“Crucial work on climate change is already underway. Right now, on the regional level all around the world. Cities, states, provinces, nations, have been hard at work. Because we know we must have climate action. That’s right: action! And that action starts with us. That’s how revolutions begin: all at the grass roots level.”
Arnold Schwarzenegger, Governor of the State of California
Address to the people before COP-15

“Climate change will require unprecedented international cooperation. Starting here in Europe. Indeed, action on climate change is exactly the kind of test for the European Union in this century. A test of our capacity to act, our capacity to deliver. And it is also a test of our capacity to lead”
Jose Manuel Durao Barroso, President of the European Commission
London, 21st of January 2008
Preface

This research was performed at the Center for Energy and Environmental Policy (CEEP) at the University of Delaware in the United States. The highly international and intellectual work environment at the CEEP enriched the study abroad experience. The six month period that I studied in the United States contributed greatly to my intellectual and social capabilities.

During the six month period I have been able to follow courses, attend conferences and had thought provoking discussions with my fellow students about recent developments in the energy and environmental policy field as well as each other’s research. The course “Technology, Environment and Society” introduced me into a realm of political ecology that I thus far had not been confronted with, which was a very interesting experience. Although certain elements were surely already familiar to me, an exhaustive investigation into the historical background of political ecology by readings of the like of Karl Marx and David Ricardo was new to me.

Frequent discussions with Prof. John Byrne and my supervisor Prof. Yda Schreuder guided my research’s direction and content. With the added transatlantic discussions with my supervisor back home, Prof. Henk Moll, the guidance and direction provided for this research was exceptional.

On a cultural level it was very interesting to find that besides big differences, there are also big similarities between the Dutch (or European) culture and the US culture. Especially a trip into the heartland of America and its culture was intriguing to say the least. Day-to-day life in Newark, Delaware is very different compared to day-to-day life in the city of Groningen and I have learned a lot from the experience. This was in major part due to my fantastic fellow students and friends of the CEEP as well as of the Urban Affairs and Public Policy institutes.
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Summary

The United States and the European Union address climate change in a fundamentally different manner. The US seems uninterested to address climate change from a federal level, but individual states within the US are definitely moving forward with climate change mitigation action. The EU addresses climate change from the supranational level of the European Commission, and directs the member states of the EU with specific targets and regulations. The US climate change mitigation approach stems from the lower, decentralized levels of government and therefore can be called bottom-up. The EU climate change mitigation approach originates in the higher centralized level of government and can therefore be called top-down.

The difference in approach can be seen in a transatlantic comparison in climate change policy: The EU adopts a wide variety of Directives and Regulations to direct the member states into a climate change mitigation direction, while the US climate change policy is mainly focused on voluntary public-private agreements and research and development. As climate change policy focuses on greenhouse gas (GHG) emission reductions, this research analyses the emission trend of CO2 to estimate the effectiveness of the implemented policies. The research is limited to the analysis of the CO2 emission trend, as CO2 is the most prominent GHG. Comparing the results of this policy difference analysing the CO2 emission trend since 1990 leads to the conclusion that the EU outperforms the US in climate change mitigation. This is illustrated by the increase in emissions of CO2 in the US and the decrease in emissions in the EU. The emission trend in the different sectors moreover shows that the EU has been able to reduce emissions in more sectors compared to the US.

However, certain states in the US show to be aggressive on climate change, enacting a large variety of climate change policies and working together to address climate change. This is in contrast to some member states in the EU that show reluctance to address climate change aggressively; little more than adoption of the EU climate change package is performed by these states. On the other hand, certain states in the EU illustrate leadership by addressing climate change vigorously, while states in the US are reluctant or even hostile to any climate change mitigation.

Analyzing the CO2 emission trend of these states and the emission distribution over the different sectors yields interesting results. Other results, such as the fact that a large portion of EU emission reductions occurred due to political restructuring and the economic downturn in the eastern European countries in the early 1990s, were already widely known.

In the end, the conclusion that the top-down approach seems to be more effective in addressing greenhouse gas emissions remains. The positive characteristics of the bottom-up approach seem to be negated by its negative effects. However, as many of the climate change policies have only recently been adopted in both the EU and the US the real effects of both approaches might not be visible in the CO2 emission trend just yet. This puts the conclusion into perspective.
Samenvatting

De Verenigde Staten en de Europese Unie hanteren een fundamenteel verschillende aanpak aangaande beleid om klimaatverandering tegen te gaan. De VS lijkt vanuit een federaal perspectief grotendeels ongeïnteresseerd om klimaatverandering agressief aan te pakken, terwijl een groeiend aantal individuele staten binnen de VS duidelijk voorop lopen in uitstoot reducerend beleid. De supranationale aanpak van de EU door de Europese Commissie dirigeert de lidstaten aan de hand van specifieke richtlijnen en wetgeving. De aanpak van de VS ontstaat daarom meer vanuit de lagere overheidslagen en is “bottom-up” te noemen, terwijl de aanpak van de EU meer ontstaat vanuit de supranationale overheidslaag van de Europese Commissie en is daarom “top-down” te noemen.

Het verschil in aanpak komt voor het daglicht door een trans-Atlantische vergelijking van het beleid aangaande klimaatverandering uit te voeren. Deze vergelijking laat zien dat de EU een groot aantal richtlijnen en wetgeving aan de lidstaten oplegt, terwijl de VS gebruik maakt van niet bindende overeenkomsten tussen de overheid en het bedrijfsleven en zich richt op onderzoek en ontwikkeling. Het algemene doel van beleid aangaande klimaatverandering is om de uitstoot van broeikasgassen terug te dringen. Een indicator voor de effectiviteit van beide aanpakken is dus de trend in uitstoot van broeikasgassen. Dit onderzoek limiteert zich tot een analyse van de uitstoot trend van CO2; het meest prominente broeikasgas. Deze analyse leidt tot de conclusie dat de aanpak van de EU effectiever is dan de aanpak van de VS. De toenemende uitstoot van CO2 in de VS en de dalende uitstoot van CO2 in de EU, en het grotere succes van de EU in vermindering van CO2 uitstoot in een groter aantal sectoren dan de VS, illustreert deze conclusie.

Bepaalde staten binnen de VS laten echter een ander beeld zien dan het federale beeld. Deze staten werken samen om klimaatsverandering aan te pakken door regionale overeenkomsten te sluiten, en implementeren een grote variëteit aan beleid om de emissie terug te dringen. Dit is tegenstelling tot sommige lidstaten die lijken te weigeren meer te doen dan het aanvaarden van het EU beleidspakket. Aan de andere kant lijken een groot aantal staten in de VS een onverschillige of negatieve houding aan te nemen ten opzichte van het ondernemen van actie om de uitstoot terug te dringen, en laten enkele EU staten leiderschap zien door klimaatsverandering agressief aan te pakken.

Een analyse van de koolstofdioxide emissie trend van deze staten en de emissie verdeling over de verschillende sectoren resulteert in interessante bevindingen. Ook zijn er resultaten, bijvoorbeeld het feit dat een groot aandeel van de emissie afname in de EU het gevolg is van de politieke herstructurering en economische teruggang in de oosterse Europese lidstaten in het begin van de negentiger jaren, die al enige tijd bekend waren.

Uiteindelijk blijft de conclusie dat de “top-down” aanpak effectiever blijkt te zijn overeind. De positieve eigenschappen van de aanpak van de VS worden teniet gedaan door de negatieve effecten van de aanpak. Echter, de bevinding dat veel beleid aangaande klimaatsverandering pas sinds 2000 in gebruik is relativiseert wel de conclusie. De daadwerkelijke effecten van de verschillen in aanpak zijn misschien nog niet voldoende zichtbaar in de trend van CO2 uitstoot.
1.0 Introduction

1.1 Setting

The Intergovernmental Panel on Climate (IPCC) change reports have shown increasing certainty about the issue of climate change and whether or not it is human induced (IPCC, 2007; IPCC, 2001). The 2007 IPCC report states that climate change is unequivocal and that an anthropogenic cause is very likely. Furthermore, the IPCC report states that when climate change is not mitigated large negative consequences on human settlements and ecosystems will follow. The IPCC argues that to avoid these consequences greenhouse gas (GHG) emissions must be reduced.

Government involvement in (global) environmental problems is both necessary and inevitable (Andrews, 2006, p. 2). The principle of subsidiarity applied by the European Union raises the question which level of governance is most suited to deal with environmental issues. Is the federal or highest level of governance most suited to deal with climate change? Or are lower levels of government, such as the state or local governments, better able to implement policy directed at climate change?

The main source of GHG emissions is the use of fossil fuels. Large industrialised nations and economic regions emit vast quantities of GHG’s and are therefore key players in the issue of climate change. Two of the major emitters are analysed in this research: the EU and the United States of America (US), they accounted for about forty percent of 2004 GHG emissions (Vig & Faure, 2004, p. 2). Both the US and the EU practice environmental federalism, addressing issues through a vertical division of authority among federal, (member) state and lower governments (Keleman, 2004, p. 113). However, the allocation of authority differs substantially between these two governmental bodies over different environmental issues (Keleman, 2004, p. 114).

Importantly, in the case of climate change it seems that the approaches of the US and EU differ significantly. The dominant international view of the US at a federal level is that the US is largely uninterested in mitigating climate change through strict enforcement (May, 2005). The perception of US disinterest in climate change has been fuelled by several key policy decisions: 1) the refusal to support the Kyoto Protocol, 2) The prioritization of US energy policy on clean coal and nuclear energy over renewables such as wind and solar and 3) The efforts by the Bush Administration to cast doubt about the issue of climate change due to scientific uncertainties, and at the same time denying a scientific consensus about the issue (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). Rabe (2004, p. 1) points out that ‘the past decade [1993 to 2004] the federal government has been unable to agree on much of anything regarding climate change’. Moreover ‘the federal government has proved largely incapable of action on GHG reduction’ (Rabe, 2004, p. 147).

In contrast, the EU works hard to promote itself as an active proponent of action on climate change, and has some of the most progressive environmental policies of any state in the world (Jordan, 2002, p. 1). The important difference here is that the EU seems to address climate change at the highest governmental level. The EU therefore apparently has a strong top-down character regarding climate change. This is illustrated by the EU ratification of the Kyoto Protocol, the pressure the EU applies to get other countries involved, and by the adoption of a climate policy package that states strong targets for GHG emission reductions (EU climate and energy package, 2008). Harmonization of regulations among the EU countries concerning issues such as car exhaust and factory emissions is common.
On the other hand, while the US does not seem to put a very high priority on regulating the issue of climate change from a federal perspective, the lower levels of government actively pursue mitigation efforts. Rabe (2004, p. 26) argues that the decade long failure of the US government has clearly created policy room for state experimentation. Significant progress is being made in the climate change policy field on the state level and lower level government. It seems that action within the USA regarding climate change is moving forward (Byrne, Hughes, Rickerson, & Kurtdelashvili, 2007). Hames and Rae state it even more strongly: ‘the continued powers and importance of state and local governments is probably the single most underestimated element of modern American politics’ (1996, p.139).

Therefore, two approaches to the issue of climate change can be distinguished. First, the EU seems to use a top-down centrally organised approach to tackle the issue of climate change. In this approach the highest organisational level, the EU as a whole, instructs and directs the smaller decentralised governments. Second, the US seems to use a bottom-up decentralised approach, led by the state level and smaller governments. In this approach policies are formulated by the lower levels of organization without direct involvement by the higher levels or organization. The federal level of government could eventually even adopt the policies used by the lower levels of organisation.

1.2 Main research aim and question

The main aim of this research is:

To compare climate change policy of the United States of America and the European Union in order to determine the main consequences of the used approach. Further, to determine the main differences and similarities between the two approaches and to establish what the two governmental bodies can learn from one another.

The main research question of this investigation is:

What are the main consequences of utilizing the bottom-up approach and the top-down approach?

The hypothesis this research is based on is:

The EU addresses the issue of climate change from a EU-wide perspective and uses a central top-down approach to tackle climate change, while the USA addresses the issue of climate change from a decentralised state level and uses a bottom-up approach to deal with the issue of climate change.

1.3 Structure of investigation

First, the methodology of the research is described in chapter 2. Definitions, limitations and specific methodologies for specific problems can be found in this chapter. Chapter 3 and chapter 4 identify the difference in approach to climate change of the US and the EU, respectively. Chapter 4 and Chapter 5 identify the climate change policies of the US and the EU and their states.

General conclusions that can already be drawn from the climate change policy analysis and the differences in approaches of the US and the EU are summarized in Chapter 6. Chapters 7 and 8 study the CO2 emission trends of the US and the EU and their regional and state level emission
trends. A comparative analysis is performed in Chapter 9, as well as some general concluding remarks are given concerning chapter 7 and 8. Finally, Chapter 10 identifies the main conclusions of this investigation and discusses these, and Chapter 11 offers recommendations to the US and the EU, as well as recommendations for further research.

Additional information is included in the Appendices A to C. Appendix A describes a theoretical framework as to the possible causes of the difference of approach between the US and the EU identified in Chapters 3 and 4. Appendix B describes arguments for and against centralization and decentralization of environmental policy, with a specific focus on climate change. Also, Appendix B describes a quantification study of the effects of the bottom-up approach on projected emissions, which is important for the conclusion section. Appendix C gives additional information on the (member) states under analysis in this investigation such as the reliance on GHG intensive industries, and the trends of some selected sectors.
2.0 Study Methodology

This section addresses the main methods used in this research in order to find an answer to the main research question and hypothesis. The section is divided in three groups: boundaries to the research, definitions, and methodology to important aspects.

2.1. Boundaries to the research

2.1.1. Selection of (member) states

Four states of the United States and four member states of the European Union will be selected for a more in-depth analysis. The states are selected based on their geographical location and on their action on the issue of climate change. Therefore, from the US two western and two eastern states are selected with of each group one state that is considered a front-runner and one state that is considered a less active state. Certain regions in the United States have similar policies on climate change or are similar in their lack of action on climate change. These states are therefore interesting to analyze as a region. Likewise, from the EU two western and two eastern states are selected based on the same criteria.

<table>
<thead>
<tr>
<th>USA</th>
<th>EU</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>Germany</td>
</tr>
<tr>
<td>Michigan</td>
<td>Spain</td>
</tr>
<tr>
<td>New England states</td>
<td>Hungary</td>
</tr>
<tr>
<td>South eastern states</td>
<td>Poland</td>
</tr>
</tbody>
</table>

Additional reasoning for the selection of these specific states is given in chapter 4 and 5 of this report where the climate change policy situation is discussed.

2.1.2. Levels of government under analysis

Multiple levels of government can address a global environmental problem. Climate change can be addressed from the local level all the way up to the international/worldwide level. This research analyzes two levels of government: the supra-national level/federal level and the (member) state level of the EU and US.

2.1.3. Sectors of the economy

This report differentiates the following four different economic sectors:

- Transportation. In 2006, this sector accounted for about 28 % of the GHG emissions in the US (EPA, 2009) and 31.5 % in the EU (EEA, 2009a). Policies such as car exhaust emissions, efficiency standards and stimulation of public transportation are examples of the policies regarding transportation
- Residential plus Commercial. In the US the residential sector accounted for 4.97 % of GHG emissions in 2007 and the commercial sector for 5.7 % (EPA, 2009). In the EU the residential sector accounts for 8 % of the GHG emissions in 2007 while the commercial sector accounts for 3 % (EEA, 2009a). For comparite purposes the two sectors are grouped.
- Industrial. In 2006, this sector accounted for 30 % of the GHG emissions in the US (EPA, 2009) and 27.6 % in the EU (EEA, 2009).
- Electric power sector. Electricity production by fossil fuels and renewables.

2.1.4. Greenhouse Gases under analysis

Carbon dioxide (CO2) is the only GHG under analysis in this investigation.

2.1.5. Parameters of the research

The emission trends are analysed according to two parameters: per capita emissions and the percentage change from the base year level.

2.1.6. Timeline of the research

The emission trend analysis covers the period 1980-2005, as the databases for the Energy Information Administration (EIA) and the European Environment Agency (EEA) cover this period.

The climate change policy analysis covers the period 1990-2008. This is in line with the base year of the Kyoto Protocol which is also 1990\(^1\). Moreover, most EEA, EIA and Environmental Protection Agency (EPA) reports cover this period. To determine climate change mitigation effort development over time, the policy analysis period is slightly longer than the emission trend analysis period.

2.2. Definitions

2.2.1. Definition of top-down policy

Top-down policy is policy that affects the vertical diffusion of policy from the higher level of government to the lower levels of government (WRI, 2007). In other words it is a process in which policies and regulations are created and regulated by a central, high level authority, and to which the lower levels of government need to adhere. An example, in the line of this research, is a EU-wide directive that sets a specific target for renewable energy that all Member States need to reach in a certain time period. If a political entity uses top-down policy as the main approach to address an issue, the approach can be called top-down.

2.2.2. Definition of bottom-up policy

Bottom-up policy is essentially the opposite of top-down policy. Bottom-up policy is policy that affects the vertical diffusion from the lower levels of government to the higher level of government (WRI, 2007; Rabe, 2006a). It is a process in which policies and regulations are created, regulated and directed by lower levels of government but are eventually adopted by the higher level of government. An example, in the line of this research, is a state car exhaust regulation that is eventually adopted by the national government to regulate the car exhaust of all states. If a political entity uses bottom-up policy as the main approach to address an issue, the approach can be called bottom-up.

\(^1\) Although Hungary and Poland do not have 1990 as the base year for their Kyoto Protocol commitment reduction targets, in this investigation the base year for both countries is set at 1990 to smoothen comparison within the EU and transatlantic comparisons. Hungary and Poland normally have the average of 1985-1987 and 1988 as their Kyoto Protocol base year respectively (Poland, 2010; Hungary, 2009),
Commonly but not necessarily, the vertical diffusion part of the bottom-up policy is preceded by horizontal diffusion (WRI, 2007b). Horizontal diffusion of policy is diffusion among authorities of the same level of government. For example, the Renewable Portfolio Standard (RPS) policy tool has experienced considerable horizontal diffusion in the US and is expected to diffuse vertically to the federal government (Rabe, 2006b).

2.2.3. Definitions of policy categories

Environmental and energy policy enacted by governments fall into several categories. In this investigation a distinction is made into three categories: No-regret policy, Insurance policy, or Indifferent policy. These categories show interesting differences between the policies used in the US and the EU.

- No regret policy (Byrne, Wang, Lee, & Kim, 1998) (Cristofaro, 1992) (Shelling, 1991). The national action response to climate change is limited to cost-effective steps without the benefits of GHG reduction included in the cost calculation. Actions that are justified on cost-benefit grounds are included in this proposal.
- Insurance policy (Cline, 1992) (Manne & Richels, 1992) (Byrne, Wang, Lee, & Kim, 1998). The insurance policy approach seeks to minimize possible GHG emission effects through a strategy of mitigation of GHG emissions. This policy category specifically incorporates the goal of GHG emission reduction in the approach, and can therefore include measures that go beyond the more restrictive no-regrets policy approach.
- Indifferent policy. Inaction on the issue of climate change by a state places it in the indifferent category. It is also possible that states express a particularly negative stance towards climate change mitigation efforts (Rabe, 2004). States that express this hostile stance are also placed in the indifferent category.

2.3. Methodology for important aspects

2.3.1. CO2 emission trends

Carbon dioxide (CO2) is the primary GHG and is therefore selected as a proxy in this research for climate change policy effectiveness (IPCC, 2007). The climate change policies analyzed in this research are aimed at a reduction of CO2 or general GHG emissions. The CO2 emission trend should therefore be influenced by the policies, depending on their effectiveness. The effectiveness is determined by using a baseline scenario, for which the methodology is explained in 2.3.2.

The CO2 emission trend is analyzed for the US and the EU on a federal/supra-national level, and compared against each other to determine the difference between the two approaches. Next to that, the CO2 emission trends of the (member) states is analyzed in order to determine the effectiveness of the front-runners compared to the laggards. In order to find out whether the top-down approach or the bottom-up approach influences the sectors differently, the CO2 emission trends of the different sectors over time are also investigated.

2.3.2. The Extrapolation scenario as the baseline scenario

The extrapolation scenario in this research is based on the historical emissions of the states and higher levels of government. The average growth rate of emissions of the period 1980-1989 is extrapolated from 1990 to 2005. This crude measure indicates whether states were able to slow down the emission growth rate as a effect of the policies established from 1990 onwards.
2.3.3. The Kyoto Protocol scenario as the reduction target scenario

Next to the extrapolation scenario, it is interesting to add additional information to further indicate the effort of the governments. An emission reduction target scenario can be included to indicate where the emissions of that government should be heading to; it illustrates the distance of the actual emissions trend to a specific target. Although the United States did not accept the Kyoto Protocol stipulations, and is therefore not legally required to follow the Kyoto Protocol, targets for all participants were agreed upon before the US refusal. The emission reduction target scenario is based on these targets.

The US agreed on a 7% emission reduction target, while the EU agreed on a 8% emission reduction target (UNFCCC, 2010). The year at which the target is set is 2012. The reduction target scenario is therefore a linear line from 1990 to the target in 2012. The difference in the actual emissions and the reduction target scenario indicates whether the effort of the government in question should be increased or is already sufficient to meet the target.

The EU as a whole agreed upon a 8% reduction target, but negotiated differentiated targets for the individual Member States. The emission reduction targets are: Germany -21%, Spain +15 %, Hungary -6% and Poland -6% (UNFCCC, 2010). The states of the US are allocated the same reduction target as the federal level of 7% below 1990 levels.

2.3.4. The emission intensity

As the extrapolation scenario is not concerned with any events after 1990, it is interesting to add the economic development of the particular state. The economic development in this research is shown as the emission intensity which is the ratio between the actual emissions and the Gross Domestic Product (GDP). Adding the emission intensity provides some extra information to fluctuations in the actual emission trend.

2.3.5. Calculation from IPPC chapters/sectors into economic end-use sectors

While the EPA and EIA present their data in economic end use sectors, the EEA reports show emissions in IPCC sectors. The database used in this investigation, the Emission Database for Global Atmospheric Research (EDGAR), also uses the IPCC sector identification. It is therefore important to calculate the IPCC sectors into the economic end use sectors. Using the IPCC sector definitions from the EEA, the following IPCC sectors can be placed in the economic end use sectors without much difficulty (EEA, 2009a):

<table>
<thead>
<tr>
<th>Economic Sector</th>
<th>IPCC sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy industries(^2)</td>
<td>1A1a (electricity and heat production), 1A1b (Petroleum refining), 1A1c (Manufacture of solid fuels and other energy industries)</td>
</tr>
<tr>
<td>Transportation (EEA, 2009a, p. 171)</td>
<td>1A3a (domestic aviation), 1A3b (Road transport), 1A3c (Rail Transport), 1A3d (Inland navigation), 1A3e (other transportation)</td>
</tr>
<tr>
<td>Residential (EEA, 2009a, p. 196)</td>
<td>1A4b Industry(^3) 1A2</td>
</tr>
</tbody>
</table>

\(^2\) Energy industries (CRF 1A1) comprises emissions from fuels combusted by the fuel extraction or energy-producing industries (EEA, 2009a, p. 117).
Using this conversion results in some difficulties. First, the Residential category 1A4b is grouped together in EDGAR with 1A4a and 1A4c. The commercial and institutional sector is represented in 1A4a, all emissions from fuel combustion in households is 1A4b, while agriculture/forestry/fishing is 1A4c (EEA, 2009a, p. 189). The dominant sources for CO2 emissions in 1A4 are 1A4a and 1A4b (EEA, 2009a, pp. 190, 193, 196). For example: in 1990, 1A4c constituted 11.0% of 1A4 and in 2007 10.5% in the EU-15 (EEA, 2009a, pp. 192, 197, 202). Although ten percent is not small, emissions from 1A4c are limited. This is mostly because most emissions from the agricultural sector are included in IPCC sector 4, and forestry is included in IPCC sector 5 of LU-LUCF (EEA, 2009a, pp. 361, 499). Therefore, 1A4 is used in its entirety to compare to the commercial and residential sectors combined of the United States.

Some IPCC categories are still excluded from the economic end use sectors: 1B1 (fugitive emissions from solid fuels), 1B2 (fugitive emissions from oil and gas), 2A (production of minerals), 2B (production of chemicals), 2C (production of metals), 2G (non-energy use of lubricants/waxes), 3 (solvent and other product use), 4D4 (other direct soil emissions), 6C (waste incineration). These categories need to be included as analysing the emission data while excluding these sectors has different effects on the different countries. For example, with the conversion table used above 77% of Austria’s 1980 CO2 emissions are included in the analysis, while 93% of Switzerland’s 1980 emissions are included.

EPA’s definitions of economic end use sectors are used to overcome the difficulty. The EPA includes the waste incineration category into the energy industry, based on the notion that many waste incineration plants are “trash to steam” electricity generation plants (EPA, 2009, p. 87). This includes category 6C in the Energy Industries sector. The EPA methodology includes in its industrial sector all “process related emissions” such as the “production of materials” (EPA, 2009, p. 87). The industrial sector currently is limited to the combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (EEA, 2009a, p. 142). Including the categories of actual production of chemicals, metals and minerals into the industrial sector is in line with the EPA definition. This places 2A, 2B and 2C in the industrial sector. Even though the fugitive emissions are defined as “intentional or unintentional releases of gases from anthropogenic activities that in particular may arise from the production, processing, transmission, storage and use of fuels” (EEA, 2009a, p. 212), and is therefore not strictly restricted to the industrial sector, the EPA includes the fugitive emissions from solid fuels, oil and gas in the industrial sector (EPA, 2009, p. 87). This places 1B1 and 1B2 into the industrial sector.

The non energy use of lubricants/waxes IPCC sector is excluded from the conversion. It is not possible to distinguish the actual use of the lubricants/waxes in order to place them in a specific economic end use sector. Furthermore, reporting on this sector is scarce as only three countries of the EU-15 use this IPCC sector (EEA, 2009a, p. 334) and according to the EDGAR database it accounted for less than 0.0001% of the total emissions in the EU-27 in 2005 (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009). For similar reasons the solvent and other product use IPCC sector is also excluded: it accounts for 0.2% of the total EU-15 GHG emissions (EEA, 2009a, p. 344), consists to a high degree of NMVOC emissions (EEA, 2009a, p. 356).

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3 Category 1A2 includes emissions from combustion of fuels in manufacturing industries and construction including fuel use of non public electricity and heat generation (EEA, 2009a, p. 142)

4 Many more are still excluded but these all have a value of zero in the case of CO2 emissions, which is the gas under analysis in this investigation and excluding these IPCC sectors/chapters therefore does not compromise the analysis.

5 Non Methane Volatile Organic Compounds
p. 346) and is caused by most of the economic end use sectors (EEA, 2009a, p. 344). IPCC sector 4D4 is related to agriculture and is therefore also excluded (EEA, 2009a, p. 368).

The section of categories now included in the different economic sectors leads to a higher percentage of emissions that are included in the analysis. For example: in the case of Austria’s and Switzerland’s 1980 emissions 99% of both countries is now included in the analysis. Summarizing, this leads to the following conversion table that will be used in this investigation:

<table>
<thead>
<tr>
<th>Economic Sector</th>
<th>IPCC sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy industries</td>
<td>1A1a, 1A1b, 1A1c, 6C</td>
</tr>
<tr>
<td>Transportation</td>
<td>1A3a, 1A3b, 1A3c, 1A3d, 1A3e</td>
</tr>
<tr>
<td>Residential + Commercial</td>
<td>1A4</td>
</tr>
<tr>
<td>Industry</td>
<td>1A2, 1B1, 1B2, 2A, 2B, 2C</td>
</tr>
</tbody>
</table>

2.3.6. Sector comparison between the United States and the European Union

The extracted sectors from the IPCC classification are not directly comparable to the economic end use sectors. As mentioned, the residential plus commercial sector differs due to the inclusion of emissions from agriculture, fishery and forestry. Another difficulty is that the EIA data for the individual states is based on CO2 emissions from fossil fuel combustion only. Although this is the majority of emissions, 83 % (EIA, 2008), it is not the same boundary as the EDGAR database. Therefore, the research focuses on the general trend of the emissions of nations/states when comparing the United States to the European Union. The general development of emissions can be clearly distinguished in both data sets, and conclusions can be drawn from these trends.
3.0 Two different approaches to climate change

3.1. The United States approach to climate change

The dominant international view of the US is that the US is uninterested in addressing climate change proactively (May, 2005). As Byrne et al., note, this view of disinterest has been caused by three key policy decisions: First and foremost, the refusal of the Bush Administration to ratify the Kyoto Protocol. Second, the focus of United States’ energy policy on nuclear energy and clean coal over renewables, and third the efforts made by the Bush Administration to cast doubt about the issue of climate change due to scientific uncertainties, and denying a scientific consensus about the issue (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). Rabe (2004, p. 26) discusses American federal climate change policy and concludes that: ‘for the past decade the federal government has been unable to agree on much of anything regarding climate change’ and “this decade long failure of federal government institutions to enact even the basic design of an emissions reductions policy has clearly created ‘policy room’ for state experimentation”.

Both Rabe and Byrne et al., argue that while federal action on climate change might be less than desired, this certainly does not mean the US is not acting on the issue of climate change. Rabe argues that most research analyzes American climate change policy as if the US were a unitary form of government, while it is a federal system with multiple levels of government (Rabe, 2004, p. xiii). Much in the same line, Byrne et al. argue that action on climate change within the US is moving forward. Climate change policy seems to be developed on a substantial scale on state and local levels. In 2007, seventeen states had set GHG emission reduction targets, representing forty-five percent of the 2007 US population and 30% of US GHG emissions (Lutsey & Sperling, 2007). Lutsey and Sperling argue that if these seventeen states are to achieve their targets, nationwide US emissions would be stabilized at 2010 levels by 2020. Currently, twenty one states have set emission reduction targets. As of 2009, thirty-six states have completed or are in the process of developing a climate action plan (PCGCC, 2009). Many other approaches are being taken by the states in absence of federal action (WRI, 2008).

The lack of strong federal action on climate change has shaped a bottom-up approach to climate change in which the states take the lead in policy development and implementation. Examples of the bottom-up character are abundant. Californian legislation regarding unleaded gasoline, catalytic converters and clean diesel fuel was later adopted at the federal level (Rabe, 2004, p. 142). New Jersey’s environmental protection programs in reaction to toxic contamination provided models that were adopted for the nation by the federal government (Rabe, 2004, p. 112).

The Renewable Portfolio Standard (RPS) has become an important policy tool in the US to address climate change (Rabe, 2006a). Byrne et al., even conclude that it has proven to be the most successful tool used by states to realize rapid development of renewable energy options (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). The standard sets a goal in percent of electricity or MW of renewable energy that needs to be in operation at a certain year. As of 2009, twenty-nine states and DC have adopted this policy tool (DSIRE, 2009). Of those twenty-nine states 16 have chosen to include solar provisions to encourage solar energy development. Figure 1 shows that there are large differences among the states. Not only the difference in percentage but also the target year shows the differences in aggressiveness that the states show towards mitigating climate change or at least diversifying their energy mix. The horizontal diffusion of RPS is expected to be followed by a federal RPS (PCGCC, 2009; Rabe, 2006b).
More recently, states have grouped together in regional cap and trade programs for GHG emissions which will possibly provide a model for a nationwide GHG cap and trade system (PCGCC, 2009). The three currently under development and implementation are: the Regional Greenhouse Gas Initiative (RGGI), the Western Climate Initiative (WCI), and the Midwestern Greenhouse Gas Reduction Accord (MGGRA). These represent 14%, 13% and 10% of US GHG emissions respectively (WRI, 2008). Figure 2 shows the states participating in these schemes. Florida has created its own cap and trade system and is expected to join one of the other schemes (PCGCC, 2009). Implementation of the cap and trade systems is expected to occur in 2010.
Figure 2. Participating states in regional cap and trade initiatives that are currently being developed in the US. Source: (PCGCC, 2009). Retrieved: November 21st 2009.

3.2. The European Union approach to climate change

With 56% of policies implemented at the member state national level being introduced as a response to EU-level policies, and 24% more national policies being reinforced by them, it is clear that the EU level policies are very important in the policy making process in the member state countries (EEA, 2009b). In contrast with the US federal government, the EU-wide government seems to be actively addressing the issue of climate change. The EU has increasingly come to see itself as an international environmental leader (Schreurs, 2004, p. 222). The EU has ratified the Kyoto Protocol, seems to prioritize renewable energy over fossil energy and has taken the international position that climate change is a serious threat that needs to be dealt with. This is illustrated by the adoption of the recent climate and energy package (Vedder & Jans, 2008), but also by the older renewable energy directive of 2003.

The EU is an active proponent of strong action on climate change. The EU has pledged itself to an overall 8 percent reduction in GHG emissions of the EU-15, with 1990 as the base year. An extensive emission trading scheme which aims to reduce GHG emissions in a cost-effective manner has been established through the European Trading Scheme directive. The EU reinforced their aspired leadership role by stating that the EU will reduce its GHG emissions by twenty percent by 2020 through the energy and climate package, and will ramp it up to thirty percent if the other developed nations also establish similar targets (EC, 2006). The package further contains the target of twenty percent renewable energy use and a twenty percent reduction in overall energy use, both in 2020.

The stance the EU adopts is very different compared to the US stance on climate change. Most notably, the EU seems to be much more willing to address climate change on an EU-wide level where the highest level of government sets the standards. The EU therefore shows strong top-down characteristics.
4.0. United States Climate Change Policy Analysis

4.1. United States national level

Climate change mitigation action by the United States on a federal level is illustrated by the Climate Action Reports (CAR) of 1994, 1997, 2002 and 2006 (USCAR, 2006; USCAR, 2002; USCAR, 1997; USCAR, 1994). These reports are submissions to the UNFCCC to detail national circumstances and actions regarding climate change. Next to these, the Energy Policy Act of 1992 and of 2005 illustrate federal action on climate change.

4.1.1. Climate Action Reports

Submitted throughout the 1990-2008 period, the CARs nicely illustrate federal action and perceptions on climate change. When the first report was issued in 1994 scientific evidence on climate change was building but many uncertainties remained. At the time of the fourth report, a scientific consensus was established. The 1994 CAR established a framework through the Climate Change Action Plan to address the issue of climate change with a economy wide portfolio approach in four categories: regulatory actions, research and development, market incentives and voluntary public-private agreements. The majority of action of the Climate Change Action Plan lies within the last two categories (CAR, 1994, p. 78).

During the establishment of the CAR97 it became clear that the voluntary actions were overshadowed by lower than expected energy prices and higher than expected economic growth (CAR, 1997, p. 2). The CAR97 expands the Climate Change Action Plan with additional voluntary agreements, but the report states that ‘new US efforts are focusing on the post 2000 period’ due to the draconian measures that would be required to be able to meet the original 1992 UNFCCC target in 2000 (CAR, 1997, p.2). The third CAR in 2002 was written during the Bush Administration. The 2002 CAR introduces a new target: the establishment of a emission reduction intensity target of 18 % in 2012 (CAR, 2002, p. 5). In absence of the additional proposed policies and measures the projected reduction in emission intensity was 14 % (CAR, 2002, p. 5). The target therefore exceeds the business as usual scenario, but appears to continue the same trend as the previous two decades during which the emission intensity fell by 21 % and 16 % respectively (PCGCC, 2002). The report acknowledges that the emission intensity reduction does not necessarily result in a absolute reduction of GHG emissions. In fact, the report states that US GHG emissions are projected to increase by 43% during the 2000-2020 period (CAR, 2002, p. 6). The earlier distributed National Energy Policy of the Bush Administration indicated that the focus of the Bush Administration would include the use of clean fossil resources and the utilization of nuclear energy (CAR, 2002, p. 79).

In an analysis of the climate change plan of the Bush Administration in 2002, which is similar to the CAR of 2006, the PCGCC states the following: ‘The Bush Administration aims to achieve its GHG intensity target entirely through voluntary measures. Prior experience has shown that despite the existence of a range of voluntary government programs to encourage early reductions [...] emissions continue to rise as these gains [the improvements in GHG intensity] are outpaced by economic expansion, changing consumer preferences and population growth.” (PCGCC, 2002). The focus on voluntary participation by industry in public-private partnerships and on research on clean coal and nuclear energy has led several authors to conclude that federal action on climate change is sub-par with what it should be (Rabe, 2004, p. 26; Byrne et al., 2006; PCGCC, 2009). The 2006 CAR reiterates the goal set by the Bush Administration in 2002 and
states that the US is on track to meet this goal. The CAR states that the focus of the US at that point is to continue to pursue the reduction in emission intensity and further reduce uncertainties in climate change science (CAR, 2006, p. 38). The use of voluntary public-private agreements is still clearly preferred over substantial mandatory federal regulation and legislation.

Table 1. Summary of US federal policies and measures. Many of these policies are reiterated in the EPAct05. Additional federal policies regarding sectors such as forestry and agriculture can be found in the CAR of 2006 and on the EPA website. Source (USCAR, 2006; USCAR, 2002; USCAR, 1997; USCAR, 1994; EPA, 2009).

<table>
<thead>
<tr>
<th>Policy</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy: Residential</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emerging Building Technologies</td>
<td>Conducts R&amp;D on building components</td>
<td>Research</td>
</tr>
<tr>
<td>Energy Star Residential</td>
<td>Promotes improvement of energy performance</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Residential Appliance Standards</td>
<td>Analyzes, develops, reviews, updates efficiency standards</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Residential Building Integration</td>
<td>Funds, develops, demonstrates and deploys energy efficient housing technologies</td>
<td>Voluntary; Research</td>
</tr>
<tr>
<td>Energy Star labeled products</td>
<td>Provides labels according to energy efficiency</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Weatherization assistance</td>
<td>Enables low-income families to weatherize their house</td>
<td>Economic</td>
</tr>
<tr>
<td><strong>Energy: Industrial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Practices Program</td>
<td>Offers tools to improve efficiency, env. Performance and productivity</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Energy Star for Industry</td>
<td>Enables industrial companies to reduce energy use</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Industrial Assessment Centers</td>
<td>Provides tools to improve productivity, reduce waste and save energy</td>
<td>Information; research</td>
</tr>
<tr>
<td>Industrial technologies</td>
<td>Addresses critical technology challenges</td>
<td>Research</td>
</tr>
<tr>
<td><strong>Energy: Supply</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>Develops new technologies</td>
<td>Research</td>
</tr>
</tbody>
</table>

Energy generation is a major contributor to climate change, due to the use of fossil fuels as the main energy source. Discussion of the Energy Policy Act of 1992 (EPAct92), and the Energy Policy Act of 2005 (EPAct05) is therefore important.

The EPAct92 addresses a large number of issues. Regarding the issue of climate change, Title XVI of the EPAct92 states that a least-cost strategy needs to be developed that prioritises on 1) the development of more efficient use of fossil fuels, 2) increased energy efficiency of existing technologies, 3) new technologies, including clean coal technologies, 4) promote the use of renewable energy sources, 5) affect the energy consumption through tax policy, 6) encourage investment in energy efficient equipment, 7) encourage the development of advanced technologies such as nuclear fusion and nuclear fission (CRS, 2006).

More than a decade after the original EPAct92, the next Energy Policy Act was enacted in 2005. The main intention of the EPAct05 is to increase energy supply (CRS, 2006). The EPAct05 aims to accomplish an increase in energy supply by providing subsidies, tax cuts and standard setting to the major sectors. Regarding climate change, Title XVI of the previous Act is amended by
adding section 1610. Section 1610 illustrates GHG emission intensity reduction strategies and technologies (EPAct05, 2005). The section requires the US to establish a National committee on climate change technology, focusing on GHG emission intensity reducing technologies (EPAct05, 2005). The Title XVI is further concerned with the deployment of GHG emission intensity reducing technology in developing countries, fuel cell technology, and carbon capture and sequestration (PCGCC, 2010).

Therefore, the provisions that directly deal with climate change focus on GHG emission intensity reduction. The EPAct05 has a large number of other provisions that indirectly deal with the issue of climate change. The Act focuses on energy efficiency, renewable energy, oil and gas, coal, nuclear matters, vehicles and fuels, hydrogen and research and development (EPAct05, 2005). The Pew Center on Global Climate Change (PCGCC) summarizes the EPAct05 with the main subsidies and tax incentives in these categories (PCGCC, 2005):

- The EPAct05 sets the standard for the bio-fuel mix to 7.5 billion gallons in 2012, from the 3.4 billion gallon bio-fuel use in 2004.
- The EPAct05 provides an extension of daylight saving time, beginning three to four weeks earlier. This is expected to save night-time electricity use.
- The National government is required to increase their renewable energy purchase to 7.5% in 2013.
- The EPAct05 provides tax credits for commercial and residential solar installations, alternative fuel vehicles, renewable electricity production, fuel cells and alternative refuelling stations.
- The EPAct05 also provides major subsidies to the clean coal initiative of US$ 200 million annually. Three new investment tax credits with an expenditure cap of US$ 1.6 billion for clean coal facilities are created in the EPAct05.
- The EPAct05 provides a US$ 1.25 billion fund for the next generation nuclear power plant. Moreover, the EPAct05 renews important legislation concerning financial government back-up regarding safety issues of nuclear power plants. Furthermore, the Act provides the Department of Energy with the permission to construct a new nuclear power plant.

4.2. United States State Level

Different regions and states stand out with respect to climate change action. The North-Eastern states and California are “front-runners and role models” for the other US states (Knudsen, 2009; Mazmanian, Jurewitz, & Nelson, 2008). Next to that, California’s characteristics make it a good mover on US’s bottom-up characteristics with many regulations that are initiated in California eventually ending up to be established nationwide (Lutsey & Sperling, 2007). Due to the participation of the New England states and their legislation regarding RPS, Rabe also places the New England states in the frontrunner category (2004, p. 109). The New England states are less dependent on the GHG intensive coal industry when compared to Michigan and the south-eastern states regarding their electricity generating potential; only 15% of their in-state produced electricity is derived from the coal industry (see Appendix C).

In 2004, Rabe identified the state of Michigan and its Department of Environmental Quality (DEQ) as the fiercest opponent of any actions that might reduce GHG emissions. The primary emphasis of the DEQ is potential economic risks of state engagement on climate change (Rabe, 2004, p. 43). Michigan has a relatively large coal industry (59%) compared to the other energy generating industries in the state as is illustrated in Appendix C. Michigan has a electricity generating capacity from coal that is 30 times larger than that of California and 3.5 times larger than
the combined coal capacity of the New England states (EIA, 2010). The reliance on coal for in-state electricity generation is therefore much larger than in California and the New England states. Next to that, Michigan houses a large automotive industry. This might explain part of the hostile stance the state positions itself in. Rabe states this as the following: “states with economic interests threatened by any unilateral action to reduce GHG may quash any serious opportunities for entrepreneurial action” (Rabe, 2004, p. 26).

The south eastern states considered as a region in this investigation are North Carolina, Tennessee, Alabama, Georgia, Florida, South Carolina and Mississippi. When combined, forty-nine percent of their electricity capacity consists of coal (See appendix C). For comparison, the electricity generating capacity of the South-Eastern states is six times larger than Michigan’s coal industry (EIA, 2010).

4.2.1. California climate change policy analysis

The main way in which California exerts its bottom-up leadership is through the California Air Resources Board (CARB). The CARB has primary responsibility for reducing GHG emissions (Cal-EPA, 2007). It was established prior to the federal EPA, and has retained much of its power. California is the only state in the US that is permitted to have a regulatory agency such as the CARB, due to the creation of CARB prior to the passage of the federal Clean Air Act. With an estimated 36.8 million people in 2008 California housed approximately twelve percent of the U.S. population (U.S. Census Bureau, 2009). Due to its unique position and large size and population, California is able to alter the course of the US.

The current major initiatives of California to reduce GHG emissions are outlined in the Assembly Bill 32, the 2005 Executive Order and a 2004 CARB regulation to reduce passenger car emissions (Mazmanian, Jurewitz, & Nelson, 2008; CARB, 2010).

The executive order of 2005 states the following targets for California: 1) California is to reduce their GHG emissions to 2000 levels by 2010; 2) reduce GHG emissions to 1990 levels by 2020 and 3) reduce GHG emissions to 80 percent below 1990 levels by 2050 (Schwarzenegger, 2005). The 2020 target requires a 25% reduction in emissions (Mazmanian, Jurewitz, & Nelson, 2008). In September 2006 California passed Assembly Bill 32 which set the 2020 reduction targets into law (CARB, 2010). The Assembly Bill 32 is the first state-level economy wide statute regarding emission reduction in the United States (Mazmanian, Jurewitz, & Nelson, 2008). Regarding energy, the Assembly Bill 32 calls for a RPS of 20% in 2010 and 33% by 2020, which makes it one of the most stringent in the United States (DSIRE, 2009; PUC, 2009).

4.2.1.1. Transportation

The in 1990 established Zero Emission Vehicle Program (ZEV) aimed to increase the share of the Zero Emission Vehicles (ZEV) onto the roads of California. The target at the time was that 2% of the vehicles in 1998 that large manufacturers produced for sale in California had to be ZEVs, increasing to 5% in 2001 and 10% in 2003 (CARB, 2010). Since the start in 1990 of the program it has been adjusted several times. For instance, in 1996 the requirements of 2% in 1998 and 5% in 2001 were removed and in 1998 Partial Zero Emission Vehicles (PZEV) were allowed into the program. In 2001 the program was adjusted again, to allow manufacturers to meet the 10% with 2% ZEVs, 2% advanced technology PZEV and 6% PZEV. A lawsuit in 2002 resulted in the preliminary injunction to enforce the ZEV program. Amendments made in 2003 resulted in the litigation drop by the involved parties. Since then, the Board held a symposium about the
future progress of the ZEV program and new regulatory changes are expected in 2010 that will affect the 2015 models.

In 2004 the CARB approved regulations to reduce GHG emissions from passenger vehicles based on the 2002 legislation Assembly Bill 1493 (Mazmanian, Jurewitz, & Nelson, 2008). However, implementation of these regulations was denied by the US EPA, based on Clean Air Act requirements. The EPA ruling has been rejected in a 2009 decision by the new EPA administration (Federal Register, 2009). States now have the option by law to either follow the federal emission standards or adopt California’s standards; sixteen states have or are in the process of adopting California’s stricter standards (PCGCC, 2010). According to the CARB GHG emissions of California passenger vehicles are expected to be reduced by about 22 % in 2012 and about 30 % in 2016 after implementation (CARB, 2010). Moreover, California has regulations in place concerning heavy duty vehicle GHG emissions, heavy duty vehicle idling and the lowering of the carbon intensity of fuels. The other main policy that has been put into place via Executive Order S-01-07 in 2007 is the Low Carbon Fuel Standard which calls for a reduction of at least 10 percent in the carbon intensity of California’s transportation fuels. This policy is seen as the world’s first global warming standard for fuel (Mazmanian, Jurewitz, & Nelson, 2008).

4.2.1.2. Industry and Electric Power

The major policy regarding industry in California is the Western Climate Initiative, the regional cap and trade system which will put a price on carbon emissions and will result in the lowering of absolute GHG emissions.

4.2.2. Michigan climate change policy analysis

The shift in environmental policy in Michigan, from a national leader on environmental and conservation issues towards a more vigorous agenda on economic development through minimizing state government reach, occurred during the three terms of Governor John Engler (Rabe, 2004, p.41). Michigan has since then become one of the “fiercest critics” and “most strident” opponents to any action that might reduce GHG emissions (Rabe, 2004, p.40). This is strongly illustrated in the adoption of House Concurrent Resolution 70 in November 1997. The resolution decries that any future efforts to reduce GHG emissions are seen as an economic threat (Rabe, 2004, p. 43). Next to that, the state attempted to amend the 1994 Natural Resources and Environmental Protection Act to prohibit any state official to propose a rule intended to reduce GHG emissions (House Bill 4651) (Rabe, 2004, p.43). The House passed the proposed legislation, but the legislation did not secure a majority vote in the Senate.

At the time of his writing, Rabe recognises that it is uncertain whether Michigan’s hostile stance will endure after the Engler administration which lasted from 1991-2003. Rabe concludes his analysis of Michigan with: “Michigan’s actions have reflected an interpretation of the potentially dire economic effects of unilateral action to address climate change. They may reflect the strong views of a dominant industry, although, in this case, they appear to be more indicative of a powerful governor’s more traditional linkage between economic development and the softening of environmental protection. [...] [Michigan] is not alone in taking actions to deter policy entrepreneurs from pursuing GHG mitigation opportunities” (Rabe, 2004, p.45).

The recent statement by the DEQ that “the future of Michigan and its citizens will be impacted by climate change” (DEQ, 2010), and the establishment of a comprehensive climate action plan for the state by the Michigan Climate Action Council (Granholm, 2007) illustrate that Michigan is shifting its position regarding climate change. The Climate Action Plan states that “Michigan is in
a period of extraordinary transition and faces unprecedented challenges. As a part of this challenge, the economic core of our prosperity, the automobile industry is undergoing tumultuous change as we move from a high carbon to a low carbon economy and a new energy future” (CAT, 2009).

The inclusion of Michigan into the Midwestern Greenhouse Gas Accord in 2007 further reinforces this new view of Michigan. The establishment of this accord calls for the construction of a Midwest-wide approach to climate change action, and proposes a market based cap and trade system among the Midwestern states (MGGA, 2007). According to the DEQ, Michigan is starting to initiate a range of measures and policies regarding climate change (DEQ, 2010). Most of these initiatives and measures have a starting date that falls outside the timeframe analysed in this investigation.

4.2.3. South-eastern states

Almost no climate change policy is in effect in the Southeast region of the US (PCGCC, 2010; DSIRE, 2009). The PCGCC identifies no state actions for the states of Mississippi and Georgia, while the states Tennessee and Alabama have one action plan on GHG emission reduction (PCGCC, 2010). However, the Tennessee ‘Greenhouse Gas Emission Mitigation Strategies’ was completed in 1999 and no subsequent policy is identified by the PCGCC, and the ‘Policy Planning to Reduce Greenhouse Gas Emissions in Alabama’ was completed in 1997 and also did not have any follow up policies (PCGCC, 2010). North Carolina and South Carolina developed their Climate Action Plan more recently, in 2007 and 2008 respectively and are both more active on climate change. For instance, they both have active legislative commissions regarding climate change, both are developing a State Adaptation Plan to climate change, North Carolina established mandatory GHG reporting, and South Carolina adopted the LEED energy efficiency standards for buildings (PCGCC, 2010). The DSIRE database identifies additional policy categories. For instance, Alabama and North Carolina are the only Southeast states with a grant program for renewables, North Carolina is the only state in the Southeast that has a RPS, and only Georgia and Florida have a rebate program for renewables in effect (DSIRE, 2009).

Identified by Rabe in 2004 as an indifferent state, inactive on climate change, Florida seems to have recently shifted their position regarding climate change (Rabe, 2004, p. 48). The Executive Order 07-127 of July 2007, states emission targets for Florida of 2000 levels by 2017, 1990 by 2005, and 80% reduction by 2050 making it the only state in the Southeast region to have done so (Crist, 2007; PCGCC, 2010). Moreover, the Executive Order 07-127 requires the development of a state wide cap and trade mechanism for the state of Florida, as well as the adoption of California’s vehicle emission exhaust standards (Crist, 2007). The subsequent House Bill 1735 enacts these climate change policy proposals, and adds the instruction to develop a Florida state wide RPS (PCGCC, 2010). The House Bill does not yet specify the percentage of renewable energy penetration the RPS will require, but 20% is the expected target (PCGCC, 2010). Moreover, the state of Florida is the only state in the Southeast to have emission caps for electricity, a completed State Adaptation Plan, and to have adopted California’s car exhaust standards (PCGCC, 2010).

4.2.4. New England states

The New England states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. The RGGI further includes the other north eastern states of Delaware, New Jersey and New York. Three main policy tools are in effect in the New England region. First, each state has set an emission reduction target that it needs to meet. Second, each state has implemented a
RPS strategy. These two policy tools are illustrated in table 3. Finally, all the states participate in the RGGI.

The RGGI is a cap and trade system in which all north eastern states participate. The RGGI system has set the target for emission reductions of 10% below 2009 by 2018 from power plants (RGGI, 2009). The goals of RGGI are: 1) to reduce CO2 emissions, 2) support a green economy, 3) promote energy independence, 4) provide a model for a national program to reduce CO2 emission (RGGI, 2009).

Next to the cap and trade system each state has developed its climate action plan to address the issue of climate change. New Hampshire and Rhode Island were the first to develop a climate change policy plan, and Vermont’s the most recent state to adopt such a plan (Knudsen, 2009). These plans establish the RPS standards and the emission reduction targets that are summarised in Appendix C.
5.0. European Union Climate Change policy Analysis

5.1. European Union supranational level

In order to identify the policies and measures required to address climate change, the EU created the European Climate Change Programme (ECCP) in 2000. The eleven working groups that were established had the objective to identify the most environmentally effective and cost effective measures. The most common tool to address climate change in the EU is the use of directives, and the second most used tool is Regulations (EEA, 2009b). Article 249 of the Treaty establishing the European Community states a directive as the following: “A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods.” (EC, 2002). Therefore, Directives set objectives that have to be achieved, but allow member states to choose how to achieve them (ECCP, 2006). Regulations are directly applicable in the Member States and therefore leave no room to the member states (EEA, 2009b). The common and coordinated policies of the EU are shown in the following table.

Table 2. Key common EU policies and measures until 2008. For a complete overview of the key common policies and measures, see the EEA 2009 report. The two voluntary measures are indicated in bold font. Source: (EEA, 2009b; EC, 2006).

<table>
<thead>
<tr>
<th>EU Key common policies and measures</th>
<th>Policy or Measure</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Cross sectoral</strong></td>
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<tr>
<td>EU Emission Trading Scheme (ETS)</td>
<td>EU ETS directive 2003.87/EC establishing a scheme for GHG allowance trading</td>
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<tr>
<td>Integrate Pollution Prevention and Control (IPCC)</td>
<td>Directive 2008/1/EC to prevent pollution (recast of 1996 directive)</td>
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<tr>
<td>Green Public Procurement</td>
<td>Directive 2004/17/EC coordinating the procurement procedures of entities operating in the water, energy, transport and postal services</td>
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<tr>
<td><strong>Energy: Supply</strong></td>
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<tr>
<td>Renewable Energy</td>
<td>RES-e directive 2001/77/EC on the promotion of electricity produced from renewable energy sources. Directive 2003/30/EC on the promotion of biofuels or other renewable fuels for transport</td>
<td></td>
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<tr>
<td>Energy end use efficiency</td>
<td>Directive 2006/32/EC repealing council directive 93/76/EEC</td>
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<tr>
<td>Category</td>
<td>Directive/Programme Description</td>
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<tr>
<td>Ecodesign of energy-using products</td>
<td>Directive 2005/32/EC: framework for the setting of ecodesign requirements</td>
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<tr>
<td>Energy Taxation</td>
<td>Directive 2003/96/EC restructuring the community framework</td>
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<tr>
<td>Motor Driven Systems</td>
<td><strong>Voluntary</strong> programme to aid industrial companies in improving the energy efficiency of electric motor driven systems</td>
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<tr>
<td>Large Combustion Plants (LCP)</td>
<td>Directive 2001-80-EC on the limitation of certain pollutants into the air from LCP’s</td>
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<tr>
<td><strong>Transportation</strong></td>
<td><strong>Voluntary</strong> agreements with car manufacturers to reduce fleet average CO2 emissions to 140 g.km by 2008/2009</td>
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</tr>
<tr>
<td>Emission performance of passenger cars</td>
<td>Directive 2009/33/EC on the promotion of clean and energy efficient road transport vehicles</td>
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<tr>
<td>Energy efficiency</td>
<td>Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce GHG emissions</td>
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<tr>
<td>Transport fuels</td>
<td>Directive 2008/101/EC amending Directive 2003/87/EC so as to include aviation activities in the EU ETS</td>
<td></td>
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<tr>
<td>HFC motor vehicle air conditioning</td>
<td>Directive 2003/30/EC on the promotion of biofuels or other renewable fuels for transport</td>
<td></td>
</tr>
<tr>
<td>Biofuels</td>
<td>Three directives on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure to promote a shift towards rail</td>
<td></td>
</tr>
</tbody>
</table>
5.1.1. Energy and climate change law

The Emission Trading Scheme (ETS) directive (directive 2003/87/EC) was established as the result of a green paper issued by the ECCP and lays the foundation for an EU-wide CO2 emissions trading scheme in order to promote reductions of GHG emissions in a cost-effective and economically efficient manner. The directive establishes an EU-wide cap and trade system, which began operation in January 2005. Currently, the directive does not apply to emissions other than CO2 (Vedder & Jans, 2008, p. 385). Emission allowances are distributed to the sectors and industries involved. The emission allowances are largely distributed for free during the first three year period; at least 95% of the allowances are distributed for free. The cap is based on Decision 2006/944 and the emission reduction objective of the member state. Expansions of the ETS are expected, such as the inclusion of the aviation sector (Vedder & Jans, 2008, p. 385).

The linking directive (directive 2004/101/EC) allows the inclusion of allowances derived from Clean Development Mechanism projects and Joint Implementation projects into the ETS. The linking directive therefore creates more flexibility for companies and industries to acquire their emission allowances. Limits have been set to the use of the allowances of CDM and JI projects into the ETS, ensuring that a certain portion of GHG reduction effort is performed domestically (Vedder & Jans, 2008, p. 387).

The RES-e directive (directive 2001/77/EC) on the promotion of electricity produced from renewable energy sources in the internal electricity market aims to increase the share of renewable energy sources in the EU. The directive mandates the EU member states to issue national indicative targets for renewable energy every two years, and their targets have to relate to the global indicative target. The Commission assesses these targets and determines the progress of the member states. In case the Commission determines the targets inconsistent, the Commission is allowed to impose mandatory targets upon the member state involved. Therefore, although the member states do not receive a mandatory target right away the targets set by them need to meet certain guidelines in order to prevent mandatory target setting by the Commission. The newly issued “energy and climate package” sets an overall EU-target of 20% renewable energy use.

5.1.2. Other climate change law

Of the directives related to climate change, the ETS directive is by far the most important and high profile instrument used by the EU to combat climate change (Vedder & Jans, 2008, p. 387). Other instruments employed by the EU that address climate change are also in place. For instance, Regulation 842/2006 aims to reduce fluorinated GHG. In order to reduce these emissions the regulation provides provisions on the use, containment, recovery and destruction of these gases and the labelling and marketing of fluorinated gases (Vedder, 2008, p. 389). Many initiatives aim at energy saving and energy efficiency, especially directive 2006/32/EC and directive 2002/91/EC. Directive 2006/32/EC aims to enhance cost-effective improvements in energy-efficiency. It does so by providing a national indicative energy savings target of 9% in 2015 (Vedder & Jans, 2008, p. 390). Directive 2002/91/EC aims to increase the energy efficiency of buildings. The directive mandates the member states to set minimum energy efficiency requirements.
5.2. European Union Member state level

5.2.1. Germany climate change policy analysis

Being the single largest country in economic size and population Germany affects the functioning and the trajectory of the EU fundamentally (Lankowski, 2006, p. 35). The country is home to Europe’s greatest concentration of industrial activity, but is at the same time home to its widest social movement sector and a very successful Green Party (Lankowski, 2006, p. 41). Germany is a system of administrative federalism in which the Länder play the leading role in implementing almost all law (Lankowski, 2006, p. 47). However, the Basic Law, amended in 1972 to allow the federal government to become active in environmental policy, states that “the maintenance of relations to foreign states is the responsibility of the federal government”; thus placing the issue of climate change under the sole legislative power of the federal government (Pehle, 1997, pp. 162, 168). In 1982 German foreign environmental policy was fundamentally revised due to the country’s new perception of itself as a country being negatively affected by pollution problems (Pehle, 1997, p. 190). This increased the efforts of the German government to deal with environmental issues. Early action on climate change is shown by the creation of the “CO2-reduction” Inter-ministerial Workgroup in 1990 which subsequently submitted CO2 reduction strategy reports in 1990, 1991, 1994, 1997, 2000 and 2005 (Germany, 2009). Early leadership position was taken through the proposal of 25% CO2 reduction in 2005 related to base year 1987 in 1990, and the creation of one hundred measures to achieve this target (Pehle, 1997, p. 168; Germany, 1994). Although the reunification of East and Western Germany would likely result in ‘wall-fall’ reductions due to the inefficient industrial system in eastern Germany, the proposal was unique at the time. Since 1990, the comprehensive climate protection policy portfolio expanded consistently (Germany, 1994; Germany, 1997; Germany, 2002; Germany, 2006).

Compared to other countries, Germany is one of the leading industrial countries regarding its climate change and renewable energy policies (Weidner, 2005). Three basic factors can be identified as the main pillars of German climate protection policies: a shift to low-emission fuels in the form of renewables, the improvement of energy efficiency and the control of emissions through the EU’s cap and trade scheme (Weidner & Mez, 2008). Of these, the single most important policy tool to German disposal is the EU cap and trade scheme, which covers about 55% of German CO2 emissions (Weidner & Mez, 2008). The emission cap and trade scheme of the EU covers the energy and industry sectors and therefore Germany focuses on the households and transportation sectors since 2005 ((BMU), 2005).

Germany is with 18% in 2007 the largest emitter of GHG emissions in the EU-27, followed by the UK, Italy, France and Spain (EEA, 2009a). During 2006-2007 approximately 40% of the EU-27 GHG emissions reductions were caused by Germany, illustrating the large influence of Germany (EEA, 2009b). The GHG emission reduction target under the Kyoto Protocol was set for Germany to be 21% below base year levels; currently Germany has reached a 22,4% reduction below base year levels, exceeding their target under the Kyoto Protocol (IEA, 2007; EEA, 2009a). The emission reduction target of 21% under the 1990 base year is the highest target among the EU member states (Weidner & Mez, 2008). In order to achieve its Kyoto obligations, the National Climate Protection Programme (NCCP) was adopted in October 2000. The NCCP was issued by the Interministerial Working Group on CO2 Reduction, which was established in 1990 (Germany, 1994). The NCCP contains a package of 64 measures for seven sectors, and was subsequently updated in 2005 and 2008 ((BMU), 2005; Germany, 2009).
The IEA concludes their analysis of the German energy and climate change policy that there is much to praise in Germany’s environmental policy (IEA, 2007). Their large and growing share of wind energy and their active policy on photovoltaic energy have created an international view of Germany as being a frontrunner in climate change action (see Appendix C).

5.2.1.1. Electric Power

Next to the international target Germany took on the EU target to have renewables provide 4.2 % of its total primary energy supply by 2010 which it surpassed in 2006 (Weidner & Mez, 2008; IEA, 2007). Moreover, Germany is well on its way to meet its domestic goal of producing 12.5 % of electricity from renewable sources by 2010 (IEA, 2007). German energy policy consists mainly of energy efficiency measures, the Renewables Energy Sources Act and Germany’s taxation policy (Weidner & Mez, 2008; IEA, 2007). Of these the Renewables Energy Sources Act is the main driver of Germany’s rapid development of its renewables sector and consists of a differentiated feed-in tariff policy. The policy is designed to level the playing field between the different energy sources, making renewables more competitive with the traditional fuel sources.

5.2.1.2. Transportation

Germany’s taxation policy is for a large part directed at the transportation sector and the first phase of the ecological taxation reform was enacted in 1999 (Weidner & Mez, 2008; IEA, 2007). The ecological taxation policy raised the taxes on motor and heating fuels, petroleum and electricity and has subsequently been amended several times. The taxation reform was completed in 2003 with the enactment of the fifth phase during which the prices of motor fuels, heating fuels and electricity was raised once again. The tax reform aimed to encourage energy savings, and secure security of supply and reach climate change mitigation.

5.2.2. Spain climate change policy analysis

Spain’s GHG emissions are allowed to grow during the Kyoto Protocol period by 15% but instead have increased by 52.6% in 2007 (EEA, 2009a; UNFCCC, 2010). The strong increase in emissions over the 1990-2007 period was largely due to emission increases from road transport, electricity and heat production and the manufacturing industries according to the EEA (EEA, 2009a). Spain is the largest emitter of GHG emissions of the countries that entered the union after 1985 emitting 9% of EU-27 emissions in 2007 (EEA, 2009a). For domestic electricity generation it relies mainly on coal, natural gas and nuclear energy. Spain does not have an overarching climate change policy framework (IEA, 2005).

A main pillar is Spain’s aim to increase energy efficiency to reduce GHG emissions. The energy efficiency strategy in Spain covers demand side measures to reduce energy consumption in all sectors of the economy (IEA, 2005). The transportation sector and the residential sector are especially viewed by the Spanish government as fields with great opportunities for increased energy efficiency (IEA, 2005). The efficiency strategy adopts incentives, legal improvements and information and awareness raising campaigns (IEA, 2005). The transportation sector is the most important in the strategy and is expected to contribute to almost half the total savings (IEA, 2005). The strategy aims at an emission intensity reduction target of 7.2 % from 2003 to 2012 (IEA, 2005). But, the IEA notes the absence of an implementation programme and recognises that the strategy has fallen behind schedule.

Another major policy area identified by the IEA that Spain uses in an attempt to reach its GHG reduction target are the Clean Development Mechanism and the Joint Implementation project.
mechanisms in combination with the EU emissions trading scheme (IEA, 2005). Spain is especially eager to enter into agreements with the Latin American countries concerning CDM projects (IEA, 2005).

5.2.2.1. Electric power

Spain’s domestic climate change mitigation policies are mainly focused on the introduction of combined cycle gas turbines to cover additional electricity demand, a reduction of energy intensity and an increase in renewable energy production (IEA, 2005). Spain has a well developed policy package to develop renewable energy and is now one of the world’s leaders in wind energy (IEA, 2005). The main policy regarding renewables is the ‘Plan for the Promotion of Renewable Energy 2000-2010’ which was adopted in 1999. The plan establishes targets for the renewable energy sector to reach 12% of total primary energy supply by 2010 and 29% generation from renewables in electricity supply in 2010 (IEA, 2005), in line with the requirements of EU directive 2001/77/EC. But the plan has so far only been partially successful. Significant increases in renewables have occurred in Spain, but the overall growth rate is below that required in order to reach the targets (IEA, 2005). Moreover, the growth is very uneven in terms of sectoral development. To further support renewable energy production in Spain, the Energy Transport Network 2002-2011 programme gives priority to the installation of transmission lines for electricity generation from renewable energy sources and to the building of gas pipelines (IEA, 2005).

5.2.3. Hungary climate change policy analysis

All the new member states begin their role in the EU as more of a “policy taker” than a “policy maker”, as they need to acquire the EU policy package (Ellison, 2006, p. 315). Hungary has implemented all the climate change legislation required under EU law and Hungarian climate change policy is fully driven by its international commitments (IEA, 2006; EC, 1997). Before 2000, no domestic need for emission reductions was identified due to the low emission level (IEA, 2006). A national climate change strategy was developed in 2000, which reiterated the 6% reduction target as the main objective (Hungary, 2002). A comprehensive climate change strategy has since been developed and published with a 2008-2025 time period (Kovacs, 2009; Diossy, 2009; Hungary, 2009).

Hungary’s energy policy is aimed at balancing the economic growth, energy security and environmental protection and the last official document regarding Hungary’s energy policy dates back to 1993 (IEA, 2006; Hungary, 2002). The main national action plan in the early 1990s was focused on energy efficiency (Hungary, 1994). Due to its high share of natural gas in the energy mix, its imports of 80% of its gas consumption from a single supplier and a Russia-Ukraine gas dispute which severely affected Hungary, energy security is the top priority (IEA, 2006).

As a 2004 accession member state Hungary, the country’s emission reduction obligation under the Kyoto Protocol does not fall under the EU burden-sharing agreement bubble, the country therefore has its own Kyoto Protocol target of 6% emission reduction compared to the average level of 1985-1987 (IEA, 2006). In 2006, Hungary’s GHG emissions are significantly below the target. The continued restructuring of the Hungarian economy from a centrally planned economy into a market economy, and the collapse of the energy-intensive Communist era heavy industry are the main reasons for the large reduction in emission (IEA, 2006; Hungary, 2009).
5.2.3.1. Transportation

The creation of the 1996 Transport Policy marks the start of Hungarian national transportation policy, and was introduced due to the falling importance of public transportation and the rise in privately owned passenger vehicles (Hungary, 1997). Main objective of the transport policy is therefore to expand the roadway system of Hungary dramatically while at the same time aim for modernisation of all transportation fleets to decrease the already substantial pollution occurring from transport (Hungary, 1997). The main addition after the 1996 Transport Policy is due to EU Directive 2003/30/EC requiring the Hungarian government to increase the share of bio-fuels in the transportation fleet (Hungary, 2005).

5.2.3.2. Electric power

The first energy policy after the transformation into a market economy in 1990 was adopted in 1993 (Hungary, 2002). The main objectives, inter alia, of this document were: 1) diversification of energy supply and elimination of import dependence on the Russian Federation, 2) increased energy efficiency and modernization of supply structures, 3) improved protection of the environment and reduction of pollution (Hungary, 2002). To achieve these objectives major energy efficiency programs were initiated, with main success achieved through the German Coal Aid Revolving Fund which funded energy conservation and efficiency projects that contributed in the shift from traditional energy sources such as coal to less polluting energy sources (Hungary, 1997). Privatization of the energy sector, mostly performed to meet EU targets, was another major influence on the performance of the energy sector (Hungary, 2002; EC, 1997). The 1996 Ministerial Decree 55/1996 established a purchase obligation for electricity from renewable sources, with the aim to double renewable energy sources in the energy balance to 5-6% (Hungary, 1997; Hungary, 2002). Privatization in the 1990s has been followed by liberalization of the energy market through the New Act on Electricity in 2001, which entered into force in 2003 (Hungary, 2002; Hungary, 2005).

5.2.4. Poland climate change policy analysis

Early actions of Poland regarding energy and climate change were the substitution of coal in households and small industrial plants for other energy carriers such as oil and gas (Poland, 1994). Next to that, energy efficiency programs were initiated (Poland, 1994). These policies and measures were however not specifically initiated due to climate change concerns, but mostly to address the economic recession of the early 1990s, that occurred due to the transformation to a market economy (Poland, 1994). Nonetheless, the strategies outlined in the first national communication to the UNFCCC were expected to result in substantial emission reductions. Especially, the industrial sector and its anticipated shift away from the then dominating heavy industry to automotive, chemical and food processing industry and the shift away from the monoculture of coal power plants to a more diversified power plant mix was expected to realise major emission reductions (Poland, 1994). Substantial increases were forecasted related to the transportation sector, but no significant policy was proposed other than the expectation that new automotive technologies would realise some emission reductions (Poland, 1994). With the submission of the second national communication to the UNFCCC a more structured approach to climate change becomes apparent.

The third communication to the UNFCCC states the general concept of Polish climate change policy with: “The process of restructuring of the national economy [...] has resulted in significant reduction of greenhouse gas emissions, particularly CO2. [...] By the reduction, Poland fulfils its obligations by the Convention and built up an emission reserve [...]. Thus, no need to undertake
any specific actions aimed at emission reduction is expected until 2008” (Poland, 2001). The report states that the actions regarding energy efficiency of the economy should be continued, and will lead to parallel emission reductions. The fourth communication report outlines a much clearer and substantial climate change policy structure, illustrated by the adoption of a wide array of programmes and plans such as ‘the Energy Policy of Poland until 2025’(2005), ‘Poland’s Climate Policy. Strategies for greenhouse gas emission reductions in Poland until 2020’(2003) and the ‘Second State Environmental Policy’(2001) (Poland, 2006).

5.2.4.1. Industrial policy

As expected, the share of oil and natural gas in industry increased during the 1992-1995 period while the share of coal and lignite decreased (Poland, 1998). Main industrial policies as outlined in the second communication are the following. First, the Cleaner Production Programme, aimed at the implementation of a cleaner production principle and initiated in 1991. Second, industrial restructuring to further develop the shift from solid fuels to liquid and gaseous fuels for industry. Third, the introduction of the Act on Energy Law with which national energy and fuel policies can be developed. Finally, the closure of unprofitable hard coal and lignite mines, and the restructuring of the hard coal sector (Poland, 1998). The Programme of Restructuring of Iron and Steel Industry in Poland, introduced in 1998, resulted in the adoption of new technologies and elimination of outdated production processes (Poland, 2001). Major new introductions in the fourth communication report are the inclusion of the EU ETS and the use of the Joint Implementation mechanism. (Poland, 2006)

5.2.4.2. Transportation policy

The second communication to the UNFCCC identifies as the main measures regarding emissions from the transportation sector the following measures. For instance, prioritization of more environmentally sound transportation methods such as railway and public transportation. The report further states that since 1992 energy efficiency measures were taken in the transportation sector that lead to CO2 emission reductions (Poland, 1998). These measures include the introduction of a CO2 emission fee for vehicles used for business purposes, the modernization of the Polish airlines and the introduction of limits to the allowed emission of vehicles (Poland, 1998). However, the submission to the UNFCCC does not clearly state the exact details on these measures.

According to the third national report the actions documented in the first and second national report succeeded in limiting the emission increase within the limits. “The fundamental problem”, the report states, “faced by the sector is the constant increase in the number of vehicles” (Poland, 2001, p. 40).

5.2.4.3. Residential and commercial policy

The second submission to the UNFCCC states that two main areas of municipal policy can be distinguished: energy conservation and management of municipal waste and sewage treatment (Poland, 1998). Energy conservation projects in the categories heating system upgrading, fuel conversion, waste heat utilisation and utilisation of renewable energy such as improvement of thermal insulation of buildings are the main measures described in the report and are expected to decrease Polish emissions by a total of 2100 Gigagrams (Poland, 1998).
5.2.4.4. Electric power policy

The second submission to the UNFCCC does not state electric power specific policies, although the mentioned restructuring affects the electric power sector. The third submission states that the main actions related to energy generation are: 1) the introduced obligation to purchase electricity generated in combination with heat generation, 2) the obligation to purchase heat and electricity from renewable and non-conventional sources, and 3) the statutory determination of maximum fixed transmission charges related to gaseous fuels and heat of 40 % and 30 % respectively (Poland, 2001). The actions taken continue the substitution of hard coal, brown coal and fuel oil for natural gas which is illustrated by the closure of twenty-one coal mines over the period 1998-2000 (Poland, 2001).
6.0. Concluding remarks chapters three, four and five

6.1. Categorization of policy

The US federal strategy is mainly based on voluntary measures and research initiatives. The targets and goals that are stated in the Energy Policy Act of 2005 are primarily to support specific sectors. These two characteristics of the US federal strategy indicate that the US federal government prefers a no-regret approach. Actions that would improve economic circumstances of certain sectors, or that are voluntarily taken by actors in the economic sphere are endorsed by the US federal government. On the other hand, actions that would possibly harm the US economy, or that might result in a loss of competitiveness with the other economies in the world are not endorsed by the US federal government.

The US federal strategy does not seem to be based on the insurance policy. Additional policies would have been put into place in the US regarding GHG mitigation. Another good example of the preferred approach of no-regret above the precautionary policy approach, is the stance the US federal government has taken regarding the science of climate change focusing on the uncertainties instead of the possible consequences.

On a state level, certain states show a somewhat hostile or indifferent stance towards climate change policy. Mississippi, Tennessee, Georgia and Alabama have virtually no policy in effect to address climate change. These states fall in the indifferent category. The other states have only recently started to pass important legislation regarding the issue. Michigan’s hostile stance seems to be softening, as more climate change policy is being developed in the state.

Several explanations to the motivation of the leadership role California positions itself in can be identified. Capturing the economic value of the 21st century green economic revolution, political recognition, public demand or simply the window of opportunity are examples (Mazmanian, Jurewitz, & Nelson, 2008). Another possible motivation is the notion that aggressive CO2 reduction measures can be adopted at no net cost. In the case of California’s Assembly Bill 32 two separate studies support such a notion (Center for Clean Air Policy, 2006; Haneman & Farrel, 2006). The results of the study do seem to have influenced recent key decisions in California’s climate change approach (Mazmanian, Jurewitz, & Nelson, 2008), and it is therefore likely that a large part of California’s approach is based on the no-regrets policy category. For transportation this is illustrated by the statement of the Climate Action Team of California as it identifies the transportation regulations in Assembly Bill 32 a “no regrets policy as it produces economic benefits to the state besides reducing GHG emissions” (CARB, 2010). The New England states and California both adopted a cap and trade mechanism, indicating that part of their policy is derived from an insurance policy stance. Like the EU ETS, continuously lowering the cap inevitably leads to a low carbon economy, forcing changes in the sectors covered by the mechanism.

The EU has chosen a path that is more dependent on regulation and legislation than on voluntary measures and increased scientific efforts. Also, the EU ETS is a prime example of the EU adopting an insurance policy approach. However, the choice to link the EU ETS to the Kyoto Protocol flexible mechanisms of the Clean Development Mechanism and the Joint Implementation mechanism illustrates that the EU does not want to jeopardize its economic competitiveness. Allowing its economy to reach the set targets in a cost-effective manner reduces the possible negative effects of the GHG reduction strategy on the competitiveness of the EU economy. Therefore, the EU seems to fall in between the insurance policy category and the no-regret policy category.
Although motivated by aspirations to remain a world leader regarding climate change mitigation, Germany places itself in the insurance policy category. The expectation of ‘wall-fall’ profits notwithstanding Germany’s strong early targets and wide array of measures are characteristics of this categorization. Besides strong climate change policy, this position is further illustrated by the 2003 statement that Germany would set a 40% reduction target if the rest of the EU would set a 30% reduction target by 2020 ((BMU) F. M., 2003, p. 33). Spain’s reliance on the Clean Development Mechanism and the Joint Implementation mechanism, the lack of an overarching climate change policy framework and the fact that implementation of its climate change strategies is lacking places it in the no-regrets category. The two eastern Member States are placed in between the insurance category and the no-regrets category. During the 1990’s both countries were mostly focused on economic growth. Any GHG reductions resulting from energy efficiency programs were a bonus next to the positive economic effects. Since 2000, national climate change programs have been developed, and GHG reduction became an additional target in the policy. Economics still plays a major role as illustrated by: “With the climate change strategy the [Hungarian] Government accepted that the reduction of greenhouse gases has a beneficial impact on almost all levels of the economy and the society” (Hungary, 2002, p. 43); and: “no need to undertake any specific actions aimed at emission reduction is expected until 2008” (Poland, 2001, p. 34)

6.2. Other concluding remarks

First of all, it is clear that the hypothesis of a US based bottom-up approach and an EU based top-down approach is reflected in the climate change policy. The EU climate change policy with a large number of Directives and Regulations states numerous targets that the Member States need to achieve. The US climate change policy on the federal level on the other hand, shows mostly policy based on additional research and voluntary agreements.

Second, within the United States a great disparity occurs in climate change policy. The states of California and the New England states have a wide array of climate change policy at their disposal and have entered into regional agreements to mitigate climate change. On the other hand, the south eastern states and Michigan have limited climate change policy in effect, although they recently seem to have increased their efforts.

Third, within the European Union the eastern European member states have not developed many own climate change policies. Mostly, the states have adopted the ‘acquis communautaire’ of the EU as policy-takers. Their climate change effort therefore depends on the EU climate change effort. Fourth, although Germany and California initiated climate change policy prior to 2000, most climate change action plans and policies have been developed post 2000.
7.0 United States CO2 emission trends

7.1. U.S. national level

The main target of the US federal government during the 1990-2005 period has been reduction of the emission intensity. The following figure clearly shows a strong decrease of the intensity ratios of carbon and energy relative to GDP. The GHG emission intensity fell during the 1990-2007 period by around 25 %. As a comparison, the GHG emission intensity of the EU-27 fell by 37 % and in the EU-15 by 33 % during the same period (EEA, 2009). The figure also shows that the ratio of carbon over energy has remained largely stable over the 1990-2007 period. This indicates that while per unit of GDP fewer emissions are generated and less energy is used, emissions per unit of energy used remains about the same as in 1990.

![Intensity Ratio's 1990-2007](image)

Figure 3. U.S. intensity ratios for carbon and energy relative to GDP and to each other for 1990-2007. It can be seen that the GHG emission intensity has decreased by about 25 % in 2007 compared to 1990. Source: (Energy Information Administration EIA, 2008) retrieved: 30th November 2009

Ultimately, absolute GHG emission reductions are necessary to realize climate change mitigation. In the following figure the national carbon dioxide (CO2) emissions of the US are illustrated, together with the 1980-1989 extrapolation scenario and the Kyoto Protocol reduction target of 7% compared to 1990. National emissions have grown over the 1990-2005 period, and the emissions growth rate of the 1990-2005 period is higher than during the 1980-1989 period. The CO2 emissions in 2007 were 17% higher than the 1990 level. The 25 % reduction in emission intensity did not materialize in an absolute CO2 emission reduction.

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6 Emission intensity is the ratio of emissions, usually in CO2-eq., to economic output measured in GDP.
Figure 4. The US CO2 emission trend in MMT. The extrapolation growth rate is averaged at 0.74 % in the 1980-1989 period. A 19.4 % increase can be seen compared to the 1990 level. Overall GHG emissions increased 17 % compared to 1990. Source: (EIA, 2007).

Dividing the emissions among the different sectors is crucial in order to attempt to distinguish the consequences of the two approaches. Differentiation in sectors and their CO2 emissions from fossil fuel combustion is illustrated in the table 3.

Table 3. US federal CO2 emissions in MMT differentiated over the four end use sectors. Source: (EIA, 2007; US Census Bureau, 1999).

<table>
<thead>
<tr>
<th></th>
<th>Actual Emissions</th>
<th>Extrapolation Scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>Residential+</td>
<td>629.22</td>
<td>563.39</td>
<td>587.96</td>
</tr>
<tr>
<td>commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>1184.26</td>
<td>1049.46</td>
<td>985.88</td>
</tr>
<tr>
<td>Transportation</td>
<td>1397.71</td>
<td>1580.48</td>
<td>1993.90</td>
</tr>
<tr>
<td>Electric Power</td>
<td>1548.23</td>
<td>1809.43</td>
<td>2386.13</td>
</tr>
<tr>
<td>Total</td>
<td>4759.42</td>
<td>5002.77</td>
<td>5953.88</td>
</tr>
<tr>
<td>Population</td>
<td>227</td>
<td>249</td>
<td>296</td>
</tr>
<tr>
<td>(Millions)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission/</td>
<td>20.97</td>
<td>20.09</td>
<td>20.11</td>
</tr>
<tr>
<td>capita</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dominant growth took place in the transportation and electric power sectors, while the residential plus commercial sector only increased slightly and the industrial sector managed to decrease emissions. The extrapolation scenario shows that all but the electric power sector increased their growth rate compared to the 1980-1989 average. The electric power sector more or less maintained its growth rate. The industrial sector is the only sector that is on track to meet the Kyoto Protocol target of 7 % reduction by 2012. Emission per capita increased slightly to 20.11 tons.
CO2 per person. To be on track to meet the Kyoto Protocol this level would have to be 4 tons CO2 per person lower. Overall, the US is about 20 % above the Kyoto Protocol 2005 level in 2005 indicating that climate change mitigation on the federal level so far is ineffective.

### 7.2. United States Regional Level

The United States Census Bureau differentiates the country in four regions: 1) West, 2) South, 3) Midwest, and 4) Northeast. Figure 5 shows the CO2 emission index of these four regions over the period 1980-2005. Overall, the four regions seem to follow a similar pattern of growth over this period. The Northeast region of the New England and Middle Atlantic states stand out as it is the only region that seems to have somewhat stabilized its emissions during the last decade. The states of the South combined reached the largest growth in emissions.

![CO2 Emission Index](image)

**Figure 5.** The CO2 emission index of the four regions of the United States. In this index the year 1990=100 and the period 1980-2005 is illustrated.

Although the CO2 emission index already shows that there are big differences among the regions of the United States, this becomes clearer when the regions are divided over the sectors and when the emission per capita levels are shown. Table 4 shows that the Northeast and West states have over a 8 ton CO2/person difference with the states of the South and Midwest. The states of the Northeast have the smallest emission/capita level and almost managed to maintain the 1990 level, growing slightly with 0.01 ton/person. The sector growth rates are comparable with the national level sector growth rates. The only sector that is on track to meet the Kyoto Protocol 2012 target is the industrial sector, with the exception of the states of the West.

---

Table 4. The CO2 emissions in MMT of the four regions of the United States differentiated over the four end use sectors. Source: (Energy Information Administration EIA, 2008; U.S. Census Bureau, 2009; US Census Bureau, 1999).

<table>
<thead>
<tr>
<th>Region</th>
<th>Actual Emissions</th>
<th>Extrapolation Scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>West</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential+commercial</td>
<td>91,83</td>
<td>91,51</td>
<td>95,26</td>
</tr>
<tr>
<td>Industrial</td>
<td>147,87</td>
<td>157,89</td>
<td>175,54</td>
</tr>
<tr>
<td>Transportation</td>
<td>318,64</td>
<td>381,96</td>
<td>472,54</td>
</tr>
<tr>
<td>Electric Power</td>
<td>195,56</td>
<td>251,44</td>
<td>325,32</td>
</tr>
<tr>
<td>Total</td>
<td>753,91</td>
<td>882,80</td>
<td>1068,66</td>
</tr>
<tr>
<td>Population</td>
<td>43,17</td>
<td>52,84</td>
<td>67,94</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>17,46</td>
<td>16,71</td>
<td>15,73</td>
</tr>
<tr>
<td>South</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential+commercial</td>
<td>146,57</td>
<td>119,96</td>
<td>127,90</td>
</tr>
<tr>
<td>Industrial</td>
<td>545,76</td>
<td>507,39</td>
<td>473,62</td>
</tr>
<tr>
<td>Transportation</td>
<td>534,48</td>
<td>620,19</td>
<td>808,25</td>
</tr>
<tr>
<td>Electric Power</td>
<td>662,89</td>
<td>796,84</td>
<td>1095,09</td>
</tr>
<tr>
<td>Total</td>
<td>1889,70</td>
<td>2044,39</td>
<td>2504,85</td>
</tr>
<tr>
<td>Population</td>
<td>75,37</td>
<td>85,46</td>
<td>107,41</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>25,07</td>
<td>23,92</td>
<td>23,32</td>
</tr>
<tr>
<td>Midwest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential+commercial</td>
<td>207,10</td>
<td>178,47</td>
<td>179,96</td>
</tr>
<tr>
<td>Industrial</td>
<td>327,55</td>
<td>266,64</td>
<td>245,72</td>
</tr>
<tr>
<td>Transportation</td>
<td>319,65</td>
<td>334,26</td>
<td>419,51</td>
</tr>
<tr>
<td>Electric Power</td>
<td>468,58</td>
<td>535,07</td>
<td>716,85</td>
</tr>
<tr>
<td>Total</td>
<td>1322,88</td>
<td>1314,44</td>
<td>1562,05</td>
</tr>
<tr>
<td>Population</td>
<td>58,87</td>
<td>59,67</td>
<td>65,81</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>22,47</td>
<td>22,03</td>
<td>23,74</td>
</tr>
<tr>
<td>North East</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential+commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric Power</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission/capita</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7.3. United States State Level

The regional differentiation shows that the overall national average trend is not followed by all regions. Further differentiation, on a state level, leads to even more disparity among the different states of the US. Of course, any analysis deeper into a national average discovers disparity among the different actors. However, the following analysis shows there are some remarkable differences among the actors on the state level.

The analysis of the CO2 emission trend focuses on the following states: California, Michigan, the New England states and the states of the Southeast\(^8\)\(^9\). The CO2 emission intensity curve of these four during the 1980-2005 period is very similar, all falling to about a quarter of 1980 levels in 2005, as is illustrated in figure 6. However, the CO2 emission intensity of the New England states and California is around half that of Michigan and the South Eastern states. The emission intensity level Michigan and the states of Southeast were at in 2005, is the level the other states analyzed were at in 1990.

\(^8\) Southeast: North Carolina, Tennessee, Alabama, Georgia, Florida, South Carolina and Mississippi.

\(^9\) Reasoning for these states is given in the methodology section and the climate change policy analysis section.
7.3.1. California GHG emissions

The Kyoto Protocol reduction target of 7% called for a decrease of 4.7% compared to 1990 in 2005 in order to meet the 2012 target. The CO2 emission increase of 8.5% of California during the 1990-2005 period therefore makes it clear that California is not on track to meet the Kyoto Protocol target. In fact, in 2005 none of the fifty states of the US managed to reduce their absolute CO2 emissions (Energy Information Administration EIA, 2008). However, the emission trend of California is 2% below the extrapolation scenario, indicating that the average growth rate of CO2 emissions in California has been slightly reduced.

The only sector in California that managed to reduce its CO2 emissions over the considered period is the residential and commercial sector. This sector’s CO2 emissions decreased with a sub-
stantial 12.9% compared to 1990, and are clearly on track to meet the Kyoto Protocol target. The electric power sector is the only sector in California that increased its average CO2 emission growth rate, resulting in a 2005 level that is 14.9% above the extrapolation scenario. Of the states analyzed, California is the only state that increased its emissions in the industrial sector.

Table 5. California CO2 emissions in MMT differentiated over the four end use sectors. Source: (Energy Information Administration EIA, 2008; Department of Finance - Demographic Research Unit, 2006)

<table>
<thead>
<tr>
<th></th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>Residential +</td>
<td>50,50</td>
<td>48,39</td>
<td>42,15</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>170,90</td>
<td>203,41</td>
<td>234,44</td>
</tr>
<tr>
<td>Industrial</td>
<td>66,23</td>
<td>72,50</td>
<td>76,88</td>
</tr>
<tr>
<td>Electric power</td>
<td>61,08</td>
<td>40,37</td>
<td>42,07</td>
</tr>
<tr>
<td>Total</td>
<td>348,71</td>
<td>364,68</td>
<td>395,54</td>
</tr>
</tbody>
</table>

California’s per capita levels are around ten tons CO2/person below the national average and five tons/person lower than the region West per capita level. Despite a 8.5% increase in CO2 emissions in California, per capita levels went down during the same period with 1.56 tons/person.

7.3.2. Michigan CO2 emission trend

Michigan’s CO2 emissions increased with 5.79% over the 1990-2005 period. The extrapolation scenario of the 1980-1989 period results in an almost horizontal line, due to the sharp drop in emissions in the 1980-1984 period and the subsequent increase in emissions in the 1985-1989 period. The CO2 emission level of Michigan is therefore higher than the extrapolation scenario.
Analyzing the sectors separately gives some interesting results. The industrial sector dramatically reduced its emissions with 26.0%, but which is still 16.5% above the 1980-1989 extrapolation scenario. This indicates that the industrial sector slowed down its CO2 emission decline. Transportation emission growth increased 18.3 % but remains close to the extrapolation scenario. The electric power sector increased emissions by 13.5 % but managed to end up below the extrapolation scenario. In contrast with California, Michigan realized a residential and commercial sector CO2 emission growth.

Table 6. Michigan CO2 emissions in MMT differentiated over the four end use sectors. Source: (Energy Information Administration EIA, 2008; Department of Community Health, 2008) retrieved 4th of January 2010.
The emission per capita level is comparable to the twenty tons/person of the national average. A slight decrease has occurred in the 1990-2005 period of 0.52 tons/person of CO2. Michigan is ten percent above the Kyoto Protocol scenario, and is therefore not on track to meet the Kyoto Protocol target. The only sector in Michigan that is on track to meet the target is the industrial sector.

### 7.3.3. South-eastern states

The combined CO2 emissions of the South-Eastern states are illustrated in the following figure, and shows a sharp increase in CO2 emissions over the 1990-2005 period. Overall emissions are 34.4% higher than their 1990 level. The emission growth rate of the 1990-2005 period is much higher than the emission growth rate of the 1980-1989 period, resulting in a higher actual emission scenario than the extrapolation scenario.

![South eastern states CO2 emissions](image_url)

**Figure 9. CO2 emissions in MMT of the south eastern states over time. Source: (Energy Information Administration EIA, 2008) retrieved 4th of January 2010.**

The differentiation between sectors shows a somewhat comparable scenario to the Michigan case. The electric power and transportation sectors show the largest growth, while the industrial sector was the only sector that realized a reduction in emissions. The residential and commercial sector increased their emissions with 9.66%. None of the sectors is on track to meet the Kyoto Protocol, but the industrial sector is close.
Table 7. South Eastern states CO2 emissions in MMT differentiated over the four end use sectors.  

<table>
<thead>
<tr>
<th>South-Eastern</th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>Residential + Commercial</td>
<td>48,93</td>
<td>45,10</td>
<td>49,46</td>
</tr>
<tr>
<td>Transportation</td>
<td>228,12</td>
<td>271,06</td>
<td>372,93</td>
</tr>
<tr>
<td>Industrial</td>
<td>111,22</td>
<td>114,28</td>
<td>109,33</td>
</tr>
<tr>
<td>Electric power</td>
<td>294,04</td>
<td>329,07</td>
<td>489,22</td>
</tr>
<tr>
<td>Total</td>
<td>682,31</td>
<td>759,51</td>
<td>1020,94</td>
</tr>
<tr>
<td>Population (Millions)</td>
<td>32,79</td>
<td>41,03</td>
<td>53,25</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>20,81</td>
<td>18,51</td>
<td>19,17</td>
</tr>
</tbody>
</table>

Increasing the emission/capita level in the 1990-2005 period from 18,51 ton/capita to 19,17 ton/capita brings it close to the national level despite the 29,8% increase in population. The combined Southeastern states are responsible for 17.1% of the nation’s CO2 emissions. The 34.42 % increase in overall emissions therefore strongly influences the nation’s CO2 emission trend.

7.3.4. New England states

The combined emissions of the New England states is illustrated in the following figure, and shows a 10,8% increase over the 1990-2005 period. Slowing down their emission growth rate, the New England states have clearly managed to remain below the extrapolation scenario.
The differentiation in sectors shows that the New England states only managed absolute emission reductions in the industrial sector. However, the New England states combined did manage to remain below the extrapolation scenario for all sectors. The emission/capita level of the New England states is much lower than the national average, but did increase slightly over the analyzed period.

8.0. European Union CO2 emission trend

8.1. European Union 27 Level

The supranational level of the EU-27 realized a CO2 emission decrease over the whole range of 1980-2005. The emission intensity of the EU has dropped by 37 % in the EU-27 and 33 % in the EU-15 (EEA, 2009b). The EEA notes that this is an indication of the decoupling of GHG emissions from economic growth as GDP rose 45 % over the 1990-2007 period in the EU-27 (EEA, 2009b).

The CO2 emissions of the EU-27 have dropped over time, by around 5 % in 2005 relative to 1990. The EU-27 is on track to meet its Kyoto Protocol target of 8 % by 2012, partly due to the drop in emissions over the years following 2005 and partly due to the drop in the other GHG emissions (EEA, 2009b). It is interesting to note that the extrapolation scenario of the 1980-1989 period results in a lower trend than the Kyoto Protocol scenario, indicating that a somewhat higher average growth rate can be achieved without jeopardizing the Kyoto Protocol target.

![Figure 11. CO2 emissions in MMT of the EU-27 over time. The largest part of the decline in emissions occurred prior to 1996. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009)](image)

The EU-27 GHG emissions in 2007 is 9.3 % lower relative to 1990 levels, in the EU-15 the percentage is 4.3% (EEA, 2009a).

While the EEA states that between 1990 and 2007 the ranking of the main sectors regarding overall GHG emissions has not changed and the percentage contribution to total GHG emissions only changed moderately, big changes in the economic end use sectors can be seen in Table 12 (EEA, 2009b). Differentiation in sectors on a supranational level shows that all but the transportation sector realized CO2 emission reductions. The transportation sector has continued to grow since 1990; both in passenger and freight transport and is now the largest consumer of energy within the EU-27 (EC, 2009). Although there appears to be slight decoupling of passenger transport from economic growth, passenger kilometers are still increasing and the demand has increased with about 1 % per year (EC, 2009). Freight transport is not yet decoupled and economic growth has lead to a rise in CO2 emissions in the transportation sector of about 3 % per year (EC, 2009). Space heating energy consumption per m2, which is a significant component of energy consump-
tion (26% in EU-27), has on average fallen since 1990 (EC, 2009). This partly caused the decline in the residential and commercial sector. The emission/capita level of the EU-27 is around 9 tons/person, which is ten tons/person lower than the United States.


<table>
<thead>
<tr>
<th></th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EU-27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential + Commercial</td>
<td>1004.57</td>
<td>806.94</td>
<td>746.34</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>1843.89</td>
<td>1379.18</td>
<td>1096.76</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>609.53</td>
<td>763.05</td>
<td>950.62</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
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<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
<tr>
<td>Electric power</td>
<td>1724.78</td>
<td>1677.29</td>
<td>1614.46</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5211.52</td>
<td>4656.38</td>
<td>4424.74</td>
</tr>
<tr>
<td>Population (millions)</td>
<td>457.05</td>
<td>470.39</td>
<td>491.02</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
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<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
<tr>
<td>Emission/capita</td>
<td>11.40</td>
<td>9.90</td>
<td>9.01</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td></td>
<td>Δ '90-'05</td>
<td>Δ actual emissions</td>
<td></td>
</tr>
</tbody>
</table>

8.2. EU-15 and EU-12 level

The analysis on the EU-27 level seems to indicate that the EU is realizing effective climate change mitigation. However, it is important to distinguish between the two EU levels of the EU-27, as the economic and political developments in the eastern part of Europe in the 1980s play a significant role in the CO2 emission trend of the EU. Next to that, certain countries in the western part of the EU substantially influence the overall CO2 emission trend.

The CO2 emission index of both EU levels shows that the EU-15 CO2 emission index remained largely constant over the 1980-2005 period. In contrast, the EU-12 emission index shows a sharp decrease in CO2 emissions around the year 1990. This indicates that the majority of the drop in EU-27 CO2 emissions is caused by the drop in emissions in the EU-12 countries.
Differentiation in sectors provides more detail to this difference between the two regions. The EU-15 region shows an overall 2.24% increase of CO2 emissions during 1990-2005, while the EU-12 shows a substantial 27.84% decrease. The overall growth in the EU-15 is mainly caused by an increase in road transport (EC, 2009). Within the EU-15 the residential and commercial plus the industrial sector managed CO2 reductions, while the transportation sector increased sharply. Significant reductions in all but the transportation sector took place in the EU-12 countries.

Table 10. The CO2 emissions in MMT of the two regions of the EU differentiated over the four end use sectors. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009; OECD Stat, 2010).

<table>
<thead>
<tr>
<th></th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005 Δ '90-'05</td>
<td>2005 Δ actual emissions</td>
<td>2005 Δ actual emissions</td>
</tr>
<tr>
<td><strong>EU-15</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>1248,90 1025,15 902,29</td>
<td>-12,0%</td>
<td>770,79 -14,6%</td>
</tr>
<tr>
<td>Transportation</td>
<td>532,52 689,01 843,27</td>
<td>22,4%</td>
<td>1020,53 21,0%</td>
</tr>
<tr>
<td>Electric power</td>
<td>1246,04 1193,78 1248,77</td>
<td>4,6%</td>
<td>1115,62 -10,7%</td>
</tr>
<tr>
<td>Residential/commercial</td>
<td>771,84 648,51 641,74</td>
<td>-1,0%</td>
<td>482,12 -24,9%</td>
</tr>
<tr>
<td>Total</td>
<td>3799,30 3556,45 3636,08</td>
<td>2,2%</td>
<td>3237,91 -11,0%</td>
</tr>
<tr>
<td>Population</td>
<td>357,05 366,00 388,49</td>
<td>6,1%</td>
<td>8,33 -1,02</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>10,64 9,72 9,36</td>
<td>-0,36</td>
<td>8,33 -1,02</td>
</tr>
<tr>
<td><strong>EU-12</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td>594,99 354,04 194,47</td>
<td>-45,1%</td>
<td>186,32 -4,2%</td>
</tr>
<tr>
<td>Transportation</td>
<td>77,01 74,04 107,35</td>
<td>45,0%</td>
<td>70,90 -34,0%</td>
</tr>
<tr>
<td>Electric power</td>
<td>478,74 483,51 365,69</td>
<td>-24,4%</td>
<td>493,27 34,9%</td>
</tr>
</tbody>
</table>
While the overall emissions of the EU-15 grew, the per capita emissions fell by 0.36 tons/person to 9.36 tons/person. The 27.84% drop in emissions in the EU-12 corresponds to a 2.72 ton/person drop in the emissions/capita to 7.53 tons/person. Although the EU-12 realized large emission reductions in certain sectors, the majority of the emissions occur in the EU-15 countries.

### 8.3. EU member state level

Because certain member states influence the CO2 emission trend much more than the other states, further differentiation is necessary to determine the effectiveness of the top-down approach. The analysis focuses on the following Member States: Germany, Spain, Poland, and Hungary.\(^\text{10}\)

The CO2 emission intensity of the four Member States under analysis in this research is illustrated in the following graph. The United States emission intensity is added in order to compare the different Member States to the US. Although Poland had a much higher emission intensity relative to the other states, it clearly managed to catch up.

![CO2 emission intensity graph](image)

**Figure 13.** CO2 emission intensity of the relevant member states in MT CO2/US$, current prices (2009 level), Purchasing Power Parity. Data is not available from OECD stat for Hungary and Poland prior to 1990. Source: [OECD Stat., 2010; EC-JRC/PBL EDGAR version 4.0](http://edgar.jrc.ec.europa.eu/), 2009; [EIA, 2007].

\(^\text{10}\) Reasoning for these member states is given in the methodology section and the climate change policy analysis section.
8.3.1. Germany

Germany has realized large reductions of CO2 emissions over the 1990-2005 period, as illustrated in the following graph. In 2005, the emission level of Germany was lower than the Kyoto Protocol scenario 2005 level, indicating that Germany is well on track to meet the Kyoto Protocol target. Next to that, the emission level was lower than the extrapolation scenario, indicating that Germany managed to decrease the emission growth rate. Germany is an interesting case due to the collapse of the Berlin wall in 1989 and the subsequent merger between West and East Germany. The initial drop in emissions in the 1990s is derived from the refurbishment of the industry in East Germany, leading to significant emission reduction. However, the sustained decrease in emissions after the year 2000 shows that other actions taken by Germany are effective. For instance, Germany states that the expansion of renewable energies contributes significantly to the decreasing trend (Germany, 2009).

![Germany CO2 emissions](image)

Figure 14. CO2 emissions in MMT of Germany over time. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009).

In the period 1990-2007, economic growth of 41.7% occurred, population growth occurred and GHG emissions decreased by 21.3 % (Germany, 2009). This shows that Germany effectively decoupled its emissions from economic growth. Germany managed to reduce the CO2 emissions in all sectors, as illustrated in the following table. While the CO2 emissions of the transportation sector showed a 1.31% drop, it is still furthest from the Kyoto Protocol scenario, as it is 13.17% above the target scenario. On an overall level, Germany also shows a drop in emissions per capita of 2.80 tons per person compared to the 1990 level.
Table 11. Germany’s CO2 emissions in MMT differentiated over the four end use sectors.

<table>
<thead>
<tr>
<th>Germany</th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1980</td>
<td>1990</td>
<td>2005</td>
</tr>
<tr>
<td>Industrial</td>
<td>391,34</td>
<td>302,41</td>
<td>212,77</td>
</tr>
<tr>
<td>Transportation</td>
<td>129,12</td>
<td>160,25</td>
<td>158,15</td>
</tr>
<tr>
<td>Electric power</td>
<td>450,20</td>
<td>423,10</td>
<td>369,88</td>
</tr>
<tr>
<td>Residential + Commercial</td>
<td>257,00</td>
<td>215,00</td>
<td>174,13</td>
</tr>
<tr>
<td>Total</td>
<td>1234,93</td>
<td>1106,73</td>
<td>918,31</td>
</tr>
<tr>
<td>Population (millions)</td>
<td>78,29</td>
<td>79,43</td>
<td>82,47</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>15,77</td>
<td>13,93</td>
<td>11,14</td>
</tr>
</tbody>
</table>

8.3.2. Spain

The following graph clearly illustrates that Spain has not managed to curtail its CO2 emissions. The strong increase in Spain’s emissions continues throughout the 1990-2005 period. The Kyoto Protocol scenario in this particular case allowed for an increase in CO2 emissions of 15 % under the EU burden sharing agreement, and is a similar scenario to the extrapolation scenario. Continuing the growth rate of the 1980-1989 period would therefore have resulted in realisation of the Kyoto Protocol target scenario. Instead, Spain has reached a level of CO2 emissions in 2005 that is 57% higher than the base year of 1990. Spain’s total GHG emissions were 52.6 % higher in 2007 compared to 1990 levels, and has grown every year since 1990 except 1993,1996 and 2006 (CEC, 2009b).CO2 is the dominant GHG in Spain’s emissions, with a weighting of around 80% throughout the 1990-2007 period (CEC, 2009b).
Strong increases in CO2 emissions can be seen in the different sectors of Spain. The residential and commercial sector nearly doubled in emissions during the 1990-2005 period, closely followed by the transportation sector and electric power sector. The two main causes for transportation emission increase seem to be increases in number of vehicles, 123 % regarding passenger vehicles, and a 103 % increase in kilometers driven (CEC, 2009b). Although the population of Spain grew strongly with 11.70 %, the per capita emissions still increased with 2.51 tons per person from 1990 to 2005.

Table 12. Spain’s CO2 emissions in MMT differentiated over the four end use sectors. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009; OECD Stat., 2010)
8.3.3. Hungary

The process of transformation into a market economy is clearly visible in the CO2 emission trend of Hungary. This process occurred mainly in the years 1989 and 1990, but the radical effects of the transformation lasted to around 1995 (Hungary, 2009). The output of the economy radically decreased during this period, and this resulted in a major decline in CO2 emissions. Hungary is clearly far below the Kyoto Protocol target scenario, while the extrapolation scenario 2005 level is close to the actual 2005 level.


The transformation process into a market economy dramatically affected the industrial sector, especially in the energy intensive industry (Hungary, 2009). The differentiation in sectors clearly shows the effects of the transformation. For example, the industrial output of 1992 was two thirds the industrial output of 1989, two out of three steel plants and two out of three aluminium plants were closed down and the ferroalloy industry ceased to exist in Hungary (Hungary, 2009). Stabilization of CO2 emissions occurs after 1995; the significant effects of the transformation process seem to have diminished. However, in the period 1995-2005 market powers became the decisive force to the CO2 emission trend. In this period, GHG emissions from transportation increased with 4 million tons CO2-equivalent which constitutes a 60 % growth (Hungary, 2009). Energy use in the transportation sector increases due to a rise in the number and mileage of vehicles used in passenger transport and trucking (IEA, 2006). At the same time, the residential and commercial sector switched from coal to natural gas as the main energy source, with over 85 % now being covered by natural gas while solid fuel almost disappeared in this sector (Hungary, 2009). This partly explains the 14.23 % drop in CO2 emissions in this sector. The overall CO2 emissions of Hungary fell by 21.25 % compared to 1990. All but the transportation sector realized a CO2 emission level that is on track to meet the Kyoto Protocol target.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Actual emissions</th>
<th>Extrapolation scenario</th>
<th>Kyoto Protocol target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>34,65</td>
<td>25,34</td>
<td>13,47</td>
</tr>
<tr>
<td>Transportation</td>
<td>8,39</td>
<td>8,47</td>
<td>11,80</td>
</tr>
<tr>
<td>Residential + Commercial</td>
<td>20,70</td>
<td>20,30</td>
<td>17,41</td>
</tr>
<tr>
<td>Electric power</td>
<td>34,47</td>
<td>25,78</td>
<td>20,38</td>
</tr>
<tr>
<td>Total</td>
<td>98,70</td>
<td>80,30</td>
<td>63,24</td>
</tr>
<tr>
<td>Population (millions)</td>
<td>10,71</td>
<td>10,37</td>
<td>10,09</td>
</tr>
<tr>
<td>Emission/capita</td>
<td>9,21</td>
<td>7,74</td>
<td>6,27</td>
</tr>
</tbody>
</table>

8.3.4. Poland

Poland is the largest GHG emitter of the EU-12 countries, both in 1990 and in 2007. In 1990 and 2007, Poland was responsible for 34.5% and 40.2% of the GHG emissions of the EU-12, respectively (EEA, 2009a). Similar to Hungary, the CO2 emission trend of Poland shows a steep drop from 1988-1992, resulting from significant changes in the Polish economy as a result of political transformation from a centrally planned economy to a free market economy (Poland, 2010). Continued emission reductions can be distinguished from 1992 to 2005, but at a much lower rate.

Figure 17. CO2 emissions in MMT of Poland over time. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009).
Especially the heavy industry in Poland suffered due to the transformation (Poland, 2010). The slight increase in emissions from 1992 to 1995 is mainly due to modernization of the heavy industry (Poland, 2010). Initiated energy efficiency programs in 1995 resulted in emission reductions until 2002, when increased economic growth caused emissions to rise (Poland, 2010). Like Hungary, the transportation sector increased its emissions substantially. Unlike Hungary, the residential and commercial sector also increased its emissions. Overall emissions fell by 13.85%, resulting in a 1.26 ton CO2/person drop to 7.68 ton CO2/person.

Table 14. Poland’s CO2 emissions in MMT differentiated over the four end use sectors. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009; OECD Stat., 2010)
9.0. Comparative analysis United States and the European Union

9.1. General concluding remarks chapters seven and eight

The emission intensity reduction target set by the US government is clearly not sufficiently stringent to ensure absolute CO2 emission reductions. The emission intensity reduction target has been achieved, but CO2 emissions have risen 19.4 % and GHG emissions 17 %. Any analysis that solely focuses on the federal level of the US regarding climate change policy is inaccurate as significant differences exist among the regions and the states. Although regional trends of CO2 emissions are comparable with the exception of the north east, the region’s sector and per capita analysis show that important differences exist.

The transportation and electric power sectors in the US have grown consistently over the entire period. The other two sectors show differing results. For example, the residential and commercial sector managed to decrease its emissions only in California, while the industrial sector managed to decrease in all states but California. On a US federal level the bottom-up approach seems to be ineffective in realizing absolute CO2 emission reductions.

The EU-27 and EU-15 have been successful in realizing a strong reduction in the emission intensity of their economies. Next to that, absolute CO2 emissions in the EU-27 have fallen, which puts the EU-27 on track to meet the Kyoto Protocol target reduction of 8 %. While the EU-15 did not manage to reduce the CO2 emissions compared to the 1990 levels in 2005, it did manage to reduce its overall GHG emissions. While the electric power industry, the industrial, and the residential and commercial sector all managed to decrease their emissions in the EU-27, the transportation sector increased its CO2 emissions sharply with almost 25%. The same can be seen at the Member State level, where the transportation sector increased significantly in three of the four Member States analysed. Only Germany managed to decrease its transportation emissions. This indicates that the top-down approach of the European Union is unsuccessful in realizing an absolute reduction of CO2 emissions in the transportation sector. Overall, top-down climate change mitigation action on the supranational level of the EU-27 seems successful.

9.2. Comparative analysis on the (supra) national and regional level

The per capita emissions development between the United States and the European Union show big differences. On the federal level of the United States the per capita emissions are double the per capita emissions of the EU-27, and increased slightly over the 1990-2005 period. Although the emission/capita development over the 1980-2005 period decreased slightly in the United States, the emission/capita development in the EU decreased over the same period and by a higher degree. In the EU-27 the emissions per capita also show a decreasing trend over the 1990-2005 period, unlike those in the United States.

Often mentioned, the economic downturn and political restructuring in Eastern Europe caused much of the decline in emissions. The per capita emissions in Eastern Europe indeed show a strongly decreasing trend which influenced the EU-27 strongly. However, the emission/capita development in the EU-15 also shows a decreasing trend over both the 1990-2005 period as well as the 1980-2005 period. This shows that the emission/capita development in the EU-27 in gen-

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As stated in the methodology section, difficulties arise in direct transatlantic comparisons due to the differences in data and general trends are therefore analysed instead of more in-depth comparisons.
eral resulted from both the economic downturn and political restructuring in the east, but also from emission reductions per capita in the west. The regional analysis in the US shows a mixed result. Although the West, South and Northeast show a decrease over the 1980-2005 period, the Midwest shows an increase over the same period. The shorter 1990-2005 period shows a similar result.

On the (supra) national level the CO2 emission trend itself shows a similar result. Emissions in all US regions and on the federal level for both the 1980-2005 period and the 1990-2005 period increased. The Northeast region managed to curtail emission growth to fewer than ten percent, but the other regions increased emissions strongly. In the EU, the 1980-2005 period results in a decrease of emissions in both the EU-15 and the EU-12. However, the EU-15 increased CO2 emissions slightly over the 1990-2005 period, and the EU-12 decreased strongly over the same period.

The federal level of the US managed to decrease emissions in the industrial sector, while the rest of the sectors increased emissions. The residential plus commercial sector realized only a slight increase, while electric power and transportation emissions increased strongly. The differentiation in regions in the US shows a similar result. Only the West increased in every sector, while the other regions reached a similar result as the national level. In the EU the transportation sector increased strongly, while the other sectors decreased emissions. The same result is obtained from the EU-12, while the EU-15 slightly increased the electric power sector next to the transportation sector.

9.3. Comparative analysis on the (Member) state level

Within the US, California outperforms the other US states on a per capita emission basis. Despite an overall increase in emissions, California managed to reduce the CO2 emissions/capita throughout the 1980-2005 period to 10.7 tons CO2 per person. This level is the lowest of the analysed states, and is comparable to many European nations. Within the EU, Germany, Hungary and Poland realize strong emissions per capita reductions. Being the biggest emitter in the EU, Germany’s results are impressive. The economic downturn and political restructuring likely probably gave rise to much of the Hungarian and Polish reductions. The slight increase in the emission/capita level of the states of the Northeast positions these states still well below the national average. Michigan and the Southeast clearly have a significantly higher emission/capita level compared to all other states analyzed. Despite a strong increase in population, the Southeast still increased per capita emissions by 0.66 ton/person, while Michigan managed a slight decrease. Although Spain’s per capita emissions are still very low, emissions per capita increased strongly.

Germany is the only state that realized an emission reduction in the transportation sector. The decline in emissions in this sector did not start until 1999, which is the same time the eco-taxation of transportation fuels was introduced in Germany (Weidner & Mez, 2008). This correlation leads some authors to conclude that the eco tax on transportation fuels is the cause of the decline (Weidner & Mez, 2008). California is the only state in the US that realized emission reductions in the residential plus commercial sector. The industrial sector decreased in almost all states analysed, except for California and Spain. The strong economic growth in Spain, illustrated by an

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12 Comparing on a (member) state level is difficult as the individual states of the US are not nations in themselves, in contrast to the individual Member States of the EU. Comparing general trends, though, does show some interesting differences.
over fourfold GDP growth since 1980 in 2005 and a fourfold GDP/capita growth in 2005 compared to 1980 is likely related to the rising emissions in Spain (OECD Stat., 2010).
10.0. Conclusions and discussion

Overall, the results are in line with the hypothesis that the United States uses a bottom-up approach to the issue of climate change while the European Union uses a top-down approach. In addition, the bottom-up character of the United States seems to evolve over time, illustrated by the possible cooperation of regional agreements and stated by Rabe: “from wind energy in Texas to CO2 standards in New Hampshire and Oregon, the elements of a bottom-up approach to climate change are beginning to take shape” (Rabe, 2004, p. 109).

On the (supra) national level the European Union outperforms the United States. Both in stringency of climate change policy and actual emission reductions the European Union seems to be more successful in climate change mitigation. On the (member) state level the EU also seems to outperform the US. The no-regrets approach of the United States based on voluntary agreements and research seems incapable of preventing major emission increases on the federal level. However, two objections to this conclusion can be made. First, as most climate change policies have been created after 2000, this investigation only considers about five years of climate change policies. As climate change mitigation efforts in both the EU and the US increased strongly after 2000 (Lutsey & Sperling, 2007; EC, 2009), it is possible that the full effects of both policies have not yet surfaced. Predicted effects of the bottom-up approach are significant: when all states and cities reach their GHG reduction targets the US GHG emissions would decrease an estimated 13 % (Lutsey & Sperling, 2007), incorporation of the average RPS across all fifty states would reduce baseline 2020 emissions from the electricity sector by 18% (Lutsey & Sperling, 2007), incorporation of the California vehicle exhaust and fuel standards by the fifteen interested states in 2007 would lead to a 4 % reduction in from the 2020 baseline which is 11% on its way to meet the 1990 level in 2020 for the transportation sector (Lutsey & Sperling, 2007), and the combined effect of the WCI and RGGI is expected to reduce emissions 21 % in those regions compared to the 2020 baseline (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). Second, it is difficult to determine how much of the EU’s emission reductions actually results from climate change policy and not from the economic downturn and political restructuring of many of the EU-12 countries. The main cause of the decrease in emissions can be assigned to economic downturn and political restructuring, while the emission increase in the EU-15 can be accounted for by the emission growth of Italy, Spain and Ireland due to strong economic development (EEA, 2009b). This increases the difficulty of concluding the effectiveness of the top-down approach.

The conclusion that the bottom-up approach is not effective regarding climate change, but has been shown to be effective in other policy areas (WRI, 2007) raises the question why it is not as effective with the issue of climate change? Next to the objections to the conclusion, several reasons can be identified. First, under the Interstate Commerce Clause of the US constitution it is forbidden for states to enact laws that place an undue burden on the interstate commerce (Mazmanian, Jurewitz, & Nelson, 2008). Therefore, it is often difficult to enact climate change mitigation policy that is highly effective but at the same time does not place a prohibited burden on the interstate commerce. In contrast, the European Union actively decided to address climate change at the supranational level, illustrated by the obligation to address environmental protection into the definition and implementation of Community policies and activities in the Amsterdam Treaty (EC, 2002). Second, the active hindering by the US EPA of establishing state level GHG emission regulations during the Bush Administration increased the difficulty to realize effective regulation (Knudsen, 2009). Third, limitations to address the global problem of climate change on an international level by states might further have hampered effective climate change regulation (Rabe, 2002). Fourth, under the Supremacy Clause of the US constitution federal law pre-empts any conflicting state law, further limiting the ability of certain states to address climate change.
effectively (Mazmanian, Jurewitz, & Nelson, 2008). Reluctance of certain states to deal with the issue and potential inefficiencies between the different approaches of the individual states are other possible causes (Rabe, 2002).

The bottom-up approach has not yet resulted in federal action. The bottom-up characteristics such as state experimentation, increasing horizontal diffusion of certain policy tools and regional cooperation in climate change mitigation mechanisms increases the motivation for federal action. The plans to link the Western Climate Initiative to the RGGI of the northeast would increase this motivation drastically (Young, 2006). The positive effects of the bottom-up approach are currently undermined by the negative effects of the bottom-up approach. The bottom-up process needs to be completed to the federal level in order to address the negative effects and realize the full potential of the positive effects. In other words, to achieve absolute emission reductions federal involvement is required.

Due to the inaction of the federal government, certain states have positioned themselves in the open policy room. This is clearly illustrated by the State of California, which has established a reputation as a frontrunner in climate change policy due to the number and stringency of climate change policies it has adopted. The strong successes of the bottom-up approach are not only illustrated by the formation of regional agreements, horizontal diffusion of the RPS policy tool and the increased number of climate action plans of states but also by the success of California to reduce emission/capita levels and the limited emission growth of California and the states of the Northeast in a national economy that shows large emission/capita levels and strong emission growth.

Both the bottom-up approach and the top-down approach show disparity in climate change mitigation effort, most notably shown in the EU by Spain and in the US by the states of the Southeast. The frontrunner reputation of Germany, California and the Northeast of the United States is justified, while the laggard status of Spain and the Southeast of the US also seems justified. The Member States of Poland and Hungary need more time to fully establish a reputation on this issue, as they so far mostly played the role of policy-taker and only recently began to design own climate change policy.

Both the bottom-up approach and the top-down approach seem to have difficulty in limiting emissions from the transportation sector. Out of the 27 Member States of the EU, only four managed CO2 emission reductions in 2005 compared to 1990, and of the fifty states in the US only two realised emission reductions in the transportation sector, illustrated in Appendix C (Energy Information Administration EIA, 2008; EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009). The combined effort of a bottom-up initiative of Germany in a top-down system in the form of eco-taxation on transportation fuels seems to have effect. Importantly, one of the main EU climate change policies regarding transportation is based on a voluntary agreement between the European Commission and the automobile industry. As the voluntary agreements on the federal level in the US have been shown to be ineffective as they are outpaced by economic and population growth (PCGCC, 2002) this might partly explain the EU failure to address the transportation sector effectively. Many new policies and measures are being introduced to limit emissions from the transportation sector (EC, 2009).
11.0 Recommendations

11.1. Recommendations for the United States

Federal involvement can come in many ways, and it will be difficult to determine the most effective options available to the US. Clearly, incorporating a top-down approach like the one of the EU directly into the bottom-up system of the US is unlikely to succeed. Instead, a federal approach is needed that strengthens the positive bottom-up effects such as state experimentation and innovation (Litz F. T., 2008; WRI, 2008; Rabe, 2006a) and pinpoint policy to a state’s specific characteristics (Weibust, 2009; Litz & Zyla, 2008), while eliminating the regulatory patchwork (Litz F. T., 2008; WRI, 2007) and the great disparity in action.

To achieve this end, several ideas can be proposed that can support each other. These ideas are extracted from this research and other sources and provide the following benefits: 1) minimum level of action in all fifty states, 2) substantial uniformity, 3) preservation of state authority and 4) flexibility (Litz & Zyla, 2008; Litz F. T., 2008).

First, federal climate change guidelines can be adopted. These guidelines should specify the policy range in which states can experiment. A federal guideline on RPS, for instance, could specify that all states need to adopt a RPS before a certain time, and that increasing targets need to be incorporated in the RPS in certain time frames. All states would then start to move in the same general direction, while state choice for aggressiveness is retained. This would provide a clear signal to the electric power industry, having clear renewable energy targets to work with.

Second, the introduction of a federal cap and trade mechanism such as the EU ETS should be incorporated. Litz and Zyla (2008) discuss this possibility extensively. It seems that a federal cap and trade mechanism that does not infringe on state authority is a good option. By distributing allowances to the states, like in the EU ETS to Member States, instead of directly to industries, state’s authority would be preserved. Especially if retirement of allowances after emission reduction on the state level would be allowed then states would still have options available to be lenient or strict on their industries, while the federal cap ensures substantial uniformity among all 50 states (Litz & Zyla, 2008).

Third, transportation is also a major issue in the bottom-up approach of the United States. Moreover, the great dependence on private transportation exacerbates this issue. Addressing this from a bottom-up perspective needs to be simplified, as current difficulties to impose stricter standards on exhaust emissions restrict state room to experiment with regulations. Like the EU, additional attention needs to be paid to demand side policies and measures, and the mode of transport portfolio needs to be increased.

11.2. Recommendations for the European Union

First, transportation is a major issue in the top-down approach of the EU. Expected transportation increases over the future are likely to increase this emission source (EEA, 2008). EU policies have so far focused on improving vehicle technology (voluntary agreements of 1999 and 2000) and fuel (Bio fuels Directive 2003/30/EC and Directive 1998/70/EC) while trends and projections show that these have not been effective enough. The fundamental problem is the increased demand for transportation and measures and policies should also address transportation demand. Germany’s eco-taxation of transportation fuels appears to have results, as it is one of the few countries that managed emission reductions in the transportation sector. Additionally, the auto-
motive industry eventually needs to move towards low- or zero emission vehicles, and certain policy needs to be created to support that aim. Experience with the Californian ZEV-program, that realized some initial successes, needs to be incorporated in such a policy effort.

Second, emission increases were allowed for five countries in the EU-15, and in the EU-12 two countries did not receive emission reduction targets due to economic development reasons (EEA, 2009a). In the EU-15 four of the countries with allowed increases contributed dramatically to overall EU-15 emissions increases since 1990. Spain, Portugal and Ireland overshot their target dramatically, while Greece barely managed to stay within their 25 % allowed increase. This indicates that special attention needs to be directed to the decoupling of emission growth rates from economic growth rates in these countries. In the EU-12 the two countries that did not receive targets were Malta and Cyprus, increasing emissions 45.7 % and 85.3 % respectively. Although these countries represent insignificant amounts of emissions compared to the other Member States (EEA, 2009a), it might indicate that some target setting is required to ensure Member State attention to emission levels. Additionally, the EU is relying for a main part on Eastern European reductions and additional EU-15 reductions need to be realized in the future.

11.3. Recommendations for further research

Most importantly, the investigation is based on a CO2 emission trend of fifteen years while most policies have not been in effect for the majority of the emission trend analysed. Further research needs to be done with a longer emission trend that constitutes a longer policy timeline. To have a significant policy timeline this research needs to be repeated around 2015. A 1990-2015 timeline would incorporate a ten year period with limited climate change policy and a fifteen year period with a (expected) much higher climate change policy effort. More time for the policies to take effect and the increased policy effort over time make a follow-up analysis more conclusive as the increased policy effort is expected to lead to far more significant results (Lutsey & Sperling, 2007; EC, 2009; Poland, 2010; Hungary, 2009).

Second, the investigation limits the focus to CO2, excluding the other GHG. This might compromise the conclusions about the effectiveness of the two approaches. It is possible that the bottom-up approach or the top-down approach is especially effective on a specific GHG, which would be valuable information to policy makers.

Third, extending the research to all fifty states and all 27 Member States of the EU might strengthen the conclusions drawn. Analyzing how many states have no significant climate change policy in effect, the general start of climate change policy in the states, and the concurrent emission trend might yield interesting results as to the efficacy of the bottom-up and top-down approaches.

Fourth, it is possible that the true bottom-up characteristics of the United States are formed by the levels of government lower than the state level such as the city, metropolitan or local level. Additionally, the local level in the EU might influence Member State level policies in the same way. Therefore, further research should include the local level of government into the analysis to determine the full vertical authority ladder.

Finally, the establishment of a business as usual scenario from 1990 onwards would surely be valuable. As 1990 is the Kyoto Protocol base year, and not much climate change policy was in effect at the time, a emission trend from 1990 onwards that simulates a scenario in which no climate change policy was in effect illustrates the climate change mitigation effort of the US and the EU much better than the extrapolation scenario used in this investigation.
Bibliography


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Appendix A: Detailed theoretical framework of the origin of difference in approach to climate change between the United States and the European Union

How did the environmental policy in both the EU and the US evolve over time? Has the power balance between state governments and the federal government been stable throughout history? The section is intended as a background to the rest of the research and consists mainly of an elaboration on the environmental policy development of the US and the EU. Next to that, the historical background and the characteristics of the American and European people are discussed. These topics provide possible causes for the difference in approach used to address climate change.

Historical background US

The formation of the US begins with the American Revolution. The American Revolution started due to King George the 3rd’s attempt to impose duties on the thirteen British colonies without the colonies representation in government (Hames & Rae, 1996, p. 10). The American Revolution resulted in the Declaration of Independence in 1776, and the formation of the first Constitution with the articles of Confederation. The articles of confederation deliberately created a weak central government: a federal congress of independent states rather than a national government preeminent over them. The central arguments of the constitutional debate were not over environmental issues but over representation in government and the power balance between state and national government (Andrews, 2006, p.58). The Confederation proved to be too weak, especially because of its lack of power to raise taxes, and after thirteen years a new Constitution was adopted with a stronger federal government (Horsman, 2000, p. 4).

The consensus among the founding elite of the Constitution eventually broke down over two issues: how to deal with foreign policy, especially the relations with France and Britain, and the power balance between state and federal government (Hames and Rae, 1996, p14). Great fear existed among the states that the federal government would get too powerful. The tenth amendment to the bill of rights was included to reassure states that their powers were not to be consumed by the new national government (Horsman, 1999, p. 10). The 10th amendment states that those powers not specifically given to the federal government by the Constitution were reserved to the states or the people (Horsman, 1999, p. 22).

The Jacksonian democracy under Andrew Jackson promoted, among others, a stronger presidency and executive branch at the expense of Congress. The fundamental principle of the Jacksonian democracy was creating more state rights as opposed to a strong federal government (Hames and Rae, 1996, p.14). In 1902 Theodore Roosevelt introduced a radically new philosophy of national governance called Progressivism (Andrews, 2006, p.137). In 1932 the introduction of the New Deal to attempt to end the Great Depression resulted in an expansion of the federal government’s responsibilities over the whole range of economic and domestic policy (Hames and Rae, 1996, p. 21). Progressivism and its New Deal successor greatly enlarged the role of federal government, from merely administering a privatization process to actively managing the environment (Andrews, 2006, p.137).

Historical background EU

“In the beginning, there was the Second World War” as Jost Dulffer put it is one way to start the history of the European Union (Dulffer, 2009, p. 18). Even though visionary scholars, such as Saint Simon, already envisioned a union of European nations, the formation of the Union started
after the Second World War (EU, Europa in 12 lessen [Europe in 12 lessons], 2010a). The unprecedented suffering and devastation initiated European integration.

It was, however, by no means the only factor fundamental to the transformation of Europe. Economic and political factors were also important contributors. Nugent (Nugent, 2006, p. 14) recognises four political areas that greatly contributed to the transformation, and furthermore identifies economic factors that led to increased cooperation between the nations. After the War, the political map of Europe was redrawn and Europe became divided into democratic Western Europe and communist Eastern Europe. The western nations turned to cooperation in fear of being usurped by communism. Secondly, the strong nationalism displayed by the nations before the war was seen as one of the major initiating factors of the War and therefore needed to be addressed. Intergovernmental cooperation and treaties were put into place to reduce the nationalism of the member states. Thirdly, as the power balance had shifted to a USA – Soviet Union balance in which Europe was caught in between, cooperation between the nations was needed to realise a more powerful Europe able to withstand the two superpowers. Finally, as Germany was seen as one of the main initiators of the both World Wars, the western nations needed to contain this apparently inherently aggressive nation. To restrain Germany, treaties of cooperation were put into place.

Additionally, there were a number of economic reasons that led to first cooperation and later integration between the Western European nations. Europe was left in ruins after the War and required economic assistance. The economic assistance came from the USA, in form of the Marshall Aid. The Marshall Aid program was provided as long as the Western nations promoted greater economic cooperation among themselves. Furthermore, the Bretton Woods conference led to the formation of the International Monetary Fund (IMF) and the World Bank (WB). Other economic institutions such as the General Agreement on Tariffs and Trade (GATT), which later became the World Trade Organization (WTO), and the Organization for European Economic Cooperation (OEEC), which later became the Organization for Economic Cooperation and Development (OECD), further create economic incentives for cooperation.

These political and economic factors led to the post-war transformation of Western-Europe. The first intergovernmental institution, the Council of Europe, was erected in 1949. Shortly after that, six nations went one step further and formed the European Coal and Steel Community (ECSC) in 1951. As the name implies, the ECSC governed the flows of coal and steel between these nations. Coal and steel are the main resources for war, and the ECSC had to make sure that none of the six nations would be able to stockpile significant amounts of these two resources. The Treaty of Rome in 1957 supplements the ECSC by adding additional sectors, and further resulted in the European Economic Community (EEC) and the European Atomic Energy Community (EURATOM). Further treaties that aim at further integration are signed in the following decades. The EU expands to reach 27 member states in 2007, with additional candidate member states on the waiting list. For the first decades, the EU is directed by western European nations. But after 1989 and the fall of the Berlin Wall and the subsequent fall of communism in eastern Europe, west and east are once again joined and many of the eastern nations join the EU.

Nugent (2006, p. 8) identifies three principal aspects of the post-war transformation. The first, and most important, is the unbroken peace between the member states since the start of the formation. Secondly, the transformed political agenda is another major aspect of the post-war transformation. The political agenda now includes issues related to wealth and welfare of the population of the EU, while before it concentrated on issues such as sovereignty and independence. Fi-

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13 The six starting nations were Belgium, France, West-Germany, Italy, Luxembourg and the Netherlands.
nally, new processes and channels for international communication have been put into place, no longer focusing only on the foreign affairs ministers.

Environmental policy development US

Early environmental policies, between 1776 and 1790, of the US were not established in separate laws or by a separate agency, but were elements in a broader process of solving the political, social and economic problems of the new nation. Environmental policies were shaped primarily by military demands (Andrews, 2006, p. 51). Progressivism, under President Theodore Roosevelt, fundamentally reshaped the character of American environmental policy (Andrews, 2006, p. 152). In Roosevelt’s view federal government should be an active force to achieve the public interest. The onset of World War I (WW1) greatly reduced American environmental policy, and left in its wake a great desire to restart the economy which sidetracked environmental policy (Andrews, 2006, p. 154).

The stock market crash in 1929 causing the Great Depression once again altered the policy context. Franklin D. Roosevelt responded with a strong reaffirmation of government leadership in managing the environment and the economy through the New Deal (Andrews, 2006, p. 155). From an environmental as well as a social reform point of view, both Congress and the President were for the first time simultaneously supportive of strong federal policies (Futrell, 1993, p.31). Environmental policy initiatives were explicit elements of the interventionist approach of the federal government, which is illustrated by the creation of the Civilian Conservation Corps (Andrews, 2006, p. 162). World War 2 plunged the country into war mobilization once again, this time in an even stronger way than during WW1. All-out industrialization towards the goal of winning the war was employed. In the post-war boom era, where the US economy grew rapidly and strongly and which led to the economy of mass consumption, public consensus on the appropriate role and goals of government fragmented once again (Andrews, 2006, p. 179). As post-war economic prosperity and general affluence surged, powerful new political conflicts began to develop between environmental conservation and protection on the one hand, and advocates of production and technological transformation on the other (Andrews, 2006, p. 201).


After being elected in 1980, Ronald Reagan attempted a drastic rollback of federal environmental regulation to shift more power to the state governments (Kramer, 2004, p. 56). Due to a strong public backlash actual deregulation failed, but Reagan did manage to drastically reduce funding
to the federal agencies (Andrews, 2006, p.256). During Reagan’s presidency, the US systematically retreated from international leadership on environmental issues. While President George H. W. Bush initially softened Reagan’s stance, he began to distance himself from environmental issues generally and international environmental issues in particular by 1990 (Andrews, 2006, p. 331). By the 1990’s all the defining features of the environmental era came under severe counter-attack. The election of Bill Clinton in 1992 raised expectations that the US would return to vigorous presidential leadership in environmental policy, but the 1994 Congressional elections swept into office a ideologically conservative Republican majority which sought “systematically to nullify federal environmental protection measures” (Andrews, 2006,p.351-354). Most recently, with the Presidency of George W. Bush, starting in 2000, the US publicly renounced its leadership in international environmental policy making, by declaring the Kyoto Protocol ‘dead’ and refusing to ratify the protocol (Andrews, 2006, p.351).

Environmental policy development EU

When the European Economic Community (EEC) was founded on 25th March 1957 the EEC had no environmental policy, no environmental bureaucracy and no environmental laws. The EU as it was then was concerned with boosting economic prosperity and repairing political relations in war-torn Europe. The EU nowadays has some of the most progressive environmental policy of any state in the world (Jordan, 2002, p. 1).

The overriding objective of the EU during the time of its conception until 1972, the year in which the Paris Summit calls for an environmental blue print for the EU, was to harmonize laws in order to abolish trade impediments between the member states (Hildebrand, 2002, p. 16). The primary aim of the founding fathers was to establish a common market in which goods, services, people and capital could move freely. During this phase environmental legislation was subject to two restrictions. First, there were no explicit formal legal provisions to support any EU wide environmental legislation. Second, whatever action could be taken under the available general provisions had to be directly related to the objective of economic and community harmonization (McGrory, 1990, p.304). McGrory concludes that environmental legislation during this period was ‘incidental’ to overriding economic objectives. Legislation with an environmental character was adopted during this period, but was mostly with economic interests in mind. For instance, in 1967 a directive was issued that established a uniform system of classification, labelling and packaging of dangerous substances. This leads Hildebrand to conclude that: ‘while environmental measures were not altogether absent during the first 15 years of the EC’s history, they cannot be regarded as adding up to any sort of proper and coherent policy’ (Hildebrand, 2002, p. 18).

After the Paris Summit of 1972, a European environmental policy framework is beginning to emerge. This is caused by an upswing in worldwide environmental concern during the 1970’s. Juliet Lodge points out that the Member States’ interest in an EU environmental policy was ‘spurred not so much by an upsurge of post-industrial values and the Member States’ endeavours to create a Human Union […] as by the realization that widely differing national rules on industrial pollution could distort competition: dirty states could profit economically by being slack’ (Lodge, 1989, p. 320).The summit called for an official EU environmental blueprint. This resulted in the adoption of the First Community Action Program on the Environment which had the objective ‘to improve the quality of life, and the surroundings and living conditions of the

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14 Article 3 of the Treaty of Rome
16 OJ No. C112, 20.12.73
Community population. To be able to achieve this objective 11 principles were adopted. Three key principles of the program require extra attention. First, the program placed emphasis on preventive action. Second, the polluter pays principle was introduced. Third, the program states that ‘for each different type of pollution, it is necessary to establish the level of action’ befitting the type of pollution and the geographical zone to be protected (Hildebrand, 2002, p. 19). The first program was subsequently followed by a second program in 1976, a third program in 1983 and a fourth program in 1987. While the second program was an expansion to the first program, it was the third program that introduced key new provisions. Especially, the third program recognized that the common environmental policy is now motivated by the observation that environmental resources are the basis of, and constitute the limit to, further economic and social development and the improvement of living conditions. This essentially was the first attempt to remove the subordination of environmental concerns compared to the economic common market (Hildebrand, 2002, p. 20). The third action program on the environment resulted in a significant increase in terms of environmental legislation. Between 1943 and the adoption of the Single European Act in 1985, over 40 directives, eight decisions and ten regulations were adopted by the Council (Hildebrand, 2002, p.20).

The introduction of the Single European Act (SEA) marks a new phase in EU environmental policy. The SEA provided a legal basis for EU wide environmental provisions by establishing Title VII on the Environment in the new EEC Treaty (Hildebrand, 2002, p. 25). Further, the SEA affected environmental policy by introducing institutional changes, realizing the completion of the EU internal market and through the new legal provisions that actually define Community environmental policy (Haigh and Baldock, 1989, p. 12). The main institutional changes are the introduction of the co-operation procedure and the introduction of the qualified majority voting in environmental issues. The co-operation procedure is designed to give the Parliament a role in the legislative process (Lodge, 1989, p. 69). The role is limited in that it only applies when a vote is taken in the Council by qualified majority voting (Hildebrand, 2002, p. 27). The co-operation procedure was included to increase democratic impact on the process of policy formation. Through the Parliament the peoples of the European Union effectively have an impact on the environmental policy process. The introduction of qualified majority voting into environmental issues substitutes in some instances unanimity voting, and thus ensures a greater possibility of the legislation to pass.

The SEA introduces articles 100a and 100b in order to achieve the objective of completion of the internal market by 1992 (Hildebrand, 2002, p. 28). These articles concern the harmonization of national laws, including environmental laws. Article 100a(3) states that a ‘high level of protection’ in the harmonization efforts should be taken. Article 100a(4) allows Member States to apply more stringent national environmental regulations when certain conditions are met. Article 100b requires the Community to create an inventory of all national measures which have not yet been harmonized. The Council then needs to decide which of these can be recognized as equivalent and all others have to be harmonized at that point (Haigh and Baldock, 1989, p. 18). These harmonization measures have an effect on environmental policy to the extent that most environmental protection standards that affect the functioning of the EU internal market will be set at the EU level (Hildebrand, 2002, p. 28).

The inclusion of the Title VII on the Environment into the new EEC Treaty affected EU environmental policy in a number of ways. Hildebrand (2002, p. 29) identifies five main impacts of which three are discussed here. First, the Title VII has given symbolic importance to environmental protection policy. Second, the Community environmental objectives outlined in the Title

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17 OJ No. C112, 20.12.73 p. 5
VII are sufficiently broad to bring almost any environmental issue within the competence of the Community legislation. Finally, the Title VII lays down the principle of subsidiarity which determines whether action is to be taken at the Community or at the Member States level.

In December 1988 the Heads of State and Government realized the progressive character of EU environmental policy and they issued a Declaration on the Environment (Wilkinson, 2002, p. 38). The Declaration states that ‘sustainable development must be one of the overriding principles of all Community policies’. The Maastricht Treaty on the European Union of 1992 introduced for the first time the precautionary principle into the Community’s environmental policy, in addition to the 11 principles mentioned earlier (Wilkinson, 2002, p. 39). The Treaty further elaborates on the qualified majority voting and stipulates where unanimity voting is required. The areas of provisions of a fiscal nature, town and country planning, land use and the management of water resources, measures significantly affecting a Member States choice between different energy sources and the general structure of its energy supply are areas in which unanimity voting is required (Wilkinson, 2002, p. 43). The Amsterdam treaty of 1997 introduces sustainable development as a fundamental objective of the EU (Jordan, 2002, p. 55).

Jordan (2002, p. 1) recognizes three puzzling characteristics of the EU regarding environmental policy. First, Jordan identifies the remarkable capacity for steady growth of Community environmental policy. The EU environmental policy has been largely unaffected by the political and economic vicissitudes (Jordan, 2002, p.1). The second puzzling characteristic identified by Jordan is that EU environmental policy now adds up to considerably more than the sum of the national environmental policies. The EU currently enjoys powers that are normally the sole preserve of states (Jordan, 2002, p.2). Finally, the pre-existing environmental policies of the Member States are no longer politically or legally separate from EU environmental policy.

The history of the development of environmental policy in the European Union shows a trend towards increased environmental protection and a greater role for the Commission in environmental policy. The top-down characteristics of the EU were beginning to unfold with the adoption of the SEA, providing a legal basis for EU-wide environmental policy.

**American individualism**

One school of thought on the American character and identity is based on the Frontier Thesis by Frederick Jackson Turner in 1893. It is by no means the only one, nor the most accurate one, as the thesis has been disputed from many sides over time. However, the ideas put forward in Turner’s Frontier Thesis propose an interesting insight into the characteristics of the American people and might indicate some of the origins of the approach used by the US today when addressing climate change.

The most important proposition put forward in Turner’s Thesis is that ‘the advance of American settlement westward’ which moved the frontier ever westward ‘explains American development’ (Turner, 1893). Turner argues that the three centuries long exploration of the frontier not only shaped American development, but it was also the source of American character and identity (Walsh, 1981, p. 12). Indeed, ‘the frontier is the line of most rapid and effective Americanization’ (Turner, 1893). Immigrants arriving from Europe were all still used to the European frame of mind of that time. The exploration of the frontier led to the constant breaking with the old customs of Europe and to new experiences. The old customs and governmental arrangements of Europe were impractical in the large undeveloped west of the US. The process of constantly moving west, and breaking with the old customs of Europe defined the new character of the American. Turner concludes that the process of expansion and exploration resulted in a strong individualism and desire of freedom. Furthermore, Hames and Rae (p.48) state that dislike and distrust of government in general has also been an abiding element of the American frame of mind. This
distrust and dislike was further reinforced by the ‘Frontier mentality rooted in the availability of free land and the desire to escape authority’ (Hames and Rae, 1996, p. 48).

The notion of a strong individualism and desire of freedom are illustrated in the lack of a major socialist or social democratic party in US history. According to Hames and Rae (1996, p.50), the fundamental reason for the failure of any socialist or social democratic party was that “its egalitarian ideology and the mass organization, discipline and concentration of governmental power necessary to achieve its ends were incompatible with the individualism, and the concomitant suspicion of governmental power’. In other words, the amount of federal governmental power required was too high to lead to any socialist movement in the USA.

European frame of mind towards cooperation

A long history of separated nations within Europe, with changing borders and continued struggles and wars between the states, ensures that no single European mentality exists. Since the formation of the European Union more integration between the peoples of Europe has become possible. Today, the main characteristic of the European frame of mind is the desire to avoid war between the nations of the EU. Of course, many struggles between the member states of the European Union do exist, but are increasingly solved through cooperation and diplomacy. Debates about the further expansion of the EU are fierce, but the overall tendency of the EU is one of more and more integration and cooperation between the member states.

Separation of power in the US- the federal government

The power in the federal government of the US is separated over three branches: the Executive branch, the Judicial branch, and the Legislative branch. This basic framework of American government is still much the same as it was in the 1780’s. According to Hames and Rae, the fundamental principles of, among others, limited government and the protection of guaranteed human rights against governmental encroachment still apply (Hames & Rae, 1996, p. 66). The federal government is mainly responsible for foreign policy, the military and tax collection.

The power of the Executive branch is vested in the President of the US. The President has certain constitutional powers such as the right to veto congressional legislation and to recommend legislation to Congress. Originally the political powers of the President were very limited, but the developments of the twentieth century, such as WW1 and WW2, the Great Depression and the Vietnam War resulted in a stronger presidency (Hames & Rae, 1996, p. 75).

The Legislative branch consists of Congress and has two important Constitutional powers: the power of the purse and the power to declare war. The Congress consists of the Senate and the House of Representatives. The Senate was intended to represent the states and therefore limit the influence of the President on policy (Hames & Rae, 1996, p. 94). The Senators of the Senate must give advice and consent to Presidential appointments of ambassadors and judges. The House of Representatives must introduce any bills for the purpose of generating revenue (Hames & Rae, 1996, p. 94)

The Judicial branch has the Supreme Court as the main court of the US. The main power of the Supreme Court is to declare legislation or executive action to be unconstitutional.
Separation of power in the US - the states of the United States

Excluding foreign policy, the military and tax collection, most other powers are awarded to the states. All of the states of the US have their own Constitution, Bill of Rights and State Supreme Court (Hames & Rae, 1996, p. 147). The power division between state and federal government has shifted many times during the history of the US. During the last thirty years, more and more power has been assigned to the states. This leads Hames and Rae to the conclusion that: “The continued powers and importance of state and local governments is probably the single most understated element of modern American politics” (Hames & Rae, 1996, p. 139).

Regulation enforcement against pollution in the US by the federal government can only be done through legal action directly against polluters and by encouraging local parties to bring litigation against state governments and polluters; the federal government is prohibited from commandeering the administrative apparatus of the states to implement the policies (Keleman, 2004, p. 123). In other words, while the US may pressure states to implement federal programs, the US federal government is not allowed to directly compel states to administer a federal program.

Separation of power in the EU - supranational level of government in the EU

Much like the US, the EU-wide level of government is composed of three pillars: the European Community, the Common Foreign and Security Policy (CFSP) and Justice and Home Affairs (NATO, 2001).

The European Community is the legal framework for community policies relating to a wide variety of areas, one of which is the environment. These three pillars are governed by a single institutional framework. The main institutions for this framework are: the European Parliament, the European Commission and the Council of the European Union (EU, 2010b). Many other important institutions exist, such as the Court of Justice and the Court of Auditors, but their function falls outside the scope of this research.

Since 1979, the members of the European Parliament (‘Parliament’) are elected by the citizens of the EU. The most important powers of the Parliament fall into three categories. Firstly, the Parliament has the power to pass legislation, jointly with the Council of the European Union (‘Council’). Adopting new legislation is based on the co-decision procedure between the Parliament and the Council. Secondly, the Parliament exercises supervision over the other institutions of the EU, especially over the European Commission (‘Commission’). Finally, the Parliament shares with the Council the authority over the EU budget (Euroguide, 2005).

The Council is the EU’s main decision making body. The configuration of the Council differs with the subjects on the agenda for the Council meeting. There are nine different Council configurations, one of which is the Environment Council. The ministers in the Council represent their member state, and are empowered to commit their government. The Council has six key responsibilities: to pass legislation, to coordinate broad economic policies of the member states, to conclude international agreements, to approve the EU budget, to develop the EU’s CFSP and to coordinate cooperation between the national courts and police forces (Euroguide, 2005).

The Commission is independent of national governments. It represents the EU as a whole. The Commission is the executive arm of the EU institutions; it is responsible for implementing the decisions of Parliament and the Council. Four main roles of the Commission can be distinguished: to propose legislation to the Parliament and the Council, to manage and to implement
EU policies and the EU budget, to enforce European law and to represent the EU on the international stage (Euroguide, 2005).

Enforcement of pollution regulation in the EU differs from that in the US. The EU relies primarily on enforcement action against member states (Keleman, 2004, p.121). The EU is allowed to use litigation against member states through the infringement procedure to ensure implementation of EU regulation (Keleman, 2004, p. 123). Many infringement cases have severely restricted the discretion of the member states of the EU.

Concluding remarks

The EU has since its conception been moving towards a greater level of integration and more centralized environmental policy. With the arrival of the SEA and the Maastricht Treaty the EU has explicitly stated that the protection of the environment should be of a high level within the EU. The US has over time been moving towards a stronger role for the federal government in environmental issues, which reached its peak during the environmental era in the 1970s. The US has more recently been moving towards decentralization and a retreat from the international stage concerning environmental issues. This has led to a divergence between the two political entities. Since 1989 when the EC imposed a total ban on growth hormone fed beef, it has become almost a constant trend to see more and more legislation being planned or adopted in Europe that sets higher standards to protect health or the environment than the US (Christoforou, p.3). Power in the US has been shifting towards the states, either because of actual deregulation at the federal level or because of inaction at the federal level due to defunding.

The historical background of both political entities shows that the power balance in any government is of importance. Overall, the EU has been able to shift much of the power originally left to the states towards the centralized authority. The power balance during US history has been shifting back and forth between the federal and states level, most recently a shift towards the state level is occurring. The individualism defined by Turner and the overall suspicion towards strong central government among the American people might have supported the bottom-up developments. In contrast, while there is not (yet) any real European mentality, the integration and cooperation process seems to have created willingness to further cooperation.

Especially the enforcement of regulation concerning pollution is different between the US and the EU. While the US on a federal level is heavily restricted in its actions to enforce its environmental regulations, the EU is much more capable to ensure implementation and execution of EU regulation.
Appendix B: Overview of the discussion about centralization or decentralization of policies with a special focus on climate change; quantification of effects of US state actions on predicted GHG emissions

This appendix serves as a theoretical background discussion to this investigation. Arguments for or against decentralization and centralization of policy are given, with special attention to climate change. Also, current state climate change policy is quantified as regards their effects on predicted GHG emission rates.

Case for decentralization

The goal of subsidiarity of the EU, which states that issues should be addressed by the lowest appropriate level of governance, is a clear example of a decentralized approach. The case for a decentralized approach to environmental problems is analysed by Weibust and she identifies several arguments and claims made for decentralization. These arguments and claims fall into six categories: information, preference aggregation, representation and responsiveness, efficiency/effectiveness, innovation and experimentation and legitimacy (Weibust, 2009, p. 11).

The arguments about information are threefold. First, lower levels of government have better knowledge of local preferences. Second, smaller jurisdictions have more accurate information about local conditions. Finally, smaller jurisdictions and ranges of legislation are easier to monitor. The second category of preference aggregation claims that decentralization leads to greater allocated efficiency because the goods provided by government reflect local preferences (Weibust, 2009, p. 13). In other words, the smaller the jurisdiction the more homogenous the population, resulting in policy that better reflects the population. Weibust concludes on this issue that there is not enough data to validate or reject this argument, and that more research is required. The third category of representation and responsiveness identified by Weibust is based on the perceived level of democracy in more decentralized systems. This is much in line with the second category as the claim made here is that smaller governments are more responsive to public opinion. Weibust argues that the example of the New England town meeting shows that this is not necessarily so19. The fourth claim is that lower levels of government are more efficient and effective. The validity of this claim depends on the type of good the policy regards to, and Weibust concludes that for environmental issues there are advantages to centralized government.

The fifth category claims that federalism is beneficial because it is more innovative; ‘it creates a multiplicity of natural laboratories, which allow for local innovations’ (Weibust, 2009, p.21). It is argued that because there are many more points of decision-making, there will be a greater variety of approaches. Weibust argues that there is very little evidence in environmental regulation to support this claim, and that even the opposite might be true. The final category about legitimacy is derived from the notion that a lower level of government receives a higher level of trust and a closer emotional identification by its constituencies. Weibust finds that although greater trust seems to be put in state governments, the ‘majority of Americans polled still wanted the federal government to have greater powers than the states for certain policy areas’ including the environment (Weibust, 2009, p.23).

19 Based on research performed by Joseph Zimmerman (1999); The New England town meeting: democracy in action, p. 95, p.165.
Case for centralization

In environmental issues, much centralization has occurred throughout the 20th century. Air and water pollution that were once considered purely local management issues, are now increasingly discussed on the higher governmental levels. In much the same way as the case for decentralization, Weibust identifies some arguments for centralization of policy in environmental issues. Drawing on literature in the finance sector, Weibust argues that one of the conditions to make local standard-setting efficient is when the effects of the pollution remain predominantly within the locality. In other words, no spillover effects should occur. Related to environmental issues this makes efficient decentralization unlikely as most major environmental problems are not restricted by local borders. Furthermore, Weibust discusses that higher levels of government realize economies of scale with greater expertise or resources.

Next to these arguments, Weibust investigates the effectiveness of centralization and decentralization using three federations with different levels of centralization: Switzerland, Canada and the US. She finds that the more centralized US reaches higher standards of protection in environmental issues than the less centralized Switzerland and the much less centralized Canada (Weibust, 2009, p. 191). Weibust concludes that decentralized environmental governance in the US, prior to more centralized governance, was not effective in the US. It was not until federal government set minimum standards that environmental protection was established at a high level. In the Canadian case, provinces have great flexibility in establishing standards regarding environmental protection. Weibust investigates whether this might lead to a race to the bottom through competition with standards, and concludes that there are no signs of a race. However, ‘rather than racing to the bottom, standards remain stuck at the bottom’ (Weibust, 2009, p.171). This statement shows that environmental protection is not necessarily used as a competition tool between provinces but also that decentralization does not seem to benefit the level of environmental protection. In a strongly decentralized system, with no federal minimum standards, there is no first-mover advantage. Weibust further found that once centralization of environmental regulation began in Switzerland environmental quality in Switzerland improved dramatically (p. 192). This leads Weibust to the conclusion that in the case of environmental regulation in general centralization will result in a higher level of protection of the environment and should thus be preferred over decentralization.

Interestingly, industries sometimes seem to prefer centralization of environmental protection in the form of minimum standards. For example, President Reagan refused to establish a national standard for household appliances in the early 1980’s. In response, many states started to develop their own standards. The household appliance manufacturers were concerned about their ability to market their products nationwide and prodded Congress to act, resulting in the establishment of a national standard (Rabe, 2004, p. 158). Industries seem to prefer a national uniform standard than fifty different state standards.

Level of governance in climate change

For the most part, the arguments mentioned in the previous section also apply to climate change. For instance, the innovation aspect of many different approaches by the different states can certainly be desirable regarding the issue of climate change. However, some extra arguments can be made for centralization of climate change regulation as the issue of climate change differs from the more common environmental issues that Weibust discusses. Most importantly the issue of

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20 Based on research performed by William Baumol and Wallace Oates (1988); The theory of environmental policy, p.295
climate change is a global issue, with emissions from one place resulting in effects somewhere else. Next to that, climate change is caused by many different sectors and is therefore difficult to address comprehensively. This raises the question whether the level of governance needed is different than with general environmental issues.

Reacting to the issue of climate change on a federal or highest level of government platform can establish an international discussion basis (Litz F. T., 2008). Due to the global perspective of climate change it is important that all major emitters of GHG’s respond. Effectuating a federal response, especially in the case of the US, would send a strong signal to the other major emitters and would make them more likely to follow. This is illustrated by the debate on climate change at the start of President George W. Bush presidency. The decision not to ratify the Kyoto Protocol by the US, the major emitter at the time, led the administration to believe that the Protocol was ‘dead’ (Schreurs, 2004, p. 209). Presumably, the administration reasoned that the other major emitters would not be able to realize the ratification threshold. But, due to the subsequently strong response by the EU to decisively go ahead with the Kyoto Protocol and enticing the other major emitters to also ratify the Protocol. A strong federal or highest level of government improves the negotiation position to ensure effective global climate action.

One of the major tools being used right now to address climate change is the cap and trade emissions program. This establishes a GHG trading market on which emitters can buy and sell GHG allowances. Experience with earlier cap and trade programs have established it as an effective tool to cut emissions. To address climate change effectively with this tool, it requires as broad a GHG market as possible (Litz F. T., 2008). Therefore, centralization of climate change regulation on the federal level and establishment of a national GHG cap and trade system would be more effective than state or regional cap and trade systems. In Litz’s analysis of US climate change policy, he further states that the challenge of climate change requires the efforts of all fifty states. Currently, substantial gaps exist because not all states address climate change. Moreover, Litz argues that inclusion of all states would level the playing field for businesses and would minimize leakage21.

These climate change specific arguments show that some kind of federal or highest level of government action is desirable. However, this certainly does not exclude states or member states roles in addressing climate change. Litz argues that a shared responsibility approach in which the US federal government sets minimum standards for all fifty states but leaves room for state innovation and experimentation might be the best option.

Quantification of effects of state actions on predicted GHG emission trend

Although this research is based on the historical aspects of the bottom-up characteristics of the US, as it specifically addresses the period 1990-2005, extra information can be derived from the predicted effects of climate change policy. Moreover, it is found that US state involvement is increasing strongly over time, increasing the effects of the policies on the GHG emission trend (Lutsey & Sperling, 2007; Byrne et al., 2007; Rabe, 2004; PCGCC, 2008.)

Lutsey & Sperling inventoried and analysed the local, state, and regional policy actions in the US in order to determine their potential effect on US future GHG emissions (Lutsey & Sperling, 2007). They conclude that when all existing sub-national policies are realized [as of September 2007] fifty-three percent of the 2007 US population would be involved covering 43 % of US GHG emissions and that US emissions could be stabilized at 2010 levels in 2020 (Lutsey & Sperling, 2007).

21 Leakage is the result of shifts in production from areas with stringent policies to areas without policies.
Table 15. Different scenario’s of Lutsey & Sperling’ investigation. The baseline scenario is calculated with the use of forecasts made by the EIA Annual Energy Outlook 2007. The data presented in this table is derived from 2007 data as used by Lutsey & Sperling. Source: Lutsey & Sperling, 2007.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Areas of GHG reductions</th>
<th>2020 emissions (MMT CO₂-e)</th>
<th>2020 reduction (MMT CO₂-e)</th>
<th>% reduction from baseline</th>
<th>% of reductions to meet 1990 emissions level in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline—no state GHG reduction targets achieved (US EIA, 2007)</td>
<td>None</td>
<td>8146</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Target-setting cities reach 7% below 1990 GHG levels by 2012</td>
<td>684 US cities representing 26% of the US population</td>
<td>7549</td>
<td>597</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Target-setting states achieve their target reductions</td>
<td>17 US states representing 45% of US population</td>
<td>7418</td>
<td>728</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>Target-setting cities and states reach GHG target reductions</td>
<td>17 states plus the 284 cities that are not in the 17 target setting states</td>
<td>7168</td>
<td>1041</td>
<td>13</td>
<td>47</td>
</tr>
<tr>
<td>US 1990 GHG emissions</td>
<td>–</td>
<td>5910</td>
<td>2237</td>
<td>27</td>
<td>100</td>
</tr>
</tbody>
</table>

The results of Lutsey & Sperling illustrate the effects the bottom-up actions of states and cities would have on the projected GHG emission trend of the US. It can be seen that when the states and cities both would reach their GHG set target reductions US GHG emissions would decrease with an estimated 13 %, which is calculated by Lutsey & Sperling to be 47 % of the needed reduction to meet 1990 emission levels in 2020 (Lutsey & Sperling, 2007).

Next to the state and city plans, Lutsey & Sperling also investigated the electricity and transportation sector separately as these sectors are the main contributors. They find that if the average renewable electricity standard [average of 2007] was adopted across all the fifty states of the US the impact would reduce baseline 2020 emissions from the electricity sector by 18 % (Lutsey & Sperling, 2007). Also, in case all fifty states of the US adopt the California vehicle and fuel GHG standards, the US light duty vehicle sector would experience an 18% reduction from the 2020 baseline (Lutsey and Sperling, 2007). Adoption of California’s standard by just the interested states, fifteen states in 2007, the US light duty vehicle sector GHG emissions would be reduced by 4 % from the 2020 baseline, eleven percent on its way to meet the 1990 level by 2020 target (Lutsey & Sperling, 2007).

Byrne et al., also aimed to quantify some of the effects of the state actions on climate change. For instance, Byrne et al. calculate that the combined effect of the regional cap and trade system of the northeast and the west coast would reduce emissions in those regions 21 % below the baseline scenario (Byrne et al., 2007). Next to that they calculated the combined effect of state energy...
efficiency policies, state renewable portfolio standards and the combined cap and trade systems of the north east and west coast to save 1822 Million Metric Tons (MMT) or a 64 % savings from the business as usual scenario in those regions (Byrne et al., 2007)

Concluding remarks

It is clear that good arguments exist both for the case of centralization and for decentralization of environmental regulation. The overall conclusion of Weibust is that centralization seems to be the more effective mechanism in environmental issues. The extra arguments for a centralized approach regarding climate change, and the cases of Canada and Switzerland that indicate that centralization is more effective do, however, suggest that centralization might be a more effective approach to climate change.

Quantifying the different actions by the states, as performed by Lutsey & Sperling, shows that considerable parts of the population and of US emissions are represented through the state actions. Even though many states of the US still are not very active on this issue, the body of states that do take action grows.
Appendix C: Extended (Member) State Analysis.

This section covers additional information relevant for understanding the (member) states under analysis in this investigation. The energy mix capacity of the states is illustrated to identify the reliance of the states on different energy sources, graphic representations of certain states’ climate change policies is included, as well as more specific emission trends of the states. The more specific emission trends provide additional information to the specific development of a sector over time. Specifically, the transportation development of Germany is shown, to illustrate the possible effect of the transportation policies, and the residential plus commercial sector development of California is given.

Appendix C1:
The energy mix of the US states shows that big differences exist between the states and their reliance on different energy sources. The figure illustrates the in-state electricity generating capacity. Especially Michigan and the South Eastern states show a high reliance on coal, while California and the New England sectors show a large reliance on natural gas.

Figure 18 A/D. The energy mix for electricity generation of the relevant US states. What is shown is the electricity generation capacity within the states, this is therefore not equal to the electricity used within
the state as part of it is exported and electricity from other states is imported. It does however give an indication of the importance of the different industries in the states. For instance, the coal industry can be determined as more important in Michigan and the South Eastern states as compared to California. Note that California's last resource differs from the other states; California has a 6% geothermal resource as opposed to biomass in the other states. Source: (EIA, 2010) retrieved at 5th of January 2010.

This difference might contribute to the willingness or reluctance of the states to address the issue of climate change. A high reliance on a much more polluting energy source such as coal might block attempts to introduce climate change mitigation strategies as this will severely affect these industries.

In the same manner figure 19 to 21 show the electricity mix of Germany, Spain and Hungary. If the coal dependency and climate change mitigation reluctance of the South Eastern states and Michigan are related, it is interesting to see that this reluctance does not seem to occur in Germany. Figure 19 shows that Germany also has a considerable electricity generating capacity that is derived from coal. The electricity mix of Hungary and Spain is much more mixed between the different energy sources.

![Electricity mix Germany](image)

Figure 20. The electricity mix of Spain. Source: (IEA, 2007) retrieved 5th of January 2010.

Appendix C2:
Table 16 and 17 illustrate the certain climate change policies of the New England states and Germany. This is background information to the investigation.

Table 16. Emission reduction targets and RPS standards that have been set by the New England states. Pursuant to RGGI and NEG-ECP are 1990 levels by 2010, 10% below 1990 by 2020 and 75-80% below 2001 levels in the long term. Vermont’s RPS standard is a de facto RPS because it does not set strict targets, only goals. RES-E stands for Renewable Energy Source –Electricity. NEG-ECP stands for New England Governors- Eastern Canadian Premiers. Source: Knudsen, 2009.

<table>
<thead>
<tr>
<th>State</th>
<th>Emission reduction target</th>
<th>RPS Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connecticut</td>
<td>10% below 1990 by 2020, and 80% below 2001 by 2050</td>
<td>27% by 2020</td>
</tr>
<tr>
<td>Maine</td>
<td>Pursuant to RGGI and NEG-ECP</td>
<td>10% additional by 2017 (30% as basic requirement)</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>10-25% below 1990 by 2020, 80% below 2001 by 2050</td>
<td>15% by 2020</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>Pursuant to RGGI and NEG-ECP</td>
<td>23.8% by 2025</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>Pursuant to RGGI and NEG-ECP</td>
<td>16% by 2020</td>
</tr>
<tr>
<td>Vermont</td>
<td>Pursuant to RGGI and NEG-ECP</td>
<td>Utilities required to provide RES-E equal to general load growth 2005-2012</td>
</tr>
</tbody>
</table>
Table 17. Germany’s primary policies for GHG reduction. (Weidner & Mez, German Climate Change Policy: A Success Story With Some Flaws, 2008).

<table>
<thead>
<tr>
<th>Sector</th>
<th>Initiative</th>
<th>Policy type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy/industry</td>
<td>Eco-Tax</td>
<td>Tax/regulatory</td>
</tr>
<tr>
<td></td>
<td>Renewable Energy Sources Act-Feed in Tariff</td>
<td>Subsidy/Regulatory</td>
</tr>
<tr>
<td></td>
<td>Emission cap and trade- EU ETS</td>
<td>Regulatory</td>
</tr>
<tr>
<td></td>
<td>Market incentive programs for renewable energy</td>
<td>Subsidy</td>
</tr>
<tr>
<td></td>
<td>Combined heat and power Act</td>
<td>Regulatory/Subsidy</td>
</tr>
<tr>
<td></td>
<td>Two voluntary agreements with industry</td>
<td>Voluntary</td>
</tr>
<tr>
<td></td>
<td>(automobile industry, high emission industry and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>power plants)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Federal energy research programme</td>
<td>Subsidy</td>
</tr>
<tr>
<td>Transportation</td>
<td>Eco-Tax</td>
<td>Tax/regulatory</td>
</tr>
<tr>
<td></td>
<td>Bio-fuel tax breaks</td>
<td>Subsidy/Regulatory</td>
</tr>
<tr>
<td></td>
<td>Exhaust emission standards</td>
<td>Regulatory/Tax</td>
</tr>
<tr>
<td>Households (buildings)</td>
<td>Energy savings ordinance for new buildings</td>
<td>Regulatory</td>
</tr>
<tr>
<td></td>
<td>Energy passport</td>
<td>Information/Regulatory</td>
</tr>
<tr>
<td></td>
<td>100.000 roofs programme (PV)</td>
<td>Subsidy</td>
</tr>
<tr>
<td></td>
<td>Financial incentive programme for buildings</td>
<td>Subsidy</td>
</tr>
<tr>
<td></td>
<td>Information programme for households</td>
<td>Information</td>
</tr>
<tr>
<td></td>
<td>Renewable energy Act- Heat</td>
<td>Regulatory</td>
</tr>
</tbody>
</table>
Appendix C3:

Figure 22. Germany’s Transportation CO2 emissions in MMT over the 1980-2005 period. Source: (EC-JRC/PBL EDGAR version 4.0 http://edgar.jrc.ec.europa.eu/, 2009)