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State Greenhouse Gas Emissions: Comparison and Analysis

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Summary

Instituting policies to manage or reduce GHGs would likely impact different states differently. Understanding these differences may provide for a more informed debate regarding potential policy approaches. However, multiple factors play a role in determining impacts, including alternative design elements of a GHG emissions reduction program, the availability and relative cost of mitigation options, and the regulated entities' abilities to pass compliance costs on to consumers.

Three primary variables drive a state's human-related greenhouse gas (GHG) emission levels: population, per capita income, and the GHG emissions intensity. GHG emissions intensity is a performance measure. In this report, GHG intensity is a measure of GHG emissions from sources within a state compared with a state's economic output (gross state product, GSP). The GHG emissions intensity driver stands apart as the main target for climate change mitigation policy, because public policy generally considers population and income growth to be socially positive.

The intensity of carbon dioxide (CO_2) emissions largely determines overall GHG intensity, because CO_2 emissions account for 85% of the GHG emissions in the United States. As 98% of U.S. CO_2 emissions are energy-related, the primary factors that shape CO_2 emissions intensity are a state's energy intensity and the carbon content of its energy use.

Energy intensity measures the amount of energy a state uses to generate its overall economic output (measured by its GSP). Several underlying factors may impact a state's energy intensity: a state's economic structure, personal transportation use in a state (measured in vehicle miles traveled per person), and public policies regarding energy efficiency.

The carbon content of energy use in a state is determined by a state's portfolio of energy sources. States that utilize a high percentage of coal, for example, will have a relatively high carbon content of energy use, compared to states with a lower dependence on coal. An additional factor is whether a state is a net exporter or importer of electricity, because CO_2 emissions are attributed to electricity-producing states, but the electricity is used (and counted) in the consuming state.

Between 1990 and 2000, the United States reduced its GHG intensity by 1.6% annually. Assuming that population and per capita income continue to grow as expected, the United States would need to reduce its GHG intensity at the rate of 3% per year in order to halt the annual growth in GHG emissions. Therefore, achieving reductions (or negative growth) in GHG emissions would necessitate further declines in GHG intensity.

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Introduction

There is a broad agreement in the scientific community that the earth's climate is changing and that the primary cause over the past few decades is an increasing concentration of greenhouse gases (GHGs) in the atmosphere. Most climate scientists have concluded that human activities — e.g., fossil fuel combustion, land clearing, and industrial and agricultural operations — have played a central role in climate change, particularly in recent decades.[1]

A variety of efforts that seek to address climate change are currently underway or being developed on the international, national, and sub- national level (e.g., individual state actions or regional partnerships). These efforts cover a wide spectrum, from research initiatives to GHG emission reduction regimes.[2]

If Congress establishes a federal program to manage or reduce GHG emissions, the emission requirements would likely impact different states differently. However, predicting the different impacts of policies is a complicated task, because multiple factors play a role. Such factors include alternative design elements of a GHG emissions reduction program, the availability and relative cost of mitigation options, and the regulated entities' abilities to pass compliance costs on to consumers.

Underlying climate change policy discussions are GHG emissions and the factors that determine their levels and growth. One of the primary factors is GHG emissions intensity. In this report, GHG emissions intensity is a measure of GHG emissions from state sources divided by the state's overall economic output, or gross state product.[3] Because carbon dioxide (CO_2) is the primary GHG in the vast

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[1] This report does not address the debates associated with climate change science or the role of human activity in climate change. For a discussion of these issues, see CRS Report RL33849, *Climate Change: Science and Policy Implications*, by Jane A. Leggett.

[2] See CRS Report RL33826, *Climate Change: The Kyoto Protocol and International Actions*, by Susan R. Fletcher and Larry Parker; CRS Report RL31931, *Climate Change: Federal Laws and Policies Related to Greenhouse Gas Reductions*, by Brent D. Yacobucci and Larry Parker; CRS Report RL33812, *Climate Change: Action by States To Address Greenhouse Gas Emissions*, by Jonathan L. Ramseur.

[3] GHG emissions intensity is a performance measure. When looking at emissions on an economy-wide scale, gross domestic product (GDP) or gross state product (GSP) is typically used. However, other economic outputs, such as a tons of steel or cement, may be used to analyze the emissions intensity of specific sources or economic sectors. A higher GHG

(continued...)

majority of states, the report focuses on CO_2 emissions intensity and its determining factors. These factors vary significantly across state lines. An analysis of these factors and how they compare among the states may contribute to a more informed debate regarding potential policy approaches.

Greenhouse Gas Emissions Data in This Report

Greenhouse gas (GHG) emissions data can be described in several different ways, which may lead to inconsistencies when comparing data from different sources.

In this report, GHG emissions include the following gases: carbon dioxide (CO_2), nitrous oxide, methane, perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride. Only emissions from human-related activities are included. To examine the emissions data in aggregate, data from the six gases are converted (based on the global warming potential of the gas) into a single unit of measure: million metric tons of carbon dioxide-equivalents ($MMTCO_2E$). One million metric tons equals one teragram (10^{12} grams), a measure used by some sources to describe emission levels. Moreover, other reports may provide emissions data in metric tons of carbon-equivalents. To convert carbon-equivalents to CO_2-equivalents, multiply carbon-equivalents by 44/12.

Unless otherwise noted, the data in this report come from the World Resources Institute's Climate Analysis Indicators Tool (CAIT). The CAIT state data are compiled using the Environmental Protection Agency's State Inventory Tool and default data for each state. Many states have prepared their own emissions inventories with more precise data, but most of these inventories only cover 1990 emissions. Although there may be slight data discrepancies between CAIT and the state inventories, CAIT serves as a homogeneous data source, providing estimates for all states and all GHGs through 2003.

This report does not include land use, land use changes, or forestry (LULUCF) in emissions or intensity data. Data from these sources are generally considered less robust than data from other sources.

Greenhouse Gas Emission Drivers

Three broad factors influence GHG emission levels in a nation or state: population, per capita income, and GHG emissions intensity of the economy. A state's GHG emission levels can be approximated by multiplying together these three variables. **Equation 1** expresses this relationship:

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[3] (...continued)
intensity value (compared to other states) indicates that a state generates more emissions per economic output (i.e., GSP) than other states.

Equation 1:

GHG Emissions	=	Population	X	Per Capita Income	X	GHG Intensity
($MMTCO_2E$)		(Persons)		(GSP/Person)		($MMTCO_2E$ / GSP)

The equation indicates that each of the variables can play a significant role in shaping a state's GHG emissions. For instance, if one of these variables increases, while the other two remain constant, GHG emissions will increase. The three emissions drivers do not operate independently of one another: a change in one variable may influence another variable.[4]

The three variables — population, per capita income, and GHG emissions intensity — differ substantially among the states and play varying roles when determining a state's GHG emissions. **Table 1** shows this relationship for the 10 U.S. states with the highest GHG emission levels in 2003. These 10 states accounted for almost 50% of total U.S. GHG emissions in 2003. A similar table for all 50 states is included in the **Appendix** to this report.

Table 1. Comparison of GHG Emission Drivers for the 10 U.S. States with the Highest GHG Emissions Levels in 2003

State	GHG Emissions	Population	Per capita Income	GHG Intensity
	$MMTCO_2E$	in 1,000s	GSP/person	TCO_2E / $million of GSP
Texas	782	22,134	34,837	1,015
California	453	35,466	37,787	338
Pennsylvania	301	12,351	33,224	734
Ohio	299	11,438	33,174	1,308
Florida	271	16,982	30,548	523
Illinois	269	12,650	37,818	561
Indiana	269	6,192	33,082	1,315
New York	244	19,238	41,731	304
Michigan	212	10,068	34,260	614
Louisiana	210	4,481	29,375	1,591
Average for all 50 States	**132**	**5,702**	**35,404**	**921**

Source: Prepared by Congressional Research Service (CRS) with data from the World Resources Institute (WRI)**,** Climate Analysis Indicators Tool.

[4] For further discussion see CRS Report RL33970, *Greenhouse Gas Emission Drivers: Population, Economic Development and Growth, and Energy Use*, by John Blodgett and Larry Parker; see also Kevin Baumert, et al., 2005, *Navigating the Numbers: Greenhouse Gas Data and International Climate Policy*, World Resources Institute.

Table 1 provides a snapshot of information. Annual changes (or growth rates, which can be either positive or negative) in the GHG emission drivers will influence whether GHG emissions rise or fall. In order to reduce emissions, the sum of the three variable rates — population, income, and intensity — must be negative. To put this goal in perspective, consider the annual average rates of change for the United States between 1990 and 2000 (**Table 2**):

Table 2. Average Annual Rates of Change for GHG Emissions and Drivers for the Entire United States: 1990-2000

GHG Emissions		Population		Per Capita Income		GHG Intensity
1.4%	=	1.2%	+	1.8%	+	-1.6%

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Table 2 reveals that the growth rates were positive for both U.S. population and per capita income during the 1990s. Although GHG intensity decreased during that time period, the decline was not enough to offset the increases from the other two variables, and GHG emission levels increased by 1.4% annually.

Annual growth rates for GHG emissions and the emission drivers vary significantly among the U.S. states. The **Appendix** contains a table listing the growth rates for all 50 states. In some states, GHG intensity declines were well above average declines, but these annual reductions were offset by increases in population, per capita income, or a combination of the two.

Greenhouse Gas Emissions Intensity

Of the three GHG emission drivers — population, per capita income, and GHG emissions intensity — the most relevant in terms of climate change policy is GHG intensity. Decreases in population and/or per capita income would contribute to lowering a state's GHG emissions. However, growth in population and personal income is generally considered a positive social outcome, and policies that would seek to directly limit these emissions drivers are essentially outside the bounds of public policy.

GHG intensity is a simple measure of GHG emissions per unit of output. Although most GHG reduction regimes address actual emissions,[5] the national target in the United States — as announced by the Bush Administration — aims to reduce the GHG emissions intensity of the national economy. In 2002, the Bush Administration set a voluntary target of reducing the ratio of U.S. GHG emissions to

[5] For example, the European Union's Emissions Trading Scheme and the Kyoto Protocol require actual emission reductions. Reduction programs under development at the state level also require actual reductions (e.g., California and the Regional Greenhouse Gas Initiative).

the U.S. Gross Domestic Product (GDP) by 18% by 2012. According to the Administration, meeting this target would reduce intensity beyond that of intensity reductions expected under a business-as-usual scenario. Based on data available in 2002, GHG emissions intensity was projected to decline by 14% under a business-as-usual scenario. Critics of the Administration's intensity target have pointed out that (1) the intensity target is more precisely quantified at 17.5%;[6] and (2) more recent data indicate that the U.S. intensity declined by 16.2% between 1990 and 2002. Thus, some observers have described the effect of the intensity target as "negligible."[7]

Intensity targets are sometimes viewed with skepticism, because the intensity target proponents may imprecisely describe (or overstate) how reductions in emissions intensity would affect actual emission levels.[8] For example, the Administration has stated that meeting the U.S. emissions intensity target would lead to GHG emission reductions.[9] Arguably, such a description can be misleading, because the reductions would occur within the context of increasing U.S. emissions. In other words, U.S. emissions would continue to increase, but if the intensity target is met, the emissions increase would be less than business-as-usual. Moreover, there is some uncertainty as to whether the "reductions" will be achieved at all. The Administration's projected reductions are based on GDP forecasts. If the GDP increases at higher than projected rates, absolute emissions can increase beyond business-as-usual scenario, while still meeting the intensity target.

Although some have questioned the environmental efficacy of intensity targets (i.e., their ability to lower GHGs), the effectiveness of an emissions target depends primarily on its stringency, not whether it applies to emissions intensity or absolute emissions.[10] Meeting an aggressive intensity target can result in actual emission reductions, if the intensity decrease outpaces the combined increases in population and per capita income. In fact, if the United States is to reduce its emissions, while maintaining population and per capita income growth rates, a stringent reduction in GHG emissions intensity would be required.

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[6] Although the Administration's supporting document uses 18%, the document also states that the goal is to reduce intensity from 183 to 151 (metric tons of carbon equivalent per million dollars of gross domestic product), a 17.5% reduction.

[7] See Herzog, Timothy, et al., 2006, *Target Intensity: An Analysis of Greenhouse Gas Intensity Targets*, WRI Report, pp.15-16.

[8] See, Pew Center on Global Climate Change, *Analysis of President Bush's Climate Change Plan*, at [http://www.pewclimate.org/policy_center/analyses/response_bushpolicy.cfm].

[9] The Executive Summary describing the intensity target states: "the President's commitment will achieve 100 million metric tons of reduced emissions in 2012 alone, with more than 500 million metric tons in cumulative savings over the entire decade." See [http://www.whitehouse.gov/news/releases/2002/02/climatechange.html].

[10] See Herzog, Timothy, et al., 2006, *Target Intensity: An Analysis of Greenhouse Gas Intensity Targets*, WRI Report, pp.15-16.

Greenhouse Gas Emissions Intensity in the States

The GHG intensity levels display a considerable range among the 50 states. **Table 3** lists the states with the five highest and five lowest GHG intensity values (based on 2003 data). The table shows that the ends of the spectrum differ by more than an order of magnitude.

Table 3. States with the Five Highest and Five Lowest GHG Intensity Levels (2003)

States with Five Highest GHG Intensity Levels	GHG Intensity (TCO_2E / $million of GSP)	States with Five Lowest GHG Intensity Levels	GHG Intensity (TCO_2E / $million of GSP)
Wyoming	3,799	Connecticut	286
West Virginia	3,097	New York	304
North Dakota	2,885	Massachusetts	327
Montana	1,755	California	338
Alaska	1,662	Rhode Island	349
Average for all 50 states: 979			

Source: Prepared by CRS with data from the WRI, Climate Analysis Indicators Tool.

What factors determine a state's intensity and lead to the wide variances among the states? In the United States, carbon dioxide (CO_2) emissions have historically accounted for 85% of the nation's GHG emissions, excluding land use changes and forestry. In all but four states,[11] CO_2 emissions accounted for at least 80% of the state's GHG emissions in 2003. As the dominant GHG, the intensity of CO_2 emissions significantly impacts the overall GHG intensity. If Table 3 were to rank states based on CO_2 emissions intensity, the results would be nearly identical.[12] Due to the dominance of CO_2 emissions in the vast majority of states, this report focuses on its role in driving overall GHG emissions intensity, and thus GHG emissions. (Note that the **Appendix** contains a table listing CO_2 emissions intensity and its drivers for all 50 states).

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[11] The four states that emit relatively large percentages of non-CO_2 GHG emissions include: South Dakota (47%), Idaho (38%), Nebraska (32%), and Iowa (26%).

[12] Wyoming, West Virginia, North Dakota, Alaska, and Louisiana rank 1st through 5th (Montana 6th); the five states with the lowest CO_2 emissions intensity are identical, but California and Massachusetts switch positions.

Carbon Dioxide Intensity and Its Drivers

Approximately 98% of the U.S. CO_2 emissions in 2003 were from energy use.[13] The primary factors that determine CO_2 emissions intensity in a state are its energy intensity and the carbon content of its energy use (or fuel mix).[14] The relationship between CO_2 emissions intensity, energy intensity and carbon content of energy use is shown in **Equation 2**.

Equation 2:

CO_2 Emissions Intensity	=	**Energy Intensity**	**X**	**Carbon Content of Energy**
(CO_2/GSP)		(toe/GSP)		(TCO_2/toe)

Note: The units cited above include gross state product (GSP), tons of carbon dioxide-equivalent (TCO_2), and tons of oil equivalent (toe).

Energy Intensity

Energy intensity is the amount of energy a state consumes — typically measured in tons of oil equivalent (toe) — per its level of economic output (gross state product). **Table 4** shows the states with highest and lowest energy intensity levels in 2003. A comparatively high energy intensity figure indicates a states uses more energy (toe) per economic output (GSP) than other states. There is wide gulf (a factor of five) between states at either end of the spectrum.

Multiple factors influence a state's energy intensity. This section of the report compares energy intensity levels with five potential drivers: economic structure, transportation use, public policy, state climate, and gross state product. An overall assessment of the factors and their interactions with energy intensity is provided at the end of this section.

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[13] The other portion (2.5%) came from industrial activity. This estimate excludes land use changes. WRI, Climate Analysis Indicators Tool.

[14] When non-CO2 gases — e.g., methane, nitrous oxide — are part of the GHG intensity calculus, other factors come into play. Approximately 50% of non-CO_2 GHGs are generated by agricultural activities, and these emission levels may be influenced by changes in related economic markets.

Table 4. States with the Five Highest and Five Lowest Energy Intensity Levels (2003 data)

States with Five Highest Energy Intensities	Energy Intensity (toe / $million of GSP)	States with Five Lowest Energy Intensities	Energy Intensity (toe / $million of GSP)
Louisiana	0.71	New York	0.13
Alaska	0.69	Connecticut	0.14
Wyoming	0.61	Massachusetts	0.14
North Dakota	0.50	California	0.15
West Virginia	0.56	Rhode Island	0.16
Average for all 50 states: 0.29			

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Economic Structure. A state's economic structure likely plays an important role. For instance, a primaryeconomic factor is whether the state's economyis based more on high-energy industries or low-energy industries. A state with a GSP based on a high ratio of high-energy industries is likely to have a higher overall energy intensity than a state with proportionately more low-energy sectors (e.g., finance, professional services).

Table 5 lists (1) the five states with the highest percentages of their GSP resulting from high-energy intensive industries; and (2) the five states with the highest percentages of their GSP based on low-energy intensive industries. A comparison of **Tables 4 and 5** indicates a correspondence between energy intensity and a state's economic structure. The top-three highest energy intensity states are also the top-three in percentage of their GSP from high-energy sectors; three of the top-five lowest energy intensity states are also among the top-six states for GSP based on low-energy sectors. Of the 25 states with the highest percentages of their GSPs based on high-energy sectors, 19 of these states are ranked in the top-25 for energy intensity.

Table 5. States with High Percentages of Gross State Product Based on High- or Low-Energy Intensive Sectors (2003 data)

State	Percentage of GSP from High-Energy Sectors[15]	State	Percentage of GSP from Low-Energy Sectors[16]
Wyoming	32	Delaware	79
Louisiana	23	Hawaii	76
Alaska	22	New York	75
West Virginia	17	Maryland	71
Texas	14	Connecticut / Rhode Island	70
50-State Average	7%	50-State Average	61%

Source: Prepared by CRS with data from Bureau of Economic Analysis, at [http://bea.gov/index.htm].

Personal Transportation. The transportation sector accounts for over a quarter (28%) of total energy consumption in the United States.[17] Within the transportation sector, personal transportation — i.e., cars, light trucks, and motorcycles — accounts for the majority of energy use (64% in 2004).[18] A measure that tracks personal transportation use in a state is vehicle miles traveled (VMT) per person. A state's per capita VMT is another factor that likely impacts a state's energy intensity.

As **Table 6** indicates, there is a significant range between states with the most and least VMT/person. The five states — New York, Hawaii, Alaska, Rhode Island, and New Jersey — on the low end of the spectrum averaged 7,598 VMT/person in

[15] For this report, high-energy sectors include the following North American Industry Classification System (NAICS) primary and secondary groupings: mining; utilities; primary metal manufacturing; paper manufacturing; petroleum and coal products manufacturing; and chemical manufacturing.

[16] For this report, low-energy sectors include the following North American Industry Classification System (NAICS) primary groups: information; finance and insurance; real estate; professional/technical services; management of companies; administration and waste services; education; health care and social assistance; arts, entertainment, recreation; accomodation and food; other services; and government.

[17] The industrial (32%), residential (22%), and commercial (18%) sectors consumed the remaining proportions. See CRS Report RL31849, *Energy: Selected Facts and Numbers*, by Carol Glover and Carl E. Behrens.

[18] U.S. Department of Energy, 2007, *Transportation Energy Data Book (Edition 26)*, table 2.6.

2003; the five states — Wyoming, Vermont, Alabama, Oklahoma, and Mississippi — on the other end averaged 14,186 VMT/person in 2003.[19]

Table 6. States with the Five Highest and Five Lowest Vehicle Miles Traveled Per Capita (2003)

States of Highest Rank	Vehicle Miles Traveled Per Capita	States of Lowest Rank	Vehicle Miles Traveled Per Capita
Wyoming	18,367	New York	7,020
Vermont	13,432	Hawaii	7,476
Oklahoma	13,048	Alaska	7,630
Alabama	13,045	Rhode Island	7,783
Mississippi	13,036	New Jersey	8,083
Average for all 50 states: 10,571			

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

There is a general correspondence between a state's per capita VMT and energy intensity. Of the 25 states with the lowest energy intensity levels, 17 of them are also in the group of 25 states with the fewest VMT/person.[20] However, there are several dramatic exceptions to this correlation. For example, Alaska ranks third for lowest VMT/person, but second for highest energy intensity. Conversely, Vermont has the second highest VMT/person, but has a relatively low energy intensity (ranks 15th). Such exceptions demonstrate that multiple factors play a role and that energy intensity drivers may have varying impacts in different states.

Public Policy. States can seek to reduce energy intensity through public policy action. Some states have enacted policies or regulations that are more stringent or broader in scope than federal standards, supporting improvements in efficiency standards for electricity generation, buildings, and/or appliances. For example, 12 states have established energy efficiency standards for appliances that are more stringent than federal requirements.[21] The American Council for an Energy-Efficient Economy (ACEEE) published an energy efficiency scorecard that ranks the states based on their energy efficiency policies.[22] The ACEEE scores show a relationship with highest and lowest energy intensity levels among the states. Of the

[19] Based on WRI CAIT data.

[20] Likewise, of the 25 states with higher energy intensity levels, 17 are also among the 25 states with higher VMT/person.

[21] EPA, Map: State Energy Efficiency Actions - State Appliance Efficiency Standards (as of 1/1/2007), at [http://www.epa.gov/cleanenergy/stateandlocal/activities.htm].

[22] American Council for an Energy-Efficient Economy (ACEEE), 2007, *The State Energy Efficiency Scorecard for 2006*, at [http://aceee.org].

states with low energy intensity levels, all were ranked highly by the ACEEE scorecard.[23] Conversely, the states with high energy intensities received low ACEEE rankings.[24] In addition, of the 25 states ranked highly by ACEEE for public policy, 19 of the states are among the 25 states with the lowest energy intensities.

State Climate. Natural factors, such as a state's climate, may influence energy intensity in some states, but the degree of influence is difficult to determine. A state's overall climate helps determine the amount of energy needed to heat or cool residential, commercial, and industrial buildings. A measurement used to evaluate this concept is the "degree day," which includes heating degree days (HDDs) and cooling degree days (CDDs).[25] In the United States, HDDs outnumber CDDs by a factor of five to one, thus states in colder climates generally have the most degree days.

An examination of energy intensity and degree days for all 50 states does not indicate an overall correlation between these two measures. While several states rank highly for both degree days and energy intensity,[26] many of the states with low energy intensities — e.g., New York, Connecticut, and Massachusetts — are among the top 25 states in terms of degree days. In addition, many of the states with few degree days are among the top 25 states in terms of energy intensity. The lack of an overall correlation between degree days and energy intensity does not rule out the influence of climate. Climate may play a supplemental role that is perhaps obscured by more influential factors.

Gross State Product. The size of a state's economy (the denominator of energy intensity) can be an important part of the equation. Of the states with the 25 lowest GSPs, 17 of the states are in the top-25 for energy intensity. A sudden increase/decrease in a variable that alters energy consumption will likely yield a more pronounced effect in states with lower GSPs. In contrast, the effects of drastic changes may be less pronounced in states with larger GSPs. Four of the states with high energy intensities rank near the bottom in terms of absolute GSP (in 2003): Alaska (45th), Wyoming (50th), North Dakota (48th), and West Virginia (40th). Conversely, California and New York, which are among the top five states with lowest energy intensities, are ranked first and second, respectively. However, in the other states listed above (**Table 4**), the size of GSP may play a lesser role. For

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[23] Including ties, California and Connecticut ranked first; Massachusetts ranked 4th; New York ranked 7th; and Rhode Island 9th.

[24] Louisiana was ranked 40th; Alaska ranked 41st; Wyoming ranked 49th; North Dakota ranked 51st; and West Virginia ranked 35th.

[25] The "degree-day" is a metric used to assess the demand for heating and/or cooling needs. Both heating degree days (HDDs) and cooling degree days (CDDs) are based on differences from a temperature of 65 °F, a base temperature considered to have neither heating nor cooling needs. For example, 10 HDDs are generated for a day with an average daily temperature of 55 °F. Higher HDDs (e.g., Alaska) and CDDs (e.g., Florida) indicate greater heating or cooling needs, respectively.

[26] Three of the five states (see Table 6) with high energy intensities — Wyoming, Alaska, and North Dakota — are in the top five for number of degree days.

example, Louisiana, the state with the highest energy intensity, ranked 24th for total GSP in 2003.

Conclusions. Other than a state's climate, each of the factors discussed above shows a relationship with energy intensity. Most of the states with high energy intensity levels are at the extreme end of the range for more than one of the underlying factors; many of the states with low intensities also have corresponding rankings with one or more underlying factors. However, there are sometimes dramatic exceptions. The exceptions highlight the diversity among the states and indicate the difficulty in making conclusions that apply in all states.

In addition, for states that have multiple factors steering towards higher energy intensity, it is difficult to determine which factor is dominant. Perhaps the most extreme example of this difficulty is Wyoming, which has the third highest energy intensity. Wyoming ranks first for percentage of energy-intensive industries, first for VMT/person, fourth for number of degree days, last (50th) for absolute GSP, and 49th in ACEEE's public policy scorecard. All of these rankings point towards increased energy intensity, thus creating a challenge to identify the primary influence in states such as Wyoming.

Carbon Content of Energy Use

The second driver of CO_2 emissions intensity is the carbon content of energy use in a state. Energy sources vary in the amount of carbon released per unit of energy supplied (e.g., British Thermal Unit). A state that uses a greater proportion of high-carbon energy sources will have higher CO_2 emissions per unit of energy use than a state that utilizes more low-carbon energy sources. **Table 7** shows the states with the five highest and five lowest carbon contents of energy use (measured in tons of CO_2 per tons of oil equivalent, toe).

Table 7. States With the Five Highest and Five Lowest Carbon Contents of Energy Use (2003)

States with Highest Carbon Contents of Energy Use	Carbon Content of Energy Use (TCO_2 / 1000 toe)	States with Lowest Carbon Contents of Energy Use	Carbon Content of Energy Use (TCO_2 / 1000 toe)
West Virginia	5,780	Idaho	1,210
Wyoming	5,460	Oregon	1,540
North Dakota	4,770	Washington	1,660
Montana	3,480	Vermont	1,660
Utah	3,470	Connecticut	1,890
Average for all 50 states: 2,527			

Source: Prepared by CRS with data from the WRI, Climate Analysis Indicators Tool.

Electricity Generation. A state's electricity sector is especially important in the context of a state's carbon content of energy use. The electricity sector produces a substantial portion of CO_2 emissions in many states and is the highest emitting sector in the United States, accounting for approximately 40% of U.S. CO_2 emissions.

Electricity can be generated from a variety of energy sources, which vary significantly by their ratio of CO_2 emissions per unit of energy. A coal-fired power plant emits almost twice as much CO_2 (per unit of energy) as a natural gas-fired facility.[27] Some energy sources — e.g., hydropower,[28] nuclear, wind, or solar — do not directly release any CO_2 emissions. Although the transportation sector contributes a significant percentage of CO_2 emissions in most states (and 33% of U.S. CO_2 emissions in 2003 — the second highest sector), this sector utilizes a more homogenous fuel portfolio. In contrast to fuels used to generate electricity, transportation fuels do not demonstrate as much variance in their CO_2 emissions per unit of energy.[29] Thus for the purposes of examining a state's carbon content of energy use, this report focuses on the electricity sector.

Compared to the other states, the five states with high carbon contents in their fuel mix utilized a relatively large percentage of coal for electricity generation in 2003. Conversely, the five states with the lowest levels generated electricity from a relatively high percentage of zero-emission energy sources in 2003. In general, hydropower and nuclear power dominate the zero-emission subcategory in terms of use, but the zero-emission sources also include: wind, solar, geothermal, and the sources that fall within the Energy Information Administration's (EIA) "other renewables" category.[30] **Table 8** lists the states that utilized the greatest percentages of coal to generate electricity and the states with the highest percentages of zero-emission energy sources.

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[27] The Energy Information Administration website provides a table listing the amount of CO_2 generated per unit of energy for different energy sources, at [http://www.eia.doe.gov/oiaf/1605/coefficients.html].

[28] Some studies have found that hydroelectric dams may be a source of GHG emissions. Dam reservoirs can emit methane through plant decomposition, but this effect varies by location, being more pronounced in warmer climates. See e.g., World Commission on Dams, 2000, The Report of the World Commission on Dams, at [http://www.dams.org/report/].

[29] In 2003, petroleum accounted for 97% of the energy consumed in the U.S. transportation sector. EIA, Energy Power Monthly, March 2004, Table 2.5, at [http://www.eia.doe.gov/].

[30] These additional sources include wood and other wood waste, black liquor, biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, and other biomass (EIA, Electric Power Monthly, March 2004, Table 1.13B). Although these sources do yield CO_2 emissions when used as fuels, their combustion does not provide *additional* CO_2 emissions to the atmosphere (i.e., they would have produced CO_2 emissions at some point via natural processes). Thus, for this report they are counted as zero-emission energy sources.

Table 8. States with the Highest Percentage of In-State Electricity Generated from Coal and Zero-Emission Energy Sources (2003)

State	Percentage of In-State Electricity Generated from Coal	State	Percentage of In-State Electricity Generated from Zero-Emissions Energy Sources
West Virginia	98%	Vermont	100%
Wyoming	97%	Idaho	96%
Indiana	94%	Washington	82%
North Dakota	94%	Oregon	70%
Utah	94%	New Hampshire	66%

Source: Prepared by CRS with data from Energy Information Administration, Electric Power Monthly (March 2004), at [http://www.eia.doe.gov/].

Electricity Exports/Imports. Another important factor that affects a state's carbon content of energy use is whether the state is a net importer or exporter of electricity. States consume fuels (e.g., coal, natural gas, etc.) to generate electricity, but the electricity may be exported to and used in another state. The method for accounting for these exchanges influences the level of a state's carbon content of energy use. In the above carbon content of energy data (**Table 7**), if one state uses an energy source (e.g., coal) to generate electricity and then sells the electricity to a consumer in a second state, the CO_2 emissions are attributed to the generating state, but the energy use is attributed to the consuming state.[31]

Table 9 lists the states in which electricity exports accounted for high percentages of energy use. Likewise, the table lists the states in which imported electricity accounted for high percentages of energy use. The import/export factor is especially prominent for states with high carbon content levels. The top four states for carbon content of energy use in 2003 — West Virginia, Wyoming, North Dakota, and Montana — exported substantial portions of electricity in that year. Of the five states with low carbon content levels, the import/export factor appears most relevant in Idaho, where imported electricity accounted for 41% of its total energy use in 2003.

[31] From a mathematical perspective, in a net exporting state the numerator (tCO_2) of the equation (tCO_2 / toe) would increase, but the denominator (toe) would remain the same. The reverse would occur in importing states.

Table 9. States with High Percentages of Exported and Imported Electricity in Terms of Overall Energy Use (2003)

State	Percentage of Energy Consumed That Is *Exported* Electricity	State	Percentage of Energy Consumed That Is *Imported* Electricity
West Virginia	44%	Idaho	41%
Wyoming	42%	Delaware	28%
North Dakota	36%	Rhode Island	22%
Montana	28%	Maryland	20%
New Hampshire	23%	Virginia	17%

Source: Prepared by CRS with data from Energy Information Administration, State Energy Data System [http://www.eia.doe.gov/emeu/states/_seds.html].

Some may argue that this characteristic of the data artificially inflates the carbon content of energy use in exporting states, while artificially lowering the measure in states that import a significant amount of electricity. Consider Wyoming and Idaho, two states at opposite extremes of the carbon contents of energy use range. Two coal-fired power plants located in Wyoming are partially owned by electricity providers that serve customers in Idaho. Idaho customers are receiving some amount of coal-fired electricity from Wyoming (and Oregon and Nevada).[32] This electricity is counted as energy use in Idaho, while the CO_2 emissions are attributed to Wyoming (or Oregon or Nevada).

From another perspective, the example is less a critique of the carbon content of energy measure, and more a highlight of how electricity generation and use is measured. There is no system in place to physically track electricity upon generation. Therefore, it is impossible to precisely attribute imported electricity to its energy source.[33] Moreover, exported electricity may come from energy sources other than coal. States may export electricity generated from low- or zero-carbon energy sources, such as hydropower or nuclear. This factor adds another layer of complexity to the accounting. As the above Wyoming/Idaho example demonstrates, rough approximations might be established based on ownership data, but it may be difficult (if not impossible) to precisely assign the CO_2 emissions from an exporting state to the importing state. Thus, states that appear to be using low-carbon energy sources, may be importing high-carbon energy, in the form of electricity.

[32] Idaho Power, which serves customers in Idaho, is a partial owner of coal- fired power plants in these states. See EIA, Annual Electric Generator Report (Database 860), at [www.eia.doe.gov]; see also [www.idahopower.com].

[33] Per telephone conversation with EIA official, July 30, 2007.

Consequences of Differences in State Emissions Drivers in the Context of a Federal Greenhouse Gas Emissions Reduction Program

As noted above, the states have, in some cases, vastly different levels of GHG emissions intensity and related underlying variables. If Congress were to enact a federal GHG emissions reduction program, these differences may lead to a wide range of impacts in the states. The range of impacts would depend on the logistics of the emissions reduction program and the ability of regulated entities to spread compliance costs.

If Congress creates a mandatory GHG emissions reduction regime, the program would assign (directly or indirectly) a cost to emissions of carbon (or carbon-equivalents in the case of some GHGs). The stringency, scope, and design of the reduction regime would play a large role in determining costs and how the costs are distributed. For instance, Congress could include specific provisions — e.g., a safety-valve or revenue recycling — that would control costs or ease the burden on particular groups.[34]

Regardless of how Congress might design a GHG reduction program, a mandatory GHG reduction regime would affect states differently. In particular, the states' different energy intensities and carbon content of energy use indicate the states would experience different effects.

States with relatively high levels of carbon content in their energy use (**Table 7**) would likely see higher energy prices. These states typically use a high percentage of coal to generate electricity, thus electricity prices would likely increase in these states.[35] The consumers' responses to these price increases would help determine impacts. Consumers may choose to conserve energy use or switch to alternative sources. The carbon price imposed by the emission reduction regime would provide incentives to switch from high-carbon to low-carbon fuel (e.g., from coal to natural gas). However, such a switch may be limited by the technology and infrastructure existing in a state, particularly in the electricity generation sector. Conventional coal-fired power plants in operation today, which account for approximately 50% of all electricity generation, cannot simply switch to another fuel source.

The producers of coal-fired electricity may be able to pass along the additional carbon costs to consumers, but some state regulations may hinder a company's ability to include the additional costs in electricity prices. Differences in the states' regulatory structures may influence which groups ultimately pay for the additional carbon costs. In states with tighter regulatory control over prices, power companies may bear a relatively higher cost; in other states, consumers of electricity may bear

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[34] For more discussion of these issues, see CRS Report RL33799, *Climate Change: Design Approaches for a Greenhouse Gas Reduction Program*, by Larry Parker.

[35] Raymond Kopp, 2007, *Greenhouse Gas Regulation in the United States*, Resources for the Future Discussion Paper.

a higher percentage of the costs, where companies are less constrained in passing costs along to customers in the form of higher prices.

Depending on particular design elements of the emissions reduction program, some of these potential disproportionate effects might be alleviated. For example, if producers are expected to pay a higher percentage of the additional carbon costs, some of the emission allowances might be provided for free. If consumers are anticipated to pay a higher proportionate cost, the allowances could be auctioned. The auction's revenues could be returned to consumers, particularly to low-income households, which would be especially impacted by higher electricity bills.

As discussed above, a state's import/export ratio of electricity may influence its carbon content of energy use (or fuel mix). This component adds a further layer of complexity when assessing the potential impacts of a carbon price. For example, depending on how emission allowances might be distributed under a federal cap-and-trade system, states that are net energy providers may receive financial gains, at least in the short-term. For instance, if power plants can pass along the mitigation costs (of carbon reduction) in higher electricity prices and receive their emission allowances for free (often referred to as "grandfathering") the companies may benefit financially.[36] These potential gains to the likely regulated entities (e.g., coal-fired power plants) have been described as "windfall profits," and have been recently observed in the European Union's Emission Trading System.[37] The gains would be temporary, because under most cap-and-trade proposals, the cap decreases over time; thus, regulated entities would receive fewer allowances as the program progresses.

If Congress enacts an emissions reduction program, states with high levels of energy intensity are likely to face higher costs than states with low energy intensity levels. As **Table 4** shows, the high and low energy intensity levels can differ by a factor of four, which suggests that the impacts between the states at the ends of the spectrum could vary dramatically.

Energy intensity levels are shaped by multiple factors. Some of these factors may be based on behavior or actions. These factors may be altered through public policy. For example, states could initiate policies or support programs that seek to change the driving behavior (i.e., VMT) of its citizens. Other factors — especially a state's ratio of high and low carbon intensive industries — are more structural, and thus more difficult (if not impractical) to alter through public policy.

In addition, depending on the degree to which a state's energy intensity is influenced by its climate, a newly-imposed carbon price may have a greater impact. In these states, the demand for energy may be less elastic (i.e., responsive to price changes) than other states, because energy is more critical for daily life necessities,

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[36] In a market-based system (e.g., cap-and-trade), emission allowances can be used to comply with an individual company's cap or sold to other parties subject to the cap. As such, allowances are a form of currency and would provide an infusion of funds.

[37] The vast majority of emissions allowances were distributed for free under the European program. See National Commission on Energy Policy, 2007, *Allocating Allowances in a Greenhouse Gas Trading System*, p.11.

such as home heating. Low-income citizens may face a disproportionate burden, as a share of income, of price increases in states with substantial heating and/or cooling needs.

States with high energy intensity may have a high percentage of carbon-intensive industries (e.g., manufacturing). These industries would likely see an increase in their operational costs due to the new carbon price, but they may be able to include the additional carbon costs in the price of their products (e.g., paper, cement, steel), thus spreading the costs to consumers in other states. However, passing along the carbon price to consumers may not be financially viable for producers. The ability of producers to pass along the carbon price would be determined by the competitiveness of the market and consumers' willingness to pay higher prices or forego purchases for a particular good. Consumers may seek out product substitutes or lower cost suppliers (which could include foreign producers not subject to a domestic carbon price).

From another perspective, higher levels in emissions drivers, particularly the energy intensity variable, may suggest a state has comparatively more "low hanging fruit" or lower-cost options to meet emission reduction requirements. As noted above, the states with high energy intensities were also ranked poorly by ACEEE's energy efficiency scorecard. Although these states' energy intensity levels are primarily due to economic structure, there may be room for improvement — via "no regrets" energy efficiency policies — within the framework of their economic structure.

Along these lines, states that currently use a substantial percentage of high-carbon fuels for energy purposes (particularly for electricity generation) may have more options in a carbon-constrained regime than states that are already utilizing a high percentage of low-carbon energy sources. For instance, if states in both categories were required to reduce current emissions by a set percentage, states using high-carbon fuels may seek low-carbon fuel substitutes, but states using low-carbon fuels would be limited in this regard. This comparison does not suggest that switching to low-carbon fuels will be easy (or inexpensive), but these states may have more ways to find emission reductions.

Moreover, low-carbon fuel substitutes may not be distributed evenly across the states. Some states that currently use large proportions of high-carbon energy sources may be in better positions — in terms of natural resource endowments and geography — than other states looking for low-carbon substitutes. For example, there is more wind energy potential in the western and mid-western states than in states in the Southeast.[38]

The above comparison also highlights the importance of selecting a baseline year for an emission reduction program. If emissions caps are compared to 1990 levels, it would reward states for reductions made during the 1990s. If the reduction

[38] See National Renewable Energy Laboratory, Map of U.S. Annual Average Wind Power, at [http://rredc.nrel.gov/wind/pubs/atlas/maps.html#2-6].

program's baseline is 2000, for example, the reductions made before that year would not count, and these states may have more difficulty finding lower-cost options.

Greenhouse Gas Intensity Levels in the Context of an Emissions Reduction Program

Several members in the 110th Congress have introduced proposals that would establish a nation-wide GHG reduction program. Any emissions reduction regime would necessitate declines in GHG intensity. The declines needed would depend on the level of absolute reductions mandated by the enacted program.

To stabilize national GHG emission growth, the entire United States would need to achieve annual reductions in GHG intensity of approximately 3% (assuming population and income continue to grow at a combined rate of 3%). Only four states — Delaware (3.7%), New Mexico (3.7%), Utah (3.4%), and Arizona (3.3%) — exceeded this annual rate of decline between 1990 and 2003; the average decline among all states was 1.7%.[39]

Reducing GHG emissions in the United States would necessitate further declines in GHG intensity. Several legislative proposals in the 110th Congress would require GHG emissions to return to 1990 levels by 2020.[40] To meet this objective, national GHG intensity would need to decline annually (starting in 2010) by 5.0%.[41]

To put this goal in perspective, consider the 10 states that emitted the most GHGs in 2003 (accounting for approximately 50% of total U.S. emissions) and the GHG intensity annual average rates of change (between 1990 and 2003) for these states (**Table 10**). These states would likely need to make further reductions in GHG intensity if the national GHG intensity levels are to decline annually by 5% starting in 2010. Many of these states would need to more than double their current annual GHG intensity declines to reach a negative growth rate of 5%.

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[39] The contrast between individual state intensity levels and the states' average level is only for comparison purposes. When calculating the states' average intensity level, all states are counted equally. Because of the significant variance in emissions between large and small states, the states' average intensity level may not coincide with the national intensity level. Ten states comprise approximately 50% of U.S. GHG emissions. The actions of these states will likely have greater effect on the national GHG intensity.

[40] For example, S. 280 (Lieberman), S. 309 (Sanders), S. 485 (Kerry), H.R. 620 (Olver), and H.R. 1590 (Waxman).

[41] This calculation assumes: (1) U.S. population will grow annually by 0.9% (U.S. Census Bureau, at [http://www.census.gov/cgi-bin/ipc/idbsum.pl?cty=US)]); (2) incomes will increase annually by 2.1% (the rate of increase from 1975 to 2003, WRI, Climate Analysis Indicators Tool); (3) GHG emissions were 6,240 MMTCO_2E in 1990 (U.S. EPA, 2007, *U.S. Inventory of Greenhouse Gas Emissions and Sinks 1990-2005*, at [http://www.epa.gov/climatechange]), and are projected to be 7,632 MMTCO_2E in 2010 (based on a 1.0% annual average growth rate between 1990 and 2005).

Table 10. GHG Emissions Intensity Average Annual (Negative) Growth Rates (1990-2003) for the 10 States with the Most GHG Emissions in 2003

State	GHG Emissions Intensity Average Annual Growth Rates (1990-2003)
Texas	-2.5
California	-1.9
Pennsylvania	-2.1
Ohio	-1.7
Florida	-1.6
Illinois	-1.6
Indiana	-2.1
New York	-1.6
Michigan	-2.6
Louisiana	-0.6

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Appendix. Select Tables with Data for All 50 States

Table A1. GHG Emissions and GHG Emissions Drivers for All 50 States, Listed Alphabetically (2003 data)

State	GHG Emissions		Population		Per capita Income		GHG Intensity
	$MMTCO_2E$		in 1,000s		GSP/person		TCO_2E / $million of GSP
Alabama	164	=	4,495	X	27,140	X	1,343
Alaska	46	=	648	X	42,784	X	1,662
Arizona	96	=	5,582	X	31,294	X	551
Arkansas	81	=	2,724	X	25,971	X	1,138
California	453	=	35,466	X	37,787	X	338
Colorado	107	=	4,546	X	39,144	X	600
Connecticut	46	=	3,482	X	45,875	X	286
Delaware	19	=	817	X	54,667	X	426
Florida	271	=	16,982	X	30,548	X	523
Georgia	186	=	8,750	X	34,228	X	621
Hawaii	23	=	1,246	X	34,180	X	550
Idaho	24	=	1,367	X	26,906	X	651
Illinois	269	=	12,650	X	37,818	X	561
Indiana	269	=	6,192	X	33,082	X	1,315
Iowa	108	=	2,942	X	32,481	X	1,133
Kansas	101	=	2,727	X	31,668	X	1,166
Kentucky	164	=	4,114	X	28,739	X	1,385
Louisiana	210	=	4,481	X	29,375	X	1,591
Maine	26	=	1,307	X	28,632	X	693
Maryland	90	=	5,507	X	36,164	X	450
Massachusetts	92	=	6,440	X	43,850	X	327
Michigan	212	=	10,068	X	34,260	X	614
Minnesota	120	=	5,059	X	39,146	X	606
Mississippi	76	=	2,874	X	23,281	X	1,131
Missouri	163	=	5,712	X	32,123	X	886
Montana	41	=	917	X	25,389	X	1,755
Nebraska	65	=	1,737	X	34,593	X	1,088
Nevada	48	=	2,241	X	36,933	X	574
New Hampshire	22	=	1,286	X	35,821	X	469
New Jersey	137	=	8,633	X	42,435	X	373
New Mexico	66	=	1,878	X	28,590	X	1,236

State	GHG Emissions		Population		Per capita Income		GHG Intensity
	$MMTCO_2E$		in 1,000s		GSP/person		TCO_2E / $million of GSP
New York	244	=	19,238	X	41,731	X	304
North Carolina	168	=	8,416	X	34,288	X	581
North Dakota	57	=	633	X	31,464	X	2,885
Ohio	299	=	11,438	X	33,174	X	788
Oklahoma	124	=	3,504	X	27,047	X	1,308
Oregon	51	=	3,561	X	32,825	X	435
Pennsylvania	301	=	12,351	X	33,224	X	734
Rhode Island	13	=	1,075	X	33,904	X	349
South Carolina	92	=	4,142	X	28,809	X	771
South Dakota	27	=	764	X	33,671	X	1,060
Tennessee	141	=	5,834	X	32,523	X	745
Texas	782	=	22,134	X	34,837	X	1,015
Utah	69	=	2,356	X	30,115	X	977
Vermont	8	=	619	X	31,693	X	399
Virginia	143	=	7,376	X	38,108	X	507
Washington	95	=	6,130	X	36,612	X	421
West Virginia	133	=	1,809	X	23,708	X	3,097
Wisconsin	123	=	5,467	X	33,799	X	666
Wyoming	72	=	501	X	37,857	X	3,799

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Note: The calculations above are based on the **Equation 1** (provided again below), but the units have been altered to make the figures more presentable and easier to compare. In particular, note that in the above table the population figure for each state is in 1,000s; and the GHG intensity figure is presented in metric tons (instead of million metric tons) of CO_2E and in million dollars of GSP (instead of one dollar of GSP).

Equation 1:

GHG Emissions	=	Population	X	Per Capita Income	X	GHG Intensity
($MMTCO_2E$)		(Persons)		(GSP/Person)		($MMTCO_2E$ / GSP)

Table A2. GHG Emissions and GHG Emissions Drivers for All 50 States, Ranked by GHG Emissions (2003 data)

State	Rank	GHG Emissions		Population		Per capita Income		GHG Intensity
		$MMTCO_2E$		in 1,000s		GSP/person		TCO_2E / $million of GSP
Texas	1	782	=	22,134	X	34,837	X	1,015
California	2	453	=	35,466	X	37,787	X	338
Pennsylvania	3	301	=	12,351	X	33,224	X	734
Ohio	4	299	=	11,438	X	33,174	X	788
Florida	5	271	=	16,982	X	30,548	X	523
Illinois	6	269	=	12,650	X	37,818	X	561
Indiana	7	269	=	6,192	X	33,082	X	1,315
New York	8	244	=	19,238	X	41,731	X	304
Michigan	9	212	=	10,068	X	34,260	X	614
Louisiana	10	210	=	4,481	X	29,375	X	1,591
Georgia	11	186	=	8,750	X	34,228	X	621
North Carolina	12	168	=	8,416	X	34,288	X	581
Alabama	13	164	=	4,495	X	27,140	X	1,343
Kentucky	14	164	=	4,114	X	28,739	X	1,385
Missouri	15	163	=	5,712	X	32,123	X	886
Virginia	16	143	=	7,376	X	38,108	X	507
Tennessee	17	141	=	5,834	X	32,523	X	745
New Jersey	18	137	=	8,633	X	42,435	X	373
West Virginia	19	133	=	1,809	X	23,708	X	3,097
Oklahoma	20	124	=	3,504	X	27,047	X	1,308
Wisconsin	21	123	=	5,467	X	33,799	X	666
Minnesota	22	120	=	5,059	X	39,146	X	606
Iowa	23	108	=	2,942	X	32,481	X	1,133
Colorado	24	107	=	4,546	X	39,144	X	600
Kansas	25	101	=	2,727	X	31,668	X	1,166
Arizona	26	96	=	5,582	X	31,294	X	551
Washington	27	95	=	6,130	X	36,612	X	421
South Carolina	28	92	=	4,142	X	28,809	X	771
Massachusetts	29	92	=	6,440	X	43,850	X	327
Maryland	30	90	=	5,507	X	36,164	X	450
Arkansas	31	81	=	2,724	X	25,971	X	1,138
Mississippi	32	76	=	2,874	X	23,281	X	1,131

State	Rank	GHG Emissions		Population		Per capita Income		GHG Intensity
		$MMTCO_2E$		in 1,000s		GSP/person		TCO_2E / $million of GSP
Wyoming	33	72	=	501	X	37,857	X	3,799
Utah	34	69	=	2,356	X	30,115	X	977
New Mexico	35	66	=	1,878	X	28,590	X	1,236
Nebraska	36	65	=	1,737	X	34,593	X	1,088
North Dakota	37	57	=	633	X	31,464	X	2,885
Oregon	38	51	=	3,561	X	32,825	X	435
Nevada	39	48	=	2,241	X	36,933	X	574
Alaska	40	46	=	648	X	42,784	X	1,662
Connecticut	41	46	=	3,482	X	45,875	X	286
Montana	42	41	=	917	X	25,389	X	1,755
South Dakota	43	27	=	764	X	33,671	X	1,060
Maine	44	26	=	1,307	X	28,632	X	693
Idaho	45	24	=	1,367	X	26,906	X	651
Hawaii	46	23	=	1,246	X	34,180	X	550
New Hampshire	47	22	=	1,286	X	35,821	X	469
Delaware	48	19	=	817	X	54,667	X	426
Rhode Island	49	13	=	1,075	X	33,904	X	349
Vermont	50	8	=	619	X	31,693	X	399

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Table A3. Average Annual Growth Rates (1990-2003) for GHG Emissions and GHG Emissions Drivers for All 50 States

State	GHG Emissions		Population		Per capita Income		GHG Intensity
Alabama	1.4%	=	0.8%	+	1.9%	+	-1.2%
Alaska	1.9%	=	1.2%	+	-2.3%	+	3.1%
Arizona	2.5%	=	3.2%	+	2.7%	+	-3.3%
Arkansas	1.6%	=	1.1%	+	2.4%	+	-1.8%
California	0.7%	=	1.3%	+	1.3%	+	-1.9%
Colorado	2.2%	=	2.5%	+	2.7%	+	-2.9%
Connecticut	0.4%	=	0.4%	+	1.5%	+	-1.5%
Delaware	-0.2%	=	1.5%	+	2.1%	+	-3.7%
Florida	2.1%	=	2.1%	+	1.7%	+	-1.6%
Georgia	1.6%	=	2.3%	+	2.0%	+	-2.6%
Hawaii	0.1%	=	0.9%	+	-0.6%	+	-0.2%
Idaho	2.2%	=	2.3%	+	2.6%	+	-2.7%
Illinois	1.2%	=	0.8%	+	2.0%	+	-1.6%
Indiana	1.4%	=	0.8%	+	2.6%	+	-2.1%
Iowa	1.1%	=	0.4%	+	2.6%	+	-1.9%
Kansas	0.9%	=	0.7%	+	1.8%	+	-1.6%
Kentucky	1.4%	=	0.8%	+	2.1%	+	-1.5%
Louisiana	0.0%	=	0.5%	+	0.1%	+	-0.6%
Maine	1.6%	=	0.5%	+	1.4%	+	-0.3%
Maryland	0.9%	=	1.1%	+	1.4%	+	-1.5%
Massachusetts	0.3%	=	0.5%	+	2.3%	+	-2.5%
Michigan	0.4%	=	0.6%	+	2.4%	+	-2.6%
Minnesota	1.5%	=	1.1%	+	2.7%	+	-2.2%
Mississippi	2.1%	=	0.8%	+	2.0%	+	-0.7%
Missouri	1.9%	=	0.8%	+	2.0%	+	-0.9%
Montana	1.1%	=	1.1%	+	1.8%	+	-1.7%
Nebraska	1.6%	=	0.7%	+	2.4%	+	-1.5%
Nevada	2.8%	=	4.8%	+	0.8%	+	-2.7%
New Hampshire	2.4%	=	1.1%	+	2.8%	+	-1.5%
New Jersey	0.7%	=	0.8%	+	1.6%	+	-1.7%
New Mexico	1.0%	=	1.6%	+	3.2%	+	-3.7%
New York	0.4%	=	0.5%	+	1.4%	+	-1.6%
North Carolina	2.3%	=	1.8%	+	2.1%	+	-1.7%
North Dakota	1.4%	=	-0.1%	+	3.1%	+	-1.6%

State	GHG Emissions		Population		Per capita Income		GHG Intensity
Ohio	0.7%	=	0.4%	+	2.1%	+	-1.7%
Oklahoma	1.1%	=	0.8%	+	1.5%	+	-1.2%
Oregon	2.1%	=	1.7%	+	3.1%	+	-2.6%
Pennsylvania	0.2%	=	0.3%	+	2.0%	+	-2.1%
Rhode Island	2.3%	=	0.5%	+	1.7%	+	0.0%
South Carolina	2.3%	=	1.3%	+	1.9%	+	-0.9%
South Dakota	1.6%	=	0.7%	+	3.6%	+	-2.5%
Tennessee	1.3%	=	1.4%	+	2.5%	+	-2.5%
Texas	1.4%	=	2.0%	+	2.0%	+	-2.5%
Utah	1.2%	=	2.4%	+	2.3%	+	-3.4%
Vermont	1.3%	=	0.7%	+	2.0%	+	-1.5%
Virginia	0.8%	=	1.3%	+	1.8%	+	-2.2%
Washington	0.9%	=	1.7%	+	1.6%	+	-2.4%
West Virginia	0.1%	=	0.1%	+	1.9%	+	-1.8%
Wisconsin	1.2%	=	0.8%	+	2.6%	+	-2.2%
Wyoming	0.9%	=	0.8%	+	1.0%	+	-0.8%

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Note: The sum of the GHG emissions driver rates may not precisely equal the rate of GHG emissions in all cases. Nevertheless, the general relationship holds true.

Table A4. CO_2 Emissions Intensity and CO_2 Emissions Intensity Drivers for All 50 States, Listed Alphabetically (2003 data)

State	CO_2 Emissions Intensity	=	Energy Intensity	X	Carbon Content of Energy Use
	TCO_2 / $million of GSP	=	toe / $million GSP	X	TCO_2 / 1000 toe
Alabama	1,178	=	0.42	X	2,690
Alaska	1,624	=	0.69	X	2,300
Arizona	517	=	0.20	X	2,570
Arkansas	933	=	0.40	X	2,180
California	295	=	0.15	X	1,900
Colorado	509	=	0.19	X	2,620
Connecticut	269	=	0.14	X	1,890
Delaware	392	=	0.18	X	2,140
Florida	478	=	0.21	X	2,260
Georgia	569	=	0.25	X	2,220
Hawaii	502	=	0.18	X	2,740
Idaho	404	=	0.32	X	1,210
Illinois	497	=	0.21	X	2,320
Indiana	1,221	=	0.36	X	3,140
Iowa	839	=	0.31	X	2,640
Kansas	935	=	0.33	X	2,780
Kentucky	1,247	=	0.40	X	3,030
Louisiana	1,508	=	0.71	X	2,080
Maine	647	=	0.32	X	1,940
Maryland	411	=	0.20	X	2,050
Massachusetts	308	=	0.14	X	2,170
Michigan	557	=	0.23	X	2,320
Minnesota	510	=	0.23	X	2,220
Mississippi	993	=	0.45	X	2,100
Missouri	770	=	0.25	X	2,950
Montana	1,442	=	0.41	X	3,480
Nebraska	737	=	0.27	X	2,630

State	CO_2 Emissions Intensity	=	Energy Intensity	X	Carbon Content of Energy Use
	TCO_2 / $million of GSP	=	toe / $million GSP	X	TCO_2 / 1000 toe
Nevada	528	=	0.20	X	2,610
New	446	=	0.18	X	2,490
New Jersey	346	=	0.18	X	1,940
New Mexico	1,088	=	0.31	X	3,440
New York	271	=	0.13	X	2,030
North	511	=	0.23	X	2,190
North Dakota	2,400	=	0.50	X	4,770
Ohio	728	=	0.26	X	2,620
Oklahoma	1,114	=	0.40	X	2,740
Oregon	356	=	0.23	X	1,540
Pennsylvania	678	=	0.24	X	2,690
Rhode Island	330	=	0.16	X	1,990
South Carolina	701	=	0.34	X	1,990
South Dakota	558	=	0.26	X	2,040
Tennessee	672	=	0.30	X	2,150
Texas	933	=	0.40	X	2,270
Utah	885	=	0.25	X	3,470
Vermont	332	=	0.20	X	1,660
Virginia	443	=	0.22	X	2,000
Washington	365	=	0.22	X	1,660
West Virginia	2,719	=	0.46	X	5,780
Wisconsin	571	=	0.25	X	2,260
Wyoming	3,473	=	0.61	X	5,460

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Note: In all but four states, the product of the energy intensity value and carbon content of energy use value is slightly lower than the CO_2 emissions intensity value. This difference reflects the small percentage (on average 2%) of the states' CO_2 emissions that come from sources outside the energy sector (e.g., agricultural).

Table A5. CO_2 Emissions Intensity and CO_2 Emissions Intensity Drivers for All 50 States, Ranked by CO_2 Emissions Intensity (2003 data)

State	Rank	CO_2 Emissions Intensity	=	Energy Intensity	X	Carbon Content of Energy Use
		TCO_2 / $million of GSP	=	toe / $million GSP	X	TCO_2 / 1000 toe
Wyoming	1	3,473	=	0.61	X	5,460
West Virginia	2	2,719	=	0.46	X	5,780
North Dakota	3	2,400	=	0.50	X	4,770
Alaska	4	1,624	=	0.69	X	2,300
Louisiana	5	1,508	=	0.71	X	2,080
Montana	6	1,442	=	0.41	X	3,480
Kentucky	7	1,247	=	0.40	X	3,030
Indiana	8	1,221	=	0.36	X	3,140
Alabama	9	1,178	=	0.42	X	2,690
Oklahoma	10	1,114	=	0.40	X	2,740
New Mexico	11	1,088	=	0.31	X	3,440
Mississippi	12	993	=	0.45	X	2,100
Kansas	13	935	=	0.33	X	2,780
Texas	14	933	=	0.40	X	2,270
Arkansas	15	933	=	0.40	X	2,180
Utah	16	885	=	0.25	X	3,470
Iowa	17	839	=	0.31	X	2,640
Missouri	18	770	=	0.25	X	2,950
Nebraska	19	737	=	0.27	X	2,630
Ohio	20	728	=	0.26	X	2,620
South Carolina	21	701	=	0.34	X	1,990
Pennsylvania	22	678	=	0.24	X	2,690
Tennessee	23	672	=	0.30	X	2,150
Maine	24	647	=	0.32	X	1,940
Wisconsin	25	571	=	0.25	X	2,260
Georgia	26	569	=	0.25	X	2,220

State	Rank	CO_2 Emissions Intensity	=	Energy Intensity	X	Carbon Content of Energy Use
		TCO_2 / $million of GSP	=	toe / $million GSP	X	TCO_2 / 1000 toe
South Dakota	27	558	=	0.26	X	2,040
Michigan	28	557	=	0.23	X	2,320
Nevada	29	528	=	0.20	X	2,610
Arizona	30	517	=	0.20	X	2,570
North	31	511	=	0.23	X	2,190
Minnesota	32	510	=	0.23	X	2,220
Colorado	33	509	=	0.19	X	2,620
Hawaii	34	502	=	0.18	X	2,740
Illinois	35	497	=	0.21	X	2,320
Florida	36	478	=	0.21	X	2,260
New	37	446	=	0.18	X	2,490
Virginia	38	443	=	0.22	X	2,000
Maryland	39	411	=	0.20	X	2,050
Idaho	40	404	=	0.32	X	1,210
Delaware	41	392	=	0.18	X	2,140
Washington	42	365	=	0.22	X	1,660
Oregon	43	356	=	0.23	X	1,540
New Jersey	44	346	=	0.18	X	1,940
Vermont	45	332	=	0.20	X	1,660
Rhode Island	46	330	=	0.16	X	1,990
Massachusetts	47	308	=	0.14	X	2,170
California	48	295	=	0.15	X	1,900
New York	49	271	=	0.13	X	2,030
Connecticut	50	269	=	0.14	X	1,890

Source: Prepared by CRS with data from the WRI**,** Climate Analysis Indicators Tool.

Note: In all but four states, the product of the energy intensity value and carbon content of energy use value is slightly lower than the CO_2 emissions intensity value. This difference reflects the small percentage (on average 2%) of the states' CO_2 emissions that come from sources outside the energy sector (e.g., agricultural).