A Blueprint for Action

Policy Options to Reduce New Mexico's Contribution to Global Warming

NMPIRG
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Executive Summary

New Mexico could make major strides toward reducing its emissions of global warming pollution over the next several decades—while leading the way toward a clean energy future—by adopting a series of policy strategies to make the state more energy efficient, reduce the use of fossil fuels, and generate cleaner electricity.

Adoption of the 15 policy strategies in this report would move New Mexico toward meeting its goals of reducing global warming pollution to 2000 levels by the year 2012, to 10 percent below 2000 levels by 2020 and to 75 percent below 2000 levels by 2050. In the process, these strategies would improve New Mexico's energy security and begin to make the technological shifts necessary to reduce New Mexico's emissions of global warming pollution to levels that do not have a harmful effect on the climate.

Even with these strategies, however, New Mexico will still need to take additional steps to reduce its contribution to global warming.

Global warming, caused by human-induced changes in climate, is a major threat to New Mexico's future.

- Since the beginning of the Industrial Age, atmospheric concentrations of carbon dioxide—the leading global warming gas—have increased by 35 percent, a rate of increase unprecedented in the last 20,000 years. Global average temperatures increased by about 1°F during the 20th century, a greater rate of increase than any in the last 1,000 years.
- The effects of global warming are beginning to appear in New Mexico. Average temperatures in the Southwest have increased by 2 to 3°F in the last century, accompanied by changing precipitation patterns and other shifts. And 2005 was the sixth-warmest year in New Mexico since record-keeping began in 1893.
- Average temperatures in the Southwest are projected to increase by 4 to 7°F by 2090, accompanied by changing precipitation patterns. These changes could lead to smaller snowpacks and earlier snow melts—increasing the risk of spring flooding, summer droughts and more intense fire seasons.

Emissions of global warming pollution are on the rise in New Mexico.

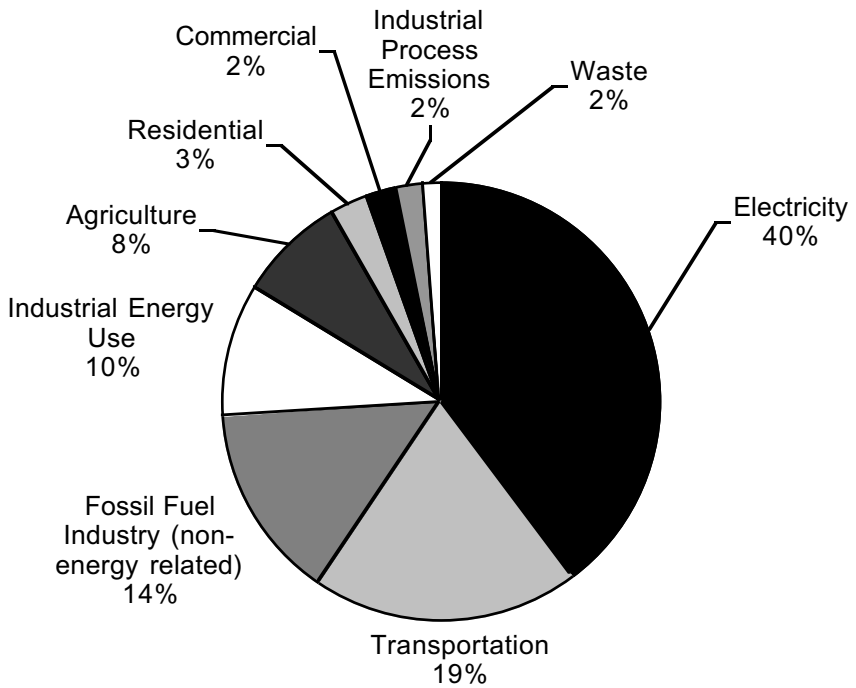
- Between 1990 and 2000, New Mexico's emissions of carbon dioxide from energy use increased by 10 percent. Electricity generation (40 percent) is the largest source of global warming pollution in the state, followed by transportation (19 percent). Energy use in homes, businesses and industry contributes another 15 percent of the state's emissions. (See Fig. ES-1.)
- New Mexico is on a path that will lead to dramatic increases in global warming emissions over the next several decades. According to U.S. Energy Information Administration (EIA) projections of energy consumption growth, New Mexico's emissions of carbon dioxide from energy use could increase by nearly 50 percent over 2000 levels by 2020, with much of the increase resulting from a projected build-out of new coal-fired electric plants a decade from now. Projections developed for the New Mexico Environment Department suggest that emissions of all global warming gases in the state could increase by 25 percent by 2020.

New Mexico could reduce its contribution to global warming by adopting 15 key policy strategies and encouraging other states in the region to do the same.

There are numerous tools available to New Mexico to reduce global warming pollution. The following 15 strategies include a mix of policies that deliver large reductions in global warming pollution with policies that take advantage of readily available savings at low cost, or even net economic benefit, to New Mexico.

The policies include:

Fig. ES-1. New Mexico Global Warming Pollution by Sector, 2000



Reducing Emissions from the Transportation Sector

1. Adopting the **clean cars program**, which will put increasing numbers of hybrid-electric cars on New Mexico's roads and impose limits on vehicle carbon dioxide emissions.
2. Requiring the sale of **low-rolling resistance replacement tires** that improve vehicle efficiency without negatively affecting safety.
3. Establishing a revenue-neutral **"feebate"** program to reward the purchase of more fuel-efficient vehicles.
4. Requiring automobile insurers to offer **pay-as-you-drive automobile insurance,** in which insurance rates are calculated by the mile, rewarding those who drive less while potentially reducing accidents.
5. Adopting policies that would **reduce growth in vehicle miles traveled** by cars and light trucks on New Mexico's highways, such as measures to reduce sprawling development and encourage the use of transit and other transportation alternatives.
6. Establishing a **renewable fuels standard**, such that a portion of motor fuel, both gasoline and diesel, comes from renewable sources.

Reducing Emissions from Homes, Businesses and Industry

7. Developing and enforcing stronger **commercial and residential building energy codes** to improve the energy efficiency of new construction and thereby reduce building-related energy costs and global warming pollution.
8. Adopting **appliance efficiency standards** for a series of residential and commercial products, saving money for consumers and reducing electric sector emissions.
9. Reducing demand for electricity generation through a **tiered electricity pricing structure**, where residential consumers are charged higher rates for consuming more energy.
10. Reducing energy use by expanding electricity and natural gas **energy efficiency programs**.
11. Expanding the use of energy-efficient **combined heat and power systems** in industry and commercial buildings.

Reducing Emissions from Electricity Generation

12. Expanding and strengthening New Mexico's **Renewable Portfolio Standard** so that 30 percent of all electricity consumed in New Mexico's comes from new, clean, renewable sources by 2020.
13. Dramatically increasing the installation of **solar energy systems** to achieve a goal of 50,000 solar homes by 2020.
14. Preventing a dramatic increase in emissions from **coal-fired power plants**, using appropriate public policy tools.

Reducing Emissions with Other Strategies

15. Reducing **government sector emissions** through "lead by example" measures, such as purchasing renewable power, cutting energy consumption in new buildings in half, increasing energy efficiency, and purchasing more efficient vehicles for state fleets.

Adoption of all 15 strategies would reduce global warming pollution while improving New Mexico's energy efficiency

Table ES-1. Projected Annual Carbon Dioxide Emission Reductions from Recommended Policy Actions ($MMTCO_2e$)

Policy	2010	2020
Clean Cars Program	0.10	1.40
Low-Rolling Resistance Replacement Tires	0.12	0.25
Feebate Program (N.M. only)*	0.00	0.01
Pay-As-You-Drive Automobile Insurance	0.63	0.79
Reduce Growth in Vehicle Miles Traveled	0.83	2.57
Renewable Fuels Standard	0.27	1.14
Residential and Commercial Building Codes	0.30	1.69
Appliance Efficiency Standards	0.04	0.14
Tiered Electricity Pricing	0.20	0.23
Expanded Energy Efficiency Programs	0.81	2.76
Combined Heat and Power	0.57	1.42
Expanded Renewable Portfolio Standard	0.93	3.50
Solar Power Development	0.01	0.18
Prevent Expansion of Coal-Fired Power Plants	0.00	11.80
Public Sector "Lead By Example"	0.29	0.99
Total	**6.74**	**21.97**

Savings from individual polices do not equal cumulative savings due to overlap between the policies
** Savings are likely to be greater from a feebate program that includes multiple states.*

and spurring the development of renewable sources of energy. (See Table ES-1.)

Adoption of the 15 strategies presented in this report would reduce New Mexico's carbon dioxide emissions by approximately 22 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) below reference case projections by 2020. This would achieve 75 percent of the reductions New Mexico would need to reduce carbon dioxide emissions to 10 percent below 2000 levels by 2020. (See Fig. ES-2, next page.)

However, New Mexico will still need to reduce carbon dioxide pollution by a further 8.3 $MMTCO_2e$ and achieve parallel reductions in emissions of other global warming pollutants (which make up a quarter of New Mexico's total global warming emissions) in order to achieve the goal of reducing global warming pollution to 10 percent below 2000 levels by 2020.

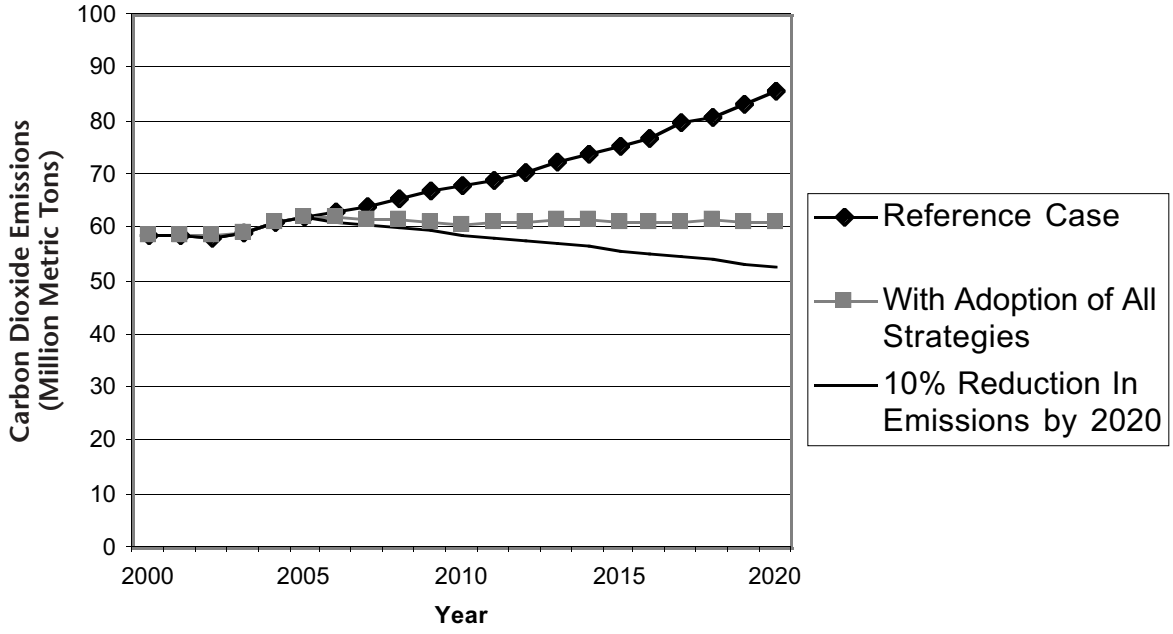
For New Mexico to live up to its potential of becoming a clean energy state and a leader in the fight against global warming, it is imperative that the state seize every opportunity to begin reducing its emissions.

- New Mexico should promptly adopt the measures in this report and investi-

gate other policy options to reduce global warming emissions, especially with regard to reducing vehicle-miles traveled, addressing projected increases in emissions from freight transport and industry, and encouraging the development of non-fossil, non-nuclear sources of energy.

- New Mexico should begin to plan for the technological and other changes that will be needed to achieve the long-term goal of 75 percent reduction in global warming emissions by 2050, and the ultimate elimination of the state's contribution to the degradation of the climate.

Figure ES-2. New Mexico's Carbon Dioxide Emissions from Energy Use after Adoption of Recommended Strategies



Introduction

The consensus view of climate science holds that global temperatures are increasing, that human activities are the cause, and that further warming of the planet is inevitable unless we significantly reduce emissions of gases that trap heat in the earth's atmosphere.

The precise impacts that global warming will have on New Mexico are unknown, but it is virtually certain that the climatic shifts brought about by warming will leave our mountain forests, arid deserts, pasture lands and weather patterns far different than we have known them—and so too the New Mexican way of life.

Recognizing this, in June 2005 Governor Bill Richardson issued an executive order creating the New Mexico Climate Change Action Council and the Climate Change Advisory Group. Together these groups are charged with providing recommendations regarding climate change policy. The goal of this process is to achieve reductions of New Mexico's total global warming pollution to 2000 levels by the year 2012, to 10 percent below 2000 levels by 2020 and to 75 percent below 2000 levels by 2050.[1]

New Mexico has a myriad of options for reducing its energy use and cutting global warming pollution. Automobiles, buildings and appliances can be made to use energy more efficiently, thereby reducing global warming emissions from the combustion of fossil fuels. Renewable energy sources such as wind and solar power can increasingly compete economically with traditional fossil fuel sources of energy, and bring with them the potential for cleaner air, greater energy security, and increased local economic opportunity. Advanced new technologies show the potential to change the way we create and use energy in fundamental ways.

The state can reduce its global warming pollution, but only if it finds the will to do so—creating programs to cut pollution and implementing these programs to achieve the greatest emission savings.

This report presents 15 policy opportunities and estimates how implementation of these policies will affect New Mexico's emissions of carbon dioxide—the leading global warming pollutant. The policy options explored in detail here would, if implemented, bring New Mexico closer to fulfilling its commitments to reducing global warming pollution in the short and medium term, while positioning the state for further reductions in the long run. And these actions, if taken, will move New Mexico closer towards the cleaner, more efficient, more sustainable and healthier future we all seek.

Global Warming and New Mexico

Global warming poses a clear danger to New Mexico's future health, well-being and prosperity. New Mexico contributes to global warming primarily through the combustion of fossil fuels, which emit carbon dioxide into the atmosphere. New Mexico's emissions of carbon dioxide and other global warming gases have increased dramatically over the last decade and will continue to increase in the absence of concerted action.

Causes of Global Warming

Global warming is caused by human exacerbation of the greenhouse effect. The greenhouse effect is a natural phenomenon in which gases in the earth's atmosphere, including water vapor and carbon dioxide, trap heat from the sun near the planet's surface. The greenhouse effect is necessary for the survival of life; without it, temperatures on earth would be too cold for humans and other life forms to survive.

However, human activities, particularly over the last century, have altered the composition of the atmosphere in ways that intensify the greenhouse effect by trapping more of the sun's heat near the earth's surface. Since 1750, for example, the concentration of carbon dioxide in the atmosphere has increased by 35 percent as a result of human activity.[2] The current rate of increase in carbon dioxide concentration is unprecedented in the last 20,000 years.[3] (See Fig. 1.) Concentrations of other global warming gases have increased as well.

As the composition of the atmosphere has changed, global temperatures have increased. Global average temperatures increased during the 20th century by about 1° F. In the context of the past 1,000 years, this amount of temperature change is unprecedented, with 1990 to 2000 being the warmest decade in the millennium.[5] Fig. 2 shows temperature trends in the Northern Hemisphere for the past 1,000 years with a relatively recent upward spike. Temperatures in the past 150 years have been measured; earlier temperatures are derived from proxy measures such as tree rings, corals and ice cores.

This warming trend cannot be explained by natural variables—such as solar cycles or volcanic eruptions—but it does correspond to models of climate change based on human influence.[7]

Fig. 1. Atmospheric Concentration of Carbon Dioxide[4]

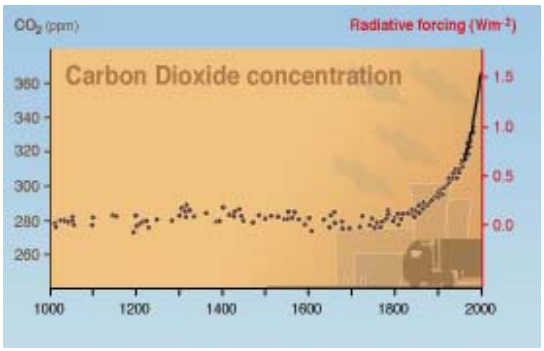
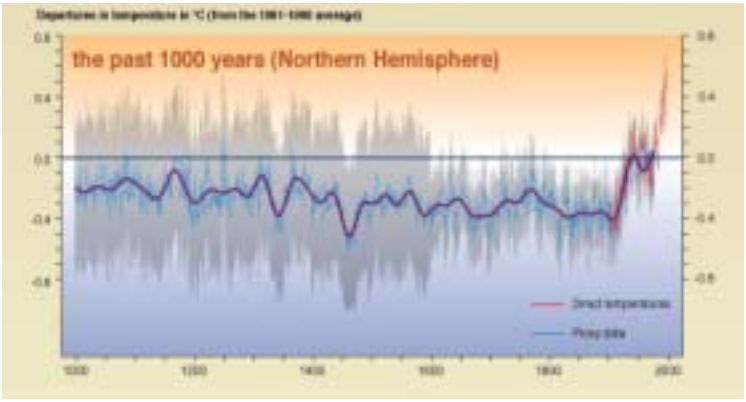


Fig. 2. Northern Hemisphere Temperature Trends[6]



Current Indications of Global Warming

The first signs of global warming are beginning to appear, both in New Mexico and around the world.

Average temperatures have risen. Global average temperatures have increased by 1° F in the past century and 2005 was the hottest year on record worldwide.[10] In the same period, an overall increase in the average annual temperature of 2° F to 3° F has been detected in the Southwestern U.S., with 2005 ranking as the sixth-hottest year in New Mexico since record-keeping began in 1893.[11]

Cold seasons have been shorter and extreme low temperatures less frequent. Mountain glaciers around the world have been retreating, and since the late 1960s, Northern Hemisphere snow cover has decreased by 10 percent.[12] Similarly, mountain snowpack is now melting earlier in the year. Indeed, the average timing of peak flows in most of the 270 snowmelt-dominated western rivers and streams occurs 10 to 30 days earlier than peak flow 50 years ago.[13]

In the past century, patterns of precipitation have begun changing. Many parts of New Mexico have experienced increases in precipitation of up to 20 percent. However, other parts of the Southwest—including eastern California, southern Arizona, and the central Rockies—have seen decreases in total rainfall.[14] In New Mexico and throughout the Western U.S., rising temperatures have led to a decrease in winter snowfall and an increase in winter rainfall.[15]

The combination of rising temperatures and changing precipitation patterns has led

Other Global Warming Pollutants

In addition to carbon dioxide, several other pollutants are capable of exacerbating the greenhouse effect that causes global warming.[8] The other major global warming pollutants are:

- **Black Carbon** – Black carbon, otherwise known as "soot," is a product of the burning of fossil fuels, particularly coal and diesel fuel. Research has suggested that, because black carbon absorbs sunlight in the atmosphere, it may be a major contributor to global warming, perhaps second in importance only to carbon dioxide. Research is continuing on the degree to which black carbon emissions contribute to global warming.
- **Fluorocarbons** – Used in refrigeration and other products, many fluorocarbons are capable of inducing strong heat-trapping effects when they are released into the atmosphere. However, because they are generally emitted in small quantities, fluorocarbons are responsible for only a tiny fraction of New Mexico's total contribution to global warming.
- **Methane** – Methane gas escapes from garbage landfills, is released during the extraction of fossil fuels, and is emitted by livestock and some agricultural practices. Methane represents about 13 percent of New Mexico's global warming emissions, and it is one of the most important global warming gases in terms of its potential to exacerbate the greenhouse effect.[9]
- **Nitrous Oxide** – Nitrous oxide is released in automobile exhaust, through the use of nitrogen fertilizers, and from human and animal waste. Like fluorocarbons, nitrous oxide is a minor, yet significant, contributor to global warming.
- **Sulfur Hexafluoride** – Sulfur hexafluoride is mainly used as an insulator for electrical transmission and distribution equipment. It is an extremely powerful global warming gas, with more than 20,000 times the heat-trapping potential of carbon dioxide. However, it is released only in very small quantities and is responsible for only a very small portion of the state's contribution to global warming.

This report focuses mainly on emissions of carbon dioxide from energy use. (See "Background on this Analysis," page 14.) Steps to reduce emissions of other global warming gases should also be part of the state's efforts to curb global climate change.

to a decrease in snowpack throughout the Southwest. Snowpack is particularly important in western states like New Mexico because snowmelt produces the majority of water for western rivers. Indeed, the Rio Grande—which provides water to Colorado, New Mexico, Texas and Mexico and which is already one of the most water-short river basins in the country—has been experiencing lower-than-average snowpack and water flows. In 2002, Rio Grande flows in New Mexico fell to only 13 percent of normal.[16]

Storms throughout the middle and high latitudes of the Northern Hemisphere have been getting more intense. The increase in the frequency of heavy precipitation events arises from a number of causes, including changes in atmospheric moisture, thunderstorm activity and large-scale storm activity.[17]

Oceans have risen as sea ice has melted. Average sea levels have risen 0.1 to 0.2 meters in the past century.[18]

Potential Impacts of Global Warming

The earth's climate system is extraordinarily complex, making the ultimate impacts of global warming in a particular location—as well as the pace of change—difficult to predict. There is little doubt, however, that global warming could lead to dramatic disruptions around the world and in New Mexico's economy, environment, health and way of life.

Temperature increases in the past century have been modest compared to the increases projected for the next 100 years. Should current trends in emissions of global warming pollution continue, some projections suggest that average temperatures in the Southwest could increase 4° F to 7° F by 2090.[19] Global temperatures are projected to have a broader range in temperature change, and could rise 2.5° F to 10° F between 1990 and 2100.[20]

Average precipitation levels also could change. Over the next 100 years New Mexico could experience a slight decrease in summer rainfall and experience an increase in precipitation during the rest of the year of up to 30 percent, with the greatest change expected in the winter.[21]

An important part of the Southwest's climate change scenario is increased year-to-year variability in rainfall.[22] This regional trend is expected to be replicated around the globe. Indeed, scientists predict that large year-to-year variations in precipitation are very likely over most land areas where an increase in average precipitation is projected.[23]

Although global warming is likely to increase average annual precipitation in New Mexico, this will not directly translate into an increase in water available for ranching, farming and urban use. Higher average temperatures—especially in the winter and summer—are expected to increase evaporative water loss, already a major problem in New Mexico.

Current global warming trends could have substantial impacts on New Mexico's economy, environment and quality of life—both for future generations and for children growing up in New Mexico today. Among the potential impacts:

- The frequency of heat waves and extreme high-temperature days in the summer would increase, resulting in an increased risk of heat-related illness and death.[24]
- The risk of wildfires in the state would grow—increased winter precipitation would increase plant productivity in the spring, which would create more fuel for potential wildfires during the hotter and drier summer months.[25]
- Increased temperatures and a higher likelihood of winter rain would lead to disruptions in New Mexico's ski industry, especially early and late in the ski season. In 2004, the ski industry had a $270 million economic impact on the state.[26]
- Smaller snowpack could reduce

groundwater supplies. Scientists have determined that in the Rocky Mountain West, snowmelt recharges groundwater supplies more effectively than rain. Thus, a decrease in snowmelt would lead to a decrease in groundwater. Since groundwater currently supplies 90 percent of New Mexico's drinking water needs, this could exacerbate existing water shortages.[27]

- More rapid snowmelt could contribute to increased winter and spring flooding, and more intense summer storms could increase the likelihood of flash floods. Increased flooding could lead to greater erosion, exacerbate levels of pesticide and fertilizer contamination in runoff from agricultural lands, and increase risks of overflow from storage reservoirs and holding ponds containing contaminants from mining operations.[28]
- Climate change could cause a reduction in the number of farmed acres in New Mexico of 20 to 25 percent. Rising temperatures would lead to decreased yields for some of the state's largest crops; wheat yields could fall by 10 to 30 percent and sorghum yields could fall by 7 to 9 percent as temperatures rise beyond the heat tolerance of these crops.[29]
- As a majority of ranchland in New Mexico is not irrigated, increased winter rain would increase rangeland carrying capacity. However, as the climate change scenarios also include increased year-to-year variability in precipitation—and variability in precipitation can directly affect the availability of grazing material—the region's ranchers would be placed in a more precarious and vulnerable position.[30]
- Greater year-to-year variation in precipitation could also lead to increases in rodent-borne diseases, such as hantavirus pulmonary syndrome. Long droughts punctuated by heavy rain can reduce populations of rodent predators (owls, snakes and coyotes) and bring about a boom in rodent populations.[31]
- Hotter summers would result in more severe smog seasons as high temperatures facilitate the formation of ground level ozone, resulting in increased threats to respiratory health.

The likelihood and severity of these potential impacts is difficult to predict. But this much is certain: climate changes such as those predicted by scientists would have a dramatic, disruptive effect on New Mexico's environment, economy and public health—unless immediate action is taken to limit our emissions of global warming pollutants such as carbon dioxide.

Global Warming Pollution Trends

Background on this Analysis

In this document, we use data and projected regional trends compiled by the U.S. Energy Information Administration to develop a baseline projection of energy-related carbon dioxide emissions in New Mexico (called the "reference case") and to estimate the benefits of various policies to reduce carbon dioxide emissions.

The emission estimates presented here differ, sometimes significantly, with those presented in the *Draft New Mexico Greenhouse Gas Inventory and Reference Case Projections* prepared for the New Mexico Environment Department (NMED) in July 2005. These variations result from the use of different sources of data and differing methods of quantifying the impact of various activities on the climate. For a detailed description of the methodology used in this report, see "Methodology and Technical

Discussion" at the end of this report.

In this report, we examine only emissions of carbon dioxide from energy use, and not emissions of the other pollutants that make up about 26 percent of New Mexico's contribution to global warming.[32] (See Fig. 3 next page.) The omission of other global warming pollutants from other sources is a result of time and resource constraints and is not intended to minimize the importance of reducing these emissions in New Mexico.

We generally do not factor in the impact of various policies on "upstream" emissions—for example, the emissions that result from the production of gasoline that is later used in cars and trucks. And we assume that any reduction in electricity consumption in New Mexico will result in an equivalent reduction in electricity production within the state.

In most cases, the policies examined in this report will generate similar reductions in global warming emissions regardless of whether one uses the reference case in this report or the *Draft New Mexico Inventory* as one's yardstick. The greatest differences will likely be in the impact of policies that affect electricity generation, for which the reference case estimates differ most significantly from those in the *Draft New Mexico Inventory*. (See "Future Emissions from Electricity Generation in New Mexico," page 17.) For this reason, we encourage policy makers to use the projections in this report as a supplement to the *Draft New Mexico Inventory* and the analytical work taking place through the New Mexico Climate Change Advisory Group.

Global Warming Pollution on the Rise

Both the reference case scenario created for this document and the reference case in the *Draft New Mexico Inventory* project a significant increase in carbon dioxide emissions from energy use in New Mexico over the next decade and a half. According to the reference case in this document, New Mexico's emissions of carbon dioxide from energy use can be expected to increase by approximately 50 percent between 2000 and 2020. The *Draft New Mexico Inventory* projects an increase in energy-related carbon dioxide emissions of a more modest 25 percent. (See Fig. 4.) The major difference between the two estimates hinges on differing assumptions about the future trajectory of coal-fired electricity generation in the state. (See "Future Emissions from Electricity Generation in New Mexico.")

Using the broader measure of total greenhouse gas emissions, the *Draft New Mexico Inventory* projects a 23 percent increase in gross emissions between 2000 and 2020, and a 30 percent increase in net emissions (which factors in the change in the amount of carbon stored in forests and other plants within the state) if no action is taken to reduce pollution.[35]

While projections of the degree of increase in global warming pollution in New Mexico may differ, it is clear that New Mexico faces a future of dramatically increasing emissions of global warming gases unless immediate and strong action is taken to reverse the trend.

Direct (Non-Electric) Emissions

New Mexicans contribute to the release of carbon dioxide in three ways:

- **Directly**, through the burning of fossil fuels in homes, businesses and vehicles.
- **Indirectly**, through the consumption of electricity produced from fossil fuels.
- Through **upstream pollution** created in the production of products and energy that New Mexicans use. (For example, pollution produced during manufacture of a car.) Since upstream pollution is difficult to quantify, it is not included in this report.

Between 1990 and 2000, New Mexico's direct emissions of carbon dioxide increased by approximately 6 percent. In 2000, the

Fig. 3. New Mexico Global Warming Emissions Included and Not Included in this Analysis, 2000[33]

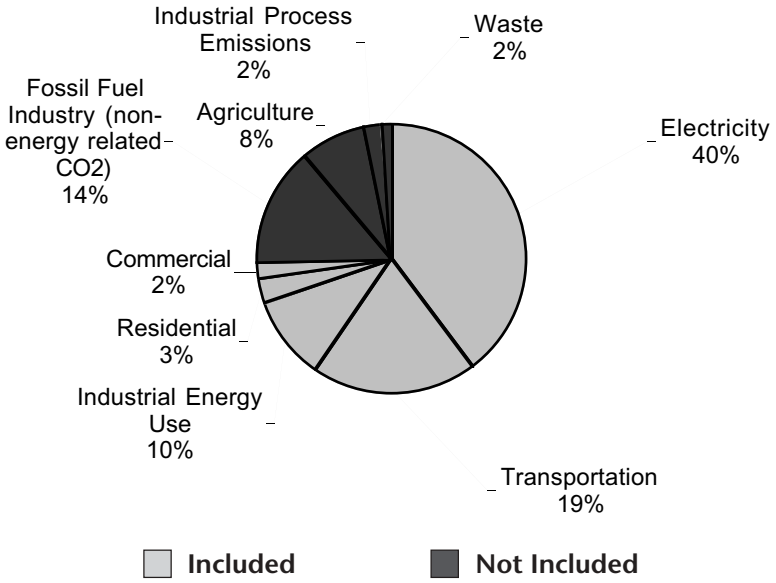
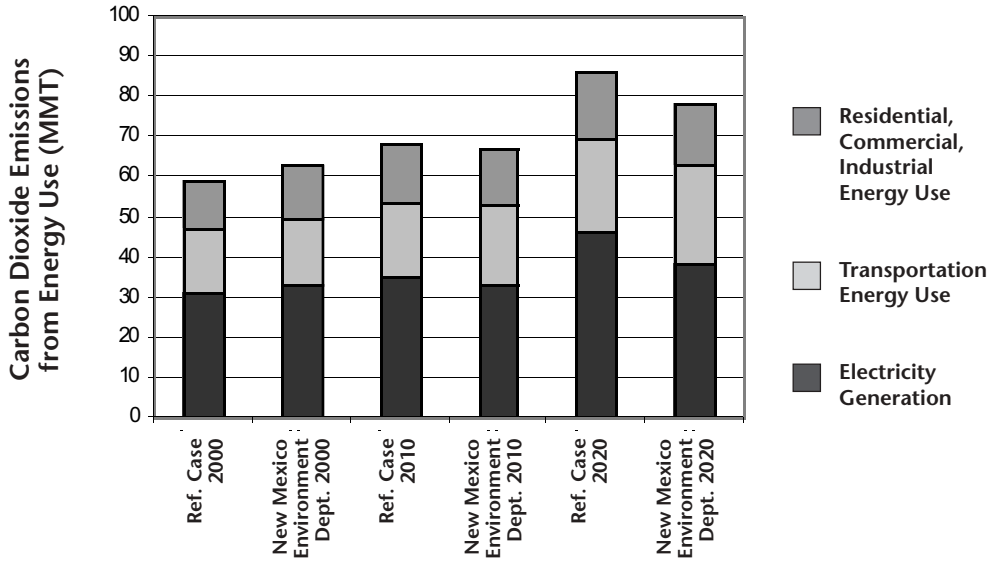


Fig. 4. Projected Carbon Dioxide Emissions from Energy Use in New Mexico, 2000-2020[34]



transportation sector was responsible for the largest share—approximately 56 percent—of New Mexico's direct carbon dioxide emissions. The industrial sector was responsible for about 29 percent of direct emissions, with the commercial and residential sectors responsible for 6 percent and 8 percent, respectively. (See Fig. 5.)

The largest increase in direct carbon dioxide emissions over the next two decades is projected to occur in the transportation sector—with annual transportation emissions of carbon dioxide growing 52 percent from 15.3 $MMTCO_2e$ in 2000 to 23.3 $MMTCO_2e$ in 2020 in the reference case. The fastest rate of growth comes from the residential sector which is projected to have a 70 percent increase in carbon dioxide emissions. During this same time, commercial sector emissions are expected to increase by 25 percent and industrial sector emissions are projected to increase by 32 percent.

Overall, direct carbon dioxide emissions are projected to increase by 20 percent over

Future Emissions from Electricity Generation in New Mexico

The greatest difference between the reference case scenario in this document and that of the *Draft New Mexico Inventory* is in the projected growth of emissions from the electricity sector. This analysis projects that emissions from electricity generation in New Mexico will increase by 47 percent between 2000 and 2020 versus the 15 percent projected increase in the *Draft New Mexico Inventory*.

Projections of future emissions from electricity generation are highly uncertain and depend on a number of factors including the type of new generation capacity added (coal vs. natural gas vs. renewables) and the amount of power generated by existing facilities.

In this analysis, we follow the regional projections included in the EIA's *Annual Energy Outlook 2005*. EIA projects that there will be no further additions of natural gas generating capacity in the Rocky Mountain Power Area and Arizona-New Mexico-Southern Nevada Power Area after 2008. Instead, EIA projects that coal-fired generation capacity will increase dramatically after 2013—increasing by nearly 50 percent between 2013 and 2020. Moreover, EIA projects that generation from existing natural gas-fired power plants in the region will peak in 2013 and subsequently decline.[36]

These projections for aggressive growth in coal-fired generation contrast somewhat with the projections in the *Draft New Mexico Inventory*, which assumes that generation from existing plants remains constant and that new capacity growth (outside of renewable development occurring as a result of the state's Renewable Portfolio Standard) will consist of 80 percent coal and 20 percent natural gas.[37]

Because conventional coal-fired power plants are major emitters of carbon dioxide, these subtle differences in assumptions produce vast differences in projected carbon dioxide emissions. Due to the many uncertainties involved, the scenarios presented in this document and the *Draft New Mexico Inventory* should be thought of as two alternative paths the state's electricity generation sector could take in the years to come.

A Note on Units

There are several ways to communicate quantities of global warming pollution. To be consistent with other recently published studies on global warming emissions in New Mexico, we communicate emissions of carbon dioxide or, when comparing the impacts of other global warming pollutants, "carbon dioxide equivalent." A million metric tons of carbon dioxide equivalent is expressed as $MMTCO_2e$. Other studies frequently communicate emissions in terms of "carbon equivalent". A million metric tons of carbon equivalent is expressed as MMTCE. To translate carbon equivalent to carbon dioxide equivalent, one can simply multiply by 44/12.

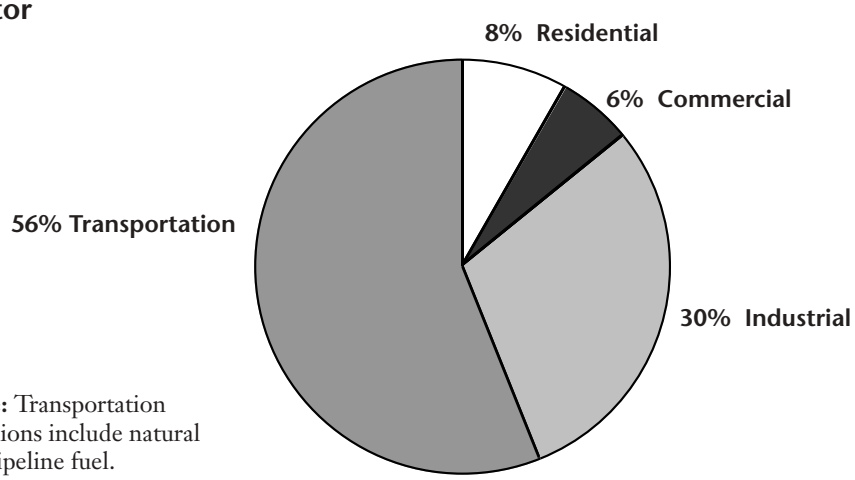
2000 levels by 2010 and by 46 percent over 2000 levels by 2020.

Electric Sector Emissions

New Mexico's power plants are the largest source of global warming pollution in the state. Energy produced by these power plants is used predominantly by the residential, commercial, and industrial sectors. This electricity is used to light buildings, run fans and cooling systems, power appliances, and operate many types of industrial machinery. New Mexico's power plants have historically produced more electricity than is consumed in the state, making New Mexico an important exporter of electricity to the rest of the Southwest. In 2000, for example, New Mexico produced 36 percent more electricity than needed for in-state use.[38]

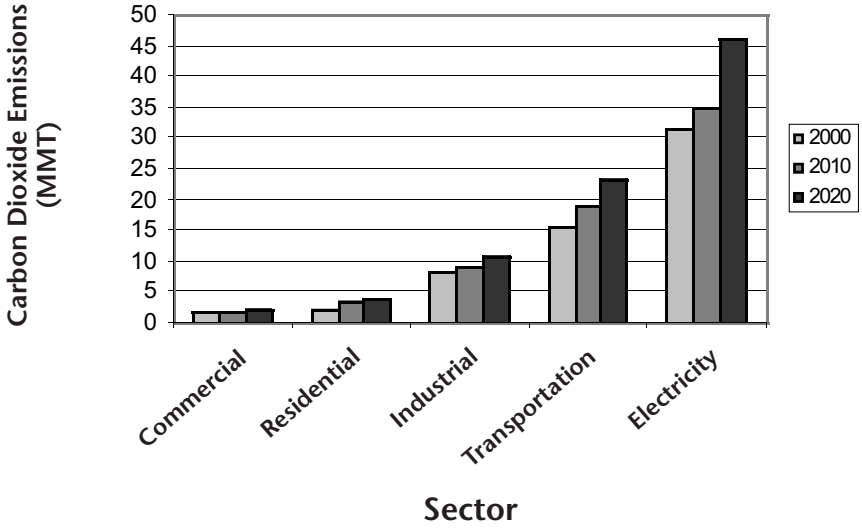
Between 1990 and 2000, New Mexico's electric sector carbon dioxide emissions increased by 12 percent. However, the EIA's projected future trends in energy consumption in the Mountain Region—of which New Mexico is part—suggest that emissions from electric generation in New Mexico will increase even more rapidly over the next 20 years. Indeed, assuming that New Mexico continues in its role as a net power exporter, the state is projected to experience an 11 percent increase in carbon dioxide emissions over 2000 levels by 2010 and a 47 percent increase over 2000 levels by 2020. (See Fig. 6.)

Fig. 5. New Mexico's Direct (Non-Electric) 2000 Carbon Dioxide Emissions by Sector



Note: Transportation emissions include natural gas pipeline fuel.

Fig. 6. Projected Carbon Dioxide Emissions by Sector, New Mexico



Global Warming Strategies for New Mexico

Reducing Global Warming Pollution from the Transportation Sector

The transportation sector poses a serious challenge for New Mexico as the state seeks to reduce its emissions of global warming pollution. Transportation is New Mexico's second-largest source of carbon dioxide pollution—responsible for more than one-quarter of the state's emissions in 2000. If current trends toward increasing vehicle travel continue, transportation-sector global warming emissions in New Mexico could increase by more than 50 percent between 2000 and 2020.

Light-duty vehicles are the largest source of transportation-sector carbon dioxide pollution, responsible for about three-fifths of transportation emissions in New Mexico.[39] Any strategy to deal with transportation's contribution to global warming, therefore, must begin with addressing emissions from cars, light trucks, and SUVs. Additional actions will be needed to reduce pollution from heavy-duty trucks, which is expected to increase dramatically over the next two decades.

Reducing transportation pollution will require swift action. Transportation strategies that target new vehicles have a long lead time before they begin to produce significant savings, since vehicles remain on the road for many years. Light-duty vehicles sold today will stay on the road for 10 to 15 years; many heavy-duty vehicles will remain in use even longer. Thus, New Mexico needs to act now if it hopes to reduce transportation pollution by 2020.

There are three ways to reduce emissions from motor vehicles: improve fuel economy, switch to low-carbon fuels, or reduce vehicle travel. To meet New Mexico's pollution-reduction goals, the state will need to make progress in all three areas. The strategies suggested below can begin to move New Mexico in the right direction.

Strategy #1

Adopt the Clean Cars Program

Potential Savings: 0.10 $MMTCO_2e$ by 2010; 1.40 $MMTCO_2e$ by 2020.

New Mexico can adopt the "clean cars program" developed by the state of California and adopted by a number of other states,

which will require significant reductions in global warming emissions from vehicle tailpipes.

The federal Clean Air Act allows states that fail to meet clean air health standards to choose between two sets of emission standards: those in place at the federal level and the traditionally tougher standards adopted by the state of California.

Over the last several decades, California's "clean cars program" has evolved to include three elements:

- Low emission vehicle standards that require reductions in smog- and soot-forming pollutants.
- Advanced technology vehicle standards that spur the introduction of low-polluting, high-technology vehicles into the fleet, such as near-zero emission gasoline cars, hybrid-electric vehicles, and eventually hydrogen fuel-cell vehicles.
- Tailpipe emission standards for global warming pollution.

Of the three components of the clean cars program, the advanced technology standards and tailpipe emission standards for global warming pollution have the greatest potential to reduce global warming pollution from New Mexico's transportation sector.

Advanced Technology Standards

While primarily a program for reducing smog-forming and toxic emissions from automobiles, the advanced technology standards will likely reduce carbon dioxide pollution by requiring the introduction of significant numbers of hybrid-electric vehicles and, eventually, hydrogen fuel-cell vehicles. Beginning in 2009 (which is when 2010 model year cars will go on sale), automakers would be required to sell several thousand hybrid vehicles per year in New Mexico, with the numbers increasing over time. Then, beginning in 2011, automakers would be required to sell small numbers of hydrogen fuel-cell vehicles—again, with the numbers increasing over time. By 2020, about 12 percent of new light-duty vehicles sold in New Mexico would be hybrids, while about 3 percent would be hydrogen fuel-cell or other vehicles with zero emissions.[40]

Hybrid-electric vehicles have proven to be increasingly popular in an era of higher gasoline prices. About 210,000 hybrids were sold in the U.S. in 2005—two and a half times as many as in the previous year.[41]

The future of hydrogen fuel-cell vehicles is less certain. Fuel cells use a chemical reaction involving hydrogen to produce electricity, which is then used to power a vehicle. When pure hydrogen is used in a fuel cell, the only byproducts are water and heat. A limited number of fuel cell vehicles are currently on the road in demonstration projects. But significant technological and market hurdles remain in the way of an effective system for generating, storing and distributing pure hydrogen. Even if pure hydrogen can be used as a fuel, the possibility exists that polluting and dangerous fuels such as coal and nuclear power could be used to generate the hydrogen, creating new environmental and public health threats. Thus, renewable sources of hydrogen are central to a fuel cell future that delivers dramatic reductions in global warming pollution.

Despite these potential problems, fuel cells are inherently more efficient than traditional internal combustion engines and, ideally, could become an emission-free form of transportation. Similarly, battery-electric vehicles could help fulfill the requirements for vehicles with no direct pollutant emissions. Other technologies, such as natural gas and other clean alternative-fuel vehicles, are advancing as well and could be used to meet program requirements.

In its Greenhouse Gases, Regulated Emissions and Energy Use in Transportation (GREET) model, the Argonne National Laboratory estimated that

hybrid-electric passenger cars release approximately 47 percent less carbon dioxide per mile than conventional vehicles. Fuel cell passenger cars operating on hydrogen derived from natural gas are projected to produce about 62 percent less carbon dioxide than conventional vehicles.[42] The advanced technology portion of the clean cars program would likely produce a 1 to 2 percent reduction in global warming emissions from light-duty vehicles in New Mexico.[43]

Global Warming Emission Standards

In 2002, California built upon its long history of pioneering efforts to clean up automobiles by enacting a law directing the state to set carbon dioxide emission standards for motor vehicles. The Greenhouse Gas Emission Standards for Vehicles Law was the first in the nation to regulate carbon dioxide from automobiles.

The legislation required the California Air Resources Board (CARB) to propose limits that "achieve the maximum feasible and cost effective reductions of greenhouse gas emissions from motor vehicles." Limits on vehicle travel, new gasoline or vehicle taxes, or limitations on ownership of SUVs or other light trucks could not be imposed to attain the new standards.[44] In September 2004, CARB adopted rules for implementation of the greenhouse gas emission standards for vehicles.

In estimating the benefits of the global warming standards, we assume that New Mexico vehicles will achieve the same percentage emission reductions as estimated by CARB—34 percent for new cars and 25 percent for new light trucks by 2016.[45] CARB estimates that adoption of the standards would lead to net consumer benefits of $3 per month for new car purchasers and $7 per month for light-truck buyers, with the higher cost of vehicles being more than offset by reductions in operating costs, primarily the cost of fuel.[46]

New Mexico can lay the groundwork for implementation of the global warming emission standards by moving forward with full adoption of the clean cars program. New Mexico should also encourage other states in the region to adopt the strongest available automobile emission standards. The emergence of a regional block of states in support of carbon dioxide emission standards will create leverage that can be used in securing stronger strategies to reduce automotive carbon emissions at the federal level.

Strategy #2

Set Standards Requiring Low-Rolling Resistance Replacement Tires

Potential Savings: 0.12 MMTCO$_2$e by 2010; 0.25 MMTCO$_2$e by 2020.

Fuel efficiency standards for replacement tires can improve the fuel economy of the existing vehicle fleet at a net savings to consumers.

Automobile manufacturers typically include gasoline-saving low-rolling resistance (LRR) tires on their new vehicles in order to meet federal corporate average fuel economy (CAFE) standards. However, LRR tires are generally not available to consumers as replacements when original tires have worn out. As a result, vehicles with replacement tires do not achieve the same fuel economy as vehicles with original tires.

The potential savings in fuel and carbon dioxide emissions are significant. A 2003 report conducted for the California Energy Commission found that LRR tires would improve the fuel economy of vehicles operating on replacement tires by about 3 percent, with the average driver replacing the tires on their vehicle when the vehicles reached four, seven and eleven years of age. The resulting fuel savings would pay off the additional cost of the tires in about one year, the report found, without compromising safety or tire longevity.[47]

Several potential approaches exist for encouraging the sale and use of LLR tires—

ranging from labeling campaigns similar to the federal Energy Star program to mandatory fuel efficiency standards for all light-duty tires sold in the state. California recently chose the latter approach, adopting legislation requiring that replacement tires sold to consumers beginning in July 2008 have the same average energy efficiency as the original tires provided by automakers.[48] The state will rate the energy efficiency of different tires based on testing information provided by manufacturers. The law does not require that each tire be labeled with its efficiency rating, but the information will be readily available to New Mexico to develop similar requirements.

A standards program that required the sale of LRR tires beginning in 2008 in New Mexico—assuming the same tire replacement schedules and per-vehicle emission reductions found in the California study—would ultimately reduce carbon dioxide emissions from light-duty vehicles by about 2 percent by 2020, while also providing a net financial benefit to consumers through reduced gasoline costs.

Strategy #3

Implement a "Feebate" Program

Potential Savings: 0.01 MMTCO$_2$e by 2020. Alternate Case (multi-state feebate): 0.65 MMTCO$_2$e by 2010; 1.97 MMTCO$_2$e by 2020.

Another potential tool to reduce the global warming impact of motor vehicles is a package of fees and rebates based on carbon dioxide emissions, commonly known as a "feebate."

A feebate program would give financial incentives to car buyers who purchase lower-emitting vehicles (which tend also to be more fuel-efficient) and fund those incentives through fees on purchasers of higher-emitting vehicles. Consumers who purchase vehicles at the mid-range of the emission scale—known as the "zero

The Federal CAFE Preemption

The setting of federal corporate average fuel economy (CAFE) standards for cars and light trucks in 1975 was the most important policy move in U.S. history to improve the fuel economy of light-duty vehicles. As a result of CAFE standards, the miles-per-gallon fuel economy of cars and light trucks nearly doubled between the mid-1970s and the late 1980s.[49]

However, CAFE standards have remained largely stagnant over the last decade; standards for cars have not increased since 1990. Moreover, the federal law that created the standards also bars states from adopting regulations that are "related to fuel economy standards." The language of the law explicitly bars states from imposing fuel economy requirements on vehicles, but the use of the phrase "related to" also casts legal shadows on other measures—from efficiency-based fees and incentives to limits on carbon dioxide emissions from vehicles—that could be construed by some as "related to" fuel economy standards.

Federal decision-makers can play a major role in reducing carbon dioxide emissions from transportation. An increase in the federal CAFE standards to at least 40 MPG, applied to both cars and light trucks and phased in over time, would have a dramatic impact on carbon dioxide emissions. However, with the federal government resisting further significant increases in CAFE standards, it may be up to states such as New Mexico to introduce other policies aimed at reducing transportation-sector carbon dioxide emissions.

point"—would receive no rebate and pay no fee. The ideal zero point for a revenue neutral feebate program is usually thought to be the average per-mile carbon dioxide emission rate of all vehicles sold.

There are many potential variations of feebate programs. Feebates can apply equally across all vehicle classes, or can include separate zero points for cars and light trucks or for vehicle subclasses (e.g. subcompacts). Feebates can be structured to apply either to new vehicles or to both new and used vehicles. Feebate rates can be applied in a linear fashion—with rates increasing in direct proportion to carbon emissions—or be structured to specifically target vehicles in the middle of the emissions spectrum. Finally, the rate of the feebate can vary, from a token charge to levels that generate maximum fees and rebates in the range of several thousand dollars.

No state currently has a feebate program in place, but many have examined the idea and continue to consider it. Maryland briefly adopted a program, but it was not implemented due to a legal dispute with the federal government over a separate labeling provision. Several New England states are currently considering feebate programs. Maine and Rhode Island have engaged in detailed discussions of potential feebate scenarios as part of their greenhouse gas stakeholder processes, Connecticut enacted legislation directing the state's Department of Environmental Protection to study feebates, and feebate legislation has been introduced in the Massachusetts Legislature for the last decade.

The impact of a feebate program depends largely on how it is structured, but it also depends on the number of vehicles covered by the program. Several studies by researchers at the Lawrence Berkeley National Laboratory found that the majority of the improvement in fuel economy that would result from a feebate program would be generated by the response of manufacturers, rather than the response of individual consumers. In other words, as long as automakers continue to produce and sell the same mix of relatively inefficient vehicles, the impact of the program would be limited. But, if the feebate system succeeds in persuading manufacturers to make more fuel-efficient cars, the program would have a greater impact.[50]

A feebate program adopted solely in New Mexico—which represents just over half of one percent of the national car and light truck market—would, therefore, have limited results, since the aggregate buying power of the state's consumers would probably not be sufficient to force manufacturers to change the mix of vehicles they produce and sell.[51] However, adoption of a feebate in New Mexico would set an important precedent for other states to follow. A regional program—implemented consistently across New Mexico and other Western states—would not only bring a significantly greater likelihood of manufacturer response, but would also ease implementation of the program by reducing the possibility of escaping the feebate by purchasing or registering vehicles in neighboring states.

The estimated emission reduction in this report is based on a New Mexico-only feebate. A feebate system that included multiple states, and that triggered a full response by the manufacturers, would likely have a far greater impact. In this alternate case, a feebate would reduce transportation emissions in New Mexico by approximately 0.65 $MMTCO_2e$ in 2010 and 1.97 $MMTCO_2e$ in 2020.

Strategy #4

Implement Pay-As-You-Drive Automobile Insurance

Potential Savings: 0.63 $MMTCO_2e$ by 2010; 0.79 $MMTCO_2e$ by 2020.

Shifting the calculation of automobile insurance rates from a flat annual rate to a per-mile basis would encourage car owners to drive fewer miles and reduce global warming emissions.

In a perfectly functioning market, the

rates individuals pay for automobile insurance coverage would accurately reflect the risk they pose to themselves and others. Insurers currently use a host of measures—including vehicle model, driving record, location and personal characteristics—to estimate the financial risk imposed by drivers.

One measure that is strongly linked to automobile safety and yet is not used with any accuracy in the calculation of insurance rates is travel mileage. Common sense and academic research suggest that drivers who log more miles behind the wheel are more likely to get in an accident than those whose vehicles rarely leave the driveway.[52] Many insurers do provide low-mileage discounts to drivers, but these discounts are often small, and do not vary based on small variations in mileage. For example, a discount for vehicles that are driven less than 7,500 miles per year does little to encourage those who drive significantly more or less than 7,500 miles per year to alter their driving behavior. As a result, the system fails to effectively encourage drivers to reduce their risk by driving less.

Requiring automobile insurers to use mileage as a factor in calculating insurance rates is just one of many potential ways to reallocate the upfront costs of driving. Currently, high initial cost barriers to vehicle ownership—such as insurance, registration fees and sales taxes—may reduce driving somewhat by denying vehicles to those who cannot afford these costs. But for the bulk of the population that can afford (or has little choice but to afford) to own a vehicle, these high initial costs serve as an incentive to maximize the vehicle's use. Per-mile charges operate in the opposite fashion, providing a powerful price signal for vehicle owners to minimize their driving and, in the process, minimize the costs they impose on society in air pollution, highway maintenance and accidents.

A pay-as-you-drive (PAYD) system of insurance in New Mexico might work this way: vehicle insurance could be split between those components in which risk is directly related to the ownership of a vehicle (comprehensive) and those in which risk is related to mileage (collision, liability). The former could be charged to consumers on an annual basis, as is done currently. The latter types of insurance could be sold in chunks of mileage—for example 5,000 miles—or be sold annually with the adjustments of premiums based on actual mileage taking place at the end of the year. Of critical importance to the success of the system would be the creation of accurate, convenient methods of taking odometer readings and communicating them to the insurer.

A pay-as-you-drive system of insurance would have broad benefits for New Mexico—not only for reducing global warming pollution, but also for improving highway safety and reducing insurance claims. Because insurers would still be permitted to adjust their per-mile rates based on other risk factors, mileage-based insurance would add additional costs for the worst drivers, giving them a financial incentive to drive sparingly. By contrast, drivers that pose a lower risk—such as many rural drivers—would see less of an impact.

Most importantly, research indicates that a mileage-based insurance system would reduce driving. Converting the average collision and liability insurance policy to a per-mile basis in New Mexico would lead to an average insurance charge of about 6 cents per mile.[53] (For comparison, a driver buying gasoline at $2.50 per gallon for a 20 MPG car pays 12.5 cents per mile for fuel.)

If 80 percent of collision and liability insurance were to be assessed by the mile, the impact on vehicle travel would be significant. Research conducted by the U.S. EPA and updated by the Victoria Transport Policy Institute suggests that a per-mile charge of this magnitude (about 4.8 cents per mile in New Mexico) would reduce vehicle-miles traveled by about 7 percent, with carbon dioxide emissions from light-duty vehicles declining by roughly the same amount.[54]

While many insurers remain resistant to

the administrative changes that would be needed to implement mileage-based insurance, the concept is beginning to make inroads. The Progressive auto insurance company offered a pilot PAYD insurance system in Texas and other pilot programs are underway elsewhere. In 2003, the Oregon Legislature adopted legislation to provide a $100 per policy tax credit to insurers who offer PAYD options.[55]

New Mexico should consider moving toward a system of PAYD insurance, perhaps by first requiring insurers to offer it as an alternative to traditional insurance. If the concept proves successful, the state (or insurers) could then require liability and collision rates to be expressed in cents-per-mile—thus maximizing the carbon dioxide emission reductions and other positive results of the policy.

Strategy #5

Reduce Growth in Vehicle Miles Traveled

Potential Savings: 0.83 MMTCO$_2$e by 2010; 2.57 MMTCO$_2$e by 2020.

The growth in vehicle-miles traveled (VMT) over the last several decades has its roots in many societal changes—rapid population growth in New Mexico, low gasoline prices, expansion of the workforce, and residential and commercial suburban sprawl.

Reversing this trend will be difficult, but success would bring benefits not only in reducing global warming emissions but also in easing traffic congestion, reducing public expenditures on highways, enhancing New Mexico's energy security, and reducing automotive emissions of other pollutants that harm public health. It would be a reasonable goal for New Mexico to seek to reduce the growth rate in vehicle-miles traveled to half the rate of population growth in the state, projected by the New Mexico Department of Labor to be approximately 1.3 percent per year between 2005 and 2020.[56]

The impact on vehicle-miles traveled of both transit improvement and growth management polices has been well documented. A variety of studies have documented that doubling the residential density of a given neighborhood reduces per-capita vehicle miles traveled by approximately 20 to 38 percent. Increasing the density of transit services has also been shown to reduce vehicle miles traveled.[57]

Because such effects are dependent on the characteristics of the community and the type of policy, it is difficult to estimate the impact of any single statewide smart growth strategy. Regardless, by adapting a package of "smart growth," transit, and transportation demand management policies, New Mexico could encourage long-term shifts in development patterns and transportation decisions that would reap benefits in reduced vehicle travel and global warming emissions.

Among the policies that could help achieve this goal are the following:

- Directing state investments in transportation and other infrastructure toward designated growth areas or existing population centers, not to areas where increased access will promote more sprawl.
- Encouraging location-efficient mortgages that allow households living near transit services or regional employment centers to borrow additional money because their reduced transportation expenses increase their disposable income.
- Providing incentives to employers who encourage telecommuting, establish carpool and vanpool programs, provide transit subsidies, or otherwise promote transportation alternatives.
- Improving the geographic reach, quality and frequency of existing transit services, and working to achieve low fares that maximize the use of existing transit infrastructure.

- Expanding bike trails and bike lanes, employing "traffic calming" techniques in town center areas, requiring sidewalks in all new developments, and adopting other policies to improve the safety and appeal of walking and biking.
- Promoting "infill" development, reuse of buildings no longer needed for their original purpose, and redevelopment in existing urban and suburban areas through transfers of development rights, brownfield redevelopment incentives, urban development programs, and other means.
- Creating a permanent state fund with a dedicated revenue stream to implement mass transit programs and oversee transit-related global warming emission reduction programs. New Mexico is currently one of only a few states that has no permanent mass transit funding mechanism.

Regardless of the specific policies involved, New Mexico must realize that land use and transportation policies are integrally related, and should be aligned to achieve the same goals of reducing automobile dependence, reducing development pressure on the state's remaining open spaces, and revitalizing urban areas. By adopting a state goal for the management of vehicle travel, and implementing that goal through a series of locally appropriate policies, New Mexico could go a long way towards meeting its global warming pollution reduction goal.

Strategy #6

Adopt a Renewable Fuels Standard

Potential Savings: 0.27 MMTCO$_2$e by 2010; 1.14 MMTCO$_2$e by 2020.

New Mexico can reduce its petroleum dependency, while reducing global warming pollution, by enacting a renewable fuels standard. A renewable fuels standard would require that a certain percentage of the gasoline and diesel sold in New Mexico consist of biomass-based renewable fuels, such as ethanol or biodiesel.

Biofuels are typically made from such crops as corn, soybeans, rapeseed, or even mustard seed. New technology that allows cellulose from plant waste or "energy crops" (such as switchgrass) to be turned into fuel holds the promise of even greater energy and global warming pollution benefits.

Renewable fuels are typically mixed with petroleum-based fuels, such as gasoline or diesel. All vehicles are capable of using fuel with a small percentage of renewables. Vehicles that run on higher percentages of ethanol, however, require special equipment and special infrastructure to deliver the fuel. However, they also provide much greater environmental advantages than vehicles using smaller percentages of renewable fuels.

A requirement that 10 percent of New Mexico's gasoline consist of ethanol (increasing to 15 percent after 2010) and that 2 percent of diesel fuel consist of biodiesel (increasing to 10 percent after 2010) would be a reasonable goal for the state to achieve. Minnesota recently began to require that biodiesel make up a small portion (2 percent) of all diesel fuel sold in the state and many states—such as California, Colorado, New York, Iowa and several other Midwestern states—now use ethanol as an oxygenate in gasoline.

As New Mexico moves forward with a renewable fuels standard, it is important that the state promote those processes that result in the greatest net energy balance and the greatest global warming benefit. The state should consider standards, incentives and other policies that encourage cellulosic biofuels to make up an increasing share of the state's biofuel supply. The state should also ensure that implementation of the renewable fuel standard does not adversely affect air quality. Because higher blends of ethanol-based fuel, such as E85 (85 percent ethanol and 15 percent gasoline) have both a greater ability to reduce

global warming emissions and a lower potential to worsen smog and toxic air pollution levels, the state should help to promote the use of E85 vehicles. This can be achieved both by leading the way and filling state-owned flexible fuel vehicles with E85, and by helping to develop the separate fueling infrastructure that is needed to refuel these vehicles. Similar efforts can also be made to promote the use and availability of higher blends of biodiesel.

Reducing Global Warming Pollution from Homes, Businesses and Industry

The residential, commercial and industrial sectors are responsible for about 44 percent of New Mexico's direct emissions of carbon dioxide. These sectors also consume virtually all of the state's electricity. There are tremendous opportunities to improve the efficiency of energy use in homes, businesses and industry. By updating and enforcing the state's building energy codes, setting strong energy efficiency standards for appliances, expanding energy efficiency programs, and promoting the use of combined heat and power, New Mexico can ensure that it is getting the most out of every unit of energy it consumes. And by instituting a tiered pricing system for electricity, the state can create an incentive for consumers to use less power.

Strategy #7

Update and Enforce Residential and Commercial Building Energy Codes

Potential Savings: 0.30 MMTCO$_2$e by 2010; 1.69 MMTCO$_2$e by 2020.

Improving enforcement of New Mexico's existing building energy codes and improving those codes over time can significantly reduce energy consumption in new homes and commercial buildings.

Nearly half of all energy use in the U.S. and in New Mexico can be linked to buildings, whether residential, commercial or industrial. In addition to heating, cooling, ventilating and lighting our homes, the places we work, and the places we shop and do business, there are a number of large appliances—such as refrigerators and washing machines—that consume energy in buildings. The importance of energy-conscious building design and construction is magnified by the fact that most buildings have a life span of at least 50 years, during which time the amount of "fixed" energy needed to heat, cool, ventilate and light the building remains fairly constant.

Building codes were originally intended to ensure the safety of new residential and commercial construction. In recent years, however, building codes have been used to reduce the amount of energy wasted in heating, cooling, lighting and the use of electrical equipment.

Model building energy codes are developed and updated at the national and international level. The International Energy Conservation Code (IECC)—developed by the International Code Council (ICC)—serves as the basis for many state codes. The latest full version of the IECC was released in early 2006. The new version is approximately half the length of the previous IECC code book, making it easier to read, understand, use and enforce.[58]

In 2003, New Mexico took strong steps to strengthen its building codes by adopting the 2003 version of the IECC. This code became effective for both commercial and residential buildings on July 1, 2004. The 2003 IECC standard for commercial buildings is roughly equivalent to the ASHRAE 90.1–2004 standards established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers.[59] Although the state purports to review its building codes every three years, there is no mechanism in place to ensure that a review of building codes results in the implementation of stronger codes.

Indeed, more than a decade had passed since the last building code update in New Mexico.

The success or failure of building energy codes depends largely on the degree to which they are enforced by local building officials. Nationally, stronger code enforcement—when coupled with efforts to educate builders about code compliance—could be expected to increase energy savings in buildings by 10 to 20 percent.[60] Building plan review and code enforcement is regulated by local jurisdictions in New Mexico. If a city or county does not elect to enforce the code or have personnel qualified to do so, the Construction Industries Division of the New Mexico Regulations and Licensing Department provides the necessary reviews and inspections for residential buildings.[61]

To maximize energy savings from buildings, New Mexico should engage in a dual strategy coupling stronger enforcement of existing codes with the development of aggressive new energy-saving building codes. We assume that enhanced enforcement of New Mexico's recently adopted building code can reduce energy consumption in new buildings by 15 percent between 2006 through 2010, and that future updates to residential building codes can reduce consumption by 35 percent below reference case levels from 2010 to 2015, and by 40 percent below reference case levels between 2016 and 2020. These savings only reflect energy efficiency improvements in new construction—applying codes to renovations in existing structures would result in even greater savings.

Across the country, a variety of private and governmental entities have demonstrated the feasibility of more aggressive building energy codes.

- **Energy Star Certification** – Many new homes in New Mexico are currently certified through the federal Energy Star Homes Program. Energy Star-qualified homes are independently verified to be at least 30 percent more energy efficient than homes built to the 1993 national Model Energy Code, and more rigorous Energy Star standards are currently being developed.[62]
- **Strong State Codes** – The state of Oregon has set building energy codes that are approximately equal to federal Energy Star standards. Oregon credits strong building codes for 35 percent of the state's total energy efficiency savings.[63]
- **Leadership in Energy & Environmental Design (LEED) Standards** – Commercial buildings certified to the LEED standards use an average of 30 percent less purchased energy than conventional buildings. While LEED-certified buildings cost an average of 2 percent more to construct, they yield 20-year financial benefits of about 10 times the construction premium.[64] LEED silver, gold, and platinum buildings are held to even higher energy-efficiency standards.
- **Private Developments** – Large-scale energy-efficient building projects are now starting to appear around New Mexico. In 2001, Artistic Homes partnered with the Department of Energy's Building America program to build more than 700 homes in the Albuquerque area, each of which is 30 to 50 percent more efficient than the state's existing energy standards.[65]

Strategy #8

Adopt Appliance Efficiency Standards

Potential Savings: 0.04 MMTCO$_2$e by 2010; 0.14 MMTCO$_2$e by 2020.

New Mexico has the power to adopt energy efficiency standards for a range of residential and commercial appliances. The standards can save New Mexico consumers money over the long haul and reduce the state's consumption of energy.

Household appliances and those used by businesses are a major source of energy demand. Since the first state appliance efficiency standards were adopted in the mid-1970s (followed by federal standards beginning in the late 1980s), the energy efficiency of many common appliances has been dramatically improved. For example, residential refrigerators consume less than one-third the electricity of refrigerators manufactured in the early 1970s despite the fact that today's refrigerators are larger and have more features.[66]

The federal appliance standards program has led to great improvements in the efficiency of many appliances, but progress has slowed in recent years. Many federal standards have either failed to keep up with advances in efficiency technologies or have failed to take advantage of known efficiency opportunities. In September 2005, New Mexico joined with a coalition of 15 other states and the City of New York in suing the federal Department of Energy for violating congressionally enacted mandates by failing to adopt stronger energy-saving standards for 22 common appliances that use large amounts of energy.[67]

States may adopt efficiency standards for products that are not covered under federal standards and may apply for a waiver to apply stronger standards to those that are covered under the federal program. In recent years, a number of states adopted efficiency standards for a variety of appliances – actions that led Congress to include federal efficiency standards for many of those products in the 2005 Energy Policy Act. (See "Energy Efficiency Standards in the 2005 Federal Energy Policy Act.")

However, there remain a set of appliances for which New Mexico can adopt improved energy efficiency standards. DVD players, compact audio products, residential furnaces and a variety of commercial appliances can meet stronger energy efficiency criteria while reducing carbon dioxide pollution and saving consumers' money. The American Council for an Energy-Efficient Economy and the Appliance Standards Awareness Project have estimated that new standards for 15 products would save New Mexico $239 million by 2030.[68]

New Mexico should move ahead with the adoption of efficiency standards for appliances not covered by federal rules and apply for waivers of pre-emption for others. In addition, the state should allow for the expedited adoption of future appliance standards set by large states, such as California, enabling New Mexico to stay on the cutting edge of energy efficiency and achieve further reductions in global warming pollution in the years ahead.

Strategy #9

Implement Tiered Electricity Pricing

Potential Savings: 0.20 MMTCO$_2$e by 2010; 0.23 MMTCO$_2$e by 2020.

In New Mexico, residential consumers generally pay flat rates for their electricity. That is, each household pays the same amount per kilowatt-hour (kWh) of electricity consumed, no matter how much electricity that household uses each month. As an alternative, the state should adopt tiered rates (also known as inverted block rates), in which electricity rates increase as usage increases.

Tiered rate pricing could be structured so that the average electricity bill paid by New Mexico households would remain about the same. For example, assume the average household in New Mexico consumes 750 kWh of electricity per month and pays 10 cents per kWh; under a revenue-neutral three-tier system, residential consumers might pay 5 cents/kWh for their first 250 kWh of electricity each month, 10 cents/kWh for the next 250 kWh, and 15 cents/kWh for all consumption over 500 kWh per month.

A series of economic studies suggest that for every 10 percent increase in the price of electricity, there is a corresponding 1.5 percent to 3.5 percent reduction in residential demand.[71] Thus, continuing with the above example, the 50 percent increase in

Energy Efficiency Standards in the 2005 Federal Energy Policy Act

In July 2005, Congress passed the Energy Policy Act, which included energy efficiency standards for 15 new products, including commercial refrigeration, commercial heaters, ceiling fan lights, traffic signs, and other home and business products. Nationally, these standards are expected to save almost 30,000 megawatts of electricity generation capacity and 90 billion kilowatt-hours of electricity by 2020, which would offset about 2 percent of total electricity use.[69]

Many of the efficiency standards included in the legislation were added after similar standards were adopted at the state level. In the previous three years, a number of states—including California, Connecticut, New York, Rhode Island, New Jersey and Maryland—had adopted many of the efficiency standards subsequently included in the federal bill, helping to build momentum for the adoption of stronger standards across the country.[70]

price for the last 250 kWh of electricity consumed by the typical New Mexican household would lead to electricity savings of between 18.8 kWh and 43.8 kWh (2.5 to 6 percent of total electricity use) a month.

The idea of variable pricing for electricity is not new. Indeed, it is commonly used throughout the Southwest to price water, and several states—including California, Florida, Washington and Utah—have various types of tiered pricing systems for electricity.[72] The most successful programs have three or more tiers and a significant price differential between high and low energy consumption. In 2001, during its energy crisis, California implemented a five-tiered rate structure designed to increase average electricity rates while encouraging greater energy conservation. A recent study found that this resulted in a 10 percent reduction in California's average residential energy use.[73]

Strategy #10

Expand Energy Efficiency Programs

Potential Savings: 0.81 MMTCO$_2$e by 2010; 2.76 MMTCO$_2$e by 2020.

Maintaining and expanding New Mexico's new energy efficiency programs can reduce energy consumption in areas not addressed by stronger residential and commercial building codes, improved appliance efficiency standards or tiered pricing.

Energy efficiency improvements are among the most promising and least costly ways New Mexico can reduce global warming emissions. But there are many barriers to the successful introduction of energy efficiency technologies. Potential users may not know about the technologies or have an accurate way of computing the relative costs and benefits of adopting them. Even when efficiency improvements are plainly justifiable in the long run, consumers may resist adopting technologies that cause an increase in the initial cost of purchasing a building or piece of equipment. In some cases, as with low-income individuals, consumers may not be able to afford the initial investment in energy efficiency, regardless of its long-term benefits.

In April 2005, the state made great strides to increase energy efficiency by passing the Efficient Use of Energy Act. The Act directs electric and gas utilities to evaluate and implement cost-effective programs for New Mexico's residential, commercial, and industrial consumers to help them reduce their energy consumption and peak

demand. The Act allows for utilities to recoup the costs associated with implementing these energy-saving programs by assessing a tariff to all ratepayers that is capped at 1.5 percent of the bill. Large industrial customers who do their own efficiency upgrades will have a mechanism for opting out of this tariff. These energy efficiency programs can apply both to electricity and to natural gas, and can begin as soon as 2006.[74]

Prior to the passage of this legislation, utilities in New Mexico had been operating minimal energy efficiency programs, largely based on providing information on energy savings options and providing limited low-interest loans for energy projects implemented by commercial and industrial customers.[75]

Although passage of the Efficient Use of Energy Act is a notable first step, there remain several important ways to strengthen energy efficiency programs in New Mexico:

- The state should set specific energy savings targets and timetables to achieve these targets.
- The Efficient Use of Energy Act currently caps costs for energy efficiency programs at 1.5 percent of customers' utility bills—a level that may not be sufficient to capture all cost-effective energy efficiency. This cap should be expanded so that up to 3 percent of total utility revenues could go towards cost-efficient energy efficiency measures. This would put funding for New Mexico's program on par with the per-customer funding from states with the most successful programs.
- In addition to requiring independent measurement, verification, and reporting of program expenditures and energy savings achieved—as is currently specified—an improved state efficiency program should also lay out consequences for non-compliance.

The near-term impacts of expanded residential, commercial and industrial energy efficiency programs may represent just the tip of the iceberg of the potential benefits of an expanded, cooperative, state and utility-driven energy efficiency program. By promoting research and development of efficient new technologies and practices, and by broadening public understanding of the potential benefits of energy efficiency, these programs can create new opportunities for cost-effective energy savings in the years to come.

Strategy #11

Expand Use of Combined Heat and Power and Local Power Generation

Potential Savings: 0.57 MMTCO$_2$e by 2010; 1.42 MMTCO$_2$e by 2020

New Mexico has many opportunities to promote the use of combined heat and power, in which wasted energy from electricity generation or heating is captured and used for other purposes, and the local generation of power, which reduces the inefficiencies created by the long-distance transportation of power.

America's electricity system is a good source of reliable power, but it is also loaded with inefficiencies. Power plants produce a large amount of waste heat during their operation, which reduces their efficiency at converting the energy in fossil fuels into useful work. Similarly, the nation's long-distance transmission system results in the loss of between 5 and 10 percent of the electricity that crosses the wires on its way from power plants to homes and businesses.[78]

New Mexico could reduce energy waste by promoting the use of combined heat and power (CHP) systems and local, distributed generation (DG) of electricity. CHP systems pair electricity generation and heating—enabling the waste heat from electricity generation to be used to provide space or water heating or to assist in industrial processes. While the average American

Improved Energy Efficiency Can Protect the Economy During an Energy Crisis

Improving energy efficiency can reduce electricity costs and global warming pollution. But it also has another benefit: the ability to be deployed quickly to protect the economy during an energy crisis. No experience demonstrates this potential as well as the response of California to the Western energy crisis of 2000-2001.[76]

In the late summer of 2000 and early 2001, California experienced periodic rolling blackouts and more than 70 days of electric system emergencies, with power supplies barely enough to meet demand. The outlook for the summer of 2001 was gloomy: the California Energy Commission anticipated a 5,000 MW power shortage and further rolling blackouts.

In response, California greatly expanded its energy efficiency programs—increasing funding for energy efficiency by 250 percent and launching a variety of initiatives to curb power use. State agencies provided appliance rebates, commercial lighting retrofits, and assistance to low-income households, while state and local governments took aggressive action to reduce their own power use. The state conducted an expedited update of its building energy codes and appliance standards. Investor-owned utilities expanded their existing efficiency programs and were required to give customers a 20 percent rebate on their electric bills if they reduced consumption by 20 percent during the summer of 2001.

The effort paid off, reducing California's peak power demand by 10 percent and preventing any rolling blackouts—saving the economy billions of dollars. Indeed, power consumption in California in 2001 was 6.7 percent lower than in 2000. These electricity savings cost approximately $0.03 per kWh over the lifetime of the measures, less than half of what the state would have spent had it attempted to build new power plants and produce additional power.[77]

power plant operates at a thermal efficiency of about 35 percent, CHP plants can achieve efficiencies of 80 percent or greater, meaning that more of the energy that goes into the plant is available for useful work.[79]

Various forms of CHP are already in use in New Mexico, accounting for more than 290 megawatts of generation capacity.[80] For example, the City of Albuquerque's Southside Water Reclamation Plant uses methane produced from the wastewater treatment process to generate electricity and hot water for the facility. In addition to reducing the amount of global warming pollution directly produced during the water treatment process, this "cogeneration" plant produces about half of the power used by the wastewater treatment facility.[81]

Many CHP systems are also a form of distributed generation (DG). While not all forms of DG recapture waste heat, they do reduce the loss of energy over long-distance transmission wires and promote greater grid stability. Among the many types of DG technologies are solar panels, small wind turbines, fuel cells and natural gas microturbines.

Both CHP and DG systems have been hampered by utility and regulatory policies that make it difficult for them to connect

to the electric grid. New Mexico does allow net metering for small CHP systems.[82] But the state should take additional actions to identify and reduce barriers to CHP and DG. Such barriers typically include burdensome interconnection requirements, unreasonably high standby power charges, and other regulatory barriers. In addition, the state should actively assist and promote the deployment of CHP.

In a 2002 study, Western Resource Advocates estimated that New Mexico could install as much as 235 MW of new industrial and commercial CHP generating capacity by 2020.[83] The carbon dioxide savings estimate here assumes that this target is met. However, the estimate does not include savings that could accrue from residential CHP or from expansion of DG. Encouraging the deployment of these technologies would lead to additional pollution reductions in New Mexico.

Additional Residential, Commercial and Industrial Sector Strategies

A number of other strategies are available to reduce energy use in the residential, commercial and industrial sectors. These strategies are not included in the pollution savings estimates in this report, but have the potential to achieve additional reductions in global warming pollution in New Mexico.

- **Energy-Efficient Mortgages and Pay-As-You-Save Programs**— Energy-efficient mortgages (EEM) and pay-as-you-save (PAYS) programs are alternative models for financing the installation of energy efficiency measures and distributed generation resources, primarily in the residential sector. EEM programs generally allow homebuyers to assume larger mortgages (sometimes on preferential terms) to finance energy efficiency improvements. PAYS programs allow consumers to pay for energy-efficient equipment or distributed generation resources (such as solar panels, small wind systems or fuel cells) over time on their utility bills rather than upfront. The charge remains on the utility bill until the equipment is paid off, regardless of who is living in the residence at the time. PAYS systems remove a major barrier for homeowners seeking to reduce energy demand: the prospect that they will not reside at the home long enough to enjoy the benefits of their investments. State officials should work with utilities to develop PAYS programs that are applicable to both efficiency and distributed generation, and they should also coordinate with mortgage lenders to encourage and publicize EEMs.
- **Promote Energy Smart Buildings**— In addition to strengthening building codes to promote energy efficiency, New Mexico should identify ways to reward builders, businesses and home buyers who choose to go beyond the minimum standard and build truly energy-smart buildings that are at least 50 percent more efficient than current standards. Energy efficiency certification programs, government-sponsored demonstration projects, advanced trainings for architects and builders and other types of incentives and programs should be considered. However, any program to promote green buildings should also reinforce the state's smart growth goals. Any "green" commercial building sited in such a way as to increase automobile travel may have a negligible—or even negative—net impact on global warming emissions.
- **Solar-Ready Home Standards –** Incorporating solar photovoltaic systems into new housing designs and construction has been key to the creation of a robust, self-sufficient solar market in other parts of the

world. Japan, for example, is currently on track to meet its goal of installing photovoltaic systems on half of all new homes by 2010.[84] An important step that would allow New Mexico to follow suit would be to revise its building codes to require that new homes and commercial structures be built to allow for easy installation of solar photovoltaic systems.

- **Cluster and Mixed Use Development** – Smart growth policies are commonly thought to reduce global warming emissions by reducing the number of automobile trips required to carry out our daily activities. But they may also have the secondary effect of reducing energy use within the buildings themselves. Many smart growth or "new urbanist" projects involve the renovation of existing buildings, construction of homes with less square footage than typical new suburban construction, or the combination of commercial and residential uses in a more space-efficient fashion. More research needs to be done to quantify the energy impacts of such projects, but New Mexico can spur their development by encouraging towns to develop zoning ordinances that allow, or provide incentives for, cluster and mixed-use developments.

Reducing Global Warming Pollution from Electricity Generation

In addition to efforts to conserve electricity, New Mexico can also reduce carbon dioxide emissions from electricity use by making electricity generation in New Mexico cleaner—specifically by encouraging a shift away from carbon-intensive fuels such as coal and toward renewable energy sources such as solar and wind. To achieve this goal, New Mexico must encourage the deployment of renewable energy sources while simultaneously adopting policies to reduce carbon dioxide emissions from fossil fuel generators. This shift is especially important given that New Mexico's power plants are the largest source of global warming pollution in the state.

Expanding the use of renewable sources of energy in the state—by expanding the state's renewable portfolio standard and following through with new incentives to develop New Mexico's abundant solar resources—can help move the state toward a cleaner, more resilient energy system with less impact on the climate. Even with those steps, however, the state still faces a large potential expansion in coal-fired electricity generation over the next two decades that could derail any efforts to reduce New Mexico's impact on the global climate. Preventing a dramatic projected expansion in coal-fired electricity generation is perhaps the single most important thing New Mexico can do to achieve its climate protection goals.

Strategy #12

Strengthen and Extend the Renewable Portfolio Standard

Potential Savings: 0.93 MMTCO$_2$e by 2010; 3.50 MMTCO$_2$e by 2020.

Increasing the proportion of New Mexico's electricity that comes from renewable sources can reduce demand for electricity from coal-fired power plants that produce vast amounts of carbon dioxide.

Like many states around the country—including other western states such as Arizona, California, Colorado, Montana, Nevada and Texas—New Mexico has adopted a renewable portfolio standard (RPS) for electricity supplied to the state's customers. Essentially, an RPS requires that a certain portion of the power delivered by the state's utilities be from renewable energy

sources. The percentage of renewable power increases over time—from 5 percent in 2005 to at least 10 percent by 2011. The state defines renewable energy sources as solar, wind, hydropower, geothermal, fuel cells that are not powered by fossil fuels, and biomass resources.[85]

However, New Mexico's RPS does not all of the state's electricity customers. New Mexico's 20 rural electric cooperatives (which serve 22 percent of the state's electric customers) and seven municipal electric utilities (which serve 8 percent of the state's electric customers) are exempt from the RPS.[86] These entities share an interest with all New Mexicans in reducing the state's contribution to global warming.

New Mexico should expand its current RPS so that by the end of 2020, 30 percent of *all* electricity consumed in New Mexico is from renewable energy sources. Such an increase is not only feasible, but barely scratches the surface of the state's full renewable energy potential.

The potential for wind power in New Mexico is enormous—the state ranks 12th in the nation for wind electricity potential. Notable areas of good-to-excellent wind resources are in the Eastern Plains, including Clovis and Tucumcari.[87] The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) has calculated that New Mexico has the potential to generate as much as 435 billion kWh of wind energy per year. This is more than 10 times the state's annual electricity production and more than 20 times the state's annual electricity consumption.[88]

Similarly, New Mexico's abundance of sun makes it ideal for solar electricity generation—the state's 3,200 hours of sunshine per year is far above the national average and substantially above most other Southwestern states.[89] Using even the most conservative estimates, and without factoring in the potential for technological improvements, New Mexico's ability to generate solar power far exceeds the state's current electricity production and consumption levels. Indeed, if current technology solar panels were placed on 20 percent of New Mexico's landmass, the amount of energy generated could displace the same amount of energy as *all* the coal, oil and gas used in the United States every year.[90]

In sum, filling a 30 percent renewable portfolio standard for New Mexico with either wind or solar alone would require the development of a fraction of the state's potential renewable energy resources—even without factoring in future technology improvements that will make wind power feasible at lower wind speeds and solar panels more effective at turning the sun's energy into electricity. Adding other types of renewable energy to the mix—such as landfill gas, geothermal energy and clean biomass (that which does not contribute to toxic air emissions)—makes the goal of generating 30 percent of all electricity consumed in New Mexico by 2020 even more feasible.

As New Mexico considers how to enforce, strengthen and expand its RPS, it should emphasize only truly clean, truly renewable technologies. Polluting and environmentally damaging technologies, along with those that rely upon non-renewable resources, should be excluded from use to fulfill RPS requirements.

Strategy #13

Support the Development of Solar Energy

Potential Savings: 0.01 MMTCO$_2$e by 2010; 0.18 MMTCO$_2$e by 2020.

Solar energy represents one of the best long-term hopes for New Mexico to slash its consumption of fossil fuels and emissions of carbon dioxide. By supporting the development of solar energy now, New Mexico can be in a better position to fully reap the benefits in the decades ahead.

Solar energy is currently a small player in the generation of electricity in New Mexico and around the country. However, solar photovoltaics (PV) and solar thermal technologies have the potential to make a

major contribution to a clean energy future. Solar PV costs have gone down by 75 percent over the past 20 years.[91] And given its enormous potential for solar power, New Mexico can play a leading role in positioning solar power to make a major contribution to the state and the region's long-term global warming emission reduction goals.

Solar Photovoltaics

New Mexico has recently taken several strong steps to promote solar energy. In December 2005, the New Mexico Public Regulation Commission (PRC) approved a plan by PNM to pay 13 cents per kWh, in addition to any net metering revenues, to solar PV owners who contract with the utility during 2006. The payment, which is being made to comply with PNM's requirements under the state's renewable portfolio standard, will remain constant over a 12-year period, removing a key area of uncertainty for consumers considering PV systems. The program is anticipated to add about 45 residential systems in PNM's territory per year for the next 12 years—or 540 systems overall.[92]

Further, in March 2006, Gov. Richardson signed a solar tax credit law that will provide $3 million annually in credits for solar PV installations and $2 million annually in credits for solar thermal systems (such as solar hot water heating).[93] The incentives will defray up to 30 percent of the cost of a solar PV system, with a maximum credit of $9,000.[94]

While these efforts are potentially ground-breaking, there are other steps the state can take as well:

- **Improve net metering**. A key component to making solar power cost-effective involves fairly compensating owners of solar photovoltaic systems for the extra electricity they generate. This can be achieved through a variety of tools, including allowing larger systems to qualify for net metering and providing more generous payback for PV owners.
- **Incorporate solar into new home design and construction**. New Mexico builds thousands of new single-family homes each year. Incorporating solar PV systems into homes during construction is one of the most cost-effective and efficient ways to build New Mexico's solar market. Policies targeted specifically at new homes—such as requirements to install solar on an increasing percentage of new homes or offer systems to homebuyers—can develop the most cost-effective parts of the residential PV market.

The state's recent solar PV initiatives will likely lead to the installation of thousands of solar PV systems and other solar energy systems in New Mexico over the next decade. New Mexico should work toward the goal of having the equivalent of 50,000 new solar rooftops in the state by 2020. Achieving this goal would not only reduce carbon dioxide emissions, but would also enhance the stability of the state's electric system and create economies of scale that will make solar power a cost-effective alternative for New Mexico homeowners and businesses within the next two decades. The state would then be poised for a dramatic increase in solar installations in the 2020-2050 period, precisely the time when the state will need to make deep reductions in global warming emissions to meet the state's long-term goal of reducing emissions to 75 percent below 2000 levels by 2050.

Solar Thermal Energy and Passive Solar

Using the sun's rays to generate electricity is just one of many ways to use solar energy to reduce the use of fossil fuels and cut global warming emissions.

Solar hot water systems use solar energy to produce hot water for bathing, laundry and other household uses. Installation of a rooftop solar hot water system can reduce energy consumption for water heating by

about two-thirds.[95] Passive solar building design uses appropriate building layouts and the judicious use of glass to heat and light interior building spaces. Solar energy can even be used to heat and cool buildings.

Many solar hot water systems and passive solar designs have the advantage of being less expensive to implement (and often more cost-effective) than solar PV systems. New Mexico's recent adoption of a tax credit for the installation of solar thermal energy systems is a strong step to promote solar energy. Incentives or standards for energy-efficient buildings could encourage the development of buildings that use passive solar heat and light.

Solar hot water systems and passive solar energy have great potential to reduce fossil fuel consumption in New Mexico, but time and resource constraints prevented the inclusion of solar thermal and passive solar technologies in the estimates of carbon dioxide pollution reductions in this report.

Strategy #14

Prevent Expansion of Coal-Fired Power Generation in New Mexico

Potential Savings: 11.80 MMTCO$_2$e by 2020.

One of the most important things New Mexico can do to combat global warming in the next two decades is to prevent the dramatic expansion of coal-fired electric generation capacity.

Rising natural gas prices are leading to a nationwide "coal rush" as utilities and merchant electricity generators seek to serve rising demand for electricity. Across the country, 135 new coal-fired power plants have been proposed—enough to generate power for 80 million homes.[96] Two new coal-fired power plants have been proposed in New Mexico, with a combined capacity of 1,800 megawatts.[97] Plans for power plants frequently change and many proposed plants are never built. Yet the rise in the number of proposed coal-fired power plants in New Mexico and elsewhere casts a pall over state and national efforts to reduce global warming pollution.

Coal-fired electricity generation produces more carbon dioxide per unit of energy produced than virtually any other option for generating power. In 2002, New Mexico's coal-fired power plants produced nearly 1.1 tons of carbon dioxide for every megawatt-hour of power produced, compared to 0.79 tons for every megawatt-hour of power produced from natural gas.[98] Newer, modern natural gas-fired power plants produce even less carbon dioxide.

The U.S. Energy Information Administration (EIA) projects that coal-fired generation will increase rapidly in the Mountain West after 2013. EIA projects that, between 2013 and 2020, the amount of coal-fired generation capacity in the Mountain West will increase by roughly 50 percent, leading to a dramatic rise in carbon dioxide emissions.[99] These regional growth rates form the basis of the projections in this report. Should these projections hold true, annual emissions from coal-fired power plants in New Mexico would increase by about 11 MMTCO$_2$e between 2013 and 2020—an amount more than twice as great as the current direct emissions from the residential and commercial sectors combined.

Allowing the dramatic expansion of coal-fired power plants would likely doom the state's efforts to achieve its global warming pollution reduction goals. Thankfully, however, alternatives do exist for New Mexico to meet its energy needs without dramatically expanding production of power from coal.

Reduce Growth in Electricity Consumption and Production

Improving the energy efficiency of New Mexico's economy and expanding clean distributed generation will reduce dependence on power from large, centralized power plants. Many of the policy recommendations in this report will move New Mexico in this direction, but more remains to be done. A 2002 report by the Southwest

Energy Efficiency Project (SWEEP) estimated that New Mexico could cost-effectively reduce its consumption of electricity by 36 percent below projected levels.[100] By contrast, the policy options proposed here would reduce New Mexico's electricity consumption by 13 percent below projected levels. Even accounting for differences in baseline projections and the passage of time between the two studies, New Mexico clearly has opportunities for energy efficiency improvements that would further reduce demand for power from coal-fired power plants.

One way to expand investment in cost-effective energy efficiency is to ensure that efficiency is considered as an alternative to new power plants in the utility regulatory process, and that it is treated fairly. Saving energy through improved efficiency generally costs less than building and operating new power plants. New Mexico's Efficient Use of Energy Act will encourage utilities to implement cost-effective energy efficiency measures. It also requires utilities to develop resource plans that include the consideration of energy efficiency, renewable energy and other cleaner sources alongside fossil fuel-fired power plants in serving future power demand. Enforcing this new law fully and effectively should result in energy efficiency taking on a larger role in New Mexico's energy supply system and reduce demand for new power plants.

However, emissions from New Mexico's power sector depend on more than just what happens inside the state's borders. New Mexico is a net exporter of electricity to the region, so regional measures to improve energy efficiency and reduce demand for power across the West could also reduce the demand for new power plants in New Mexico.

Consider the True Cost of Coal-Fired Power Plants

Coal-fired power plants currently have a series of economic advantages over cleaner sources of energy. Coal-fired power plants are not forced to account or pay for the many environmental and social costs they impose—costs ranging from the public health damage caused by air pollution to the consumption of scarce water supplies to their contribution to global warming. In addition, many older coal-fired power plants are exempt from modern clean air standards. Excluding these costs makes coal-fired power production in New Mexico look artificially cheap.

Considering the true cost of coal-fired power plants in utility regulatory proceedings would tend to give a leg up to lower-carbon sources of electricity—such as natural gas and renewables. It could provide an incentive to replace existing, inefficient power stations with cleaner, more efficient technologies—possibly including technologies to capture and store carbon dioxide. (See "'Clean Coal' and Global Warming.") One way to ensure that the global warming-related costs of coal-fired power plants are "priced in" to the cost of electricity is to adopt a carbon cap-and-trade system in New Mexico.

Create a Carbon "Cap and Trade" Program

"Cap and trade" systems are among the most widely considered options for limiting carbon dioxide emissions from electricity generation. In the Northeastern U.S., seven states recently agreed to create such a program, called the Regional Greenhouse Gas Initiative (RGGI). The initiative calls for emissions from the region's power producers to stabilize at 2009 levels until 2015 and then to be cut by 10 percent below that level by 2019.[105]

The RGGI agreement sets a cap on power plant carbon dioxide emissions for each state. Power plants must hold an "allowance" (or permit) for every ton of carbon dioxide they emit to the atmosphere. States may choose whether to auction off the allowances or give up to 75 percent of them to power generators for free. States

that choose to auction the allowances may then use the funds to promote energy efficiency improvements and non-carbon emitting forms of power, such as renewables. Any power plant owner that wishes to increase emissions must buy additional allowances from the owners of other power plants that have extra allowances to sell. In theory, this cap and trade system will lead to reductions in carbon dioxide emissions at the lowest aggregate economic cost.

A carbon cap and trade program could be adopted by New Mexico alone, or by a

"Clean Coal" and Global Warming

Gasified coal (often called "clean coal") has been promoted as an environmentally responsible way to use coal to generate electricity. Gasified coal technologies, such as integrated gasification combined cycle (IGCC) coal-fired power plants, have important advantages over conventional coal-fired power plants: they are significantly more efficient and have lower emissions of conventional pollutants. In addition, IGCC technology allows for the capture of carbon dioxide, which some believe can be stored in large quantities underground—theoretically allowing for the production of low- or zero-carbon power from coal.

However, coal gasification is far more expensive than cleaner and more sustainable ways of addressing our energy-related and environmental problems. Coal gasification with carbon storage is more than twice as expensive as typical energy efficiency measures and more than 50 percent more costly than the best wind power projects.[101] Even without carbon storage, coal gasification would cost roughly twice as much as energy efficiency and could at best compete with an average wind farm.[102]

Moreover, carbon capture and storage—on the scale at which it must be implemented to fight global warming—is an immature technology with serious questions about future viability. Carbon dioxide has been injected into the ground for some time to enhance oil recovery. However, the storage of captured carbon dioxide from utility operations, or from the use of coal gasification to create hydrogen fuel for automobiles, would require a vast expansion of carbon transportation infrastructure and storage. For example, storing all U.S. power plant coal emissions would require enough infrastructure to liquefy and store roughly 2 billion metric tons of carbon dioxide *annually*.[103]

In addition, carbon dioxide stored in geological formations must be guaranteed to remain underground for hundreds or thousands of years to prevent re-release to the atmosphere and to prevent accidental, large-scale releases of carbon dioxide, which can be fatal to humans and wildlife. Ocean storage, which has been considered a possible option for carbon management, appears less attractive given recent research tying increasing ocean carbon dioxide levels with damage to ocean ecosystems.[104]

Provided that the technological hurdles can be overcome, IGCC will likely only become a key player in the energy mix if policies are in place to make it economically competitive with conventional coal technology. A carbon cap that places a market price on carbon dioxide emissions from power plants could provide an incentive for cleaner technologies such as IGCC to develop. Even then, however, IGCC would only deliver global warming benefits if it is used as a replacement for existing dirty and inefficient coal-fired power plants, not as an addition to them.

group of Western states. A regional cap and trade program would likely produce better results, as it reduces incentives to merely shift power generation out of New Mexico and into neighboring states.

Impacts of Stopping the Expansion of Coal-Fired Generation

New Mexico has several policy options, described above, for preventing a dramatic increase in coal-fired generation in the state in the years to come. Each of the options would produce different results in terms of the state's electricity consumption, its generation mix, and the degree to which it remains a power exporter to the region.

In estimating the benefits of stopping the "coal rush," we assume that emissions from coal-fired power plants in the state are held constant at projected 2010 levels until 2020. Should this generation be replaced with forms of generation that emit carbon dioxide, such as natural gas, the pollution reductions achieved would be less than estimated here.

In any case, New Mexico must plan now for meeting its future energy needs with sources other than coal burned in conventional coal-fired power plants.

Public Sector and Other Strategies

Strategy #15

Public Sector "Lead by Example"

Potential Savings: 0.29 MMTCO$_2$e by 2010; 0.99 MMTCO$_2$e by 2020.

State and local governments are significant users of energy in New Mexico. Reducing energy use in the government sector not only has a direct impact on global warming pollution; it also sets an example for the private sector as to what can be achieved. The government should reduce its energy use in government buildings by 30 percent by 2015 and reduce global warming emissions from vehicles by 30 percent by 2015. At the same time the state government should aggressively increase its reliance on renewable energy by purchasing 20 percent of its electricity from clean renewable sources by 2010 and 50 percent by 2020.

Over the past several years, New Mexico has staked out a position of leadership in reducing global warming emissions from government operations.

- In 2002, the Legislature passed the Alternative Fuel Vehicle Acquisition Act, which requires 75 percent of applicable light-duty vehicles purchased by state government and educational institutions to be gas-electric hybrids or to operate on alternative fuels.
- In September 2005, Gov. Richardson issued an executive order requiring all cabinet-level state agencies, public schools and higher education institutions to obtain 15 percent of their total transportation fuel requirements from ethanol or biodiesel by 2010. This executive order also called for purchasing the most fuel-efficient vehicle available for a given purpose and for investigating ways to reduce the number of miles traveled by state agencies.[114]
- In January 2006, Gov. Richardson issued an executive order requiring new and renovated state buildings to meet "green building" standards including energy efficiency 50 percent better than the average for a given building type nationwide.[115]

The state of New Mexico should work to achieve the goals set out in these policies and adopt other policies to meet the following minimum goals:

1) Reduce Energy Use in State Facilities 30 Percent by 2015

The state government can achieve significant energy savings by reducing energy

The Dangers of Nuclear Power

Nuclear power is often touted by the nuclear industry as having low emissions of carbon dioxide. However, nuclear power is both more expensive than many other substitutes for fossil fuel-fired power generation (such as wind power and improved energy efficiency) and poses a series of unique threats to the environment and public safety.

Although the Nuclear Age began in July 1945 when the U.S. tested the first nuclear bomb near Alamogordo, New Mexico, the state has no commercial nuclear reactors. For several reasons, nuclear power should remain off the table as a way to reduce global warming emissions in New Mexico.

- **Accident risk**
  In the short history of nuclear power, the industry has experienced two major accidents—at Three Mile Island and Chernobyl—that endangered the health of millions of people. While the Unites States has thus far been spared an accident the scale of Chernobyl, there have been numerous "near-misses." For example, in 2002, workers discovered a football-sized cavity in the reactor vessel head of the Davis-Besse nuclear reactor in Ohio. Left undetected, the problem could have eventually led to the leakage of coolant from around the reactor core and possibly a meltdown.

- **Natural disasters**
  Natural disasters, such as wildfires, have the potential to threaten nuclear facilities. The Cerro Grande Fire of 2000 was the largest, most destructive wildfire that New Mexico has ever known. However, the damage done by this fire would have been even greater if—in addition to burning buildings at the Los Alamos National Laboratory—the fire had reached the Lab's above-ground radioactive waste staging facility or the test sites contaminated from years of nuclear research.[106] Building new nuclear power facilities increases the potential that natural disasters could result in the release of radioactive contamination.

- **Terrorism and sabotage**
  The security record of nuclear power plants is far from reassuring. In tests at 11 nuclear reactors in 2000 and 2001, mock intruders were capable of disabling enough equipment to cause reactor damage at six plants.[107] A 2003 Government Accountability Office (GAO) report found significant weakness in the Nuclear Regulatory Commission's oversight of security at commercial nuclear reactors.[108] As late as September 2004—three years after the September 11, 2001 terrorist attacks—GAO reported that the NRC had not yet implemented some of GAO's earlier recommendations and that the NRC is

not yet in a position to assure that plants are able to defend against terrorism.[109]

- **Uranium mining**
  Uranium provides fuel for nuclear power, and New Mexico has a wealth of uranium resources. Unfortunately, uranium mining has had significant adverse health and environmental impacts, and many communities in New Mexico are still struggling with its legacy. It is estimated that as many as 1,000 uranium miners have died of lung cancer and hundreds of abandoned mines in the Southwest have not been cleaned up.[110] At present, there is little uranium mining occurring in New Mexico, but four new mines have been proposed for the northwestern part of the state. Local communities are vigorously resisting the mines, with more than 10 communities having already passed resolutions opposing new mining operations and the Navajo Nation having passed a law banning all forms of uranium mining on Navajo lands.

- **Spent fuel**
  Nuclear power production results in the creation of tons of spent fuel, which must be stored either on-site or in a centralized repository. Both options pose safety problems. Centralized waste repositories require the transportation of high-level nuclear waste across highways and rail lines within proximity of populated areas. Once the waste arrives, it must be held safely for tens of thousands of years without contaminating the environment or public. On-site storage poses its own problems. Nearly all U.S. nuclear reactors currently store waste on site in water-filled pools, often at densities approaching those in the reactor cores. Should coolant from the spent-fuel pool be lost, the fuel could ignite, spreading highly radioactive compounds across a large area. In 2005, the National Academy of Sciences (NAS) warned that "[s]pent nuclear fuel stored in pools at some of the nation's 103 operating commercial nuclear reactors may be at risk from terrorist attacks."[111] One study estimated that such an event would result in between 2,000 and 6,000 additional deaths from cancer.[112]

- **Cost**
  Nuclear power has often proven to be expensive in market terms, due to the high cost of building, maintaining and decommissioning nuclear reactors. But looking only at market costs obscures the more than $100 billion spent by U.S. taxpayers for research and development, protection against liability from accidents, and other subsidies for nuclear power.[113] Without these subsidies, the nuclear industry likely could not have survived, and new plants likely would not be built.

used in state facilities by 30 percent over the next 10 years. Meeting this goal will require that the state implement an aggressive building retrofit program and design all new buildings (and major renovations) to consume at least 50 percent less energy.

Aggressive Building Retrofit Program

The state should seek to retrofit at least half of all state buildings for improved energy efficiency by 2010. The state's new Energy Efficiency and Renewable Energy Bonding Act—which can be used to fund energy efficiency and renewable energy projects in existing state agencies, universities, and public school buildings—is one vehicle for financing retrofits. A similar efficiency-promoting mechanism is the recently revised Public Facility Energy Efficiency and Water Conservation Act, which permits governmental units (public schools, universities, municipalities and state agencies) to enter long-term installment payment contracts and lease-purchase agreements of up to 10 years for the evaluation, recommendation, purchase and installation of energy efficiency measures. Since 1978, when this Act first passed, the state has implemented $30 million worth of project savings, while conserving 28.9 million kilowatt-hours (kWh) of electricity and 864,132 million therms of natural gas.[116] Efficiency improvements under both of these programs are paid for from the projected savings in energy costs resulting from the project. Only projects that can be demonstrated to be cost-effective can be considered.

These programs provide a good starting point. The state should monitor the progress of these programs to ensure that at least half of state buildings are retrofitted for improved energy efficiency within the next four years.

Increase Energy Efficiency Standards for State Buildings Over Time

Gov. Richardson's 2006 executive order requiring new and renovated state buildings to use 50 percent less energy than similar existing buildings nationwide is a good first step down a long road to reducing the global warming impact of state buildings.

Ideally, the state's standards for new buildings would incrementally increase every five to 10 years so that by 2030 all new state funded buildings would be carbon neutral in their energy use. A strong building standard would help reduce energy costs, decrease carbon dioxide emissions and set an example for the private sector to follow.

State-funded buildings could meet strong energy consumption goals through a combination of strategies, including:

- Energy-aware building designs that take advantage of natural lighting and maximize natural heating and cooling;
- Energy-efficient building materials—both construction materials that help reduce heating and cooling costs once installed (items such as insulation and energy-efficient windows) and materials that require less fossil fuels to manufacture (such as recycled brick, stone and steel);
- Energy-saving building appliances—including such big-ticket items such as lighting systems, water heaters, furnaces and air conditioners; and
- Electricity that comes from renewable sources, either in the form of solar panels and other types of on-site renewable electricity generators, or from the energy grid.

2) Reduce Government Vehicle Fossil Fuel Consumption by 30 Percent by 2015

New Mexico should be lauded for its efforts to reduce fossil fuel consumption from government sector vehicles. As noted above, the governor recently ordered that 15 percent of all fuel used by state vehicles come from alternative or renewable sources by 2010, and that all cabinet-level state

agencies purchase vehicles that have the highest fuel economy possible for their intended use.

There are a number of ways New Mexico could achieve a 30 percent reduction in global warming emissions from state government's fleet within the next 10 years. These include:

- Following the example set by the city of Albuquerque and running all diesel vehicles on B20 (a blend of 20 percent biodiesel and 80 percent gasoline);
- Developing a more extensive ethanol fueling infrastructure, which would enable the state to operate more of its flexible fuel vehicles on E85 (85 percent ethanol and 15 percent gasoline) rather than on gasoline;
- Switching to E10 (10 percent ethanol) for the rest of the state government's vehicle fleet; and
- Creating stronger incentives for the incorporation of hybrid technology and the use of very fuel-efficient vehicles.

3) Purchase 20 Percent of State Government's Electricity from Clean Renewable Sources by 2010 and 50 Percent by 2020

Under Gov. Richardson's direction, state agencies have been increasing their use of renewable energy. Currently, about 7 percent of electricity used by state government agencies comes from renewable sources—this is slightly behind the initial goal of 10 percent green energy, primarily because budget-strapped state agencies have not always prioritized paying the extra cost currently associated with purchasing green energy.[117]

Enlisting New Mexico state government as an aggressive purchaser of renewable electricity—purchasing 20 percent renewable energy by 2010 and 50 percent by 2020—would provide a critical incentive for the development of wind, solar and other forms of renewable power in the state and region. Government purchases of "green" power should be over and above the levels of renewable power required by the state's Renewable Portfolio Standard and should include the development of distributed renewable resources on state buildings and land, such as rooftop solar systems where appropriate.

4) Encourage Public Sector Improvements Outside of State Government

Educational intuitions (including public schools, junior colleges, colleges and universities) as well as tribal and municipal governments are major consumers of energy. The state should help promote efforts to reduce carbon dioxide emissions from these institutions. This includes helping to drive improvements in energy efficiency, increasing use of renewable energy—either through purchasing green power or installing distributed electricity generation such as solar photovoltaics—and helping other government agencies to pool their purchasing power for energy-efficient vehicles and equipment.

The Impact of the Strategies

Short- and Medium-Term Impacts

The 15 strategies listed above outline a path that would move New Mexico within range of meeting its goal of reducing global warming pollution in 2020 to 10 percent below 2000 emission levels.

We estimate that the strategies listed above would reduce New Mexico's direct emissions of carbon dioxide by 24 percent below projected levels by 2020. (See Table 1 next page and Fig. 7, page 49.) The policies modeled in this report fall shy of reducing direct emissions in 2020 below 2000 direct emission levels. However, when combined with other policies that the state can employ—such as those that will drive greater reductions in vehicle-miles traveled—and actions at the federal level in areas in which New Mexico's freedom of action is limited, even greater reductions in direct emissions are possible.

The combination of reduced electricity consumption in the residential, commercial and industrial sectors, the increased use of renewable sources of energy, and avoidance of future growth in coal-fired generation would result in a significant reduction in carbon dioxide emissions from the electricity sector versus projected levels. Adopting all strategies would reduce electric sector emissions by 15.3 $MMTCO_2e$ or 33 percent below projected levels by 2020.

Overall, the 15 recommendations in this report would bring New Mexico about 75 percent of the way to achieving the goal of reducing carbon dioxide emissions to 10 percent below 2000 levels by 2020. New Mexico would need to achieve further reductions of 8.3 $MMTCO_2e$, and achieve parallel reductions in emissions of other global warming pollutants (which make up about 26 percent of New Mexico's total global warming emissions) in order to meet the goal of reducing overall global warming emissions to 10 percent below 2000 levels by 2020.

Putting It in Perspective—Achieving the Long-Term Goal

Ultimately, New Mexico's efforts to reduce global warming pollution will be judged not by the state's ability to achieve interim goals,

Table 1. Projected Annual Carbon Dioxide Emissions Reductions from Recommended Policy Actions ($MMTCO_2e$)

Policy	2010	2020
Clean Cars Program	0.10	1.40
Low-Rolling Resistance Replacement Tires	0.12	0.25
Feebate Program (N.M. only)*	0.00	0.01
Pay-As-You-Drive Automobile Insurance	0.63	0.79
Reduce Growth in Vehicle Miles Traveled	0.83	2.57
Renewable Fuels Standard	0.27	1.14
Residential and Commercial Building Codes	0.30	1.69
Appliance Efficiency Standards	0.04	0.14
Tiered Electricity Pricing	0.20	0.23
Expanded Energy Efficiency Programs	0.81	2.76
Increase Use of Combined Heat and Power	0.57	1.42
Expanded Renewable Portfolio Standard	0.93	3.50
Solar Power Development	0.01	0.18
Prevent Expansion of Coal-Fired Power Plants	0.00	11.80
Public Sector "Lead By Example"	0.29	0.99
Total	**6.74**	**21.97**

Savings from individual polices do not equal cumulative savings due to overlap between the policies.
* Savings are likely to be greater from a feebate program that includes multiple states.

but by the speed with which the state can reduce—and eventually eliminate—its contribution to the degradation of the climate. Achieving the long-term reductions in emissions of 75-85 percent that scientists believe will be needed to eliminate any harmful threat to the climate is the true test by which the state's efforts must be assessed, and should remain the overarching goal.

The 15 strategies above not only move New Mexico far toward achievement of the state's short-term goals, but they also begin to lay the groundwork for a deeper transition that will bring the long-term goals within reach. In the transportation sector, swift implementation of a clean cars requirement will ensure the placement of thousands of high-efficiency and zero-emission vehicles on New Mexico's roads, while helping to focus the research energy of automakers on the development of the next generation of clean automobile technologies. The vehicle global warming emission standards program will create the framework to ensure that all vehicles make the least possible impact on the climate. New buildings will be designed to reduce energy consumption and will house more

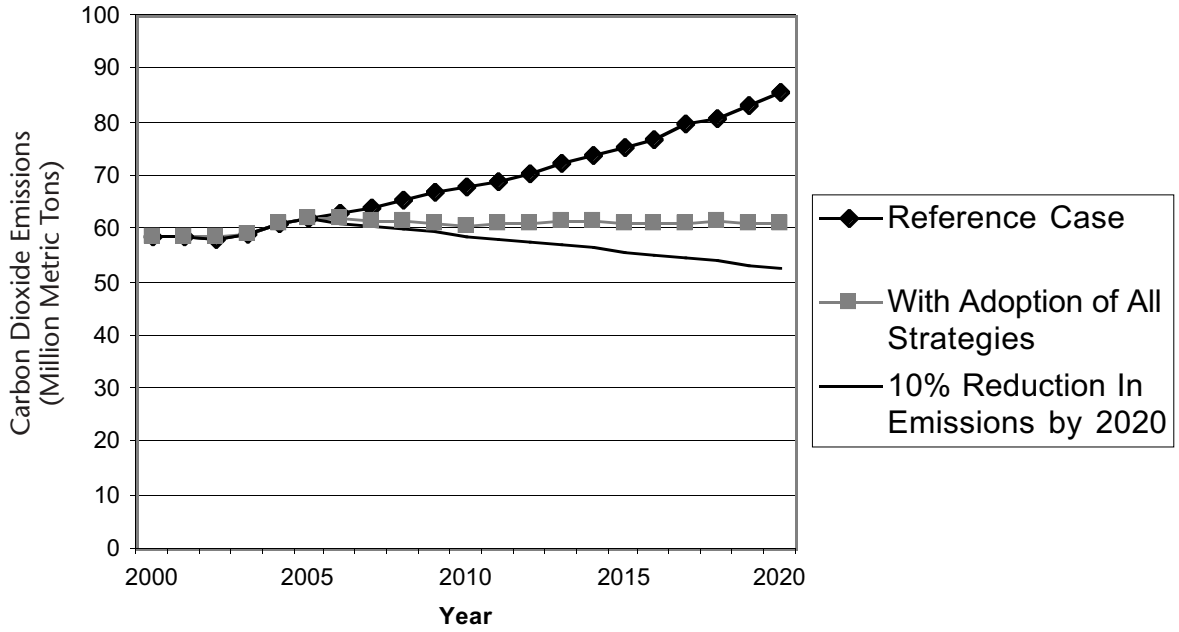
energy efficient appliances. Owners of existing buildings and appliances will be able to take advantage of energy efficiency programs to reduce their energy consumption. Wind, solar and other renewable power sources will produce 30 percent of the electricity used by consumers in New Mexico, while fuel cells and other new technologies will be market-ready and prepared to compete with traditional fossil and nuclear electricity.

Even with these advances, New Mexico will still face difficult challenges. Our communities will have to be reshaped to rely less on individual cars and trucks to transport people and goods. Our buildings will have to be designed to minimize their reliance on fossil fuels. Our economic system will have to reflect more fully the environmental and public health costs of the energy we use, and provide the capital needed to make the transition to cleaner and more efficient ways of living and doing business. Emissions of other global warming gases will have to be reduced dramatically. And other states, regions and nations far from New Mexico will have to do their share as well.

Affecting these changes will require an unprecedented amount of research, discussion, cooperation and political will. The early signs are positive: New Mexico has a long term goal of reducing emissions by 75 percent below 2000 levels by 2050, and the state is now engaging in the discussion and study of global warming, its impacts, and the means of addressing the problem in a way that has never been done before. But the critical test—implementation—lies ahead.

The strategies laid out in this report show the way forward. By using existing technologies and reasonable public policy tools, New Mexico can make large strides towards reducing the state's contribution to global warming in the near term, while in many cases improving public health, economic well-being and energy security, and providing a model of leadership for others to follow.

Fig. 7. New Mexico Carbon Dioxide Emissions with Adoption of the Recommended Strategies



Methodology and Technical Discussion

General Assumptions and Limitations

This report relies primarily on data and projections from the U.S. Energy Information Administration (EIA) to estimate past, present and future global warming emissions in New Mexico. Future emission trends in New Mexico are, with limited exceptions, based on EIA's projected rates of energy consumption growth for the EIA's Mountain Region—including New Mexico, Colorado, Arizona, Nevada, Idaho, Utah, Wyoming, and Montana—as a whole. New Mexico trends will differ, but the EIA growth projections provide a reasonable approximation of future trends. EIA's projections of future energy use—as published in the *Annual Energy Outlook 2005* (AEO 2005)—are intended to reflect all federal, state, and local legislation adopted as of September 1, 2004. Several policy changes adopted after that date will have an impact on carbon dioxide emissions in New Mexico (including more stringent federal appliance efficiency standards). We have attempted to revise EIA's assumptions to reflect these changes where appropriate and feasible.

This analysis focuses exclusively on emissions of carbon dioxide from energy use and electricity production in New Mexico. The exclusion of other global warming gases from this analysis is not intended to minimize their importance, but is the result of time and resource limitations. This report also limits its scope of analysis to New Mexico and does not attempt to estimate "upstream" emissions or any "leakage" of emissions into other states.

All fees, charges and other monetary values are in 2005 dollars, unless otherwise noted.

Baseline Emissions Estimates

Baseline estimates of carbon dioxide emissions from energy use for 2000 were based on energy consumption data from EIA, *State Energy Consumption, Price and Expenditure Estimates 2001*. To calculate carbon dioxide emissions, energy use for each fuel in each sector (in BTU) was multiplied by carbon coefficients as specified in EIA, *Documentation for Emissions of Greenhouse*

Gases in the United States 2003, May 2005.

Adjustments were made for storage of carbon through non-fuel consumption of natural gas and petroleum products using data and following the methodologies described in EIA, *Documentation for Emissions of Greenhouse Gases in the United States 2003*, May 2005.

Carbon dioxide emissions, carbon coefficients and non-fuel sequestration factors for "other petroleum products," as defined in *Energy Consumption, Price and Expenditure Estimates 2001* were derived as follows:

- For 2000 and 2001, New Mexico consumption data (in BTU) for the various components of "other petroleum products" was derived from detailed, state-specific energy use data downloaded from EIA's State Energy Data System (SEDS) on 15 August 2005.
- Specific carbon coefficients and percentages of carbon stored through non-fuel use of the products were applied to seven high-use products within the "other petroleum" category to produce an estimate of carbon dioxide emissions for each product. Any remaining consumption was applied a generic carbon coefficient of 73 $MMTCO_2E$ per quad BTU and a carbon emission per unit fuel consumed factor of 0.4.
- These emission estimates were then aggregated and divided by the total consumption of the various products to produce a per-BTU coefficient used to estimate carbon dioxide emissions from the "other petroleum products" line item in *State Energy Consumption, Price and Expenditure Estimates 2001*. The coefficient for 2001 was used to calculate emissions in subsequent years.

Combustion of wood and other biomass was excluded from the analysis per EIA, *Documentation for Emissions of Greenhouse Gases in the United States 2003*. This exclusion is justified by EIA on the grounds that wood and other biofuels obtain carbon through atmospheric uptake and that their combustion does not cause a net increase or decrease in the overall carbon "budget."

Future Year Projections

Projections of energy use and carbon dioxide emissions for New Mexico are generally based on applying the Mountain Region year-to-year projected growth rate for each fuel in each sector from EIA's *Annual Energy Outlook* to the New Mexico baseline emissions estimate for 2001. The growth rate from 2001 to 2002 is based on *AEO 2004*; growth rates for all subsequent years are based on *AEO 2005*.

There are three exceptions to this rule:

- Energy consumption and carbon dioxide emissions from the residential sector were adjusted downward to account for differences in projected population growth rates between New Mexico and the Mountain region as a whole. The annual growth rate in energy consumption from *AEO 2005* was multiplied by 0.995, or the ratio between New Mexico's projected annual rate of population growth for 2005 through 2020 and the regional population growth rate in *AEO 2005*. The New Mexico population growth rate was derived from New Mexico Department of Labor, *New Mexico Annual Social & Economic Indicators 2005*, May 2005.
- A New Mexico-specific growth rate for renewable electricity generation was calculated to reflect the goals and targets of the state's Renewable Portfolio Standard. Adjustments to baseline energy use by electric generators were made based on the methodology described in "Renewable Portfolio Standard" below.

- Adjustments to residential and commercial electricity consumption were made to reflect the federal adoption of energy efficiency standards for a variety of appliances in the Energy Policy Act of 2005. Estimates of the aggregate energy savings from the standards in 2020 were based on state-specific estimates compiled for Appliance Standards Awareness Project, *State-by-State Energy, Economic and Environmental Benefits from New Appliance and Equipment Efficiency Standards*, downloaded from standardsasap.org/a051states.htm, 13 March 2006. These estimated energy savings were then applied to each year using the methodology in "Appliance Efficiency Standards" below.

Carbon Dioxide Reductions from Electricity Savings and Renewable Energy Use

Measures that reduce electricity consumption in New Mexico or that expand renewable electricity generation were assumed to reduce the generation of fossil electric power in New Mexico proportionately. Further, these reductions were assumed to result in a proportionate reduction in generation from coal-fired power plants, which are projected to make up most of the new generating capacity installed in New Mexico, particularly after 2010.

Reductions in carbon dioxide emissions from energy efficiency measures were calculated as follows:

- Reductions in site electricity consumption were calculated as described in the sections below.
- Reductions in energy consumption for electricity generation were calculated by multiplying the site electricity savings of efficiency measures by the ratio of fuel consumption (in BTU) for each fossil fuel to electricity generation for each fuel for power plants in the Western Electricity Coordinating Council—Rocky Mountain Power Area and Arizona-New Mexico-Southern Nevada Power Area from *AEO2005*, Supplementary Table 71. The resulting reductions in power plant fuel use were then deducted from the baseline projected fuel use as calculated above.

Transportation Sector Strategies

All estimated reductions from transportation-sector strategies (except biodiesel use in heavy-duty vehicles) were derived by estimating the percentage reductions in light-duty vehicle motor gasoline use from the baseline arrived at by the methods above. Light-duty vehicle gasoline use was estimated by multiplying the motor gasoline baseline by the percentage of motor gasoline used by light-duty vehicles, derived from the supplementary tables to *AEO 2005*.

Clean Cars Program

Emission reductions from the clean cars program were estimated based on percentage year-to-year emission reductions from ConnPIRG Education Fund, *Cars and Global Warming*, June 2005. The ConnPIRG Education Fund report uses national estimates of the breakdown of VMT among various vehicle classes and ages, as well as an implementation schedule for the program that is consistent across all states that have thus far adopted the program. The results of that analysis have been consistent with estimates of the benefits of the program produced for other states and are largely applicable to New Mexico. Program implementation was assumed to begin with model year 2010.

Low-Rolling Resistance Tires

Savings from the use of low-rolling resistance replacement tires were estimated using a methodology developed for RIPIRG Education Fund, *Cars and Global Warming*, Winter 2005. Emission reductions were generated by reducing carbon dioxide emission factors by 3 percent from baseline assumptions for vehicles reaching four, seven and 11 years of age beginning in 2008, per California Energy Commission, *California Fuel-Efficient Tire Report*, *Volume II*, January 2003. Vehicle age estimates were based on VMT accumulation rates presented in U.S. Environmental Protection Agency, *Fleet Characterization Data for MOBILE6*, September 2001. This estimate assumes that the tire stock will completely turn over, that is, that LRR tires will supplant non-LRR replacement tires in the marketplace through a state requirement. Other policies to encourage, but not mandate, LRR tires would likely produce reduced savings.

Feebates

Potential savings from a feebate program are based on outputs from the Feebate Impact Estimator v. 1.1 developed by Meszler Engineering Services. Default inputs were adjusted to reflect gasoline tax rates in New Mexico (per Federal Highway Administration, *Highway Statistics 2004*) and projected New Mexico VMT growth (per New Mexico Department of Transportation, *New Mexico 2025 Statewide Multimodal Transportation Plan*). The feebate incentive rate was set to $680 per ton of carbon dioxide per year. The default input for manufacturers' response was adjusted to 0.006 to reflect New Mexico's share of new motor vehicle registrations nationwide in 2004, per "Vehicles in Operation and Scrappage," *AutoExec* magazine, May 2005. The assumption that manufacturer response would be proportional to the state's share of the new vehicle market is conservative, producing a relatively low impact from the feebate program. Should the manufacturer response to a New Mexico feebate be greater, or should New Mexico join with other states in development of a feebate program, the reduction in vehicle carbon dioxide emissions would be much greater. To gauge the impact of a greater manufacturer response, an alternate case was run that assumed 100 percent manufacturer response.

Pay-As-You-Drive Automobile Insurance

Estimates of the impact of PAYD insurance are based on the assumption that 80 percent of collision and liability insurance payments in New Mexico would be transferred to a mileage-based system, with participation in the system increasing by 25 percent per year from 2007 to 2010. The average per-mile cost of insurance was computed by multiplying the average expenditure on collision and liability insurance in New Mexico in 2003 as reported in *Facts and Statistics: Auto Insurance Expenditures*, *By State* (Insurance Information Institute, downloaded from www.iii.org/media/facts/statbyissue/auto, 27 September 2005) by the total number of light-duty vehicles registered in New Mexico from FHWA, *Highway Statistics 2003*. This total expenditure figure was then divided by light-duty VMT derived from adjusted FHWA figures to arrive at an average per-mile cost for liability and collision insurance. This per-mile cost was then multiplied by 0.8 to account for any non-mileage related aspects of liability and collision coverage and to ensure the conservatism of the estimate, yielding an average per-mile charge of 5.5 cents, in 2003 dollars. The estimated reduction in VMT that would result from such a charge was obtained from *Online TDM Encyclopedia: Pay-As-You-Drive Vehicle Insurance* (Victoria Transport Policy Institute, downloaded from www.vtpi.org/tdm79.htm, 23 August 2005, dollars adjusted from 2001 to 2003 dollars for sake of comparison). It was assumed that the decrease in VMT for driv-

ers participating in the program would take place beginning immediately upon program implementation in 2007.

VMT Stabilization

VMT in this scenario is assumed to grow by half the rate of population growth in New Mexico between 2005 and 2020. The estimated annual population growth rate of 1.3 percent from 2005 to 2020 is based on New Mexico Department of Labor, *New Mexico Annual Social and Economic Indicators 2005*, May 2005.

Renewable Fuels Standard

Emissions reductions from a renewable fuels standard were estimated assuming a 10 percent ethanol standard implemented in 2007 for light-duty vehicle gasoline sold in the state, increasing to 15 percent in 2011, and a 2 percent biodiesel standard for transportation diesel fuel sold between 2007 and 2010, and increasing to 10 percent after 2010. The share of ethanol coming from cellulosic sources is assumed to be 1 percent in the first year of the standard, rising to approximately 4 percent in 2012 and 12.5 percent in 2015, targets recommended for a federal renewable fuels requirement in Nathaniel Greene and Yerina Mugica, Natural Resources Defense Council, *Bringing Biofuels to the Pump: An Aggressive Plan for Ending America's Oil Dependence*, July 2005. The percentage of cellulosic ethanol is assumed to further increase to approximately 25 percent by 2018.

Net per-mile carbon dioxide emission reductions from corn ethanol use were assumed to be 18 percent compared with gasoline, and per-mile reductions from cellulosic ethanol use were assumed to be 85 percent compared with gasoline based on Michael Wang, Argonne National Laboratory, *Updated Energy and Greenhouse Gas Emissions Results of Fuel Ethanol*, PowerPoint presentation to the 15th International Symposium on Alcohol Fuels, 26-28 September 2005. Greenhouse gas emission savings were used in lieu of carbon dioxide savings. Net per-mile carbon dioxide emission reductions from biodiesel use were assumed to be 78 percent per U.S. Department of Agriculture and U.S. Department of Energy, *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus*, May 1998.

Combined Transportation Strategies

Combined emission reduction estimated from the transportation strategies were derived by multiplying the percentage of emissions remaining from each of the strategies by the percentage remaining from the other strategies. The impact of a feebate program is not included in the combined policy case because it is difficult to ascertain how such a program would interact with a carbon dioxide tailpipe standard.

Residential, Commercial and Industrial Strategies

Building Energy Codes

The projected impact of building energy codes was derived by estimating the percentage of residential energy use that would take place in new buildings under EIA projections and applying estimated percentage reductions in energy use that would take place under updated codes and improved enforcement of existing codes. Revised codes were not assumed to affect energy use in existing buildings.

The proportion of projected residential energy use from new homes was derived by subtracting estimated energy use from homes in existence prior to 2004 from total residential energy use for each year based on *AEO 2005* growth rates. Consumption of energy by surviving pre-code homes was calculated by assuming that energy consumed per home remains stable over the study period and that 0.4 percent

of homes are retired each year, per EIA, *Assumptions to AEO 2005*.

For commercial building codes, commercial building retirement percentages were estimated for states in the U.S. Census Mountain Region by determining the approximate median age of commercial floorspace in the Mountain Region based on data from EIA, *2003 Commercial Building Energy Consumption Survey* (CBECS); estimating a weighted-average "gamma" factor (which approximates the degree to which buildings are likely to retire at the median age); and inputting the result into the equation, *Surviving Proportion = 1/(1+(Building Age/Median Lifetime)^{Gamma}* as described in EIA, *Assumptions to Annual Energy Outlook 2005*. Baseline 2005 commercial energy demand was then multiplied by the percentage of surviving per-code commercial buildings to estimate the energy use from buildings not covered by the code.

Energy savings from improving enforcement of New Mexico's recently adopted building code are assumed to be 15 percent above *AEO 2005* baseline projections from 2006 through 2010, based on Steven Nadel and Howard Geller, American Council for an Energy-Efficient Economy (ACEEE), *State Energy Policy: Saving Money and Reducing Pollutant Emissions through Greater Energy Efficiency*, September 2001. Energy savings from future updates to residential building codes are assumed to be 35 percent compared to baseline levels from 2010 to 2015 and 40 percent compared to baseline levels for 2016 through 2020. Energy savings from updating New Mexico's building codes were assumed to take place equally among the various fuels. No attempt was made to estimate the impact of building code revisions on energy use due to renovations of existing commercial and residential space.

Appliance Efficiency Standards

Estimates of potential energy savings from appliance efficiency standards were based on state-specific estimates for New Mexico from American Council for an Energy-Efficient Economy (ACEEE) and Appliance Standard Awareness Project (ASAP), *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, March 2006. Electricity and natural gas savings estimates for 2020 were prorated for each year beginning in 2007.

Tiered Electricity Pricing

Empirical studies of residential electricity demand have estimated widely varying price elasticities of demand, ranging from nearly zero to about -0.6. These estimates reflect differences in the geographic regions examined, as well as considerable variation in data quality and statistical techniques. However, studies conducted by electric utilities—which often have higher-quality data—obtain price elasticities within a narrower range of -0.15 to -0.35.[118] We have assumed a price elasticity of -0.25 for this analysis.

We modeled a revenue-neutral, three-tier variable-price structure. Average residential electric demand was evenly divided into three tiers, the price of the first tier was set at 0.5x, the second tier price was assumed to be x, and the third tier was set at 1.5x. This three-tiered model resulted in a 4 percent reduction in residential electricity consumption. Implementation is assumed to begin in 2006.

Energy Efficiency Programs

Projections of benefits from energy efficiency programs were based on average savings from existing energy efficiency programs nationwide. For electricity programs, energy savings per percent of utility revenue were obtained from Martin Kushler, Dan York, and Patti Witte, American Council for an Energy-Efficient Economy, *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, April 2004. For natural gas programs, energy savings were

obtained from Suzanne Tegen and Howard Geller, Southwest Energy Efficiency Project (SWEEP), *Natural Gas Demand-Side Management Programs: A National Survey*, January 2006. Savings from each of the programs included in these studies were plotted on a graph and used to generate a linear equation for the percentage of annual energy use that could be reduced via efficiency per percentage of utility revenue devoted to energy efficiency programs. These equations were then used to generate estimated percentage savings for proposed electricity and natural gas efficiency programs funded with 3 percent of utility revenue. Because there are fewer natural gas efficiency programs and the benefits of these programs vary based on climate and other factors, the percentage savings from natural gas programs was reduced by 25 percent to ensure the conservatism of the estimate.

Future year savings from efficiency measures were assumed to be 90 percent of the first year's annual savings in the first through fourth years after implementation of the measures, 80 percent in years five through nine, 60 percent in years 10-14 and 50 percent afterward. These estimates are arbitrary, but yield maximum "lifetime" savings of about 12 times annual savings by the end of the study period, a rate lower than many estimates of lifetime savings from efficiency programs.

Our estimate of projected carbon savings includes any savings resulting from energy efficiency programs created under the Efficient Use of Energy Act.

Combined Heat and Power

Commercial and industrial power generation from CHP was estimated based on data from Western Resource Advocates, *A Balanced Energy Plan for the Interior West*, 2004. We assumed that the plan's target of 175 MW of new CHP capacity in New Mexico by 2014 and 235 MW by 2020 would be realized through incremental additions to CHP capacity beginning in 2007. Additional global warming emissions from natural gas consumed in CHP applications were estimated based on a heat rate of 5,000 BTU/kWh and CHP capacity factor of 91 percent, per the Western Resource Advocates report. Emission reductions from centralized power generation were derived using a similar methodology to the other electricity-saving measures in this section.

Electric Sector Strategies

Renewable Portfolio Standard

An RPS for electricity consumed by New Mexico residents and produced by the state's investor-owned utilities is already in place to achieve 10 percent renewables by the end of 2010. We estimated the impact of accelerating and extending the current rate of increase per year to achieve 30 percent renewable energy by the end of 2020. The projected amounted of energy consumed from renewable sources was calculated by multiplying total projected electricity demand in New Mexico by the proposed annual increase in the RPS—1 percent annually between 2007 and 2010 and 1.8 percent per year between 2010 and 2020. It was also assumed that consumption from non-investor-owned utilities would be incorporated within a future revised RPS.

Solar Power

The impact of expanded solar power in New Mexico was estimated by assuming that current and future programs to encourage solar photovoltaic systems would achieve the goal of having the equivalent of 50,000 PV systems installed on residential rooftops by 2020. The number of annual installations was assumed to begin in 2006 with 474 systems of 2.5 kW each, representing the minimum number of systems that would be stimulated by PNM's purchase of renewable energy certificates and

New Mexico's new solar tax credit. Installations were then assumed to increase by 25 percent each year, an annual rate of growth lower than the annual world growth rate in PV generating capacity per BP, *Statistical Review of World Energy 2005*, 14 June 2005.

Electricity output from this new installed capacity was estimated based on operating at average 25 percent capacity, meaning that a 2.5 kW system generates 5,475 kWh a year (2.5kW x 8,760 hours/year x 25% = 5,475 kWh/year). This is based on average daily solar radiation at locations in New Mexico, which ranges from 6.0 to 6.6 kWh/meter-squared—equivalent to full sunlight for 25 to 27 percent of the day. (Renewable Resource Data Center, Department of Energy, *Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors*, downloaded from rredc.nrel.gov/solar/pubs/redbook/PDFs/NM.PDF, 10 October 2005.)

One-quarter of the new solar electricity was assumed to count toward fulfillment of RPS requirements, the other three-quarters to offset fossil fuel-fired generation. All new solar capacity was assumed to be distributed, with no line losses.

Preventing Expansion of Coal-Fired Generation

Emissions savings from preventing the expansion of coal-fired generation were derived by holding carbon dioxide emissions constant at 2010 levels until 2020. Savings from this strategy are likely to be overstated if the coal consumption displaced in this strategy is replaced with other fossil fuels that emit carbon dioxide (such as natural gas), rather than zero-carbon alternatives such as renewable power, energy efficiency, or reductions in power generation for out-of-state sales. In addition, when calculating the combined emission reduction benefits of the 15 strategies, we assume that reductions in electricity use and increases in renewable power generation are used to offset power generation from coal-fired power plants already in existence as of 2010. To the extent that electricity savings and renewable power use offset natural gas generation instead, the carbon dioxide emission reductions in the combined scenario will be reduced.

State Government "Lead by Example"

Emissions savings from state government are based on three categories of action. In each case, we assumed that government energy use does not grow.

Data for electricity and natural gas consumption by New Mexico state agencies from investor-owned utilities was obtained from the New Mexico Energy, Minerals and Natural Resources Department.[119] To adjust for state energy use from municipal and cooperative utilities, these figures were divided by 0.8 per recommendation from Dan Hagan, Energy Conservation and Management Division of the New Mexico Energy, Minerals and Natural Resources Department, 26 August 2005. Data for state government transportation fuel use were not available; thus, we relied on the Federal Highway Administration's figures for gas use by non-federal governments from Federal Highway Administration, *Highway Statistics 2003*. As a result, these data represent gasoline consumption by state, county, and local governments. Total statewide diesel use figures are from the same source. We estimated non-federal public sector diesel use by assuming that government diesel use is the same proportion of total diesel use as government gasoline use is of total gasoline use.

To calculate emissions savings from reducing energy use in state facilities by 30 percent by 2020 we, multiplied the energy savings for each fuel by its carbon coefficient.

Savings from improving the efficiency of the state's vehicle fleet come from both gasoline and diesel savings. Projected efficiency improvements assume that non-federal government vehicle fleets achieve

20 percent more gallons per mile by 2012 and 30 percent more gallons per mile by 2020. We assumed that there would be no rebound effect of increased miles driven. Carbon savings were calculated by multiplying the energy savings for each fuel by its carbon coefficient.

Carbon savings from having state government purchase 20 percent of its electricity from renewable sources by 2010 and 50 percent by 2020 relied on data we obtained as described above. The calculations assume that the state has already reduced its energy use by 25 percent. The carbon output of the non-renewable electricity assumes that renewable power generation allows the retirement of high-emission coal plants.

Glossary of Acronyms

ACEEE	American Council for an Energy-Efficient Economy
CAFE	Corporate average fuel economy standards
CARB	California Air Resources Board
CHP	Combined heat and power
DG	Distributed generation
EEM	Energy-efficient mortgage
EIA	U.S. Energy Information Administration
FHWA	U.S. Federal Highway Administration
GAO	U.S. Government Accountability Office
GREET	Greenhouse Gases, Regulated Emissions and Energy Use in Transportation model
IGCC	Integrated gasification combined cycle
LRR	Low rolling resistance
MMT	Million metric tons
MMTCE	Million metric tons carbon equivalent
$MMTCO_2(e)$	Million metric tons carbon dioxide (equivalent)
MPG	Miles per gallon
NAS	National Academy of Sciences
NMED	New Mexico Environment Department
PAYD	Pay-as-you-drive
PAYS	Pay-as-you-save
PRC	New Mexico Public Regulation Commission
PV	Photovoltaic
RGG	Regional Greenhouse Gas Initiative
RPS	Renewable portfolio standard
SUV	Sport utility vehicle
SWEEP	Southwest Energy Efficiency Project
VMT	Vehicle-miles traveled

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