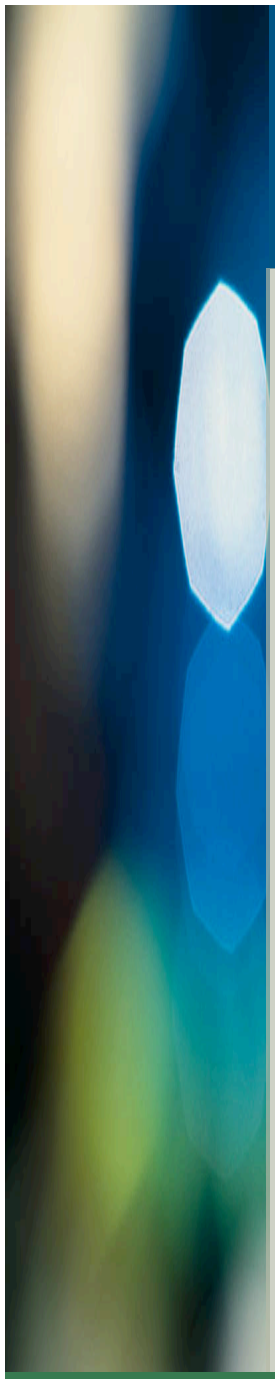

Current Practices for Reducing Greenhouse Gas Emissions

A Study of Electric Utilities in the United States

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March 2007

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As authors of this Group Project report, we are proud to archive it on the Bren School's web site such that the results of our research are available for all to read. Our signatures on the document signify our joint responsibility to fulfill the archiving standards set by the Donald Bren School of Environmental Science & Management.

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The mission of the Donald Bren School of Environmental Science & Management is to produce professionals with unrivaled training in environmental science and management who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School is that the analysis of environmental problems requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise from scientific or technological decisions.

The Group Project is required of all students in the Master's of Environmental Science and Management (MESM) Program. It is a four-quarter activity in which small groups of students conduct focused, interdisciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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ABSTRACT

In 2005, the electric power sector alone was responsible for nearly two fifths of the total carbon dioxide emissions as well as significant amounts of other greenhouse gases (GHG), making electric power a larger source of GHGs than transportation or any other industrial segment. Any attempt to stabilize or reduce further GHG emissions must therefore engage the electric power sector in a meaningful way. Doing so requires an understanding of the mitigation options available to electric utilities as well as an understanding of the factors that influence utilities decisions on whether or not to take action. This study surveyed electric utilities across the U.S. in order to discover how electricity generators are currently managing GHG emissions and also the most influential motivations for and barriers to taking action.

The analysis shows that the majority of survey respondents have adopted at least one reduction strategy while fewer utilities are engaged in offsetting. Demand-side management and switching to renewable energy are the leading strategies used to reduce GHG emissions. The most commonly adopted offsetting practices are reforestation and recycling of coal byproducts. Executive leadership was the strongest motivation for municipal utilities to mitigate GHG emissions. Taking all survey respondents together, improved efficiency and trade association pressure were also strong motivators. The strongest barrier preventing utilities from mitigating GHGs was regulatory uncertainty.

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Acronyms & Abbreviations

AB32	California Assembly Bill 32, April 2006
APPA	American Public Power Association
C2P2	U.S. EPA Coal Combustion Products Partnership
CCS	Carbon capture and sequestration
CCX	Chicago Climate Exchange
CDP	Carbon Disclosure Project
CH_4	Methane
CHP	Combined heat and power
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DOE	U.S. Department of Energy
DSM	Demand side management
eGRID	Emissions and Generation Resource Integrated Database
EEI	Edison Electric Institute
EEPS	Energy efficiency portfolio standards
EIA	Energy Information Administration
EOR	Enhanced oil recovery
EPA	U.S. Environmental Protection Agency
EPACT	U.S. Energy Policy Act
EPRI	Electric Power Research Institute
ERT	Environmental Resources Trust, Inc.
ESI	Environmental Synergy, Inc.
EUEC	Electric Utilities Environmental Conference, Arizona 1/2007
FERC	U.S. Federal Energy Regulatory Commission
GHG	Greenhouse gases
Gt	Gigaton
IGCC	Intensified Gasification Combine Cycle
IOU	Investor-owned utility
IPCC	Intergovernmental Panel on Climate Change
IUEP	International Utility Efficiency Partnership
MMT	Million metric tons
MUNI	Municipal utility
MWh	Megawatt hour
N_2O	Nitrous oxide
NARC	North American Reliability Corporation
NG	Natural gas
ppm	Parts per million
PRP	Public Renewables Partnership
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable portfolio standards
SF_6	Sulfur Hexafluoride
TMT	Thousand metric tons
Wm^{-2}	Watts per square meter

EXECUTIVE SUMMARY

The electric power industry is the largest emitter of greenhouse gas (GHG) emissions among all major economic sectors in the United States. The lack of federal regulations mandating GHG reductions has led to the development of a patchwork of state and regional regulations, partnerships, and voluntary initiatives aiming to mitigate GHG emissions. Subsequently, limited literature is available on the current state of GHG management strategies used by U.S. electric utilities or their motivations and barriers to taking action.

This project was developed to achieve three primary objectives. The first objective was to assess GHG emission reduction strategies and offsetting practices currently used by electric utilities in the U.S. The second objective was to identify the motivations and barriers impacting a utility's decision to take action to mitigate its GHG emissions. The final objective was to explore the effects that a utility's ownership-type, size, region, fuel mix, and CO_2 emissions have on its decision to adopt GHG management practices.

We collected our primary data through a mail questionnaire to U.S. electric utilities with additional supporting data retrieved from industry and government databases. The survey methodology was selected because it allowed us to gather data not found in traditional industry statistics regarding the practices, strategies and motivations and barriers that govern utilities' approaches to the management of GHG emissions. The survey was sent to 39% of the municipal power generating utilities in the U.S., and to all of the parent company level, investor-owned generating utilities in the U.S.

The analysis of the survey responses show that overall, utilities are more involved in GHG emission reduction than they are in offsetting. Of those utilities that are currently managing their GHG emissions, large utilities are far more active than small utilities.

Survey respondents ranked anticipated regulatory pressure, executive leadership, and improved efficiency as the top motivations for mitigating GHG emissions. However, a regression model revealed that the strongest motivators actually affecting reduction behavior were improved efficiency and trade association pressure. The model also showed that state financial subsidies and existing state regulations were weak motivators. According to the ranking of barriers by survey respondents, cost of mitigation is the largest barrier to GHG reduction followed by regulatory uncertainty and lack of technologies. Modeling actual reduction behavior revealed that the most influential barrier is clearly regulatory uncertainty.

The results of this report will provide a snapshot of GHG management options currently in use by electric utilities and will identify the motivations that are driving those actions. Using this report, a utility can compare and evaluate their approach to GHG emissions management to the aggregated industry survey results and use this information in their long-term operational and environmental planning efforts. Policy-makers will be able to use this report to better understand the motivations that encourage, and barriers that discourage utilities from taking action to mitigate GHG emissions.

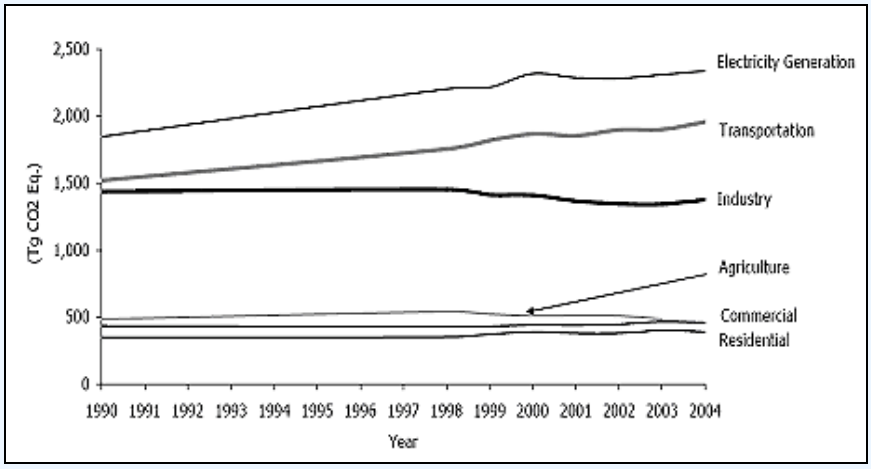
1. INTRODUCTION

This section provides an introduction to the importance of the project and the goals it aims to accomplish. It will begin with a description of the problem statement that was the impetus for this research. This will be followed by a brief discussion of the significance of this project. Finally, this section will conclude with the statement of the project objectives.

1.1 Problem Statement

Climate change has become an increasingly pressing issue in both the environmental and business arenas. In 2005, anthropogenic sources of greenhouse gases within the United States added 7,147.2 million metric tons (MMT) of carbon dioxide equivalent (CO_2e) emissions into the atmosphere; a 16.9% increase over 1990 levels ("Emissions", Energy Information Administration, 2006). That same year, the electric power sector alone was responsible for 39.5% of total CO_2 emissions, making it the largest single emitter of greenhouse gases in the country (Figure 1). Therefore, any serious attempt to reduce GHG emissions in the U.S. must engage the electric utilities in a meaningful way.

Figure 1: CO_2e emission levels among U.S. economic sectors from 1990 to 2004



(Source: Energy Information Administration, 2005)

Responding to the climate change issue, a number of regulations, partnerships, and voluntary initiatives have emerged at the local, state, and regional levels. Lack of federal regulations targeting GHGs has created a patchwork of local approaches aiming to achieve similar goals. Electric utilities find themselves caught in the middle – they feel the pressure to take action but can be at a loss for how to approach the issue. For policy makers, understanding the obstacles preventing utilities from reducing GHG emissions and how to properly establish incentives to encourage mitigation are crucial aspects of effective regulations. This study aims to fill the knowledge gaps in these areas so that GHG mitigation can proceed.

1.2 Project Significance

This study goes directly to decision makers within U.S. electric utilities to discover exactly what is being done to address GHG emissions and why utilities choose to act or not act. The results show which approaches are most often used and also highlight the principal motivations and barriers to action. Differences in approaches are evaluated based on characteristic of the utilities including ownership, size, operating region, CO_2 intensity, and fuel mix.

With the aid of this report, electric utilities in the U.S. can take effective action toward reducing GHG emissions and lowering their impacts on global climate change. By being able to compare their approaches to GHG emissions management to the aggregated industry data from this report, utilities will be able to use the findings of this study in their long-term operational and planning efforts. This project can also provide policymakers with insights on how to properly engage utilities in GHG mitigation efforts.

1.3 Project Objectives

This project was developed to achieve the following objectives:

- Assess GHG emissions reduction strategies and offsetting practices currently used by electric utilities in the U.S.
- Identify the motivations for and barriers to utilities' decision to take action to mitigate their GHG emissions.
- Explore the effects of ownership, size, region, CO_2 intensity, and fuel mix on utilities' decision to adopt GHG management approaches.

This study is intended to provide a snapshot of GHG management options currently in use by electric utilities and will identify the motivations that are driving those actions. Section 2 of this report will provide a detailed description of background information regarding: climate science, GHG regulations, GHG emissions within the electric utility sector and finally a description of recent studies of GHGs in the U.S. electric utility industry. Section 3 of the report will describe the survey design process and the methodology used to gather the primary data set. The results of the survey and analysis of the responses are presented in Section 4 of the report. The discussion of the results and analysis is then provided in Section 5. Finally, a summary of the conclusions and implications of the project is presented in Section 6.

2. BACKGROUND

This section provides background information that will aid in the understanding of the setting and importance of this project. It will begin with a description of the current state of climate science. This is followed by a brief synopsis of GHG regulations. Next, an analysis of the GHG emissions produced by the U.S. electric utility sector is provided. Finally, the recent studies conducted on GHG emissions in the electric utility are described and compared to the scope of this project.

2.1 Climate Science

In "Climate Change 2007: The Physical Science Basis, Summary for Policymakers," scientists from the Intergovernmental Panel on Climate Change (IPCC) stated that the "increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations" (Alley et al., 2007). If anthropogenic GHG emissions remain at or above current atmospheric concentration levels, further temperature increase will "*very likely* be larger than that observed during the 20th century" (Alley et, at., 2007). Thus, actions taken to "slow, stop, and reverse the growth of greenhouse gas […] emissions over the shortest period of time reasonably achievable" is necessary ("Call", U.S. Climate Action Partnership, 2006).

Prior to the industrial revolution (1750), the concentration of CO_2 in earth's atmosphere was about 280 parts per million (ppm). Since that time, the concentration has risen 35% to 379 ppm in 2005. The natural range over the last 650,000 years has been determined to be 180 to 300 ppm. The growth rate of CO_2 concentration is presently about 1.9 ppm per year (average from 1995 to 2005), which is faster than the growth rate since the beginning of continuous direct atmospheric measurement (1.4 ppm per year average from 1960 to 2005).

The influence of CO_2 in altering the balance of incoming and outgoing energy in the Earth-atmosphere system is measured in terms of radiative forcing. Since 1750, the radiative forcing caused by increased levels of CO_2 has increased by 1.66 Watts per square meter (Wm^{-2}). In the last decade, the radiative forcing of CO_2 increased by 20%, which marked the largest change for any decade in at least the last 200 years. The increase in positive radiative forcing due to greenhouse gases has been partially offset by an increase in negative radiative forcing due to anthropogenic aerosols (primarily sulfate, organic carbon, black carbon, nitrate and dust). Aerosols reduce radiative forcing directly by -0.5 Wm^{-2} and indirectly by an additional -0.7 Wm^{-2}. The indirect effect of aerosols results from their influence on cloud formation and lifetime. Ozone-forming combustion byproducts such as nitrogen oxides, carbon monoxide and hydrocarbons have also indirectly increased radiative forcing by 0.35 Wm^{-2}.

The total temperature increase over the last century is 0.76°C, or 1.37°F. This warming has been moderated by the ocean, which has absorbed more than 80% of the heat added to the climate system. Observed warming has not been distributed evenly across earth's

surface. For example, average Arctic temperatures increased at almost twice the global average rate in the past 100 years. Paleoclimate information suggests that the warming over the last 50 years is unusual in at least the previous 1300 years.

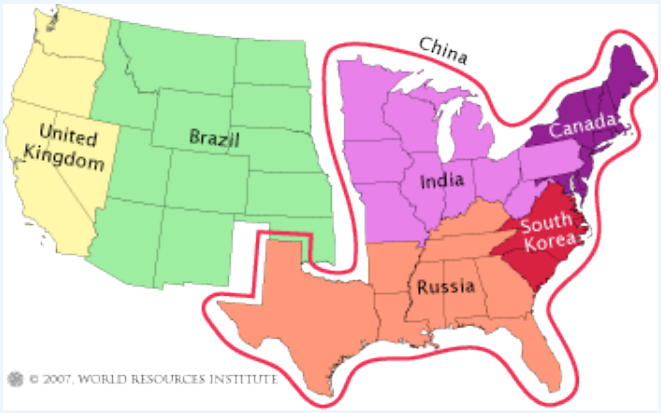
Annual CO_2 emissions from fossil fuel combustion averaged 23.5 gigatons (Gt) per year in the 1990's. Since the new millennium, that average has increased to 26.4 Gt per year. Under a business as usual scenario with a fossil fuel intensive economy and without additional climate initiatives, the radiative forcing in 2100 due to anthropogenic greenhouse gases and aerosols corresponds to an atmospheric concentration of 1550 ppm CO_2. Alternatively, the scenario for rapid change toward a service and information economy – with reductions in material intensity and the introduction of clean and resource efficient technologies – projects anthropogenic radiative forcing in 2100 equivalent to 600 ppm CO_2. These projected changes in radiative forcing correspond with increases in global average surface temperature of 4.0°C and 1.8°C, respectively.

Even if GHG concentrations were stabilized, anthropogenic warming would continue for centuries due to the atmospheric lifetimes of GHGs and the timescales associated with climate processes and feedbacks.

The likelihood that human activity has had an impact on global climate change has resulted in proposals for national programs and international conventions to curtail GHG emissions. The Kyoto Protocol is a result of an international effort aiming to reduce GHG emissions worldwide. With the U.S. being one of only two Annex I countries that has not ratified the Protocol, the nation's contribution of GHG emissions continues to grow rapidly. In 2005, anthropogenic sources of GHGs within the U.S. added over 7 billion metric tons of CO_2 equivalent emissions into the atmosphere; a 16.9% increase above 1990 levels ("Emissions", Energy Information Administration, 2006). This level of emissions represents approximately one-fifth of global GHG emissions ("Voluntary", Research Reports International, 2006).

To put these numbers into perspective, consider this: if the GHG emissions levels from six U.S. states (Texas, California, Pennsylvania, Ohio, Illinois and Florida) are compared internationally, all these six states would rank among the top 30 greenhouse gas emitters internationally ("Earth Trends", World Resource Institutes, 2006). If the GHG emissions from the entire low 48 states are compared internationally, the emissions would be equal to the those of China, Brazil, and United Kingdom combined ("Earth Trends", World Resource Institutes, 2006) (Figure 2). This imbalance leads some to argue that the U.S. is emitting more that it's "fare share" of GHGs ("Voluntary", Research Reports International, 2006).

Figure 2: International comparison of U.S. GHG emissions



(Source: "Earth Trends", World Resource Institutes, 2006)

2.2 GHG Regulations

This section provides background information on the recent five bills introduced to the Congress calling for mandatory GHG emission caps nationwide. Next, this section discusses voluntary initiatives to reduce GHG emissions at the federal level, particularly the Voluntary Reporting Program and the Climate Challenge Initiative followed by an introduction to state GHG regulations.

The Kyoto Protocol targets six principle types of GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Five bills have recently been introduced to Congress aiming to create a national cap on emissions of these GHG ("Summary", Resources for the Future, 2007) (Table 1) [see Appendix C for further details]. This high level of activity suggests that federal GHG regulations are likely in the near future.

Table 1: Recently introduced bills addressing GHGs

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Scope	Economy-wide	Economy-wide	Electricity Sector	Economy-wide	Economy-wide
Coverage	All six GHGs	All six GHGs	All six GHGs	All six GHGs	All six GHGs
Emissions Targets	Mandatory Caps • 2012: GHG emissions intensity 2.6% below 2011 levels, decreasing by a further 2.6% each year through 2021 • 2022: emissions intensity to drop by 3% each successive year Long-term goal: • none	Mandatory Caps • 2020: 1990 GHG levels • 2030: 26.7% below 1990 levels • 2040: 57.4% below 1990 levels • 2050: 80% below 1990 levels Long-term goal: • 450 ppm concentration stabilization	Mandatory Caps • 2011-2014: capped at 2006 levels • 2015: capped at 2001 levels • 2016-2019: cap declines 1% from previous year • 2020 and thereafter: emissions cap declines 1.5% each year Long-term goal: • none	Mandatory Caps • 2012-2019: 6,130 million tons of CO2e • 2020-2029: 5,239 million tons of CO2e • 2030-2049: 4,100 million tons of CO2e • 2050: 2,096 million tons CO2e thereafter Long-term a goal: • none	Mandatory Caps • 2020: 1990 GHG levels • 2021-2030: emissions reduced by 2.5% per year • 2031-2050: emissions reduced by 3.5% per year Long-term goal: • 450 ppm concentration stabilization
Regulated Entities	Set forth in the Act Coal mines, petroleum refineries, natural gas processors, importers of fossil fuels, and selected non-fuel entities	Determined by EPA	Set forth in the Act All electricity generating entities of 25 MW or greater	Set forth in the Act All facilities that emit 10,000 tons CO2e per year, petroleum refineries, and importers	Determined by EPA Sources or sectors with greatest GHG emissions, as determined by the EPA

(Source: "Summary", Resources for the Future, February 2007)

With the prospect of federal GHG regulations high, proactive utilities are taking actions to be prepared. These actions include developing inventories, registering emissions, becoming involved in partnerships, reducing emissions at the source, and offsetting.

Two prominent voluntary initiatives taking place at the federal level to reduce GHG emissions are the emissions registration program (i.e. the Voluntary Reporting Program) and the emissions reduction partnership between governmental agencies and utilities (i.e. the Climate Challenge Initiative). Required by Section 1605(b) of the Energy Policy Act of 1992, the Voluntary Reporting Program was launched in 1994 and directed by the Energy Information Administration to create a database for documenting entities' voluntary reporting and reductions of in GHG emissions ("Voluntary Reporting," Energy Information Administration, March 2006). Reporters, including individuals, organizations, and corporations, are permitted by the program to conduct annual GHG emission inventories.

In their inventories, reporters also record activities, programs, or strategies taken to achieve GHG emission reductions. With reporters' voluntarily submissions of actions that have reduced and/or sequestrated GHG emissions, the Voluntary Reporting Program has provided invaluable information on "innovative emission reduction activities […]" and "created a 'test' database of approaches to emission reductions" for evaluating future policy instruments that aim to reducing GHG emissions ("Voluntary Reporting," Energy Information Administration, March 2006).

The Climate Challenge Initiative is a joint initiative between the U.S. Department of Energy (DOE) and the electric utility industry to voluntarily reduced greenhouse gas emissions. The initiative has helped to formalize electric utilities' commitments to "reduce, avoid or sequester greenhouse gases" ("Voluntary GHG," Research Reports International, November 2005). Most participating electric utilities have made commitments to adopt specific GHG emission mitigation approaches like efficiency improvements in generation and end-use, distribution, and transmission. Several participating utilities have launched partnerships with environmental groups to follow through with their Climate Challenge commitments ("Voluntary GHG," Research Reports International, November 2005). Just like the Voluntary Reporting Program, the Climate Challenge Initiative has helped to create a "quasi – database" on GHG mitigation strategies that are currently available for utilities' adoption and established a new playground on which new partnerships and initiatives can be formed to manage GHG emissions.

In addition to voluntary GHG mitigation initiatives taken place at the federal level, state regulations have also instigated electric utilities' reductions in their GHG emissions. Several states have passed laws that specifically target GHG emissions (i.e. the California's Global Warming Solutions Act (AB 32)) and legalized state-specific GHG emission reduction objectives. Besides state-specific GHG emission mitigation regulations and objectives introduced in Appendix C, two prominent federal regulations that have effects on utilities' GHG emission management approaches at the state level are the Renewables Portfolio Standards (RPS) and the Energy Efficiency Portfolio Standards (EEPS).

The RPS is a policy implemented at the state level to "obligate each retail seller of electricity to include in its resource portfolio […] a certain amount of electricity from renewable energy resources, such as wind and solar energy" ("Renewables," U.S. Department of Energy, Retrieved in March 2007). As of March 6, 2006, twenty-three states and the District of Columbia had an RPS policy, and twenty-one states had no RPS or renewable energy goals ("Summary of State," U.S. Environmental Protection Agency).

Likewise, the EEPS is a state-implemented policy with an aim to improve energy efficiency at the end-user. As of March 6, 2006, ten states had an EEPS policy with thirty-nine states having no EEPS policy or similar energy efficiency goal policies ("Summary of State," U.S. Environmental Protection Agency). Hence, the use of state regulations adds a layer of regulatory obligation that electric utilities must comply with to reduce GHG emissions even when such regulations are, sometimes, written for purposes other than reductions in GHG emissions.

Besides the initiatives and regulations taken place at both the federal and state levels, electric utilities are proactively taking actions to mitigate GHG emissions. However, electric utilities' individual mitigation approaches vary somewhat depending on ownership, size, operating region, and fuel mix. It is the intent of this report to provide utility managers, policymakers, and other interested parties with a comprehensive assessment of current GHG mitigation efforts as well as the types of incentives that motivate behavior. A timetable of highlighted events addressing climate change between 1992 and 2007 is provided in Appendix D.

2.3 GHG Emissions in the U.S. Electric Utility Sector

The principle GHG emitted by the electric power sector is CO_2. Other GHGs, such as methane (CH_4) and nitrous oxide (N_2O), are also released by electricity generation. However, as shown in Table 2, the amount of these gases produced is markedly smaller than the amount of CO_2. The overall contribution of GHGs to climate change is measured by their global warming potential in CO_2 equivalents. This is because some GHGs are more potent than others. For instance, one molecule of methane is 23 times as strong one molecule of CO_2 in terms of global warming potential. Nitrous oxide is 296 times more potent than CO_2.

Table 2: 2005 GHG emissions from electric power generation in the U.S.

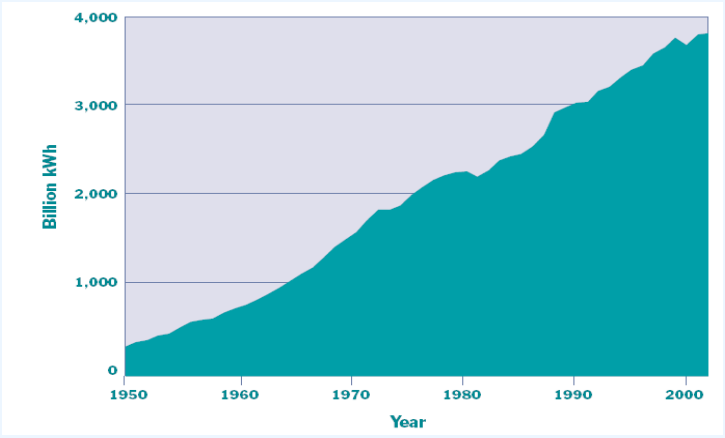
	CO_2 (MMT)†	CH_4 (TMT CO_2e)*	N_2O (TMT CO_2e)*
Coal	1,944.2	288	8,635
Petroleum	100.3	14	216
Natural Gas	318.9	13	165
Biomass	n/a	-	196
MSW	11.1	n/a	n/a
Geothermal	0.4	n/a	n/a
Total	2,375.0	315	9,212

† MMT = million metric tons
*TMT CO_2e = thousand metric tons of carbon dioxide equivalent

(Source: "Emissions", Energy Information Administration, 2005)

Since 1990, emissions from U.S. electric utilities have increased by 31.7%, reaching 2,375 million metric tons (MMT) of CO_2 in 2005 ("Emissions", Energy Information Administration, 2006). This can be traced to the dramatic increase in electricity demand over recent decades (Figure 3). According to the U.S. Department of State, emissions derived from electricity production will continue on their upward trajectory and by 2020 are projected to reach 2,898 MMT annually ("U.S. Climate", U.S. Department of State, 2002). This projection incorporates policy measures, technology improvements, demand-side efficiency gains, and cleaner fuels. However, these factors are expected to be offset by growth in population and economic output.

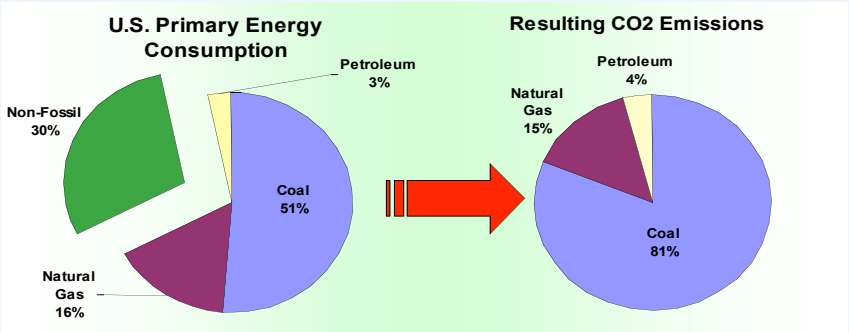
Figure 3: U.S. net electricity generation, 1950 – 2003



(Source: The Pew Center on Global Climate Change, Retrieved in 2007)

Coal-based electricity generation accounts for a large portion of the industry's GHG emissions, and remains the most prominent energy source for generating electricity to this date. Data from 2001 shows that while coal combustion produced 51% of the nation's electricity, it also accounted for 81% of CO_2 emissions from the electricity sector that year ("Greenhouse", Energy Information Administration, retrieved 2007) (Figure 4). Adding to the effect, fuel extraction and processing also release GHG emissions. In 2005, U.S. coal mining 2.8 MMT of methane, a potent greenhouse gas with 23 times the global warming potential of carbon dioxide ("Emissions", Energy Information Administration, 2006).

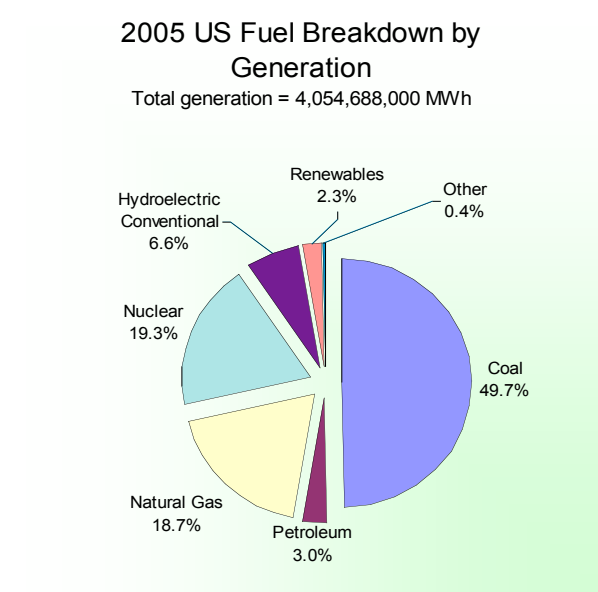
Figure 4: 2001 U.S. electricity generation by fuel type + resulting CO_2 emissions.



(Source: "Greenhouse", Energy Information Administration, Retrieved on 2007, February 20)

Little has changed since 2001 in terms of fuel mix. In 2005, coal remained the dominant fuel type – producing 49.7% of U.S. electricity. By comparison, non-fossil energy sources contributed only 28.6% of net generation. Of this, the nuclear contributed the most (19.3%), followed by conventional hydropower (6.6%), and finally renewable generation (2.3%) (Figure 5). Renewable energy has experienced tremendous growth recently – for instance, wind generation capacity increased by more than 30 percent in 2003 – yet the overall contribution of renewable energy to net generation remains quite small ("Electric Industry", Edison Electric Institute, 2005).

Figure 5: 2005 U.S. electric power industry net generation, by fuel type



(Source: "Annual Electric Generator Report", Energy Information Administration, retrieved in 2007)

2.4 Recent Studies of GHGs in the Electric Utility Industry

There is a significant amount of literature available that addresses GHG emissions management within the U.S. electric utility industry. However, the majority of the studies focus on a select number of utilities and look at one or more of the following: GHG mitigation methods, potential motivations and barriers to GHG management, and GHG reporting practices. Although the literature is abundant, there is a need for industry wide data on what utilities are actually doing to mitigate GHG emissions on a national scale, and the factors that influence their GHG management decisions. This section identifies and briefly describes four reports that study GHG emissions within the electric utility industry.

In January 2007 the Edison Electric Institute (EEI) released a report titled, ***"The Power Partners℠ Annual Report."*** The report focused on voluntary efforts within the U.S. electric utility industry to reduce GHG emissions. EEI used a questionnaire administered during the summer of 2006 to survey all of its member utilities to see what is being done to reduce GHG emissions. The findings of this report were based on the responses from 37 utilities (18 investor-owned utilities, 15 municipal utilities, 3 cooperatives, and 1 federal utility authority). The report demonstrates the benefits of voluntary climate change approaches that rely on flexible programs and use of available technology to reduce GHG emissions. This information is presented in an analysis of GHG emission reduction partnerships and by providing utility specific case studies of GHG emissions ("Power", EEI, 2007).

In 2006 the Research Reports International released a report titled *"Voluntary GHG Reduction in the U.S. Electric Power Industry."* The objective of this study was to provide a current assessment on what U.S. electric utilities are doing to reduce GHG emissions. This report provided a comprehensive list of GHG emission reduction strategies and offsetting practices along with a list of potential motivations and barriers to taking GHG emission mitigation action. This report was primarily a research report that used several case studies of utilities to identify industry actions ("Voluntary", Research Reports International, 2006).

In 2006, in collaboration with the Pew Center on Global Climate Change, Andrew Hoffman from the University of Michigan released a report titled, *"Getting Ahead of the Curve: Corporate Strategies that Address Climate Change."* The first objective of the study was to identify all GHG emission reduction and offsetting practices, clean technology research and the associated investment in the corporate sector. After identifying current corporate GHG emission management strategies the study went on to explored the risks, rewards, opportunities, and barriers to reducing GHG emissions. Twenty-seven companies from the Pew Center's Business Environmental Leadership Council (BELC) were surveyed. These companies were mainly publicly-owned, large, and multinational companies in North America covering many economic sectors like the electric power sector, oil and gas sector, and metals and mining sectors (Hoffman, 2006).

In 2006 by the *Carbon Disclosure Project* (CDP) released a report focusing on the electric utility industry's carbon emissions. In this study, electric utilities worldwide were surveyed with the objective of evaluating electric utilities' carbon emission disclosure practices. Also, the CDP explored the effects of many variables like region, size of utility, and existing national GHG emission regulations on the quantity and quality of the disclosed information. This study was conducted to assess the information disclosure aspect of utilities' carbon emission management. The study of motivations and barriers to reducing CO_2 emissions and specific reduction strategies was outside the scope of this project (TRUCOST, 2007).

The studies identified above all investigate GHG emissions from the electric utility sector. Some of the studies look primarily at what is being done in the industry by providing detailed case-studies. Some of the reports look into several different economic sectors but provide limited data on the efforts of the electric utility industry. A few of the studies used survey methodology to collect original data from a specific sample of the industry, while others were solely based off of publicly available information. Our project is unique because we used a nationwide survey to gather first-hand data to identify the current in-use GHG mitigation strategies, identify motivations and barriers to action, and look into the effects that a utility's characteristics have on their decision to adopt GHG management strategies.

3. METHODOLOGY

Primary data was collected through a questionnaire surveying U.S. electric utilities with additional supporting data derived from EPA's eGRID (Emissions and Generation Resource Integrated Database). The survey gathered data not available in traditional industry information sources regarding mitigation approaches as well as motivations and barriers that influence utilities' GHG management decisions. This section will discuss how the survey was designed, how the sample was selected, and how the survey was distributed.

3.1 Survey Design

Due to the selection of a survey as the primary data collection tool, the project had to meet the requirements of the University of California Santa Barbara's Office of Research regarding human subjects. First, each group member obtained the official certification required of any individual (associated with the University) conducting human subjects research or handling data that includes identifiable private data of a human subject. Second, the scope of the project, methodology, draft survey and mail-out materials had to be approved for consistency with the Human Subject guidelines by the Office of Research prior to administration of the survey.

The survey was designed over a five month development process. Numerous iterations of the survey were presented to the faculty advisor, the two external advisors and a group of seven industry experts selected to participate in a pre-test of the survey. Each member of the pre-test group was asked to complete the survey and to identify any areas needing clarification, formatting issues, and to make suggestions for the addition or removal of questions. Feedback from the pre-test group was then incorporated into the final version of the survey.

Participation in the survey was on a voluntary basis and respondents were assured that all information would be kept strictly confidential. The time estimated for a respondent to complete the survey was between 10 and 15 minutes. The final version of the survey was completed at the end of October 2006 and was set up in a way that could be posted on an internet survey website (http://www.Surveymonkey.com) in the same layout, wording and question order as the paper-based survey. The objectives of posting the survey on the internet in addition to the mailing were to:

- Increase the response rate by giving the respondents more flexibility
- Reduce the time it takes for participants to complete and submit a survey
- Reduce the problems caused by lost or damaged paper surveys
- Reduce potential human error associated with data entry of responses
- Reduce problems related to interpreting hand writing

As part of the literature review for this project extensive research was done regarding current electric utility actions regarding the reduction of GHG emissions. A detailed description of the methods used by utilities to reduce and offset GHG emissions, as well as inventory registries, GHG emission reduction partnerships is provided in Appendix E

of this report. This research played a vital role in the design and development of the survey.

The survey was titled, *Current Practices for Reducing Greenhouse Gas Emissions from Electric Utilities*, and consisted of twenty questions requesting data about utilities' generation, purchase of electricity, fuel mix, and management of their GHG emissions. The survey was broken up into nine sections: (1) Respondent Information, (2) Human Resources in the Environmental Department, (3) Capacity and Generation, (4) GHG Inventory and Registration, (5) GHG Reductions, (6) GHG Offsetting, (7) Motivations and Barriers, (8) Additional Information, and (9) Final Results. These sections included both closed and open-ended questions [please see Appendix A for the final survey and accompanying cover letter]. Below is a brief description of each of the nine sections.

The first section of the survey was titled *"Respondent Information."* This section asked for basic information on the person responding to the survey and the utility being represented. This information was important so that the respondent could be contacted if clarification on the information provided was needed and clarified the title/ position of the respondent.

The second section of the survey was titled *"Human Resources in your company's Environmental Department."* This section consisted of questions regarding the number of employees working on environmental issues at the utility, GHG issues as well as any GHG consulting services that were utilized. The purpose of these questions was to determine if a utility had the staff resources to handle GHG management and/or whether they outsourced these tasks to consultants.

The third section of the survey was called *"Capacity and Generation."* This section primarily contained questions about the utility's 2005 fuel mix, capacity, net generation, and purchased power. Also, the survey recipients were asked to identify the means by which their 2005 purchased power was procured (i.e. long-term contracts, spot market or power marketer). The purpose of this section was to determine the size and fuel mix of the utilities responding to the survey. The data received from these questions was verified using industry statistics from Energy Information Administration (EIA) and the Federal Energy Regulatory Commission (FERC) databases.

The fourth part of the survey was called *"GHG Inventory and Registration."* This section requested information on GHG inventories that the utilities may have completed and whether or not they registered these inventories. The survey recipients that have completed a GHG emissions inventory were also asked to identify the protocol used to conduct the inventory.

The fifth part of the survey was titled *"GHG Reductions."* This section asked the respondents questions relating to the GHG emission reduction methods utilized by the utility. The respondents were given twelve GHG emission reduction methods to choose from, while also having the "none" and "other" (with space to identify the other method) options available. The respondents were also asked for information regarding "green power" programs that they may have available to their customers. The list of

possible GHG emission reduction strategies was derived from a review of industry reports, research and correspondence with utility representatives, and the survey pre-test process that allowed for industry and academic professionals to add or edit the list of reduction strategies. A complete list and detailed description of the strategies listed in the survey is located in Appendix E.

The sixth section of the survey was titled *"GHG Offsetting."* This section was made up of questions about the GHG offsetting practices used by the utilities. Also the respondents were asked to identify any GHG emissions reduction partnerships that they may be involved in. The respondents were given the option of choosing from a list of five offsetting practices and nine partnerships, and were able to once again select the other or none options. Like reduction strategies, the list of GHG offsetting practices and partnerships was derived from reports, research of publicly available sources, and a pre-testing survey review process. A complete list of explanations for the offsetting practices listed in the survey is also located in Appendix E.

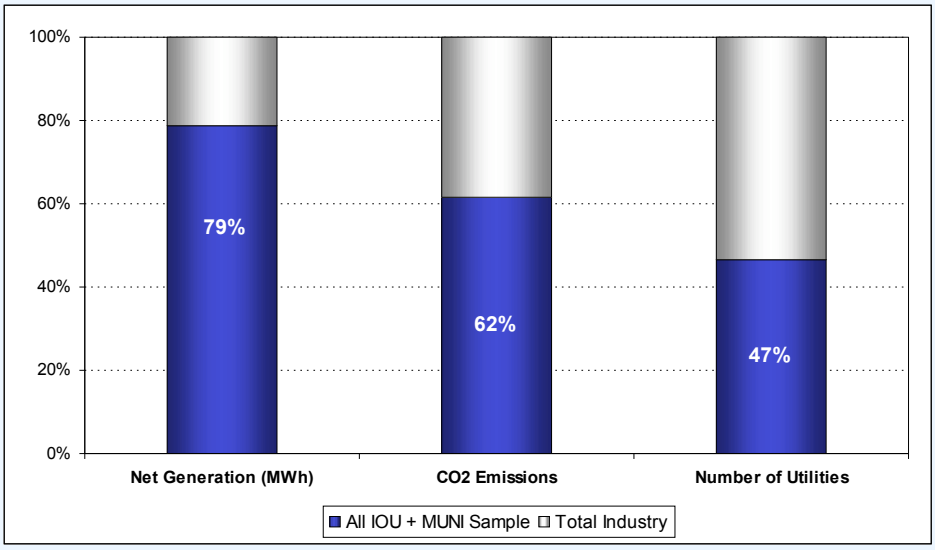
The seventh segment of the survey was titled *"Motivations and Barriers."* This section consisted of 2 questions listing the motivations and barriers that may impact the utility's approach to GHG management. The respondent was asked to rank these eleven motivations and seven barriers in terms of the degree of influence that they have on whether or not the utility is reducing GHG emissions using a 7 point scale from "none" to "strongest." There was also space available for the respondent to write in any motivations and barriers that may have been omitted from the lists provided in the survey.

The eighth section of the survey, *"Additional information,"* gave the respondent the opportunity to describe any additional information on the utility's efforts to reduce GHG emissions that was not covered in the previous questions. The final part of the survey called asked the respondent whether or not they would like a final copy of the report and requested an email address for the report to be sent if they were interested.

3.2 Sample Selection

The sample population of 314 utilities targeted for this project consisted of 88 investor-owned utilities and 226 municipal utilities. The utilities that make up the survey recipients include 100% of the investor-owned generating facilities and 39% of the municipal generating facilities located in the contiguous United States, Alaska, Puerto Rico and the U.S. territories. As shown in Figure 6, investor-owned utilities and sampled municipal utilities represent 79% of the total electric utility industry's net power generation in 2004, 62% of the industry's CO_2 emissions in 2004, and 47% of the total number of utilities in 2004.

Figure 6: Surveyed population as percentage of total industry



This chart does not include data for Independent Power Producers
(Sources: eGRID, EPA, 2006; EIA, 2004)

Figure 7 shows the investor-owned utilities and sampled municipal utilities that received surveys as a percentage of their respective sector of the industry. As the figure shows, 100% of the investor-owned generation and utilities received surveys. The municipal utilities sampled for this project represent 39% of the municipal utilities by number and 74% of the 2004 net generation. The methodology used to select the sampled municipal utilities is described later in this section.

Figure 7: IOU and MUNI sample as percentage of total net generation and number

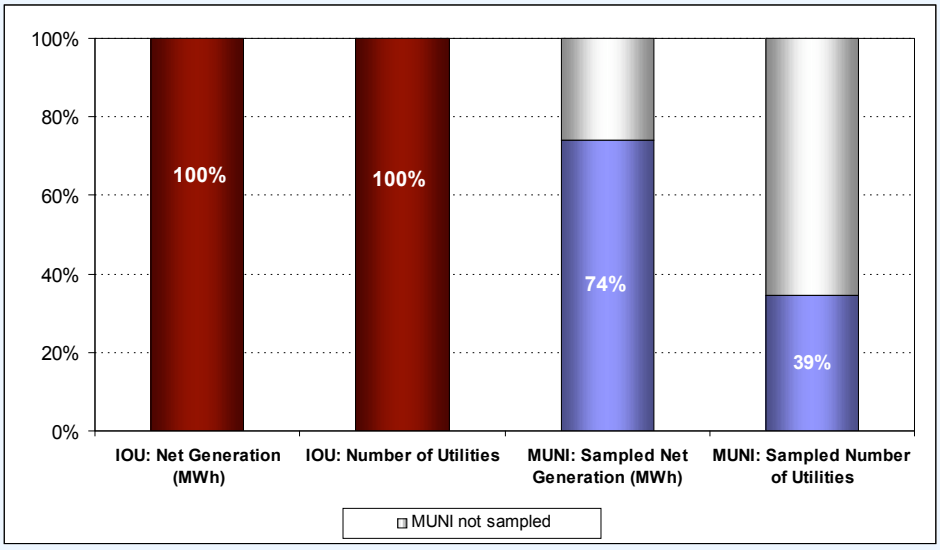
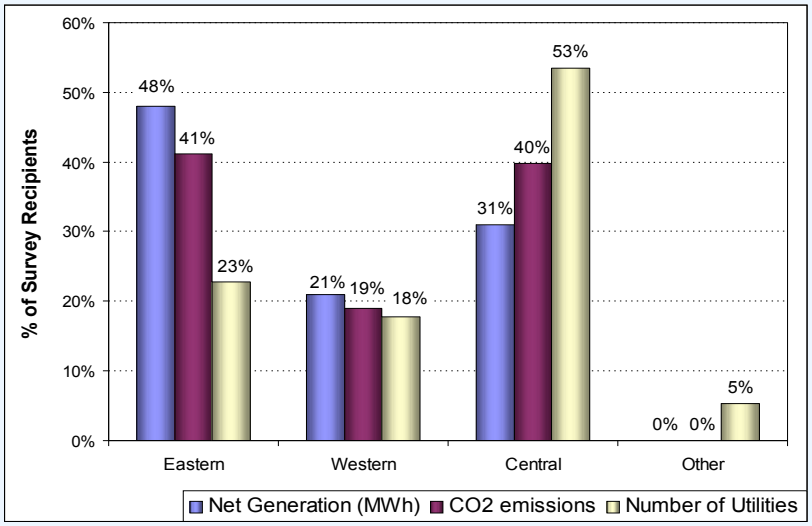


Figure 8: Regional analysis of survey recipients, by net generation, CO_2, and number



(Sources: eGRID2006 and EIA 2004)

Figure 8 is a regional analysis of the survey sample in terms of net generation, CO_2 emissions, and number of utilities. The regions used for the analysis were selected based on grouping of the North American Electric Reliability Corporation (NERC) regions.

The map in Figure 9 illustrates the eastern, central and western regions. The other region represents utilities in Alaska, Puerto Rico, and the U.S. Territories. The graph in Figure 8 shows that the Central region had the largest number of the utilities represented in the sample, while the eastern region had the largest percentage of net generation and CO_2 emissions represented by the survey sample.

Figure 9: Eastern (red), Central (green) and Western (yellow) regional divisions

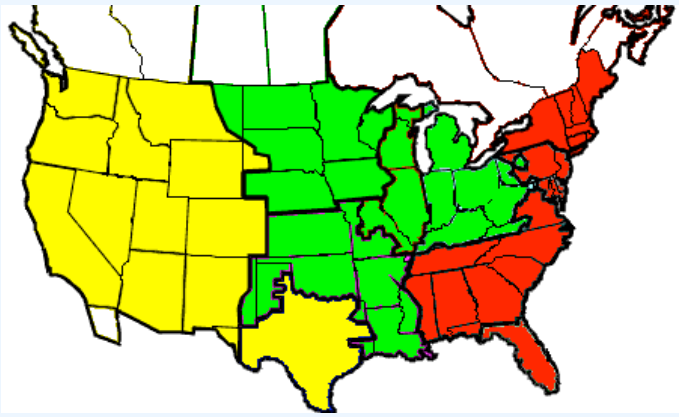
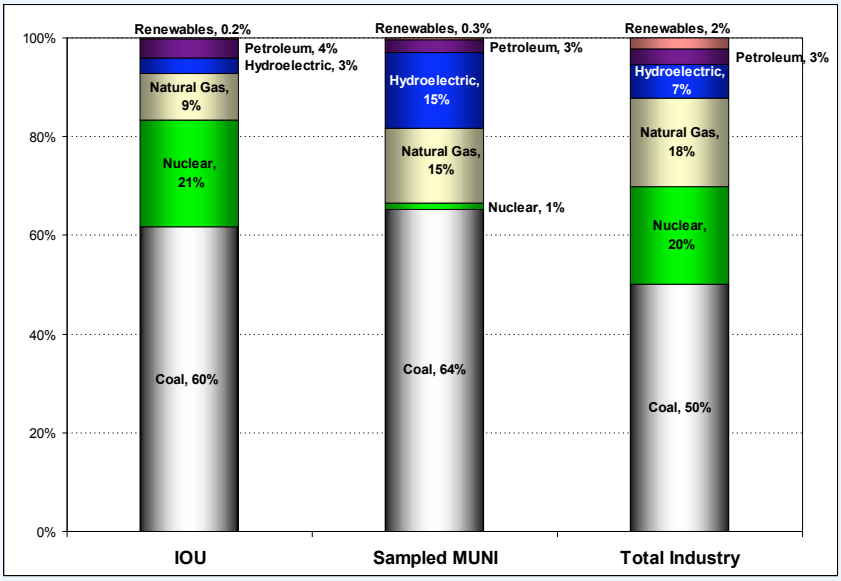


Figure 10 shows the fuel mix for the all of the IOUs and the sample of MUNIs separated by ownership type and compared to the entire industry. The 2004 net generation for both the investor-owned and sampled municipal utilities are made up predominantly of coal and the petroleum, natural gas and renewable sources of generation are comparable. The major difference between the two ownership types is that the investor-owned utilities' fuel mix has a larger percentage of nuclear generation and the municipal utilities' fuel mix has a larger percentage of hydroelectric generation. One reason for the difference between survey recipients and the industry, in terms of fuel mix is the omission of Federal utilities which represented about 7% of the 2004 generation in the U.S. and the fuel mix of its generating capacity was made up of approximately 57% hydroelectric power, and only 25% coal.

Figure 10: Fuel mix comparison



Fuel mix (as percentage of net generation) for investor owned (IOU) and sampled municipal (MUNI) utilities compared to industry. (Source: eGRID 2006)

Investor-owned utilities

The investor-owned utilities (IOU) that received surveys represent all of the generating IOUs in the U.S. regulated by FERC with the subsidiaries grouped under the parent companies. The list of investor-owned utilities was taken from the FERC website (http://www.ferc.gov/industries/electric.asp). With the list of investor-owned utilities the group then used various communication channels to obtain contact information for the person responsible for environmental policy within the company. Table 3 gives a summary of the number, net generation and CO_2 emissions for this portion of the survey population. The communication channels used to gather contact information included the following:

- Phone calls to individual utilities
- Utility websites
- U.S. EPA's Clean Air Market - Data and Maps website (http://cfpub.epa.gov/gdm/)
- Hoovers (www.hoovers.com)
- Referrals

Table 3: Investor-owned utility sample *(Source for CO_2 data and net generation: eGRID2006)*

Number of utilities sampled	88
Net generation (MWh)	1,805,084,595
CO_2 Emissions	1,269,647,033

Municipal utilities

Due to the large number of municipal utilities in the U.S. a random sampling method was utilized to determine the municipal portion of the survey population. The municipal sample was selected using the American Public Power Association's (APPA) ***2006-2007 Annual Directory & Statistical Report*** (APPA 2006). The 2,015 municipal utilities were narrowed down to 580 utilities by identifying and numbering (by state) only those utilities that generated electricity ("X" in Figure 11). A table (See Figure 11) was then developed identifying the number of public utilities, and the number of public generating facilities by state.

Figure 11: Municipal utility sample selection

			X	Y					
State	2004 Generation (MWh)	Number of public utilities in 2004	Number of Public Utility Generating facilities (2004)	% of state's generating utilities to be sampled = 35%		Random #1	Random #2	Random #3	Random #4
Alabama	6,868	37	1	1		1			
Alaska	1,935,840	35	35	13		8	10	4	19
American Samoa	181139	1	1	1		1			
Arizona	25,030,439	29	2	1		2			
Arkansas	3,071,495	15	7	3		1	2	7	
Virginia	48,556	17	10	4		1	6	4	3
Washington	40,001,076	42	17	6		17	11	15	14
West Virginia	0	2	0	0					
Wisconsin	1,061,319	84	19	7		12	10	4	19
Wyoming	169,481	14	1	1		1			
Total	**415,836,009**	2015	580	226					
		Final % =	39%						

To remove the potential for regional bias from the random selection process a set percentage (35%) of generating facilities were taken from each state/ territory. The actual final percentage of municipal utilities was 39% because a minimum of one generating municipal utility per state/ territory was selected when possible and all decimals resulting from the initial 35% calculation were rounded up to the nearest integer. With the number of municipal utilities to be selected per state/ territory ("Y" in Figure 11) identified the random number generator function in Excel was run for each state until there were Y unique values. These values then corresponded to the generating facilities for that state/ territory as numbered in the APPA directory. Once the utilities were identified, the contact information was taken from the APPA directory and recorded. Table 4 gives a summary of the number, net generation and CO_2 emissions for this portion of the survey population.

Table 4: Municipal utilities sampled *(Source: eGRID, 2006)*

Number of utilities sampled	226
Net generation (MWh)	309,067,856
CO_2 Emissions	244,235,228

3.3 Survey Distribution

The administration of the survey involved contacting the survey recipients through three forms of media: mail, email, and phone calls. This contact was made over the period of about two months and the details of this process can be found in Table 5 below. The phone calls were made by dividing the number of utilities that had not responded among the four group members. The mailing materials sent out can be found in Appendix A, the email reminders that were sent out can be found in Appendix B.

Table 5: Survey administration process

Date(s) of Action	Media	Description
11/3/06	Mail	Mailing #1 finalized and sent to all contacts included in the sample. Mailing sent in 9" x 12" envelope and included: Cover letter, survey and a self-addressed stamped return envelope.
11/9/06	Email	Email #1 sent to contacts with available email address information.
11/9/06 – 11/19/06	Phone	1st round of phone calls made to all contacts that have not submitted a completed survey as a reminder
11/19/06	Mail	Mailing #2 finalized and sent to all contacts that have not responded to the survey. Mailing sent in 9" x 12" envelope and included: Cover letter, survey and a self-addressed stamped return envelope.
11/27/06	Email	Email #2 sent to contacts with available email addresses that have not completed and returned a survey.
11/29/06 – 12/10/06	Phone	2nd round of phone calls made to all contacts that have not submitted a completed survey as a reminder
12/13/06	Mail	Mailing #3 finalized and sent to all contacts that have not completed and returned a survey. Mailing included a postcard notification and directions for the recipient to take the survey online.
1/2/07	Email	Email #3 sent to contacts with available email addresses that have not completed and returned a survey.
1/9/07	**SURVEY CLOSED**	

4. RESULTS

This section will present the results of the survey responses. First we compare the respondents' characteristics against the surveyed population and the entire electric utility industry. Then we look at the various partnerships and inventory registries the respondents are involved with. Next we explore the respondents' use of GHG reduction strategies, offsetting practices, and motivations and barriers to mitigating GHG emissions. Finally, we examine the effects that ownership-type, fuel mix, and regional location have on utilities' involvement in GHG management.

4.1 Respondents

Among the total 314 generating utilities surveyed (representing the surveyed population), 61 utilities (19.43%) responded to the survey, 15 utilities (4.78%) explicitly declined to participate, and 238 utilities (75.8%) neither responded nor declined. Among the respondents, 16 utilities were investor owned representing 18.18% the sampled IOUs and 45 were municipal utilities representing 19.91% of sampled MUNIs. Given the options for filling out the survey (hardcopy or electronically), 34 utilities chose to fill the survey out online, 24 utilities chose mail, and 3 utilities chose email.

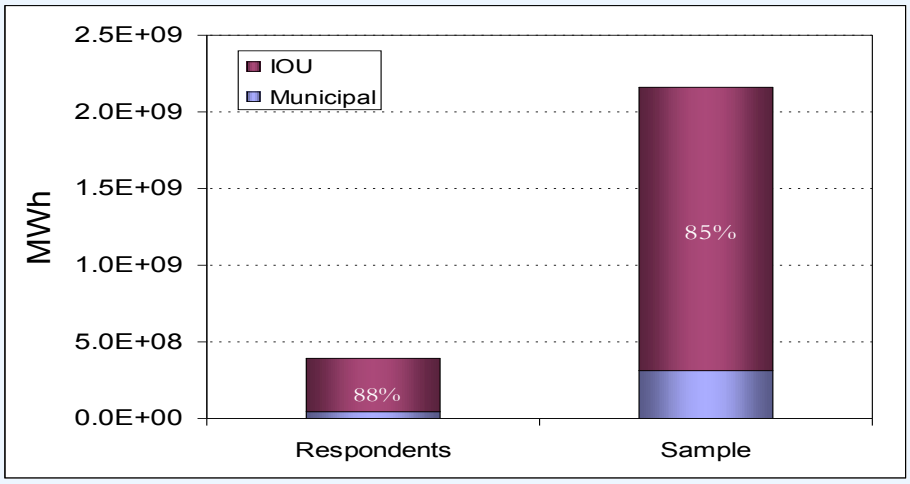
The 61 utilities that responded to the survey were found to be unbiased in relation to the sample population. We used five categories – net generation, CO_2 emissions, CO_2 emission intensity, fuel mix, and NERC regional representation (in net generation and CO_2 emissions) – for the examination of potential bias.

Several regression models were developed in order to predict which characteristics influence utilities' decision to respond to the survey. For this analysis we examined ownership type, net generation (in logarithm), CO_2 intensity, and fuel mix (% of renewable energy and % of coal). Due to the lack of significance for all the variables at the 0.05 level, we confirmed that survey respondents are not biased in relation to the sample population with respect to ownership, net generation, CO_2 intensity, or fuel mix.

Ownership Type Potential Bias

By comparing the total net generation for the respondents for both investor owned and municipal utilities to the sample population, we found respondents not to be bias for ownership type. With 88% of respondent net generation represented by IOUs compared with 85% of sample generation (Figure 12) respondents are representative of the sample population with respect to ownership.

Figure 12: Respondents vs. sample, by net generation

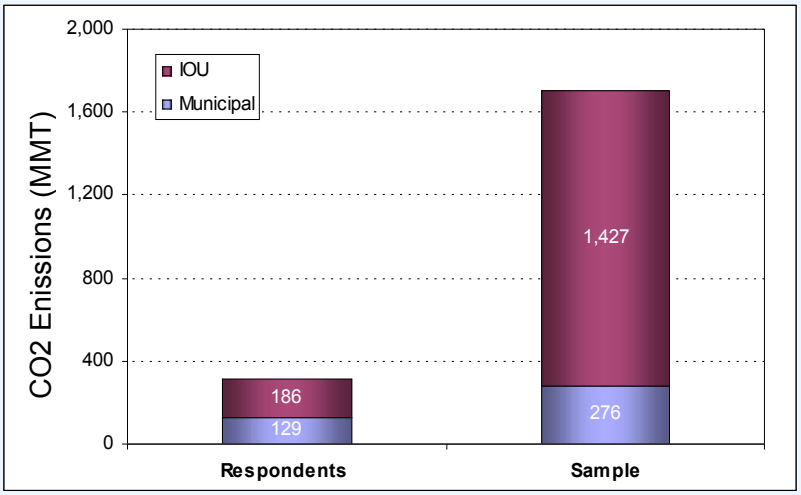


Total net generation of the respondents is 389,388,747 MWh, representing 18.05% of the sample's net generation, 2,157,518,970 MWh.

CO_2 Emission Potential Bias

We evaluated the respondents' representation of the sample with respect to CO_2 emission level (Figure 13). The 53 respondents for which CO_2 emissions data was available contributed a total of 315 MMT of CO_2 emissions in 2004. This is 19% of the sample's total CO_2 emissions (1703 MMT).

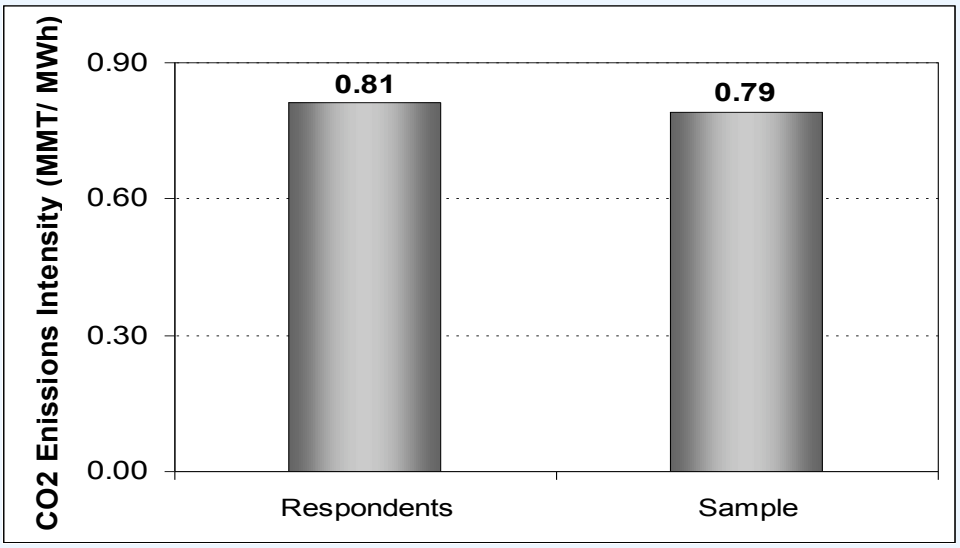
Figure 13: Respondents vs. sample, by CO_2 emissions (MMT)



The CO_2 emissions of investor owned utilities that responded to the survey represent 13% of sample IOUs' CO_2 emissions. In contrast, municipal utilities that responded to the survey represented 46% of sample municipal CO_2 emissions. Therefore, the respondents in general emit significantly less CO_2 emissions than the sample population (81% less). But, when comparing CO_2 emissions by ownership, the municipal utilities that responded to the survey are more representative of the sampled municipal utilities than IOUs. Nevertheless, respondents appear to have a significant bias with respect to CO_2 emission level.

In contrast, the results show that respondents have only a slightly higher CO_2 intensity than the sample population (Figure 14). Hence, based on the CO_2 emission intensity variable (CO_2 emissions / MWh), respondents are very representative of the sample.

Figure 14: Respondents vs. sample, by CO_2 emission intensity



Carbon dioxide emission intensity indicates the amount of CO_2 emissions generated for every unit of electricity produced, and can be calculated by dividing CO_2 emissions in metric tons by net generation in megawatt hours. The CO_2 intensity of respondents is 0.811 metric ton/MWh and that of the sample is 0.79 metric ton/MWh.

Fuel Mix Potential Bias

We examined the respective fuel mixes of respondents and the sample population (Table 6). The percent use of coal-based generation of respondents is slightly higher than the sample population. However, the sample population's oil-based generation is higher than that of the respondents. Overall coal remains to be the most predominant energy source followed by nuclear, natural gas, hydro, oil, and other renewable sources like biomass for both respondents and the sample.

Table 6: Fuel mix of respondents vs. sample

	Respondents	Sample
Coal	71.58%	61.55%
Oil	0.96%	4.59%
Natural Gas	6.74%	10.79%
Nuclear	16.17%	18.10%
Hydro	4.30%	4.77%
Other Renewable Sources	0.25%	0.22%

Geographic Location Potential Bias

In looking at geographical location (Table 7) of respondents vs. sample utilities, the sample population's net generation and CO_2 emissions weighs slightly toward the Central region (Figure 15). In contrast, that of respondents is located more heavily in the Eastern region. Therefore, respondents may be slightly biased toward the central region.

Table 7: Nine NERC regions

Central Region	Eastern Region	Western Region	AK / Territories
ECAR, MAIN, MAPP, SPP, SERC (parts)	FRCC, MAAC, NPCC, SERC (most)	WECC, ERCOT	Alaska, Puerto Rico, Virgen Islands, Guam

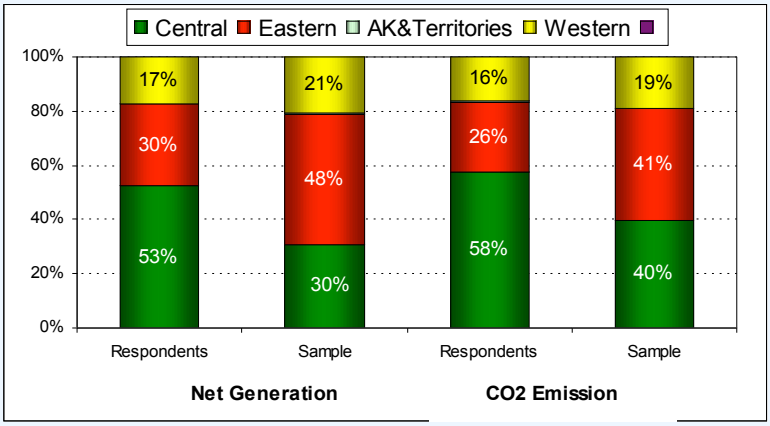


Figure 15: Respondents vs. sample, by region

For both respondents and the sample, the Central region used more coal for electricity generation than any of the other three regions, and the Western and Alaska / U.S. territories regions used more renewable energy sources to generate electricity than the Central and Eastern regions (Figure 16). Hence, in each region, the fuel mix of respondents (in percentage) closely represents that of the sample.

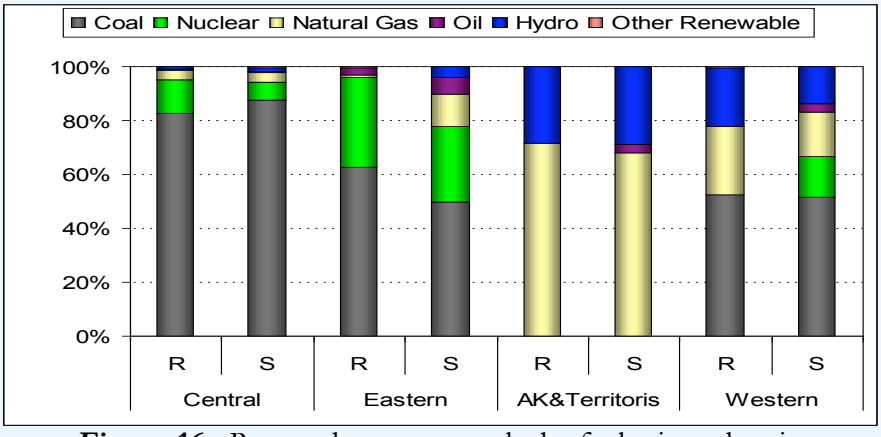


Figure 16: Respondents vs. sample, by fuel mix and region
R = Respondents, S = Sample

Regression Analysis

To test for any bias in the respondents, survey responses were analyzed based on ownership (investor owned = 1, municipal = 0), size (log of total net generation in MWh), CO_2 intensity (metric tons CO_2/MWh), percent coal generation, and percent renewable generation. Due to the enormous range of values for total net generation (7 orders of magnitude), a log base 10 transform was used to rescale this variable so that large generators did not overwhelm the model. A similarity matrix revealed that percent coal generation was significantly correlated with ownership, size, CO_2 intensity, and percent renewable generation (Table 8). Because the term for percent coal generation is essentially redundant, it was not included in further modeling. Two other significant correlations also emerged. Size was positively correlated with ownership and CO_2 intensity was negatively correlated with percent renewable generation. These latter correlations were anticipated and indicate high quality data.

Table 8: Pearson correlation between vectors of values

		1			0	1
	N					
O			1	*		* 4
	N					
			*	1		* 8
	N					
		0			1	*
	N					
		1	*	*	*	1
	N					
			4	8		1
	N					

Lack of correlation between survey response and ownership, size, CO_2 intensity, and percent renewable generation supports the notion that respondents are not biased. Taking the analysis one step further, a binary logistic regression predicting survey response was created (Table 9). The vector for response was coded "1" for utilities that did respond and "0" for utilities that did not respond or declined to respond. The model summary shows that none of the variables have a significant effect on response at the 0.05 level. Of all the terms used to predict response, percent renewable generation comes nearest to being significant.

Table 9: Binary logistic model predicting survey response

	B	S.E.	Wald	df	Sig.	Exp(B)
Ownership	-0.08098	0.411459	0.038732	1	0.843981	0.922215
Log of Net Generation	0.032488	0.106873	0.092406	1	0.761141	1.033021
CO_2 Intensity	0.504518	0.612042	0.6795	1	0.409759	1.656186
% Renewable Generation	1.217541	0.676168	3.242331	1	0.071758	3.378868
Constant	-2.12141	0.892834	5.645586	1	0.017499	0.119862

This logistic model is based on ownership, size, CO_2 intensity, and % renewable generation. 80% of cases were classified correctly. R^2 = 0.028 (Nagelkerke), 0.018 (Cox & Snell).

In order to test whether significance could be improved through the elimination of extraneous terms, a backward stepwise elimination process was implemented to sequentially remove the least significant terms and then recalculate the model. After 4 steps, percent renewable generation remained the only term that was likely having an effect on response (within 90% confidence). By eliminating the other variables, the confidence in the significance of the effect of percent renewable generation was improved to nearly, but not quite, 95% (Table 10). However, the model was only able to explain 2.2% of total variance, suggesting that it is a very poor model. A bias toward utilities with higher renewable generation is possible, but not certain. Overall, lack of significance at the 0.05 level for all parameters indicates that survey respondents are not significantly biased in terms of ownership, net generation, CO_2 intensity, or fuel mix.

Table 10: Binary logistic model predicting survey response (% renewable generation)

	B	S.E.	Wald	df	Sig.	Exp(B)
% Renewable Generation	0.759442	0.393858	3.718011	1	0.053828	2.137084
Constant	-1.5609	0.18787	69.02959	1	9.7E-17	0.209946

This logistic model is based on % renewable generation. 80% of cases were correctly classified. R^2 = *0.022 (Nagelkerke), 0.014 (Cox & Snell).*

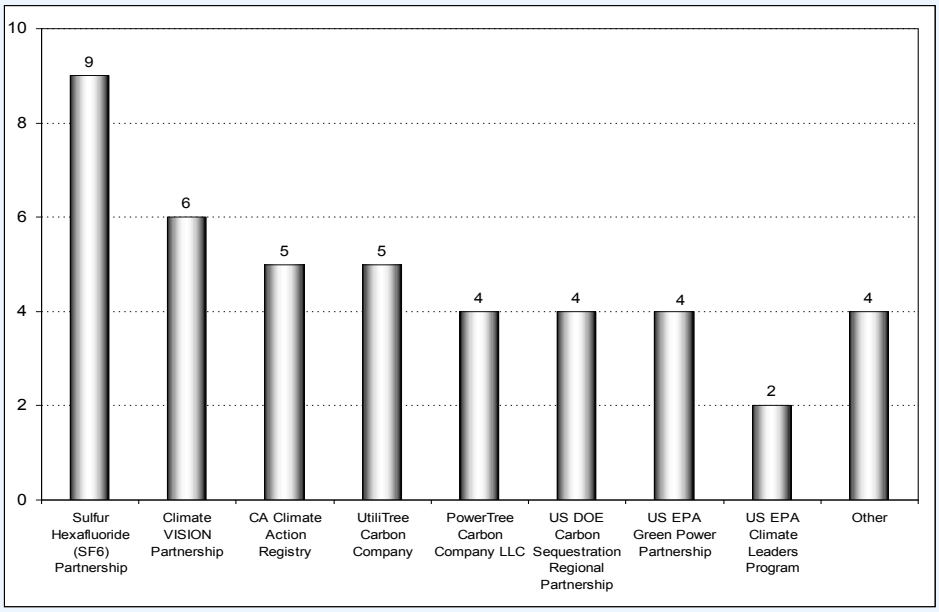
4.2 GHG Emission Reduction Partnerships

The GHG Emission Reduction Partnership involvement section of the survey was completed by 39 utilities. The utilities were given a choice of nine partnerships, the "none" option and an opportunity ("other") to specify a partnership that may not have been listed in the survey. For more information on the electric utility partnerships for reducing GHG emissions see Appendix E. The partnerships listed in the survey were:

- California Climate Action Registry
- Climate VISION Partnership
- International Utility Efficiency Partnership
- PowerTree Carbon Company
- Sulfur Hexafluoride (SF_6) Partnership
- U.S. DOE regional Carbon Sequestration Partnership.
- U.S. EPA Green Power Partnership
- U.S. EPA Climate Leaders Partnership
- UtiliTree Carbon Company

Figure 17 summarizes the total number of utilities participating in the partnerships that were listed in the survey. The figure shows that the Sulfur Hexafluoride (SF_6) Partnership was the most frequently selected partnership, followed by Climate VISION, the CA Climate Action Registry and the three Carbon Sequestration Partnerships: UtiliTree, PowerTree and the U.S. DOE regional Carbon Sequestration Partnership. The utilities responding to the "other" category identified the following partnerships in which they participated in to reduce GHG emissions: Climate trust, World Wildlife Foundation (WWF) international power switch campaign and, International Emissions Trading Association (IETA). There were 21 utilities that responded that they did not belong to a partnership.

Figure 17: Total respondents participating in partnerships



Municipal utilities represent 28 of the 39 total responses while investor-owned utilities accounted for the remaining 11. Figure 18 shows the percentage of utilities responding to this portion of the survey analyzed by type of ownership. The figure shows that the top three most frequently selected partnerships among investor-owned utilities are: UtiliTree, SF_6 partnership, and PowerTree. The figure also shows that the top three most frequently selected partnerships among the municipal utilities are: The CA Climate Action Registry, SF_6 partnership, and a tie between Climate Vision and the EPA Green Power Partnership. These results indicate that there is a preference for municipal utilities to be involved in partnerships operated by the State or Federal government, while the investor-owned utilities had a preference for the industry based partnerships, with the exception of the SF_6 partnership.

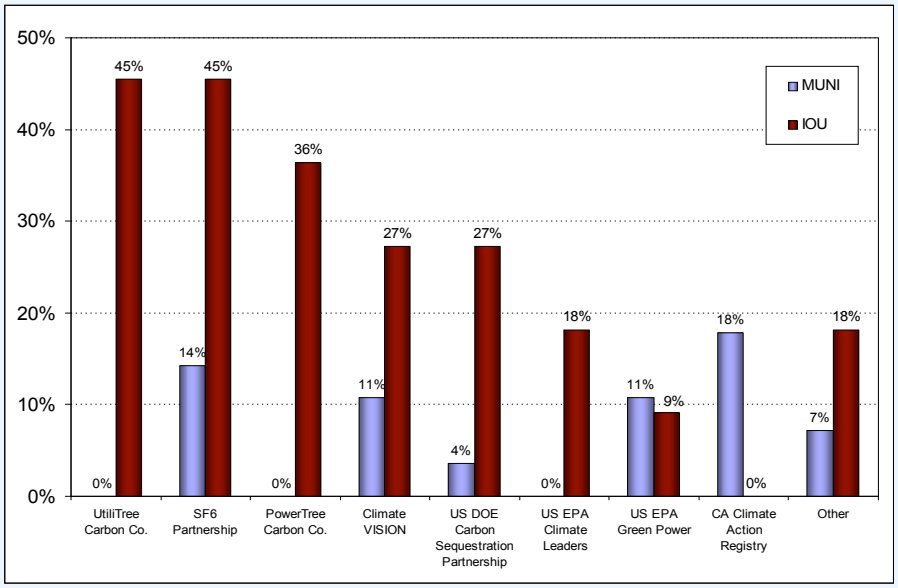


Figure 18: Percentage of respondents participating in partnerships, by ownership type

Figure 19 shows the regional analysis of the utilities responding to the questions in the partnership section of the survey. The figure shows that the western region had the greater number of utilities responding, while the central region had the largest percentage of the net generation and CO_2 emissions of the total responses. Figure 20 shows the regional analysis for each of the partnerships listed in the survey by percentage of the count of utilities involved in each.

Figure 19: Regional analysis of utilities responding to partnership questions

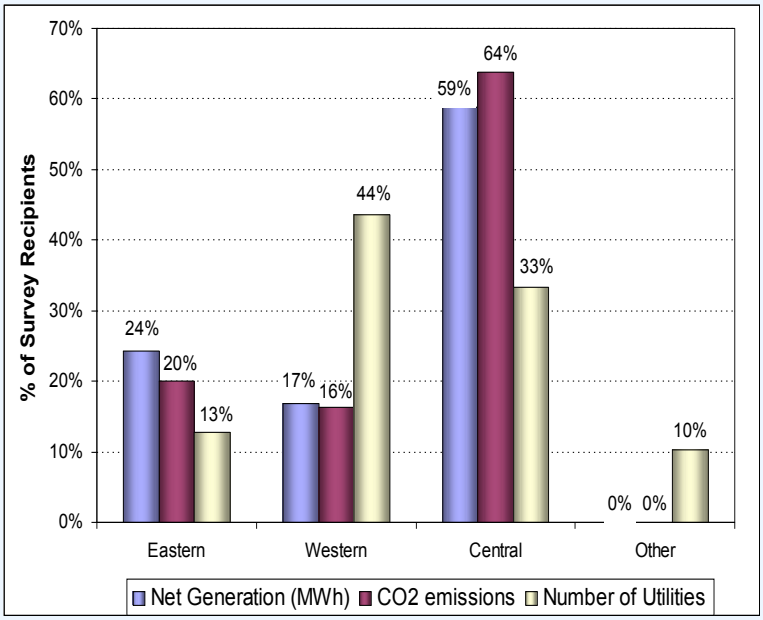


Figure 20 shows that four of the partnerships have representation in all three of the major regions: Climate Vision, U.S. DOE Carbon sequestration partnership, UtiliTree, and the SF_6 partnership. The PowerTree partnership responses came from only the eastern and central regions, while the Climate Leaders program responses are dominated by the central region and the EPA Green Power partnership and CA Climate Action Registry are dominated by responses from the western region.

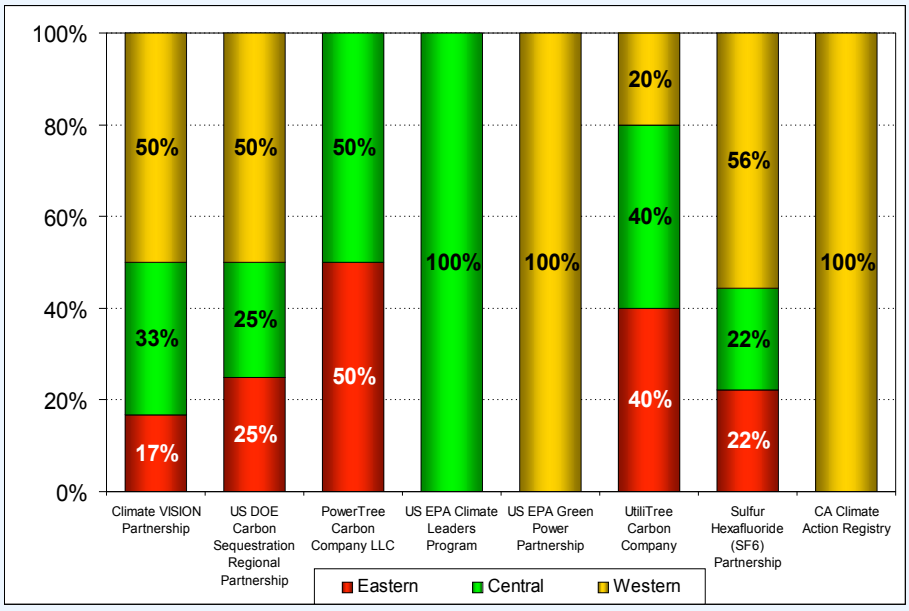


Figure 20: Regional analysis of partnerships, by count

The utilities responding to the partnership questions were also analyzed according to fuel mix. Figure 21 shows the fuel mix for each partnership. The figure shows that the partnerships' fuel mix is heavily dominated by coal use and in all cases except the EPA Green Power partnership the percentage of coal use is greater than the percentage of coal use (61%) for the total pool of utilities receiving surveys. The nuclear portion of the fuel mix is the second largest fuel source for all partnerships except the EPA Green Power Program and CA Climate Action Registry which has the natural gas as the second largest source. This fuel mix analysis shows that the higher emitting, heavy coal using utilities are involved in partnerships to reduce GHG emissions.

Figure 21: Fuel mix analysis of partnerships (as % of net generation)

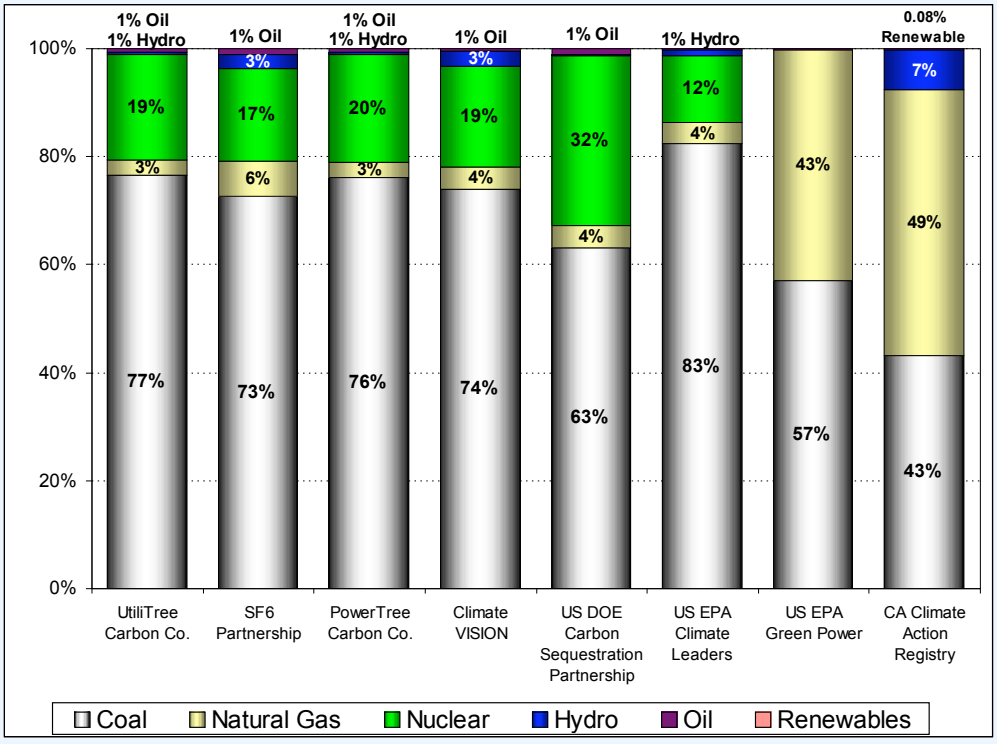


Figure 22 shows the CO_2 intensity for the different partnerships. All partnerships show a higher CO_2 intensity than the CO_2 intensity of the pool of utilities receiving surveys, with the exception of the DOE regional carbon sequestration partnership. This finding is Consistent with the previous graph which showed a heavy reliance on coal from the utilities involved in partnerships. Figure 23 shows the count of responding utilities and the number of partnerships they are involved in. The figure shows that most of the responding utilities are not involved in a partnership.

Figure 22: CO_2 intensity of partnership respondents

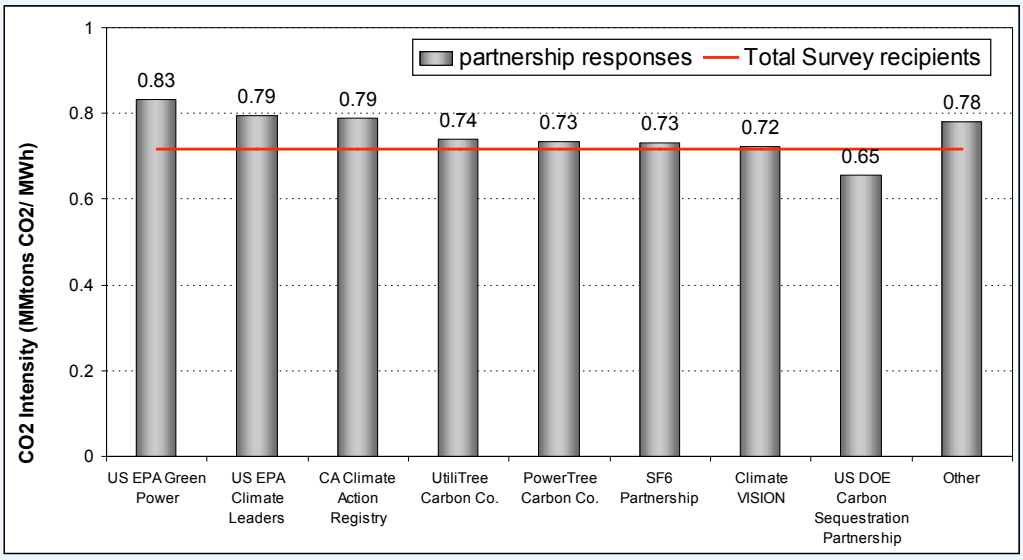
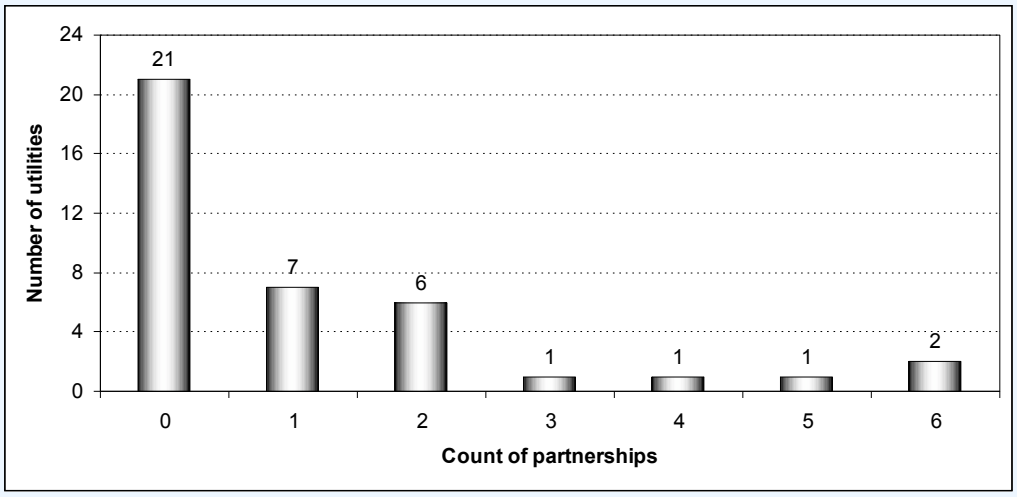


Figure 23: Number of partnerships involved

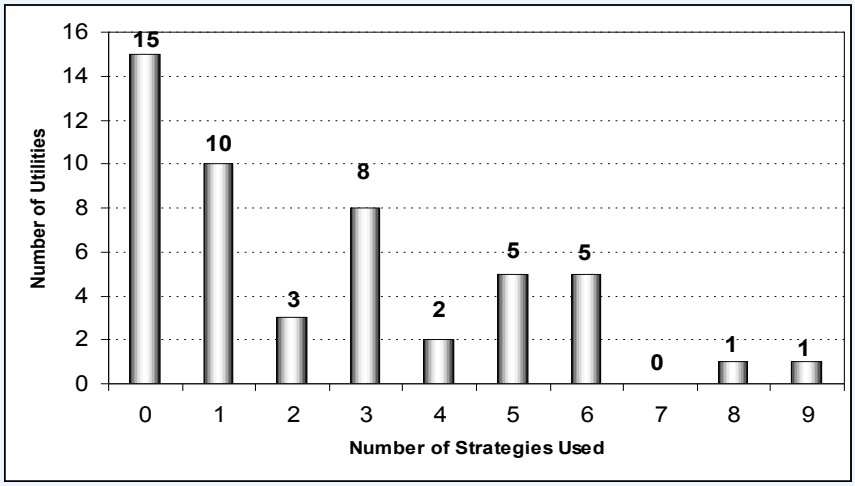


Most utilities are not involved in partnerships to reduce GHG emissions. Investor-owned utilities are more involved in partnerships than municipal utilities. The most frequently selected partnerships are the SF_6 partnership, Climate VISION partnership, the CA Climate Action Registry and the carbon sequestration partnerships. Carbon sequestration is the most frequently selected GHG reduction method when the responses from UtiliTree, PowerTree and the U.S. DOE Regional partnerships were combines. Municipal utilities tend to favor partnerships established by the Federal and State government while investor-owned utilities tend to favor industry partnerships. The utilities with the larger percentage of coal in their fuel mix and high CO_2 intensities are involved in partnerships. This makes sense because the utilities with lower CO_2 intensities would not feel as much pressure to reduce GHG emissions because their impact is less than that of the bigger polluters.

4.3 GHG Reduction Strategies

We analyzed the survey responses to assess the usage of GHG reduction strategies by electric utilities in the U.S. Fifty respondents completed the reduction strategies section of the survey. The remaining 11 respondents were excluded from the analyses because we didn't want to assume that they use 0 strategies. The majority of utilities rely on at least one strategy to reduce GHG emissions with 35 utilities using 1 or more strategy and 14 using none (Figure 24). In addition, the following analyses exclude the strategy, 'Environmental Dispatch,' although it was an option for reduction in the survey because none of the respondents use the strategy.

Figure 24: Number of GHG reduction strategies used by utilities



A binary logistic model was created to investigate whether ownership, size, CO_2 intensity, percent coal generation, and percent renewable generation have an effect on a utility's decision on whether or not to adopt GHG reduction strategies (At least one reduction strategy = 1, no reduction = 0). For this model, the term percent coal generation was reintroduced in order to test whether heavy coal users were more or less likely to implement GHG reduction. As it turns out, size (represented by log of net generation) has a very significant effect on whether or not a utility has adopted GHG reduction (Table 11). Using the backward stepwise elimination process as before leaves size as the singular predictor of GHG reduction significant well within 99% confidence (Table 12). No other terms had a significant influence on GHG reduction activity within 90% confidence.

Table 11: Binary logistic model of GHG reduction activity predicted

	B	S.E.	Wald	Sig.	Exp(B)
Ownership	1.454	1.138	1.631	0.202	4.280
Log of Net Generation	0.986	0.400	6.084	0.014	2.682
CO_2 Intensity	-2.415	3.174	0.579	0.447	0.089
% Coal Generation	1.340	2.093	0.410	0.522	3.820
% Renewable Generation	-1.913	2.547	0.564	0.453	0.148
Constant	-4.466	3.429	1.696	0.193	0.011

This logistic model is by ownership, size, CO_2 intensity, % coal generation, and % renewable generation. 71.4% of cases were correctly classified. R^2 = 0.415 (Nagelkerke), 0.311 (Cox & Snell).

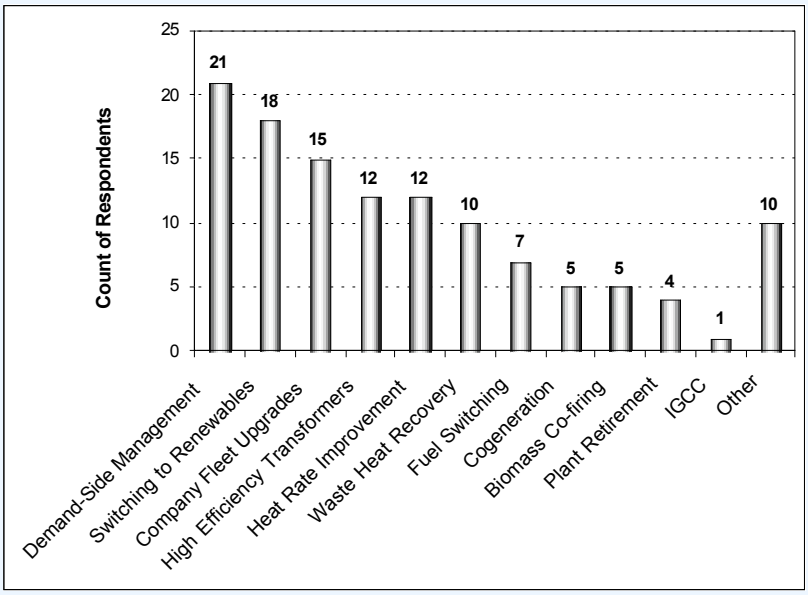
Table 12: Binary logistic model of GHG reduction activity predicted by size.

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	0.829262	0.267441	9.61454	0.00193	2.291626
Constant	-4.34393	1.503736	8.344904	0.003868	0.012985

71.4% of cases were correctly classified. R^2 *= 0.371 (Nagelkerke), 0.278 (Cox & Snell).*

Knowing now that larger utilities are more likely to be taking action to reduce their GHG emissions, it is useful to investigate the type of strategies that utilities have adopted. Among survey respondents, the strategies most frequently adopted to reduce GHG emissions were demand-side management and switching to renewable energy (Figure 25).

Figure 25: "In 2005, which of the following methods did your company utilize to reduce GHG emissions?"



Demand-Side Management is the most commonly used strategy with 21 utilities (34% of respondents) employing it. Details of the strategies identified by the "other" response option are found in Table 13.

Table 13: Responses to 'Other' option

Hydro efficiency upgrades; commute trip reduction program
Nuclear Generation
MSW LF Gas
Refrigerant, SF6 Recycling
The utility started a loan program for solar hot water heaters
Maximizing hydro generation
Energy efficiency investments wind and hydro purchases
Office solar system
Energy conservation

Many of the utilities that utilize demand-side management and switching to renewable energy sources as GHG reduction strategies also operate within states that have energy efficiency and renewable portfolio standards in place [see Appendix F]. This raises the question of whether utilities adopting these strategies are doing so truly for the purpose of GHG reduction or rather because they are forced by existing regulations. In order to test this, binary logistic regressions were performed to attempt to predict adoption of specific GHG reduction strategies in response to a set of variables explaining existing regulations (again, adopted = 1, not adopted = 0). The size parameter was preserved from the previous reduction activity model due to the demonstrated influence it has over GHG reduction behavior.

Of the 21 utilities that claim to be reducing GHG emissions through demand side management, 5 operate within states with Energy Efficiency Portfolio Standards (EEPS). The logistic model shows that EEPS has almost no effect on a utility's decision of whether or not to use demand side management to reduce GHG emissions (Table 14). A marginal effect of financial subsidies was detected, however the effect was not significant within 90% confidence.

Table 14: Binary logistic model predicting adoption of demand side management

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	0.398	0.234	2.905	0.088	1.489
EEPS	-0.037	0.901	0.002	0.968	0.964
Existing State Regulations	-0.146	0.237	0.379	0.538	0.864
State Financial Subsidies	-0.430	0.276	2.431	0.119	0.651
Constant	-0.935	1.893	0.244	0.622	0.393

This logistic model predicts the adoption of DSM as a function of net generation, energy efficiency portfolio standards (EEPS), existing state regulations, and state financial subsidies. 63.4% of cases were classified correctly. R^2 = 0.279 (Nagelkerke), 0.209 (Cox & Snell).

Of the 18 utilities that claim to be reducing GHG emissions through switching to renewable energy sources, 13 operate within states with Renewable Portfolio Standards (RPS). As the logistic model shows, the presence of a state level RPS does not significantly influence a utility's choice of switching to renewable energy sources as a means to reduce GHG emissions (Table 15). Again, a slight effect of state financial subsidies appears.

Table 15: Binary logistic model predicting switching to renewable energy

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	0.603	0.284	4.508	0.034	1.827
RPS	-1.036	0.885	1.369	0.242	0.355
Existing State Regulations	-0.154	0.289	0.282	0.596	0.858
State Financial Subsidies	-0.709	0.422	2.828	0.093	0.492
Constant	-1.659	2.006	0.684	0.408	0.190

This logistic model predicts switching to renewable energy as a function of net generation, renewable portfolio standards (RPS), existing state regulations, and state financial subsidies. 75.6% of cases were classified correctly. R^2 = 0.458 (Nagelkerke), 0.338 (Cox & Snell).

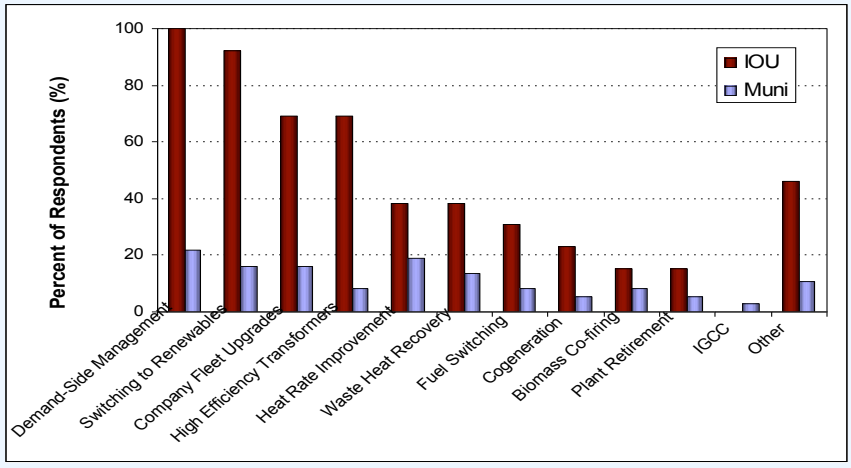
In a final test, a similarity matrix (Table 16) was developed to examine the correlations between variables explaining existing state regulations, incentives, and GHG reduction strategies. Significant correlations exist between EEPS and RPS. Also significant is the correlation between the use of demand-side management and switching to renewable energy generation. Less significant is the correlation between state financial subsidies and switching to renewable energy generation.

Table 16: Similarity matrix of variables explaining existing state regulations, incentives, and GHG reduction strategies

		1					
			1				
				1			
					1		
						1	
							1

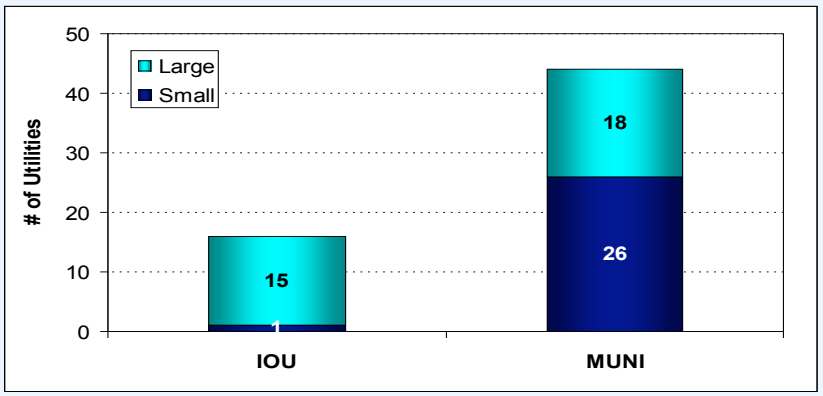
Looking at reduction strategies with respect to ownership type (Figure 26), we see the difference in how investor owned and municipal utilities use strategies. Overall, IOUs are more active in using reduction strategies with almost all of the strategies being used significantly more by IOUs than municipal utilities. In addition, the orders of preference for reduction strategies differ among ownership type. While Demand-Side Management is the most commonly used strategy for both investor owned and municipal utilities, switching to renewable energy sources is second for IOUs whereas heat rate improvement is second for Municipals. Heat rate improvement is the fifth most commonly used strategy for IOUs.

Figure 26: GHG reduction strategies, by ownership type



We then looked at utilities with respect to size (Figure 27) and all but one of the IOUs were large utilities whereas the majority of municipal utilities are small. 'Large' utilities are those that generated more than 150,000 MWh and 'small' utilities generated less than 150,000 MWh. There were 8 utilities for which there were no generation data available and they were excluded from the analysis.

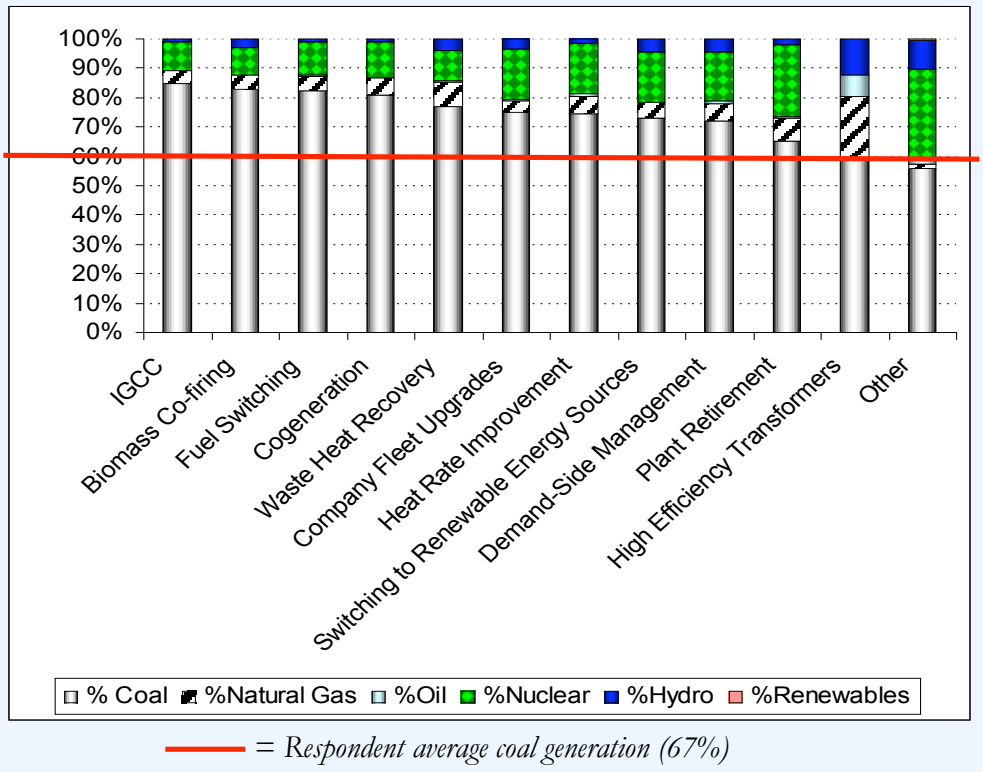
Figure 27: Utility size analysis



(Sources: egrid, EIA)

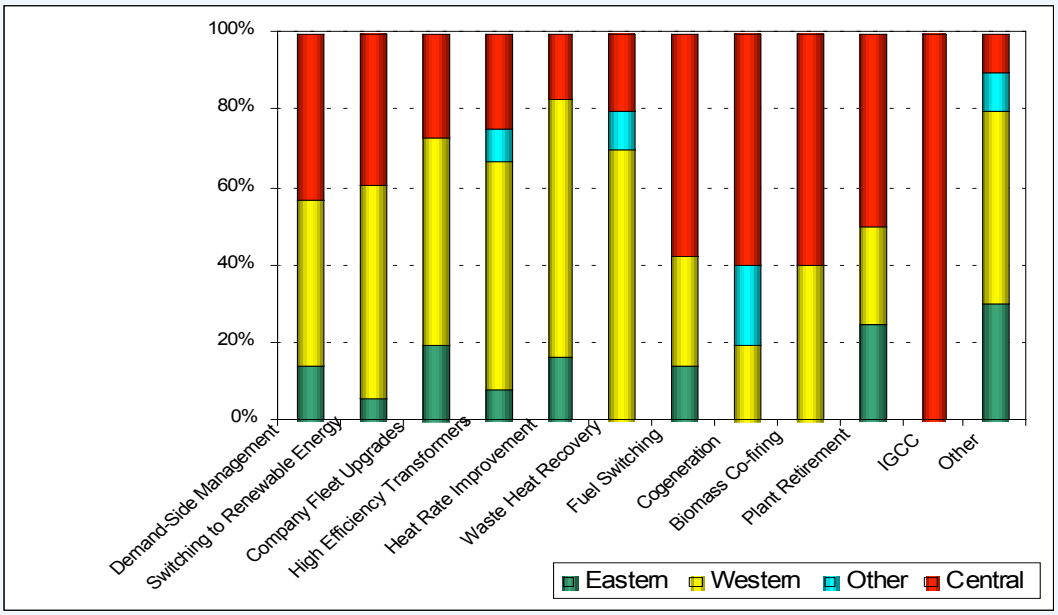
Figure 28 shows the reduction strategies represented by fuel mix (each fuel type as percent of net generation). In addition to large utilities being more active in using reduction strategies, results show that respondents who are using reduction strategies have slightly higher percent coal generation (72%) than the respondent average of 67%. Therefore, it appears that utilities who have coal as a significant percentage of their fuel mix are the ones using GHG reduction strategies.

Figure 28: Fuel mix analysis of reduction strategies (as % of net generation)



In looking at the use of reduction strategies by region (Figure 29), utilities in the Western and Central regions appear to be more active in reducing greenhouse gases than those in the Eastern region. Figure 29 shows the percentage that strategies used by respondents shows up in each region. For example, IGCC is used by one company, and that company is located in the Central region.

Figure 29: GHG reduction strategies, by region



Overall, the leading GHG reduction practices used by the respondents are demand-side management, followed by switching to renewable energy and company fleet upgrades. Investor-owned utilities are more active than municipals and the majority of investor-owned utilities are large. Although there is some variation in respondents' use of strategies with respect to fuel mix and regional location, these factors did not significantly influence the utilities' use of strategies.

4.4 Offsetting Practices

Although the majority of respondents use at least one reduction strategy, zero is the most common number of offsetting practices used by respondents with 62% using no offsetting practices. Figure 30 shows the distribution of the number of GHG offsetting practices used by the respondents.

Figure 30: Number of GHG offsetting practices used by utilities

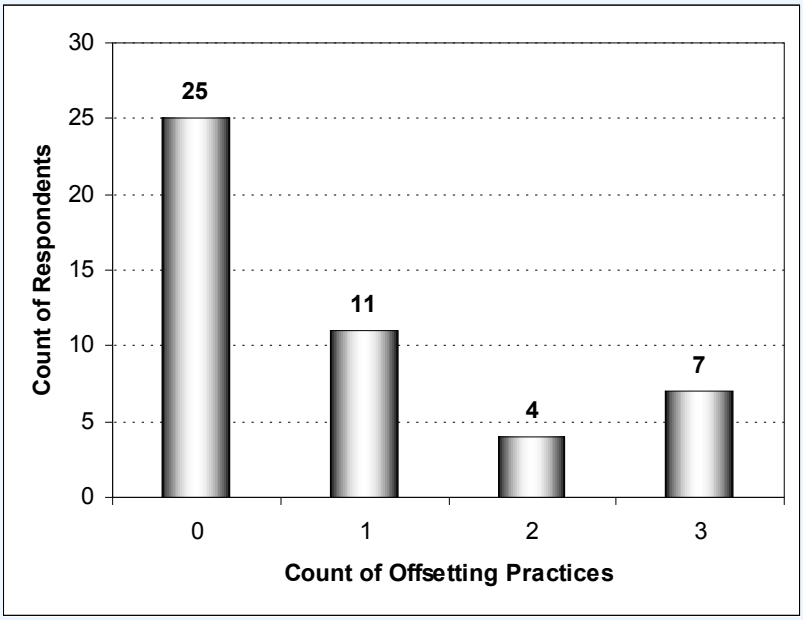


Figure 31 shows the most commonly used practices among the utilities involved on offsetting. The two most common practices are Reforestation and Recycling of Coal By-Products followed by Landfill Methane Gas Capture. As with the list of reduction strategies, the choice of offsetting practices in the survey was not exhaustive and practices that were not on the list are captured in the 'other' category found in Table 17.

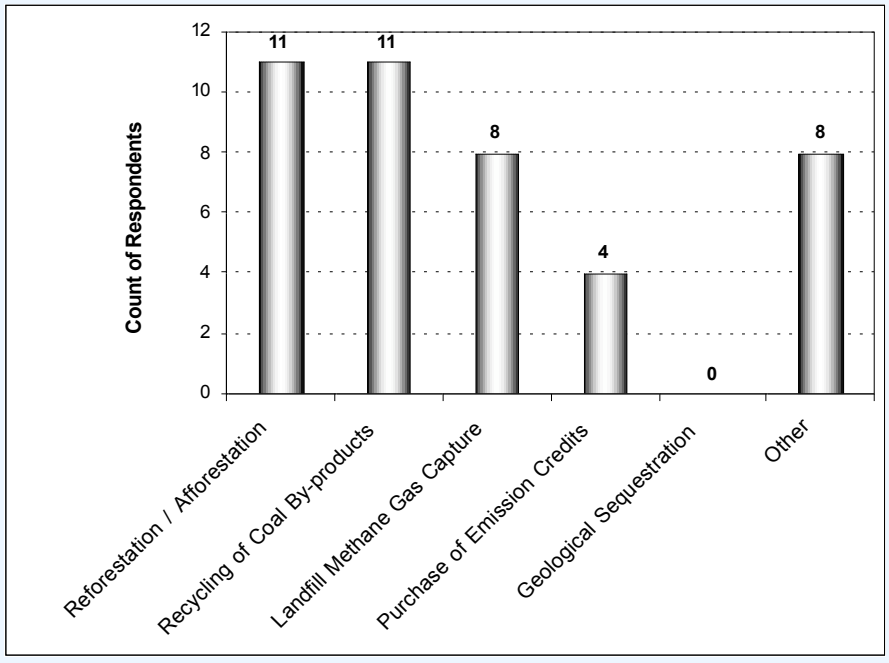


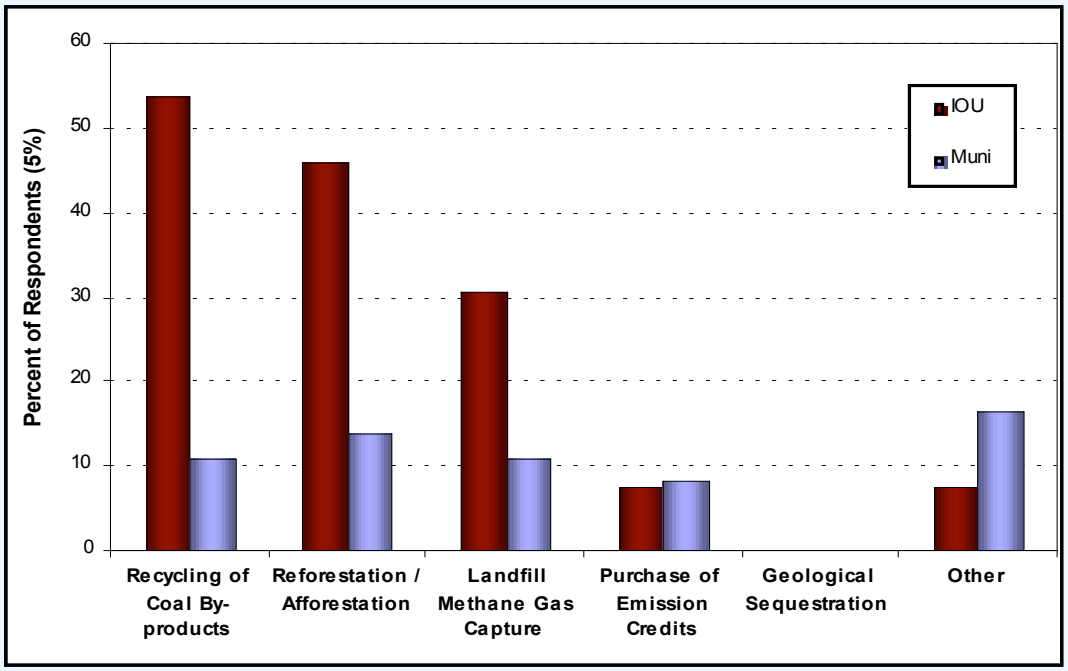
Figure 31: "In 2005, which of the following practices did your company utilize to offset GHG emissions?"

Table 17: Responses to 'Other' option

Truck stop idling program
In our state we are required to buy Renewable Energy Certificates, even though we cannot purchase the energy associated with unit power.
We provide trees to customers to reduce energy consumption. Our goal is one tree per meter.
Tree Planting, Electric Lawn equipment rebates, Partial conversion of service fleet to (E85), and Nuclear power.
Additional Renewable Power Purchase Agreement
We purchased offsets from funding the use of biodiesel in City trucks, solid waste trucks, metro buses and from the electrification of cruise ships in port. We also purchased offsets from the destruction of a potent GHG chemical.
Wind Purchase

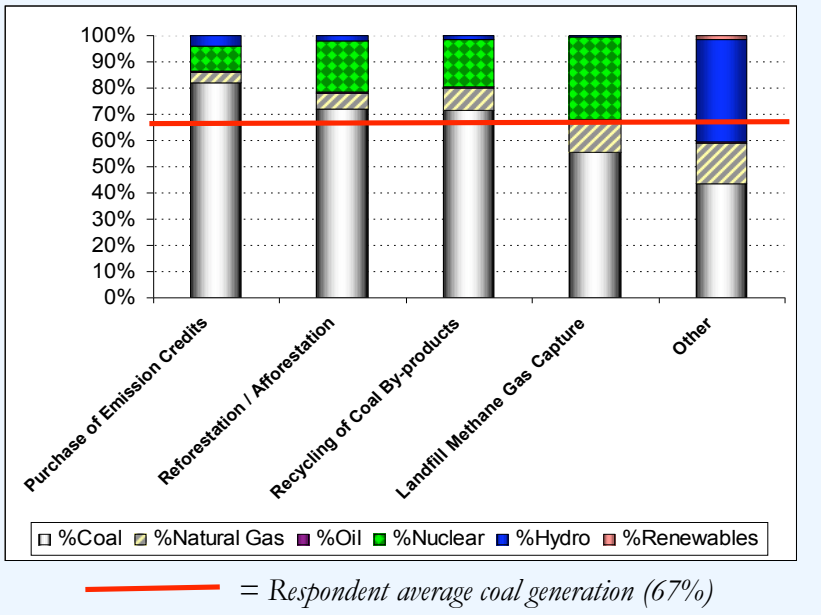
As with GHG reduction strategies, IOUs are in general, significantly more active in offsetting GHG emissions than municipals, with the exception of purchasing emissions credits which is slightly more utilized among municipal utilities. The percentages in Figure 32 represent the amount of utilities within each ownership type that use a certain offsetting practice out of the total number of utilities in that category. Note that utilities that were assumed to have not answered the question (i.e. did not claim to use any practice and did not check the 'none' category) were excluded from the calculations.

Figure 32: GHG offsetting practices, by ownership type



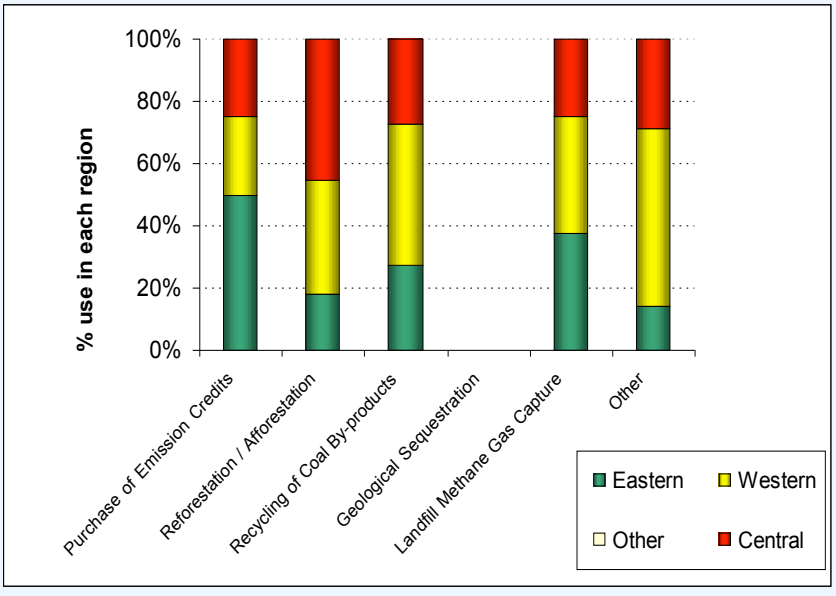
As with reduction strategies, the fuel mix representation of utilities using offsetting strategies is heavily dominated by coal use. Thus we see (Figure 33) that the utilities, which are engaging in offsetting, are in fact using coal for generation.

Figure 33: Fuel mix analysis of offsetting practices (as % of net generation)



Unlike reduction strategies, the use of offsetting practices appears to be more evenly distributed throughout the county (Figure 34).

Figure 34: Regional analysis of GHG offsetting practices



The top offsetting practices used by respondents were reforestation and recycling of coal by-products. Investor-owned utilities are more active then municipals in offsetting GHG emissions. Fuel mix and regional location did not significantly influence respondents' use of offsetting practices. In addition to reducing and offsetting GHG emissions, many utilities offer green power options to customers. An analysis of such programs is discussed in the next section.

4.5 Green Power Programs

In addition to GHG reduction strategies and offsetting practices, we asked respondents if they offer a green power program to customers. Results (Figure 35) show that about half of respondents offer such a program with a range of customer participation from 0 to 5% with 71% of green power program providers having less than 1% customer participation. See Table 18 for descriptions of the individual programs of some of the respondents.

Figure 35: "In 2005, did your company offer its customers the option of purchasing renewable energy ('green power')?"

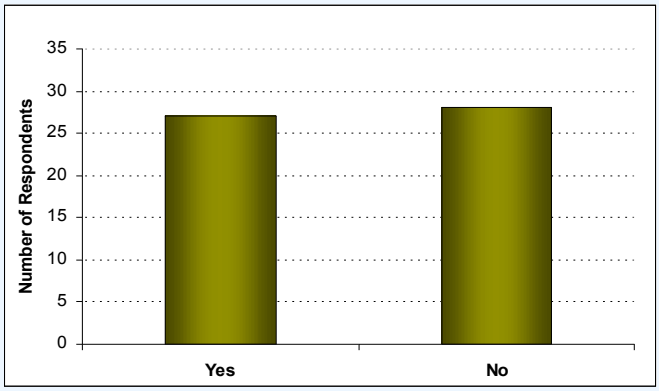


Table 18: Descriptions of programs

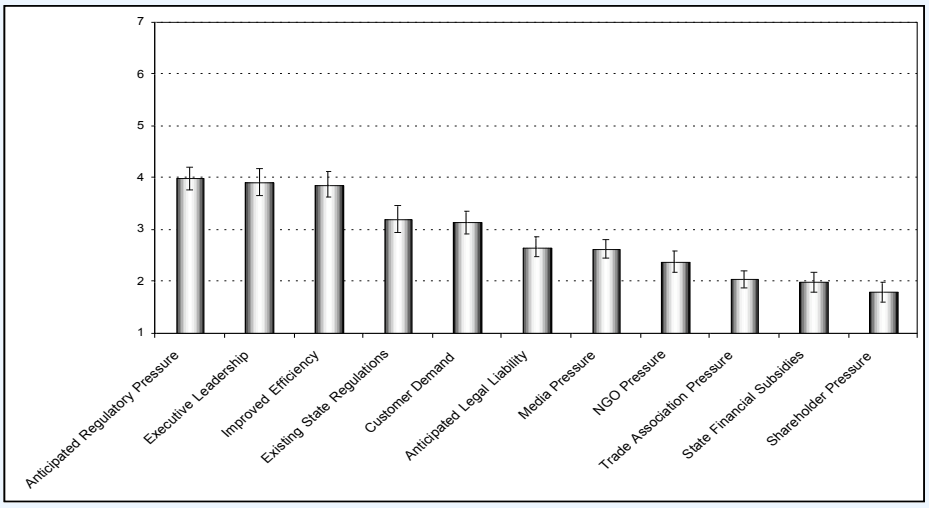
Subscription program that allows residential and commercial customers to receive their electricity from 100% renewable energy sources. Customers enter into 10-yr agreements at a fixed GC price, which replaces the regular fuel charge. Energy sources are comprised of 90% wind s and 10% biofuel from landfills.
300 kWh of wind power off-sets for just one dollar a block. The typical customer purchases five blocks/month.
Customers can choose to donate to a renewable energy fund. These funds are used to invest in renewable energy property or a tangible investment such as a Biofuel Project.
Customers can either purchase green power for the electric grid or contribute to build solar systems at schools. Residents can contribute one of the following: $1.50/100kWh or $3.00/200kWh or $4.50/300kWh per 30-day billing period.
Municipal waste to energy projects, the purchase of wind energy, low interest loans to customers wishing to install solar hot water heaters.
Wind power is sold to customers in 'Blocks' of Kilowatt hours. One 'Block' of wind is equal to 100 kW of wind energy.
Electricity from 2 windmills in blocks of 100 kW/month with a one year commitment at a premium cost dependent on location and type of service
$2 per 100 kWhr block added for purchase renewable green power. Normal retail rate is 4.27 cents/kWh.
Sell energy attributes from two generation resources to a local college
Customers have the option to purchase 200 kWh for $5.00 premium. REC's are purchased.
Contribution program which invests in local solar generation and regional renewable projects by purchasing wholesale green tags. customer could purchase a green tag for a fixed dollar amount
We blend in our wind in the resource mix
Offers customers renewable energy at $3 per 100 kWh block, with bulk discounts.
Customers may contribute a fixed amount per month to be used toward purchase and/or development of green power. To date funds have been used for biodiesel emissions testing.
Additional $0.10/kWh for the first 20 kWh, +$0.075/kWh for purchases beyond 20 kWh. Customer contributions go directly toward building renewable power systems in the state.
Customers can sign up at a 25, 50 or 100 percent level, and the company produces or purchases renewable energy from wind, water, solar and landfill gas to match that percentage of electric usage, which replaces equal amounts of electric generation from traditional sources.

4.6 Motivations

A key element to our research is identifying the principal motivations that drive GHG emission reductions among electric power producers. Knowledge of the strongest motivations is critical to understanding the GHG management decision-making process from the perspective of electric utilities. This information can be used to create convincing incentives for electric utilities to actively reduce their emissions.

The survey asked respondents to rank how strongly 11 factors motivated their decision to reduce GHG emissions on a scale from 1 (no motivation) to 7 (strongest motivation, see Appendix A for exact question format). The motivations that respondents ranked as having the strongest influence are anticipated regulatory pressure, executive leadership, and improved efficiency (Figure 36).

Figure 36: Motivations for GHG mitigation, aggregated for all respondents



Scale: 1 = none, 4 = moderate, 7 = strongest

Respondents were invited to write in additional comments on motivations. One motivation often sited in the free response section is an institutional environmental ethic (Table 19).

Table 19: Additional motivations

Being good environmental stewards and exercising proper risk management with company investments.
Our motivation has come from our customers, our executives and our city council.
The cost of wind generation is becoming attractive on a cost per unit basis in addition to all the environmental benefits.
1. Cost implications regulated vs. non-regulated 2. Technology development and cost 3. Market pricing
The cost of diesel fuel
Change in existing state regulations that may require mandatory CO2 emissions reduction.
Concern about the future of hydro resources. Concern about the future of our environment and desire to mitigate for our impacts.
Company history of environmental stewardship
Local economic impact of promoting agriculture based biofuels.
'It is the right thing to do'

A binary logistic model was used to determine which of the motivational factors was having the most significant impact on whether or not a respondent was taking action to reduce GHG emissions. The variable for utility size was preserved from earlier analyses due to its strong affect on reduction behavior. In order to simplify the model and eliminate unnecessary factors, a backward stepwise selection process was used. After 8 steps, the most significant motivations were state financial subsidies, improved efficiency, trade association pressure, and existing state regulations (Table 20). Running the regression with one motivational factor at a time and size as the predictors shows that the sign of the beta coefficients is stable. Respondents that ranked improved efficiency and trade association pressure as strong motivations were more likely to be engaged in GHG reduction activity. Also, respondents that ranked state financial subsidies and existing state regulations as weak motivations were more likely to be engaged in GHG reduction.

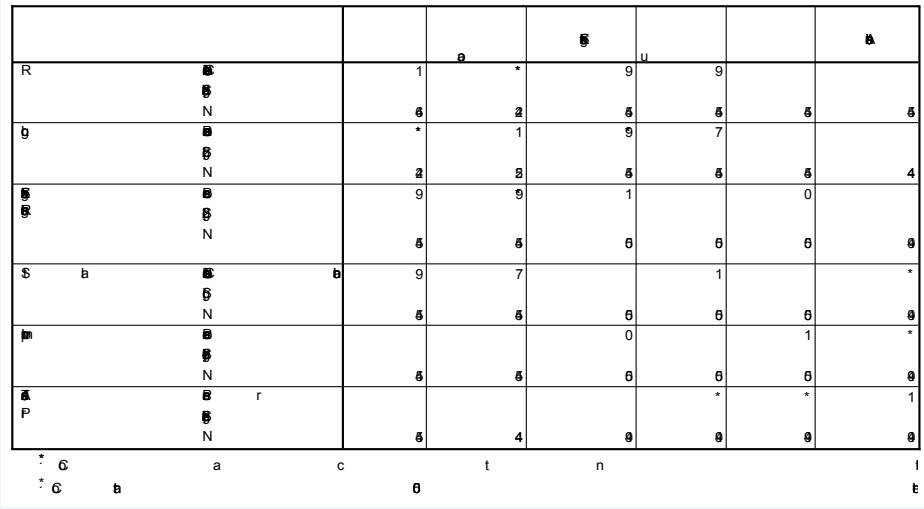
Table 20: Binary logistic model predicting GHG reduction activity

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	0.817	0.331	6.102	0.013	2.264
Existing State Regulations	-0.653	0.389	2.812	0.094	0.520
State Financial Subsidies	-0.680	0.346	3.878	0.049	0.506
Improved Efficiency	0.596	0.326	3.345	0.067	1.815
Trade Association Pressure	0.825	0.456	3.271	0.071	2.281
Constant	-4.873	2.418	4.061	0.044	0.008

This logistic model predicts GHG reduction activity based on the most significant motivational factors and size. 90.2% of cases were classified correctly. $R^2 = 0.613$ (Nagelkerke), 0.459 (Cox & Snell).

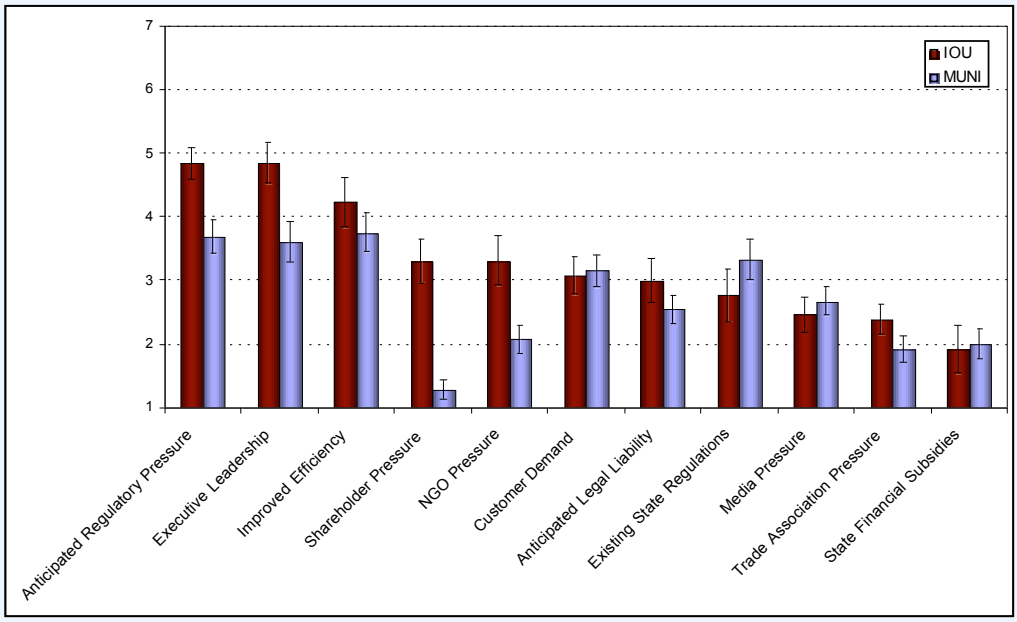
A similarity matrix (Table 21) reveals that the four significant motivations are, for the most part, independent of one another. Trade association pressure was significantly positively correlated with state financial subsidies and improved efficiency at the 0.05 level. Also significant is the negative correlation between size and existing state regulations. This suggests that larger utilities (i.e., investor owned utilities) tend to rank existing state regulations as a weak motivation.

Table 21: Similarity matrix of correlations between reduction, size, and significant motivational factors



Separating utilities by ownership type (Figure 37) shows that differences exist between investor owned and municipal utilities in the extent to which these motivational factors influence behavior. Investor owned utilities are more strongly motivated by anticipated regulatory pressure, executive leadership, shareholder pressure, nongovernmental organization pressure, and trade association pressure than municipal utilities.

Figure 37: Motivations for GHG mitigation, by ownership type



Scale: 1 = none, 4 = moderate, 7 = strongest

Modeling municipal utilities only shows that, of the respondents representing municipal utilities, those who ranked executive leadership as a strong motivation were more likely to be actively reducing their GHG emissions (Table 22). As seen before, those who ranked existing state regulations as a weak motivation were more likely to be actively reducing their GHG emissions. Regressing these motivations individually revealed that the signs of the beta coefficients were stable.

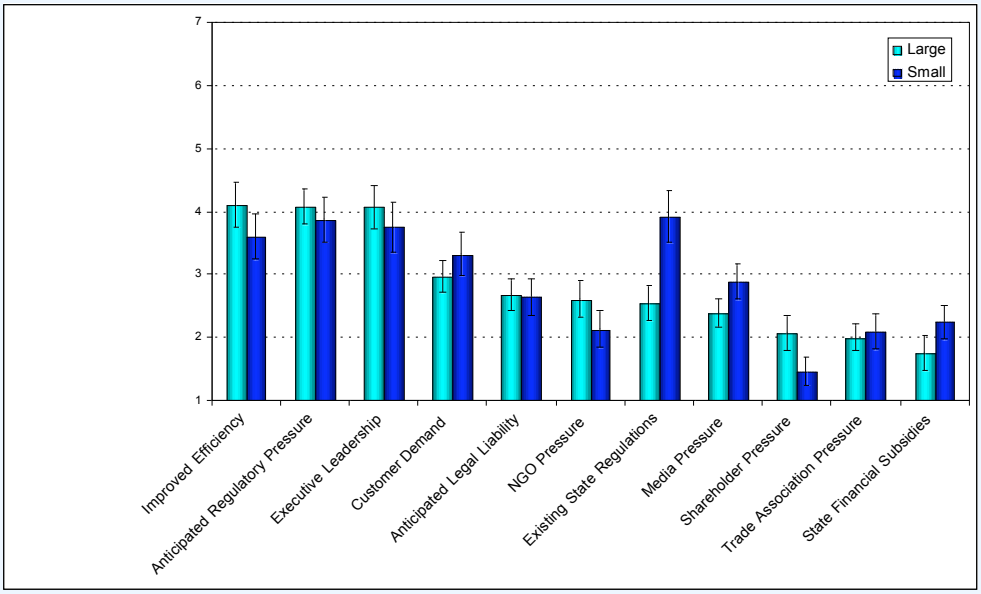
Table 22: Logistic model of GHG reduction activity for MUNIs

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	1.461	0.718	4.143	0.042	4.309
Existing State Regulations	-1.040	0.533	3.807	0.051	0.353
Executive Leadership	0.835	0.416	4.022	0.045	2.305
Constant	-6.600	3.541	3.475	0.062	0.001

This logistic model identifies the most significant motivations, selecting for municipal utilities only. 69.2% of cases were classified correctly. R^2 = 0.737 (Nagelkerke), 0.552 (Cox & Snell).

Overall, size of utilities has little effect on the strength of motivation to mitigate GHG emissions (Figure 38). Small utilities (<150,000 MWh net generation) are more strongly influenced by existing state regulations than large utilities. Shareholder pressure is a stronger motivation for large utilities, suggesting that more investor owned utilities fall into the large utility category than the small category.

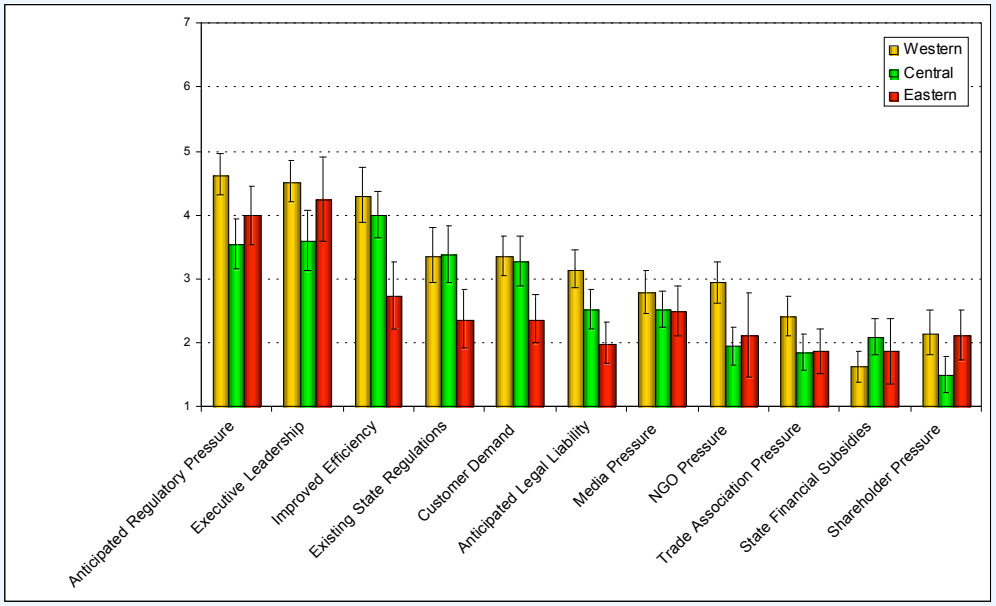
Figure 38: Motivations for GHG mitigation



Motivations for GHG mitigation, by size (large indicates >150,000 MWh net generation). Scale: 1 = none, 4 = moderate, 7 = strongest.

Examining for the effect of region (Figure 39) on motivation shows that, in general, utilities operating in the Western region tended to rank the strength of motivation more highly than utilities in the Central or Eastern regions. Western and Eastern utilities ranked improved efficiency, existing state regulations, and customer demand more highly than utilities in the East.

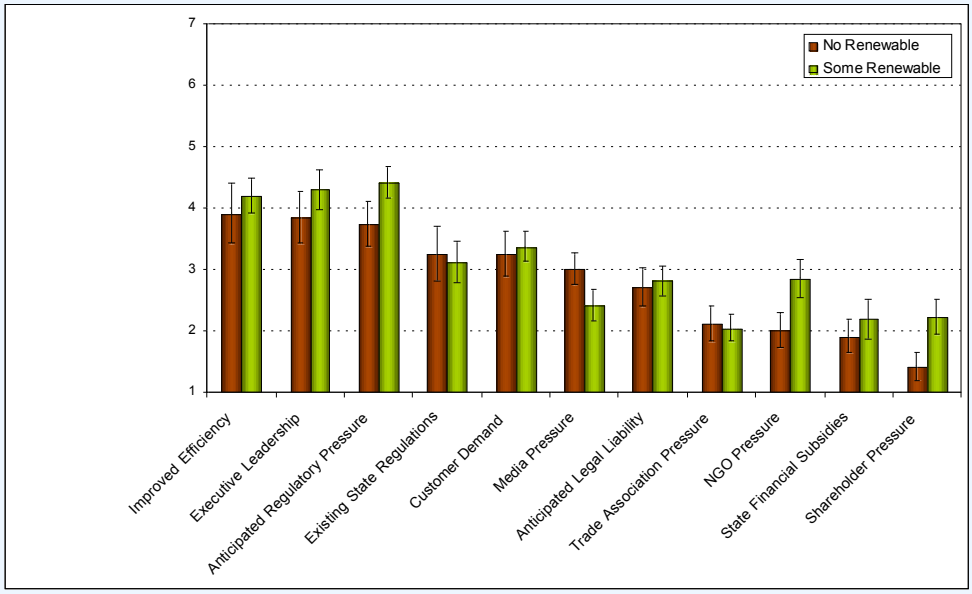
Figure 39: Motivations for GHG mitigation, by region



Scale: 1 = none, 4 = moderate, 7 = strongest.

Utilities that use at least some renewable generation (Figure 40) are more strongly motivated by anticipated regulatory pressure, nongovernmental organization pressure, and shareholder pressure than utilities that have no renewable generation. Utilities without renewable generation are more strongly motivated by pressure from the media.

Figure 40: Motivations for GHG mitigation, by fuel mix



Scale: 1 = none, 4 = moderate, 7 = strongest.

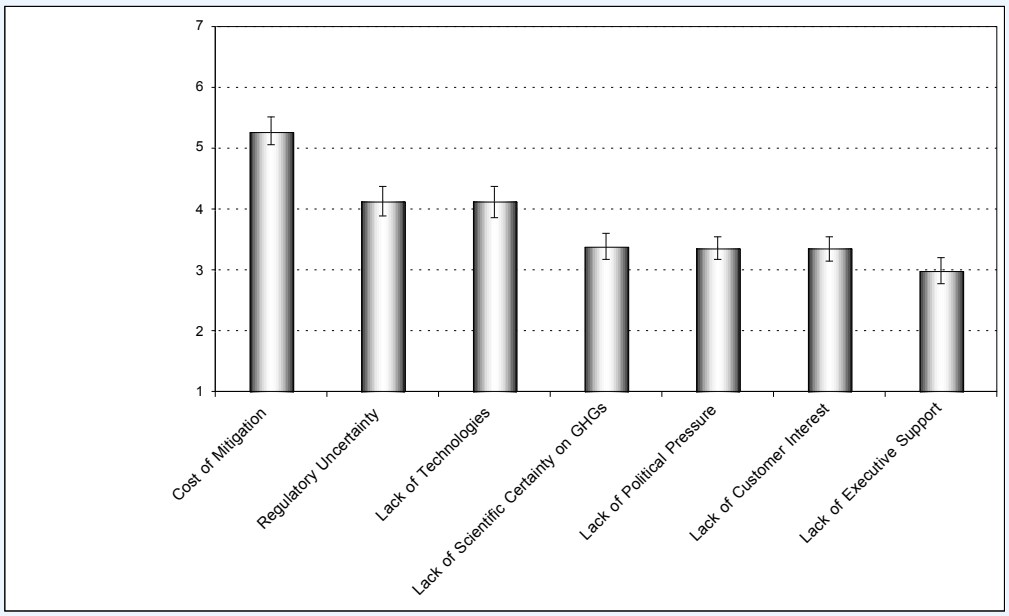
Survey respondents ranked anticipated regulatory pressure, executive leadership, and improved efficiency as the strongest motivations to reducing GHG emissions. A logistic regression model determined that improved efficiency and trade association pressure were the strongest motivations that have a significant and measurable effect on actual emission reduction behavior. However, modeling municipal utilities alone revealed executive leadership as the strongest motivation having a significant and measurable effect on reduction behavior. Focusing on these primary motivations, both stated and revealed, will be instrumental in properly incentivizing further emission reductions.

4.7 Barriers

Identifying the primary barriers that prevent utilities from doing more to reduce GHG emissions is just as important as identifying the primary motivations that drive action. Removing barriers will critical for allowing utilities to engage in GHG reduction or proceed further with existing programs.

The survey asked respondents to rank the strength of 7 barriers to mitigate GHG emissions, again from 1 (not a barrier) to 7 (strongest barrier). Aggregated survey results (Figure 41) show that respondents ranked cost of mitigation, regulatory uncertainty, and lack of technologies as the strongest barriers that prevent GHG mitigation.

Figure 41: Barriers to GHG mitigation, aggregated for all respondents



Scale: 1 = none, 4 = moderate, 7 = strongest

Respondents were invited to write in additional information on barriers that may not have been appropriately conveyed through our list of 7 barriers. Among the comments, cost recovery was repeatedly addressed as a barrier to reduction (Table 23). Utilities are under pressure to keep rates low, which makes it difficult to invest in GHG reduction unless there are mechanisms in place ensuring that those investments with be paid back over time.

Table 23: Additional Barriers

Certainty of regulatory cost recovery.
The primary [barrier] is the lack of FEDERAL regulation.
Most of the incentives are tax credits. To be of any value to municipal utilities like us, they have to be tradable, or a different incentive than a tax credit.
At this time essentially all of our power is hydro which is 'greenhouse gas' neutral. The only other large scale, reliable, and viable source of generation that is 'greenhouse gas' neutral is nuclear.
Staffing limitations
The costs of developing new hydro projects and connecting to other systems with excess available hydro generation
1) Lack of cost recovery mechanisms 2) Prudence barriers with local commissions 3) Competing environmental issues, e.g. environmental regulations like Hg that favor existing coal resources and keep new cleaner resources (like IGCC) from being built
Current state air quality regulations present obstacles to use of biodiesel at blends higher than B2
Cost/rate pressure

A binary logistic model was used to determine which of these factors was having a significant impact on respondent's GHG reduction actions. Again, a backward elimination method was applied in order to identify only the most significant barriers. After 6 steps, regulatory uncertainty and lack of political pressure emerged as the most significant barriers (Table 24). Respondents who ranked regulatory uncertainty as a strong barrier were more likely to be reducing their GHG emissions. Respondents who ranked lack of political pressure as a weak barrier were more likely to be reducing their GHG emissions. Regressing these barriers individually reveals that the signs of the beta coefficients are stable.

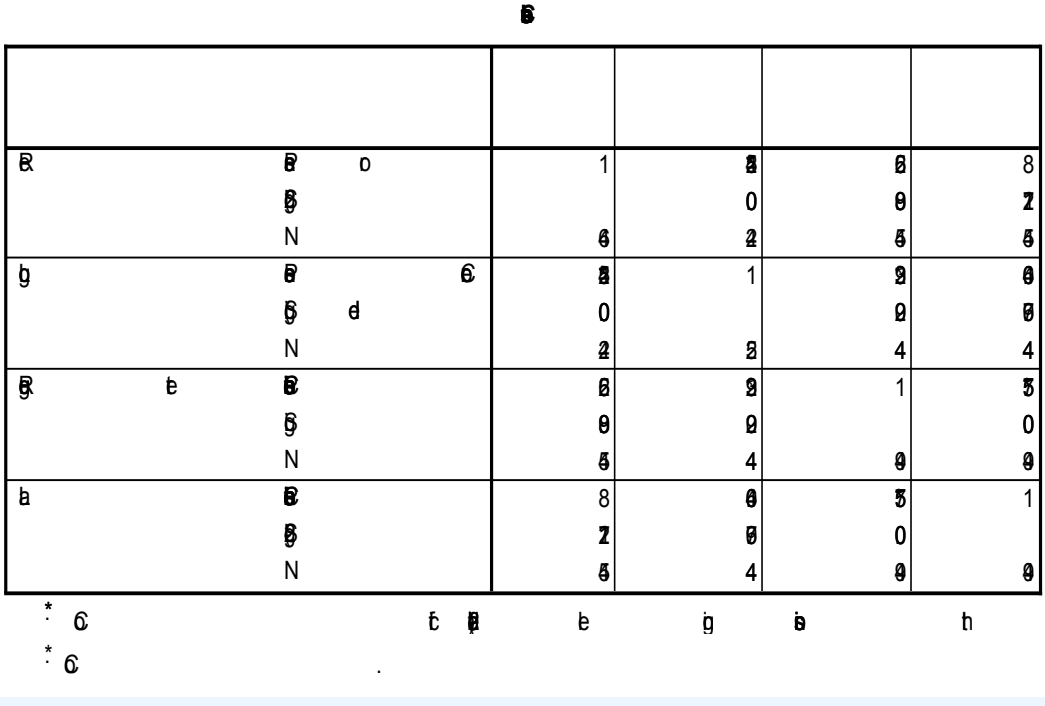
Table 24: Logistic model of GHG reduction activity

	B	S.E.	Wald	Sig.	Exp(B)
Log of Net Generation	0.781	0.299	6.837	0.009	2.184
Regulatory Uncertainty	0.912	0.417	4.774	0.029	2.489
Lack of Political Pressure	-0.839	0.479	3.071	0.080	0.432
Constant	-5.015	2.125	5.568	0.018	0.007

This logistic model identifies the most significant barriers. 75.6% of cases were classified correctly. R^2 = 0.528 (Nagelkerke), 0.396 (Cox & Snell).

A similarity matrix reveals that the two barriers that most significantly influence GHG reduction are highly positively correlated, significant at the 0.01 level (Table 25). This is perhaps not surprising as one would expect political pressure and regulations to be related. The other significant correlation is between size and regulatory uncertainty. That this correlation is positive shows that larger utilities (i.e., investor owned utilities) tend to rank regulatory uncertainty as a strong barrier.

Table 25: Similarity matrix of correlations: reduction, size, and significant barriers.



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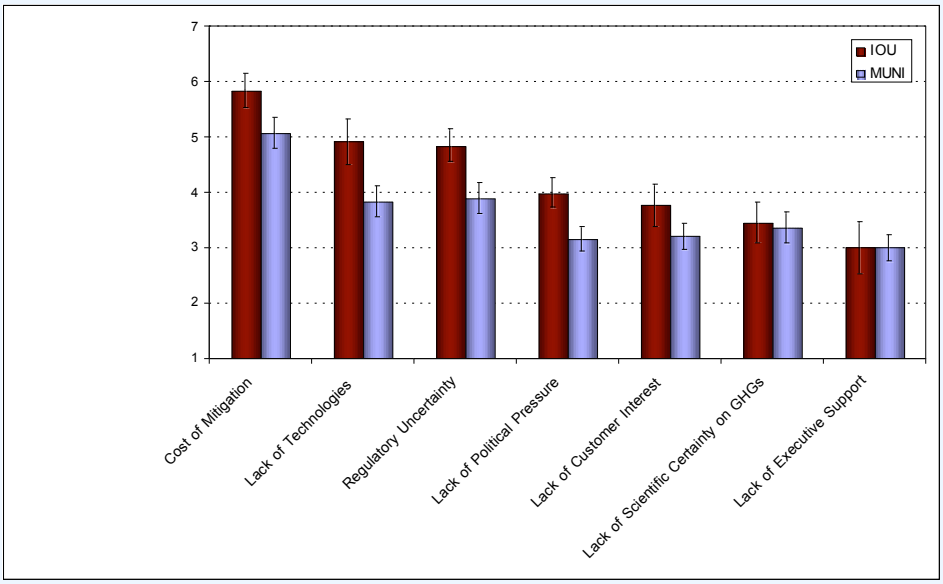
Separating survey respondents by ownership type (Figure 42) reveals that investor owned utilities rank cost of mitigation, lack of technologies, regulatory uncertainty, and lack of political pressure as stronger barriers to mitigation than municipal utilities.

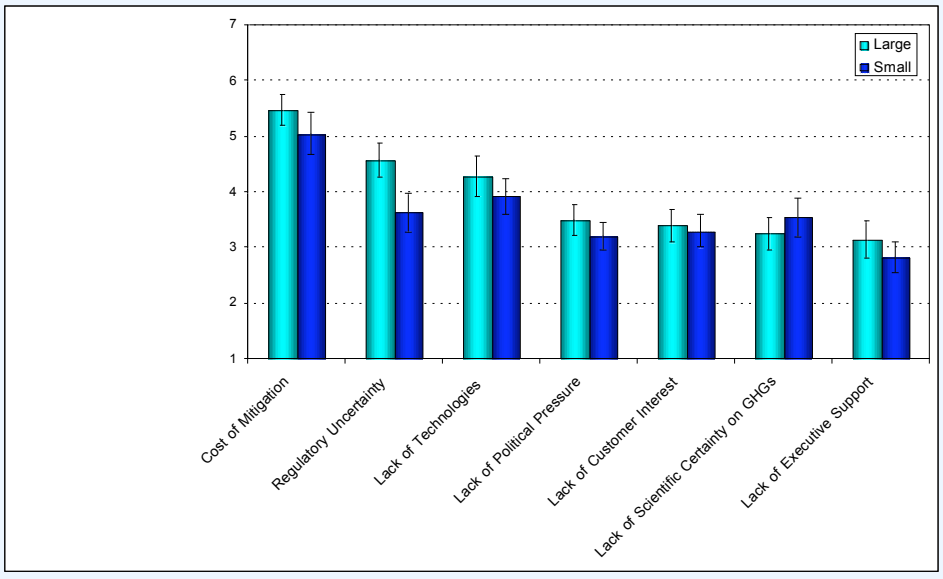
Figure 42: Barriers to GHG mitigation, by ownership type



Scale: 1 = none, 4 = moderate, 7 = strongest

As seen in Figure 43, size has a discernable effect on the degree to which regulatory uncertainty acts as a barrier to mitigating GHG emissions. Large utilities perceive regulatory uncertainty as a stronger barrier to mitigation than small utilities.

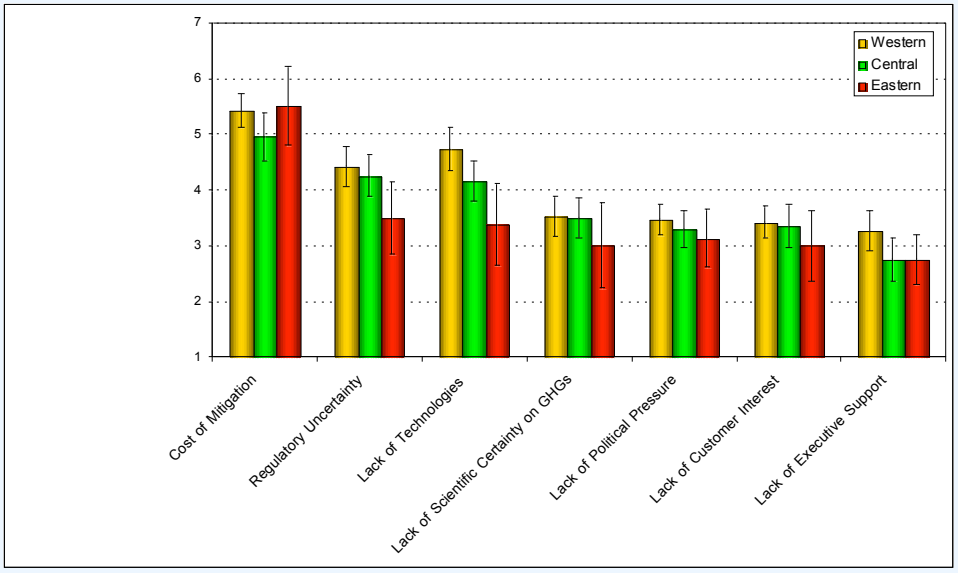
Figure 43: Barriers to GHG mitigation, by size



(large indicates >150,000 MHh net generation). Scale: 1 = none, 4 = moderate, 7 = strongest.

Results from our survey indicate that there is no significant effect of region on the strength of barriers to GHG mitigation (Figure 44).

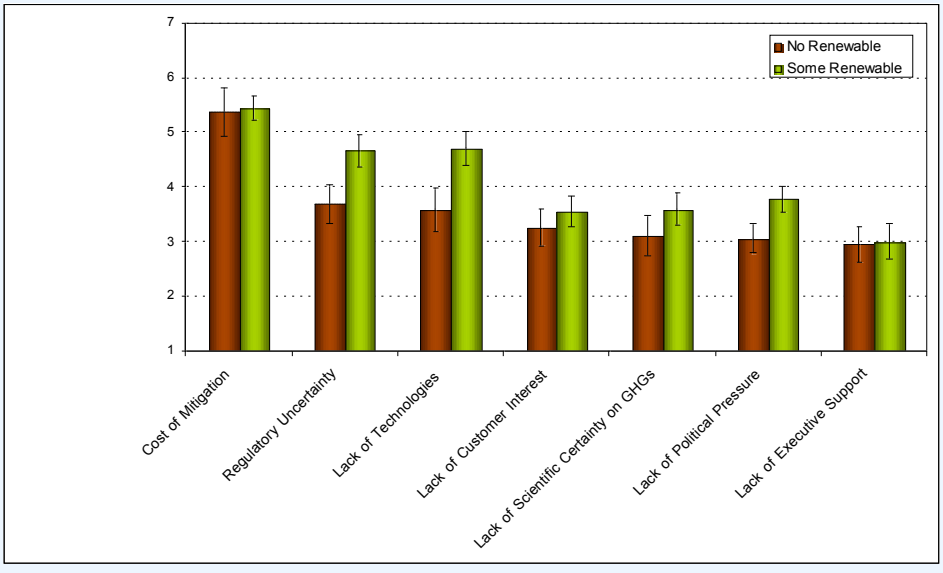
Figure 44: Barriers to GHG mitigation, by region



Scale: 1 = none, 4 = moderate, 7 = strongest.

Utilities with at least some renewable generation perceive regulatory uncertainty, lack of technologies, and lack of political pressure as stronger barriers to mitigation than utilities with no renewable generation (Figure 45).

Figure 45: Barriers to GHG mitigation, by fuel mix.



Scale: 1 = none, 4 = moderate, 7 = strongest

While respondents ranked the cost of mitigation as the strongest barrier to reducing GHG emissions, regression analysis revealed that the barrier having the most significant measurable effect on respondents' reduction activity is regulatory uncertainty. Implementation of federal regulations will remove the strongest revealed barrier to GHG emission reduction (regulatory uncertainty) and may simultaneously address the strongest stated barrier (cost of mitigation) by driving technological innovation that can reduce costs of implementation.

4.8 Open-ended Questions

An open-ended response section was included at the end of the survey to give respondents the opportunity to discuss any additional efforts that they may be implementing to reduce GHG emissions that may not have been covered by the survey (Table 26). Comments highlighted difficulties associated with resource limitations, financial and personnel. Respondents also commented that reductions must be a concerted effort on a national scale. Some representatives of small generators indicated that they did not feel that the magnitude of their emissions were large enough to have a significant effect on earth's atmosphere.

Table 26: Additional Comments

We support federal legislation to regulate GHGs.
Our Utility owns 6 MW capacity in a Wind Farm. Due to Transmission issues, the power was sold and we were not able to take credit for that portion of our GHG reduction in 2005.
As a small rural municipality our effect on GHG emissions are negligible. The impact of GHG emissions from wildfire in our area exceeds any impact of our utility by many orders of magnitude. A return to good forest practices with sustainable logging would do far more to reduce GHG than any impact we as a utility could do.
We are looking at installing wind generation capable of providing between 10-20% of our overall energy consumption.
The utility offers ongoing energy education programs to customers and Public schools. We have designed a curriculum supplement. This program is taught to all 9th graders in the Schools. Promotion of CFLs. The utility is a member of an Energy Efficiency Alliance and participates in the programs they have developed. Including the Change a Light change the world campaign, Building Operators certification program and are working to develop and Energy Star Home program in our community.
We are an isolated system, not connected to a grid. Our goal is to have available sufficient hydro generation capacity to eliminate the need to burn oil.
Our Strategic Plans consider fuel switches to natural gas and use of renewable energy sources.
We are committed to GHG reduction. However, it must be a national effort. Energy generation crosses state boundaries and cannot be regulated on a piecemeal basis.
As a small municipally owned utility we are limited in our ability to reduce GHG emissions. Using biodiesel in our plant presents the best opportunity to significantly reduce most GHG emissions. Although use of biodiesel can drastically reduce GHG emissions, it slightly increases NO_X emissions. Because the units are permitted based on NO_X emissions the state does not allow use of blends higher than B2 without extensive, and costly emissions testing. In November of 2006 the utility participated in a project to utilize EPA methodology to measure emissions from one unit at blends of B10, B20 and B100. The purpose of the test was to provide data to allow the state's Dept of Natural Resources to develop rules that will reduce the barriers to increased use of biodiesel.
We are a very small municipality with small pockets. We try to do all we can afford for GHGs.

5. Discussion

In this study we analyzed the strategies used by investor-owned and municipal, power generating U.S. electric utilities to reduce or offset GHG emissions. The utilities with higher renewable generation are possibly over represented compared to the pool of originally surveyed utilities. However, the survey respondents were overall a fair representation of the electric power industry in terms of ownership, size, CO_2 intensity, and fuel mix.

According to the survey results, utilities prefer to use reduction strategies over offsetting practices. We found that the majority of utilities rely on at least one strategy to reduce GHG emissions with 35 utilities (out of 61 respondents) using 1 or more strategy and 14 using none. Regarding offsetting practices, although the majority of respondents use at least one reduction strategy, zero is the most common number of offsetting practices used by respondents with 62% using no offsetting practices One possible reason for this could be that reduction strategies have the potential for cost-savings due to improved operational efficiency. In contrast, offsetting practices are costly. Even if the cost of the offsets is passed on to the consumer, such as in PG&E's Climate Neutral Program, there can be high administrative costs associated with the offsetting. In addition, the uncertainty surrounding many currently available offsets may also be a factor in utilities' decision to use reduction strategies more than offsetting practices.

Size, in terms of net generation, had a very significant effect on a utilities' decision to reduce GHG emissions. This is likely due to the fact that larger utilities have more capacity to take action. Smaller utilities, on the other hand, are more limited in their resources to allocate to GHG mitigation. In the open ended response section 4.8, two commonly stated reasons for this were lack of resources (financial and personnel) and relatively small amounts of GHG emissions, making reductions seem insignificant.

The most common strategy adopted by respondents for the purpose of reducing GHG emissions were demand-side management and switching to renewable energy sources. This raised the question of whether these strategies were adopted in response to state regulations such as energy efficiency or renewable portfolio standards (EEPS/RPS). Testing for an effect of these portfolio standards as well as existing state regulations and state financial subsidies generally revealed that these factors did not have a significant effect on the use of demand-side management and switching to renewable energy sources as a means to reducing GHG emissions. These results indicate that utilities may adopt these strategies voluntarily.

We found that the majority of utilities are not involved in partnerships to reduce GHG emissions. According to our survey results, 21 of the 39 utilities responding to the partnership question are not involved in any GHG emission reduction partnerships. Of those utilities that are participating in partnerships investor-owned utilities are more involved than municipal utilities. The most popular partnerships are the SF_6 partnership, Climate VISION partnership and the carbon sequestration partnerships. Carbon sequestration is the most frequently selected method for reducing GHG emissions, as seen by the participation in the three sequestration partnerships. Municipal utilities tend

to favor partnerships established by the Federal and state government while investor-owned utilities tend to favor industry partnerships. The utilities with the larger percentage of coal in their fuel mix and high CO_2 intensities are involved in partnerships

Improved efficiency and trade association pressure were identified as strong motivations for reducing GHG emissions. In a business sense, it is logical that improved efficiency would motivate utilities to reduce GHG emissions because efficiency improvements also reduce costs through time. The effect of trade association pressure suggests that trade associations are encouraging utilities to reduce their GHG emissions and that this is having a measurable effect on adoption of GHG reduction strategies.

Weak motivations included state financial subsidies and existing state regulations. In the open ended response section, respondents expressed that state regulations would not be sufficient because "energy crosses state boundaries and cannot be regulated on a piecemeal basis." With respect to financial subsidies, one respondent representing a municipal utility noted, "Most incentives are tax credits. To be of any value to municipal utilities like us, [incentives] have to be tradable, or a different incentive than a tax credit."

By controlling for ownership, the logistic model revealed that municipal utilities' decision to reduce greenhouse gases was most significantly affected by existing state regulations and executive leadership. Executive leadership was the strongest motivation for municipal utilities, suggesting that GHG reduction activity of municipal utilities is strongly driven by internal forces. In contrast, existing state regulations were identified as a weak motivation.

Lack of political pressure was identified as a weak barrier to reducing GHG emissions. In other words, utilities are experiencing political pressure to address GHGs. Regulatory uncertainty was clearly a strong barrier. More specifically, respondents expressed a need for cost recovery mechanisms. Respondents stated that they are under pressure to keep their rates low; therefore it is difficult to pass on the costs of investment in GHG reduction to the consumers. Without a clear idea of the regulatory future, utilities are finding it difficult to engage in GHG reduction. Table 27 summarizes the strong and weak motivations and barriers to GHG reduction.

Table 27: Summary of motivations and barriers to GHG reduction

	Strong	Weak
Motivations	- Improved efficiency - Trade association pressure	- State financial subsidies - Existing state regulations
Barriers	- Regulatory uncertainty	- Lack of political pressure

6. CONCLUSION

While the majority of respondents are currently engaged in at least one GHG reduction strategy, those utilities engaged in offsetting practices are the minority. A likely reason for this observation is that reductions are generally more easily quantified and verified than are offsets.

The top two reduction strategies adopted by our respondents were demand-side management and switching to renewable energy sources. Reforestation and recycling of coal by-products tied for the top offsetting practices utilized by respondents. Coal by-products may have economic value as inputs for industrial processes such as cement manufacture. Therefore, recycling of coal by-products may be an opportunity for utilities to generate an additional revenue stream while simultaneously addressing GHG emissions. Similarly, reforestation can be associated with peripheral benefits such as positive public relations.

None of the survey respondents were engaged in geological sequestration. However, compared to conventional technologies, CCS requires higher capital costs and results in efficiency losses of some 30% (S. Koonin, personal communication, University of California, Santa Barbara, 2007). This means that in the absence of a price on carbon, there is no economic rationale for pursuing CCS – with the possible exception of enhanced oil recovery (Specker, 2007).

Size, in terms of net generation, has a large effect on a utility's choice of whether or not to adopt GHG emission mitigation measures. As one self described small rural municipal utility put it, "the impact of GHG emissions from [a] wildfire in our area exceed any impact of our utility by many orders of magnitude." For our survey respondents, size was highly correlated with investor ownership; therefore it often appears as though investor owned utilities are more actively pursuing GHG mitigation than municipal utilities even though the effect may be resulting from differences in size alone.

Although respondents ranked cost of mitigation as the strongest barrier to reducing GHG emissions, regression modeling revealed that regulatory uncertainty is the strongest barrier that has a significant, measurable effect on utilities' reduction activity. Lack of regulatory certainty acts as a barrier by hindering utilities' long term planning process. This problem was highlighted in the recent release of "A Call for Action" in which the U.S. Climate Action Partnership states that "we need a mandatory, flexible climate program." Under a mandatory climate program, utilities would have better information on the future costs and benefits of engaging in GHG emissions reduction which would allow them to make appropriate long term decisions.

The primary motivation for GHG reduction among municipal utilities is executive leadership. Analyzing all respondents together identified improved efficiency and trade association pressure as the strongest motivations influencing GHG reduction behavior.

This study has demonstrated that there is a range of voluntary initiatives in use by the U.S. electric utility industry to reduce GHG emissions. A logistic analysis revealed that the strongest barrier to reducing greenhouse gas emissions is regulatory uncertainty. The current state of regulatory limbo is hamstringing GHG reduction in the electric power sector. However, some proactive utilities are moving forward and reducing their GHG emissions, primarily through demand-side management and switching to renewable energy. A number of additional reduction strategies are also currently in use, which demonstrates that utilities have many options to choose from. Further implementation of these strategies will be highly dependent on the future of federal regulations.

Appendix A

Survey and mailing materials

1. Initial mailing cover letter
2. Survey (paper form)
3. Third mailing postcard

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DONALD BREN SCHOOL OF ENVIRONMENTAL SCIENCE AND MANAGEMENT
2400 BREN HALL
UNIVERSITY OF CALIFORNIA, SANTA BARBARA
SANTA BARBARA, CALIFORNIA 93106-5131 http://www.bren.ucsb.edu/

October 30, 2006

(Contact name)
(Utility Co.)
(Address)
(City, State, Zip Code)

Subject: Current practices for reducing greenhouse gas emissions from electric utilities

Dear _____,

We would like to invite you to participate in a benchmarking study of current practices for reducing greenhouse gas (GHG) emissions from electric utilities. The goal of our research project is to understand the motivations and barriers to reducing GHG emissions in the electric utility sector. In exchange for your participation, we will provide you with a summary of the survey results that will enable you to learn how your responses compare to other comparable companies in the electric utility industry. Please be sure to check the box at the end of the questionnaire if you would like us to send you the aggregated results of the survey.

All responses will be kept **strictly confidential**, as our report and analysis will be based only on aggregated results. The survey should take about 10 minutes to complete and your participation is voluntary. We strongly encourage you to complete the survey as your contribution is very important to us for conducting a complete and accurate benchmarking study that will be useful to you and your company.

To complete the survey you may either **(1)** complete the hard copy of the survey included with this letter and return it using the enclosed self-addressed, stamped envelope, or **(2)** complete the survey online at ***www.bren.ucsb.edu/~greenhouse/survey***. We request that you complete the survey within 2 weeks of the date of this letter. Please feel free to contact Avra Goldman at (805) 560-7326 or consult the website listed below if you have any questions on the content of the survey or the survey process. We look forward to receiving your completed survey and sending you a copy of the benchmarking results.

Sincerely,

Professor Magali Delmas, Project Advisor
Donald Bren School of Environmental Science & Management
University of California, Santa Barbara

Email: greenhouse@bren.ucsb.edu
Project website: http://fiesta.bren.ucsb.edu/~greenhouse/index.html

Current Practices for Reducing Greenhouse Gas Emissions from Electric Utilities
UCSB Donald Bren School of Environmental Science and Management

RESPONDANT INFORMATION

Name: _____
Title: _____
Company Name: _____
Address: _____
City _____ State_____ Zip_____

HUMAN RESOURCES IN YOUR COMPANY'S ENVIRONMENTAL DEPARTMENT

1. How many full-time equivalent employees are there in your environmental department? _____

2. In terms of full equivalent positions, how many in-house employees does your company's environmental department have working on Greenhouse Gas (GHG) related issues?
   □ None □ Less than ¼ □ ¼ – ½ □ ½ – 1 □ 1 – 2 □ 2 – 3 □ 3+

3. Does your company utilize GHG consulting services? □ yes □ no

CAPACITY AND GENERATION

4. What was your company's total generation capacity in 2005? _____ MW

5. What was your company's total generation in 2005? _____ MWh

6. How much electricity did your company purchase in 2005? _____ MWh

7. If your company purchased electricity in 2005, what percentage was through:

   7.a. Long term contracts with specific generators _____ %
   7.b. Power marketer _____ %
   7.c. Spot market _____ %

8. What was your company's fuel mix in 2005?

SOURCE	2005 CAPACITY	2005 GENERATION	2005 PURCHASE
Coal	%	%	%
Oil	%	%	%
Natural Gas	%	%	%
Biomass	%	%	%
Nuclear	%	%	%
Hydro	%	%	%
Wind	%	%	%
Solar	%	%	%
Other	%	%	%
Other	%	%	%
Total	**100%**	**100%**	**100%**

GHG INVENTORY AND REGISTRATION

9. Has your company conducted a GHG emission inventory? □ yes □ no

If yes to Question 9, proceed to 9.a. If no, please go directly to Question 10:

9.a. What were your total GHG emissions in 2005 (please provide units)?

From generation _____ From purchase _____

9.b. Has the inventory been verified by an independent third party? □ yes □ no

If yes to Question 9.b., please name of verifying party: _____

9.c. What is the baseline year for the inventory? _____

9.d. Which of the following tools or resources were used in conducting the inventory?
- □ The GHG Protocol Initiative (WRI & WBCSD)
- □ 1605(b) Reporting Guidelines (EIA)
- □ Guidelines for National Greenhouse Gas Inventories (IPCC)
- □ Power Utility Protocol (PUP)
- □ Other(s): _____
- □ None

9.e. To which of the following registries does your company report?
- □ EIA Voluntary Registry
- □ Carbon Disclosure Project
- □ California Climate Action Registry
- □ Other(s): _____
- □ None

GHG REDUCTIONS

10. In 2005, which of the following methods did your company utilize to reduce GHG emissions?

- ☐ Intensified Gasification Combine Cycle (IGCC)
- ☐ Cogeneration
- ☐ High Efficiency Transformers
- ☐ Plant Retirement
- ☐ Demand-Side Management
- ☐ Switching to Renewable Energy Sources
- ☐ Fuel Switching
- ☐ Heat Rate Improvement
- ☐ Waste Heat Recovery
- ☐ Biomass Co-firing
- ☐ Environmental Dispatch
- ☐ Company Fleet Upgrades
- ☐ Other(s) _____
- ☐ None

11. Compared to 2004, what was the quantity of emissions reductions achieved in 2005 (please provide units)? _____

12. In 2005, did your company offer its customers the option of purchasing renewable energy ("green power")? □ yes □ no

If yes to Question 12, proceed to 12.a. If no, please go directly to Question 13:

12.a. What, if any, was the price premium paid by consumers for "green power?" _____$/KWh

12.b. What percentage of your customers chose the "green power" program? _____

If yes to Question 12.b., please provide a brief description of the green power program:

_____

_____

_____

GHG OFFSETTING

13. In 2005, which of the following practices did your company utilize to offset GHG emissions?

- ☐ Purchase of Emission Credits
- ☐ Reforestation / Afforestation
- ☐ Recycling of Coal By-products (e.g. Sale of Fly Ash)
- ☐ Geological Sequestration
- ☐ Landfill Methane Gas Capture
- ☐ Other(s): _____
- ☐ None

14. What was the total quantity of GHG emissions offsets in 2005? _____

15. Is your company engaged in GHG emission trading? ☐ yes ☐ no

If yes to Question 15, please provide the name of the exchange: _____

16. What, if any, partnerships is your company currently involved in for offsetting GHG emissions?

- ☐ Climate VISION Partnership
- ☐ PowerTree Carbon Company LLC
- ☐ UtiliTree Carbon Company
- ☐ Sulfur Hexafluoride (SF6) Partnership
- ☐ U.S. EPA Climate Leaders Program
- ☐ U.S. DOE Carbon Sequestration Regional Partnership
- ☐ U.S. EPA Green Power Partnership
- ☐ International Utility Efficiency Partnerships
- ☐ The California Climate Action Registry
- ☐ None
- ☐ Other(s): _____

MOTIVATIONS AND BARRIERS

17. Please rank your company's motivations to reduce GHG emissions …

		None	Very Weak	Weak	Moderate	Strong	Very Strong	Strongest
A	Existing state regulations	0	1	2	3	4	5	6
B	Pressure from the media	0	1	2	3	4	5	6
C	Customer demand	0	1	2	3	4	5	6
D	Financial subsidies from the state	0	1	2	3	4	5	6
E	Improved efficiency	0	1	2	3	4	5	6
F	Shareholder pressure	0	1	2	3	4	5	6
G	Pressure from trade associations	0	1	2	3	4	5	6
H	Pressure from NGOs	0	1	2	3	4	5	6
I	Anticipated regulatory pressure	0	1	2	3	4	5	6
J	Leadership of executives	0	1	2	3	4	5	6
K	Anticipated legal liability	0	1	2	3	4	5	6

Please include any additional motivations that influence your company's approach to GHG emissions:

18. Please rank your company's barriers to reduce GHG emissions …

		None	Very Weak	Weak	Moderate	Strong	Very Strong	Strongest
A	Lack of technologies	0	1	2	3	4	5	6
B	Lack of scientific knowledge regarding the impacts of GHG emissions	0	1	2	3	4	5	6
C	Cost of reduction strategies	0	1	2	3	4	5	6
D	Lack of regulation / Uncertainty regarding nature of future regulation	0	1	2	3	4	5	6
E	Lack of political pressure	0	1	2	3	4	5	6
F	Lack of executive support	0	1	2	3	4	5	6
G	Lack of customer interests	0	1	2	3	4	5	6

Please include any additional barriers that influence your company's approach to GHG emissions:

ADDITIONAL INFORMATION

19. Please feel free to include any additional information on your company's efforts to reduce GHG emissions not covered in this survey:

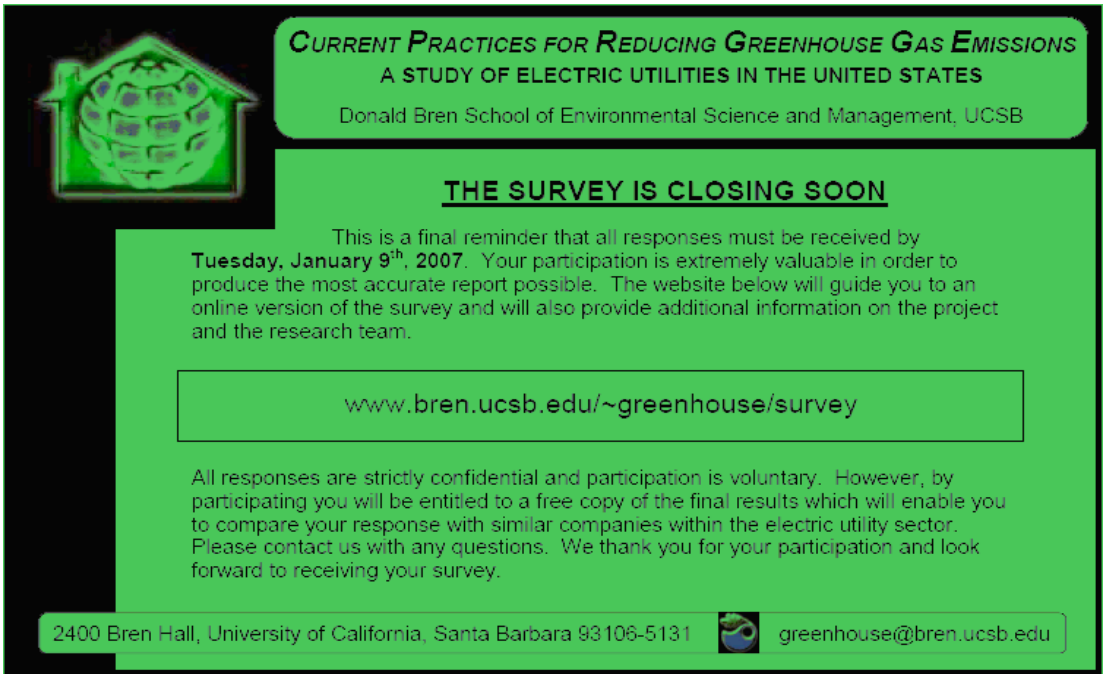
FINAL RESULTS

20. Would you like to receive a copy of the final report? □ yes □ no

If yes to Question 20, please provide your email address: _____

Thank you for your time and participation!

Mailing #3: Postcard reminder



APPENDIX B

Internet Survey and Email Reminders

1. Email reminder #1
2. Email reminder #2
3. Email reminder #3

Email Reminder #1

Subject: [COMPANY] greenhouse gas emissions

Dear [FIRSTNAME] [LASTNAME],

I would like to invite you to participate in a benchmarking study of current practices for reducing greenhouse gas (GHG) emissions from electric utilities. You should have recently received a copy of the survey through the mail and this email serves as an additional invitation to take the survey online if it would be more convenient for you. The goal of the research project is to understand the motivations and barriers to reducing GHG emissions in the electric utility sector.

In exchange for your participation, we will provide you with a summary of the survey results that will enable you to learn how your responses compare to other comparable utilities in the electric utility industry. All responses will be kept **strictly confidential**, as our report and analysis will be based only on aggregated results. The survey should take about 10 minutes to complete.

You can take the survey by clicking on the following link: [SURVEYLINK]

Please feel free to contact me with any questions that you may have. I look forward to receiving your completed survey and sending you a copy of the benchmarking results.

Sincerely,

Anthony Fournier
University of California Santa Barbara
afournier@bren.ucsb.edu

Project website: http://fiesta.bren.ucsb.edu/~greenhouse/index.html

Email Reminder #2

Subject: Greenhouse gas emission benchmarking study

[FIRSTNAME] [LASTNAME]
Utility: [CustomData]

Dear [FIRSTNAME] [LASTNAME],

I would like to personally invite you to participate in a benchmarking study of current practices for reducing greenhouse gas (GHG) emissions from electric utilities. You should have recently received a copy of the survey through the mail and this email serves as an additional invitation to take the survey online if it would be more convenient for you. The goal of the research project is to understand the motivations and barriers to reducing GHG emissions in the electric utility sector.

In exchange for your participation, we will provide you with a summary of the survey results that will enable you to learn how your responses compare to other comparable utilities in the electric utility industry. All responses will be kept **strictly confidential**, as our report and analysis will be based only on aggregated results. The survey should take about 10 minutes to complete.

You can take the survey by clicking on the following link: [SURVEYLINK]

If you are not the appropriate contact for this request, I would greatly appreciate it if you could forward it on to the correct person. Please feel free to contact me with any questions that you may have. I look forward to receiving your completed survey and sending you a copy of the benchmarking results.

Sincerely,

Anthony Fournier
University of California Santa Barbara
afournier@bren.ucsb.edu

Project website: http://fiesta.bren.ucsb.edu/~greenhouse/index.html

Email Reminder #3

RE: FINAL Reminder: Greenhouse gas emission benchmarking study (CLOSING 1/9/07)

Dear [FIRSTNAME] [LASTNAME],

I would like to extend to you and [CustomData] a final, personal invitation to participate in a benchmarking study of current practices for reducing greenhouse gas (GHG) emissions from electric utilities. You should have recently received a hard copy of the survey and a postcard with the online survey address through the mail; this email serves as an additional invitation to take the survey online if it would be more convenient for you. If you have already submitted or are in the process of submitting the survey you may disregard this email.

PROJECT OBJECTIVE:
The goal of the research project is to gain an understanding of the current practices as well as motivations and barriers to reducing GHG emissions in the US electric utility sector. See project website (listed below) for more information.

BENEFITS:
In exchange for your participation, we will provide you with an aggregated summary of the survey results and final analysis that will enable you to learn how your responses compare to other comparable utilities in the electric utility industry.

SURVEY:
* You can take the survey now by clicking on the following link: [SURVEYLINK]

* ALL responses must be received by Tuesday, January 9th, 2007

* The survey should take about 10 minutes to complete

* All responses will be kept strictly confidential, as our report and analysis will be based only on aggregated results

If you are not the appropriate contact for this request, I would greatly appreciate it if you could forward it on to the correct person. Please feel free to contact me with any questions that you may have. I look forward to receiving your completed survey and sending you a copy of the benchmarking results. Please feel free to contact me directly with any questions that you may have. Thank you for your time.

Happy Holidays!

Anthony Fournier
University of California Santa Barbara
afournier@bren.ucsb.edu

Project website: http://fiesta.bren.ucsb.edu/~greenhouse/index.html

APPENDIX C

Table on Five Recently Introduced Bills to the 110th Congress

(Source: "Summary", Resources for the Future, Feb. 2007)
State Regulations – A Highlight from Seven U.S. States

State Regulations

California

2005 – Executive order S-3-05 signed by the Governor established GHG emission reduction targets to 2000 levels by 2010 and to 1990 levels by 2050

2006 – Senator Bill 1368 ("Global Warming Emissions Standard for Electric Generation") was passed.

– In April, California announced the "Global Warming Solutions Act" (AB32) imposing tighter state-wide GHG reduction targets, achieving 1990 emission levels by 2020 (25% projected business-as-usual emissions reduction) and to levels 80% below those of 1990 by 2050.

Connecticut

2005 – "Connecticut Climate Change Action Plan" aiming to reducing GHG emissions to 1990 levels by 2010 and additional 10% below that by 2020 was passed.

Maine

2003 – The GHG emission reduction goals of achieving 1990 levels by 2010 with 10% additional cut by 2020 and a long-term reduction of greater than 7% was signed into law.

Massachusetts

2001 – Set GHG emission standard requiring a reduction of an average 1800 lbs CO2 / Megawatt-hour (MWh) by 2006 or 2008.

New Hampshire

2002 – A new law requiring power plants' CO_2 emission reductions was passed - the establishment of CO_2 emission baseline

New York

2003 – New York set GHG emission reduction targets – 5% below 1990 levels by 2010, 10% below 1990 levels by 2020, to levels of 25% below 1990 by 2010 for the electric generation sector.

Oregon

1997 – The CO_2 standard for new energy facility was adopted.

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Scope	Economy-wide	Economy-wide	Electricity Sector	Economy-wide	Economy-wide
Coverage	All six GHGs	All six GHGs	All six GHGs	All six GHGs	All six GHGs
Emissions Targets	Mandatory Caps • 2012: GHG emissions intensity 2.6% below 2011 levels, decreasing by a further 2.6% each year through 2021 • 2022: emissions intensity to drop by 3% each successive year Long-term goal: • none	Mandatory Caps • 2020: 1990 GHG levels • 2030: 26.7% below 1990 levels • 2040: 57.4% below 1990 levels • 2050: 80% below 1990 levels Long-term goal: • 450 ppm concentration stabilization	Mandatory Caps • 2011-2014: capped at 2006 levels • 2015: capped at 2001 levels • 2016-2019: cap declines 1% from previous year • 2020 and thereafter: emissions cap declines 1.5% each year Long-term goal: • none	Mandatory Caps • 2012-2019: 6,130 million tons of CO2e • 2020-2029: 5,239 million tons of CO2e • 2030-2049: 4,100 million tons of CO2e • 2050: 2,096 million tons CO2e thereafter Long-term a goal: • none	Mandatory Caps • 2020: 1990 GHG levels • 2021-2030: emissions reduced by 2.5% per year • 2031-2050: emissions reduced by 3.5% per year Long-term goal: • 450 ppm concentration stabilization
Regulated Entities	Set forth in the Act Coal mines, petroleum refineries, natural gas processors, importers of fossil fuels, and selected non-fuel entities	Determined by EPA	Set forth in the Act All electricity generating entities of 25 MW or greater	Set forth in the Act All facilities that emit 10,000 tons CO2e per year, petroleum refineries, and importers	Determined by EPA Sources or sectors with greatest GHG emissions, as determined by the EPA

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Allowance Allocation	Auction • 10% of all allowances from 2012-2016, increasing by 2% per year thereafter to a maximum of 65% Gratis • Industry: 55% of all allowances from 2012-2016, declining by 2% each year thereafter • States: 29% of all allowances from 2012-2021, 30% each year thereafter • Agricultural Sequestration: 5% of all allowances allocated to agricultural sequestration projects each year • Early Reduction Allowances: 1% of all allowances from 2012 to 2021; zero thereafter	If EPA determines a market-based cap & trade system is to be used, the Administrator may promulgate regulations regarding the allocation of allowances, including to communities and companies that are disproportionately adversely affected by global warming or the transition to a lower carbon economy	Auction • 2011: 15% auction, remainder gratis • 2012-2031: additional 3% per year auctioned • 2031-2036: an additional 5% per year auctioned • 2036 and thereafter: 100% auctioned Gratis • Allocation based on electricity generation output • No allocation to new coal unless meeting "Clean Coal" definition	EPA and Sec. of Commerce to set allocation and determine auction/ gratis split. • Oversight by Senate EPW Comm. • EPA Administrator may grant allowance for early reduction actions • At least 50% of allowances allocated to the Climate Change Credit Corporation are used to fund technology programs, remainder used to mitigate economic costs of the act	President assigned authority to develop allocation plan, decide on auction/gratis split and amount used from the Climate Reinvestment Fund to fund other programs • Oversight by Senate • Climate Reinvestment Fund controlled by Treasury
Banking, Borrowing, and Safety Valves	Sec. of Energy responsible for setting up trading system that • Sets safety-valve price of $7/ton CO2e, to increase by approximately 5% per year • Permits banking of allowances is permitted	EPA Administrator responsible for setting up trading system that features • Declining cap with technology-indexed "stop price"	EPA Administrator responsible for setting up trading system that • May allow allowance borrowing and 1 for 1 repayment plus interest • May permit state level allowances to be used in federal program • Permits banking of allowances • may in 2015 modify the cap and reduction goals	EPA Administrator shall establish a program to permit • Inter-sector trading, banking, and borrowing of permits (repaid with interest)	EPA Administrator responsible if a tradable allowance program is developed, and • Allowances may be banked

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Domestic Offsets and Credits	Sec. of Energy promulgates regulations establishing • Credits for domestic offset projects • Programs to grant allowances for early reduction actions • Programs to grant allowances for sequestration Sec. of Agriculture promulgates regulations establishing • Programs to grant allowances for soil sequestration	Sec. of Agriculture promulgates regulations establishing • Programs to grant allowances for biological sequestration	EPA promulgates regulations establishing • Programs to grant allowances for early reduction actions • Programs to certify GHG offsets Sec. of Agriculture promulgates regulations establishing • Programs to certify agricultural, wetland, and forest management offsets	Sec of Commerce promulgates regulations establishing • Programs to grant allowances for agricultural sequestration	Sec. of Agriculture promulgates regulations establishing • Programs to grant allowances for biological sequestration
International Offsets and Credits	Sec. of Energy promulgates regulations establishing • Programs to permit use of international GHG credits from CDM projects and foreign GHG regulatory programs	No offset provisions	EPA promulgates regulations establishing: • Programs to permit international GHG credits, from CDM projects or projects in countries with mandatory GHG limits	EPA establishes a program to • Permit tradable allowances to be generated from project activities in developing countries	

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Provisions for Advanced Technology and Related Programs	Administered by Sec. of Energy Funds from auctions and "safety-valve" collections to be deposited into a trust fund to be distributed as follows: • 50% to producers of electricity from low-carbon generation or to manufacturers of high efficiency consumer products • 35% to advanced coal and sequestration technologies (28%) and biofuels (7%) • 15% to advanced technology vehicles Funding • Specific sources identified • Max amount $50 billion	Administered by EPA • Provisions to perform and support research on climate change standards and to study carbon sequestration • Sense of the Senate call for 100% increase in federal funding for low-carbon energy R&D each year for ten years • Grants for geological storage of CO2 Funding • No source identified	Administered by EPA Auction proceeds directed to a Climate Action Trust Fund, which will disburse the money as follows: • 35% to developing and deploying low- or zero-emissions electricity-generating technologies • 20% to the development and deployment of clean coal technologies • 15% to energy efficiency measures for buildings and industry • 10% to R&D for energy efficiency technologies • 10% to provide adaptation assistance for workers and communities • 10% to help mitigate effects of climate change on fish and wildlife habitats Funding • Specific sources identified • No limitation on the size of the fund	Act establishes Climate Change Credit Corporation • Receives an allotment of allowances which it can auction, using part of the proceeds to fund technology programs Funding • Specific source identified – amount determined by auction revenues	Administered by EPA • Sense of the Senate call for 100% increase in federal funding for low-carbon energy R&D each year for ten years • Tax incentives for the purchase and manufacture of low carbon vehicles Funding • Specific source identified – amount unknown

(Appendix C: Continued…)

	Bingaman/Specter	Sanders/Boxer	Feinstein/Carper	Lieberman/McCain	Kerry/Snowe
Other Provisions & Specific Regulatory Programs		EPA promulgates regulations establishing • Emissions standards for vehicle fleets under and over 10,000 lbs. • Emissions standards for new electricity generation • Requirements for low-carbon electricity generation as proportion of coal-fired generation • Renewable energy portfolio standard for the electricity-generation sector • End-use electricity efficiency performance standards. SEC promulgates • Regulations requiring climate risk disclosure			EPA promulgates regulations establishing • Emissions standards for passenger vehicles • End-use electricity efficiency performance standards • Renewable energy portfolio standard for the electricity-generation sector The Act calls for • Increases in the renewable fuels requirement up to 60 million gallons by 2030 Sec. of Energy promulgates regulations • Requiring the installation of E85 fuel pumps SEC promulgates • Regulations requiring climate risk disclosure
Actions of Other Nations	Emissions caps and other regulations of the act • are subject to congressional review on the basis of actions taken by major U.S. trading partners.	Emissions caps and other regulations of the act • are not linked to the actions of other nations – developed or developing	Emissions caps and other regulations of the act • are not linked to the actions of other nations – developed or developing	Emissions caps and other regulations of the act • are not linked to the actions of other nations – developed or developing	Emissions caps and other regulations of the act • are not linked to the actions of other nations – developed or developing

APPENDIX D

Timetable of Highlighted Events Addressing Climate Change

1992

- President George H. W. Bush signed a multilateral treaty, the Framework Convention on Climate Change, committing the U.S. to take steps toward GHG gas emissions reduction.
- The voluntary GHG emission reduction reporting program was launched under Section 1605(b) of the Energy Policy Act of 1992 and administered by Energy Information Agency (EIA).

1993

- The Climate Change Action Plan (CCAP) was launched in October under the Clinton Administration.

1994

- Edison Electric Institute (EEI) and Department of Energy (DOE) created "Climate Challenge," a joint government – industry partnership that used a voluntary CO_2 emission reduction approach.

1995

- In July, the first cycle of voluntary reporting on GHG emissions reduction activities started.

1997

- In June, the state of Oregon adopted CO_2 standard for new energy facility.

2001

- In May, The state of Massachusetts set GHG emission standard requiring a reduction of an average 1800 lbs CO2 / MWh by 2006 or 2008.

2002

- On February 14th, President Bush challenged American businesses to further reduce GHG emissions, proposed the use of GHG emission intensity, and set a goal to reduce U.S. GHG emission intensity by 18% by 2012.
- The state of New Hampshire passed a new law requiring power plants' CO_2 emission reductions - establishment of emission baseline.

2003

- Climate VISION partnership between the federal government and the electric industry organizations.
- The West Coast Global Warming Initiative was established by California and Washington.
- Senate Bill 139, the Climate Stewardship Act what would reduce 859 million metric tons of CO2e in 2010, was introduced to the House in January and re-introduced in 2005
- Maine signed into law the GHG emission reduction goals of achieving 1990 levels by 2010 with 10% additional cut by 2020 and a long-term reduction of greater than 7%.
- New York set GHG emission reduction targets – 5% below 1990 levels by 2010, 10% below 1990 levels by 2020, to levels of 25% below 1990 by 2010 for the electric generation sector.

2004

- February 13th: The creation of Power Powers℠, the latest voluntary partnership between the electric power industry and DOE
  - Voluntary climate action with emphasis on sustainable economic growth with 5 principles: improved energy efficiency, increased investment in R&D, technological innovation, market-based initiatives, and cost-effective CO2 emission reductions.
  - Members: APPA, LPPC, EEI, NRECA, EPSA, NEI, and TVA.
- The U.S. Government Accountability Office (GAO) released the report on how the Securities and Exchange Commission (SEC) could improve the tracking and transparency of environmental and GHG emissions disclosures
- ON June 14, 2004, Connecticut passed Climate Change Action Plan aiming to reducing GHG emissions to 1990 levels by 2010 and additional 10% below that by 2020.

2005

- The U.S. Energy Policy Act of 2005 legislating new and extended tax incentives and funding to renewable power projects, so-called "clean coal" funding.
- Executive order S-3-05 signed by the Governor from the state of California established GHG emission reduction targets to 2000 levels by 2010 and to 1990 levels by 2050
- In December, 7 Northeastern U.S. states formed the Regional Greenhouse Gas Initiative (RGGI), which underpinned a multi-state "cap and trade" system starting in 2009.

2006

- In January, the Asia-Pacific Partnership on Clean Development and Climate ("AP6") was launched among the U.S., China, India, Australia, Japan, and South Korea.
- Entergy announced a voluntary commitment to stabilize CO_2 emissions at 20% below 2000 levels from 2006 to 2010.
- In California, Senator Bill 1368 ("Global Warming Emissions Standard for Electric Generation") was passed.
- In April, California announced the "Global Warming Solutions Act" (AB32) imposing tighter state-wide GHG reduction targets, achieving 1990 emission levels by 2020 (25% projected business-as-usual emissions reduction) and to levels 80% below those of 1990 by 2050.
- In April, ten state Attorneys sued the U.S. EPA for failing to develop stringent CO_2 emission standards for new power plants.
- On May 3rd, U.S. Sen. Tom Carper (D-Del) and a bipartisan group of senators introduced a legislature that would cap CO_2 emissions from power plants at 2006 levels by 2010 and reduce the emission to 2001 levels by 2015.
- The state of California announced an agreement with Britain to develop a market-based framework to reduce GHG emissions.
- The Chicago Climate Exchange (CCX) announced two other regional exchanges in the U.S. as well as a partner exchange in Montreal, Canada.
- Mayors from 187 U.S. cities and towns have committed to adopt Kyoto-inspired limits on GHG emissions.

- In May, the Republican-led house Appropriations supported the notion that without harming the U.S. economy, the country should use a mandatory cap system on U.S. emissions to address global warming issues.
- The U.S. Supreme Court agreed in June to hear a case (Massachusetts v. Environmental Protection Agency) arguing that the U.S. EPA should regulate CO_2 emissions.
- Eight states (CA, CT, IA, NJ, NY, RI, VT, and WI), New York City, and numerous environmental groups sued 5 electric utilities for annually emitting a total of 650 million tons of CO_2.
- The Southwest Climate Change Initiative ("SCCI") was launched by the state of Arizona and the state of New Mexico.

2007

- American Electric Power agreed to extend its reduction efforts over the period from 2007 to 2010, which would result in a cumulative CO_2 emission reduction of 19.75%.
- Twenty-two states have established renewable portfolio standards or goals that require electric utilities to generate certain amounts of electricity from renewable energy sources.
- On February 5th, IPCC released "Summary for Policymakers."
- Electric Power Research Institute released "Electric Technology in a Carbon-Constrained Future" claiming a portfolio of technologies, which still need R& D and demonstration can reduce CO_2 emissions in the U.S. electric sector over coming decades.
- On February 20th, the Global Roundtable on Climate Change issued a statement encouraging governments around the world to take proactive actions to address global warming.
- On February 26th, the Western Regional Climate Action Initiative ("WRCAI") was formed to implement a joint regional strategies to reduce GHG emissions in the West five states (AZ, CA, NM, OR, and WA).

APPENDIX E

GHG Mitigation, Inventory Registries and Partnership Descriptions

GHG Mitigation Descriptions

Our goal was to generate a list of practices used by electric utilities to reduce or offset their greenhouse gas emissions. In order to achieve this goal we surveyed literature, websites and industry experts on current practices for reducing and offsetting GHGs and used the following reports.

- Research Reports International: Voluntary GHG Reduction In The U.S. Electric Power Industry
- The U.S. Electric Power Sector and Climate Change Mitigation: Pew Center on Global Climate Change

In addition, we interviewed experts in several electric utilities when testing the survey questionnaire and asked them whether they could suggest additional reduction and offsetting strategies. Below we provide short definitions of the reduction strategies and offsetting practices that were listed in the survey. The list is not exhaustive and strategies and offsets are continually being developed. In order to obtain the most comprehensive list possible, the following sources were used to gather information:

The fact that Coal comprised 49.7% of sources used to generate electricity in the US in 2005 shows that coal is a preferred source of fuel. Therefore, reducing coal-use may not be a viable or desired option for electric utilities. There are, however, a number of ways to decrease the amount of greenhouse gas emissions associated with coal-based electricity production. The two main categories of greenhouse gas mitigation strategies are GHG Reduction and GHG Offsetting.

GHG Emissions Reduction Strategies

Without decreasing the amount of coal use in one's fuel mix, there are a number of ways to reduce greenhouse gas emissions related to the production of coal-based electricity.

Direct Reduction Strategies

Intensified Gasification Combine Cycle (IGCC)

Although IGCC is currently expensive and not very commonly utilized (only one surveyed utility claims to use this strategy), it has both the potential to reduce CO_2 emissions by increasing the efficiency of electricity generation and capture the CO_2 emissions that do get created in a concentrated stream.

In an IGCC power plant, coal is fired in a gas turbine, similar to natural gas, and the hot exhaust of that turbine is used to generate steam for an addition steam turbine. Both turbines generate electricity, decreasing the waste heat typical of a traditional pulverized coal (PC) plant, and converting more of the coal into electricity. By using a 'combined cycle,' an IGCC power plant can potentially increase its fuel efficiency from 38% (that of a typical PC plant) to over 50%. By using more of the gases created by combusting coal to produce electricity, less CO_2 is released (RRI 2005). In addition, as stated above, IGCC allows the CO_2 produced to be captured. Captured CO_2 can then be stored or injected into the earth.

Plant Retirement
Retiring a plant from operation is usually an economic-based decision based on the age of the plant and the repairs, retrofits, and investments associated with continuing to use it. However, retiring a coal-based plant for the purpose of reducing the GHG emissions associated with it is considered to be a GHG reduction strategy.

Green Power Programs
Green power programs provide an avenue by which customers can choose to pay extra to have their personal energy usage be derived directly from renewable energy sources. Different from climate neutral power which uses customer-paid premiums to offset the greenhouse gas emissions associated with their electricity use, green power programs use the premiums to purchase or generate renewable energy which inherently is considered to have no greenhouse gas emissions associated with it. See below for climate neutral power definition.

Switching to Renewable Energy Sources
Like the title implies, switching to renewable energy consists of the electric utility switching its fuel source from fossil based such as coal or natural gas to renewable energy sources such as wind and solar. In some states, hydro is considered renewable energy. By decreasing the amount of fossil-based fuel in ones fuel mix, GHG emissions are subsequently decreased. Currently, approximately 22 states have either a renewable portfolio standard (RPS) or a state mandate for an amount of renewable energy required by an electric utility (EIA web 2005).

Fuel Switching
As opposed to 'switching to renewable energy' fuel switching refers to switching from a high CO2 emitting fuel to a lower one. Common switches are that of switching from coal to natural gas because of the lower carbon content of the latter. By switching from bituminous coal to natural gas, CO2 emissions can be reduced by 43% per unit of energy consumed (IEA web 2000). However, despite the lower carbon content, CH4 emissions from natural has have a global warming potential (or CO2 equivalent) 21 times greater than CO2. Thus, when calculating GHG emissions reductions, it is important to consider the efficiency of the electricity production as well as potential releases of natural gas during the transmission and production phases of generation.

Biomass Co-firing
Biomass co-firing involves combining biomass material with coal in existing coal-fired boilers. Coal-fired boilers can handle a pre-mixed combination of coal and biomass in which the biomass is combined with the coal in the feed lot and fed through an existing coal feed system. Alternatively, boilers can be retrofitted with a separate feed system for the biomass such that the biomass and coal actually mix inside the boiler (EIA web 2000). Replacing coal-based fuel with a non-greenhouse gas producing biomass fuel would reduce the amount of GHG emissions associated.

Environmental Dispatch
Environmental dispatch refers to the dispatch of electricity according to environmental objectives. In environmental dispatching, the demand for electricity must be satisfied without violating certain emissions restrictions (EIA web 2000).

Company Fleet Upgrades
By switching a company's fleet of vehicles from diesel or petroleum based fuel to compressed natural gas, hybrid or electric vehicles can significantly reduce CO2 emissions associated with the operations of a utility.

Efficiency-Related GHG Reduction Strategies

Heat Rate Improvement
Heat rate is defined as the "amount of fossil energy (measured in Btu) needed to produce each kilowatt-hour of electricity," (EIA, 2000). By increasing efficiency of electricity generation processes, less fossil energy is required to produce the same amount of electricity and thus the 'heat rate' is reduced or improved. By decreasing the amount of fossil energy required to produce electricity and thus increasing efficiency, CO2 emissions are subsequently reduced (EIA, Retrieved in 2007).

Cogeneration
Otherwise known as combined heat and power (CHP), cogeneration captures the excess heat produced by electricity generation and uses it for domestic or industrial purposes either on-site or nearby. By using the heat by-product from electricity production for other heating needs, like additional electricity production, indoor heating or industrial plants with large heating needs, less electricity is needed to produce heat. Thus the overall efficiency of electricity production can potentially increase to 70% (International Energy Agency, 2000).

Waste Heat Recovery
Waste heat recovery expands the capturing of waste heat from just electricity generation to include the optimization of all process controls.

High Efficiency Transformers
In order to change voltage between various segments of the transmission and distribution system, transformers are employed. These transformers represent a large source of 'system losses' due to the impedance to the flow of current in the transformer 'windings. By replacing low efficiency transformers with improved silicon steel and amorphous core transformers, electricity losses are reduced. Decreased wasted electricity translates into a decrease in the need for electricity production and subsequent decrease in CO2 emissions (International Energy Agency, 2000).

Demand-Side Management
Demand-side management (DSM) is increasing efficiency at the end-user. DSM programs are designed to encourage consumers to modify their level and pattern of electricity usage. In the past, DSM was used to avoid the need for new power sources. However, due to changes in the industry, DSM is now used to enhance customer services (EIA, 2000). PG&E's 'Energy Star' program is one example of a DSM program.

Offsetting Practices

Offsetting GHG emissions is a relatively new strategy for reducing GHG emissions in the U.S. Generally, utilities offset greenhouse gases voluntarily either by investing in offsetting projects, such as reforestation and afforestation, or by offering climate 'neutral power' to customers. Either way, offsetting is not as clear quantitatively as reducing GHG emissions with regards to making sure the amount of greenhouse gases that are considered to be offset equals the amount produced from a certain amount of electricity production. The third party verification of emissions credits provides for assurance as to the amount of greenhouse gas a credit is worth. However standardization of verification and accreditation of verifying organizations is important to assure accuracy among offsetting practices.

Reforestation / Afforestation

The act of planting trees by either reforesting an area where clear-cutting had taken place or populating a new area with trees (afforestation) in order to sequester carbon from the atmosphere is used to offset GHG emissions. Reforestation is used as GHG offsetting packaged in many ways: as GHG emissions reduction credits, by companies themselves in their GHG reduction strategy portfolio and as offsets for climate neutral power customers.

Recycling of Coal By-products (e.g. Sale of Fly Ash)

Considered a potentially tradable commodity, fly ash, as a by-product of coal, can be used to offset the greenhouse gas emissions associated with the manufacturing of cement.

The cement-like property of fly ash allows it to be used in place of "Portland" cement in the production of concrete. The manufacturing of Portland cement is an extremely energy-intensive process. Using high heat to fire limestone and other substances in a kiln, the process requires significant energy inputs. In addition, the process creates a chemical reaction that releases carbon dioxide as a byproduct. Thus by using fly ash to displace or supplement the making of cement, CO2 emissions are avoided (Henry, John, & Thompson, 2006).

Landfill Methane Gas Capture

Coal can be displaced by capturing methane that gets released from decomposing solid waste in landfills. The result is twofold: by displacing some of the need for coal combustion with natural gas, CO2 emissions are also decreased and by capturing methane that would otherwise have been released into the atmosphere greenhouse gases are again decreased. Currently, methane emissions from landfills and 10% below 1990 levels and there are approximately 570 candidate landfills in the US (Hall, 2007).

One of the problems, however, with Landfill Methane Gas Capture is that the end users proximity to the landfill is an important factor in the feasibility of the strategy. The average end-user location is 5-10 miles from the landfill. However, as stated above, the reduced GHG emissions associated with LFG capture can be sold as GHG emissions reductions credits.

Geological Sequestration

Geological sequestration is one form of carbon sequestration whereby carbon that is captured from power plants (i.e. by using IGCC) and injected into geologic formations for long-term storage. Currently, carbon capture and sequestration (CCS) is expensive, taking into account capture technologies as well as compression, transportation, and injection costs. In addition, when combining IGCC with CCS, CO_2 emissions associated with the energy needed for compression, transportation and injection would increase overall CO_2 emissions associated with the method. Besides injecting the CO2 into geologic formations, there are additional innovative methods of storage being considered; Enhanced Oil Recovery (EOR) and Ocean Sequestration using wave-driven deep ocean pumps are two such methods (Higgins, 2007).

Note that carbon sequestration has many forms depending on the type of sequestration. Terrestrial sequestration such as tree planting as well as oceanic sequestration, such as increasing algae growth, is considered straight offsetting. However, as geological sequestration *stores* the CO2 that is produced it doesn't offset other sources of CO2 emissions. In a carbon-constrained landscape, though, geological sequestration could potentially become offsets if a utility were to meet its own GHG emission standard and have additional sequestration capacity to sell as emissions reduction offsets or credits to another utility.

Avenues Used to Employ Offsets

Purchase of Emission Credits

Emissions credits aim to offset GHG emissions by buying tons of CO2 reduction. The reduction can be a result of a number of activities and projects. One example is using the reduced GHG emissions associated with capturing the methane from landfills as emissions reduction credits. Emissions credits are used in cap and trade programs such as the EU trading Scheme and the Chicago Climate Exchange.

Because there are no current regulations addressing GHG emissions in the US, there are still no standards for GHG emissions credits and quality of credits can vary among sellers.

Climate Neutral Power

As opposed to 'green power programs," climate neutral power programs are an avenue by which customers pay a premium to have GHG emissions associated with their personal electricity usage offset by the utility. The offsets can come from a variety of reduction sources such as those offset products stated above. Currently the only utility in the US that offers climate neutral power to its customers is PG&E.

GHG Inventory Registries and Partnerships

In the absence of nationwide GHG regulations a patchwork of inventory registries and voluntary GHG emission reduction partnerships have developed at government and industry levels. The primary objective of these collaborative efforts is to quantify an electric utility's GHG emissions and encourage utilities to adopt strategies or participate

in offsetting practices to mitigate their GHG emissions. These collaborative efforts are also useful tools that provide a forum for information exchange regarding GHG reduction strategies and relationship building among stakeholders with interests in the electric utility industry. U.S. electric utilities can use these national programs and international resources for assistance in their efforts to lower their GHG impact.

Our goal was to generate a list of registries and partnerships used by electric utilities to quantify and reduce GHG emissions. In order to achieve this goal, we surveyed literature and websites on partnerships and used the Research Reports International's study on "Voluntary GHG Reduction
In The U.S. Electric Power Industry," (2005) and "Power Partners Annual Report" from the Edison Electric Institute (2007). This section will introduce and briefly describe the GHG inventory registries and partnerships that are being utilized by US electric utilities today. The description of each registry and partnership will also provide a link for additional information.

GHG Inventory Registries

GHG inventory registries in the US have been created by government, investor and non-governmental organizations with which companies can quantify and make public their annual GHG emissions. Registries can help utilities establish a baseline of GHG emissions against which additional reductions can be measured. As the registration is voluntary only a small percentage of utilities choose to participate in the reporting. Some of the current voluntary reporting registries are listed below.

California Climate Action Registry
One local regulatory greenhouse gas initiative is the California Climate Action Registry. This registry is a non-profit voluntary registry established by the state of California to encourage early reductions of GHG emissions. Organizations that are willing to meet the accounting standards and third party certification requirements of the registry show their intent to address their impact on climate change. Registrants benefit from participation by demonstrating their organization's environmental leadership, gaining competitive advantage by increasing operational efficiency, managing carbon-related risks, early action (voluntary emission reductions) and participating in the climate change policy discussion relevant to their industry. The California Climate Action Registry is working with other states to develop harmonized GHG reporting standards and tools.

The registry is designed to encourage companies and organizations to report their national as well as statewide emissions. Participants agree to calculate both direct and indirect emissions of greenhouse gases. The registry requires inventory results to be certified by third-party certifiers that have been identified by the state as qualified to undertake the certification process

More information on the Climate Action Registry at:
http://www.climateregistry.org/Default.aspx?refreshed=true

The Carbon Disclosure Project (CDP)

The Carbon Disclosure Project (CDP) acts as a secretariat for the world's largest institutional investor collaboration on the business implications of climate change. CDP represents an efficient process where many institutional investors collectively sign a single global request for disclosure of information on Greenhouse Gas Emissions. The CDP has been a very successful campaign to urge large companies worldwide to report their carbon emissions. Some electric utilities participate in the CDP. The Carbon Disclosure Project is a special project of Rockefeller Philanthropy Advisers, with US IRS 501(c)3 charitable status, with the sole purpose of providing a coordinating secretariat for the participating investors.

More information on the CDP program at:
http://www.cdproject.net/

Chicago Climate Exchange (CCX)

The Chicago Climate Exchange (CCX) is North America's only, and the world's first, greenhouse gas emission registry, reduction and trading system for all GHG. CCX is a self-regulatory, rules based exchange designed and governed by the CCX members. Members make a voluntary but legally binding commitment to reduce GHG emissions. By the end of Phase I (December, 2006) of the program all Members were expected to reduce direct emissions by 4% below a baseline period of 1998-2001. Phase II, which extends the CCX reduction program through 2010, will require all members to reduce GHG emissions 6% below the baseline. As of May 2006 five electric power generators were members of CCX: American Electric Power, Central Vermont Public Service, Green Mountain Power, Manitoba Hydro, and TECO Energy, Inc.

The goals of CCX are:

- To facilitate the transaction of GHG emissions allowance trading with price transparency, design excellence and environmental integrity
- To build the skills and institutions needed to cost-effectively manage GHG emissions
- To facilitate capacity-building in both public and private sector to facilitate GHG mitigation
- To strengthen the intellectual framework required for cost effective and valid GHG reduction
- To help inform the public debate on managing the risk of global climate change

More information on CCX can be found at:
http://www.chicagoclimatex.com/

Energy Information Administration (EIA) Voluntary Registry

The Energy Information Administration (EIA) was directed by the 1992 US Energy Policy Act (EPACT) to create a mechanism for "the voluntary collection and reporting of information on . . . annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, methane recovery, cogeneration,

chlorofluorocarbon capture and replacement, and power plant heat rate improvement…"

For the 2004 reporting year, 226 U.S. companies and other organizations reported to the EIA that they had undertaken 2,154 projects to reduce or sequester greenhouse gases in 2004. The electric utility sector made up 42% of the organizations reporting information. Of the projects reported, 518 were related to the generation, transmission or distribution of electricity.

More information on the EIA program at:
http://www.eia.doe.gov/oiaf/1605/frntvrgg.html

Environmental Resources Trust, Inc. (ERT)
Environmental Resources Trust, Inc. (ERT) is a Washington, DC-based, non-profit organization that pioneers the use of market forces to protect and improve the global environment. Founded in 1996, ERT uses the power of markets to address the challenges of tempering climate change, securing clean and reliable power, and encouraging environmentally beneficial land use.

ERT has developed three focused programs to accomplish its mission. The ERT GHG RegistrySM records validated GHG emissions profiles with the aim of creating a market that will enable efficient emissions reductions. The EcoPowerSM Program catalyzes the market for clean energy by substantiating and marketing blocks of power that include new renewable sources of energy and have significantly reduced environmental impacts. ERT's EcoLandsSM Program facilitates deals that enable and encourage landowners to make environmentally beneficial land use decisions.

ERT funding is derived both from philanthropic contributions and fee-for-service revenues. ERT is not an advocacy organization, and has no political affiliation.

More information on ERT can be found at:
http://www.ert.net/

New Hampshire GHG Registry
In July 1999, Governor Shaheen signed into law the New Hampshire Greenhouse Gas Reduction Registry. This registry was intended to quantify and submit GHG emission reduction actions to a state database for safekeeping against some future federal requirements. This approach was developed through a collaborative of business, government, and environmental leaders to encourage early reductions of GHG emissions.

Prior experience under the federal Clean Air Act Amendments of 1990 led companies to be cautious about making voluntary GHG reductions. The emission reduction requirements required by the 1990 Amendments seemed to reward sources that had been dirtier or slower to clean up because they started off with more uncontrolled emissions, making percentage reductions easier to accomplish. To avoid a potentially similar outcome with GHG emission reductions, the NH Registry was developed to ensure to the greatest extent possible appropriate recognition of voluntary actions taken

by New Hampshire businesses, industries, and individuals to reduce GHG emissions. In the event that future GHG reduction targets are implemented, the NH Registry would help New Hampshire entities establish a baseline against which future federal greenhouse gas emission reductions may apply.

More information on the New Hampshire GHG registry can be found at:
http://www.des.state.nh.us/ard/climatechange/ghgr.htm

Regional Greenhouse Gas Initiative (RGGI)
The Regional Greenhouse Gas Initiative (RGGI) includes nine Northeastern and Mid-Atlantic states. RGGI is a cooperative effort by these states to reduce CO_2 emissions. This is the first mandatory cap-and-trade program to control carbon dioxide emissions in the US. Beginning in 2009, RGGI will stabilize emissions from power plants in the region at current levels through 2015, and reduce emissions by 10% by 2019. This program is focused on all industries, while we will focus specifically on the electricity sector.

More information on the RGGI program at:
http://www.rggi.org/

Wisconsin Voluntary Emission Reductions Registry Advisory Committee
The Wisconsin Voluntary Emission Reduction Registry is a registry of voluntary quantification and reductions of greenhouse gas and air contaminant emissions that result from actions taken by businesses, governments, organizations, individuals, or others. The GHG emission reductions are voluntary, either because they are not required by law or go beyond legal requirements. The registry exists primarily as a database that lists the registered emission reductions, and includes rules, application forms, a handbook, and lists of quantification protocols.

More information on the Wisconsin Voluntary Emission Reductions Registry can be found at:
http://www.dnr.state.wi.us/org/aw/air/registry/index.html

Partnerships Developed to Reduce GHG Emissions

In addition to the strategies implemented by individual utilities, electric utilities have formed partnerships with government agencies, NGOs, and other companies to manage and reduce GHG emissions. Collectively, these partnerships can develop strategies and projects to accelerate the reduction of GHG emissions within the U.S. electric utility industry and creates a forum for information exchange. By pooling resources between members, the partnerships enable the utilities to make more of an impact in reducing GHG emissions than they could if they acted alone.

Carbon sequestration partnerships

PowerTree Carbon Company LLC
PowerTree Carbon Company LLC is a voluntary group of 25 U.S. electric utilities that have established a multi-million dollar fund to undertake six bottomland hardwood reforestation projects in Louisiana, Mississippi and Arkansas. As the trees grow, they are

expected to capture more than 1.6 million tons of carbon dioxide (CO2) from the atmosphere and provide critical habitat to threatened and endangered species.

In addition to the participating utilities the partnership's projects bring together a diverse group of national conservation entities (The Conservation Fund, The Nature Conservancy, Ducks Unlimited and the Wild Turkey Federation), regional and state conservation groups (Old South Woodlands, Central Arkansas Resources Conservation and Development Council, The Carbon Fund, Black Bear Conservation Committee, Friends of Red River and Mississippi Fish and Wildlife Foundation), local landowners, Federal agencies (the Department of Interior's Fish & Wildlife Service, the Department of Agriculture's Natural Resources Conservation Service and the U.S. Forest Service), leading practitioners of tree planting and monitoring (Environmental Synergy, Inc. and Winrock International).

More information on Power Tree Carbon Company LLC can be found at:
http://www.powertreecarboncompany.com/

Tree Power
A commitment to the environment and desire to help public power customers save money and conserve energy are the drivers behind the American Public Power Association's (APPA) TREE POWER program. TREE POWER was established in 1991 and is a nationwide effort by public power utilities to plant trees. Each public power utility designs its own tree-planting program based on local resources and needs, while participating in the national TREE POWER program.

More information on Tree Power can be found at:
http://www.appanet.org/special/index.cfm?ItemNumber=9377&sn.ItemNumber=2057

U.S. DOE Carbon Sequestration Regional Partnerships
The U.S. DOE created a national network of public/ private sector partnerships targeted at GHG mitigation. One of the goals of this network was to determine the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage and sequestration in different areas of the country.

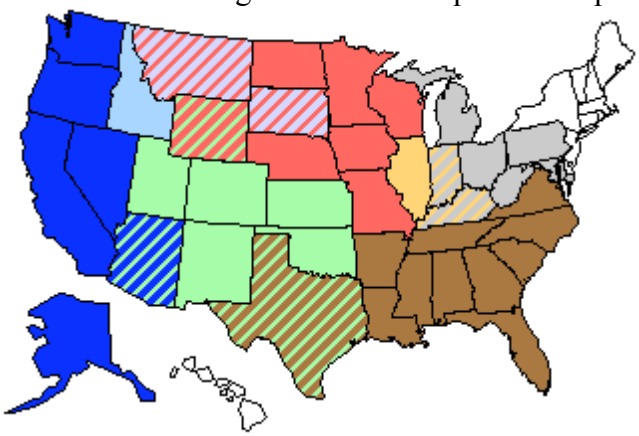
In Phase I of the program, (2003 to 2005) seven regional partnerships (See map in figure A) developed the framework needed to validate and potentially deploy carbon sequestration technologies. They studied the numerous sequestration approaches and identified the ones that were best suited for their specific regions of the country. They also began studying possible regulations and infrastructure requirements that a region would need should it be determined that sequestration be deployed on a wide-scale basis in the future. In Phase II of the program, the partnerships will field test and validate carbon sequestration technologies, evaluate regional carbon dioxide repositories, conduct public outreach, satisfy permitting requirements and identify best-management practices for future deployment.

Together, the partnerships include more than 240 organizations spanning 40 states, three Indian nations, and four Canadian provinces. Each partnership is projected to receive

about $4 million per year in DOE funding. At least 20 percent of project costs are provided by non-DOE funding. The total value of the projects exceeds $145 million over the next four years. See Figure 46 for a map of U.S. DOE regional carbon sequestration partnerships and links to the websites of each regional partnership.

More information on the DOE regional partnerships can be found at:
http://www.fossil.energy.gov/programs/sequestration/partnerships/
http://www.fossil.energy.gov/programs/sequestration/

Figure 46: U.S. DOE regional carbon sequestration partnerships



West Coast Regional Carbon Sequestration Partnership	http://www.westcarb.org/
Southwest Regional Partnership for Carbon Sequestration	http://www.southwestcarbonpartnership.org/
Big Sky Regional Carbon Sequestration Partnership	http://www.bigskyco2.org/
Plains CO2 Reduction Partnership	http://www.undeerc.org/pcor/
Southeast Regional Carbon Sequestration Partnership	http://www.secarbon.org/
Midwest (Illinois Basin) Geologic Sequestration Consortium	http://sequestration.org/
Midwest Regional Carbon Sequestration Partnership	http://198.87.0.58/

(Source: Pew Center website, Retrieved in 2006)

UtiliTree Carbon Company

In 1995, the non-profit UtiliTree Carbon Company was established by 41 utilities to sponsor a collection of projects that manage GHG, especially CO2. The projects consist of a diverse mix of rural tree planting, forest preservation, forest management and research efforts at both domestic (Louisiana, Mississippi, Arkansas and Oregon) and international (Belize and Malaysia) sites. UtiliTree has committed slightly over $3 million to fund these projects.

The UtiliTree Carbon Company has selected Environmental Synergy, Inc. (ESI) to reforest 500 acres in the Lower Mississippi River Valley. The marginal quality farmland will be restored with a mixture of indigenous bottomland hardwood trees. The restoration project is located at the St. Catherine Creek National Wildlife Refuge in Southwest Mississippi. This refuge is one of more than 500 national wildlife refuges

managed by the U.S. Fish and Wildlife Service. The nonprofit UtiliTree Carbon Company, managed by the Edison Electric Institute, is a partnership of 40 investor-owned electric utilities sponsoring a portfolio of forestry projects that manage carbon dioxide. Currently, there are nine UtiliTree projects consisting of a diverse mix of rural tree planting, forest preservation, forest management, and research efforts at both domestic and international sites.

More information on the UtiliTree Carbon Company can be found at:
http://www.environmental-synergy.com/popups/utilitree.html

Climate VISION
Climate VISION (Voluntary Innovative Sector Initiatives: Opportunities Now) is a Presidential public-private partnership initiative launched by the Department of Energy on February 12, 2003 to contribute to the President's goal of reducing GHG intensity. Other U.S. agencies participating in Climate VISION include the Environmental Protection Agency, Department of Transportation, Department of Agriculture, and Department of the Interior.

Part of the program included the development of the Power Partners Resource Guide (PPRG). PPRG is a Web-based, resource tool developed to help companies undertake actions to reduce, avoid or sequester GHG emissions and/or reduce emissions intensity. The PPRG is designed to help guide companies to emission or emission intensity reduction opportunities. PPRG helps the users find the latest information on a variety of topic areas through the use of links to credible Web sites and sources. The PPRG also creates the opportunity for a dialogue between people/ companies implementing projects and people wanting to implement similar projects through a registration section allowing companies to include a point of contact for information on successful projects.

More information on Climate VISION can be found at:
http://www.climatevision.gov/index.html

E7
The e7 electricity companies operate on the national territories of the G8 countries (Canada, France, Germany, Italy, Japan, Russia and United States). Membership in the e7 is by invitation. The e7 may also invite other organizations from around the world to become Partners and contribute to the implementation of the e7's goals. The number of e7 members from a single country is limited to a maximum of two (2). The company must be the largest, or among the two largest companies, in the country that is under consideration.

The e7 can be characterized as an entity with an operational knowledge of the electricity sector. The diversity of the e7 group is made up of experience and expertise that complement each other with a holistic view of the global electricity industry. Sharing this knowledge and experience with countries facing new pressures on their electrical industry is the most valuable way the e7 can contribute to sustainable development throughout the world.

More information on E7 can be found at:
http://www.e7.org

Edison Electric Institute

Edison Electric Institute (EEI) is the association of US shareholder-owned electric companies, international affiliates, and industry associates worldwide. EEI members serve 97 percent of the ultimate customers in the shareholder owned segment of the industry, and 71 percent of all electric utility ultimate customers in the nation. Their members generate almost 60 percent of the electricity produced by U.S. electric generators.

Organized in 1933, EEI works closely with all of its members, representing their interests and advocating equitable policies in legislative and regulatory arenas. In its leadership role, EEI provides advocacy, authoritative analysis, and critical industry data to its members, Congress, government agencies, the financial community and others. EEI provides forums for member company representatives to discuss issues and strategies to advance the industry and to ensure a competitive position in a dynamic industry.

More information on EEI can be found at:
http://www.eei.org/industry_issues/environment/climate/index.htm

Electric Power Research Institute (EPRI)

The Electric Power Research Institute (EPRI), with major locations in Palo Alto, California, and Charlotte, North Carolina, was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together members, participants, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of electricity generation, delivery, and use, including health, safety, and environment. EPRI members represent over 90% of the electricity generated in the United States. International participation represents about 15% of EPRI total research, development, and demonstration programs.

More information on the EPRI can be found at:
http://www.epri.com

FutureGen

FutureGen is an initiative to build the world's first integrated sequestration and hydrogen production research power plant. The $1 billion dollar project is intended to create the world's first zero-emissions fossil fuel plant. When operational, the prototype is believed to be the cleanest fossil fuel fired power plant in the world.

More information on FutureGen can be found at:
http://www.fossil.energy.gov/programs/powersystems/futuregen

International Utility Efficiency Partnerships (IUEP)
The goal of the IUEP program is consistent with President Bush's voluntary climate initiative announced on February 14, 2002, and the International Power Partnerships program, a joint venture between the IUEP and the Department of Energy. IUEP strives to reduce emissions by identifying, coordinating, and providing funding for development of international environmentally-friendly energy development projects.

The IUEP's objectives and goals will be met through two important mechanisms:

- The sponsorship of projects that prove real potential to reduce emissions in the atmosphere
- The development of strong partnerships between the developing world and U.S. manufacturers, developers, and electricity providers.

More information on IUEP can be found at:
http://www.ji.org/

Public Renewables Partnership
The Public Renewables Partnership (PRP) is an initiative dedicated to enabling public organizations, co-operatives, and Tribal utility authorities to effectively integrate renewable energy into their power portfolios and business strategies. PRP members include municipal utilities and public power agencies, and other organizations wishing to establish renewable energy programs. The primary objective of PRP is to better inform utility decision makers about renewable energy technology options and potentials. The PRP also strives to make it easier for electric cooperatives, public utilities and Tribal utility authorities to quickly access important, timely and updated information about green power programs, renewable energy technologies, products and services.

More information on Public Renewables Partnership can be found at:
http://www.repartners.org/prpabout.htm

U.S. EPA Climate Leaders Program
Climate Leaders is an EPA industry-government partnership that works with companies to develop long-term comprehensive climate change strategies. Partners set a corporate-wide greenhouse gas (GHG) reduction goal and inventory their emissions to measure progress. By reporting inventory data to EPA, partners create a lasting record of their accomplishments. Partners also identify themselves as corporate environmental leaders and strategically position themselves as climate change policy continues to unfold.

More information on the EPA Climate Leaders Program can be found at:
http://www.epa.gov/climateleaders/index.html

U.S. EPA Coal Combustion Products Partnership (C2P2)

The Coal Combustion Products Partnership (C2P2) program is a cooperative effort between the U.S. Environmental Protection Agency, American Coal Ash Association, Utility Solid Waste Activities Group, U.S. Department of Energy, and US Federal Highway Administration. The objective of the partnership is to help promote the beneficial use of Coal Combustion Products (CCPs) and the environmental benefits that result from their use. Currently the partnership consists of 43 utility members and 19 others providing financial support.

More information on C2P2 can be found at:
http://www.epa.gov/epaoswer/osw/conserve/c2p2/

U.S. EPA Green Power Partnership

The U.S. EPA's Green Power Partnership encourages organizations to purchase green power as a way to reduce the environmental impacts associated with conventional electricity use. Green power is an environmentally friendly electricity product that is generated from renewable energy sources. Buying green power is easy, and it offers a number of environmental and economic benefits over conventional electricity. The Green Power Partnership provides assistance and recognition to organizations that demonstrate environmental leadership by choosing green power.

More information on the U.S. EPA Green Power Partnership can be found at:
http://www.epa.gov/greenpower/

U.S. EPA Sulfur Hexafluoride (SF_6) Partnership

The SF_6 partnership was developed as part of a group of voluntary industry programs within EPA's Climate Change Division. In 1999, the SF_6 Partnership began with 49 electric utilities as Charter Partners. During the next five years, an additional 25 utilities have joined the partnership. Currently, the program represents over 38 percent of U.S. transmission mileage. In 2004, SF_6 Partners managed equipment on their systems with a total SF_6 capacity of 4,635,465 pounds. The partnership has allowed electric utilities to take progressive and comprehensive actions in addressing GHG by reducing SF_6 emissions. SF_6 is the most potent GHG used in the electric power industry (23,900 times greater than CO_2), with an atmospheric residency time on the order of centuries.

M*ore information on the SF_6 Partnership can be found at:*
http://www.epa.gov/highgwp/electricpower-sf6/index.html

APPENDIX F

Energy Efficiency and Renewable Portfolio Standards

States with Renewable Portfolio Standards (RPS)

State	Amount	Year	Organization Administering RPS
Arizona	15%	2025	Arizona Corporation Commission
California	20%	2017	California Energy Commission
Colorado	10%	2015	Colorado Public Utilities Commission
Connecticut	10%	2010	Department of Public Utility Control
District of Columbia	11%	2022	DC Public Service Commission
Delaware	10%	2019	Delaware Energy Office
Hawaii	20%	2020	Hawaii Strategic Industries Division
Iowa	105 MW		Iowa Utilities Board
Illinois*	25%	2017	Illinois Department of Commerce
Massachusetts	4%	2009	Massachusetts Division of Energy Resources
Maryland	7.5%	2019	Maryland Public Service Commission
Maine	10%	2017	Maine Public Utilities Commission
Minnesota	25%	2025	Minnesota Department of Commerce
Montana	15%	2015	Montana Public Service Commission
New Jersey	6.5%	2008	New Jersey Board of Public Utilities
New Mexico	20%	2020	New Mexico Public Regulation Commission
Nevada	20%	2015	Public Utilities Commission of Nevada
New York	24%	2013	New York Public Service Commission
Pennsylvania	18%	2020	Pennsylvania Public Utility Commission
Rhode Island	15%	2020	Rhode Island Public Utilities Commission
Texas	5,880 MW	2015	Public Utility Commission of Texas
Vermont*	10%	2013	Vermont Department of Public Service
Washington	15%	2020	Washington Secretary of State
Wisconsin	2.2%	2011	Public Service Commission of Wisconsin

*Two states, Illinois and Vermont, have set voluntary goals for adopting renewable energy instead of portfolio standards with binding targets.
http://www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm

States with Energy Efficiency Portfolio Standards (EEPS)

State	EEPS Description	Applies to	Savings Target	Time Frame
California	Sets specific energy and demand savings goals	Investor-owned utilities (IOUs)	Savings goals set for each program year from 2004 to 2013 The savings target for program year 2013 is: • 23,183 GWh 4,885 MW peak • 444 million therms	2004-2013 Annual megawatt-hours (MWh), MW, and therm savings adopted for each of these years
Connecticut	Includes energy efficiency at commercial and financial facilities as one eligible source under its Distributed RPS (also includes combined heat and power and load management programs)	IOUs	Savings goals set for the beginning of each program year:	
			1%	2007
			2%	2008
			3%	2009
			4%	2010 and thereafter
Hawaii	Allows efficiency to qualify as a resource under RPS requirements	IOUs	20% of kWh sales (overall RPS target, energy efficiency portion not specified)	2020
Illinois	Will set goals as percentage of forecast load growth	IOUs	10%	2006–2008
			15%	2009–2011
			20%	2012–2014
			25%	2015–2017
New Jersey	Will set energy and demand goals for overall PBF program	PBF program administrators (based on competitive solicitation; originally it was IOUs)	1814 GWh (four-year total)	2005–2008
Nevada	Redefines portfolio standard to include energy efficiency as well as renewable energy	IOUs	Energy efficiency can meet up to 25% of the energy provider's portfolio standard:	
			6%	2005–2006
			9%	2007–2008
			12%	2009–2010
			15%	2011–2012
			18%	2013–2014
			20%	2015 and thereafter
Pennsylvania	Includes energy efficiency as part of a two-tier AEPS	IOUs	4.2%	Years 1–4
			6.2%	Years 5–9
			8.2%	Years 10–14
			10.0%	Years 15 and thereafter
Texas	Sets goals as percentage of forecast load growth	IOUs	10%	2004 and thereafter

Source: U.S. EPA, *EPA Clean Energy-Environment Guide to Action*, Chapter 4. April 2006. http://www.epa.gov/cleanenergy/pdf/gta/guide_action_chap4_s1.pdf

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