Meeting Energy Demand in Texas:

The Hidden Cost of Coal

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August 2007

Meeting the Growth in Energy Demand in Texas

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1 EXECUTIVE SUMMARY

Based on current projections, the state of Texas will soon find it difficult to meet its peak load energy demand through current energy infrastructure. In order to address this shortfall, Texas has proposed building a host of new coal-fired power plants. However, coal plants include various environmental and health externalities that have not been factored into the cost of coal-fired power generation by the generating corporations or the government of the State of Texas. This paper includes an initial valuation of two of these associated costs: carbon emissions and public health.

Recent studies have asserted that coal-fired power is the cheapest option for Texas to meet its burgeoning peak load energy demand. However, a report released by the American Council for an Energy Efficient Economy (ACEEE) challenges those claims. That study found that implementing a suite of programs to meet the state's energy needs through increasing the efficiency of energy use and by investing in renewable energy would actually reduce current electricity costs in Texas by 50%, and provide a cheaper solution than new coal plants.

The proposed coal plants will incur high costs for their emissions. Based on current EPA regulations, the coal plants will incur a total cost of $5.5 billion for their sulfur dioxide, carbon dioxide, nitrogen oxide, and mercury emissions from 2008 to 2023. This price does not include the potential increased cost of carbon dioxide resulting from federal climate change legislation that is likely to pass in the next few years. In sum, all nineteen proposed plants will emit 125 million tons of new carbon dioxide per year. Under three pricing scenarios based on projections from current legislation in Congress, resulting carbon costs to those plants will range from $3.9 Billion to $54 Billion for the fourteen year period of 2009 to 2023.

In addition to these costs, the state will also face costs due to the increased prevalence of diseases that the plants will cause. The accumulated health costs associated with the increased incidence of chronic obstructive pulmonary disease, congestive heart failure, and pediatric asthma will total $4.8 Billion from 2009 to 2023. When accounting for the mortality that these diseases will cause, the cost is $38 Billion, based on the current value of a statistical life.

It is possible that the state will decide not to build all nineteen of the proposed plants analyzed in this report. However, each kilowatt-hour generated from a coal-fired power plant will create a percentage of the external costs described above. When the highest projected costs resulting from carbon legislation are added to projected health costs with mortality defined above, they add 7.46 cents to every kilowatt-hour of coal power generated, which almost doubles its current retail price.

The analysis in this report confirms the conclusion of ACEEE highlighted above, and makes the cost savings of the ACEEE strategy even more apparent by revealing the additional carbon costs of $3.9 to $54 Billion, and public health costs of $4.8 to $38 Billion for the proposed plants. Total additional costs from the higher end of the estimates included in this report could total as much as $90 Billion. Texas legislators and political leaders should consider these costs when deciding whether to meet their energy needs through coal-fired power plants.

2 BACKGROUND: PROPOSED COAL-FIRED POWER PLANTS IN TEXAS

The state of Texas has a unique electricity market. There are a total of 185 electricity-producing entities in Texas (Texas Energy Planning Council, 2004) combining to form the largest electricity market in the nation (Deregulation of the Texas Electricity Market, 2007).

The market was deregulated in January of 2002 by the Texas legislature (Deregulation of the Texas Electricity Market, 2007) this deregulation has been both heralded for keeping energy prices in Texas low and blamed for their increase. Though most deregulated Texas electricity customers still pay rates that are higher than those in regulated regions (such as Austin, which is served by a public utility), the amount of increase has been less than the corresponding increase in the price of natural gas over the same time period. Natural gas currently provides most of the peak demand electricity to the state, primarily needed on very hot days in August with high demand for air conditioning (see Tables 2.1 and 2.2). The overall price of electricity is based on natural gas which is costlier than coal, but can more easily and rapidly be turned on and off to provide support during times of high electricity demand. Thus, companies that provide coal-fired electricity, but whose rates are by necessity based on the cost of natural gas electricity, are making strong profits. The price difference between coal-generated electricity and natural gas-generated electricity has attracted significant interest in bringing more coal-fired power online in Texas as electricity demand is forecasted to rise. As is the case in an open market, companies enter the market or expand their product offerings with the intent to gain profits in the short term and consequently lower overall electricity prices in the long run. Texas supplies approximately half of the coal it currently consumes, while importing the remainder mainly from Wyoming (Texas Energy Planning Council, 2004).

Table 2.1

Percentage of Texas Electric Power Generation by Energy Source (1993/97/2002)

	1993	1997	2002
Coal	43.7%	41.2%	36.8%
Petroleum (1)	0.6%	0.5%	0.4%
Natural Gas	49.1%	45.0%	50.9%
Other Gases (2)	1.1%	1.1%	0.8%
Nuclear	4.1%	11.1%	9.2%
Hydroelectric	0.6%	0.5%	0.3%
Other Renewables	0.5%	0.5%	1.0%
Other	0.1%	0.1%	0.5%
Total Electric Industry	100%	100%	100%

Table 2.2

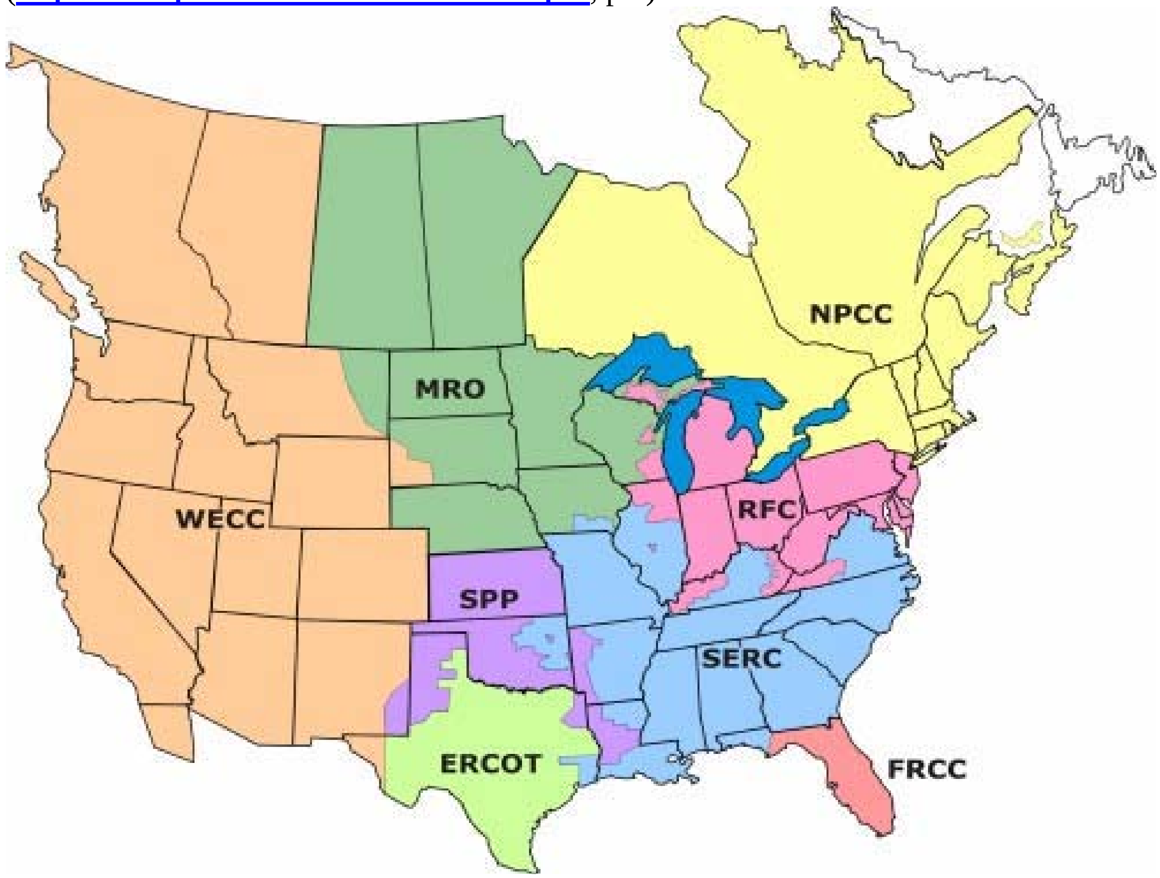
2002 Texas Electric Generating Capacity (megawatts)

Coal	20,196	21.37%
Petroleum	473	0.50%
Natural Gas	36,379	38.50%
Other Gases	295	0.31%
Dual Fired	30,385	32.16%
Nuclear	4,737	5.01%
Hydroelectric	697	0.74%
Other Renewables	1,208	1.28%
Other	118	0.12%
Total Electric Industry	**94,488**	**100.00%**

(http://www.rrc.state.tx.us/tepc/TexasEnergyOverview.pdf)

Most of the state is reliant on one electric grid; the grid has a generation capacity of 78,000 megawatts, delivering approximately 85% of Texas' overall electricity (Texas Energy Planning Council, 2004). The grid is operated by the Electric Reliability Council of Texas (ERCOT) (ERCOT, 2007) which is regulated by the Public Utility Commission of Texas (PUCT) (Texas Energy Planning Council, 2004). Because so much of the state's electricity is provided by this single grid, it has less flexibility to import electricity should it encounter a peak demand crisis (see Figure 2.1).

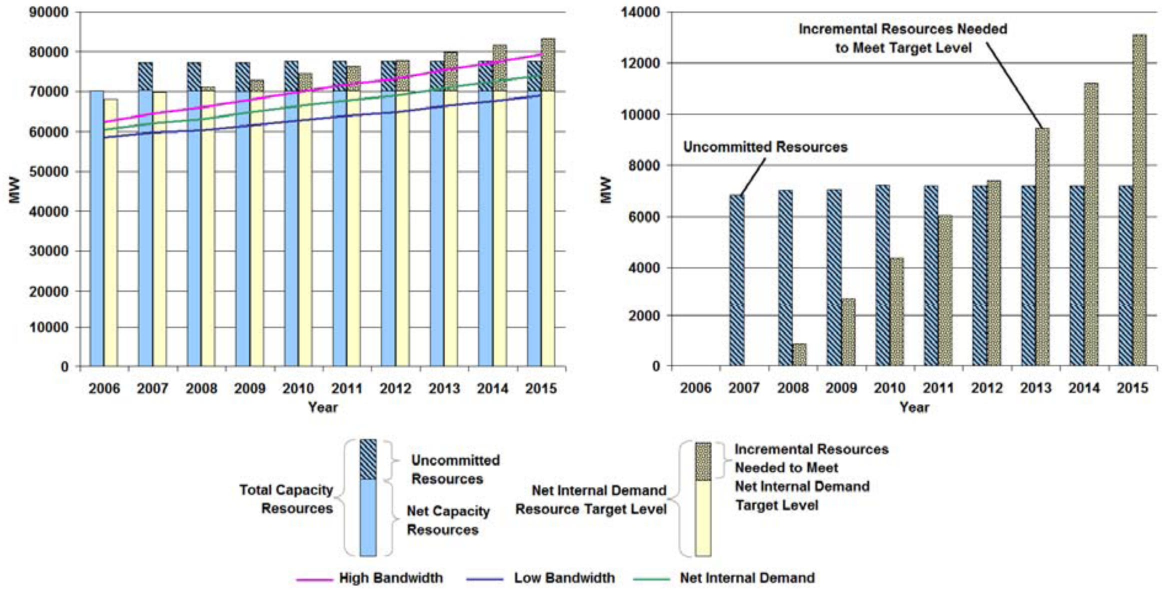
Figure 2.1: NERC Regional Reliability Councils as of October 16, 2006
(**http://www.pserc.wisc.edu/LTRA2006.pdf**, p.5)



A peak demand crisis is looming in Texas. In recent history, Texas has experienced significant population growth and job growth and thus significant growth in its demand for energy. From 1990 through 2002, Texas saw its rate of electricity demand increase an average of 2.5% per year (Texas Energy Planning Council, 2004). In February of 2007, the Public Utility Commission of Texas presented a summary of the electricity supply and demand from 2006 (Texas Electric Market, 2007). An all-time peak high demand was reached on August 17, 2006 of 62.3 GW. The peak demand growth from 2005-2006 was 3.5%.

In 2002, a minimum reserve margin target of 12.5% was agreed upon by the ERCOT board for the region under its jurisdiction (Jones, 2005). As of 2006, the reserve margin was able to be maintained at 14% due to sufficient capacity (Texas Electric Market, 2007). By 2008, however, the available capacity margins will drop below the 12.5% minimum target level (North American Electric Reliability Council, 2006). If the electricity demand is not decreased, or the supply increased by the summer of 2008, Texas' electricity grid could be at risk. As Gaffen and Ross have shown, Texans rely on air conditioning to minimize the health effects of increasing summer heat stress, the product of longer periods of high heat combined with humidity (longer heat waves) (Gaffen and Ross, 1998.) Gaffen and Ross have also observed less nighttime relief from the high temperatures and humidity. When temperatures rise to the 85th percentiles of temperature and humidity measurements they are correlated with weather related mortality (Lawrimore and Seidel, 2006.) Without reliable air conditioning sources, medically fragile and elderly Texas residents are put at increased risk. By 2013, the potential capacity, including "mothballed," or retired, generators, will be just above the required minimum target level (see Figure 2.2 below). It is important to note that these forecasts do not take into account the likelihood of increasing frequency and intensity of unusually hot summers that may be brought upon the state as a consequence of global climate change.

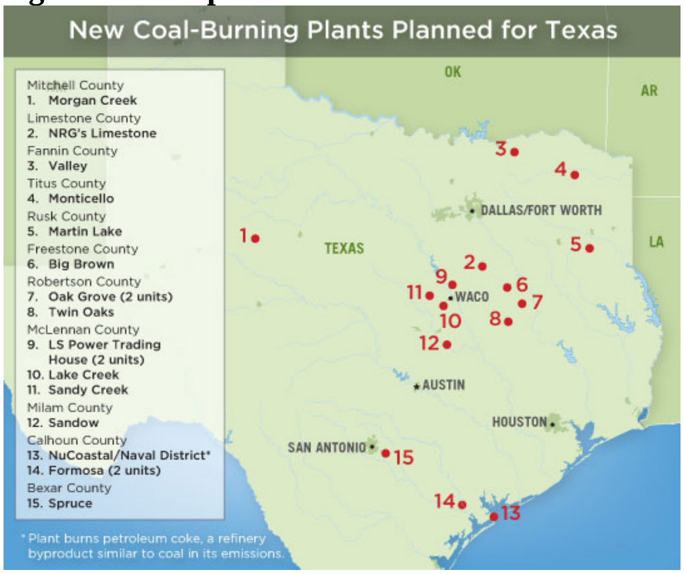
Figure 2.2: Forecasted Peak Demand Shortfall



(http://www.pserc.wisc.edu/LTRA2006.pdf)

In order to address their peak demand shortfall, Texas faces two energy and climate change policy choices. The state can invest in and construct up to 19 new coal-fired electricity plants (see Figure 2.3), or the state can invest in efficiency programs and the growth of renewable energy resources. Initially, the governor was most supportive of implementing the coal plant strategy (Perry, 2006). It was assumed that coal-fired electricity would be the most economical strategy for the state in order to continue to support the growth of its economy. In addition, the governor was not concerned by the plants' production of large amounts of carbon dioxide pollution. By our estimate, the sum of the new plants will emit 125 million tons of new carbon dioxide emissions per year. It was the governor's assertion that since carbon dioxide was not a federally regulated pollutant, the concerns of those worried about climate change resulting from carbon dioxide pollution were exaggerated (Perry, 2006). However, in April 2007, the US Supreme Court ruled that carbon dioxide is a pollutant and should be regulated by the federal government in its Massachusetts vs. EPA decision (Stevens, 2007). Though it is beyond the scope of this paper to offer proof of such, the state risks additional liability costs associated with emitting the now classified pollutant, CO_2, into the atmosphere at high rates.

Figure 2.3: Proposed Coal-Fired Power Plant Locations



(http://www.npr.org/templates/story/story.php?storyId=6110191)

Within the past few months, two additional important findings have been made public. First, a report released by the American Council for an Energy Efficient Economy (ACEEE) found that implementing the coal plant solution would be more costly to the state than implementing proposed efficiency and renewable programs (Elliot et al, 2007). The ACEEE study did not consider the impact of healthcare costs, or the potential cost of CO_2 emissions were they to be regulated by the federal government. Second, in February and April of this year, the 2007 Intergovernmental Panel on Climate Change (IPCC) released its latest reports detailing the important contribution of carbon dioxide and other greenhouse gas emissions to global climate change, and the details of likely regional impacts of climate change (IPCC, 2007).

In the following pages we will summarize the ACEEE report and detail likely market-based prices for the pollutants, including CO_2, emitted by the proposed coal plants based on evidence surrounding the bills that are currently being considered in Congress. In addition, we will consider likely health effects and health-related costs to the state of Texas due to the increased air pollution that will be regionally generated by the coal plants.

3 ESTIMATE OF EMISSIONS FROM ELECTRICITY GENERATION

3.1 ACEEE Study

The American Council for an Energy Efficient Economy (ACEEE) is a non-profit organization based in Washington, DC, whose mission is to advance "energy efficiency as a means of promoting both economic prosperity and environmental protection" (ACEEE Website). In response to the proposed Texas coal-fired power plants, ACEEE released a report comparing the economic impact of the plant construction to an alternative suite of energy efficiency and renewable energy policies (Elliot et al, 2007). In the report, the authors assume that the increase in electricity usage and summer peak demand projected by the Electricity Reliability Council of Texas (ERCOT) occurs as the ERCOT forecast predicts. However, instead of meeting this increase in demand with new coal-fired generation capacity, ACEEE advocates implementing nine policies aimed at reducing electricity demand and meeting any remaining increase with renewable energy and combined heat and power. The nine policies are as follows (Elliot et al, 2007):

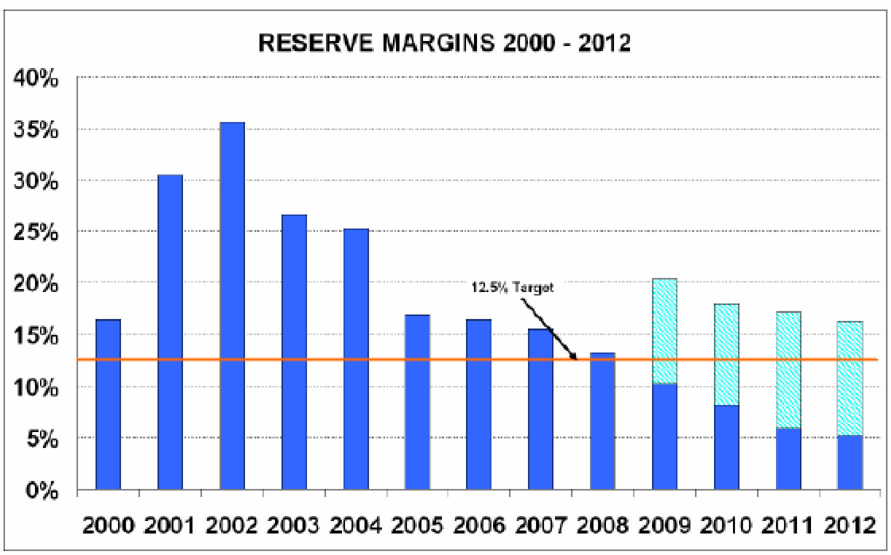
1) Expanded Utility-Sector Energy Efficiency Improvement Program
2) New State-Level Appliance and Equipment Standards
3) More Stringent Building Energy Codes
4) Advanced Energy-Efficiency Building Program
5) Energy-Efficiency State and Municipal Building Program
6) Short-Term Public Education and Rate Incentives
7) Increased Demand Response Programs
8) Combined Heat and Power (CHP) Capacity Targets
9) Onsite Renewable Energy Policies

The ACEEE report estimates that, with these policies put into effect, electricity consumption would have a levelized cost to consumers of 4.5¢ per kilowatt-hour. This cost is less than half of the current average retail price of electricity in Texas, quoted at 9.1¢ per kilowatt-hour in the ACEEE report (Elliot et al, 2007). By including the external costs related to human health impacts and the damage to the environment caused by the coal plant emissions, this report shows that the efficiency and renewable policies are even more favorable.

3.2 Emissions Projections

In order to estimate the costs from coal plant emissions, we first created a schedule that estimates the sequence in which the coal plants will begin generating electricity. The generating capacity and annual emissions projections for each of the plants were taken from a research brief by the Public Citizen's Texas Office and Sustainable Energy and Economic Development (SEED) Coalition (SEED Report, 2007). These projections are shown in Table 9.1 of the Appendix. We assume that the plants will come online in order to meet the projected shortfall in summer peak demand. Starting in 2009, the ERCOT region is projected to fall below the 12.5% reserve margin target for peak capacity (see Figure 3.2.1 below, from Elliot et al, 2007).

Figure 3.2.1: Reserve Margin Projections

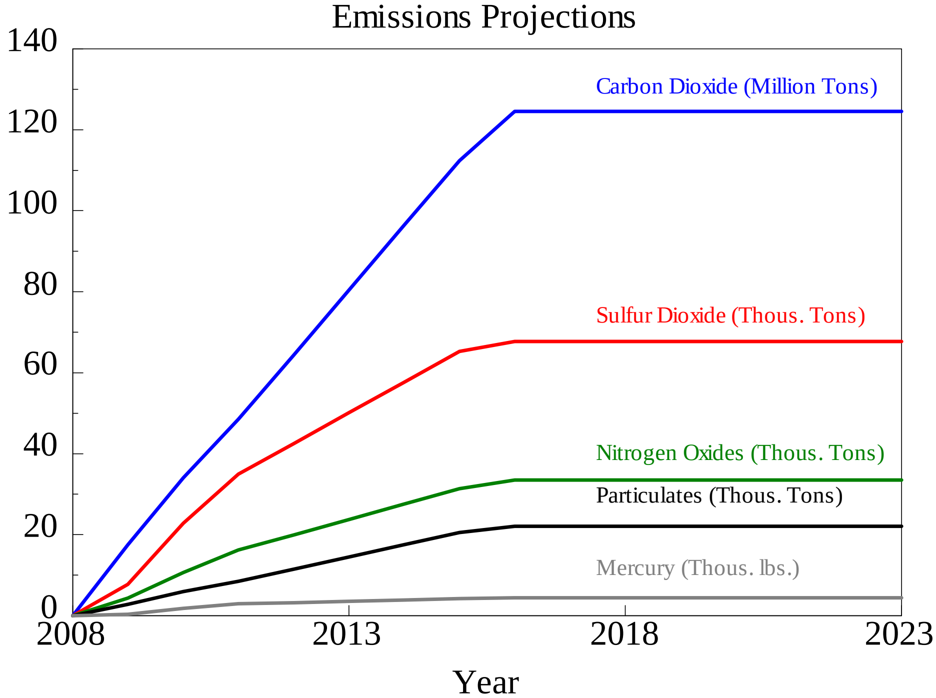


Source: Jones 2007
Note: Lighter shaded bars represent "mothballed" units—generating units that are currently out of service but could be returned to service if conditions warrant as defined in ERCOT (2006a).

At that point, utilities must either restart "mothballed" or retired generating capacity (light blue regions) or build new capacity. We assume that no "mothballed" units are returned to service. Instead, we bring each of the proposed 19 coal-fired power plants online in order to increase peak capacity and keep the region above the 12.5% reserve margin target. When one of the plants comes online, we assume that it meets its annual emissions projections in its first year of operation.

Based on this approach, we project that the first plants will begin generating electricity in 2009 and all of the plants will be operating at full capacity by 2016. The calculations and exact schedule are shown in Table 9.2 of the Appendix. Given this schedule, we were able to calculate the annual emissions of carbon dioxide, sulfur dioxide, nitrogen oxides, particulate matter, and mercury that the proposed coal plants will produce. These emissions are shown in Figure 3.2.2 below for the period from 2008 to 2023, the same period modeled by the ACEEE study.

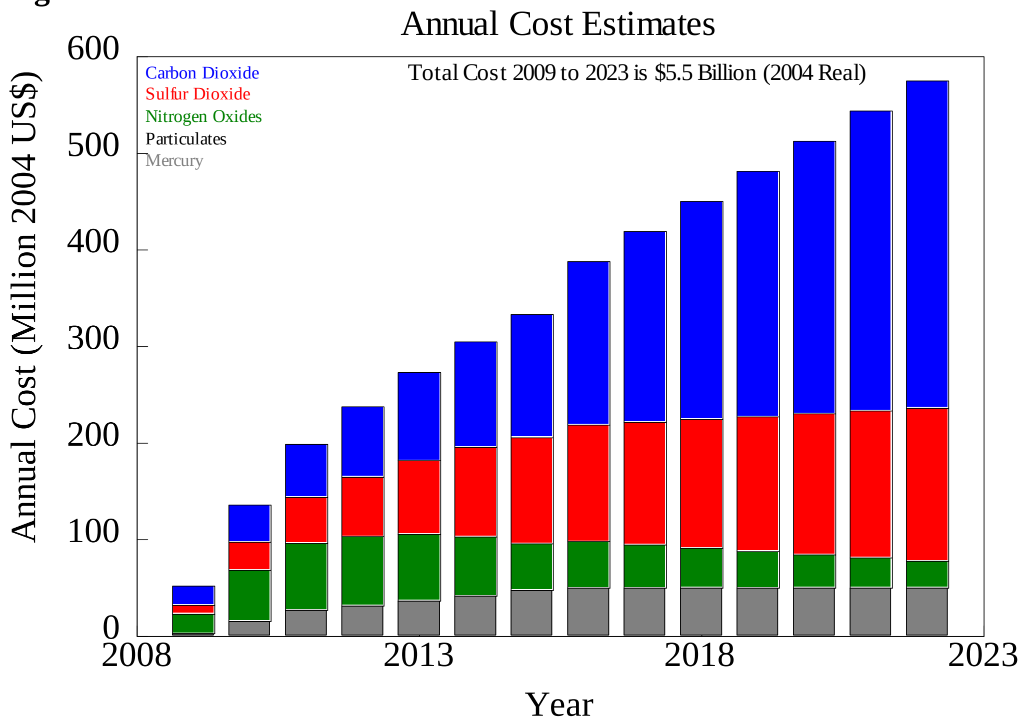
Figure 3.2.2: Annual Emissions Projections



3.3 Baseline Cost Projections

Once the emissions levels were set, the next step was to translate the amount of each pollutant produced into a dollar value that estimated their impact on society and the environment. While a more nuanced approach that looks at pending climate change legislation and direct human health impacts follows, our initial cost estimates came from an Environmental Protection Agency (EPA) planning document. As part of their review for any new legislation, the EPA conducts cost-benefit analyses to estimate the economic impact of regulations. In October of 2005, the EPA released a document that analyzed a number of potential multi-pollutant proposals based upon their impact on air quality, human health benefits, and the power sector (EPA Report, 2005). The report gives estimated prices for carbon dioxide, sulfur dioxide, nitrogen oxides, and mercury for the years 2010, 2015, and 2020. We used the estimates for the Clean Air Planning Act and extrapolated between years to get prices for the period 2008 to 2023. The prices for the EPA estimates are shown in Table 9.3 of the Appendix. When applied to the Texas coal plants, the emissions add a total cost of $5.5 billion (2004 dollars) to the state during the period modeled by ACEEE, with annual costs shown in Figure 3.3.1 below. It is important to note that coal plants have a realistic lifetime of 30 to 50 years. Therefore, these cost estimates are conservative and the true costs would continue for the entire lifetime of the plants.

Figure 3.3.1: Annual Emissions Cost Estimates



4 ASSOCIATED CARBON COSTS

4.1 Carbon Costs and Texas: Background Information

Unlike many other states, Texas has been reticent to implement statewide policies curbing greenhouse gas emissions, citing potential economic harm. In September of 2006, Governor Rick Perry stated:

> There is great debate in the scientific community about whether we are experiencing man-made global warming. I am not a scientist, but this I will say: I will not impose stricter sanctions on carbon dioxide emissions when the federal government does not even recognize it as a pollutant and when setting standards that are more punitive than almost every other state and nation would cause economic ruin for the people of Texas (Rick Perry, 2006).

As a result of this perspective, Texas has not incorporated the potential costs of carbon into its energy planning to date. However, since Governor Perry made the above statement, several national factors have evolved to increase the likelihood of federal recognition of the cost of carbon emissions in the near future. First and foremost, on April 2, 2007, the Supreme Court issued a ruling in the Massachusetts vs. EPA case that carbon dioxide must be classified as a pollutant (Stevens, 2007). In addition, the significant shift of power in Congress as a result of the 2006 elections makes federal climate legislation more likely than it has ever been in the past (Mongoven, 2007). It now seems that the question is not whether the cost of carbon will be acknowledged, but rather when that cost will be implemented and how much it will be.

Texas emits more carbon dioxide than any other state in the country (723 million tons per year), and ranks seventh in carbon dioxide emissions worldwide (Cassady, 2007). As a result, its economy is vulnerable to the costs that may be imposed on carbon emissions, and it should think about likely carbon costs when planning to meet its future energy needs. This section outlines a framework for examining those potential costs.

4.2 Current Climate Change Proposals in Congress

A flurry of bills related to climate change are being considered in the 110th U.S. Congress, the majority of which have been introduced in the Senate. These bills generally fall into three categories: proposals to improve the monitoring of greenhouse gas emissions, bills requiring renewable portfolio standards, and legislation capping greenhouse gas emissions and establishing a market mechanism for carbon trading (Mongoven, 2007). The following discussion focuses on four bills in the latter category, all of which vary considerably in terms of compliance mechanisms and ultimate caps.

<u>Bingaman/Specter</u>

Compared to other bills being considered in the Senate, the Bingaman/Specter bill is at the low end of the reduction spectrum. It would implement a cap-and-trade program to gradually slow the growth of greenhouse-gas intensity, or the amount of greenhouse gases emitted per dollar of gross domestic product, beginning in 2012. Emissions would be reduced by 2.6% per unit of GDP from 2012 to 2021 and by 3% per unit of GDP from 2022 onward. The proposal also offers a "safety valve," or price cap, which would limit the amount of money that companies are required to spend on emission-reduction efforts or emission allowances (Bingaman-Specter, 2007).

<u>Lieberman/McCain/Obama</u>

The McCain/Lieberman bill has been changed since its last introduction to Congress, and it also recently added Barak Obama as a sponsor. The primary change is to extend the bill's timeframe out to 2050. The bill would require industries to reduce their emissions to 2004 levels within five years (2012 – 2019), and then drop emissions to meet milestones every ten years until they reach 60 percent below 1990 levels by 2050. The bill also includes hefty subsidies for nuclear power (Larsen, 2007).

<u>Feinstein/Carper</u>

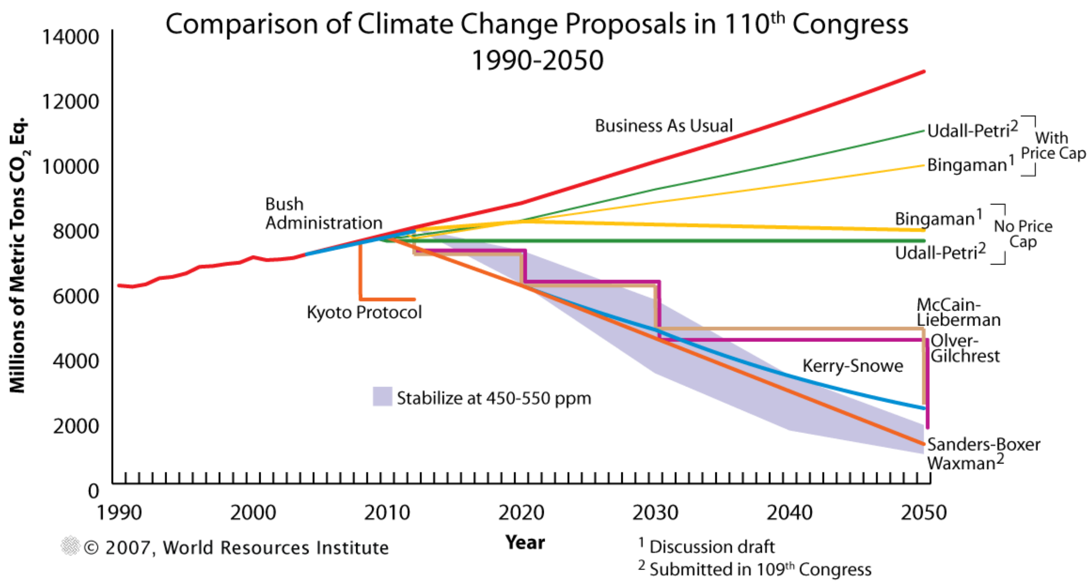
The Feinstein/Carper bill would address emissions only from electric utilities, mandating emissions levels 25 percent below projected emissions levels in that sector by 2020. In addition, the bill would allow an unlimited carbon offset program, so instead of upgrading their technology or directly reducing their greenhouse gas emissions, power companies could invest in other carbon reduction projects, such as protecting or planting forested areas that absorb carbon dioxide (VanNess Feldman, 2007).

<u>Boxer/Sanders</u>

The Global Warming Pollution Reduction Act introduced by Senator Boxer and Representative Sanders calls for 80 percent emission reductions from 1990 levels by 2050, which would be achieved through a series of ambitious emissions targets combined with incentives for clean energy technologies. Boxer referred to this bill as the "gold standard" - perhaps implying a lofty and unreachable goal. However, it is the only bill discussed here that has a chance of reaching the goal of stabilizing greenhouse gases at 450 to 550 parts per million, the level which most scientists believe is required in order to avoid dangerous climate change (VanNess Feldman, 2007).

The following chart from the World Resources Institute shows the different emissions levels allowed by different legislation, not including the Feinstein/Carper bill:

Figure 4.2.1: Climate Change Legislation Comparison



4.3 Likely Nature and Timing of Legislation

At this point, it is very difficult to accurately predict when mandatory legislation governing carbon will pass, and the specific requirements it will have. Two things are virtually certain: federal climate legislation will eventually be enacted, and that legislation will incorporate a cap-and-trade system to govern greenhouse gas emissions. Given the plethora of bills currently in Congress and the building national dialogue about climate change, some analysts have theorized that legislation could pass this year (Mongoven, 2007). However, climate change legislation will have far-reaching effects on the U.S. economy, and such policy will meet significant industry opposition. Even if the bill does pass Congress, it is possible that the President would veto any far-reaching legislation.

Next year is the 2008 Presidential election. It is unlikely that major legislation would be pushed through during an election year; Congress will be distracted and advocates will hold out for a more favorable administration. All of the current front-running Presidential candidates from both parties favor a federal carbon cap, so the next President will undoubtedly be more amenable to climate change legislation, regardless of their party or platform.

The first year of a new Presidential term is a highly productive time in federal policymaking. Climate policy advocates will be lobbying hard for legislation, and legislators will have had time to analyze the different proposals. A new President will also want to garner favor abroad, and may use action on climate change as one vehicle towards that goal. Therefore, 2009 is the most likely year for Congress to implement a federal carbon cap.

4.4 Likely Carbon Pricing Resulting from Legislation

Political bargaining and maneuvering over climate change is increasing, and the resulting negotiations will likely change the current Congressional bills substantially before any is enacted into law. The final iteration of any climate legislation is still difficult to predict. However, current legislation and recent trends in international markets do allow us to presume a range of carbon prices that may emerge from climate legislation.

At one end of the spectrum, the Bingaman legislation includes a $7 price ceiling on metric tons of carbon emissions that would increase 5% per year above inflation. This is probably the lowest realistic price scenario for carbon; under free market mechanisms the price will be significantly higher. The Chicago Climate Exchange has been operating a voluntary carbon-trading market since 2003, where carbon prices range from $3.67 -$18.33 per metric ton of carbon emissions without the presence of a carbon cap (CCX, 2007). Therefore, it is likely carbon would reach the set price cap of $7 fairly quickly if the program were adopted. There are 12 tons of carbon per 44 tons of carbon dioxide, so the Bingaman price ceiling on carbon corresponds to a significantly lower price ceiling on CO_2. Therefore, if the Bingaman program were implemented in 2009, the price per ton of carbon dioxide would be $3.52 by 2023 based on current 2.42% rates of inflation.

At the higher end of a price spectrum, the U.S. Department of Energy's Energy Information Administration analyzed different carbon pricing and trading scenarios, and presented a range of carbon prices from $14 to $49 in 2030 depending on the stringency of the cap (EIA, 2006). Bills to stabilize carbon at "safe" levels, like the Boxer-Sanders bill, will drive carbon prices to the higher end of that spectrum. Extrapolating from those ranges and discounting back from 2030 based on current rates of inflation, one can say that a high-end carbon price (resulting from a bill like Boxer-Sanders) would be approximately $43 per ton of carbon dioxide in 2023.

Obviously, the range between $3.52 and $43 is substantial, and it is likely the final cap will create carbon prices somewhere in the middle of these two extremes. Therefore, one can average the different estimates included in the Energy Information Administration report and get a price of $23.63 per metric ton of carbon dioxide, which may be the most realistic price of the options (EIA, 2006). Since it is difficult to know exactly where the cap will be set and what carbon pricing will result, this study will analyze the economic viability of the proposed coal projects in Texas under all three of those different carbon pricing scenarios.

4.5 Applying Likely Costs of Carbon to the Texas Case

When climate legislation is passed and the designated regulatory agency sets a carbon cap, there are several ways the pollution permits could be distributed. One possibility is to distribute by sector nationwide. However, the potential exists to distribute allocations to every state, which would then be responsible for allocating specific caps to each of the companies operating within its borders. (Cowart 2004) Therefore, it is very difficult to predict what dollar amount each of the proposed coal plants in Texas would have to pay for its greenhouse gas emissions. Those costs may or may not be passed on proportionately to each individual plant. However, it is certain that someone in the state will have to pay for every ton of carbon emitted from the new coal plants. Therefore, this study treats the calculated cost of carbon from these plants as an aggregate cost to the state of Texas.

When the three pricing scenarios defined above are applied to the projected emissions of the proposed coal plants, they result in the following total costs from 2009 to 2023:

1. With a price of $3.52 per metric ton of carbon dioxide, corresponding to proposals in the Bingaman Bill, state costs total $3.9 Billion.
2. With a price of $23.63 per metric ton of carbon dioxide, which is an average of prices projected by the Energy Information Administration, state costs total $30 Billion.
3. With a price of $43 per metric ton of carbon dioxide, corresponding to proposals in the Boxer/Sanders Bill, state costs total $54 Billion.

Clearly these costs are substantial, both to the state and potentially to the coal plant operators themselves. Though estimates span a large range, some price on carbon will no doubt be implemented over the lifespan of these plants. It is necessary for the state of Texas to take those costs into account when deciding whether to move forward in the plant permitting process.

5 ASSOCIATED HEALTH COSTS

5.1 Major Pollutants and Health Effects Considered

Coal-fired electricity plants create more than the greenhouse gas emissions that are causing global climate change. They also emit other common air pollutants that are responsible for an increased prevalence and severity of diseases in the regions in which these pollutants are emitted. The state of Texas uses more electricity than any other state in the union, 23% more than California, and 57% more than Florida (Cool Texas Buildings, 2007). Texas also leads the nation in emissions of nitrogen oxide (NO_x), carbon dioxide (CO_2) and mercury. Texas is sixth in the nation in sulfur dioxide (SO_2) emissions. The 19 proposed coal-fired plants would cause an increased prevalence of diseases such as chronic obstructive pulmonary disease (COPD), pneumonia, congestive heart failure (CHF), and pediatric asthma. By building these new plants, the state of Texas can expect a dramatic rise in health care costs in a state where the healthcare system is already under significant stress. Table 5.1.1 lists some of the major pollutants emitted from power plants, as well as their associated health effects.

Table 5.1.1

Health Effects of Selected Power Plant Pollutants[a,b]

	Human Toxicity		
Substance	Acute	Chronic	Comments
Sulfur dioxide	Lung irritant, triggers asthma, low birth weight in infants.	Reduces lung function, associated with premature death.	Also contributes to acid rain and poor visibility.
Nitrogen oxides	Changes lung function, increases respiratory illness in children.	Increases susceptibility to respiratory illnesses and causes permanent alteration of lung.	Forms ozone smog and acid rain. Ozone is associated with asthma, reduced lung function, adverse birth outcomes and allergen sensitization.
Particulate Matter	Asthma attacks, heart rate variability, heart attacks.	Cardiovascular disease, pneumonia, chronic obstructive pulmonary disease, premature death.	Fine particle pollution from power plants is estimated to cut short the lives of 30,000 Americans each year.
Hydrogen chloride	Inhalation causes coughing, hoarseness, chest pain, and inflammation of respiratory tract.	Chronic occupational exposure is associated with gastritis, chronic bronchitis, dermatritis, photo sensitization in workers.	
Hydrogen Fluoride	Inhalation causes severe respiratory damage, severe irritation and pulmonary edema.		Very high exposures through drinking water or air can cause skeletal fluorosis.
Arsenic	Ingestion and inhalation: affects the gastrointestinal system and central nervous system.	Known human carcinogen with high potency. Inhalation causes lung cancer; ingestion causes lung, skin, bladder and liver cancer. The kidney is affected following chronic inhalation and oral exposure.	
Cadmium	Inhalation exposure causes bronchial and pulmonary irritation. A single acute exposure to high levels of cadmium can result in long-lasting impairment of lung function.	Probable human carcinogen of medium potency. The kidney is the major target organ in humans following chronic inhalation and oral exposure.	Other effects noted from chronic inhalation exposure are bronchiolitis and emphysema.
Chromium	High exposure to chromium VI may result in renal toxicity, gastrointestinal hemorrhage and internal hemorrhage.	Known human carcinogen of high potency.	Chronic effects from industrial exposures are inflammation of the respiratory tract, effects on the kidneys, liver, and gastrointestinal tract.
Mercury	Inhalation exposure to elemental mercury results in central nervous system effects and effects on gastrointestinal tract and respiratory system.	Methyl mercury ingestion causes developmental effects. Infants born to women who ingested methylmercury may perform poorly on neurobehavioral tests.	The major effect from chronic exposure to inorganic mercury is kidney damage.

a Agency for Toxic Substances and Disease Registry Online. ToxFAQs. Division of Toxicology, Atlanta, Georgia.

b U.S. EPA, 2000. Integrated risk information system (IRIS). Online. Office of Health and Environmental Assessment, Cincinnati, Ohio.

(CATF: Cradle to Grave, 2001)

5.1.1 *Particulate Matter*

Particulate matter (PM) emissions are generally the most damaging power-plant pollutants in terms of health effects (Bascom et al., 1996), so in this report we focus on the health impact due to emissions of PM and the secondary PM formed from nitrogen oxide and sulfur dioxide emissions. For simplicity, this analysis does not include (1) the non-PM impacts of SO_2 and NO_x, (2) the health effects of resulting tropospheric ozone production, or (3) the health effects due to inhalation or ingestion of the many other toxics emitted from coal-fired power plants. Including these effects would further increase the health consequences and cost estimates.

Particulate matter is a mixture of harmful pollutants consisting of tiny particles of solid or liquid suspended in gas. Primary PM is emitted directly, such as soot from combustion, whereas secondary PM is formed when chemicals such as SO_2 or NO_x are oxidized to form acids or salts (e.g., sulfuric acid) (SEED, 2006). PM is damaging to human health because smaller particles can be inhaled deeply and absorbed into the bloodstream

5.1.2 *Health Effects Examined*

In this analysis, we have focused on four of the most costly health impacts due to particulate matter (Schneider, 2007): Chronic Obstructive Pulmonary Disease (COPD) (COPD Fact Sheet, American Lung Association, 2006), Congestive Heart Failure (CHF), Pediatric Asthma, and Mortality. Other typical health effects associated with coal use but not discussed here are: Dysrhythmia, Heart Attacks, Lung Cancer, and Pneumonia.

5.2 Health Effects and Cost Per Incidence

5.2.1 *Chronic Obstructive Pulmonary Disease (COPD)*

Chronic Obstructive Pulmonary Disease (COPD) is a general term for chronic bronchitis and emphysema (COPD Fact Sheet, American Lung Association, 2006). Both obstructive lung diseases have gradual onset and restrict airflow to the lungs. Chronic bronchitis is inflammation of the bronchial tubes. Eventually the lining of the bronchial tubes is scarred, excessive mucus is produced constantly, and an irritating, chronic cough develops. Air flow becomes limited by this chronic inflammation and scarring, and the lungs are commonly infected. Emphysema begins with the destruction of air sacs (alveoli) in the lungs. The damage to the alveoli is permanent and the lungs become more and more limited in their ability to transfer oxygen and carbon dioxide to and from the bloodstream. Patients with emphysema have increasing difficulty breathing, especially exhaling, and eventually require supplemental oxygen to survive.

The United States spent over $37 billion on COPD in 2004, $20.9 billion in direct health care expenditures, $7.4 billion in indirect morbidity costs, or costs of caring for related illnesses, injuries or disabilities, and $8.9 billion in indirect mortality costs (COPD Fact Sheet, American Lung Association, 2006). Over 15 million cases of COPD were recognized in the US in 1993, or 61.9 per 1000 persons (Sullivan et al., 2000.) The CDC reports that COPD may be significantly under diagnosed (Mannino et al., 2002).

According to a study of COPD in the state Medicaid programs in California and Florida, the mean excess cost of COPD (the increased health costs relative to Medicaid patients without COPD) was between $5500 and $7000 per patient in 2004 dollars (Marton et al., 2006). As is often the case, the most severe 10% of cases account for 50-70% of the total costs (Sullivan et al., 2000). Total hospital costs per patient varied from nearly $13,000 to over $130,000 (in 2004 dollars) with varying severity, with costs skyrocketing to $220,000 in the cases where lung transplant was required. Since COPD is most often diagnosed in those older than 65, a growing segment of the population, the US rate of hospitalization increased 25.4% between 1992 and 1995, a trend that is likely to continue.

In 2004 dollars, the direct medical cost per year per person with COPD was over $10,000 on average, with 25% of those costs directly attributable to COPD (Strassels et al., 2001). The additional costs are due to the various co-morbidities, or associated illnesses, that are commonly seen in patients with COPD. Patients with COPD spend an average of 5 days per year in the hospital due to acute flare-ups of their disease and issues relating to their co-morbidities. COPD is one of the 3 most common causes of lost work days, and in considering the growing economy of Texas, may be most costly to the state in lost productivity (Wouters et al., 2003). When the economic impact of COPD was studied globally, the direct costs from COPD hospitalizations and indirect costs from lost productivity were the most significant for the United States of the 7 industrialized nations studied. COPD is one of the top 10 most economically burdensome diseases to employers due to the high cost of disability (Darkow et al., 2007).

Employees with COPD in various industries, including the utility industry, were seen as burdensome to their employers based on the disability costs resulting from their COPD. Employees with COPD were more than twice as likely to have a short term disability claim and more than four times as likely to have a long term disability claim as employees without COPD, even after adjusting for relevant co-morbidities. Additionally, employees with COPD were disabled longer, incurring an average of $4770.52 in additional indirect costs without taking into account the additional costs of recruiting, training and paying replacement workers. Occupational exposure is costly to employees who are exposed to COPD exacerbating air pollutants on the job as well. Over 19% of all COPD cases can be attributed to occupational exposure to pollutants, the proportion rising to 31.1% of cases among people who have never smoked (COPD Fact Sheet, American Lung Association, 2006).

5.2.2 *Congestive Heart Failure (CHF)*

Like COPD, Cardiovascular disease costs Texas residents both their heath and their healthcare dollars. Here we will focus on congestive heart failure (CHF.)

CHF is the failure of the heart to pump enough blood to meet the needs of the other organs (American Heart Association, 2007). Physicians are becoming better able to prevent death from heart disease, thus the numbers of patients requiring long term medical care for CHF is increasing (The News, University of Texas Health Science Center, 2000). Since 1940, cardiovascular disease has been the leading cause of death in Texas (Texas Council on Cardiovascular Disease and Stroke, 2005). In Texas, there are 55,600 deaths per year from cardiovascular disease, 16.8% which are due to CHF. The number of cases is growing, and CHF is now the leading cause of hospitalization for patients over 65 (Texas Council on Cardiovascular Disease and Stroke, 2005 & News, Baylor College of Medicine, 2003).

In one unpublished pilot study performed by the Stanford University-based Global Healthcare Productivity Group, the burden of CHF was examined across 11 countries (Garber, 2001). The United States had the second highest costs associated with yearly CHF medical care, second only to France, and the most acute hospital admissions of all of the nations studied. Estimated annual health expenditures for CHF in the US were reported to be $4,398.61 per patient in 2004 dollars. Another recent study examined the economic effect of a hospital-based heart transplant program using a sample of patients who underwent complete transplant evaluations (Gregory et al., 2005). In each case in which the patient ultimately did not require transplant, the treatment cost approximately $45,000 (in 2004 adjusted dollars) through the first year, and each case that required a heart transplant cost approximately $200,000 in the first year. As CHF is a chronic illness, the costs don’t end with the first year of treatment, but continue to rise to nearly $300,000 by the second year if a transplant is required. The care and costs can be expected to continue throughout the life of the patient. Thus, while hospitals in Texas may benefit in increased revenue, the burden on the state, federal and individual payors will be significant with each new case of CHF brought on or exacerbated by additional air pollution, particularly as the severity of some cases increases to require heart transplant.

5.2.3 *Pediatric Asthma*

Many are rightly concerned with the impact that the proposed plants will have on the health of children in Texas. Death in childhood from preventable disease has lasting impacts on parents, siblings, extended families and communities. Pediatric asthma is the most common chronic disorder in childhood in the United States (Asthma & Children Fact Sheet, American Lung Association, 2006). An asthma episode is defined by a series of events that results in narrowed airways such as swelling of the lining of the lungs and/ or increased secretions in the lungs. The excessive lung sensitivity that characterizes asthma can be triggered by various factors which include gaseous and particle pollution. In 2004, 4 million American children experienced an asthma attack or episode, and 154 died from asthma the previous year. Children with asthma miss more school days than children with any other chronic condition.

The annual economic cost of caring for Texans with asthma is estimated to be $763 million by the Allergy and Asthma Foundation (Cool Texas Buildings, 2007).

According to the American Lung Association of Texas, 1 million children in Texas have asthma, and 200,000 of those are hospitalized each year (Robert Wood Johnson Foundation, 2006). Over 9% of children in Texas were affected by asthma in 2003, with 18.7% of their families being "greatly or moderately" affected by their condition (National Survey of Children's Health, 2003). Asthma is the most common reason for hospitalization of children in the US after birth, and the average length of stay (LOS) is 2.5 days with each admission (Meurer et al., 1998). The costs vary with hospital setting (rural vs. urban, public vs. for-profit, teaching vs. non-teaching.) But, on average, the total direct yearly costs for asthma treatment in children were $727.53 per patient between the ages of 5 and 17, and $1876.81 per patient under age 5 in 2004 adjusted dollars (Smith et al., 1997). A child with asthma misses more school days than children with any other chronic disease, and caregivers, employers and states incur significant costs when the primary caregiver is required to stay home with a sick infant or toddler. In 2004 adjusted dollars, the US spent over $245 million on missed school days, and over $23 million in infant and toddler sick days for babies and children with asthma.

To confound the costs, children without health insurance or who are covered by public insurance plans such as Medicaid or State Children's Health Insurance Plan (CHIP) have higher rates of total hospital admission, increased mortality, increased illness severity, and increased hospital charges (Todd et al., 2006). In southeast Texas alone, more than 53,000 children seek asthma treatment through the emergency department each year (Robert Wood Johnson Foundation, 2006). According to the authors of a study published in *Pediatrics* in 2006 comparing the mortality, morbidity and hospital charges of children with no insurance or public insurance versus those with private health insurance, "If children with public or no health insurance in the United States in 2000 had the same hospitalization outcomes as children with private insurance, $5.3 Billion in hospital charges could have been saved." (Todd et al., 2006). As of 2003, only 82.7% of Texas children were insured either publicly or privately, nearly ten percentage points less than the national average (National Survey of Children's Health, 2003). Texas children have a much higher rate of health care coverage inconsistency compared with the rest of the nation's children. It is well documented that children with poor quality health insurance or without health coverage tend to go without routine preventative care and end up receiving primary treatment through the emergency department. Barbara Best of the Gulf Coast CHIP Coalition stated recently in an interview that, "According to the Harris County Hospital District in Houston, the cost of preventive treatment for an established patient's mild asthma attack in a doctor's office is $94 to $103 using oxygen or a nebulizer and medicines, while the cost of treating an asthma patient who comes to the Harris County Hospital District's emergency room with full symptoms and has to be hospitalized for an average stay of three days is $9,209. These costs are assumed by local taxpayers, and thus, the lack of insurance coverage becomes expensive for the entire community." (World Health Organization, 2006). Twenty percent of children living in Texas with asthma must be hospitalized each year. As the number and severity of asthma cases rises in Texas with the added pollution generated by the coal fired electricity plants, Texans can expect to compound the growth of their state's healthcare costs.

5.2.4 *Mortality*

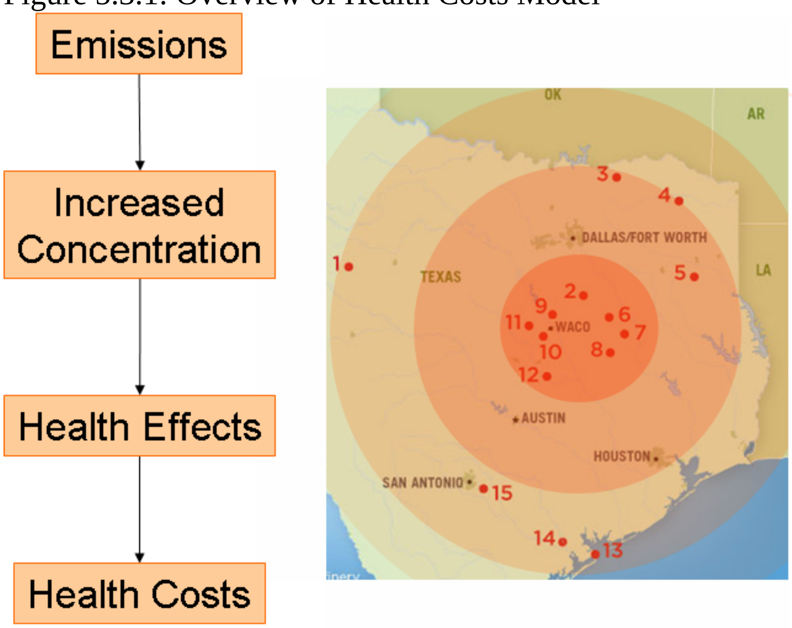
Rather than linking pollutant concentrations to diseases, many studies determine correlations between pollutant increases and increases in mortality (where mortality is often an ultimate result of the diseases listed above) (Hofstetter, 1998). Based on such studies, it has been estimated that coal-fired power plants result in more deaths (22,000) than drunk driving (17,000) or homicides (20,000) (CATF: Dirty Air Dirty Power, 2004). In order to estimate the costs associated with mortality, risk scientists use the "value of statistical life", which is based on economic factors such as the salaries for dangerous jobs or the cost of averting risky behaviors. Such estimates range from $0.7 million to $16.3 million, and the EPA finds a central tendency of $6.8 million per life, which we use here (EPA, 2000).

5.3 Model to Estimate Health Costs

5.3.1 *Model Overview*

In order to estimate final health costs, we combine a Particulate Matter (PM) dispersion model with health effect damage factors and cost estimates for each incidence (Figure 5.3.1).

Figure 5.3.1: Overview of Health Costs Model



5.3.2 *PM Dispersion Model*

The model used to estimate pollutant concentration (Greco, 2006) is based on the amount of pollutant emitted and the distance from the source. The concentration is presented as a step function of distance, where one value is given for people 100-200 km away and another given for people 200-500 km away. We found that the three major cities in Texas, Austin, Houston and Dallas, are generally 100 to 700 km away from the proposed plants (Table 5.3.1).

Table 5.3.1: Distance of 19 proposed plants from three major Texas cities

Distance to Three Cities [km]			
County	**Austin**	**Dallas**	**Houston**
Mitchell	440	403	776
Mclennan (3)	166	157	301
Fannin	446	132	517
Titus	507	197	454
Ruk	416	214	310
Freestone	267	160	234
Limestone	222	158	256
Robertson (3)	179	238	214
Bexar	123	435	325
Milam	116	248	230
Calhoun (3)	240	590	214
Nueces	338	650	347
AVERAGE	**257**	**309**	**313**
Std. dev.	*117*	*177*	*140*

To simplify future calculations, we assume that all plants emit an equal portion of each pollutant's total emissions. Based on this table, we further approximate Houston as being 200-500 km from all 19 plants, whereas both Austin and Dallas are approximated as 200-500 km from half of the plants and 100-200 km from the other half. Using this model, we estimate the resulting increase in concentration (in ug/m^3) in Austin, Dallas, and Houston, as well as a background value for the rest of Texas.

5.3.3 *Disease Indicators and Costs*

We then use this modeled increase in concentration to estimate the increase in health incidences and subsequent costs. For each health effect, we find the dependence of that effect on an increase pollutant concentration (Hofstetter, 1998). We then multiply this dependence by the increase in pollutant concentration and population density in the area considered to find the total increase in incidences. Finally we multiply the increased incidence by the cost per incidence to estimate a total cost:

$$\text{Total Cost} = \frac{\text{cost}}{\text{increased cases}} \times \frac{\text{increased cases per person}}{\text{increased concentration}} \times \text{people affected}.$$

For each of the diseases considered, we have used certain indicators found in the literature (Hofstetter, 1998). The indicators and associated pollution dependence and cost are summarized in Table 5.3.2.

Table 5.3.2: Summary of health effect indicators, pollution dependence and cost.

	Indicator	Affected Population	Cases [cases/yr/(ug/m^3)]	Cost / case [2004 $]
COPD	Chronic Bronchitis	adults	7.80E-05	$15,057
CHF	CHF	>65	3.09E-05	$4,399
Pediatric Asthma	Medication Usage	child asthmatics	0.129	$1,431
	ERV	children	1.08E-05	$251

	Indicator	Affected Population	Increase of Mortality Rate [%/yr/(ug/m^3)]	Cost / case [2004 $]
Mortality	Chronic Mortality	>30	0.64%	$6,807,082

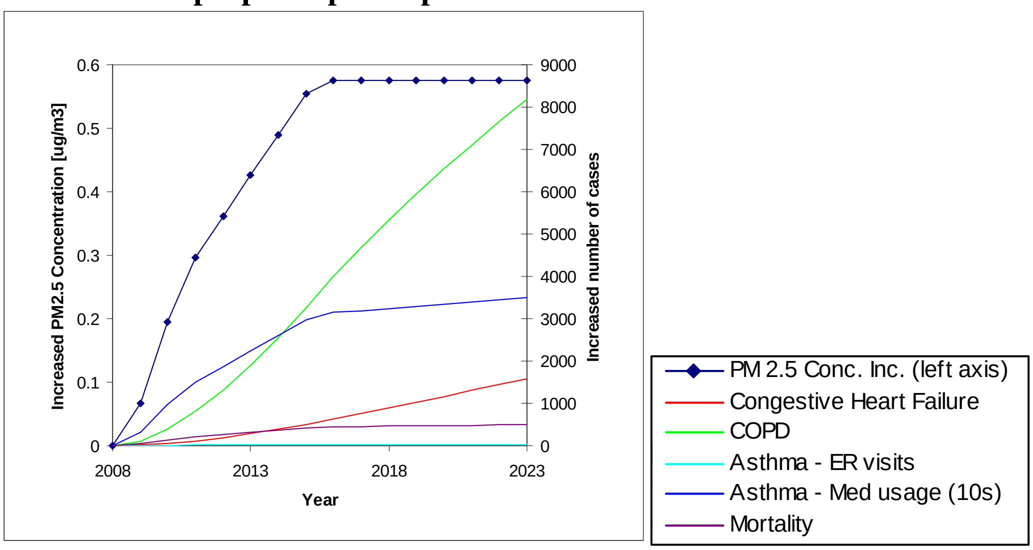
The amount of people in each affected population was estimated by assuming a growth rate of 1.5% in Texas (http://www.bidc.state.tx.us/overview/2-2te.htm#Population) and using standard fractions of the population in each age group (Hofstetter, 1998). The number of child asthmatics was assumed to be 8% of children (http://www.epa.gov/envirohealth/children/child_illness/d1.htm). We used 0.678% as the Texas mortality rate (http://www.dshs.state.tx.us/CHS/VSTAT/vs04/t26a.shtm).

5.3.2 *Results: Increase in PM Concentration and Incidence of Disease*

We find an increase in $PM_{2.5}$ (PM smaller than 2.5 microns) concentrations of just under 0.6 ug/m^3, which led to significant increases in the incidences of the diseases considered (Figure 5.3.2). In 2010, Texas is predicted to have $PM_{2.5}$ concentrations ranging from 1 to 20 ug/m^3, with most of eastern Texas around 10 ug/m^3 (CATF: Power Plant Emissions, 2004). The National Ambient Air Quality Standard for $PM_{2.5}$ is an annual average of less than 15 ug/m^3.

Although the power plant emissions level off around 2016, the number of people with congestive heart failure and COPD continually increases because these are lifelong diseases.

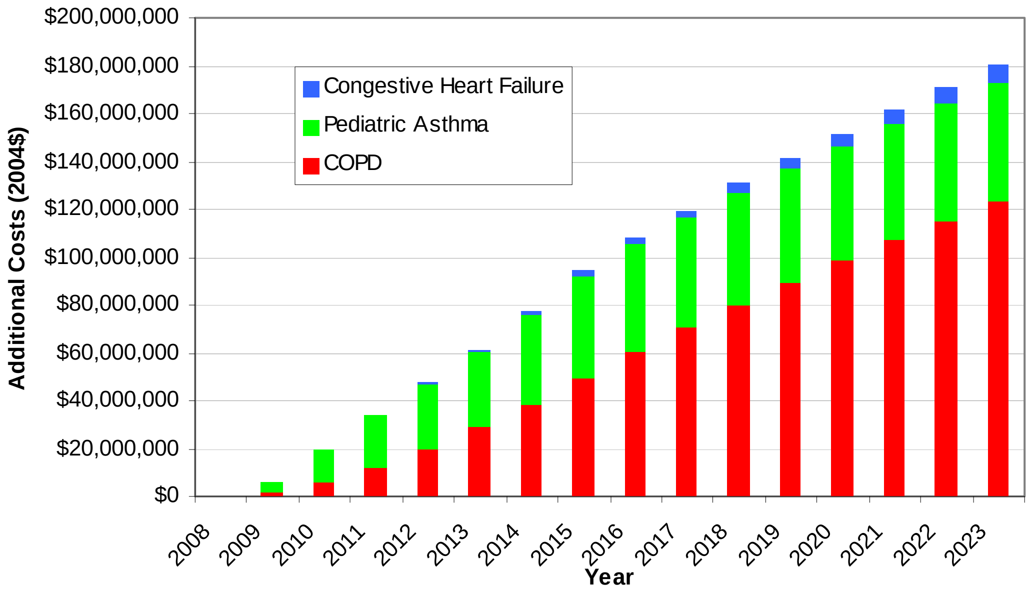
Figure 5.3.2: Estimated increase in $PM_{2.5}$ concentrations and corresponding increase in disease due to proposed power plant emissions.



5.3.3 *Results: Health Costs*

Using the health costs described in Section 5.2, we calculate the annual costs attributable to each disease. Due to the high value of a statistical life ($6.8 million in 2004$), the mortality costs dwarf the costs due to disease, adding up to $3.1 billion in 2023.

Figure 5.3.3: Estimated annual costs associated with increase in disease due to power plant emissions. Mortality costs not shown – range from $290,000 in 2009 to $3.1 billion in 2023.



We used conservative lower estimates of all values involved and only consider a few of the many pollutants and diseases, thus these values are seen as lower limits on the health costs resulting from the construction of the 19 coal-fired power plants.

6 TEXAS' VULNERABILITY TO CLIMATE CHANGE

The economic cost to the State of Texas may also include liability for damages from burning coal. The generation of electricity from coal-fired power plants emits significant CO_2 emissions as we have discussed above. Since CO_2 emissions are now classified as a pollutant by the federal government and are a known contributor to climate change, Texas risks costly liability in its own state from climate related damages and from other regions as a leading global emitter of greenhouse gases.

The State of Texas is likely to be impacted significantly by climate change. Although the overall contribution of these 19 coal-fired power plants to global CO_2 emissions may be small, they represent an approach that further intensifies the rate of climate change. By increasing its overall emissions, Texas will solidify its standing as a leading global greenhouse gas emitter. Texas is most likely to be stressed by issues of heat, especially summer heat indexes, heat waves and night time heat stress, droughts and floods, air quality issues, issues of frequency and intensity of coastal storms, and security of ports and offshore refineries that are essential to the nation's economy (Impacts of Climate Change in the United States, 2007).

According to the EPA, the southeast and Gulf Coast region is likely to experience reduced winter cold stress, but the summers will be hotter (U.S. EPA, 2007). Texas' average temperature has increased by 2 degrees Fahrenheit in the last three decades (Berger, 2007). "If the climate scientists' report is correct (meaning the 2007 IPCC report), then Texas can expect the state's winters, on average, to warm between 2 and 5 degrees Fahrenheit, and summers between 4 and 11 degrees by mid-century" according to Katharine Hayhoe, a Texas Tech University geoscientist. In a recent study modeling future heat wave intensity, areas already experiencing heat waves, such as Texas, were found to be likely to experience more intense future heat waves (Meehl and Tebaldi, 2004.) Regions less adapted to heat waves are predicted to see increased heat wave intensity as well. In less adapted regions, the human health impacts could be more serious since most cities lack adequate heat response plans (Bernard and McGeehin, 2004). By continuing to be a leading CO_2 emitter, Texas is making itself vulnerable to liability challenges from regions that will soon be impacted by intense heat waves that are unprepared to protect their populations from the associated health consequences.

Stress to some of Texas' most important ground waters, such as the Edwards aquifer and the Ogalla aquifer, which underlies 8 states including Texas, could lead to significant water shortages, negative environmental impacts, and economic losses to the agricultural sector (Science Daily, 2007). Eric Barron, dean of the Jackson School of Geosciences at the University of Texas in Austin voiced the following concern: "Our water resources are already vulnerable. My view is, if you already sense that have you (sic.) a vulnerability to climate, and these models are suggesting a consistent picture, then you need to address the societal factors." (Berger, 2007). The State Water Board has forecasted water availability in Texas through 2060, but the Board did not consider predicted climate change impacts on the state water supply.

Texas' coastlines are likely to be subjected to more flooding from sea level rise, storm surge, and extreme precipitation events, and possibly more intense and/or frequent hurricanes (U.S. EPA, 2007). Barrier islands and wetlands could experience significant losses as well. "In my home state of Texas we are too well-acquainted with the devastating effects that severe weather events can have on individuals, communities, and the economy. If we succeed in reducing the vulnerability of society to these events, we will not only reduce the monetary costs of responding to and recovering from these events, we will avoid and reduce the costs in human stress, suffering and loss associated with them," said Rep. Nick Lampson, Chairman of the U.S. House of Representatives Subcommittee on Energy and Environment (United States. Cong. House, 2007). The federal government is currently working on a multi-year research project to assess potential climate change impacts on the Gulf Coast's transportation system (U.S. Department of Transportation, 2007). Texas' ports and offshore refineries could be at risk from storm surges and other climate change related impacts.

In a 2000 review of observations and models of global extreme events, Easterling et al. found evidence for extreme weather events of increased intensity and in some cases frequency throughout the world (Easterling et al., 2000). In addition, the study considered societal impacts from the rise in extreme weather events, and found the economic and loss of life costs to be high even before the South Asian Tsunami in 2004 and Hurricane Katrina in 2005, which resulted in tens to hundreds of billions of dollars in damages and lost revenue to the local economies and hundreds of thousands of lives lost. The energy infrastructure for the entire United States is vulnerable to Gulf Coast storm disruption. During hurricanes Katrina and Rita, 457 oil and natural gas pipelines were damaged and 113 oil refining platforms were destroyed (Minerals Management Service, 2006).

If Texas continues to be a global leader in carbon dioxide emissions, its potential economic costs in damages and liabilities far outweigh the cost of implementing a proactive state-wide energy plan. It will be most cost effective, based on our analysis of known economic risks, to implement a comprehensive program to minimize peak electricity demand by using efficiency technologies and public education, and to increase the supply of renewable energy based electricity.

7 RESULTS AND RECOMMENDATIONS

7.1 Total Costs for Different Scenarios

Based on the different emissions and health cost estimates, we examined the total costs of the following scenarios (Figure 7.1.1):

(1) EPA - EPA's conservative cost estimates of Mercury, CO_2, and SO_2/NO_x/PM emissions discussed in Section 3

(2) Cap 1: Bingaman - replacing the EPA's CO_2 cost with the cost resulting from Bingaman's cap-and-trade legislation (as discussed in Section 4)

(3) Cap 2: Average - using an average cost from the various proposed cap-and-trade legislations

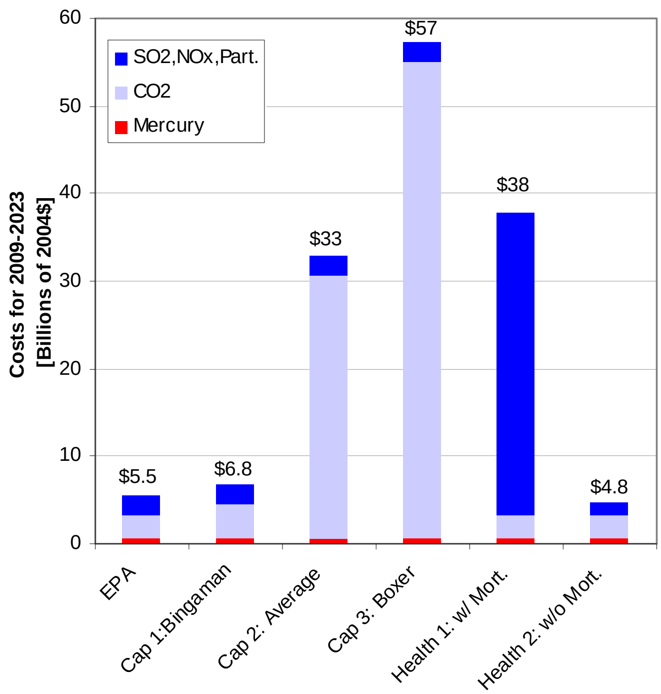
(4) Cap 3: Boxer - using the CO_2 cost based on Boxer's cap-and-trade legislation

(5) Health 1: with Mortality - replacing EPA's SO_2/NO_x/PM costs with the estimated health costs due to mortality discussed in Section 5

(6) Health 2: without Mortality - using the estimated health costs due to disease rather than the exorbitant and less tangible mortality costs associated with the value of a statistical life.

Clearly, the Boxer proposed legislation would result in the highest costs. It's also interesting to note that the EPA's cost for the SO_2 and NO_x of \$2.2 billion is quite similar to our estimated health costs without mortality of \$1.5 billion.

Figure 7.1.1: Comparison of Total Costs Based on Different Scenarios



As a final perspective for the cost differences, we calculated the effective cost per kWh of electricity generated by the 19 plants over their lifetime (assuming a 90% duty rate). Without taking external costs, such as human health and climate change, into account, the current average retail price of electricity in Texas is 9.1 cents/kWh and the cost of ACEEE proposed policies is 4.5 cents/kWh. Table 7.1.1 lists the additional number of cents/kWh due to emissions under the various scenarios. When we combine the potential costs resulting from the Boxer bill and the health costs including mortality, we add an extra 7.46 cents/kWh, which almost doubles the current retail price.

Table 7.1.1: Additional Cost per kWh due to Emissions Costs

Scenario	Total Cost	per kWh* (cents/kWh)
EPA Baseline	$5.5 Billion	0.45
Bingaman	$6.8 Billion	0.56
Average	$33 Billion	2.72
Boxer	$57 Billion	4.71
Health w/ Mortality	$38 Billion	3.12
Health w/o Mortality	$4.8 Billion	0.40
Boxer plus Mortality	$90 Billion	7.46

*Assumes 1209 TWh generated by plants 2008 to 2023

7.2 Uncertainties Involved

This report covers a wide range of predictions requiring many parameters and resulting in many potential sources of uncertainty.

Due to the recent developments occurring with TXU, the uncertainty in emissions is mostly due to whether or not and when the power plants will be built.

The total estimated health costs depends mainly on the Texas population, the modeled concentrations, the health effect factors resulting from these concentrations and the subsequent health costs associated with each health effect. The predicted Texas population should be within a factor of 2 of the actual population. The parameters used to predict average concentrations had 10% uncertainties, which would be compounded by the approximate distances used, leading to an uncertainty of a factor of 10. The health effect factors used to estimate disease incidence based on pollutant concentration are very difficult to pin down by risk scientists, resulting in uncertainties ranging from factors of 5 to factors of 20. Finally, the health costs per disease are highly variable given the varying magnitude of each incidence, but are estimated to be within a factor of 2 when averaged over a whole population.

Despite the many approximations needed to perform this analysis, the mortality results correspond well to a similar study; a report by the Sustainable Energy and Economic Development Coalition (SEED, 2006) estimated that the 19 coal-fired power plants would cause 240 premature mortalities per year, whereas our analysis predicts an average mortality rate of 317 per year.

7.3 Recommendations

This study further demonstrates the ACEEE finding that the proposed coal plants will be extremely costly to Texas. The ACEEE study already shows that renewables and efficiency are a better economic choice, and we have demonstrated that the external costs from the power plant emissions amount to $5-$60 billion between 2008 and 2023, or as much to $90 Billion including health mortality. This is a conservative estimate given the 30-50 year plant lifetime.

We agree with the proposed ACEEE policy tools, particularly the following which are already being discussed within the Texas legislature: Utility-Sector Energy Efficiency Program, State-Level Appliance and Equipment Standards, New Building Energy Codes, Combined Heat and Power Program, and Onsite Renewable Energy Incentives. We would also propose developing a statewide carbon regulation and energy policy, stronger renewable portfolio standards, and a strengthening of children's health insurance programs to reduce the increasing health costs associated with pollution.

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9 APPENDIX: Data Tables

Table 9.1: Annual Emissions Projections for Coal Plants

Power Plant	Permit #	Megawatts	CO_2	SO_2	NO_x	Particulate	Mercury
			(Mil. tons/yr)	(tons/yr)	(tons/yr)	(tons/yr)	(lbs/yr)
CPS Spruce	70492	750	7.4	2102	1752	771	133
Sandy Creek Energy	70861	800	7.5	3585	1793	1434	136
Calhoun Co. Nav. Dist	45586	303	2.6	2071	813	597	70
TXU's Oak Grove 1,2 (2 Units)	76474	1600	16.5	15086	6286	3144	1440
TXU's Sandow 5 at Alcoa	48437	581	5.4	5186	2593	1037	192
Twin Oaks Power 3	76381	680	6.1	5818	2037	1018	860
Formosa Plastics (2 Units)	76044	300	3	1091	920	446	78
(Second Value)			0	6518			
TXU's Tradinghouse 3,4 (2 Units)	78762	1716	15.9	7574	3788	3030	320
TXU's Lake Creek 3	78751	858	8	3787	1894	1515	160
TXU's Big Brown 3	78759	858	8	3787	1894	1515	160
TXU's Monticello 4	78744	858	8	3787	1894	1515	160
TXU's Martin Lake 4	78750	858	8	3787	1894	1515	160
TXU's Valley 4	78763	858	8	3787	1894	1515	160
TXU's Morgan Creek 7	78761	858	8	3787	1894	1515	160
NRG's Limestone 3	79188	745	7.4	2103	1752	1402	140
Nueces IGCC Plant	80024	600	4.7	392	423	147	86
Total		13223	124.5	67730	33521	22116	4415
(Total with Formosa 2nd)				73157			

Table 9.2: Plant Phase-In Schedule

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Peak Demand (MW) - All Texas	75,668	77,588	79,468	81,216	83,014	84,850	86,728	88,647	90,608
Peak Demand (MW) - ERCOT (85%)	64317.8	65949.8	67547.8	69033.6	70561.9	72122.5	73718.8	75349.95	77016.8
Peak Demand Increase - ERCOT		1632	1598	1485.8	1528.3	1560.6	1596.3	1631.15	1666.85
Added Demand		1853	1600	1561	1716	1716	1716	1716	1345
Total Added Demand		1853	3453	5014	6730	8446	10162	11878	13223
Plant Addition Schedule		**70492**	**76474***	**48437**	**78762***	**78751**	**78744**	**78763**	**79188**
		70861		**76381**		**78759**	**78750**	**78761**	**80024**
		45586		**76044***					
Number of Units Added		**3**	**2**	**4**	**2**	**2**	**2**	**2**	**2**
								Total Units = 19	

Table 9.3: EPA Clean Air Planning Act Emissions Price Projections

	2010	2015	2020
CO2 (2004$/ton)	1.13	1.13	2.27
SO2 (2004$/ton)	1279.72	1684.38	2153.65
Nox (2004$/ton)	4960.19	1535.89	1026.95
Particulates (No Data)	0.00	0.00	0.00
Mercury (2004$/lbs)	8741.54	11334.98	11334.98