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Business Initiatives for Environmental Action in the Auto Industry: A Comparative Study between Germany and the United States

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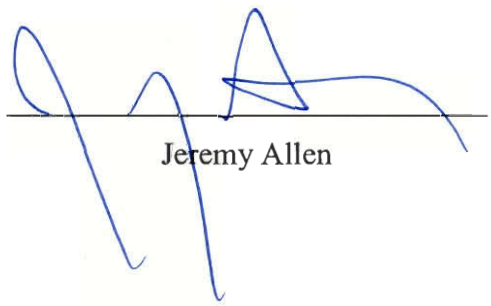

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Abstract

This report examines the incentives and initiatives for environmental action undertaken by German and American automakers. The backgrounds of six individual automotive manufacturers, of German and American environmental policy-making, and of current environmental issues are all included and the countries are compared with each other. The current and projected successes of both countries are critically analyzed and recommendations are made for the near future.

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Table of Contents

List of Figures

1 Introduction

It has been observed that as nations move towards democracy, economic stability, and improved education, there is an initiative to become more environmentally conscious. Legislation is drawn up and ratified in an effort to repair damages from the past and to conserve what resources remain. Often in times of rapid economic development, the environment is disregarded and exploited for its resources. In post-industrial times however, environmental concern rises and the public seeks to preserve its natural surroundings after having secured the means by which to afford it. Environmental preservation and protection become the task of every person, organization, and business.

The auto industry contributes its share of environmental damage through both its plants and products, mostly in the form of air pollutants, solid and liquid wastes, and oil consumption. The United States and Germany are both post-industrial nations with powerful economies and globalized businesses, which include the mammoth auto industry. Both countries have a recent record in environmental policy-making, and have made great contributions to automotive technology. The following six automotive manufacturers are the focus of this report: Ford, General Motors, DaimlerChrysler, Volkswagen, Audi, and BMW. More detailed information on these background topics can be found in section 2.

The business incentives and initiatives that motivate automakers to be environmentally responsible are many and varied. Each incentive-initiative combination explains how the automotive company, the country itself, and the environment benefit. These initiatives, with their correlating incentives, are described in full in section 3.

Taking the background information and varied initiatives into account, separated by which country it pertains to, and analyzing the differences yields the current and projected successes of the two countries. Following the listed successes are the author's recommendations, which are based on the data in the report and the successes of each country. These recommendations are intended for the auto industry, the German and American governments, and the general public as a means to educate and suggest improvements. These current and projected successes, along with the recommendations, can be found in section 4.

2 Background

In order to understand the influences that affect the decisions of an industry to be environmentally active, an understanding of the effect of cars on the environment and the background of the organizations involved is important. The history that shapes decisions, the laws that mandate change, and the pressure from the public and organizations all play a role in the existence and evolution of environmental policy and auto industry initiative. This section identifies those details by providing background on the environmental impact of automobiles, on the United States and German governments, and on the automakers themselves.

2.1 Environmental Impact of the Automobile

By simply looking at a running automobile, one can see the exhaust dissipating into the atmosphere. Accordingly, most people would primarily think of air pollution when asked about the possible harmful effects of cars on the environment. In terms of this report, these emissions will be the main focus on the environmental impact cars have, however there are other ways in which cars contribute environmental stress. Some of these include depletion of irreplaceable fossil fuels, solid waste, and the effects the plants which manufacture the cars have. Nevertheless, the automobile industry's contribution to air pollution is of primary concern and therefore a center of attention for this report.

There are a few reasons why auto emissions are the best polluting factors to analyze in this report. Not only is it easy to measure, but the techniques used to measure output are comparable between the United States and Germany. There is also a lot of

research done in this field by governments, independent organizations, and the auto-makers themselves, so information is abundant. There is also a long history of air pollution data collection, where changes through time have been charted. Emissions have also been the major focus of the auto industry for improvement.

2.1.1 Emissions

Cars produce energy through the combustion of liquid fuel, primarily gasoline or diesel. Ideally speaking, this process involves a highly combustible hydrocarbon (the fuel) and air (oxygen; O_2) exploding to produce energy and the products water vapor and carbon dioxide (CO_2). Unfortunately, this process does not always create those ideal products and in different circumstances, a number of other chemicals can be formed. Atmospheric nitrogen, which is taken into the engine along with the oxygen, can react to form various nitrous oxides (NO_x); the sulfur content in the gasoline can also react with the oxygen to produce sulfur oxides (SOx), of which the most notable is sulfur dioxide (SO_2); instead of the formation of CO_2, the carbon and oxygen can also form carbon monoxide (CO); the hydrocarbons (HCs) in the fuel form may also be broken down slightly instead of combusted, and produce smaller chain HCs, which are part of a family of emissions called volatile organic compounds (VOCs); and lastly, when the fuel is too concentrated, parts of it do not breakdown whatsoever and are emitted as particulates, which are more commonly found in diesel engines. These chemicals involved in the combustion of fossil fuels are not only found in automobiles, but in every machine used to get energy from fossil fuels. The facilities and plants where the cars are manufactured

also produce emissions, and it is the direct responsibility of the manufacturer to manage them as well.

Each of these emissions has particular effects on the environment and on human health. They can be primarily broken down into two main groups: conventional emissions and greenhouse gas emissions. Conventional emissions are air pollutants that have a direct effect on human health and other forms of life. Conventional emissions include NO_x, VOCs, CO, and particulates. NO_x and VOCs both produce ground level ozone, which is one of the most serious urban air quality problems around the world. Along with particulates, NO_x, VOCs, and ozone are all lung irritants and can contribute to asthma, bronchitis, and general breathing difficulties. CO is a colorless and odorless gas which suffocates tissue by cutting off oxygen delivery.[1]

Greenhouse gas (GHG) emissions are pollutants, particularly CO_2 and methane (a HC; CH_4), that affect the environment by trapping heat radiated by the earth in the atmosphere. These GHGs are thought to contribute to global warming and climate change throughout the world. CO_2 is the most important of the GHG emissions due to its direct relation to fuel consumption by cars.[2] Every gallon of gasoline burned in a vehicle produces 20 pounds (9.1 kg) of CO_2 into the atmosphere.[3] CO_2 is also a major pollutant emitted by the plants which manufacture the cars, and is likewise a focus for individual companies to manage and reduce. Refer to Figures 10-14 in section 2.2.3 for graphical representations of national emission levels in the United States and Germany.

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[1] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 2.
[2] *Ibid.*
[3] "Model Year 2003 Fuel Economy Guide." Environmental Protection Agency and Department of Energy, 2003, pg 3.

Neither the United States nor Germany has direct regulations for CO_2 emissions from motor vehicles, however they do have regulations for fuel economy. Since CO_2 output is a direct reflection of how much fuel is used, regulations on fuel consumption also limit the amount of CO_2 emissions.[4] Likewise, fuel economy programs also decrease other emission levels, although most emissions are specifically and strictly regulated by both nations. Both countries have current legislation regulating the specific volume of emissions a vehicle may have, including HC, non-methane HC (NMHC), VOCs, CO, NO_x, and particulates.[5] See Figures 16 and 17 in section 2.2.3 for comparisons between the regulations in the United States and Germany.

Technological improvement in cars has cleaned them up; present-day cars are about 95% cleaner per mile than new cars of the 1960s.[6] Some improvements include catalytic converters, electronic fuel controls, fuel-injection systems, exhaust gas recirculation, and evaporative emissions controls.[7] Regrettably even these improvements have not solved the problem entirely. The Environmental Protection Agency (EPA) estimates that vehicles contribute about 66% of total CO emissions, 33% of NO_x emissions, and 25% of VOC emissions in the United States. These percentages are even higher in urban areas. The upgrades in automobile technology up to this point have primarily been improvements on existing technology, instead of the development of new

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[4] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 3.
[5] "Emission Standards: USA Cars and Light-Duty Trucks." DieselNet, 2003, http://www.dieselnet.com/standards/us/light.html
"Emission Standards: Europe Cars and Light-Duty Trucks." DieselNet, 2003, http://www.dieselnet.com/standards/eu/ld.html
[6] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 3.
[7] "Green Vehicle Guide." Environmental Protection Agency, 2003, http://www.epa.gov/greenvehicles/

technology.[8] Average fuel efficiency has actually *decreased* in the past 15 years; new vehicle fuel economy peaked in 1987-1988. Average fuel economy for all model year 2003 (MY2003) light-vehicles is 6% lower than the average in MY1988.[9] When divided into the subgroups of cars and light trucks (which includes SUVs, vans, and pick-ups), car fuel efficiency has changed very little since 1986, ranging from 23.6 to 24.8 miles per gallon (mpg) [10.0 kilometer per liters (kpl)-10.5 kpl]. Light truck fuel efficiency has also remained practically the same, ranging from 17.3 to 18.4 mpg [7.4 kpl to 7.8 kpl].[10] Refer to Figure 1 below for a graphical representation of this data.

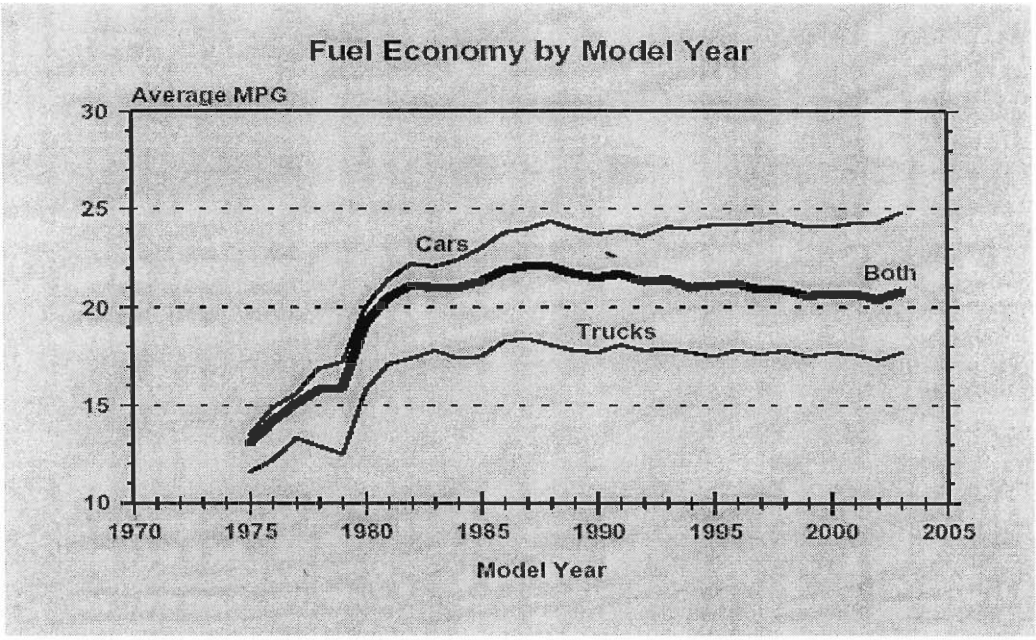

Figure 1: Fuel Economy by Model Year. This table charts the average fuel economy (mpg) for cars, trucks, and the combined value. This data is for vehicles in the United States, model year 1975 until 2003. Source: Hellman KH and Heavenrich RM. "Light-Duty Automotive Technology and Fuel Economy Trends." Page 2.

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[8] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 3.

[9] Hellman KH and Heavenrich RM. "Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2003." Environmental Protection Agency, April 2003, pg 1.

[10] *Ibid*, pg 2.

2.1.2 Other Environmental Issues

The auto-makers and the cars they produce affect the environment in other ways besides emissions. An increasingly noticeable problem is the rapid depletion of the earth's finite fossil fuel resource. In the United States, light-vehicles account for about 40% of national oil consumption.[11] In the United States, gasoline consumption per capita has increased 145% from 1960 to 1997, and in Germany it has increased a significant 500% in the same time period.[12] Refer to Figure 2 below for a graphical representation of gasoline consumption per capita in the United States and Germany.

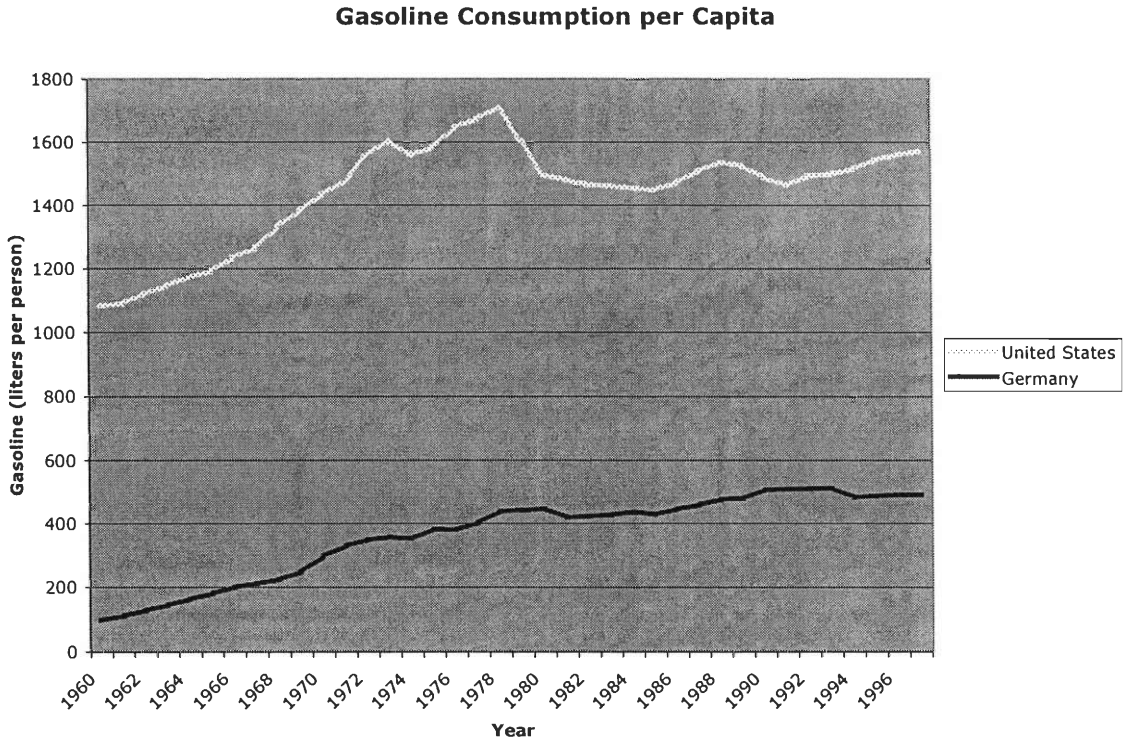

Figure 2: Trend of gasoline consumption per capita in the United States (lighter) and Germany (darker) between 1960 and 1999. Source: EarthTrends, 2003.

[11] *Ibid*, pg 1.
[12] "EarthTrends: The Environmental Information Portal." World Resources Institute, 2003, http://earthtrends.wri.org/

At the end of a car's useful life, there arises the problem of solid waste. Unused fluids in the car are also a waste, as are most deteriorated mechanical joints and high impact pieces. The simple fact that cars take up a lot of space when out of use is an environmental concern, as landfills and junkyards are already exceeding their limit.

The plants which manufacture the cars also contribute a great amount of pollution, in terms of the previously mentioned emissions, as well as wastes and energy use. Throughout the process of making a vehicle these plants produce CO_2; waste metal, other component materials, paints, and solvents; and use a great amount of energy. The solid and liquid wastes must then be disposed of, and therefore affect the local environments where the plants are found. Energy consumption in the plants is similar to the oil consumption of cars: it is expensive and finite. Manufacturing facilities use high amounts of local energy for many steps of the processes, including heating metal, powering assembly machines, pressurizing air, preparing paints, and controlling the climate of the buildings. All of these place a demand on the local and national environments in which they exist.

2.1.3 Public Concern

So why should people care? How does this even pertain to average American or German citizens and their daily life? Maybe it doesn't. Many big scares about the environment have been unjustified, according to a report in *The Economist*, an internationally respected magazine of politics and economics. Bjorn Lomborg, a statistician at the University of Aarhus in Denmark, claims that some environmental reports are exaggerated and unjustified. For example, the claim that natural resources are

running out does not agree with the fact that more reserves of fossil fuels have been discovered since environmental concern for them began in the 1970s.[13] Of course, the earth has a finite mass and a finite amount of fossil fuels and other resources; however this defined amount is still unknown to us, since we are still finding fossil fuel deposits. In fact, the limiting factor thus far is not the *quantity* of oil reserves, but the cost of discovering and exploiting them. At the current rate of consumption of oil, the known reserves could fuel the world need for at least 150 years.[14] Throughout history, man has exploited a resource, energy for example, until its demand supercedes its supply, prices increase, and new methods of obtaining energy are researched and employed.[15] That is the case with current research in hybrid engines, hydrogen fuel cells, and other alternate forms of engine fuel.

Pollution is not as bad as environmentalists would like the public to believe either, especially in richer and more democratic nations, like the United States and Germany. Concern for pollution is an economical factor as much as it is environmental. In nations where industrial growth outweighs the need for environmental concern, economics wins. Such has been the case with the United States and Germany in their industrial revolution periods, where the volumes of emissions were not as much of a concern as the need for economic growth. As the nations grew economically, they had the ability to then tighten and restrict polluting sources, but only after their economic strength had been secured.[16][17] The greenhouse effect seems to be somewhat 'hyped up' in the sense that its long lasting

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[13] Lomborg B. "The truth about the environment." *The Economist,* 2 August 2001.
[14] *Ibid.*
[15] "Our durable planet." *The Economist*, 9 September 1999.
[16] *Ibid.*
[17] Lomborg B. "The truth about the environment." *The Economist,* 2 August 2001.

effects may be less damaging than the public is led to believe. Estimated increases in global temperature should reach 1.9 degrees Celsius by 2094 without any action taken, according to a UN report from the Climate Change Panel. In the same report, the lasting effects of the Kyoto Protocol, an international agreement to take measures against GHGs, would only postpone this temperature increase until 2100.[18] Both the United States and Germany are signers of this agreement (1998), however only Germany ratified it (2002).[19] Perhaps one reason the United States did not ratify this agreement is because this minute change in global temperature would most likely be financially easier to adjust to when the time came. Nonetheless, the major reason that pollution has decreased in these nations is because of the concern they had and the measures they took to prevent it. Without these preventative measures, the levels of air and water pollution would have continued to rise, and thus it is important that these countries, albeit developed and rich, continue to support restrictions and regulations on pollutants.

The average consumer also seems unaffected by environmental concern. The sales of light trucks (SUVs, pickups, and vans), which are known gas guzzlers and environmentally unfriendly, have steadily risen in the past quarter century in the United States. Figure 3 below illustrates the growing trend in vehicle sales in the past 25 years. The increase in sales for SUVs has been over 1000% since 1975, vans have been 80%, and pickups generally constant. This subdivision of light-vehicles focused on in this

[18] *Ibid.*
[19] "EarthTrends: The Environmental Information Portal." World Resources Institute, 2003, http://earthtrends.wri.org/

report, the light trucks, accounts for 48% of the light-vehicle market.[20]

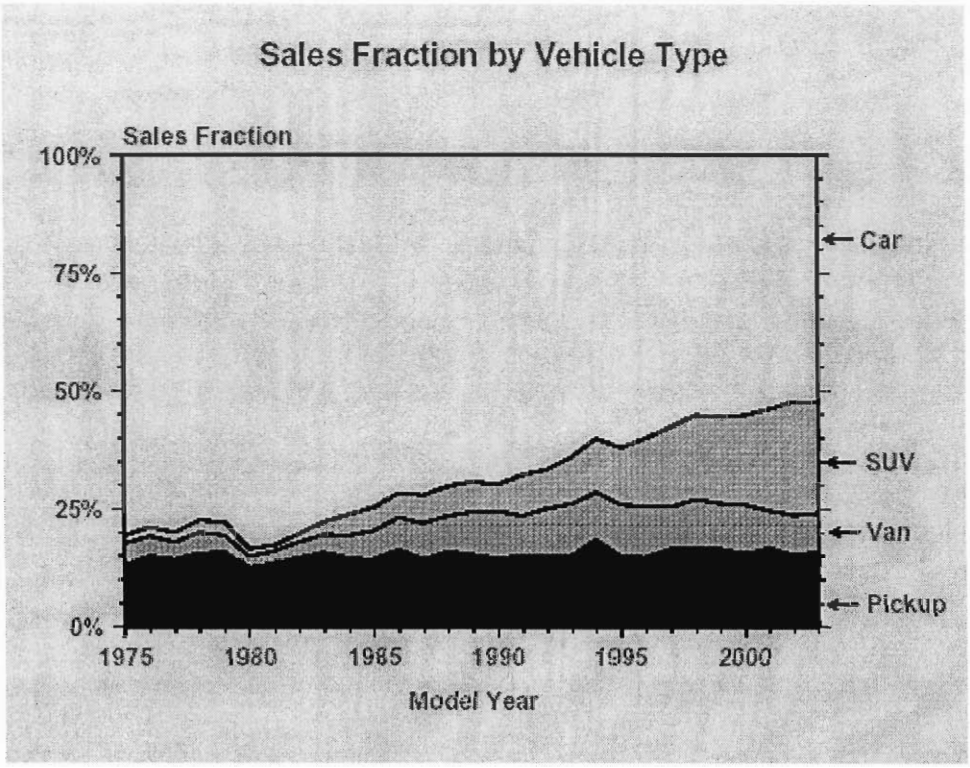

Figure 3: Sales Fraction by Automotive Type. This figure charts the increase in light-duty truck sales since 1975. What used to be mostly a car dominated market, in 2003 almost half of the sales are light-duty trucks. Source: Hellman KH and Heavenrich RM. "Light-Duty Automotive Technology and Fuel Economy Trends." Page 3.

These vehicles average more than 6 mpg [2.55 kpl] less than the light-vehicle car subdivision. It has been observed that most people who purchase cars are aware of their environmental damages, however the desire for cars is in fact increasing yearly. People also rate other details of their new car, such as size, power, speed, comfort, and accessories, higher on their list than environmental factors.[2122] This increase in sales

[20] Hellman KH and Heavenrich RM. "Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2003." Environmental Protection Agency, April 2003, pg 3.

[21] Jensen D. "Rüben in der Tür, Rhabarber im Sessel." *Frankfurter Rundschau*, 5 September 2001. "Turnips in the door, rhubarb in the seats." Translated by Jeremy Allen and David Dollenmayer.

when the public is aware of their fuel inefficiency is disheartening when trying to promote greener vehicles, and makes auto companies less likely to invest in a market that is not as financially rich as light truck sales.

However, it is clear that both air and other forms of pollution caused by cars play a role in people's lives, affecting their health, finances, and future. As mentioned previously in section 2.1.1, various emissions have detrimental effects on human health, ranging from irritated lungs to pollution-induced asthma and bronchitis. There are also financial incentives to purchase a green vehicle; it is estimated that one could save 300-500 dollars [270-450 euros] in fuel costs per year by driving a more fuel efficient car.[23] One may also be eligible for a tax break by purchasing a qualifying electric or clean-fuel vehicle, in the form of federal income tax credits or reductions.[24] Car companies can also effectively reduce the cost of new vehicles from the money saved from various forms of recycling.

The future of the economy is also affected by the decision of the population to purchase green vehicles. Since fuel efficient vehicles and fuel consumption are inversely proportional, a nationally greater number of economical vehicles would decrease that nation's dependency on fossil fuels. This in turn would decrease national spending on what is mostly imported fossil fuel and free up funds for economic growth. For example, the United States consumes over 90 million barrels of oil per week, costing almost 2 billion dollars [1.8 billion euros]. Since half of the oil used by the US is imported, a

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[22] Wille J. "Vom grünen Ladenhüter zum Verkaufsknüller." *Frankfurter Rundschau*, 6 November 2001. "From the shelf-warmer to the big seller." Translated by Jeremy Allen and David Dollenmayer.
[23] "Model Year 2003 Fuel Economy Guide." Environmental Protection Agency and Department of Energy, 2003, pg 3.
[24] *Ibid*, pg 2.

decreased dependence would allow the US to spend the saved money on other factors to improve the nation.[25] Likewise, the decreased need for fossil fuels would offset the supply-demand scale and cause a lowered price tag on gasoline and diesel. A decreased dependence on fossil fuels would also provide a political advantage. The United States and the European Union would have more political leeway with nations who control the oil trade, namely Iraq, Iran, and other nations in the Middle East.

These factors should play a role in the consumer's decision when purchasing a new vehicle. Their decisions are meticulously observed and recorded by the auto industry, mostly to determine what the consumer wants in an effort to stay on top of the market. And while most auto manufacturers follow consumer trends to determine how green their vehicles should be, there are certain means by which the federal government can influence the direction of environmental policy in the auto industry.

2.2 Governments

The German and American governments both have very developed environmental laws, and have been in the forefront of the international environmental policy making since the 1970s. While they come from very different pasts, both countries have established themselves in the world as economic superpowers and international role-models. The United States and Germany also support large populations and are among some of the largest car manufacturing nations, showing the inherent need to stay on top of environmental protection. Each country, however, is approaching it from different angles.

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[25] *Ibid*, pg 3.

2.2.1 The United States

With a population of 280.6 million people and a land area of 9.2 million square kilometers, the United States of America is the third largest country by both population and size. Nevertheless, it is the strongest, most influential and powerful nation in the world. A federal republic, with a strong tradition of democracy, the US is often looked at in times of trouble and prosperity as the international example of 'what to do.' It is likewise often criticized and reprimanded for taking action that goes against the character of an international role-model.

The Central Intelligence Agency (CIA) World Factbook describes relevant US environmental issues to include air pollution resulting in acid rain in the US and Canada, as well as the US being the largest single emitter of carbon dioxide (CO_2) from burning fossil fuels.[26] Its energy consumption is also among the highest in the world, at 3.613 trillion kWh per year, or about 13000 kWh per capita.[27] With both America's size and population, these energy consumption statistics seem difficult to change, as they have been set in 'the American way' since the very beginning of American history.

After declaring its freedom from Britain in the late 1700s, the newly born United States of America sought to establish itself as an independent economic strength. This led to reckless exploitation of the country's resources as a means of fast economic growth and development. This exploitation continued for almost 200 years as the United States expanded westward, conquered new territories, and fought wars both on the home front

[26] "The World Factbook: United States." The Central Intelligence Agency, 2002, http://cia.gov/cia/publications/factbook/geos/us.html
[27] *Ibid.*

and internationally. In the late 1960s and early 1970s, both the government and growing 'green organizations' began to take notice of the country's growing environmental issues. Among the relevant issues, they included high rates of fossil fuel combustion both per capita and per unit of economic output; major air and water pollution due to coal burning and increased industry from war; high and continually rising rates of air pollution from cars, both due to high per capita ownership and high amounts of usage; and the transfer of public and industrial transport from trains to motor vehicles[28].

The United States has had a five-stage process to the development of its environmental policy. Before the federal government became active in policymaking, the sub-national governments took on full responsibility for environmental action. This was mostly ineffective though, as most forms of pollution (e.g. air and water) know no boundaries. Then, between 1970 and 1980, the federal government took over and instituted "authoritative national regulatory policies for environmental protection"[29]. The Environmental Protection Agency (EPA) was founded to establish national environmental standards. The National Environmental Policy Act (NEPA, 1969) established a nationwide policy goal of "harmonizing human activities with environmental conditions,"[30] as well as created the Council on Environmental Quality to advise the President on environmental policy. The Clean Air Act (1970) and the Clean Water Act (1972) were also established to institute national goals for air and water quality control.

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[28] Andrews RNL. "United States." National Environmental Policies: A Comparative Study of Capacity-Building. Springer, 1997, pg 26.
[29] *Ibid*, pg 25.
[30] *Ibid*, pg 28.

Between 1980 and 1983, during the Reagan administration, environmental policy took a big hit. This great backward step was done with intentions to free up big business from governmental control. Some examples of backward movement during this administration were the approximate 33% budget cut from the EPA, the removal or rewriting of 50 environmental regulations, and the substantially reduced reinforcement of existing policies.[31]

The next stage of American environmental policy occurred between 1984 and 1994, and had the daunting task of repairing the previous three years of damage the Reagan administration caused. In these ten years, the "authoritative policies" mentioned before were reinstated, and with conviction. Criminal indictment, increased reinforcement of the laws, and numerous lawsuits were among the means by which environmental policy was re-established. In the last and final stage of American environmental policy, from 1994 until when the source was published, 1997, small business and local government continue to challenge the federal government. When the government introduces new regulations for better environmental consideration, they are faced with outspoken businesses and local governments fighting strict regulations. These opposing forces spell an uncertain future in American environmental policy;[32] which could go in either direction. If the United States returns to a Reagan-like administration, with the backing of small business and local governments, environmental protection could be minimalized. On the other side of the spectrum, the federal government could win out in the struggle and a greener outlook within the government could help accelerate the US into the leading nations of environmental policy.

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[31] *Ibid*, pgs 28-29.
[32] *Ibid*, pgs 29-30.

At the 1992 UN Conference on Environment and Development, President George Bush Sr. "refused to consider any reduction in [the United States'] consumption of fossil fuels and other resources, and was the one nation that refused to sign the Biodiversity Convention."[33] Continued globalization will most certainly play a role on environmental policy among international business. ISO 14000 environmental certification and EU eco-audit and product standard compliance both loom across the Atlantic (see section 3.1.2). This may also backfire, as international businesses may request exemption, when they comply with international environmental standards that are more lenient than the correlating American standards.

One major problem in the development of US environmental policy is the inherent nature of the 'checks and balances' system created at the birth of the nation. In order to avoid any one division of the government to have power, each major branch has the authority to alter or veto a decision made by the other. Many different parts of the government therefore have a part in the policymaking of the country, for example the national and sub-national governments, the court system, and various agencies. With all of these players, it is too easy for policymaking to come to a standstill as they all try to find a common ground on which to agree. Most countries have a particular ministry or department that deals solely and independently on environmental concerns and policymaking. Unfortunately this isn't the case in the United States, as the EPA is not completely in charge of American environmental issues. The courts play a politically independent role in the environmental policymaking, and the state and local governments play a role as the greater owner of land and resources in the country. State and local

[33] *Ibid*, pg 37.

governments are not required to implement national regulations, but in so doing are at risk of losing federal funding. It is also noteworthy that some states have taken independent initiative to increase their own capacity for environmental policy, such as California's stricter air quality standards and New Jersey's mandatory recycling laws.[34]

There are also a large number of green organizations, which consist of national groups, green research groups, local groups, as well as civic and philanthropic groups that support green work. It is also important to note, "many of these organizations are also far more active and effective in policy advocacy than their counterparts in other countries[35]." Mass media in the US plays a great role in heightening public awareness of environmental issues, both through the news and documentaries.

So where is the United States now? Since the beginning of the environmental laws in 1970, there has been great improvement overall in care for the environment. There have been major reductions in most air pollutants: there has been a one third to one half decreases in most emissions, nitrous oxides have remained somewhat steady, and lead has almost totally been eradicated from the air. What was the highest output of volatile organic compounds (VOCs) per capita among all of the Organization for Economic Cooperation and Development (OECD) countries in 1970, the United States reduced its output by almost 50% by 1990. The pollutions standard index (PSI), which is "the best integrated indicator of air pollution exposure,"[36] improved by 50% for most major urban areas between 1980 and 1991. Recycling increased significantly throughout the nation, going from 7% to 17% from 1970 to 1990.

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[34] *Ibid*, pg 35.
[35] *Ibid*, pg 33.
[36] *Ibid*, pg 27.

Unfortunately, the United States still has environmental problems. The nitrous oxide (NO_x) emission has remained constant since 1970. The amount of vehicles per capita has increased, as well as a 68% increase in number of vehicle miles traveled.[37] The actual rate of energy consumption is high, as mentioned before to be about 13000 kWh per capita. In 2002, energy production by source was 71% fossil fuel,[38] and the petroleum production was 40% higher in 1990 than it was in 1970.[39] Even with the improved recycling percentage, it is still significantly less than found in most countries. Overall, the United States has made a positive step forward since the beginning of its environmental policy-making in 1970, yet still has many steps to take on the road to become a sustainable and environmentally conscious society.

2.2.2 Germany

As Europe's largest economy and most populous nation, Germany has been in the spotlight in Western Europe for various reasons since its initial birth in 1871. It marked itself as a highly industrial nation in the late 1800s, and in the early to mid 1900s, played major roles in World War I and II. In the 50 years since its defeat in World War II and about 10 years after the reunification of East and West Germany, the economy of present-day Germany is among the strongest in all of Europe. This was accomplished mostly due to the large population density (about 238 people per km2) and its highly industrialized

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[37] *Ibid*, pg 27-28.
[38] "The World Factbook: United States." The Central Intelligence Agency, 2002, http://cia.gov/cia/publications/factbook/geos/us.html
[39] Andrews RNL. "United States." National Environmental Policies: A Comparative Study of Capacity-Building. Springer, 1997, pg 28.

sector.[40] Environmentally speaking however, this economic comeback came with some heavy consequences.

The industrial sector of Germany is cause for a great environmental threat to both Germany and its surrounding neighbors. Among other concerns, the agricultural sector had become heavily industrialized based on a need for efficient use of space, the transport network is very dense, and the amount of traffic is steadily increasing.[41] In the 1970s and 1980s, the air pollution from both mobile and stationary sources called attention as the air pollutants (e.g. sulfur dioxide [SO_2], particulates, carbon monoxide [CO], NO_x, and VOCs) were noticeably decreasing air quality, causing smog throughout the country, and having an adverse effect on the plant life. To this day, Germany is described as having problems with emissions from coal burning utilities, as well as acid rain from excess SO_2 emissions.[42] Still, Germany began its environmental policy making around the same time as the United States, in response to both internal and external pressures to take action against further environmental degradation.

The (Western) German government began to examine environmental policy in the late 1960s, and when pressured from outside interest groups, initiated its own environmental policy in 1970. Modeled after the United States' NEPA, the German government's first environmental protection acts were passed in 1970. Likewise, the German Council for Environmental Advisers was founded in 1971, based on the US Council of Environmental Quality, with the purpose of providing advice on environmental matters. The German Council published its first paper in 1972 on

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[40] *Ibid*, pg 133.
[41] *Ibid.*
[42] "The World Factbook: Germany." The Central Intelligence Agency, 2002, http://cia.gov/cia/publications/factbook/geos/gm.html

automobiles and the environment. The German Federal Environmental Agency (*Umweltbundesamt*) was founded in 1974, using the EPA as a model.[43]

Internationally speaking, Germany was not the trendsetter in environmental policy-making; the US, Sweden, Japan, and the UK all provided the groundwork on which the German government based its early policies. Nonetheless, Germany made steady progress for the next 20 years, and brought itself from a follower to a leader among the Western European nations. Germany was successful based on its position for developing pollution control technology. One example is its emission-reducing technologies, which are extremely widespread throughout Europe and the world. Germany actually has some of the strictest emission standards throughout Europe, based on their superior SO_2 and NO_x reducing technology.[44]

As with the United States, there are a number of influential groups and organizations that play a role in the development of German environmental policymaking. The head division within the government is the Ministry of Environment, in conjunction with the sub-national 16 state environmental ministries. The Ministry of Environment is more powerful than its American counterparts, and therefore has more freedom in designing and passing new environmental policies. *Die Grünen*, the German green political party, has a lot of support and is the third largest political party in the nation. Germany also has its share of green organizations, and boasts more than four million total members.[45]

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[43] Jänicke M and Weidner H. "Germany." National Environmental Policies: A Comparative Study of Capacity-Building. Springer, 1997, pg136.
[44] *Ibid*, pg 142.
[45] *Ibid*, pgs 144-145.

One particularly helpful factor in Germany's development of environmental policy is its marriage of economic and ecological growth. The OECD report on environmental performance in Germany states that it has made amazing progress in combining economic growth with its environmental goals. This 'eco-industry' dominates the market, both internally and comparatively, and employs about 2% of Germany's total employment. The eco-industry's goals are to develop green products, and therefore a green market, driven by environmentally conscious consumers.[46] Rainer Greisshammer, a researcher for the Eco-Institute in Freiburg, believes that "no longer is the main environmental concern emissions and waste water, but the types of products [on the market] and their applications."[47] This is the belief of many in Germany, which has initiated such a nationally widespread drive towards 'eco-friendly' products. The Ministry of Research in Berlin is also working to develop new versions of old products with sustainability in mind. They are also developing market plans to promote these products through means of media and research competitions. The Ministry has defined eight important product fields where environmental consideration should be taken: mobility, household products/appliances, computers, televisions, grocery products, and textiles. These combined account for about 66% of Germany's energy and resource use.[48]

This concerted effort towards producing a whole market for environmentally friendly products, geared towards environmentally conscious consumers, has made a

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[46] *Ibid*, pg 145.
[47] Wille J. "Vom grünen Ladenhüter zum Verkaufsknüller." *Frankfurter Rundschau*, 6 November 2001. "From the shelf-warmer to the big seller." Translated by Jeremy Allen and David Dollenmayer.
[48] *Ibid.*

good and lasting mark in Germany. The public has also played a role in the development of environmental policy. In the early 1990s, the public opinion of Western Germany still considered its environmental situation to be bad.[49] This has been an important driving force in the further improvement of German environmental policy since its beginning in 1970.

In June 1990, a program for reducing CO_2 emissions was passed, which worked in conjunction with major industry to accomplish a set goal: reducing CO_2 emissions by 25-30% of their 1987 level by 2005. In 1995, both the chemical and energy industries began publishing advertisements of reducing emissions by 25-30% based on 1990 levels by 2000 and 2015, respectively.[50] Another positive step in environmental policy-making was in 1997, when the German automotive industry agreed to reclaim outdated models for recycling and disposal, as part of a trend of "an increasing number of voluntary agreements between industry and public authorities or environmental organizations."[51] This legislation is known as the "end-of-life" mandate, and can be seen in Figure 4. By 2005, automotive makers in the EU must prove that they can comply with the 2006 deadline that 85% of each vehicle must be recoverable, and no more than 5% of that for thermal energy recovery. By 2015, the recovery amount is up to 95%, with a 10% maximum of thermal energy recovery.[52] This means that the automaker must be responsible for both the collection and disposal of end-of-life vehicles. Using thermal energy as a means to recover the vehicle relates to the combustion of certain materials in

[49] Jänicke M and Weidner H. "Germany." National Environmental Policies: A Comparative Study of Capacity-Building. Springer, 1997, pg 135.
[50] *Ibid*, pg 138.
[51] *Ibid*, pg 140.
[52] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 74.

the car to be used as heat for various purposes. Associated with this end-of-life directorate was a new regulation passed in July 2003 on heavy metals used in manufacturing automobiles, restricting the use of lead, cadmium, mercury, and hexavalent chromium except "in exceptional cases."[53]

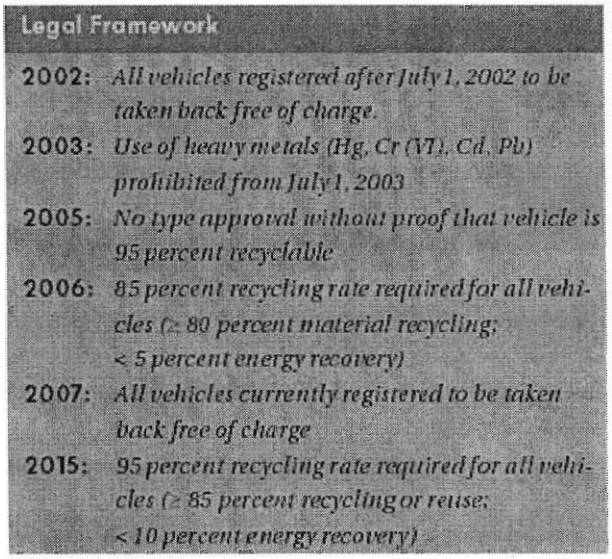

Figure 4: End-of-life mandate schedule. These affect only the European Union. Source: VW Environmental Report 2001-2002, pg 68.

Germany's current status, much like that of the United States, is marked with both improvements and setbacks since its environmental policy inception over 30 years ago. Some of the emissions have decreased remarkably throughout the years, particularly SO_2, CO, and air particulates. Increase in road traffic has had an adverse effect on the air though, which can be observed in the increase or stability of such emissions as CO_2, NO_x, VOC, and CH_4. The damage to the environment based on the increase in private transport is still an environmental threat; the current trend for increase in number of passenger cars, increase in mileage driven, cars with larger engines, and an increase in road construction all point to the continued issue with automobile pollution.[54]

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[53] *Ibid.*
[54] *Ibid*, pg 134.

2.2.3 Comparing Backgrounds: The United States and Germany

While both the United States and Germany have had a similarly long history of environmental policy-making, they both approached it by different means and achieved somewhat different goals. To make accurate comparative statements, it is important to look at both countries from the same perspective. Figures 5 through 8 below compare statistical information for each country: populations, land area, population density, and energy use per capita. Looking at the graphs, it is apparent that the United States dwarfs Germany in both actual population and land mass. It is therefore no surprise that, with the current trends towards increased number of cars per household,[55] the following statistics are higher in the US: total number of cars is higher, the total number of miles driven is higher, and greenhouse gases emitted are higher, particularly CO_2. That stated, Germany has eight times the population density of the US, and the vehicle density is 4.5 times higher as well.[56] High population and vehicle density is a major problem, as it contributes concentrated amounts of pollutants rather than more dispersed. Urban areas take the greatest toll on automotive pollution due to the high population density, vehicle density, and constant and often heavy road traffic.

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[55] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 3.

[56] Chen HW and Fang SH. Air Pollution Control Fee: The Taiwan Experience. Environmental Protection Administration, Taiwan, 2003. http://cemnt.epa.gov.tw/eng/webezA-4/code/main1.asp?catNo=4&cat=Air%20Pollution%20Fee

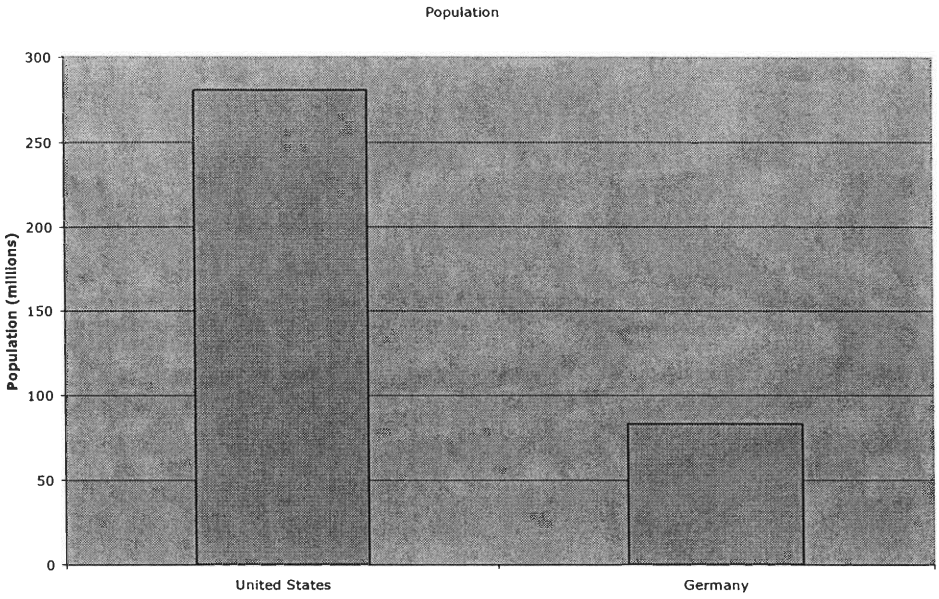

Figure 5: Population comparison. Data Source: The CIA World Factbook 2002, Germany.

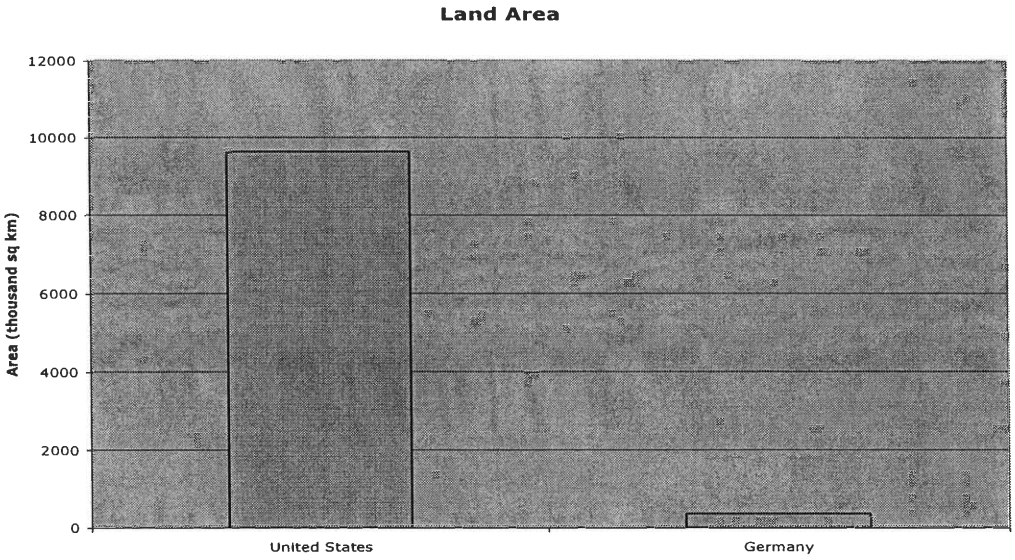

Figure 6: Land area comparison. Data Source: The CIA World Factbook 2002.

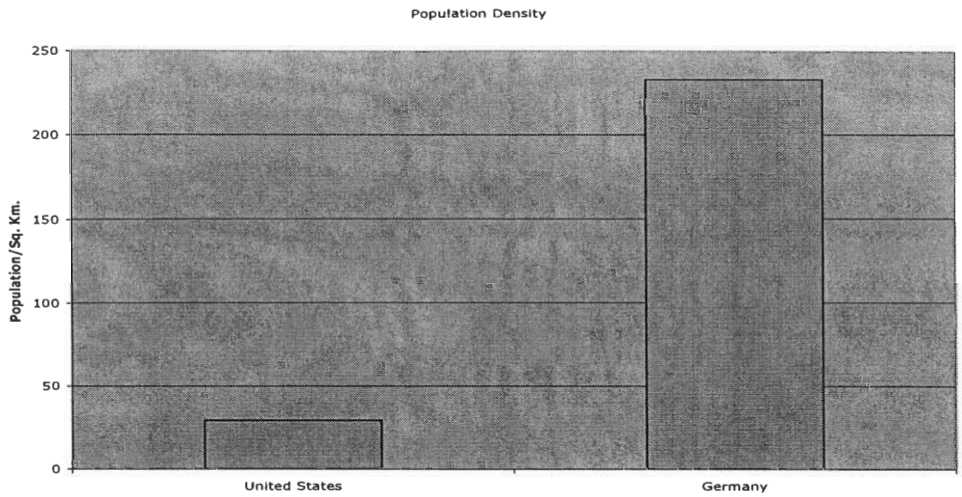

Figure 7: Population density. Data Source: The CIA World Factbook 2002.

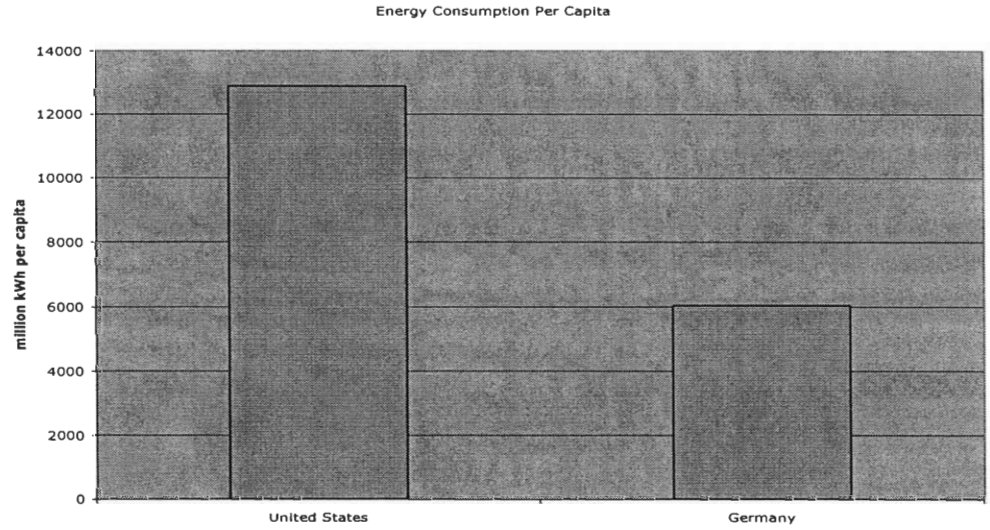

Figure 8: Energy Consumption per Capita. Data Source: The CIA World Factbook.

Energy use in Germany has remained stubbornly constant since 1973,[57] where Germany uses about 501.72 billion kWh per year, or about 6000 kWh per capita.[58] This is, however, only half that of the average per capita usage in the United States. Energy use in the United States has been continually growing, and is one of the more reckless of

[57] *Ibid*, pg 135.
[58] "The World Factbook: Germany." The Central Intelligence Agency, 2002, http://cia.gov/cia/publications/factbook/geos/gm.html

the developed nations in terms of fossil fuel consumption. Germany's electricity and heat production account for 37% of its total CO_2 emissions, as compared to the United States' 45%.[59] Along with comparing the two pie charts in Figure 9 below, it is noticeable that these percentages come from the fact that the United States' largest source of energy output is by means of fossil fuels. Germany has a 10% greater use of nuclear power than the United States; the current German government signed an agreement to phase out nuclear power in the next 15-20 years in 2001.[6061] The major opposing political party, who are in favor of nuclear power, bring up a good point: When all of the energy from nuclear source is phased out, where will that other third of energy come from? If Germany, even temporarily, relies on conventional power plants to produce that extra energy, the extra amount of CO_2 emissions would severely set back any progress made with automobile technology.[62] It would also put Germany at 93% energy output from fossil fuels. With this much energy output creating emissions like CO_2, it is imperative that automobiles contribute as little as possible in terms of greenhouse gas output.

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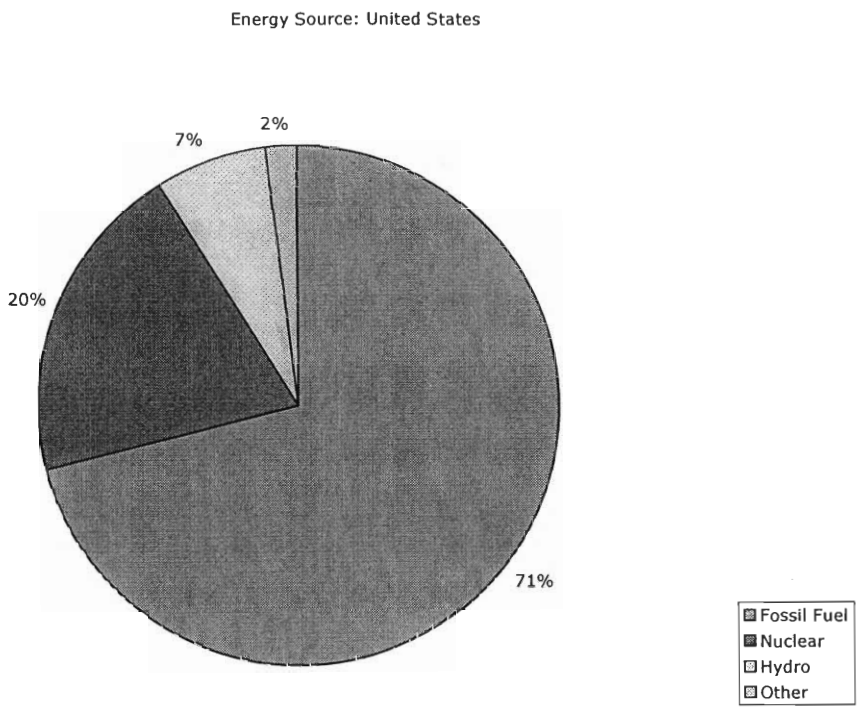
[59] *Ibid.*
[60] *Ibid.*
[61] "Germany signs to end nuclear power." http://news.bbc.co.uk/1/hi/world/europe/1382816.stm, *BBC Online*, 12 June 2001.
[62] "Germany renounces nuclear power." http://news.bbc.co.uk/1/hi/world/europe/791597.stm, *BBC Online*, 15 June 2000.



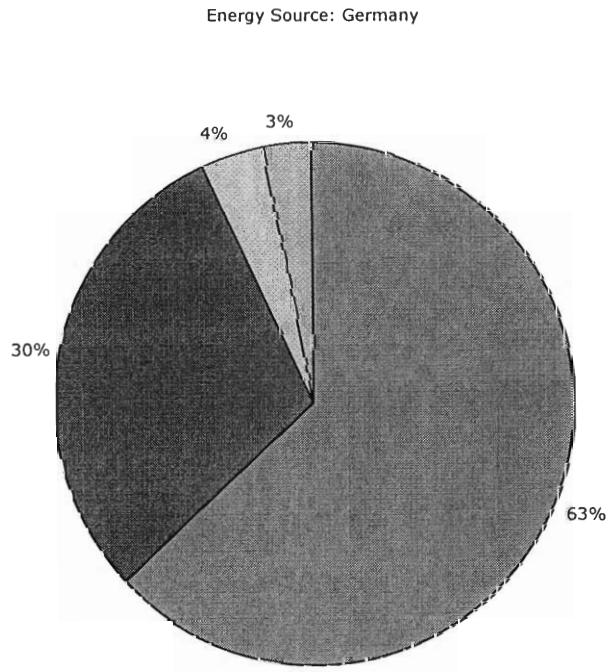


Figure 9: Energy output by source, top United States, bottom Germany. Data Source: The CIA World Factbook 2002.

The amount of emissions per nation is also revealing. While the combined total emissions from CO_2, SO_2, NO_x, CO, and NMOGs from the United States and Germany remain at 25% or less of the world totals (see Figure 10 below), the United States is mostly responsible for this amount. As diagrammed in Figure 11 below, the United States often has multiple times the amount of any particular pollutant than Germany. Each of the emissions listed in Figure 11 are also individually charted in relation to time using available data (see Figures 12-16 below). 21% of Germany's total CO_2 emissions come from transportation, as compared to 32% in the US.[63] This figure is rising quickly for the US as road transportation CO_2 emissions increase linearly (see Figure 17 below).

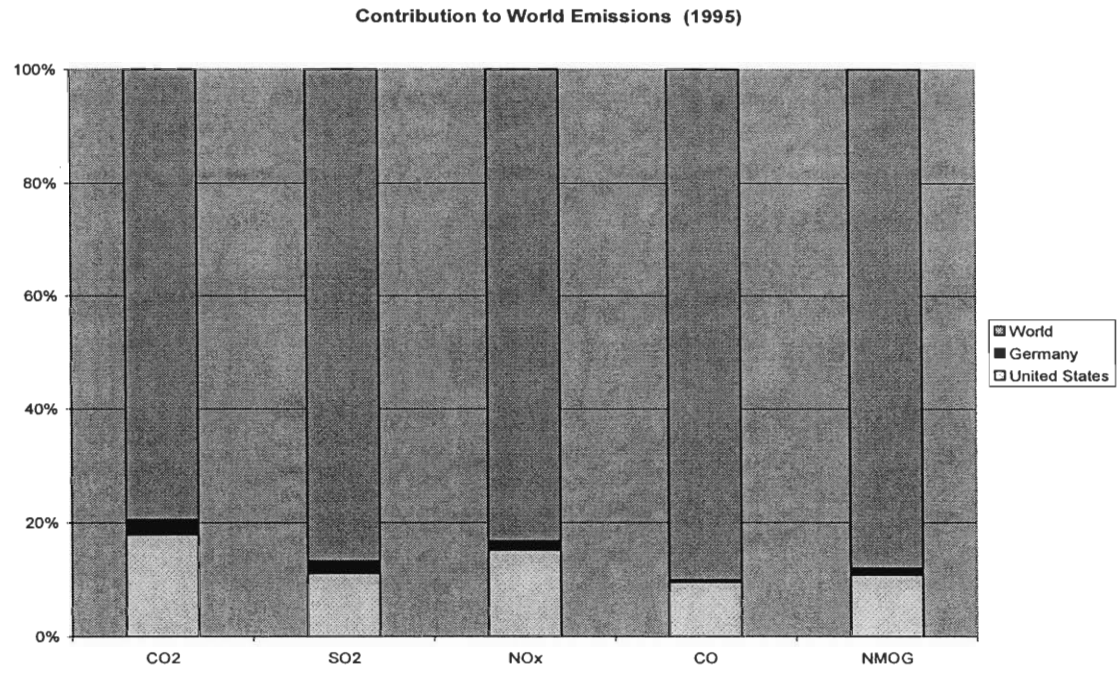


Figure 10: Percentage contributions of air pollutants by the United States (lighter) and Germany (darker) as compared to world figures (grey). CO_2, carbon dioxide; SO_2, sulfur dioxide; NO_x; nitrous oxides; CO, carbon monoxide; NMOG, non-methane organic gases. Data Source: EarthTrends website.

[63] "EarthTrends: The Environmental Information Portal." World Resources Institute, 2003, http://earthtrends.wri.org/

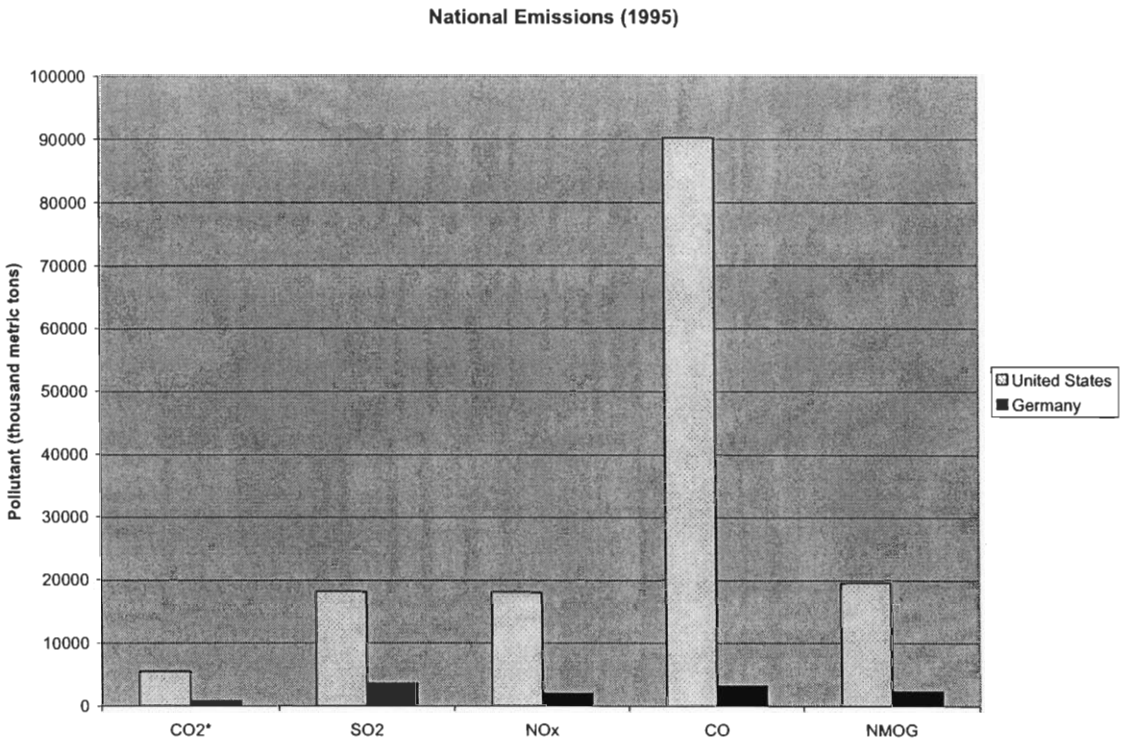


Figure 11: Actual contributions of air pollutants by the United States (lighter) and Germany (darker). CO_2, carbon dioxide; SO_2, sulfur dioxide; NO_x; nitrous oxides; CO, carbon monoxide; NMOG, non-methane organic gases. * denotes CO_2 values actually in million metric tons. Data Source: EarthTrends website.

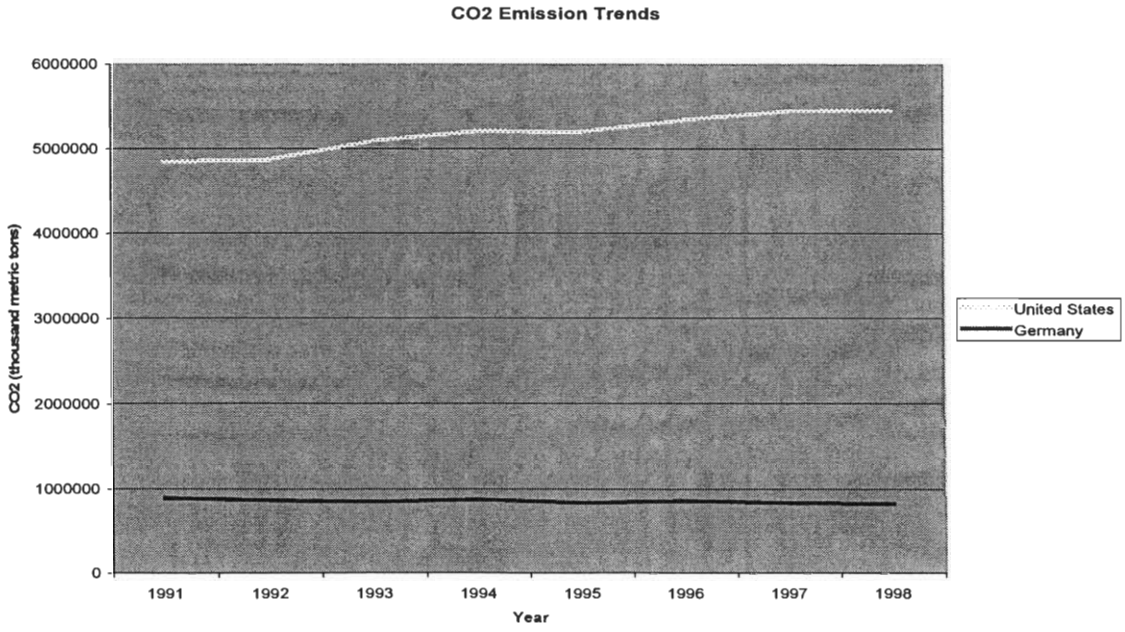


Figure 12: CO_2 emission trends in the United States (lighter) and Germany (darker) since 1991. Data Source: EarthTrends website.

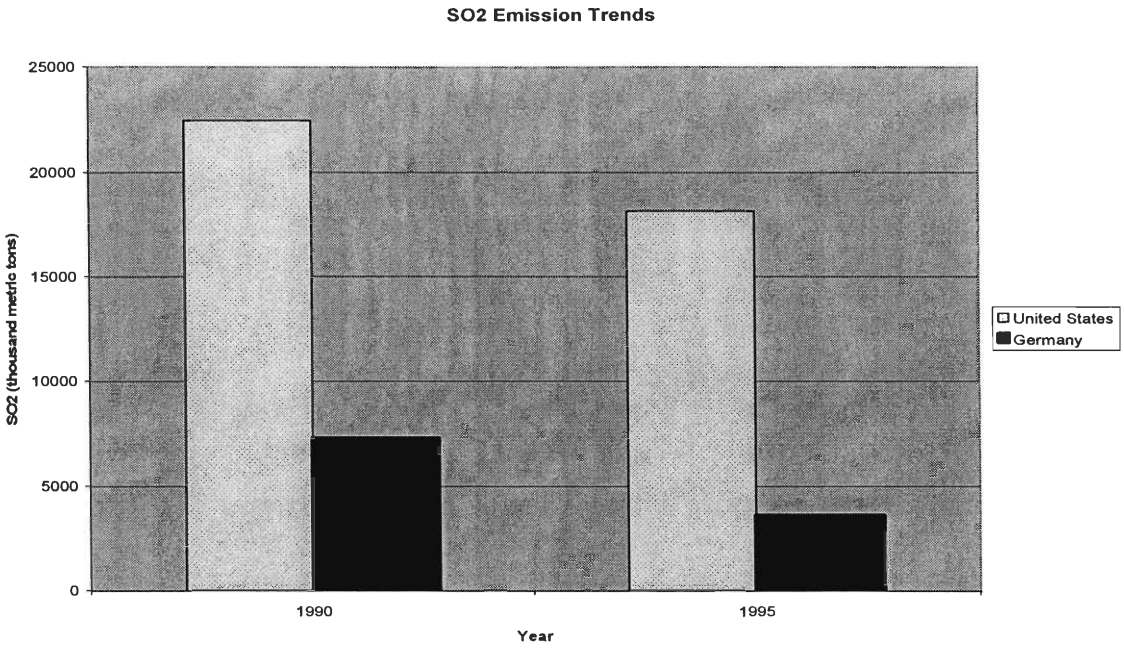


Figure 13: SO_2 emission trends in the United States (lighter) and Germany (darker) between 1990 and 1995. Data Source: EarthTrends website.

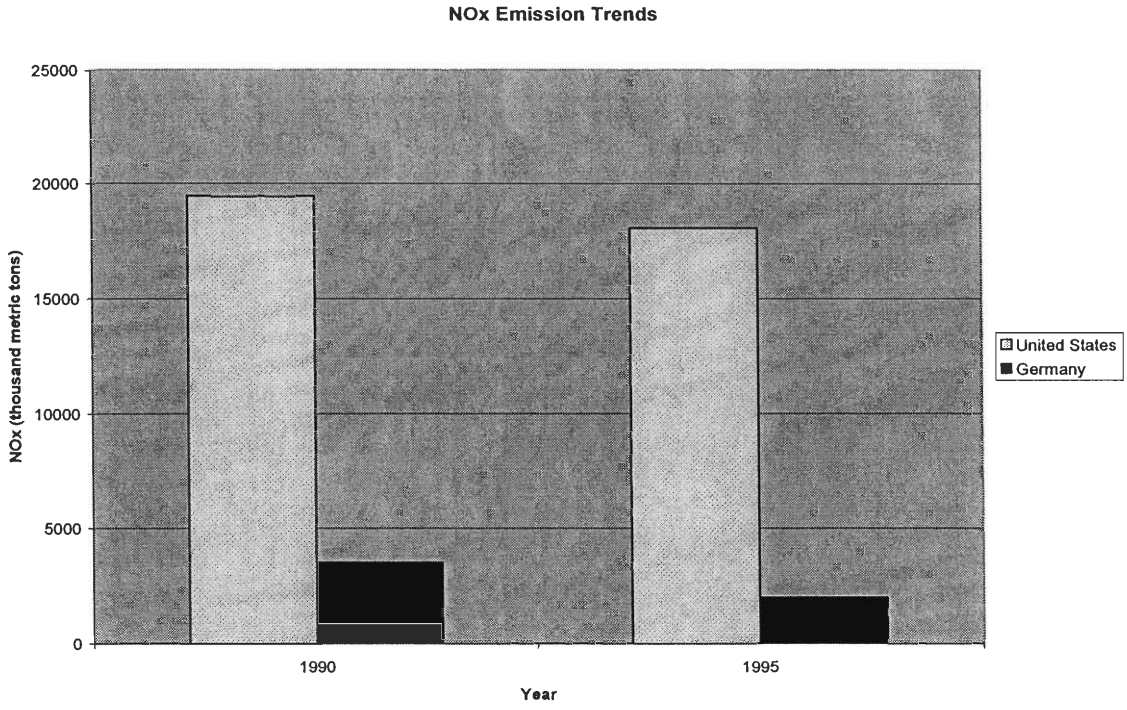


Figure 14: NO_x emission trends in the United States (lighter) and Germany (darker) between 1990 and 1995. Data Source: EarthTrends website.

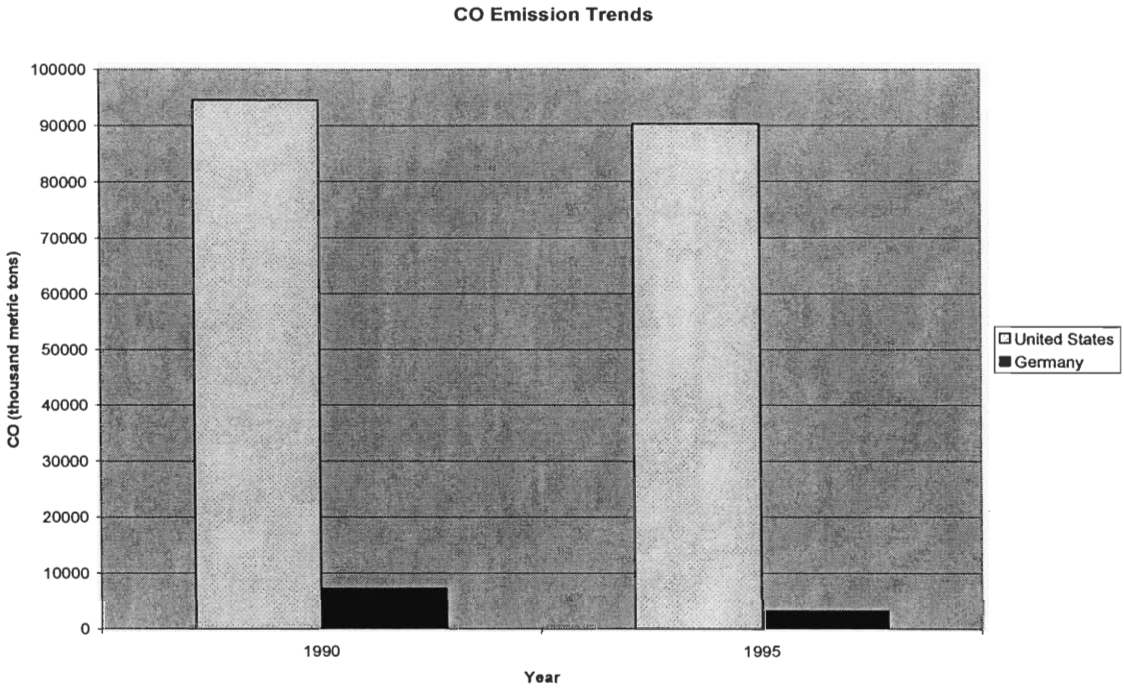


Figure 15: CO emission trends in the United States (lighter) and Germany (darker) between 1990 and 1995. Data Source: EarthTrends website.

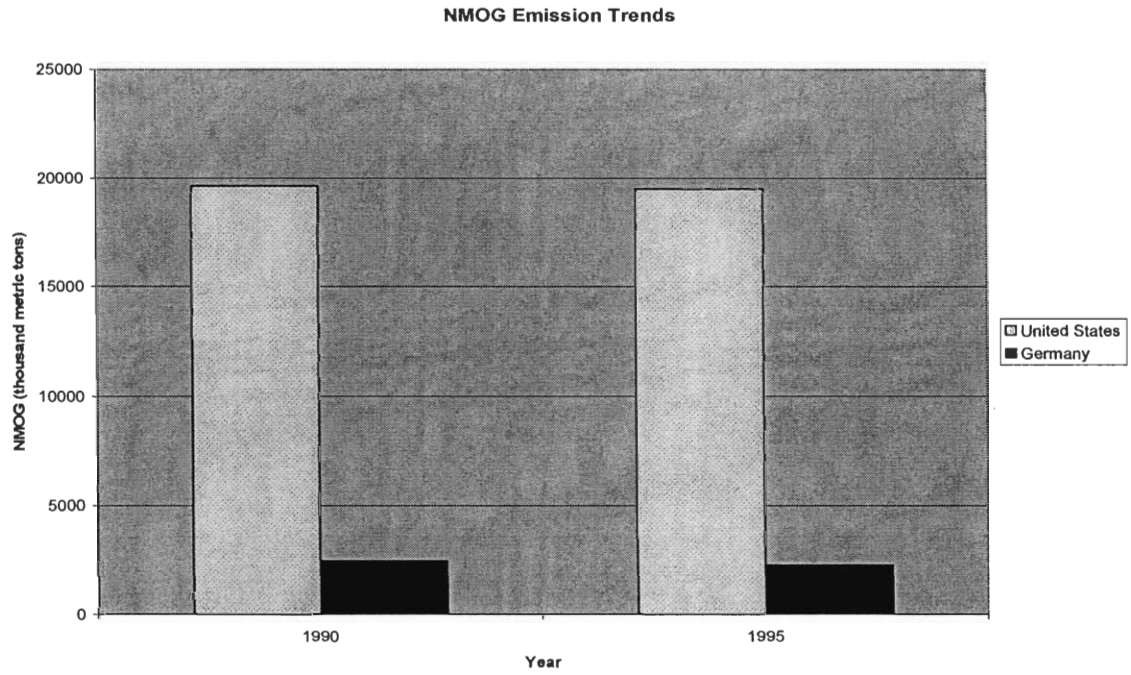


Figure 16: NMOG emission trends in the United States (lighter) and Germany (darker) between 1990 and 1995. Data Source: EarthTrends website.

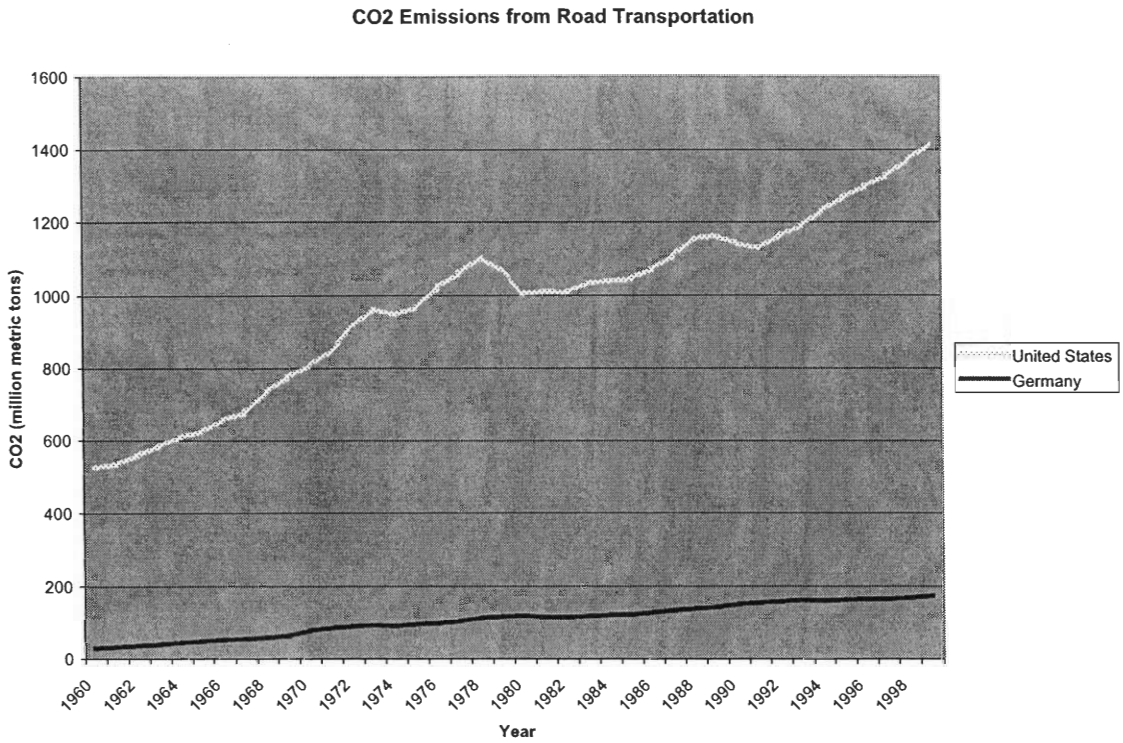


Figure 17: CO_2 emission trends from road transportation in the United States (lighter) and Germany (darker) between 1960 and 1999. Data Source: EarthTrends website.

Policy making has also been different for each country. While Germany may have arrived later in the game than the United States, especially when taking measures against air pollution from cars and power stations, it has become "an influential player in the international environmental policy arena… [which] bears not only on what is now a leading position in the world market for pollution control technology, but also on environmental achievements relative to other industrialized countries."[64] And while Germany improved itself and its environmental policy, the United States has stayed somewhat stagnant in its ability to move ahead with policy making. Comparatively speaking, Germany's Ministry of Environment is more powerful than the EPA within its own government, where the Ministry has more authoritative power and policy-making

[64] Jänicke M and Weidner H. "Germany." National Environmental Policies: A Comparative Study of Capacity-Building. Springer, 1997, pg 142.

ability than any one division of the US government. This authority, coupled with Germany's involvement in the EU, allow Germany to implement regulations more efficiently. Every law passed within the EU is effective in all of the member countries, including Germany, and Germany has the power to implement stricter codes as it sees fit. Case in point is a recent proposal (28 July 2003) by the *Umweltbundesamt*, with the purpose of reducing the emission levels from diesel vehicles. This proposal hopes to limit the emissions to .004 g/mi [.0025 g/km], which is 10% of the Euro 4 standards set for 2005.[65]

Emission regulations are strict both in the United States and Germany. Germany's emission regulations come down from the European Union regulations, and are therefore implemented throughout Western Europe. California (CA), the third largest state by size and the most populous state in the US, goes above and beyond the federal requirement of emission regulations, and has some of the strictest regulations in the world. The US, California, and EU regulations are all multiple step programs to progressively decrease emission volumes in their vehicles, where most of them are initiated in a certain year, but made completely effective a few thereafter. This is to help auto companies comply with the standard, and gives them time to phase into the law. Each of the three is also looking to severely limit the amount of sulfur in gasoline and diesel throughout this process. At the time this report was submitted, the US was in Tier 1, California in LEV I, and the EU in Euro 3. Tier 1 was effective in 1997, LEV I in 1994, and Euro 3 in 2000. For a detailed table of the various factors in the emissions regulations in the US, California, and the EU, refer to Figures 18 and 19 below. The US

[65] Krix, P. "Lower emissions." *Automotive News Europe*, 28 July 2003.

measures its pollutants, mileage, and weight in the English system (i.e. grams per mile, pounds, etc.). In Figures 18 and 19, the data measured in the English system were converted to the metric system by multiplying mile related information by a factor of 1.61, gram per miles by a factor of 0.621, and pounds divided by a factor of 2.2. This converted all of the data into the same measurement system, and was therefore comparable.

Year	Tier	Vehicle Type	Vehicle Weight	Useful Life	CO	NMHC/NMOG	HC	HC+NOx	NOx	PM	HCHO
1994	LEV I	TLEV	<1760	161000	2.6	0.097	-	-	0.37	0.05	0.011
1994	LEV I	LEV	<1760	161000	2.6	0.056	-	-	0.19	0.05	0.011
1994	LEV I	ULEV	<1760	161000	1.3	0.034	-	-	0.19	0.025	0.007
1997	Tier 1	Diesel	<1760	161000	2.6	0.193	0.5	-	0.78	0.062	-
1997	Tier 1	Gasoline	<1760	161000	2.6	0.193	0.5	-	0.37	0.062	-
2000	EURO 3	Diesel	<1305	80000	0.64	-	-	0.56	0.5	0.05	-
2000	EURO 3	Gasoline	<1305	80000	2.3	-	0.2	-	0.15	-	-
2002	EURO 3	Diesel	1305-1760	80000	0.8	-	-	0.72	0.65	0.07	-
2002	EURO 3	Gasoline	1305-1760	80000	4.17	-	0.25	-	0.18	-	-
2004	Tier 2	Both	8	193200	2.6	0.078	-	-	0.12	0.012	0.011
2004	Tier 2	Both	7	193200	2.6	0.056	-	-	0.09	0.012	0.011
2004	Tier 2	Both	6	193200	2.6	0.056	-	-	0.06	0.006	0.011
2004	Tier 2	Both	5	193200	2.6	0.056	-	-	0.04	0.006	0.011
2004	Tier 2	Both	4	193200	1.3	0.043	-	-	0.025	0.006	0.007
2004	Tier 2	Both	3	193200	1.3	0.034	-	-	0.019	0.006	0.007
2004	Tier 2	Both	2	193200	1.3	0.006	-	-	0.012	0.062	0.002
2004	Tier 2	Both	1	193200	0	0	-	-	0	0	0
2004	LEV II	LEV	<3860	193200	2.6	0.056	-	-	0.04	0.006	0.011
2004	LEV II	ULEV	<3860	193200	1.3	0.034	-	-	0.04	0.006	0.007
2004	LEV II	SULEV	<3860	193200	0.6	0.006	-	-	0.012	0.006	0.002
2005	EURO 4	Diesel	<1305	100000	0.5	-	-	0.3	0.25	0.025	-
2005	EURO 4	Gasoline	<1305	100000	1	-	0.1	-	0.08	-	-
2006	EURO 4	Diesel	1305-1760	100000	0.63	-	-	0.39	0.33	0.04	-
2006	EURO 4	Gasoline	1305-1760	100000	1.81	-	0.13	-	0.1	-	-

Figure 18: Current and impending emission regulations from California (light grey), the United States (dark grey), and the European Union (Germany; white) in vehicles weighing under 1760 kg. Going from left to right the columns represent the following: Year, year the regulation is implemented but not necessarily strictly enforced; Tier, the category title by the respective lawmaker; Vehicle Type, emission category (TLEV, LEV, ULEV, SULEV) for California, diesel or gasoline for the US and Germany; Vehicle Weight, weight range for applicable vehicles (kg) or Bin number for Tier 2 regulations; Useful Life, maximum mileage vehicle can have to still be regulated by the law (km); CO, carbon monoxide; NMHC/NMOG, non-methane hydrocarbons/non-methane organic gases, NMHC used only for Tier 1 regulations, all other applicable restrictions use the term NMOG; HC, hydrocarbons; HC+NO_x, combined value of hydrocarbons and nitrous oxides; NO_x, nitrous oxides; PM, particulates or particulate matter; HCHO, formaldehyde. Hyphens represent lack of regulation. All emission values in grams per kilometer (g/km). Values for US & CA weight classes 1760 kg and 3860 kg actually 1705 kg and 3864 kg, respectively. Source: Dieselnet.com.

Year	Tier	Vehicle Type	Vehicle Weight	Useful Life	CO	NMHC/NMOG	HC	HC+NOx	NOx	PM	HCHO
1994	LEV I	TLEV	>1760	161000	3.4	0.124	-	-	0.56	0.062	0.014
1994	LEV I	LEV	>1760	161000	3.4	0.081	-	-	0.31	0.062	0.014
1994	LEV I	ULEV	>1760	161000	1.7	0.043	-	-	0.31	0.031	0.008
1997	Tier 1	Both	>1760	161000	3.4	0.248	0.5	-	0.6	0.062	-
2002	EURO 3	Diesel	>1760	80000	0.95	-	-	0.86	0.78	0.1	-
2002	EURO 3	Gasoline	>1760	80000	5.22	-	0.29	-	0.21	-	-
2004	Tier 2	Both	8	193200	2.6	0.078	-	-	0.12	0.012	0.011
2004	Tier 2	Both	7	193200	2.6	0.056	-	-	0.09	0.012	0.011
2004	Tier 2	Both	6	193200	2.6	0.056	-	-	0.06	0.005	0.011
2004	Tier 2	Both	5	193200	2.6	0.056	-	-	0.04	0.006	0.011
2004	Tier 2	Both	4	193200	1.3	0.043	-	-	0.025	0.006	0.007
2004	Tier 2	Both	3	193200	1.3	0.034	-	-	0.019	0.006	0.007
2004	Tier 2	Both	2	193200	1.3	0.006	-	-	0.012	0.062	0.002
2004	Tier 2	Both	1	193200	0	0	-	-	0	0	0
2004	LEV II	LEV	<3860	193200	2.6	0.056	-	-	0.04	0.006	0.011
2004	LEV II	ULEV	<3860	193200	1.3	0.034	-	-	0.04	0.006	0.007
2004	LEV II	SULEV	<3860	193200	0.6	0.006	-	-	0.012	0.005	0.002
2006	EURO 4	Diesel	>1760	100000	0.74	-	-	0.46	0.39	0.06	-
2006	EURO 4	Gasoline	>1760	100000	2.27	-	0.16	-	0.11	-	-

Figure 19: Current and impending emission regulations from California (light grey), the United States (dark grey), and the European Union (Germany; white) in vehicles weighing over 1760 kg. Going from left to right the columns represent the following: Year, year the regulation is implemented but not necessarily strictly enforced; Tier, the category title by the respective lawmaker; Vehicle Type, emission category (TLEV, LEV, ULEV, SULEV) for California, diesel or gasoline for the US and Germany; Vehicle Weight, weight range for applicable vehicles (kg) or Bin number for Tier 2 regulations; Useful Life, maximum mileage vehicle can have to still be regulated by the law (km); CO, carbon monoxide; NMHC/NMOG, non-methane hydrocarbons/non-methane organic gases, NMHC used only for Tier 1 regulations, all other applicable restrictions use the term NMOG; HC, hydrocarbons; HC+NO_x, combined value of hydrocarbons and nitrous oxides; NO_x, nitrous oxides; PM, particulates or particulate matter; HCHO, formaldehyde. Hyphens represent lack of regulation. All emission values in grams per kilometer (g/km). Values for US & CA weight classes 1760 kg and 3860 kg actually 1705 kg and 3864 kg, respectively. Source: Dieselnet.com.

A number of observations can be made from Figures 18 and 19. Firstly, the United States, California inclusive, apply the next level of emission regulations earlier than the EU does. Secondly, the useful life of the vehicle tested is much higher in the US and California than in the EU, practically doubling the mileage in which a car has to comply, both in the Tier 1/LEV I: Euro 3 and the Tier 2/LEV II: Euro 4 comparison. There is also no weight defining factor in the Tier 2 regulations, meaning that they apply to vehicles of any size. They are divided, however, by categorized sets of regulations called 'bins.' The automobile manufacturers choose to certify particular vehicles to any of the 8 bins. This applies to all of the pollutant regulations, except that the average NO_x emissions of the entire vehicle fleet sold must meet the level of 0.043 g/km.[66] In the Tier 1/LEV I: Euro 3 comparison, in both vehicles under and over 1760 kg, the US/CA had stricter regulations for gasoline fueled CO emissions, and in vehicles over 1760 kg, had stricter regulations for diesel fueled NO_x and particulate emissions. The fact that the US/CA stricter regulations on diesel-fueled engines comes as no surprise, because the US market for diesel engines is so small (i.e. the regulations are too strict). In this same comparison, the EU is stricter in diesel fueled CO emissions, under-1760 kg diesel fueled vehicle NO_x emissions, and gasoline fueled NO_x and HC. The EU does not regulate against gasoline fueled particulate emissions nor diesel fueled HC emissions. In the Tier 2/LEV II: Euro 4 comparison, 'who is stricter than who' changes a great deal. One change is that Tier 2 and LEV II do not have varying regulations for multiple size weight classes as does the EU. This would normally account for lenient regulations for smaller

[66] "Emission Standards: USA Cars and Light-Duty Trucks." DieselNet, 2003, http://www.dieselnet.com/standards/us/light.html

cars, and more stringent regulations for the larger ones. Regardless, the US/CA regulations are stricter in every comparable aspect than the EU, except diesel fueled CO emissions. The most notable change is the increased rigorousness of the NO_x permissible amounts in Tier 2 and LEV II, and that they both include vehicle types not yet on the market, the Super Ultra Low Emission Vehicle (SULEV) and the Bin 1 Zero Emission Vehicle (ZEV).

Overall, both countries are on the right path towards positive environmental policy making, regardless of how fast each is moving along it. Each country is also in a good financial position to fund environmental research, develop 'eco-products,' and factor sustainability into all of its long term plans. They also have industries volunteering environmental compliance, providing research, and showing initiative towards a partnership for a better environment. This includes the focus of this report: the auto industry.

2.3 The Auto Industry

There are many automakers in the world, and since there is a focus on American- and German-based companies, the following automakers will be examined in this report: Ford, GM, and DaimlerChrysler (known as Detroit's "Big Three"), as well as Audi, Volkswagen, and BMW. Each of these companies is of interest for varying reasons, be it history, location, or unique environmental perspective.

Ford is the archetypical American automobile company, founded in 1903 by Henry Ford in Michigan. Ford Motor Company is the parent company of many other familiar automakers around the world: Ford, Lincoln, Mercury, Mazda, Volvo, Jaguar,

Land Rover, and Aston Martin. Ford Motor Company has expanded throughout the world and been one of the biggest in American automotive manufacturing for over 100 years.[67]

General Motors (GM) is another example of an American automaker of long standing. General Motors was founded in 1908 in Michigan as a conglomeration of many smaller car companies of that time, including Buick, Oldsmobile, Pontiac, Cadillac, and Chevrolet. GM later came to include Saab, Saturn, and Opel. Opel is of particular interest here because it was purchased by an American company in the early part of the 20th century. Founded in Germany in 1862, then named Adam Opel AG, it was bought by GM in 1929. Opel's stance on being bought by GM was that it was "not intended to make any changes to the Adam Opel AG product range, since it [was] well matched in every detail to the German market needs."[68] During World War II, the German government seized Adam Opel AG and operated it between 1940 and 1948, at which point GM resumed managerial control. In the following 50 years, Opel produced GM's smallest and most economical models, including the Kadett and Corsa. In 1989, Opel was recognized as the leader in producing environmentally friendly cars and led the way in automaking with the widest model and engine range of low emission cars.[69]

DaimlerChrysler is also a unique car company because it is the product of a merger between the American company Chrysler Corporation, and the German company

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[67] Ford Motor Company Heritage section.
http://www.ford.com/en/heritage/history/default.htm
[68] General Motors History Section, Opel Video.
http://www.gm.com/company/corp_info/history/gmhis1920.html, Link under 1929 Opel Acquisition to "View Video" (1920_opel.mov).
[69] History section, General Motors website.
http://www.gm.com/company/corp_info/history/gmhis1980.html

Daimler-Benz AG. Daimler-Benz AG, founded as the merger between Daimler-Motoren-Gesellschaft and Benz & Cie. in 1926, is famous around the world for its German engineered automobiles, most notably the Mercedes series. Chrysler Corporation has also been around for a long time, officially founded in 1925 by a former employee of GM. It acquired and incorporated a number of car companies, including Dodge, Jeep, and Plymouth.[70] In 1998, Daimler-Benz and Chrysler Corporation merged to form DaimlerChrysler, creating a company epitomizing globalization by sharing goals while retaining their original identities.[71]

Audi is another company that prides itself in a long history. Audi's official name is Audi AG, but it has been known throughout most of its history as Auto Union AG. Auto Union AG was the conglomerate of four older German car companies: Audi, DKW, Horch, and Wanderer. All four companies had their beginnings between 1899 and 1913, when automotive and motorcycle history was still in its infancy. On 29 June 1932, the four Saxon car companies joined to become Auto Union AG, and still today use four interlocked rings as their symbol. Between 1958 and 1964, the shares of Auto Union AG are bought completely by Daimler-Benz, and it became its subsidiary during this time. In a radical move in 1965, Volkswagenwerk AG bought a majority of the Auto Union AG shares, and became a fully owned subsidiary of VW at the end of 1966.[72] In 1969, Auto Union GmbH merged with NSU Motorenwerk AG to become "Audi NSU Auto Union AG." It changed its name to the familiar "Audi AG" in 1985. When the company was

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[70] Heritage section, DaimlerChrysler website. http://www.daimlerchrysler.com/history/epochen_e.htm

[71] Birth of a Global Company, DaimlerChrysler website, Archives section. http://www.daimlerchrysler.com/specials/81117birth/sr81117_e.htm

[72] Heritage section, Audi website. http://www.audiusa.com/about_heritage_timeline/

purchased by Volkswagenwerk AG, they wanted to maintain Audi as a separate entity, as Volkswagen respected the innovation and technical advances specific to Audi. Audi is still an independent subsidiary of VOLKSWAGEN AG, and therefore initiates its own environmental policies. Audi also publishes its own environmental report separate from Volkswagen.

Volkswagen, while having a shorter history than its hundred-year-old competition, is one of the biggest car companies in the world. Volkswagen (VW) was founded in 1937 as the "*Gesellschaft zur Vorbereitung des Deutschen Volkswagens mbH*," and 16 months later renamed itself "Volkswagenwerk GmbH." Shortly thereafter the company was taken over by the Nazis during World War II. After years of regaining control and reestablishing itself in Europe as a formidable car manufacturer, it became partially privatized and was renamed VOLKSWAGEN AG. By 1964, VOLKSWAGEN AG had a presence in Canada, Mexico, the US, South Africa, Brazil, and a few locations in Europe. By 1990, individual regions are detailed to better manage its subgroups, including the North American Region, Asia-Pacific Region, and South America / Africa Region. As mentioned previously, in 1965 the Daimler-Benz subsidiary "Auto Union GmbH" was bought by VW. This was just one subsidiary taken under the vast wing that is the Volkswagen Group, which now includes the Spanish independent company SEAT, the Czech company Skoda, and the familiar luxury companies Bentley, Bugatti, and Lamborghini.[73] Volkswagen prides itself in being a very environmentally conscious corporation, being one of the only companies to consistently advertise its environmental considerations in its cars.

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[73] History section, Volkswagen website. http://www.volkswagen-ag.de/english/defaultNS.html

BMW, which stands for *Bayerische Motoren Werke* (Bavarian Motor Works), was founded as an airplane engine manufacturer and produced engines during World War I and II. In 1948, after the war, BMW also started to produce motorcycles and cars.[74] Throughout the years, BMW has maintained its independence from other companies and affiliates, however came to own the rights to the auto brands MINI (1994, production 2001) and Rolls-Royce (rights purchased 1998, transition of ownership 2003). MINI, which received the "2003 North American Car of the Year" with its Cooper model,[75] was redesigned in an effort to combine its original environmental friendliness and fuel efficiency with more speed and agility. MINI sales are increasing, selling over 144,000 worldwide in 2002, of which 24,500 were sold in the US and 23,000 in Germany.

These automakers are among the biggest companies in the world. They all have manufacturing plants throughout their home nations, as well as internationally on most major continents; many of them have also diversified into the areas of energy, non-automotive manufacturing, and the sciences; and all of them have an environmental department, which manages current technologies, and researches and develops new ones.

It is noteworthy that of the six biggest automotive companies in the United States, only three are included in this report. The other three companies are Honda, Toyota, and Nissan- all of Japanese origin. In fact, it is important to mention that the Japanese automobile manufacturers are far ahead of the American and German companies in terms of green capabilities and environmental consideration. In a recent report by the Union of Concerned Scientists (UCS), the top six auto companies, who are responsible for "over

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[74] History section, BMW website.
http://www.bmw.com/bmwe/pulse/heritage/history/index.html
[75] Annual Report 2002. BMW Group, 2003.

90 percent of emissions from America's most polluting product,"[76] are Honda, Toyota, Nissan, GM, Ford, and DaimlerChrysler. How did "the Big Three" rank out of the six companies? They came in dead last. In this report, the UCS looked at each company's average at emitting GHGs and conventional pollutants in MY2001 vehicles, and used MY2000 for comparative purposes. Some of the key findings were that: 1) Ford is the greenest of the Big Three, due to its recent improvement in truck and SUV emission restrictions, 2) Trucks are generally dirtier than cars, as allowed by US emission regulations, and hence companies that sell a high number of trucks tend to be dirtier, and 3) DaimlerChrysler is the environmentally worst of the companies, due to its focus on selling trucks, having the typically dirtier cars and trucks on the market, and being the most aggressive automaker in looking for means to avoid or manipulate emission regulations.[77] Even leading environmentally among the Big Three, with stats like having their biggest trucks emitting 20-25% fewer pollutants than GM's, Ford has a long way to go. Their highly advertised commitment to increase their SUV fuel efficiency between 2000 and 2005 by 25% seems to be a difficult goal for them. Ford recently issued a statement (August 2003) saying that their goal of 25% improvement may be harder to achieve than expected as technology improvements do not seem to be as effective as hoped. Sue Cischke, Ford's vice president of environmental and safety engineering, says that "...when [looking] at the different technologies we thought we could employ, as you get further down the development stream you might find they don't give you the fuel

[76] "Automaker Rankings: The Environmental Performance of Car Companies." Union for Concerned Scientists, September 2002, http://www.ucsusa.org/clean_vehicles/cars_and_suvs/page.cfm?pageID=1065

[77] *Ibid.*

economy improvement you thought."[78] Ford is nonetheless still committed to reach the goal by 2005. Even if Ford achieves this goal, it will be overshadowed by the increasing sales of low economy pickup trucks, as it was in the first year of their commitment: 4.8% improvement in SUV efficiency, 0.8% improvement in light weight truck division efficiency.[79]

So which cars models and makers are the most economic? Which have the least emissions? The EPA publishes an annual report called the "Green Vehicle Guide," which ranks new models in terms of smog-forming pollutants. In this rating, a score of 10 indicates the best class, causing less than 1 pound of these pollutants per 15,000 miles [.45 kg per 24,150 km], and a score of 0 indicates the worst class, causing between 63.8 and 121.1 pounds of pollutants per 15,000 miles [28.9-54.9 kg per 24,150 km].[80] Of the top 20 MY2003 vehicles with a score of 10, Ford found itself in places 10th, 11th, 13th, 14th, and its subsidiary Volvo in places 16th and 17th. These models were the Ford Focus and Focus Station Wagon, both manual and automatic versions, as well as the Volvo S60 and V70. In 18th, 19th, and 20th place were the BMW 325ci, 325i, and 325i Sport Wagon models, all automatic. On the other end of the scale, the worst 20 MY2003 vehicles, with a score of 0, 19 out of 20 were one of the Big Three companies. 11 out of those 20 were DaimlerChrysler models, which were completely represented by differing versions of the Dodge Ram Pickup. The Ford F150 Supercrew, E250 Strip Chassis and E250 Cab

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[78] "Ford says SUV fuel economy goal getting tougher." *Automotive News*, 5 August 2002.
[79] "Automaker Rankings: The Environmental Performance of Car Companies." Union for Concerned Scientists, September 2002, http://www.ucsusa.org/clean_vehicles/cars_and_suvs/page.cfm?pageID=1065
[80] "Green Vehicle Guide." Environmental Protection Agency, 2003, http://www.epa.gov/greenvehicles/ratings

Chassis came in at the 4th, 5th, and 6th worst. GM represented the bottom 5 places with the GMC Sierra 1500, Chevrolet Silverado 1500, GMC Yukon 1500 XL, Chevrolet Suburban 1500, and Chevrolet Avalanche 1500.[81] These rankings show how far behind the American automakers are in terms of producing clean vehicles. The score-10 vehicles are mostly Japanese, and in the entire score-0 category containing 95 MY2003 vehicles, only 4 models are Japanese (Toyota/Lexus). Only two models in this category, the Mercedes SUVs G55 AMG and ML55 AMG, bear a German name; however remember that Mercedes is owned by DaimlerChrysler, which has 35 other models out of the 95 total.[82]

Another report called the "Fuel Economy Guide," jointly written by the EPA and Department of Energy (DOE), annually analyzes the fuel economy of the year's new models. It also lists the leading models of the year in terms of fuel efficiency, categorized into the following light weight vehicle divisions: Two-Seater, Minicompact, Subcompact, Compact, Midsize, Large, Small Station Wagons, Midsize Station Wagons, Cargo Vans, Minivans, Passenger Vans, SUV, Small Pickup Trucks, and Standard Pickup Trucks. Figure 20 lists the factors determining in which category each model, depending on passenger and cargo volume or gross vehicle weight. These leaders in each category are listed in Figure 21. Here the six companies in the report are better represented, as opposed to the "Green Vehicle" ratings. Except for the Compact, Midsize, and SUV classes, one of the six is represented.[83] A cause for concern is that the three vehicle

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[81] "Green Vehicle Guide." Environmental Protection Agency, 2003, http://www.epa.gov/greenvehicles/

[82] *Ibid.*

[83] "Model Year 2003 Fuel Economy Guide." Environmental Protection Agency and Department of Energy, 2003, pg 4.

classifications that do not have one of the six are the best selling vehicle categories in the United States, putting them all at an extreme disadvantage. Throughout the report, there are also cars with a label "tax," which are cars subject to 'gas guzzler' taxes for being particularly fuel-inefficient. Some models of this sort include the Aston Martin Vanquish (Ford), Cadillac Limousine (GM), Mercedes-Benz SL500 (DaimlerChrysler), Audi S8, Lamborghini L-147 Murcielago (VW), and the BMW Z8.[84] From the same data, the

[84] *Ibid.*

actual top 10 most fuel efficient cars are over half Japanese make, with the Honda Insight as the most economic of MY2003, having a 61 mpg city [26 kpl] and 68 mpg highway [26 kpl] fuel efficiency. In that top 10, the 6th, 7th, 9th, and 10th most economic vehicles are from VW, with many of their own models tied in those positions.[85] Refer to Figure 22 for the top 10 cars with coordinating city and highway ratings. As one would expect, the top 10 least fuel efficient vehicles were all luxury sport cars well known for that vice (Ferrari, Lamborghini, Maserati, Bentley, Aston Martin, etc.), of which most are owned by parent companies Ford, GM, and VW.[86]

CARS (based on interior passenger and cargo volume)		TRUCKS (based on body style and load-bearing capacity)	
TWO-SEATER CARS		*PICKUP TRUCKS*	*Gross Vehicle Weight Rating*
SEDANS	*Passenger and Cargo Volume*	Small	Under 4,500 Pounds
Minicompact	Under 85 Cubic Feet	Standard	4,500 to 8,500 Pounds
Subcompact	85 to 99 Cubic Feet	*VANS*	Under 8,500 Pounds
Compact	100 to 109 Cubic Feet	Passenger	
Midsize	110 to 119 Cubic Feet	Cargo	
Large	120 or More Cubic Feet	*MINIVANS*	Under 8,500 Pounds
STATION WAGONS	*Passenger and Cargo Volume*	*SPORT UTILITY VEHICLES*	Under 8,500 Pounds
Small	Under 130 Cubic Feet	*SPECIAL PURPOSE VEHICLES*	Under 8,500 Pounds
Midsize	130 to 159 Cubic Feet		
Large	160 or More Cubic Feet		

Figure 20: Fuel Economy Guide Vehicle Classes. Source: The 2003 Fuel Economy Guide, pg 2.

[85] Milbourn C. "EPA and DOE announce fuel economy leaders for 2003 model year cars." Environmental Protection Agency, Washington DC, 29 October 2002. http://yosemite.epa.gov/opa/admpress.nsf/b1ab9f485b098972852562e7004dc686/e47890fed06d8af485256c610062d9d5?OpenDocument

[86] *Ibid.*

TWO-SEATER CARS
Honda Insight (hybrid electric) ..... man trans 61/68
..... auto trans 57/56

MINICOMPACT CARS
BMW MINI Cooper ..... man trans 28/37
..... auto trans 25/32

SUBCOMPACT CARS
Volkswagen New Beetle (diesel) ..... man trans 42/49
..... auto trans 34/44

COMPACT CARS
Toyota Prius (hybrid electric) ..... auto trans 52/45
Honda Civic (hybrid) ..... man trans 46/51

MIDSIZE CARS
Honda Accord ..... man trans 26/34
..... auto trans 24/33

LARGE CARS
Chevrolet Impala ..... auto trans 21/32

SMALL STATION WAGONS
Volkswagen Jetta Wagon (diesel) ..... man trans 42/50
..... auto trans 34/45

MIDSIZE STATION WAGONS
Ford Focus Station Wagon ..... man trans 27/36
..... auto trans 27/33

CARGO VANS
Chevrolet Astro 2WD ..... auto trans 17/23
GMC Safari 2WD ..... auto trans 17/23

MINIVANS
Chrysler Voyager/Town & Country ..... auto trans 21/27
Dodge Caravan ..... auto trans 21/27

PASSENGER VANS
Chevrolet Astro 2WD ..... auto trans 16/20
GMC Safari 2WD ..... auto trans 16/20

SUV
Toyota Rav4 2WD ..... man trans 25/31
..... auto trans 24/29

SMALL PICKUP TRUCKS
Chevrolet S10 Pickup 2WD ..... man trans 22/28
..... auto trans 19/25
GMC Sonoma 2WD ..... man trans 22/26
..... auto trans 19/25

STANDARD PICKUP TRUCKS
Ford Ranger 2WD ..... man trans 24/29
..... auto trans 23/26
Mazda B2300 2WD ..... man trans 24/29
..... auto trans 23/26

Figure 21: MY2003 Fuel Economy Guide most efficient vehicles by class. Source: 2003 Fuel Economy Guide.

Position	Manufacturer	Model	Fuel	Transmission	City (mpg [kpl])	Highway (mpg [kpl])
1	Honda	Insight	hybrid electric	manual	61 [26]	68 [29]
2	Honda	Insight	hybrid electric	automatic	57 [24]	56 [24]
3	Toyota	Prius	hybrid electric	automatic	52 [22]	45 [19]
4	Honda	Civic Hybrid	hybrid electric	automatic	48 [20]	47 [20]
5	Honda	Civic Hybrid	hybrid electric	manual	46 [20]	51 [22]
6	VW	Jetta Wagon	diesel	manual	42 [18]	50 [21]
7	VW	New Beetle	diesel	manual	42 [18]	49 [21]
7	VW	Golf	diesel	manual	42 [18]	49 [21]
7	VW	Jetta	diesel	manual	42 [18]	49 [21]
8	Toyota	Echo	gasoline	manual	35 [15]	43 [18]
9	VW	Golf	diesel	automatic	34 [14]	45 [19]
9	VW	Jetta	diesel	automatic	34 [14]	45 [19]
9	VW	Jetta Wagon	diesel	automatic	34 [14]	45 [19]
10	VW	New Beetle	diesel	automatic	34 [14]	44 [19]

Figure 22: Top ten vehicle models available in the United States. Shaded boxes represent automakers found in this report, here exclusively VW. Source: Hellman, KH and Heavenrich, RM. "Light-Duty Automotive Technology and Fuel Economy Trends" Appendix D2.

It is apparent that each manufacturer has its environmentally good and bad sides. As the consumer begins to take more notice, and the governments under whose laws the manufacturers operate legislate and enforce stricter regulations, there is no place to go except green. With each automaker's environmental standing presented, the question is now asked: what initiatives do they plan to take to become greener corporations? And what incentives do they have to take them?

3 Business Incentives and Initiatives for Environmental Action

How active in environmental protection a company chooses to be is the decision of the company itself. Granted there are laws and regulations determining what a company may and may not do, but there is no directive saying how much farther beyond the minimum it needs to go. Each business therefore decides what level of participation it plans to have by analyzing its incentives for action and taking the consequent initiatives. Here it is important to define the terms *incentives* and *initiatives* in terms of this report. A business incentive is something that inspires, motivates, or requires the company to take action. Laws obligating predetermined emission standards or a program to save money through recycling are both examples of business incentives that would compel or encourage an automaker to be more environmentally active. A business initiative is the first step and consequent actual process of acting on that incentive. Decreasing the emissions of their next developed fleet of cars and recycling car parts to save the millions are the initiatives based, respectively, on the two examples of incentives above. This section will look at both the incentives that drive an automaker towards environmental consideration and the initiatives they take to act on those incentives.

3.1 Compliance with Emission Laws

An automotive company, like any company, has particular incentives to be environmentally active. The origin and the effect of these incentives vary. Complying

with the law, which can be meeting current standards or getting ahead of them, is an important role for the environmental departments in the auto industry.

3.1.1 Incentives

Perhaps the most obvious incentive to comply with national and international laws is the penalty of *not* complying. Noncompliance carries the consequence of incurred taxation, restricted sales, and in extreme cases, forced recalls and shut-down plants. All of these would cost a company a great deal of money to take care of and recover from. In the US, a company that fails to meet the emissions standards is fined for each ton of GHGs over the limit at three times the market value of a GHG ton.[87] Similar taxation occurs in Germany under EU regulations, combined with the prohibition of an auto manufacturer to sell vehicles in other EU Member nations.[88] There are also taxes which curb automakers from overproduction of vehicles that are detrimental to the environment. Luxury cars, which include the more expensive models from companies like BMW, Mercedes (DaimlerChrysler), and Lamborghini (VW), tend to have low gas mileage and high pollutant output. When they are imported into the United States, they used to be taxed upwards of 15%, although since 1997, vehicle luxury tax has been phasing out.[89] As mentioned in section 2.3, the United States also has a gas guzzler tax, which was mandated in the Energy Tax Act of 1978. This law requires automakers to

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[87] Lazaroff C. "US Senate Would Cap Greenhouse Emissions." 8 January 2003. http://www.freerepublic.com/focus/news/819429/posts

[88] Legislation in regards to Motor Vehicle Air Pollution. Europa: the EU Online. http://europa.eu.int/scadplus/leg/en/s15004.htm

[89] Gray M, CPA. "Changes to Luxury Tax for Vehicles in the New Tax Law" 12 January 1999. http://www.taxtrimmers.com/luxury.shtml

pay a tax on the sale of passenger cars with very low fuel economy, regardless of the fleet average.[90]

As globalization continues to increase, possible markets around the world would provide new customers to the companies based in the US and Germany. Already most of these companies have divisions in Asia, Africa, and Oceania. Varying restrictions and regulations in these areas of the world could hold a company back from expanding into the new market. It is therefore an incentive to ensure compliance in all current and possible future markets.

In addition to the incentive to avoid being fined for the failure to meet current regulations, automotive companies are also encouraged to go beyond compliance, both in the anticipation of stricter laws going into effect and as motivation to 'get ahead.' In January 2002, COWI A/S, contracted by the European Commission's Directorate-General for the Environment, published a report concerning the fiscal measures to reduce CO_2 emissions of new passenger cars in the EU. This report had the following conclusions:

- It is essential to apply a tax scheme, which is directly or indirectly CO_2 related in order to provide for significant reductions in the average CO_2 emissions from new cars
- It is essential to differentiate the taxes in such a way that taxes for very energy effective cars are significantly lower than taxes for cars with poor energy efficiency

[90] "Model Year 2003 Fuel Economy Guide." Environmental Protection Agency and Department of Energy, 2003, pg 2.

- Replacing the existing taxes with purely and directly CO_2 related taxes that are sufficiently differentiated provide the largest reductions
- Adding a differentiated CO_2 element to existing taxes provides smaller, but still quite large, CO_2 reductions. If allowance were made for a subsidy to the most energy efficient vehicles, this would however increase the rate of progression and thus lead to even more CO_2 reduction
- Merely enhancing the differentiation of existing taxes also provides significant CO_2 reductions, although the reductions are smaller than in the above two cases
- The level of the potential CO_2 reductions does not depend on the type of taxes, e.g. registration or circulation tax, but more on the CO_2 specifically and the level of the tax differentiation.
- Simple increases of the tax that do not involve changes to neither the tax base, i.e. the parameter(s), which determine the tax, nor the differentiation schemes provide only very small CO_2 reductions
- It is essential to modify national taxes that are of a significant size and where there is scope for improving the CO_2 relation of that tax in order to harvest the full potentials of CO_2 reductions within the boundary conditions
- Fuel tax increases provide only very small reductions of the average CO_2 emissions of new cars compared to vehicle taxes. Fuel taxes may however still be a very effective means of controlling the total CO_2 emissions that are attributable to passenger car transport[91]

[91] COWI A/S "Fiscal Measures to Reduce CO_2 Emissions from New Passenger Cars." European Commission's Directorate-General for Environment, January 2002. http://europa.eu.int/comm/environment/air/pdf/cowi_finalreport2.pdf

Looking at these conclusions foreshadows the possibility of new laws directly related to CO_2 emissions. It brings attention to the fact that vehicles should not be taxed equally, but based on the volume of their emissions. This would provide incentive to the automakers to produce and consumers to purchase cleaner and more fuel efficient vehicles. While none of these suggestions from the COWI A/S report have been implemented yet, there is a good chance that governments will take them into serious consideration as they look for solutions to the air pollution problem associated with automobiles. In the United States, there is already a tax credit and deduction system for consumers who purchase electric or "clean-fuel" vehicles.[92] Germany is also in the process of initiating laws that reward the purchase of cleaner vehicles. In the United States, the EPA is also rewarding the companies for making their facilities more environmentally friendly by providing tax waivers, breaks, or credits for "purchasing pollution control equipment, implementing a retrofit pollution prevention program or hiring additional environmental staff."[93]

3.1.2 Initiatives

Up to now, every automaker has made a strong effort to take initiative in complying with the laws related to their manufacturing plants and their products. There are different actions which companies have undertaken in response to these incentives,

[92] "Model Year 2003 Fuel Economy Guide." Environmental Protection Agency and Department of Energy, 2003, pg 2.
[93] Economic Incentives in the Voluntary Diesel Retrofit Program. EPA website, http://epa.gov/otaq/retrofit/over_econ_from_template.htm

which include contesting new laws, ensuring current compliance, obtaining voluntary certification, and planning ahead for future regulations.

One way to react to strict laws is to contest them in court. This is exactly what GM and DaimlerChrysler did in the early summer of 2003. As described in section 2.2, California has significantly stricter emissions regulations and is working on incorporating zero-emission vehicles (ZEVs) into automakers' fleets by the mid to late 2000s. GM and DaimlerChrysler, along with other auto companies and dealers, sued the California Air Resources Board over new legislation mandating increased production of ZEVs within the next 15 years.[94] The companies maintained it was up to the Federal Government to mandate emission regulations, not up to an individual state. The companies were especially motivated because California is the state with the biggest market for cars. However, the lawsuits were dropped in early August 2003. An agreement was reached between GM and DaimlerChrysler and the California Air Resources Board to cooperate and combine effort to reduce emissions. The laws were revised to include hybrid vehicles as part of the mandated amount of ZEVs, and the yearly requirement numbers were decreased. The positive outcome of this conflict will strongly influence the direction of the international automotive industry towards ZEVs, as California is the United States' biggest market, and the US is the world's biggest market.

The most common initiative is to simply meet the requirements of the laws already passed and to voluntarily be certified by national or international environmental management standards. In MY2003, all six automakers included in this report passed

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[94] Hakim D. "Automakers drop suits over clean-air regulation." *New York Times*, 12 August 2003.
http://www.nytimes.com/2003/08/12/business/12AUTO.html?ex=1061784000&en=90779c39a962cc29&ei=5070

both fuel economy and emissions regulations for sale in both the United States and Germany. Likewise, many of the companies have received certification by International Organization for Standardization (ISO) environmental management system (ISO 14001) and the EU's Eco-Management and Auditing Scheme (EMAS). Perhaps the most important and internationally recognized of the voluntary certifications, the ISO 14001 "establishes a coordinated framework of controls to manage environmental protection in [an] organization."[95] ISO 14001 is used primarily outside of Europe, as EMAS is the European certification and is mostly the same as ISO 14001. GM has certification in 96% of its total worldwide sites,[96] BMW has 100% certification in Germany and the US,[97] VW has 92% EMAS certification, a number of ISO 14001 certifications and has many more in the process of being certified,[98] Audi has all three of its plants in Germany and Hungary EMAS certified,[99] DaimlerChrysler has all of its plants and subsidiary plants ISO 14001 certified with only a few exceptions,[100] and Ford has 100% ISO 14001 certification in all of its and its subsidiaries' manufacturing plants. All of these companies have saved significant amounts of money and made major improvements in environmental management.[101] BMW, like many other companies, reports that "almost

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[95] ISO14000 website. http://www.iso14000.org/iso14000.aspx
[96] "Environment and Energy Information." Corporate Responsibility and Sustainablility Report 2001-2002. General Motors, 2002, pg 38.
[97] Annual Report 2002. BMW Group, 2003.
[98] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 6.
[99] Interim Report: Environmental Review of Audi AG. Audi AG, August 2000, pg 42.
[100] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 95.
[101] O'Brien, Tim. Book review for "Ford & ISO 14001." http://www.qsuonline.com/BodyPages/FordandISO.html

all of [their] environmental improvement projects have improved the efficiency of our processes reduced waste, and saved money for the company at the same time."[102]

Getting ahead of schedule is another profitable initiative, as well as researching new technologies that would help the companies prepare for upcoming regulations. Audi hopes to improve the environmental situation far beyond what is required by law, as do most companies, by "endeavor[ing] to undercut statutory limits and to comply with them earlier than is necessary."[103] It is also the main focus of most automakers to improve their fleet's fuel economy and emission levels. VW is currently reducing their fuel consumption of their new vehicle fleet by 25% between 1990 and 2005 (as mandated by the Association of the German Automotive Industry; *Verband der Automobilindustrie, VDA*), as well as reducing their CO_2 emissions to an average of 140 g/km.[104] Both Ford and DaimlerChrysler are ahead of schedule in terms of emission regulation compliance: the Mercedes-Benz MY2002 fleet had surpassed the 2005 target[105] and Ford offers vehicles to Germany five years ahead of regulation schedule in response to consumer interest.[106] Ford also has committed itself to a 25% increase in fuel efficiency in their SUVs from 2000 levels by 2005. Ford is also designing their vehicles for the United

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[102] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 6.
[103] "The Environment." Audi Annual Report 1999. Audi AG, 1999, pg 26.
[104] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 35.
[105] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 95.
[106] "Cutting Emissions Worldwide." Ford website, environmental section. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/airAndClimate/cuttingEmissionsWorldwide.htm

States to meet upcoming California regulations as opposed to federal regulations.[107] DaimlerChrysler and VW have both developed diesel engines that meet United States Tier 2 regulations, run almost as cleanly as gasoline engines, and last for 10 years or 150,000 miles [241,500 km].[108] Recent advances in fuel efficiency technology helped VW, Audi, and DaimlerChrysler create what they call the "3 Liter Cars." These vehicles, the VW Lupo 3L TDI, the Audi A2 1.2 TDI, and the DaimlerChrysler smart, consume about 3 L per 100 km [78 mpg].[109][110] While not yet available for sale in the United States, all three models have been available in Germany since 1999. These cars greatly surpassed the average vehicle fuel economy of that time, and still do.

The Clean Automotive Technology Program, formerly known as the Partnership for a New Generation of Vehicles (PNGV), is a joint research project by the Big 3 (Ford, GM, and DaimlerChrysler) and EPA between 1993 and 2003. It has the goal of creating both an environmentally friendly car with fuel economy of 80 mpg [34 kpl] while maintaining size, safety, performance, and affordability, as well as attempting to "help ensure long-term competitiveness of the domestic auto industry."[111] This program is scheduled to end in September 2003, and presumably its results will be published soon thereafter.

There has been a great deal of research in alternative energy sources in automobiles. The short-term focus is on hybrid fuel-electric engines and the long-term

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[107] "Ford says SUV fuel economy goal getting tougher." *Automotive News*, 5 August 2002.
[108] Truett R. "Diesel meets EPA's '07 rules." Automotive News, 11 August 2003.
[109] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 50.
[110] Interim Report: Environmental Review of Audi AG. Audi AG, August 2000, pg 6.
[111] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 2.

focus on hydrogen fuel cells. The drawback to using hydrogen fuel cells is that there is no world infrastructure to support them. As detailed in Figure 23, there are both advantages and disadvantages to using hydrogen as an energy source, and it unfortunately will not be technically implemented within the next 15 years. Herbert Kohler, DaimlerChrysler's Chief Environmental Officer, describes the hydrogen fuel cell situation best:

> "[The] vision of the future is one in which automobiles are powered by fuel cells. Such vehicles generate no exhaust emissions and they can fill up on hydrogen produced from renewable energy sources. However, to arrive at this solution, there must first be a transitional phase. Hybrid vehicles represent such a link between present and future, because they have an internal combustion engine and an electric motor, and they can store energy in a battery, which makes them doubly economical… An inexhaustible supply of energy derived from water and free from emissions is of course a wonderful vision. But to produce the hydrogen – for example using wind power and solar energy – and distribute it, we need a whole new infrastructure which will cost billions and take time to develop. I reckon it will take between 30 and 50 years to set up a hydrogen infrastructure."[112]

[112] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 48-49.

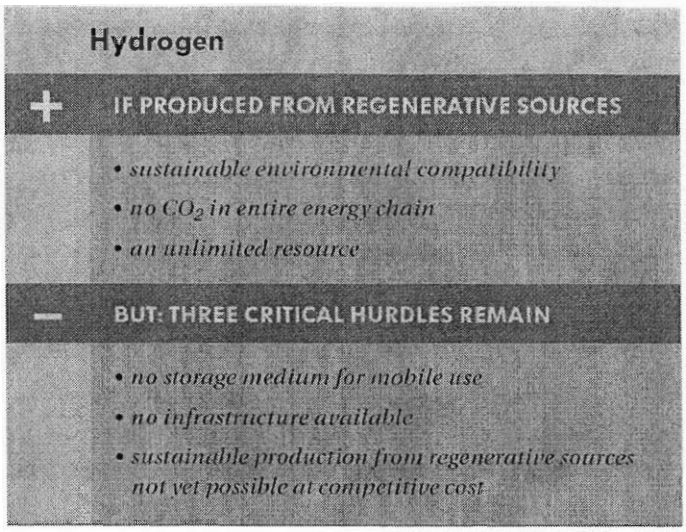

Figure 23: Advantages and disadvantages to hydrogen as a fuel source. Source: VW Environmental Report 2001-2002, pg 54.

Hybrids have slowly entered the market, with more companies producing them as the years progress. Japanese automakers like Honda and Toyota lead the US vehicle market in fuel efficiency with their hybrid vehicles, showing the other companies that it is a successful venture. Ford went a step further with the Escape Hybrid SUV, due for release in 2004. Ford advertises its new breed of SUV as achieving 35-40 mpg [14.9-17 kpl] yet maintaining all of the same features as the conventional Escape model. On top of that, Ford has effectively subsidized the price of the new technology to make it a more affordable vehicle to the consumer, attracting customers for both fuel economy and reasonable price.[113]

Even with the prospect of a long road until fuel cells are implemented in new model vehicles, research has been ambitious within all of the companies. DaimlerChrysler has been doing extensive research in hydrogen fuel cell technology and its implementation in automobiles. In 2003, the company produced 60 Mercedes-Benz A-Class fuel cell powered ZEVs, called the "F-Cell." Customers in the US, Germany,

[113] "Ford Escape Hybrid." Ford website. Ford Motor Company, 2003, http://www.fordvehicles.com/escapehybrid/frameset.asp

Japan, and Singapore are testing the F-Cell cars in everyday use. This advancement puts DaimlerChrysler in the forefront in automotive fuel cell development, as they are the first automaker to put fuel cell vehicles on the road.[114]

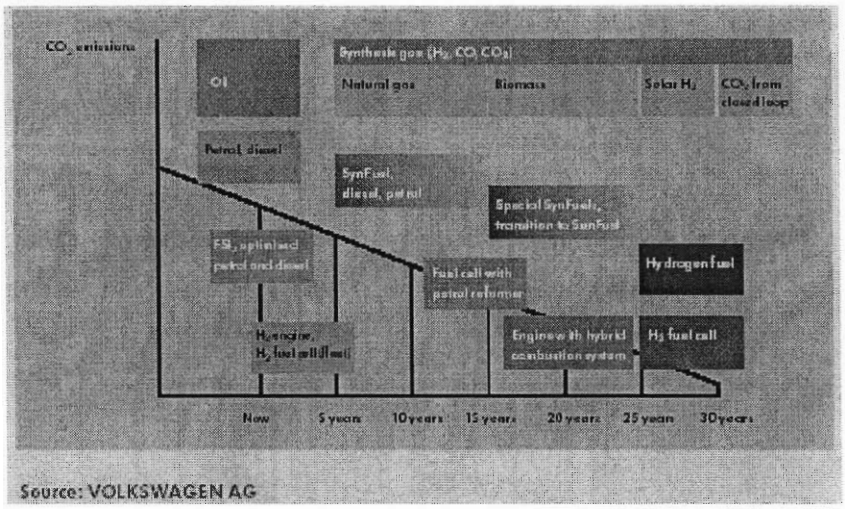

Figure 24: Predicted future trends in fuels and correlating drive systems. Source: VW Environmental Report 2001-2002, pg 57.

Using alternate energy sources helps the environment by reducing emissions and decreasing fossil fuel consumption. It helps the American and German economies by decreasing their oil dependency. For the automobile industry, using alternate energy sources is an incentive to meet national and international emission regulations, ensuring the sales of their respective products.

3.2 Financial Incentives and Initiatives

The incentives in section 3.1.1 are, for the most part, financially motivated, as is common for incentives in any kind of business. Other financial incentives not related to the law usually take increased profit or major savings into account, and can be very beneficial to the company. Some of these are merely redesigning existing manufacturing

[114] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 94-95.

processes to make them more efficient, while others include recycling materials, using new or alternative materials, and cutting down on utility usage.

3.2.1 Increasing Efficiency

Many different materials are used in the production of an automobile. Metals, woods, plastics, and other man-made materials all need to be a specific shape to carry out a specific job. Chemicals are also used, for example in the metal working process and painting process. Often these materials are wasted or inefficiently used, and in a business, wasting materials equals wasting money. Wasted money on materials becomes an incentive to find alternate or more efficient methods of using them.

An example of such an initiative to increase efficiency is found at the BMW plant in the United States. At the manufacturing facility, where the world's stock of Z3s (replaced with Z4s) and X-5s are produced, paint colors of the vehicles are made to order. There is therefore the possibility that of ten cars on the production line, each is to be painted a different color. Paint spray nozzles need to be both purged and cleaned between each color change, which can be a very wasteful process since excess paint, water, and solvents are used between each color change. The facility recognized this waste of materials (and money) and developed a computer program to sort through the orders and group them by color on the production line. This program increased the efficiency greatly and saved the facility time, materials, and money.[115]

[115] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 11.

3.2.2 Recycling Materials

The incentives to recycle materials are many, from cost reduction from reuse of already-processed materials to compliance with recycling laws. As time progresses, recycling has not only become a cheaper process, but a better financial path for many businesses to take. Within the factory, recycling materials helps reduce the need for more raw materials, and therefore saves the company money when purchasing fewer raw materials. In different countries there are different laws about how much waste is allowed by the plant, how much of that waste must be recycled, and what percentage of vehicles must be recycled. In this instance, Germany (and the EU as a whole) is much more stringent about recycling than the US. The "end-of-life" directorate (see section 2.1.2) in Europe mandates that 85% of an unusable vehicle must be recycled. This puts pressure on the German automakers to fund both the collection *and* the recycling of their end-of-life vehicles. Therein lies an incentive to find a technique to minimize costs during this process. Companies like DaimlerChrysler have helped decrease their costs by providing many locations to collect the ELVs, making the retrieval process more convenient.[116] Even though the 95% recovery rate does not take effect until 2015, VW began a program in 2001 to increase the recycling rate of their new vehicles to comply with this recovery percentage.[117]

In terms of solid waste, many companies have initiated programs for recycling. Paper and packing material account for a great amount of waste in the auto industry, however it is among the easiest and cheapest materials to recycle. Metals are also

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[116] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 94.
[117] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 36.

relatively easy and cost effective to recycle, since unused metal is not wasted but rather reused, which reduces the amount of raw materials purchased. Plastic and rubber can also be recycled, but usually at a greater price. BMW recycles many of its materials, including paper, cardboard, metal, wood, plastic, rubber, paint sludge, fluorescent light bulbs, oil, and paint. They separate out all of their recyclable waste, from paper to soda cans to production parts.[118] VW saves 1.3 million dollars [1.2 million euros] and reduces about 815,700 pounds [370,000 kg] of waste by recycling packing material (plastic and cardboard) by reselling it to the original suppliers and recycling companies.[119] Ford has a recycling program that uses an annual 50 million plastic soft drink bottles and one billion bottle caps to make various car parts for production.[120] Ford also recycles its tires, assuring that they meet a certain standard, and then puts them on their new vehicles. Tires that do not meet the standard are then recycled for use in other products, such as ergonomic floor mats.[121]

Many of the companies are improving their recycling programs and waste reduction programs. GM reduced its total amount of waste between 2001 and 2002 by 1.3%, however increased the amount of recycling by 4.5%.[122] Audi has had a 10 year, 87% improvement of refuse volume to recycling volume, and the recycling percentages

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[118] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 7.
[119] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 31.
[120] "Ford Field." Ford website. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/recycling/fordField.htm.
[121] "Vehicle Recycling." Ford website. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/recycling/vehicleRecycling.htm
[122] "Environment and Energy Information." Corporate Responsibility and Sustainablility Report 2001-2002. General Motors, 2002, pg 55.

at the Neckarsulm and Ingolstadt plants are 94.7% and 96%, respectively.[123][124] The BMW South Carolina plant produced 17.8 million pounds [8.1 million kg] of waste in 2000, of which 78% was recycled, or 13.9 million pounds [6.3 million kg].[125]

Recycling liquids is a more difficult process, as most fluids used in automobiles are combinations of different ingredients. Some of the fluids used, like oil, are easily reused and save companies a lot of money. For example, GM saved close to one million dollars [.9 million euros] by recycling oil used by its plants in 2001.[126] DaimlerChrysler has designed a device to separate coolants from oils, and reuses the coolants; this process has cut the coolant flow to the waste water treatment plant by 1.2 million gallons [4.5 million liters] since May 2001.[127] VW recycles their brake fluid by collecting brake fluid from older cars, sending it to a subcontractor to be treated, and then reusing it in new vehicles.[128]

Painting involves a great amount of fluids, including water and solvents. As mentioned before, the BMW US plant reduced their need to change the nozzles from different colors, but they also minimized their paint solvent usage by switching to water-based paints.[129] DaimlerChrysler switched to water-based paints as well, significantly reducing its need for paint solvents. DaimlerChrysler also developed a technique to

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[123] "The Environment." Audi Annual Report 1999. Audi AG, 1999, pg 26.
[124] Interim Report: Environmental Review of Audi AG. Audi AG, August 2000, pg 40.
[125] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 7.
[126] "Environment and Energy Information." Corporate Responsibility and Sustainablility Report 2001-2002. General Motors, 2002, pg 59.
[127] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 94.
[128] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 36.
[129] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 7.

reclaim paint particles that miss the body of the vehicle being painted. The paint sludge that comes from the rinsing system is dried out, ground, and used to replace inert filler in floor pan sealers. This process not only reduces large volumes of liquid waste, but also saves an annual 350,000 dollars [315,000 euros].[130] It is clear that the financial advantage of reusing materials in the auto industry is well worth the initiative to develop recycling programs, however sometimes the more advantageous technique is to find new or alternative materials instead of conventional ones.

3.2.3 New and Alternative Materials

As technology develops, new materials are being created and discovered that are better for the job than their predecessors. These improvements may be in weight, strength, or cost. Certain materials may be better for recycling, or somehow contribute to fuel efficiency or emission volume. There is a strong incentive to try to find the most efficient, cost-effective, and time-saving materials to manufacture the best product at the greatest profit to the company.

Audi and VW have both been implementing new metal alloys for their vehicle frames in the past few years. Audi uses all aluminum bodies in its A8 and A2 models, which is just as strong as steel, but is lighter, cheaper, and easier to recycle.[131] VW began designing and implementing magnesium alloys into its vehicle bodies, which reduces weight even beyond that of aluminum alloys and equally as recyclable.[132]

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[130] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 97.
[131] "The Environment." Audi Annual Report 1999. Audi AG, 1999, pg 26.
[132] "Mobility and Sustainability." Environmental Report 2001-2002. Volkswagen AG, December 2001, pg 35.

Natural fibers have been a new source of cheap and effective materials for upholstery and binding materials. The use of natural fibers has a lot of measurable advantages. A joint study by the Technical Universities of Braunschweig and München compared the material and energy balance of the side upholstery and trunk lining between conventional petrochemical materials and fiber binding materials out of flax and jute. The study showed that the natural fibers were ecologically better in terms of use in material and energy, ease to work with in the production phase, as well as extending the useful life of the vehicle and saving energy during production of the upholstery.[133] The only disadvantage of using natural fibers, as compared to petrochemical materials, is that it releases less heat when burned for fuel. European automakers used about 21,000 metric tons of natural fibers in production; Germany accounted for more than half of that. It is predicted that within the next decade, German companies will use about 70,000 metric tons of natural fibers in production. Already, Audi, VW, and Opel (GM) have been using plant materials like flax, hemp, sisal, and jute for diverse form-pressed materials in their automobiles.[134] New developments for adhesives for cars are coming from starches, fats, cellulose, and fatty acids, all of which are derived from turnips and peas. Since 2000, Audi has been researching and implementing a new environmentally friendly tanning material, derived from rhubarb, for the leather interiors. Companies are also using wood fibers to strengthen plastic in the handles and dashboards of their vehicles.[135] Using these fibers has not only been environmentally advantageous to the

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[133] Jensen D. "Rüben in der Tür, Rhabarber im Sessel." *Frankfurter Rundschau*, 5 September 2001. "Turnips in the door, rhubarb in the seats." Translated by Jeremy Allen and David Dollenmayer.
[134] *Ibid.*
[135] *Ibid.*

automakers, but has also benefited regional development in the countries where these fibers are grown, such as Brazil, South Africa, and the Philippines.[136]

3.2.4 Saving Energy

Saving energy on the industrial level helps reduce costs greatly. While there are indubitably environmental benefits to reducing CO_2 emissions and lowering energy dependency, the major incentive for the automakers to conserve energy is to save money. Within different companies, saving energy has taken the form of recycling energy, redesigning energy plants, and finding different sources of energy.

Audi has initiated a heat recovery program to conserve the energy used to produce heat for different purposes in the plant, mostly climate control. Audi saves the equivalent of 1.017 billion cubic feet [28.8 million cubic meters] of natural gas in heat per year, which represents a saving of 27% of heat generation energy.[137] DaimlerChrysler is also working on reducing their energy consumption. The process of painting vehicles has been redesigned so that, instead of heating the bodies of the vehicles to dry them faster, a refrigeration unit was installed to draw out the humidity in the air and allow the water-based paints to dry faster. There is an expected drop in energy consumption between 30% and 40%.[138] GM has decreased its global energy consumption by 9.9% between 2000 and 2001.[139]

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[136] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003pg 94.
[137] Interim Report: Environmental Review of Audi AG. Audi AG, August 2000, pg 38.
[138] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 97.
[139] "Environment and Energy Information." Corporate Responsibility and Sustainablility Report 2001-2002. General Motors, 2002, pg 49.

Other energy reduction initiatives have been accomplished by discovering new ways to obtain energy. Audi developed a major project to design and put into operation an efficient energy producing plant. Costing 22.3 million dollars [20.1 million euros], this plant has two large gas turbines which convert natural gas into electricity and heat. The electricity either goes directly to the plant or is used to compress air. The heat given off with the emissions from combustion is captured and used as heating energy, which heats part of the process to condition car paint, as well as climate control in the plant. Overall, these turbines are 80% effective, and the gas consumption and correlating CO_2 emissions are 25% lower than with conventional energy generation methods.[140] Both Ford and BMW are researching the use of landfill gases (primarily methane) to generate energy. This technique has many advantages, which include the conservation of fossil fuels, the reduction of GHG emissions, the prevention of a renewable source of energy from being wasted, and the reduction of costs.[141] The US BMW plant has been studying the possibility of harnessing this energy source from a nearby landfill as a means to save money by reducing the need to purchase natural gas.[142] Methane is harnessed by using turbines to create electricity and heat, which, in the case of Ford, produce 2.4 Megawatts of electricity daily.[143] Using this unexploited, renewable resource is both the epitome of sustainability, as well as a 'goldmine' for saving money.

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[140] "The Environment." Audi Annual Report 1999. Audi AG, 1999, pg 27.
[141] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 10.
[142] *Ibid.*
[143] "Landfill Gases." Ford website. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/recycling/landfillGases.htm.

3.3 Public Relations

The combination of corporate image and customer loyalty comprise an important factor in public relations. What the public and the average consumer think about when they are looking at different automakers and how the automakers present themselves play a role in how well their products sell. Creating a strong customer base through the promotion of customer loyalty provides a company with life-long consumers. For these reasons, there is an incentive within the industry to present itself well, and that includes its environmental friendliness. There are many ways in which a company can do this, be it through advertising, providing perks with purchases, winning awards, and making philanthropic contributions.

When watching television, one rarely misses seeing at least one car commercial. Often, car commercials depict a single car driving through the desert or forest, completely alone and being 'one with nature.'[144] Some of these commercials include the DaimlerChrysler-owned Jeep Liberty and Wrangler going off-roading and tackling any obstacle, the Ford-owned Mazda 6 driving at high speeds through the desert with catchy music in the background, the VW Bug with a complimentary Apple iPod, and many more, going fast, uninhibited, and in gorgeous scenery.[145] It is then interesting that the very same automobiles that are depicted 'one with nature' are the automobiles that do the most damage to it. The companies use advertising to suggest environmental friendliness; the high-fuel-consuming Jeep Wrangler and the landscape-destroying Mazda 6 are quite

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[144] Jensen D. "Rüben in der Tür, Rhabarber im Sessel." *Frankfurter Rundschau*, 5 September 2001. "Turnips in the door, rhubarb in the seats." Translated by Jeremy Allen and David Dollenmayer.

[145] Savard J. Recorded televised automobile commercials, Pittsburgh Charter Cable, July 2003.

the opposite. Cars do boast some environmentally friendly features in their commercials to help with buyer's impulse, such as new technology and high fuel efficiency, however there are just as many, if not more, commercials for vehicles that focus on their big size and powerful engines.[146] DaimlerChrysler developed a program with its European smart car model, called "smartmove." This program provides perks to the consumer for purchasing a smart car, including for example specialized parking spots, negotiated rates at Avis car rental for cars that seat more than 2 people, ferry and train transport discounts, hotel discounts, and car wash discounts.

Similar to voluntarily meeting international standards, companies also apply for awards and recognition to help improve corporate image. A list of prestigious awards won for a particular model is helpful in advertising that vehicle. The MINI Cooper (BMW) received the 2003 North American Car of the Year award, and BMW has seen increasing sales of the Cooper ever since.[147] The US division of BMW was also initiated into the National Environmental Performance Track, which is an EPA program to certify companies with effective environmental management systems, a commitment to continuous environmental improvement, a history of compliance, and dedication to public outreach.[148][149] Formerly known as the National Environmental Achievement Track, BMW applied for and received the year 2000 certification, and is the only

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[146] Jensen D. "Rüben in der Tür, Rhabarber im Sessel." *Frankfurter Rundschau*, 5 September 2001. "Turnips in the door, rhubarb in the seats." Translated by Jeremy Allen and David Dollenmayer.
[147] Annual Report 2002. BMW Group, 2003.
[148] EPA National Environmental Performance Track website. http://www.epa.gov/performancetrack/
[149] Environmental Report. BMW Manufacturing Corp., Spartanburg, SC, September 2001, pg 1.

automotive manufacturer in the program out of the current 302 members.[150] DaimlerChrysler received the Clean Air Excellence Award in 2002 for its combined work with DuPont to create a clear coat paint which cuts emissions by 29%.[151]

The auto industry is quite philanthropic. It may not be widely known that automakers like GM, DaimlerChrysler, and Ford donate millions to various charities, many of which are environmental organizations. Ford plants a tree for every retired vehicle to promote cleaner air,[152] and GM initiated a program to restore and protect 30,000 acres [121.4 km2] of Brazilian rainforests.[153] DaimlerChrysler has initiated programs in different parts of the world to improve life and preserve history. DaimlerChrysler won the 2002 UN Award for Excellence in the Workplace for launching a comprehensive anti-AIDS program in South Africa; DaimlerChrysler supported the development of a Museum of the Desert in Saltillo, Mexico, which focuses on conserving desert resources and cultural heritage.[154] Ford built an entire stadium in Detroit for (American) football, which is now home to the Detroit Lions. Ford used many different types of renewable and recycled materials to construct the stadium, including bamboo flooring, recycled plastic bathroom dividers, and recycled tires in the form of crumb rubber holding the turf in place.[155] The entire stadium is strictly managed with environmental concerns in mind.

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[150] *Ibid.*
[151] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 66.
[152] "Vehicle Recycling." Ford website. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/recycling/vehicleRecycling.htm
[153] "Environment and Energy Information." Corporate Responsibility and Sustainablility Report 2001-2002. General Motors, 2002, pg 66.
[154] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 93.
[155] "Ford Field." Ford website. Ford Motor Company, 2003, http://www.ford.com/en/goodWorks/environment/recycling/fordField.htm

4 Analysis and Recommendations

With a detailed background and a comprehensive list of initiatives undertaken by the automakers this report has focused on, the next step is to analyze the current and projected successes of the auto industries in the United States and Germany, as well as recommend ways in which both nations could improve. The author recognizes the limitation of only evaluating Germany and the US, as there may be other initiatives undertaken by different nations and automakers not considered in this report. Nevertheless, Germany and the US could learn a lot from each other, in terms of policy making, industrial technology, and the automotive business. Unless otherwise stated, the term "Germany" is henceforth used to represent German environmental policy making, the German automakers (VW, Audi, and BMW), and the German people. Likewise, "the United States" refers to American environmental policy making, American automakers (Ford and GM), and the American people. DaimlerChrysler is excluded from either country, as it is an equal combination of German and American business policy.

4.1 Current Success

It is the opinion of this author that Germany is currently more successful than the United States in taking environmental initiative. For a current evaluation, that is, taking into account only what each country is doing now, and not what they plan to in the future, the following **four** conclusions can be drawn:

- Germany has stronger public presence in environmental policy-making than the United States

- Germany recycles more of its vehicles
- Even with major declines in American emissions and a relatively unchanging amount of German emissions, the United States is still emitting more pollutants per capita
- Germany is ahead of the United States in automotive technology

Germany has stronger public presence in environmental policy-making than the United States. The American public has remained particularly disinterested in the environmental impact their mobile lives have. Comparatively, Germany is quite active, notably in the strongly-backed Green Party, growing "eco-industry," and government-promoted national pride for being eco-conscious. The greater strength of the Ministry of Environment, as compared to the EPA, allows Germany more flexibility in writing up and quickly implementing new environmental policies. The strength of the Green Party, the junior member of Germany's ruling coation along with the Social Democratic Party (*Sozialdemokratische Partei Deutschlands*, SPD), is invaluable in the acceleration of environmentally related legislation. The much less powerful American Green Party, coupled with lackluster public environmental initiative, show that the United States is more economically-minded than ecologically-minded.

Germany recycles more of its vehicles. Not only do the German automakers take more initiative towards production recycling, the end-of-life vehicle mandate in Europe pushes total vehicle recycling above and beyond that observed in the United States. The absence of similar such legislation in the United States accounts for a lack in vehicle retrieval and subsequent mass recycling of unusable vehicles. The **average** vehicle in the

United States is 75% recyclable, whereas the **mandated** percent a vehicle must be recyclable in Germany is 85%.

Even with major declines in American emissions and a relatively unchanging amount of German emissions, the United States is still emitting more pollutants per capita. There has been a greater decline in emission volumes in the United States than there has been in Germany, as recorded since the 1970s. Germany has remained practically at a stand-still, suggesting that the changes in emission regulation thus far have not been enough to incite change. This said, the United States still emits more total pollutants per capita than Germany. The United States is the largest single emitter of CO_2 in the world, and its energy consumption is the highest as well. The recent decade's explosive trend towards larger vehicles and higher fuel consumption in the United States takes a step in the wrong direction in American pollutant improvement. Legislatively speaking, California has the strictest emission regulation, more so than Germany; however the United States federal regulations rank below them both. In this case, Germany's stagnancy is better than the United States' overall decline.

Germany is ahead of the United States in automotive technology. Looking only at the current technological improvements, Germany proves itself far ahead of the United States. It is apparent that initiative has been taken on both sides of the race to implement more efficient and alternate energy consumption, however, Germany has implemented it more broadly and with higher quality than the United States. Audi, VW, and DaimlerChrysler ("smart" GmbH is an original subsidiary of Daimler-Benz before the Daimler-Chrysler merger) all produce, sell, and improve upon their "three liter cars." The United States does not sell any non-hybrid vehicles that obtain such a high fuel

economy. Production models of hybrids are also scarce in the United States auto industry, compared to Germany's greater proliferation of hybrid and fuel cell vehicles.

4.2 Projected Success

The projected success of the two nations is factored by taking present accomplishments, published intentions, impending laws, and predicted trends. With this in mind, the United States seems to be in a better position for improvement than Germany. This may be self-evident with the realization that the US is currently doing more poorly than Germany, and can only improve from that position. Nevertheless, Germany has set itself up for a few failures that will heavily affect its future environmental policy-making and ecological well-being. In respect to the projected success of Germany and the United States, the following **four** conclusions can be drawn:

- Germany will run into an energy crisis or encounter significantly increased CO_2 emissions
- High population density areas will be heavily affected by vehicle emissions; therefore Germany with its greater population density will thus be more affected
- Impending emission regulations will shape national technological development
- Germany will have limited use of alternate materials regulated by the end-of-life mandate

Germany will run into an energy crisis or encounter significantly increased CO_2 emissions. Due to recent changes in German legislation, nuclear energy is in the process of being phased out, with completion in 2021. To this point, no one has suggested how

the 30% of national energy currently coming from nuclear power will be replaced. It is predicted to come from the combustion of fossil fuels. The Green Party, who was the antagonist against nuclear energy, will be blamed for either having to import energy from other nations, or provide the energy by other means. The German infrastructure is not yet able to support a major percentage of energy from solar, wind, or water power, and therefore may resort to fossil fuel combustion. This would significantly increase the amount of pollutants, particularly CO_2, emitted by Germany as a nation, and would make any improvement in the transportation sector's emission reductions negligible.

High population density areas will be heavily affected by vehicle emissions; therefore Germany with its greater population density will thus be more affected. With the world trend towards increased vehicles per capita and increased distance driven per year, emissions not only need to decrease from model year to the next, but also in relation to the increased driving. That is to say that with this increasing trend in distance driven, automobiles need to produce less emissions just to keep pollution constant, and **to reduce pollutants would require drastic reductions in pollutant output.**[156] It is also known that urban areas are more heavily affected by vehicle emissions, as there is a higher vehicle and population density, there is more traffic for longer periods of time, and the pollutants get trapped by the buildings. Since Germany has both a greater population density and vehicle density, it appears that it will be affected more by this trend.

Impending emission regulations will shape national technological development. With the upcoming Tier 2/LEV II and Euro 4 emission regulations taking effect between 2004 and 2007, the newly enforced laws will push automakers to advance technology at

[156] "Partnership for a New Generation of Vehicles and the Environment." Environmental Protection Agency, April 1998, pg 3.

an accelerated pace to comply. The upcoming regulations are much stricter in the United States (and California) than in Germany, so the Big Three will have to make big improvements in their fuel economy and pollutant emissions in the next few years. These new regulations will help the United States curb its trend toward high pollutant volume and begin to reduce it. These new regulations will also spur a jump in technology from currently being behind Germany to being ahead of them, implementing both what Germany has (high fuel efficiency vehicles and fuel cells) and what different companies are currently researching. This may also help advance the development of the hydrogen fuel cell infrastructure, putting the United States in the position of being the leading nation in producing renewable energy. The one saving point for Germany is that it has the independent power from the European Union to make the regulations stricter within the Federal Republic, matching those of the United States.

Germany will have limited use of alternate materials regulated by the end-of-life mandate. The European Union "end-of-life" mandate may actually prove to be detrimental in implementing cheaper and more environmentally friendly materials. Since the law clearly mandates that 85% of the vehicle must be recycled, with a maximum amount of 5% used for thermal energy, an excessive amount of materials that can only be recycled through incineration is not beneficial unless there is still 80% of the vehicles recoverable through different means. Natural fibers, which are environmentally beneficial for many reasons, are very difficult and expensive to recycle by any means besides incineration.[157] This decreases the value of using these natural fibers for the

[157] Jensen D. "Rüben in der Tür, Rhabarber im Sessel." *Frankfurter Rundschau*, 5 September 2001. "Turnips in the door, rhubarb in the seats." Translated by Jeremy Allen and David Dollenmayer.

German automakers, as they do not help achieve compliance with the mandate. This law therefore discourages the German auto industry from implementing the fibers as a renewable and environmentally friendly alternative material.

4.3 Recommendations

Taking into account the current and projected successes of Germany and the United States, the author has formulated **five** recommendations that would help both nations continue to develop their environmental policies and improve their environmental situation. These recommendations are based on the collected data found primarily in sections 2 and 3 as interpreted by this author:

- Germany should bring its impending Euro 4 emission regulations to the same levels as those of the United States' Tier 2
- The United States should implement a recycling program similar to the end-of-life mandate
- Both Germany and the United States should implement CO_2 regulations that are tax-based
- Both Germany and the United States should make 100% certification of ISO 14001 or EMAS mandatory for the auto industry
- Both Germany and the United States should provide tax breaks to automotive companies that have more environmental initiatives, and likewise those companies should reward customers for purchasing green cars

Germany should bring its impending Euro 4 emission regulations to the same levels as that of the United States' Tier 2. As mentioned in the "Projected Success" section, with the upcoming EU regulation change, emission volumes in Germany will remain unchanged. Given the trend toward increased vehicle volume and distances driven, slight changes in emission regulations only keep the amount emitted balanced, rather than cause it to decline. Germany has the legislative power to tighten national regulations above the level of the Euro 4 regulations, but not to make them more lenient. Since the German automakers have such a large portion of their market in the United States, their imported vehicles will have to comply with American standards, and therefore equal regulations in Germany would force those manufacturer to make *all* of their fleets compliant. American vehicles imported into Germany would most likely be compliant with the American standards as well, so having more lenient regulations in Germany only gives these automakers an excuse to have vehicles that emit more pollutants.

The United States should implement a recycling program similar to the end-of-life mandate. Even though there are efforts to recycle retired vehicles by many of the automotive manufacturers in the United States, the amount of recycled material in Germany is much more widespread and efficient. With the end-of-life mandate, by the year 2015, German automobiles will be 95% recyclable, and without any legislation, American automobiles will remain between 75-80%. By increasing the homogeneity between the two countries' emission and recycling legislation, the automakers will all have to comply with the strictest of standards from each country. Since companies like VW are producing new cars that are almost already 90% recoverable, it is clear that this

technology exists and can be implemented throughout the auto industry. This program should allow for flexibility with alternate materials, so that natural by-products that can only be recycled by means of incineration are still used as a renewable and environmentally friendly resource.

Both Germany and the United States should implement CO_2 regulations that are tax-based. As suggested by the COWI A/S report, the fiscal means by which to limit vehicle CO_2 emissions are quite beneficial to both the national economy, as well as the environment. By creating a tax scheme that rewards cars for low emissions, and consequently heavily taxes a car for high emissions, the new incentive for automakers will be to reduce taxation and hence reduce CO_2 emissions. Phasing in any of the suggestions made by the COWI A/S report would be beneficial to both nations.

Both Germany and the United States should make 100% certification of ISO 14001 or EMAS mandatory for the auto industry. By mandating environmental management systems to be present in every branch and manufacturing plant of the auto industry, the governments will fore every company to reorganize its environmental department for maximum effectiveness. This forced compliance would help relieve the feeling that the environmental departments of many companies are not finding it easy to get their ideas heard within the company.[158] Restructured programs and other environmentally related activities would most likely be carried out more efficiently and with better results after ISO 14001 and EMAS certification.

Both Germany and the United States should provide tax breaks to automotive companies that have more environmental initiatives, and likewise those companies

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[158] *Ibid.*

should reward customers for purchasing green cars. Along the same lines as the COWI A/S suggested program for CO_2 emissions, a multileveled program for automotive companies that provides tax incentives to produce more environmentally friendly vehicles would be very beneficial to the further development of greener vehicles. Likewise, the automakers receiving the tax break for carrying environmentally conscious vehicles should provide a discount, tax break, or other perks with the purchase of said vehicles. This could be done as a tax incentive directly from the federal government; however, if it is promoted by the automakers, competition among them would increase the benefits to the consumer purchasing the vehicle. Increased incentive for the consumer would drive the sales of greener vehicles, such as hybrid, smaller sized, or higher fuel economy vehicles, to a level that could compete with conventional diesel and gasoline vehicles. As of now, the consumer is not fully aware of the environmental considerations taken, and effectively doesn't care- so long as their requirements are met, which usually include size, comfort, safety, engine power, and price. If environmental considerations would drastically reduce vehicle cost, the average consumer would be more concerned with the environmental advantages of different models, as they are not heavily advertised at this time.[159] Phillip Schiemer, Head of Marketing and Sales at smart GmbH, sums it up best:

"A car that gets by on less fuel but is too expensive for potential buyers is no use to the environment."[160]

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[159] *Ibid.*

[160] 360 Degrees: Environmental Report 2003. DaimlerChrysler, 2003, pg 60.

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