vehicle Development

Table 5-5

Reductions of CO_2 from CNG & Electric Vehicle Fleet Penetration in the Delaware Transportation Sector

Strategies	CO_2 Reduction from 2010 Baseline (metric tons)	Percent Reduction from 2010 Transportation Sector Forecast
Modest Commitment	11,760	0.4%
Major Commitment	20,570	0.7%
Full Implementation	102,820	2.1%

The AFV strategies analyzed for the Action Plan involve the introduction of compressed natural gas (CNG) and electric vehicles (EV) into Delaware's fleet of cars and light-duty trucks. For the Modest Commitment strategy for AFVs, a 1.2% level of

[3] This turnover rate was obtained by analyzing yearly new car and light-duty truck purchase figures and comparing those to the total number of registered cars and light-duty trucks in the US. These figures were obtained from the *Transportation Energy Data Book, Edition 18,* (USDOE 1998).

CNG vehicle usage resulted in a CO_2 emissions reduction of 11,760 mtCO_2 from 2010 levels. The Major Commitment strategy for AFVs increases the proportion of CNG vehicle VMTs from 1.2% to 2.1%. This higher level of CNG vehicle usage reduces CO_2 emissions by 20,570 mt from 2010 levels. In the Full Implementation strategy, the CNG VMT proportion increases to 3.5%, and EVs are introduced into Delaware's vehicle mix. EVs account for 1.75% of Delaware's VMTs in the Full Implementation scenario. This scenario reduces CO_2 emissions by 102,870 mtCO_2 from 2010 levels (as shown in Table 5-5). The AFV proposals in the Modest and Major Commitment strategies are modeled on STAPPA/ALAPCO projections, while the AFV strategy in the Full Implementation strategy follows the most aggressive projection of the Interlaboratory Working Group Study (IWG 1997).

3. Diffusion of TCM measures

Table 5-6

Summary of TCM Packages for Scenario Analyses of the Delaware Transportation Sector

Strategies	Percent Reduction In VMTs	Percent Reduction from 2010 Transportation Sector Forecast
Modest Commitment	2.9%	6.5%
Major Commitment	15.9%	13.2%
Full Implementation	20.4%	22.7%

Transportation control measures (TCMs) represent a broad range of policy tools including pricing, ridesharing, alterations to work patterns, and transit improvements. The packages vary in the Action Plan by implementation scenario. Itemized TCM packages with their respective VMT reductions are listed in Table 5-7.

Under the Modest Commitment strategy for TCMs, five measures – ridesharing, transit improvements, creation of restricted high-occupancy vehicle (HOV) lanes, the use of compressed work weeks as an option for some organizations and telecommuting (where practicable) - produce a VMT reduction of just under 3%.[4] This amounts to a transportation sector emissions reduction of almost 7% by 2010. By adding parking pricing, congestion pricing, non-work parking pricing and pay-as-you-drive insurance measures, the TCM package for the Major Commitment strategy produces approximately a 13% reduction in CO_2 emissions from the BAU scenario of 2010. By increasing the participation in telecommuting and the intensity of parking and congestion pricing, the Full Implementation strategy produces approximately a 23% reduction in CO_2 emissions from the BAU scenario of 2010 (as shown above in Table 5-6).

The TCM packages were developed from discussions of the transportation sector committee of the Delaware Climate Change Consortium. The strategies represent a spectrum of policy options available to Delaware. A review of other states' Action Plans indicates the alternatives analyzed for Delaware are within the range of what is being considered in U.S. state transportation conservation policy.

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[4] A major study regarding the impact of telecommuting on VMTs was conducted by the Wisconsin Department of Natural Resources, *Wisconsin Greenhouse Gas Emissions Reduction Cost Study* (1998).

Table 5-7

Transportation Control Measures (TCM) Scenarios

Modest Commitment		Major Commitment		Full Implementation	
TCM	**VMT % Reduction**	**TCM**	**VMT % Reduction**	**TCM**	**VMT % Reduction**
Area-Wide Ridesharing	0.5	Area-Wide Ridesharing	1.0	Area-Wide Ridesharing	1.0
Transit Improvements	0.5	Transit Improvements	1.0	Transit Improvements	1.0
HOV Lanes	0.3	HOV Lanes	0.3	HOV Lanes	0.3
Compressed Work Week	0.6	Compressed Work Week	0.6	Compressed Work Week	0.6
Telecommuting	1.0	Telecommuting	3.0	Telecommuting	5.0
		Parking Pricing (work)	1.5	Parking Pricing (work)	3.0
		Parking Pricing (non-work)	3.5	Parking Pricing (non-work)	3.5
		Congestion Pricing	3.0	Congestion Pricing	4.0
		Pay-as-You-Drive Insurance	2.0	Pay-as-You-Drive Insurance	2.0
TOTAL	**2.9**	**TOTAL**	**15.9**	**TOTAL**	**20.4**

Results

Results for the transportation sector CO_2 reductions are derived by combining the fuel economy, AFV, and TCM tools into implementation scenarios. Improvements in fuel economy of light-duty vehicles contribute the most to CO_2 mitigation, while also being the most cost-effective. TCMs have almost the same potential, while AFVs emerge as a relatively expensive measure. The various combinations of policy tools, which form the Action Plan's three implementation scenarios, are depicted in Table 5-8.

Table 5-8

CO_2 Reduction Scenarios for the Delaware Transportation Sector

Scenario	Fuel Economy Strategy	AFV Strategy	TCM Strategy
Modest Commitment	2 mpg increase for LDVs	1.2% CNG vehicles	2.9% VMT reduction
Major Commitment	5.9 mpg increase for light-duty cars, 3.4 mpg increase for light-duty trucks	2.1% CNG vehicles	15.9% VMT reduction
Full Implementation	7.7 mpg increase for light-duty cars, 6.6 mpg increase for light-duty trucks	3.5% CNG & 1.75% EVs	20.4% VMT reduction

The Action Plan analyzes each scenario for its impact on fuel consumption and CO_2 emissions in 2010. The Modest Commitment scenario achieves a 10% reduction below BAU; the Major Commitment scenario produces a 24% reduction, and the Full Implementation scenario results in a 36% reduction. The reductions achieved by each scenario are presented in Table 5-9.

Table 5-9

CO_2 Reduction Scenario Results for the Delaware Transportation Sector

Scenario	CO_2 Reduction from 2010 Forecast (metric tons)	Percent Reduction from 2010 Transportation Sector Forecast
Modest Commitment	508,970	10%
Major Commitment	1,166,970	24%
Full Implementation	1,778,360	36%

Conclusion

Emissions from the sector were 4.0 mmtCO_2 in 1990 and are forecast to increase by more than 20% to 4.9 mmtCO_2 by 2010 under the BAU scenario. Emissions reductions under the Modest Commitment scenario result in 4.4 mmtCO_2 by the target year. While under the more effective Major Commitment scenario, the emissions are 3.7 mmtCO_2 by 2010. The Full Implementation scenario would further reduce emissions to 3.1 mmtCO_2. Using the Major Commitment scenario as the benchmark for action, emissions in the transportation sector can be reduced by 24% from the forecast level for 2010. This is equivalent to an 8% reduction from 1990 levels for this sector.

Effective measures to reduce emissions are strongly influenced by cost-effectiveness, available technology, and the relatively short time between the present and the target year of 2010 for achieving change. Improving fuel economy emerges as a cost-effective means to reduce emissions. However, its achievement depends heavily upon federal action. TCMs have been shown to have high potential, but involve considerable behavioral change. The State can play a major role in formulating policies to realize the TCM strategies described in the Action Plan, especially if it adapts the recommended Major Commitment package as part of land use planning reforms to curb sprawl in the State. The proposed AFV penetration into Delaware's vehicle fleet is relatively small and therefore has a lesser impact on CO_2 emissions. However, a larger number of AFVs in the vehicle fleet could greatly lower emissions. Market expectations of the automobile industry, technology development, and federal and state policy will all affect early rates of market penetration of this promising option.

As noted in the introduction of this chapter, the policy tools identified in the Action Plan for the transportation sector will need a general planning framework to inform their development. For this reason, the Consortium believes that all levels of Delaware government will need to cooperate in reforming land use planning so that the State's development is informed by principles of growth management (see CEEP 1996).

Specific policy actions to support the adoption of the analyzed measures for CO_2 emission reduction in the sector are identified in Chapter 9.

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