Greenhouse Gas Emissions:
Policy and Economics

A Report Prepared for the Kansas Energy Council Goals Committee

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Executive Summary

Global average temperature has increased 1.44°F since the Industrial Revolution, and the latest report from the U.N.'s Intergovernmental Panel on Climate Change states that there is "very high confidence" that human activities have caused a net warming of the planet. Although certain details about climate interactions and specific effects remain uncertain, there is broad political consensus that efforts to reduce greenhouse gas (GHG) emissions should be undertaken along with continued research and monitoring.

Numerous policy options have been proposed to reduce GHG emissions. Nevertheless, it is paramount to recognize that for the same outcome, different methods have vastly different costs. Clearly, prudent policy will consider strategies that make the wisest use of resources, without throwing the entire financial burden on one economic sector or socioeconomic group. Climate change economics seeks to neither devote so many resources to climate change that other important social and economic issues are neglected, nor delay action or take meaningless steps to create the appearance of action.

This review of current studies on climate change policy makes one thing exceedingly clear: market-based policies are far better at reducing GHG emissions at the lowest cost than command-and-control regulations and mandates.

	Greenhouse Gas Reduction Policy Options
Lowest Cost	1. Economy-wide Greenhouse Gas Tax
↓	2. Hybrid Cap-and-Trade System
↓	3. Cap-and-Trade with banking, borrowing, and permit auction
↓	4. Traditional Cap-and-Trade System
Highest Cost	5. Non-market Mandates and Standards

In fact, non-market policies can raise costs tenfold to achieve the same amount of GHG emissions reduction. Regulatory mandates that target particular solutions—for example, Renewable Portfolio Standards—raise demand for certain products, which creates higher prices for consumers and a subsidy for producers.

In contrast, policies that directly target the problem—for example, placing a tax on GHG emissions—produce myriad solutions that work best for different situations. By using market-based methods, policymakers can internalize the environmental and social costs of GHG emissions by including them in the price of the product or activity that produces them. This will drive efforts to minimize these costs by lowering GHG emissions by implementing the strategies that work best for each individual or business.

Market-Based Mechanisms: Tax vs. Cap-and-Trade

Two market-based mechanisms that seek to internalize the costs of emitting GHGs are a cap-and-trade system and a tax. Both have been shown to be effective at reducing pollution at a much lower cost than mandates and standards. However, the emissions tax can reduce greenhouse gases at a much lower overall cost than a cap-and-trade system. In fact, a recent report from the Congressional Budget Office (CBO) concluded that the net benefits of a GHG tax could be 30% to 34% higher than those of a cap.

One advantage of a GHG tax is that it provides clear, predictable prices that facilitate long-term investment planning. In a cap-and-trade system the permit prices fluctuate, with the potential of either extremely high permit prices causing debilitating compliance costs or extremely low permit prices creating insufficient incentive for emissions reductions. In addition, a GHG tax has much lower administrative costs and is more transparent than a cap-and-trade. Furthermore, since it does not create a valuable commodity like the cap-and-trade, a GHG tax is less vulnerable to profiteering and thus requires less oversight.

Quantitative goals are attractive to policy makers, and a cap-and-trade system lends itself to clearly stated annual emissions limits (or goals). Yet global warming depends on the accumulation of GHGs, and annual emissions, therefore, make a small, incremental impact on atmospheric concentrations. For this reason, focusing on the quantity of annual emissions may actually detract from the goal of reducing atmospheric concentrations over time in the most cost-effective manner.

GHG Tax

The method of reducing GHG emissions that is most widely supported by economists is a tax on GHG emissions that would apply to all sectors of the economy. As Nobel Laureate Joseph Stiglitz notes, “It makes much more sense to tax things that are bad, like pollution, than things that are good, like savings and work.”

The tax acts as a direct incentive to reduce consumption and spur technological development of alternatives, both of which can stimulate further reductions in emissions. Slowly increasing the tax, consistent with what has been termed the “climate change ramp,” allows the economy to make improvements at the lowest cost first and then slowly move to more substantial changes. This puts steady, predictable pressure on the markets to determine the best pathway towards reduction and alternative energy development.

Although taxes are never politically popular, opposition to the tax could be reduced if the GHG tax revenues were used in politically popular ways, such as offsetting other taxes. Some economists favor slowly increasing the GHG tax while slowly decreasing regressive sales or property taxes—thereby helping to mitigate the impact on low-income individuals. The policy would be a GHG tax shift—shifting taxes away from beneficial activities, such as labor or commerce, towards activities that create GHG emissions.

Cap-and-Trade

In general terms, a cap-and-trade policy sets a limit on the level or quantity of GHG emissions, issues permits equaling that quantity, and allows trading of the permits among entities who emit greenhouse gases. This creates a market for greenhouse gas reductions a market, and, thus, a direct monetary cost for GHG emissions.

One major economic problem with cap-and-trade policies is that emissions are capped at a fixed level, regardless of the cost to achieve that level of reduction. Large fluctuations and unpredictability in permit prices make it difficult to make prudent decisions about investing in abatement technologies and strategies.

Existing cap-and-trade systems have shown that permit price volatility is a major, valid concern. U.S. acid rain permit prices have ranged from $66 to $1550, with average monthly changes of 10% and average annual changes of 43%. EU ETS permit prices have ranged from a high of €31.50 to a low of €0.29, with monthly average price shifts of 17.5%. By adding certain features (such as banking, borrowing, and adjustments to the quantity of available permits), a cap-and-trade system can be improved so that its efficiency outcome is more similar to the GHG tax.

Significant administrative oversight will be required to track emissions, ensure permit compliance, and monitor trading in a cap-and-trade system, all of which adds to the overall costs of reducing emissions. To keep compliance rates high and costs low, a GHG cap-and-trade should follow the precedent of the successful acid rain permit-trading program by creating stringent penalties for permit violations that are not subject to appeals or waivers. Additionally, public access to emissions and trading data should be required to give transparency to the process.

A cap-and-trade policy is broadly considered more politically feasible than a GHG tax, even though it is likely to cost consumers more. Industry has voiced considerable support for a cap-and-trade policy. However, that support may wane if the permits are auctioned rather than given away for free, which economists agree leads to a less optimal outcome. The CBO summarizes the issue by pointing out that a giveaway of emissions permits "would transfer income from energy consumers—among whom lower-income households would bear disproportionately large burdens—to shareholders of energy companies, who are disproportionately higher-income households." However, if permits are auctioned, the revenue can be used to offset other taxes or provide other public services and consumers would share in the benefits (Goulder and Pizer 2006).

Hybrid Cap-and-Trade System

To address the political limitations of a GHG tax and the economic efficiency issues of a cap-and-trade policy, some economists have proposed hybrid systems that combine elements of the two policies. One such system creates a fixed number of tradable, long-term emissions permits that equal long-term reduction goals (expressed by the cap) as well as short-term, annual permits that the government would sell at a fixed price but in unlimited quantities.

Like both the tax and cap-and-trade, this hybrid system will help achieve the reductions where they are the cheapest. However, the annual permits sold for a fixed price place an upper limit on the cost of emissions reduction. Even if the long-term reduction target is set very low and is difficult to achieve, the government can prevent undue economic hardship by placing a moderate price on the annual permit and adjusting it as needed to respond to costs of reduction, fluctuations in demand, and tightening of emissions.

This system also minimizes the problem of setting an overly lax cap, as occurred with the EU ETS. Instead of setting a cap at the level of the short-term goal, which may be too high to elicit any real reduction, the long-term permits are based on a long-term goal and the price of the short-term permits can be controlled to affect the level of pressure towards further reductions.

Conclusions

Most climate change economists agree that a tax on greenhouse gas emissions is the most effective and least expensive way to reduce emissions. Therefore, Kansas could push for the best possible policy tool: a Federal greenhouse gas tax as a way to fix the broken logic of the current tax system, not as a way to raise revenue. However, because the current national discussion is focused almost exclusively on a cap-and-trade, the State could put pressure on Congress to pass a well-designed “hybrid” cap-and-trade program as a good second-best policy option.

Every greenhouse gas reduction policy is shaped by a multitude of factors, not all of which lead to the most effective and most economical way to reduce GHG emissions. For this reason, a policy that treats all GHG sources equally—according to the global warming potential of their emissions, not the particular industry or technology from which they arise—will have the best chance of effectively and efficiently reducing emissions. Policies that focus on the problem of all GHG emissions, instead of a few politically advantaged programs, are likely to prompt effective solutions to reduce greenhouse gas emissions across all economic sectors.

Introduction

Climate change is receiving increasing media attention and options for regulation of greenhouse gas emissions are actively debated in both the public and private sectors. The Kansas Energy Council has decided to examine this issue to help determine whether there are steps that Kansas should take to reduce greenhouse gas emissions. While Kansas is just one state and climate change is a global problem, it is important not to understate the significance of Kansas in the global emissions of greenhouse gases. To put it into a global perspective, if Kansas were an independent nation, it would rank as the 44th largest emitter of carbon into the atmosphere, just after Iraq (Marland et al. 2006a, 2006b).[1]

The global average temperature is now 0.76°C (1.44°F) warmer than it was before the Industrial Revolution. The majority of this increase occurred in the twentieth century, and the temperature has been rising most rapidly since 1970 (UN Foundation 2007). The newest information evaluated by the Intergovernmental Panel on Climate Change leads the Panel to conclude with very high confidence that climate change is caused by human activities (IPCC 2007a).

Nonetheless, it may be ineffective to pursue haphazard policies to reduce emissions. Prudent policy planning, with special attention given to scientific and economic realities, should consider strategies that make the wisest use of our resources without throwing the financial burden entirely on any given sector of the economy or socioeconomic group. The costs of greenhouse gas reductions will vary widely depending on the regulatory policy, which is why policymakers need to carefully consider the available methods (Parry 1997).

This review of current expert opinion it is intended to bring clarity and a solid understanding to policymakers on an issue that is extremely complex and that touches every part of the world ecologically, environmentally, socially, politically, and economically.

Scientific Conclusions on Climate Change[2]

While there are still details about climate interactions and specific effects that are not clearly understood, the international scientific community has largely reached a consensus that the climate change the planet is experiencing is mainly driven by the rising concentrations of greenhouse gases in the atmosphere that have resulted from human activities (IPCC 2007a, Oreskes 2004, Pearce 2005, Foukal et al. 2006). Because of the potential impacts of global warming, definitive efforts to reduce greenhouse gases emissions should be undertaken alongside continued vigorous scientific inquiry to better understand this complex issue and resolve some of the remaining uncertainties.

[1] Since this figure compares 2001 data from Kansas with 2003 data for nations, and Kansas' numbers do not include emissions from cement manufacturing or gas flaring while the national data does, it is likely that Kansas would be ranked even higher.

[2] For a more detailed discussion of climate change science, see Appendix 1 (p. 38).

Summary of Greenhouse Gas Emissions[3]

Greenhouse gas emissions from human processes have changed the composition of the global atmosphere (IPCC 2007a). In the United States, carbon dioxide (CO_2) is the most significant greenhouse gas, followed by the methane (CH_4), nitrous oxide (N_2O), and then hydrofluorocarbon (HFC), perfluorocarbon (PFC), and sulfur hexafluoride (SF_6). Atmospheric concentrations of CO_2, CH_4, and N_2O have increased by 35%, 148%, and 18%, respectively, since 1750. Carbon dioxide emissions from energy use (including transportation) accounted for 83% of U.S. GHG emissions in 2005 (EIA 2006).

In comparison to other states, Kansas ranks 13th in total energy consumption per capita and 12th in percentage of energy coming from coal (EIA 2003, U.S. EPA 2007). Kansas also ranks in the top one-third of states in its per capita energy consumption from the residential, commercial, industrial, and transportation sectors, but motor gasoline consumption per capita (one element of the transportation sector consumption) is more moderate at 24th in the U.S. (EIA 2007). As consumption can be related to prices, it is of note that electricity prices in Kansas are 22% to 30% lower than the national averages (EIA 2007).[4] With regards to GHG emissions, Kansas ranks 10th in carbon dioxide emissions per capita (U.S. EPA 2007).

The multitude of sources of greenhouse gas emissions highlights the diversity of opportunities to slow the accumulation of greenhouse gases in the atmosphere. While energy production and transportation account for a large portion of greenhouse gas emissions, mandates that target only these sectors miss low cost measures to reduce emissions across the entire economy.

Economics and Greenhouse Gas Policy

Greenhouse gas abatement policy design is exceedingly difficult because GHG emissions result from nearly all modern human activities. It involves every sector of the economy as well as habits and choices of individuals. Economics is more than just a study of business, it is the science which studies human behavior as a relationship between aspirations and the scarce means to reach those goals (Lionel 1932). Individuals make decisions every day that influence the amount of greenhouse gases that enter the atmosphere. If a stable climate is one objective among the many to which society aspires, then economics is a tool well-suited to understand how those decisions are made and how efficient and effective outcomes can be reached.

Economic Principles Relevant to the Discussion

As any discussion becomes difficult if the participants are not speaking the same language, this section seeks to define and clarify a few commonly used terms before discussing the economics of climate change and emissions reductions.

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[3] For a more detailed discussion of U.S. and Kansas GHG emissions, see Appendix 2 (page 47).

[4] Kansas residential electricity prices are 24% lower than the national average; commercial electricity is 30% lower; industrial electricity is 22% lower (EIA 2007).

Market-based Initiatives

In the media and the policy arena, much has been said about the need for market-based initiatives to deal with the problems of climate change. It is important to make the distinction that a market-based initiative is not synonymous with a marketable permit system. A market-based initiative is one that strives to make use of market forces – "the pressures from buyers and sellers in a market"—to accomplish a given policy goal (Bishop 2004). Usually this translates to changing prices through taxes, incentives, or a permit system, all of which give a monetary value to something that was previously external to market forces.

Externalities

This brings us to the idea of an externality. Externalities are costs or benefits that result from an economic activity that affect someone or something other than the decision maker involved in the economic activity. Pollution costs not reflected in market prices but nonetheless borne by members of society are the classic example. Another classic example is that of the collective or "public good" – such as the global climate. With public goods, one's use or consumption of the good can affect the welfare of others.

When externalities exist, market prices fail to signal the actual cost to society of a commodity. And when that distortion of prices occurs, decisions based on those faulty price signals will not be optimal, resulting in economic waste. In short, the presence of externalities yields a non-optimal use of scarce resources and may lead to lower levels of social welfare. Economic waste can be avoided if externalities are eliminated, that is, fully accounted for or reflected in prices and, thus, internalized.

Marginal Costs and Benefits

Another important concept in the economics of climate change is the difference between marginal and average costs and benefits. The marginal cost of reducing greenhouse gas emissions is the cost of reducing by one additional unit, likewise with the marginal benefit. At the most efficient point (the market equilibrium), the marginal cost of controlling GHG emissions would equal the external cost of that unit. The marginal costs and benefits can differ greatly from the average costs and benefits.

Economic theory shows that "thinking at the margins" leads to better economic decisions compared with using either old or averaged information.[5] To use an example from greenhouse gas reduction, the costs of reducing the first ton of carbon dioxide for a household may be very inexpensive such as simply turning off lights when they are not in use. But after many of the easier reductions have been made, the last ton of carbon reduction might necessitate an expensive measure such as adding solar panels to the roof

[5] By relying on marginal information, GHG emissions can be reduced so that for each unit of reduction, including the last, some amount of positive net benefit can be realized or assured. More precisely, a nonnegative net benefit can be realized. That way, total GHG reductions can be made so that the overall net benefit is maximized. However, if average information is used to decide on the level of reduction, then it is likely (almost guaranteed) that the total reduction will not be optimal, either being too large or small and, therefore, failing to maximize the net benefit.

and would cost far more than that first ton. The average cost of the total reduction would not give the same information, nor would it lead to the best decisions.

Discount Rate

Because many greenhouse gases remain in the atmosphere for more than a century, some for many centuries, reduction benefits are measured on a much longer time scale than most problems we face. As a result, the discount rate becomes very important for climate change analysis.[6] Often, the discount rate selected is simply a particular rate of interest which incorporates the idea that if you were to invest money today, it would be worth more in the future, so the value of receiving money in the future is worth less than receiving it today.

However, the interest rate can be an insufficient determinant of the discount rate over long time scales. In fact, many economists have suggested that the discount rate used in present value calculations should be lower than any expected future discount rate (Weitzman 1998, Goulder and Pizer 2006, Pindyck 2006).

According to Yale economist William Nordhaus, there are three parameters that determine the discount rate:

- the rate of time preference, which is the relative importance of the well-being of future generations compared with current generations;
- the degree of inequality aversion, which is a measure of egalitarianism; and
- the growth in consumption factors, which is the relative wealth of future generations (Nordhaus 1997).

Because of the long time scales involved, the choice of the discount rate has a substantial influence on empirical economic analyses of climate change. This is one major reason why there are such widely different estimates of the costs and benefits of reducing greenhouse gas emissions.

Climate Change Economics

Climate change is a complex issue with large uncertainties surrounding both the costs and benefits of reducing emissions. Accordingly, Michael Toman, former senior economist of the President's Council of Economic Advisors, recommends a "gradual but purposeful approach" to greenhouse gas reductions (2003). This optimal policy approach is often called the "climate change ramp" and would involve modest emissions reductions in the short term followed by increasingly sharp reductions in the medium and long term (Nordhaus 2006a).

Climate change economics seeks to neither devote so many resources to climate change that other important social and economic issues are neglected, nor delay action or take meaningless steps to create the appearance of action. Gradual increases in GHG reduction targets would be coupled with investment in new technologies to make it easier to meet more stringent reductions in the future (Toman 2003).

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[6] A discount rate is a number per unit of time that converts values in the future into values today (Nordhaus 1997).

Estimating the Benefit of Reducing Greenhouse Gases

The benefits of reducing GHG emissions are the avoided damages that would occur through the business-as-usual path. The estimated benefits of reduction vary widely with estimates ranging from -$10 to $350 per ton of carbon (Goulder and Pizer 2006).

According to the estimates of former Chief Economist of the World Bank, Sir Nicholas Stern, the overall cost of global warming in the business-as-usual scenario is at least 5% of the global GDP with estimates ranging up to 20% of the GDP (Stern 2006). These dramatic figures received a lot of attention in the media and by other climate change economists, many of whom criticize the methods used to arrive at such astronomical numbers.

In a response to the Stern Review, William Nordhaus praises much of the report, but criticizes the choice of a near-zero discount rate which leads to the extremely high estimations of avoided costs (Nordhaus 2006b). According to Nordhaus, if a conventional discount rate is substituted, then the data would suggest following the "climate change ramp" policy structure. Other climate change economists agree that Stern's analysis probably overestimates the potential costs of climate change and the recommended expenditures on reductions (Mendelsohn 2006a, Dasgupta 2006). However, some economists, such as Pindyck, assert that a near zero discount rate is "not implausible" (Pindyck 2006).

Estimating the Cost of Reducing Greenhouse Gases

The cost to reduce greenhouse gases will vary widely depending on which tools or policies are used (Parry 1997). In general, the more sectors of the economy that are targeted for emissions reduction policies, the lower the overall cost. Excluding a limited number of sectors from emissions reduction policies does not dramatically increase costs; however, targeting only transportation and electricity may double the cost of abatement compared to those that target all sectors of the economy, and using non-market-based policies can raise cost by a factor of ten (Pizer et al. 2006).

The cost of emissions reduction also depends on how much society can substitute one fuel for others; modify production processes to use less energy in production of commodities; and replace the current, high energy-intensive consumption with consumption activities that require less energy use. If substitutions, switching, and replacements are all possible—that is, if there is flexibility in the system—then the cost of reducing GHG emissions will be substantially lower (Goulder and Pizer 2006).

The potential for technological progress also must be a factor in assessing the costs of reduction, given the long-term nature of climate change (Goulder and Pizer 2006). In many economic models, policy-driven technological change significantly lowers the costs of emissions reductions.[7]

[7] Focused support for technological development tends to be less cost-effective than general support for research and development of technological advances. This avoids the problem of the government "choosing" favored solutions and instead allows researchers to determine the solutions they believe to be most feasible and/or effective.

It is interesting to note that studies looking back on the estimated costs and actual costs of environmental regulations have found that the costs of compliance are routinely and grossly overestimated (Hodges 1997). This may point to a tendency to underestimate the ability of the economy to adapt to new regulations and other changes.

Economic modeling is a complex process that depends on the validity of the assumptions used. However, despite the complexities involved in producing a complete and accurate estimate, cost-benefit analysis is an important tool for policymakers because it attempts to develop an objective perspective of the difficult tradeoffs in many policy decisions.

Dealing with Uncertainty

Uncertainties in climate change are often cited as a reason to delay emissions mitigation until the problem is better understood. In many investment decisions, waiting until more is known before an investment is made is preferable to acting immediately because once that money is spent, it is often an irreversible loss.

Nevertheless, Pindyck, who literally wrote the book on *Uncertainty and Investment,* explains that "the uncertainties are greater and more crucial to policy design and evaluation" for environmental problems such as climate change, and, as a result, call for a different assessment than conventional decision-making under uncertainty (Pindyck, 2006, p. 3).

The potential of an unknown threshold or tipping point (where the impacts of climate change increase dramatically) suggests that a precautionary approach should be taken with earlier and more intense emissions reductions.[8] In addition to investment irreversibilities, there are major potential irreversibilities due to the long-lasting accumulation of greenhouse gases in the atmosphere and the permanent damage to natural systems and human society.[9] Moreover, the long-term nature of climate change exacerbates these uncertainties in has important implications for discount rates. For these three reasons, basing policy on the expected values of costs and benefits can be "misleading" (Pindyck 2006, p. 23).

When models ignore the possibilities of catastrophic impacts, they tend to recommend that it is better to wait than to take early action. Yet, when models take into account the possibility of rising health, economic, and ecological impacts, they lead to the recommendation that reductions should begin now, especially since initial reductions have smaller costs (Goulder and Pizer 2006, Pindyck 2006). It may be the case that with climate change, "uncertainty…[does] not justify inaction" (Toman 2003).

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[8] Examples of tipping points: harming the population of a species vs. causing extinction or collapse of the ecosystem, increasing global temperatures which may have economic costs vs. creating near-catastrophic consequences on human life.

[9] Investment irreversibilities and environmental irreversibilities work in opposite directions leading to some ambiguity in whether early action is favorable. Resolving the ambiguity in analysis partially depends on when and if the uncertainties are expected to be resolved (Pindyck 2006).

Mitigating Climate Change: Atmospheric GHG Stabilization Goals

If policymakers and the public decide that climate change is a problem that needs to be addressed and accept that reducing emissions will likely cost money, then one major question follows: How much of our resources should be invested now in mitigating global warming? To answer that question, we must evaluate the benefits of reducing, the costs of reducing, and then develop a reduction goal based on the tradeoffs that exist among those considerations. Different reports and different experts recommend a variety of maximums for warming, and part of the goal-setting process is deciding how much warming and its subsequent effects society is willing to tolerate (Figure 1).

In terms of what climate goals should be pursued, policies directed toward limiting the increase in temperature are the most efficient, whereas those that attempt to stabilize annual emissions are much less efficient (thus yielding a relatively lower net benefit).[10] According to William Nordhaus, "the further the policy tool is from the ultimate objective, the more inefficient is the policy" (Nordhaus 1997).

The Stern Review focuses on the goal of stabilizing atmospheric greenhouse gas concentrations around 450-550 ppm CO_2e, which would cause an estimated warming between 1.5°C and 4.5°C (2.70°F and 8.10°F) relative to pre-industrial levels.[11] In order to stabilize concentrations at this level, global emissions would need to peak in the next 10 to 20 years, then fall 1-3% per year, and by 2050, be 25% below current levels. He estimates that an investment of 1% of the global GDP each year to reduce greenhouse gases would be sufficient to reach this climate goal (Stern 2006).

The UN Foundation suggests emission reduction targets compatible with limiting increases in global average temperature to 2°C to 2.5°C (3.6°F to 4.5°F) above the 1750 temperature. In order to reach that goal, the report projects that the global emissions must level off by 2015 to 2020 and decline by one-third by 2100 (UN Foundation 2007).

NASA's top climate scientist, James Hansen, advises that we limit warming to 1°C (1.8°F) above 2000 levels (1.76°C (3.17°F) over pre-industrial levels). He translates that climate goal to a 450-500 ppm CO_2e stabilization level and reductions by industrialized nations of 60% to 80% below today's levels by 2050 (Kutscher 2007).

Countless factors intermingle to make it difficult to come to an estimation of the acceptable increases in global temperatures. Two major factors are the level of resources that will be placed in adaptation, especially for the most vulnerable countries in the low latitudes, and the losses that society is willing to accept in biodiversity. Depending on these and many other valuations, the maximum increase in global temperatures that should be the basis for global emissions reductions will vary.

Although quantitative goals can be useful benchmarks to guide policy, it is essential to recognize the distinction between setting goals and enacting policies to reach them. Goals must be followed by effective policies to bring about emissions reductions.

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[10] Because climate change is related to the total stock of greenhouse gases and not the annual flow of greenhouse gases, a goal that focuses on annual emissions is further from the objective of minimizing temperature increase as opposed to a goal that focuses on the accumulation of emissions over time.

[11] The current concentration of greenhouse gases in the atmosphere is approximately 430 ppm CO_2e (Stern 2006).

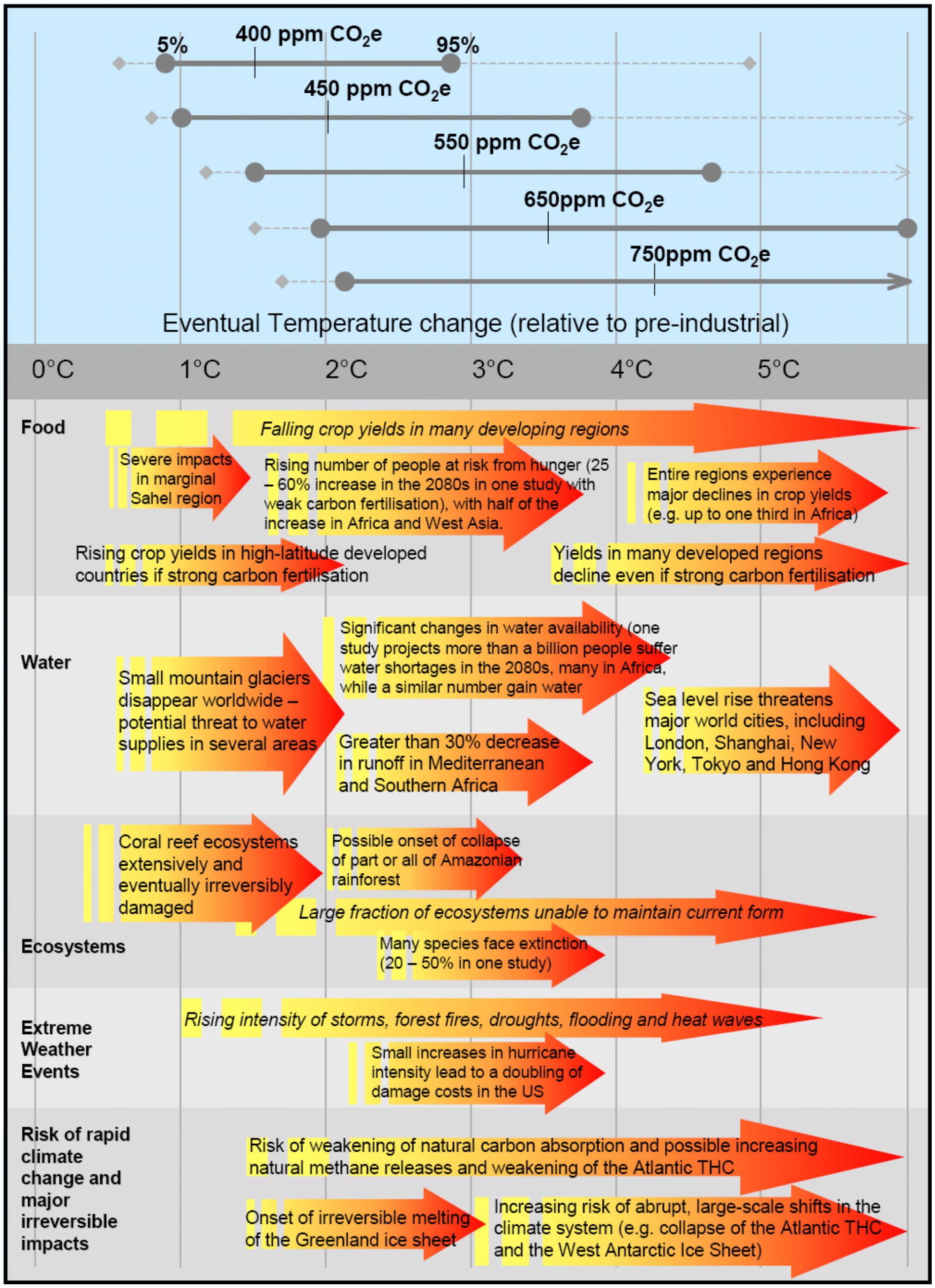

Figure 1: Potential impacts of climate change at different atmospheric GHG stabilization levels (Stern 2006).[12]

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[12] "The top panel shows the range of temperatures projected at stabilization levels between 400ppm and 750ppm CO_2e at equilibrium. The solid horizontal lines indicate the 5 - 95% range based on climate sensitivity estimates from the IPCC 2001 and a recent Hadley Centre ensemble study. The vertical line indicates the mean of the 50th percentile point. The dashed lines show the 5 - 95% range based on eleven recent studies. The bottom panel illustrates the range of impacts expected at different levels of warming. The relationship between global average temperature changes and regional climate changes is very uncertain, especially with regard to changes in precipitation" (Stern 2006).

Overview of Control Methodologies: Market vs. Non-Market Approaches

While there is a multitude of different policy tools that can be used to reduce greenhouse gas emissions, most fit into two different categories: market transformation tools and non-market tools. Application of either type of policy tool is usually premised on the assumption that there are certain market failures that lead to non-optimal levels of greenhouse gases and that reduction in those emissions is warranted.

A market transformation tool uses market forces to correct a socially inefficient use of resources.[13] On the other hand, the non-market-based approaches eschew reliance on the marketplace, opting instead for a government command and control approach.

The major policy tools or control methodologies discussed below are those that endeavor to rely more heavily on market forces by attempting to correct market failures. The market transformation method is largely one of internalizing externalities by giving greenhouse gases a monetary value.

A price-based market transformation method places a tax on a unit of GHG emissions.[14] Another approach is to use quantity-based methods. The popularly known cap-and-trade system is a quantity-based method which establishes a monetary value of emissions by assigning property rights to GHG emissions, limiting the quantity of emission rights, and allowing market trading of those rights. Other control methodologies can be considered market-based if they attempt to correct a market failure and they work with and utilize market forces as an integral part of that approach; consumer education and technology research and development are such examples.

Non-market-based solutions to greenhouse gas emissions simply impose mandates requiring certain practices or standards or products. While these "command-and-control" policy tools may seek to correct the problems associated with market failures, they bypass reliance on the market by simply choosing the solutions to the perceived problem. One popular example of a non-market solution is a renewable portfolio standard which requires a certain percentage of renewable energy production.

Regardless of the specific control methodology, the most essential features of a greenhouse gas reduction policy are as follows:

- Applies to all sectors of the economy
- Maximizes the use of market forces
- Ensures uniform and predictable costs of reducing emissions
- Minimizes complexity and administrative costs
- Provides transparency to companies and consumers
- Promotes global participation
- Adjusts to new developments in climate science and economic impacts of the policy (Dinesh 2007).

[13] See discussion of market initiatives on p. 5.
[14] The value of the tax could be made consistent with the expected external cost of one unit of emissions.

Controlling the Quantity of GHG Emissions: The Greenhouse Gas Tax

The method of reaching lower GHG emissions that appears to be most widely supported by economists is a tax on GHG emissions that would apply to all sectors of the economy.[15] Nobel Laureate Joseph Stiglitz encapsulates the logic of emissions taxes by noting, "It makes much more sense to tax things that are bad, like pollution, than things that are good, like savings and work" (Stiglitz 2006).

The tax can be applied "upstream," meaning that the tax is paid by producers, processors, or shippers based on the amount of carbon dioxide equivalent (CO_2e) emissions that the fuel will produce when it is consumed, or it can be applied "downstream," which places the tax on the retail level.[16] Either way, depending on the competitiveness of the economy, the bulk of the tax will be borne by final consumers which will provide the incentive to reduce their carbon footprint.[17]

The Economics of the Greenhouse Gas Tax

The effects of greenhouse gas emissions are currently an externality—that is, they are damages that all of society incurs but that are not included in the market price of commodities whose production and consumption result in emissions of GHGs. A tax on GHGs would internalize some of those costs, and, as a result, the price of goods or activities that produces GHG emissions would reflect more of the true cost, including the related emissions costs.

These types of taxes are intended to improve the efficiency of the economy by reaching a quantity of emissions that better balances the interests of all of society, not just the heavy emitters. These are often called Pigouvian taxes, and there is widespread support for them among economists (Shapiro 2007, Mankiw 2006). A *Wall Street Journal* poll of 47 economists found that a majority agreed that a tax on GHGs would be the most efficient way to reduce emissions (Izzo 2007). Alan Greenspan, the former chair of the Federal Reserve, also endorsed an increase in the gasoline tax (Arends 2006).

The tax on greenhouse gas emissions augments the price-signal that encourages emissions reductions. This acts as a direct incentive to reduce consumption and spur technological development of alternatives, both of which can stimulate further reductions in emissions.

Slowly increasing the tax, consistent with the "climate change ramp," allows the economy to make improvements at the lowest cost first and then slowly move to more substantial changes (Shapiro 2007). For example, if the tax starts out at $5 per ton of CO_2e, businesses will make the easiest improvements to reduce emissions until the

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[15] Using a carbon dioxide equivalence to take the global warming potential of each gas into account.

[16] In an upstream system, the producers, shippers, or processors of a carbon based fuel would be taxed depending on the amount of greenhouse gases that would be released when their fuel is combusted. In a downstream system, the tax could be charged at the point of combustion (i.e. the individual power plant, personal vehicle, etc.) or the point of combustion (i.e. the electricity consumer, personal vehicle, etc.).

[17] In a more competitive market where more options are available for consumers, the producers will bear a greater proportion of the tax burden than in a less competitive market. In a monopoly, the consumers will bear the entire tax burden. For example, as utilities currently operate as regulated monopolies, the costs of the tax on gas and electricity will be largely passed on to the consumer.

marginal cost of the next improvement is more than $5 per ton of CO_2e saved. When the tax is increased, then more costly changes will be made as they become financially advantageous. The gradual approach allows time for adjustment, investments, and technology development.

When there is a clear, predictable price for GHG emissions, businesses have a transparent long-term incentive to plan prudent investments in energy efficiency and research and development of new technologies (Shapiro 2007). This puts steady pressure on the markets to determine the best pathway towards emissions reduction and alternative energy development (Izzo 2007).

Nonetheless, there is a concern that there will be volatility in quantity of emissions as demand for energy varies. A GHG tax may not produce an easily predictable annual emissions reduction. But some variation in annual emissions need not cause major concern as climate change results from the total accumulation of gases in the atmosphere. The effects of short-term fluctuations in emissions are minimal.

One drawback of an emissions tax is the potential increase in economic distortions resulting from the existing tax system—known as the tax-interaction effect. The tax-interaction effect is the creation of additional costs of reductions in employment and investment due to the increased costs of production, which can amplify the costs of reducing emissions.[18]

However, if tax revenues are used to reduce other distortionary taxes such as those on income and labor (known as revenue-recycling), the negative effect can be mitigated by 75% (Parry 1997, Nordhaus 2006). This gives revenue-recycling policies a significant cost advantage over policies that do not generate revenue, use revenue for other purposes, or require additional revenue to be raised (such as incentives and technology investment) (Goulder and Pizer 2006).

Some economists have argued that the demand for energy products is not very sensitive to price, so a tax would be limited in its effectiveness to actually reduce the quantity of emissions (Mintz and Jaccard 2006). This argument is based on the logic that fossil fuel energy is essential to nearly every daily practice throughout society; therefore, reductions in demand are limited—in contrast with what might occur with less essential commodities.

Nevertheless, there is quite a lot of room for improvement in efficiency and simple changes in behavior in the short term, and changes in technology and infrastructure in the long term; thus, this argument may be limited in applicability. For example, in response to increasing natural gas prices, the consumption of natural gas in the state of Kansas declined by 7.8 percent from 2002 to 2003 and is expected to continue to decline 2.0 percent annually through 2009 (Kansas Energy Council 2007).

Administration of a Greenhouse Gas Tax

The actual implementation of a greenhouse gas tax is a relatively simple administrative measure. The major difficulty with a tax is choosing the level that will produce the optimal amount of emissions reductions (Cooper 2006). Because the actual

[18] This negative effect is also associated with a cap-and-trade policy.

cost of emissions reductions is largely unknown, establishing the economically efficient tax level may be difficult (Cooper 2006). Moreover, the quantity of emissions reductions in response to a tax cannot be easily predicted ahead of time, which is often contrary to policymakers' desire to set quantitative goals.

However, the tax can be adjusted on a regular schedule to decrease or increase the quantity of emissions reductions (Shapiro 2007). One potential problem with adjusting the tax is that the government could become reliant on the revenues of the tax and may be hesitant to reduce it when needed (Mintz and Jaccard 2006). Additionally, adjusting the tax too often and allowing it to be subject to variable political cycles may cancel out the benefits of providing a steady predictable price signal to investors and consumers alike while creating opportunities for corruption and repeated pressures from vested interests. Nevertheless, a well thought-out policy can help prevent these potential problems.

Political Considerations of a Greenhouse Gas Tax

The major obstacle to implementing greenhouse gas taxes is political feasibility. Not only does the public tend to be averse to gasoline taxes and other price-type approaches, but environmentalists and policymakers are unaccustomed to price-type approaches (Jamieson 2006, Global Strategy Group 2007, Nordhaus 2006).

As a flat tax on emissions would involve large transfers of income to the government, it is not surprising that this creates a political liability. If it were clearly articulated that the government would be returning some or possibly all of the GHG tax revenue by reducing other taxes, then the tax would become more politically palatable (Roberts 2007).[19]

Consequently, tax cuts that offset the revenue generated by the greenhouse gas pricing are an essential element of the political feasibility of the policy. The policy would be a GHG tax shift—shifting taxes away from economically beneficial activities, such as shopping or working, and towards activities that create GHG emissions. As mentioned earlier, many economists argue that using GHG taxes on pollution to decrease other taxes reduces the cost of the abatement policy and improves the efficiency of the economy.

Opposition could also be reduced if the revenues generated by the tax were used in other politically popular ways. A portion of tax revenue could be used to fund energy efficiency projects, renewable energy, research, development of new technologies, or to offset costs of adapting to global warming by funding hurricane relief, drought relief, or flood prevention. Most proposals also recommend that some revenue is used to help defray the burden of the GHG regulation on lower income individuals (Mintz and Jaccard 2006).

One method that could meet both of these objectives is to phase out the sales tax as the greenhouse gas tax is phased in. The sales tax is often cited as the most regressive tax, in that it puts a disproportionate burden on low income individuals—a much larger percentage of their income is paid in sales tax than that of middle and high income

[19] Al Gore recently made this suggestion in his testimony to the United States Senate Environment & Public Works Committee (Gore 2007).

individuals. If the state of Kansas enacted a $5 per ton CO_2e tax, an estimate could be made on the expected revenue that would be generated by the tax. Based on that estimate, the state sales tax could be reduced to a level that would offset the additional revenue. The CO_2e tax could be slowly increased while the sales tax was slowly decreased. This logical method of taxing has been advocated by economists for decades: tax things that are damaging to society instead of taxing things that are beneficial.

A small, statewide tax policy based on CO_2e emissions paired with significant tax cuts for revenue neutrality would be a ground-breaking policy that would put Kansas at the forefront of environmentally and economically sound policy. This might pave the way for other states to enact similar legislation and could help to refocus the national debate on the best policy at the lowest cost. If Kansas makes a bold move towards a smart, revenue neutral, greenhouse gas pricing policy, a paradigm shift in the national policy debate could follow.

Case Study: Sweden's Carbon Tax

Sweden enacted a tax on carbon emissions in 1991. Currently, the tax is $150 per ton of carbon dioxide, but no tax is applied to fuels used for electricity generation and industries are required to pay only 50% of the tax (Johansson 2000). However, non-industrial consumers pay a separate tax on electricity. Fuels from renewable sources such as ethanol, methane, biofuels, peat, and waste are exempted (Osborn). As a result the tax had a huge impact on the expansion of the use of biomass for heating and industry. The Swedish Ministry of Environment projected that the tax policy lowered carbon dioxide emissions in 2000 by 20 to 25% from 1990 levels (Johansson 2000).

Programs similar to Greenhouse Gas Taxes

While Boulder is the only government in the United States that has levied an actual GHG tax, other measures around the country have a similar effect, though they are not specifically tied to GHG emissions. These are often called Public Benefits Funds (PBF) and twenty-three states have them. Most of the states use the funds to promote renewables, energy efficiency, or both. Some of the PBFs are simply a flat fee added to consumer's utility bills. However, the PBF fees that are based on energy usage are essentially a tax on energy usage. Fees range from $0.000178/kWh in Delaware to $0.004/kWh in Connecticut (Pew Center on Global Climate Change 2006d). The state of Oregon has a fee equal to 3% of the customer's monthly utility bill (Kelley 2006). These fees do not differentiate based on the carbon content of the energy source, yet they may help internalize some of the external costs of energy production.

While a GHG tax that targets the entire economy is economically preferable, a small greenhouse gas charge on electricity could be a step in the right direction. If Kansas implemented a one mill ($0.001) per kilowatt hour (kWh) greenhouse gas charge, it could create a greenhouse gas fund of over $40 million (EIA 2007).[20] The revenue could be used to finance other emissions reductions efforts or reduce taxes.

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[20] Current residential electricity prices are $0.0754/kWh, thus such a charge would equate to a 1.3% price increase (EIA 2007).

Controlling the Quantity of GHG Emissions: The Cap-and-Trade Method

In the discussion of mandatory policies for GHG emissions in the current political arena, the cap-and-trade method clearly dominates. The basic idea behind cap-and-trade policy is to set a limit (or cap) on the level or quantity of carbon dioxide equivalent (CO_2e) emissions, issue permits equaling that quantity, and allow trading of the permits among entities who emit greenhouse gases.

The Economics of Cap-and-Trade

Requiring a permit to emit greenhouse gases and allowing permit trading gives greenhouse gas reductions a market, and thus, a direct monetary value. If permits are selling for $4.00 per ton of CO_2e, then reducing emissions by one ton has an economic value of $4.00. Based on the assumption that reducing emissions benefits society, cap-and-trade policies can improve economic efficiency because they help to internalize some of the external costs of emitting greenhouse gases, and they do so where the reduction costs are the lowest (Shapiro 2007).

One major problem with cap-and-trade policies is that emissions are capped at a fixed level, regardless of the cost to achieve that level of reduction (McKibbin and Wilcoxen 2002). Especially given the large uncertainties about the costs and benefits of emissions reductions, this policy could prove unwise. If the cap is set too low and the costs of abatement are higher than expected, then the financial hardship may have large negative effects on the economy, which could far exceed the societal benefits gained by the reductions. On the other hand, the cap could be set too high because abatement costs are lower than expected, and the economy would lose out on environmental benefits that could have occurred at low costs, thus reducing economic efficiency.[21]

Closely related to the unpredictability of the costs to reduce greenhouse gas emissions is the uncertainty and volatility of emissions permits prices (Shapiro 2007). Because the supply of permits is fixed, what economists call a completely inelastic supply, the only response to changes in demand is fluctuations in price (Nordhaus 2006).[22] The demand for products and services that require greenhouse gas emissions is influenced by many external, often uncontrollable, factors such as weather that affect energy demand (Nordhaus 2006).

This combination of inelastic supply and changing demand is a recipe for extreme volatility in prices. Examples of cap-and-trade systems such as the acid rain program and the European Union's ETS program have shown that this is exactly what has happened. The prices of SO_2 and NOx permits have ranged from $66 to $1550 with an average monthly change of 10% and an average annual change of 43% (Shapiro 2007). EU ETS permit prices have ranged from a high of €31.50 to a low of €0.29 with average price shifts of 17.5% per month (Point Carbon 2007a, Point Carbon 2007b, Shapiro 2007).

Large fluctuations and unpredictability in permit prices make it very difficult for businesses and individuals to make prudent decisions about investing in abatement

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[21] See p. 54 for a discussion of this problem with the EU ETS.

[22] While some policies have a "safety valve" provision that allows the regulator to supply additional permits to soften price fluctuations, these types of provisions have been shown to be largely ineffective in the case of SO_2 and NOx permit trading (Shapiro 2007).

technologies and strategies. According to Nordhaus, "quantity limits are particularly troublesome in a world of growing economies, differential economic growth, and uncertain technological change" (Nordhaus 2006).

Emissions Permit Distribution

How permits are distributed—that is, whether they've given away for free or auctioned—can influence the economic performance and fairness of a cap-and-trade policy. If permits are originally given away for free, then three major economic issues emerge.

- First, existing firms are favored to receive the free permits, which allow them to be grandfathered into the new regulations.[23] This may create a barrier for new firms to enter the market which is a violation of one of the requirements for a perfectly competitive market (Newell et al. 2005). As a result, competition decreases, and the market becomes less efficient resulting in less innovation and higher prices for consumers.
- Second, regulations can increase market distortions created by the tax-interaction effect which can add significantly to the cost of abatement.[24] If permits are auctioned and the revenue is used to reduce other taxes, then the overall cost of a GHG reduction policy can be reduced by 75% (Parry 1997).
- Thirdly, whether permits are given away or auctioned, the prices for consumers would increase to reflect the added monetary value of GHGs. If the permits are given away, the higher prices will offset compliance costs and add to the firms' profits. The Congressional Budget Office summarizes the issue by pointing out that a giveaway of emissions permits "would transfer income from energy consumers—among whom lower-income households would bear disproportionately large burdens—to shareholders of energy companies, who are disproportionately higher-income households" (Dinan 2007, p. 2). However, if permits are auctioned, the revenue can be used to offset other taxes or provide other public services and consumers would share in the benefits (Goulder and Pizer 2006).

Banking and Borrowing of Permits

While price-based approaches are considered to be more economical than quantity-based approaches, features such as banking and borrowing of permits as well as adjustments to the quantity of available permits can be part of the permit system in order to create an efficiency outcome that is more similar to the price-based approaches (Newell et al. 2005).

As caps are lowered and/or energy demand grows, permits will likely become more valuable. Permit banking is the practice of allowing firms to save their permits to use at a later date. This encourages investment in abatement strategies that may reduce

[23] Grandfathering is the practice of giving pre-existing situations exemptions to new laws.
[24] See previous discussion of distortionary taxes with respect to GHG tax, p. 13.

emissions further than required by giving reduction in the short term the same value as reduction in the future.

Permit borrowing is the opposite practice of allowing firms to borrow from future allowances to give flexibility in meeting current standards.[25] Because climate change results from the accumulated stock of emissions and not just the periodic flow of emissions, the benefits of emissions reductions are not dependent on only the annual flow of emissions. Thus, by building in flexibility over time the net cost of emissions abatement can be reduced without reducing the benefits (Goulder and Pizer 2006).

The importance of allowing some adjustments to the quantities of permits available is also related to the fluctuations in permit prices that were discussed above. If the quantity of permits is set too high or too low—as would be evidenced through very low or very high permit prices—then a mechanism built into the policy could allow the quantity to be adjusted to reflect true costs of abatement or temporary fluctuations in demand.

Administration of a Cap-and-Trade Policy

As the SO_2 trading program demonstrates (see discussion below), a cap-and-trade system can be successful on a relatively small scale (i.e., national as opposed to global) (Shapiro 2007). The essential problem with the implementation of a cap-and-trade policy is the additional administrative costs involved with the distribution of permits and monitoring a trading system, which add to the overall costs of reducing emissions (Shapiro 2007).

A more complicated issue concerns the method of initially allocating the permits. As mentioned above, it may be preferable to auction the permits and use the revenues to offset distortionary taxes or provide other public services; auctioning also avoids some of the difficult equity issues regarding the distribution of permits between current and future emitters (Cooper 2006). For instance, if allowances are assigned based on current emissions, then emitters who have already made substantial reductions before the policy was created or who have had historically rapid growth will be penalized and heavy emitters and those with slow growth will be rewarded (Nordhaus 2006).

Because the emissions permits will have a monetary value through the trading system, the allocation will likely be highly political (Cooper 2006). The cap creates artificial scarcity and valuable commodities (i.e., permits) that make it more susceptible to corruption than price-type controls, and the distribution of permits will invite favoritism and pressure from influential, vested interests (Nordhaus 2006, Shapiro 2007).

According to economists Newell, Pizer, and Zhang, a cap-and-trade system that distributes free permits "in essence, prints money for those in control of the permits"(2005). Indeed, the *Wall Street Journal* opinion page alleges that the widespread support of a cap-and-trade policy from businesses is simply a strategic maneuver to be at the negotiating table to shape the policy in their favor (2007).

[25] In short, by allowing banking of permits, time arbitrage trading of permits is facilitated. The flexibility that comes with arbitrage trading enables more efficient use of permits over time and tends to reduce the risk of abatement investment decisions.

Regardless of equity issues, two additional problems could render the cap-and-trade system ineffective. First, a cap-and-trade system is vulnerable to cheating because the buyer and the seller of the permit have little incentive to enforce the emissions limits (Shapiro 2007). However, the firms may monitor each other to prevent cheating. Cheating devalues the permits and creates an overall competitive disadvantage for those that don't cheat (McGibben and Wilcoxen 2002).

Secondly, there is the issue of what level to set the cap. If the cap is set too high, then emissions are only shifted around among the participants in the permit market and no overall reduction is achieved. The only real outcome is the profits made on trading (*The Wall Street Journal* 2007). If the cap is set too low, then the costs incurred to meet the cap would put a overly heavy burden on the economy and society could end up worse off than without the cap.

The Political Outlook for Cap-and-trade

A cap-and-trade policy is broadly considered far more politically feasible than a GHG tax. In fact, there is considerable support from industry and policymakers for a cap-and-trade policy.[26] The public responds well to clearly defined goals by which progress can be measured (Jamieson 2006). An emissions cap provides this target and allows policymakers to set an exact level of reduction (Shapiro 2007). This stability and predictability of quantity is something that makes a policy easier to sell in the political arena. Moreover, policymakers and environmentalists are accustomed to quantity restraints making them more comfortable with supporting quantity-based policies (Nordhaus 2006).

Case Study: SO_2 Trading Program in the United States[27]

The 1990 Clean Air Act established a market-based permit trading system to control the levels of sulfur dioxide emissions from power plants, which cause acid rain. The permits were freely allocated based on fixed emissions rates established by law and by historic fossil fuel use. Allowance banking and trading is permitted, and fines are levied on plants that exceed the emissions allowed by the permits they held through allocation or trading. The program has two phases, five years apart, with the first addressing large, heavy-emitting power plants and the second incorporating smaller plants and tightening restrictions on larger plants (U.S. EPA 1991).

The SO_2 trading program has a number of features that are relevant to a potential cap-and-trade program for greenhouse gas emissions. The initial free allocation of permits was said to be essential in order to gain political acceptance. Banking of permits is allowed in order to provide temporal flexibility to meet emissions standards.

Significantly, there is a "hands-off" approach to how the reductions are achieved: the regulators only track emissions results--that is, they are only concerned with compliance with the cap. The emissions are carefully tracked, with strong monitoring and enforcement provisions. Measurement and, thus, monitoring of SO_2 emissions is

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[26] See Appendix 7, p. 63 for a brief discussion of support for and opposition to mandatory policies.
[27] For a discussion on the European Trading Scheme and the Chicago Climate Exchange, see Appendix 4, p. 54.

reasonably accurate, and penalties for non-compliance are not subject to appeals or waivers. Additionally, there is public access to actual emissions and trading data, which gives transparency to the process (Kruger 2005).

A few major modifications would be necessary to apply a similar program to greenhouse gas emissions. Whereas the SO_2 trading program addresses only power plants, ideally, a greenhouse gas emissions program would address all sectors of the economy. Secondly, it may be preferable to regulate "upstream," which means regulating producers or processors of GHG-related commodities, such as coal, rather than directly regulating emitters (e.g., those that burn the coal). This is especially important for non-point sources such as transportation vehicles (Kruger 2005).

The current SO_2 cap-and-trade program is widely considered to be a success. Not only have emissions been reduced to the targeted levels, but the actual cost of reductions has been only half of what was expected when the program was enacted (Kruger 2005). Furthermore, it is estimated that the market-based approach saves $1 billion annually over a command-and-control regulatory policy (Stavins 2005). The success of the SO_2 trading program paved the way for other cap-and-trade policies, such as the EU Emissions Trading Scheme.

Comparing Methods: GHG Tax vs. Cap-and-Trade

A GHG cap-and-trade system and a GHG tax are both market transformation mechanisms that seek to internalize the costs of emitting carbon dioxide and other GHGs. Both methods have been shown to be effective ways of reducing pollution at a much lower cost than more traditional mandates and standards. However, the emissions tax can reduce greenhouse gases at a much lower overall cost than a cap-and-trade system.

If administrative costs are ignored, the tax and cap would cost the same *if* they were set at the ideal level.[28] However, because there is uncertainty about the exact costs and benefits of reducing emissions, then the relative cost of each type of policy becomes markedly different (Weitzman 1974). As policymakers are unlikely to choose the perfect cap or tax level, the key question is what happens if the cap or the tax are set too high or too low.

In fact, the Congressional Budget Office studied this question and concluded that the net benefits of a GHG tax could be 30% to 34% higher than the net benefits of a cap (Dinan 2005).[29] Because of the scientific and economic realities of greenhouse gas emissions, it is better to allow uncertainty in the level or quantity of emissions reductions rather than in the price or incremental cost of those reductions (Goulder and Pizer 2006).[30]

[28] The ideal level would be the point at which the marginal benefits of reducing emissions equal the marginal costs of reducing emissions. See p. 5 for further discussion.

[29] The study compared a $10 per ton of carbon tax with a cap to reduce carbon emissions by 29 million metric tons and examined the outcomes under scenarios where the cost of reducing was 50% lower than expected and 50% higher than expected.

[30] The marginal benefits of reducing are relatively steady because the reduction of one additional unit of GHG has a very similar benefit as the reduction of each unit reduced before it. The cost of the investments to reduce emissions accrue rapidly with each additional unit, so it produces a steep cost function. It is well

Because there are large uncertainties in the costs of reducing, there are significant economic risks associated with requiring a certain level of reduction regardless of the costs.[31] The GHG tax can also be viewed as a method to deal with the risk and uncertainty surrounding the costs of reducing emissions (Toman 2003).

Unlike cap-and-trade policies, GHG taxes avoid the potential of extremely high permit prices causing debilitating compliance costs or extremely low permit prices creating insufficient incentive for emissions reductions. A stable price signal puts steady pressure on the markets to determine the best pathway towards reduction and alternative energy development (Izzo 2007). When there is a clear, predictable price for GHG emissions, businesses can plan prudent investments in energy efficiency and have a transparent, long-term incentive for investments in research and development of new technologies (Shapiro 2007).

Cap-and-trade systems allow policymakers to set a specific quantitative goal on how much to reduce greenhouse gas emissions. Politically, this is a definite advantage; economically, this is a disadvantage; environmentally, the advantage or disadvantage is not clear. Anthropogenic climate change depends on the total accumulation of GHGs in the atmosphere, not the amount of emissions in any given year. Because of the long atmospheric lifetimes of greenhouse gases, short-term fluctuations are relatively insignificant; it is the total amount of GHGs released in the atmosphere that determines the benefit. The GHG tax focuses on gradually shifting the market away from GHG emissions by making it more and more costly to emit. This allows the periodic quantity of emissions to fluctuate, but the overall emissions released would decrease.

Furthermore, a quantity cap does not mean that there will be more emissions reduction than with a tax. A cap based on a cost-benefit analysis that overestimates the costs of abatement would reduce emissions much less than a tax based on the same estimate. Historically, the costs of complying with environmental regulations have been overestimated and this trend of overestimating compliance costs will likely continue with GHG policy.[32] If that is the case, then a GHG tax could cut emissions more than a cap-and-trade policy.

Any policy-making process is susceptible to undue influence from vested interests. A cap-and-trade policy could be particularly vulnerable if permits are not completely auctioned. If permits are given away, then problems of favoritism and grandfathering emerge.[33] If GHG tax exemptions are allowed, then the same problems may exist. However, a tax does not create an additional commodity like the cap-and-trade, so it is much less vulnerable overall to corruption and profiteering (Shapiro 2007).

A GHG tax would be much easier and less costly to implement than a cap-and-trade system or some type of command-and-control regulation. The administrative system needed for a GHG tax is largely in place. While some GHG trading systems currently operate, a mandatory, economy-wide permit system would create serious

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established that under these circumstances, price-type regulations will produce a more efficient outcome (Nordhaus 2006).

[31] There are similar economic risks for command-and-control policies.

[32] See discussion of cost-benefit analysis on pp. 7-8, and the experiences of the EU ETS on p. 54.

[33] See discussion of problems with permit allocation on p. 17.

administrative challenges. These administrative costs add to the overall cost of reducing greenhouse gases.

Although a cap-and-trade system can be structured to mimic the advantageous aspects of a GHG tax through the use of permit auctions, banking, borrowing, and a price safety valve (or in a hybrid cap-and-trade design discussed below), the simplicity of a GHG tax cannot be replicated and creates a major cost advantage. Moreover, the straightforward nature of the GHG tax lends itself to a high level of transparency, which contrasts with the more convoluted cap-and-trade system. When the costs of reducing are very clear and the tax is applied evenly throughout the economy, the purpose—to reduce GHG emissions—can more easily remain intact.

Hybrid Cap-and-Trade System

Although under most conditions GHG taxes have been shown to be a more economically efficient solution, albeit with political limitations, a cap-and-trade system is generally viewed as more politically feasible, despite its potential economic efficiency problems.

To address these concerns, various hybrid systems that combine elements of the two programs have been proposed to help overcome these limitations.[34] According to William Pizer, former senior economist of the President's Council of Economic Advisers, an optimally designed hybrid policy produces slightly improved overall social welfare and economic efficiency compared with a GHG tax and is five times more efficient than a global cap-and-trade system (1997).

The hybrid system proposed by McGibben and Wilcoxen creates a *fixed* number of tradable, *long-term* emissions permits that equal long-term reduction goals (2002).[35] These "perpetual permits" could be given away, auctioned, or otherwise distributed by the regulator and could be traded. In addition to these long-term permits, the government would also sell *short-term* annual permits at a fixed price but in an unlimited quantity. The total emissions in a given year must not exceed the total number of perpetual and annual permits.

This hybrid system avoids many of the economic downfalls of the standard permit system. Like both the tax and cap-and-trade, it will help achieve the reductions where they are the cheapest. However, the annual permits sold for a fixed price place an upper limit on the cost of emissions reduction. Even if the long-term reduction target is set very low and is difficult to achieve, the government can prevent an undue financial burden on industries and consumers by placing a moderate price on the annual permit and adjusting it as needed to respond to costs of reduction, fluctuations in demand, and tightening of emissions.[36]

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[34] Roberts and Spence (1976) originally proposed a hybrid system that has permits available at a fixed "trigger" price in addition to the tradable permits to put a price ceiling on pollution reduction costs.
[35] Warwick McGibben is a professor of economics at the Australian National University and Peter Wilcoxen is an associate professor of economics and public administration at Syracuse University.
[36] However, with government discretion and flexibility, opportunities may arise for regulated interests to assert an undue influence on policymakers. It is important to have mechanisms in place to prevent corruption and insure a long term commitment to the policy goals.

This system also minimizes the problem of setting emissions limits (i.e., caps) too high, as occurred with the EU ETS. Instead of setting a cap at the level of the short-term goal, which may be too high to elicit any real reduction, the long-term permits are allocated based on a long-term goal and the price of the short-term permits can be controlled to affect the level of pressure towards further reductions. This system could also help to reveal the true costs of reducing by showing the actual decisions of firms to reduce or purchase permits at various price levels.

This system presents a political compromise, but like many compromises, problems from each side remain in a reduced form. Emitting firms might see the perpetual permits as a form of grandfathering that gives them an economic advantage; this may lessen industry opposition to the policy. This system also avoids the large transfers of money to the government that would occur with a pure GHG tax. However, the problems of permit allocation still exist.

The political hurdle of money transfers to the government also remains through the sale of annual permits. On the other hand, the annual permits have the advantage of generating revenue that could be used to reduce taxes or to promote popular programs. Furthermore, with the hybrid system, no specified quantity of reduction can be guaranteed which, as discussed before, can add to the political difficulties of the policy.

The hybrid policy may create legislative and administrative difficulties because implementation would cut across traditional institutional boundaries, involving various legislative committees, executive agencies, and the treasury. As with the cap-and-trade policy, mechanisms and rules for trading would have to be established.

On the other hand, the flexibility this policy affords may more than make up for these disadvantages. The policy also has built-in incentives for monitoring and enforcement: the government is collecting revenues based on emissions, so it has an incentive to enforce limits, and the firms may monitor each other to prevent cheating. Cheating devalues the permits and creates a competitive disadvantage for those that don't cheat.

The hybrid system developed by McGibben and Wilcoxen is just one possible control mechanism that may bring about the best combination of political feasibility and economic benefit. These hybrid systems are certainly not without flaw, but the complexities may be worth the gain in efficiency.

Energy Subsidies

A discussion of the economics and policy of greenhouse gas emissions would not be complete without some mention of the existing subsidies in the energy industry. A subsidy can take many different forms including tax breaks, direct payments, price regulation, research and development, and government services. Converse to taxes, subsidies tend to encourage certain activities or products.

By one estimate, the energy industry subsidy structure has contributed 1% to 7% of the total U.S. carbon emissions (Kammen and Pacca 2004). Another study estimated that subsidy reform could reduce carbon dioxide emissions 8% by 2035 (Koplow and Dernbach 2001).

Unfortunately, the analysis of government subsidies is very difficult due to the multitude of forms—direct and indirect—and the convoluted nature of tax and subsidy policies. A published review of fossil fuel subsides finds that estimates of fiscal subsidies ranged from $2.6 to $121 billion a year (Koplow and Dernbach 2001).[37]

A study published by the National Academies of Sciences estimates that since 1950, the U.S. government has spent $644 billion (in 2003 dollars) to support the energy industry. The majority of this support has come in the form of tax breaks (43.7%), with only 18.7% going for research and development. The oil industry has received nearly half of the subsidies ($302 billion). Renewable energies, including hydropower and geothermal, have received a total of $111 billion (Bezdek and Wendling 2006).

Reducing subsidies that encourage uneconomic energy use is a correction of a market failure that can lead to a win-win solution. In addition to reducing greenhouse gas emissions, removing subsidies can increase overall economic efficiency and lower the tax burden or deficit (Toman 2003).

Investment in Technology

Policies that promote investment in technology can be justified (in terms of economic efficiency) because the benefits of a given technology often accrue to society as a whole (Goulder and Pizer 2006). Research and development subsidies can help to correct the market failure of underinvestment in a public good (Popp 2006).[38]

While supporting research and development of low-emission technologies is good, the effect on reducing emissions is not as great as policies that attempt to directly correct the emissions externalities (Popp 2006). However, studies have shown that there are substantial cost savings when technology research and development policies are combined with emissions reductions policies (Popp 2006). In general, encouraging investment and correcting market failures is much better than giving the government the task of picking technological "winners" (as occurs with renewable portfolio standards and other technological mandates or by biasing research grants towards particular technologies) (Toman 2003).

Command and Control Policies: Mandating Particular Solutions

Up until fifteen years ago, command-and-control strategies dominated the environmental policy debate (Harrington and Morgenstern 2004).[39] The current national and international debate on how to address climate change focuses largely on cap-and-trade policies, a market-based solution. However, on a state level, the majority of policies being proposed and implemented are not market based, but are command-and-control mandates. Unfortunately, mandating particular solutions is nearly always more expensive and less effective than directly targeting the problem (Fischer and Toman 1998).

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[37] Studies that attempted to include externalities and offsets (i.e., taxes) had an even less manageable range from $200 million to $1.7 trillion annually (Koplow and Dernbach 2001).
[38] In his recent testimony to Congress, Swedish economist Bjørn Lomborg suggested that we invest 0.5% of the nation's GDP in research and development of zero emission technologies (Lomborg 2007).
[39] A policy is considered to be command and control when it specifies the method of reaching a given goal.

A policy is considered to be command-and-control when it dictates the method of reaching a given goal. Policies that choose a specific solution often exclude other low-cost solutions and create counterproductive side effects. On the other hand, policies that monetarily penalize greenhouse gases automatically create incentives for the development and use of low-emission technology, while encouraging behavior and institutional changes towards lower emissions (Fischer and Toman 1998).

To take transportation as an example, if the government mandates that vehicles achieve a Corporate Average Fuel Economy (CAFE) standard of 40 mpg, vehicles will become more efficient (and more expensive), but people will drive more because it will be cheaper to do so (Kleit 2004). However, if a tax on greenhouse gases or a permit system raised the price of gasoline, consumers demand for more fuel-efficient vehicles would cause the average efficiency of vehicles to increase, while also stimulating alternative modes of transportation and less vehicle use. The result could be a larger reduction in greenhouse gas emissions at a much lower cost.[40]

Economists widely agree that command-and-control strategies are more expensive and, therefore, less efficient than market-based strategies. According to a study by five leading climate change economists, non-market policies can raise emissions reduction costs by a factor of ten (Pizer et al. 2006). Regulatory mandates raise demand for a certain product, which allows the producer to sell the product at higher prices. The result is a subsidy for the producer and higher costs for the consumer (Fischer and Toman 1998).

Nonetheless, the majority of the policies and proposals currently in place across the U.S. are non-market solutions. These include mandates for renewable portfolio standards, vehicle standards, appliance standards, and building standards. One problem with minimum standards is that although they may raise the minimum efficiency, they may not strongly affect the overall average energy efficiency. Many of these policies project monetary savings, but, as stated before, market-based policies are cheaper and more effective.

For example, renewable portfolio standards are in place for twenty-four states and the District of Columbia. The goals of renewable portfolio standards are often related to reducing greenhouse gas emissions and other pollutants or reducing dependence on foreign sources of energy and the method is to require a specific proportion of energy to come from renewable sources. Although there are many different methods of reaching those goals, the renewable portfolio standard designates one method as the solution and, by doing so, ignores many other options.

In contrast to mandates that target a particular solution, policies that directly target a problem produce a myriad of different solutions that work best for different situations. If a particular solution is mandated, then the assumption is made that one solution will work best for all situations. With respect to reducing atmospheric concentrations of greenhouse gases, there are thousands of potential solutions with a wide

[40] A study by Andrew Kleit, professor of energy and environmental economics at Pennsylvania State University, modeled a 3.0 mpg increase in the CAFE standard and found that an $0.11 increase in the gasoline tax would bring about the same reduction of fuel use at one fourteenth the cost (Kleit 2004).

range of costs and benefits. The government cannot implement all of the best solutions individually.

However, policymakers can cause some of the environmental and societal costs of greenhouse gas emissions to be included in the price of the product or activity that produces them. This will drive efforts to reduce these costs by reducing greenhouse gas emissions through a multitude of solutions that work best for each individual or organization.

State Level Action

The argument is often made that with a global problem like climate change, state-level actions are negligible and have little impact. However, considering that most states emit more greenhouse gases than the large majority of countries in the world, it can be argued that each state should take responsibility for their own contribution whether it is towards the problem or the solution.

There are some valid issues such as the problem of "leakage" where economic activity and emissions may shift from one state to another with fewer restrictions. Then there is the classic problem of some states not taking steps for reductions and simply "free-riding" on those that do (Kruger 2005). Moreover, if this issue is addressed state-by-state, a patchwork of regulations will be created that could reduce economic efficiency and increase compliance costs (Rabe 2002).

Nonetheless, state-level action may have some distinct advantages. States may be better able to address the concerns of the people and the stakeholders on a more localized level. Innovative technologies and novel policy ideas are often generated at the state level. There are also ways states can encourage economic development while addressing greenhouse gas reductions. Environmental co-benefits such as reductions in air pollution that may result from strategies to reduce greenhouse gases may confer most of their benefits at a localized level.

One interesting effect of patchwork regulation is that it may influence large businesses and industries to argue for a national standard because multiple local standards can be more costly for them. This may be a factor in the current business support of national policies.

National policy has often followed the lead of the states and if states are proactive in their approach to these issues, they may benefit by being ahead of the curve once a national policy is in place (Kruger 2005).

Conclusions

The international scientific community has largely reached a consensus that climate change is mainly driven by increased concentrations of greenhouse gases in the atmosphere resulting from human activities (Oreskes 2004). While there are still details about climate interactions and specific effects that are not clearly understood, definitive efforts to reduce greenhouse gases emissions should be undertaken in concert with continued research and monitoring.

There are many different types of policies that can lead to reductions in greenhouse gases. Nevertheless, it is paramount to understand and acknowledge that for the same outcome, different methods have vastly different costs. Because society has many goals and obligations, governments must be particularly careful when choosing among methods because implementing a higher-cost alternative means that there will be fewer resources available for other important public services.

Economics provides critical insights into which efforts are most effective at the lowest cost. A review of the current studies on climate change policy makes one thing exceedingly clear: market-based policies are far better at achieving reductions in GHG emissions at the lowest cost than command-and-control regulations and mandates.

Most climate change economists agree that a tax on greenhouse gases is the lowest cost way to reduce emissions, especially when the revenue is used to reduce other taxes. Therefore, Kansas could push for the best possible policy tool: a greenhouse gas tax shift. However, because the current national discussion is focused almost exclusively on a cap-and-trade program, the State could take a leadership position and put pressure on Congress to pass a well-designed cap-and-trade program.

	Greenhouse Gas Reduction Policy Options
Lowest Cost	1. Economy-wide Greenhouse Gas Tax
↓	2. Hybrid Cap-and-Trade System
	3. Cap-and-Trade with banking, borrowing, and auction of permits
	4. Traditional Cap-and-Trade System with auction of permits
	5. Traditional Cap-and-Trade System with permit giveaways
Highest Cost	6. Non-market Mandates and Standards

It is important that a GHG tax policy be approached as a way to fix the broken logic of the current tax system and not simply as a way to raise government revenue. For this reason, revenue neutrality could be the key to enacting this GHG tax shift. Reducing regressive taxes could also help insure that low-income individuals are not financially disadvantaged by the new policy. The State of Kansas could implement this win-win solution with a small statewide greenhouse gas tax while pushing for a more comprehensive national tax shift.

When designed effectively, a GHG cap-and-trade system is a good second best policy option. The most essential provision of an effective cap-and-trade system is a full auction of GHG emission permits. Permit giveaways add to utility and industry profits and place the full burden on consumers without providing additional offsetting public benefits.

Ideally, this policy would be modeled on a hybrid system that would have long-term tradable permits as well as annual permits available at a set price. The system should also allow banking of permits to encourage early, strong reductions. It should follow the precedent of the successful acid rain permit-trading program by creating stringent penalties for permit violations that are not subject to appeals or waivers. Additionally, public access to emissions and trading data should be required to give transparency to the process.

However, as a national policy regulating greenhouses gases is expected, Kansas could begin looking for ways to make early adjustments to better position itself to adapt to national GHG regulations. A small GHG tax could provide the incentives to improve and expand energy efficiency and alternative energies and the resources to assist the transition. At the same time, it could reduce other taxes that are harmful to the economy.

In addition to a GHG tax shift, there are a number of steps Kansas can take to facilitate the reduction of greenhouse gases without imposing economically inefficient mandates. Subsidies that promote GHG-emitting activities could be reduced and eventually eliminated. The State could encourage cities to adopt zoning and city planning policies that encourage low-emission practices such as public transportation, walking, biking, and urban tree planting. The State could also encourage municipalities to follow the example set by the Governor's Directive 07-373 and take action to make the government practices more energy efficient.[41] Educating the public on these issues and the available solutions is another extremely important way to transform Kansas into a low-emission state.

Furthermore, any policy should include strong support for research and development of low-emission technologies in Kansas, as well as technologies aimed at developing methods of adapting to the climate change. The potential for technological solutions to climate change is enormous over the long term, and Kansas could benefit from putting itself on the forefront of research and development.

Every greenhouse gas reduction policy is shaped by a multitude of factors, not all of which lead to the most effective and most economical way to reduce GHG emissions. For this reason, a policy that treats all GHG sources equally—according to the global warming potential of their emissions, not the particular industry or technology from which they arise—may have the best chance of effectively and efficiently reducing emissions. Policies that focus on the problem of all GHG emissions, instead of a few politically advantaged programs, may better reach the myriad sources and prompt effective solutions for each individual source.

Climate change is a global problem and, ideally, there will be a global solution. However, until that level of global cooperation is achieved, actions on a national and state level are realistic and essential first steps. Kansas now has an opportunity to take meaningful first steps towards implementing efficient solutions to mitigate and adapt to climate change.

[41] See Appendix 8, p. 65 for Executive Directive 07-373.

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Appendix 1: Climate Change Science

Greenhouse Gases and Their Contribution to Climate Change

The "greenhouse effect" is a well-established phenomenon that occurs in the atmosphere when the concentration of greenhouse gases traps heat from the sun that would otherwise radiate back into space. This occurs because greenhouse gases are transparent to incoming solar radiation, but opaque to outgoing longwave radiation (U.S. DOE 1995). The current concentrations of greenhouse gases in the atmosphere have increased significantly since 1750 from a carbon dioxide equivalence of 280 ppm to 430 ppm (Stern 2006).[42]

Experts generally focus on six major greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). Water vapor is also an important greenhouse gas, but since humans do not generally have a direct affect on water vapor concentration in the atmosphere, it is not included in this review. Because each greenhouse gas traps different amounts of heat and stays in the atmosphere for different lengths of time, studies use measures of global warming potential to compare between gases. Carbon dioxide is used as the benchmark, so all other gases are measured in carbon dioxide equivalence (CO2e)—how much carbon dioxide it would take to cause the same amount of warming.

Gas	Global Warming Potential	Atmospheric Life (years)
CO_2	1	5 to 200 [43]
CH4*	21	12
N_2O	310	114
HFC	140 to 11,700	1.4 to 260 [44]
PFC	6,500 to 9,200	10,000 to 50,000+
SF6	23,900	3200

Table 1: The global warming potential of six major greenhouse gases. This measure takes into account the heat trapping abilities and the time the gas stays in the atmosphere (IPCC 2001a, 2001b).

Natural and Anthropogenic Causes of Global Warming

The most recent IPCC publication states that there is a "very high confidence" that human activities have caused a net warming of the planet (IPCC 2007a).[45] Since the IPCC Third Assessment Report was released in 2001, an improved understanding of the human influences on climate change has led to an increase in the level of certainty (IPCC 2007a).

[42] Carbon dioxide equivalence (CO2e)—how much carbon dioxide it would take to cause the same amount of warming as the gas(es) in question. See Appendix 2, p. 47 for a full discussion of greenhouse gases.
[43] No single lifetime can be defined for CO2 because of the different rates of uptake by different removal processes.
[44] Depending on the type of HFC
[45] Very high confidence translates to a 90% level of certainty.

The potency of the greenhouse effect of each gas is denoted by a value called radiative forcing which measures how much the gas affects the balance of heat coming in and going out of the atmosphere. [46] The combined radiative forcing of carbon dioxide, methane, and nitrous oxide is +2.30 [+2.07 to +2.53] W m^{-2} (watts per square meter) compared to the radiative forcing of solar irradiance[47] of +0.12 [+0.06 to +0.30] W m^{-2}. In other words, the accumulated greenhouse gases in the atmosphere are causing between 7 to 42 times as much warming of the atmosphere than the increase in solar energy coming from the sun. There is large agreement that natural variations in solar cycles and volcanic frequency do not account for the warming that has been observed (Pearce 2005, Foukal et al. 2006).[48] Figure 2 shows the balance of all major anthropogenic and natural factors and their influence on climate change.

Some of this warming is balanced by the cooling effects of aerosols in the atmosphere. Aerosols are small solid or liquid particles suspended in the air such as sulfate, organic carbon, black carbon, nitrate and dust. Not only do they cause a negative radiative forcing (cooling) of -0.5 [-0.9 to -0.1] W m^{-2}, they have a secondary effect on cloud formation which is estimated to have a cooling effect of -0.7 [-1.8 to -0.3] W m^{-2}. While the scientific understanding of the effects of aerosols has improved since the Third Assessment, there is more uncertainty about their impact on climate change than any of the other factors discussed in the IPCC report.

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[46] Radiative forcing is a measure of the influence that a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. Positive forcing tends to warm the surface while negative forcing tends to cool it. In this report radiative forcing values are for 2005 relative to pre-industrial conditions defined at 1750 and are expressed in watts per square meter (W m-2) (IPCC 2007a).

[47] Solar irradiance is the amount of solar energy that arrives at a specific area of a surface during a specific time interval. A typical unit is W/m^2. (Renewable Resource Data Center)

[48] For example, a literature review published in Nature magazine concludes that the variations in solar luminosity (known as the sunspot cycle) are too small to have had a significant impact on increasing global temperatures since the 17^{th} century. (Foukal et al. 2006)

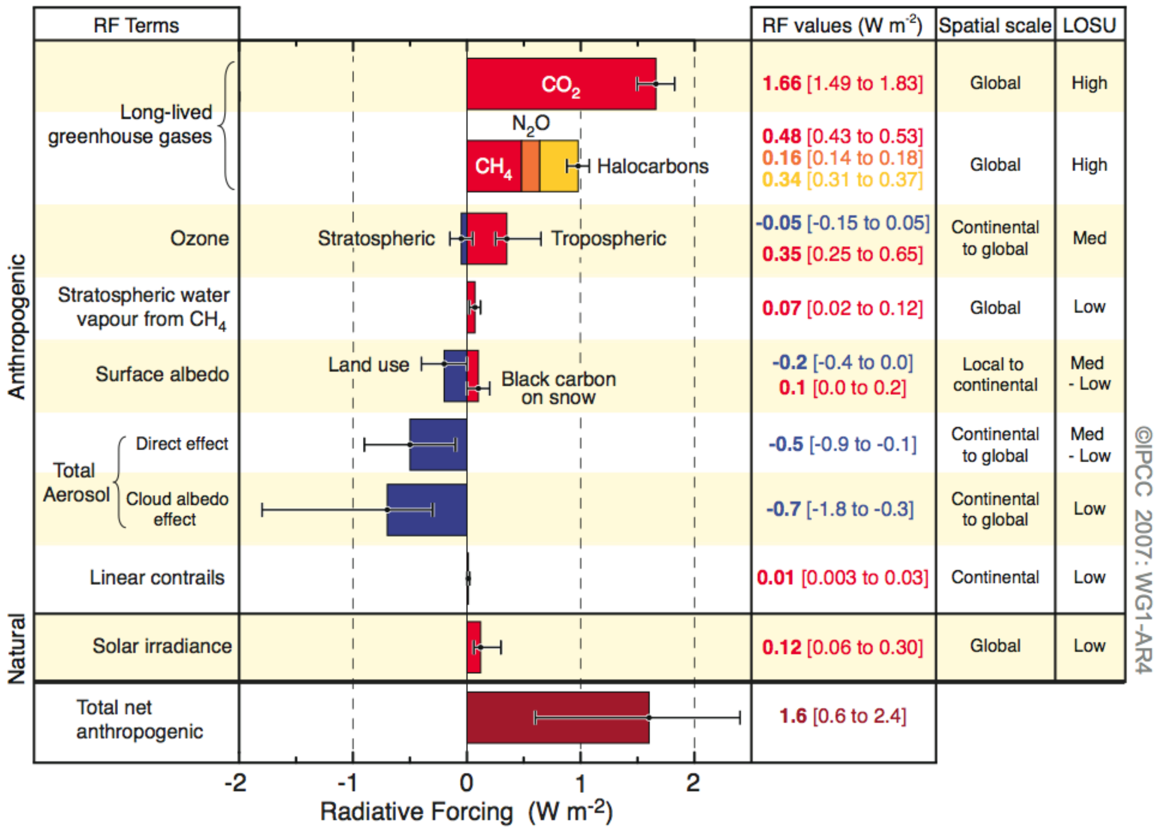

Figure 2: Global-average radiative forcing (RF) estimates and ranges in 2005 for anthropogenic CO_2, CH_4, N_2O and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net anthropogenic radiative forcing and its range are also shown. These require summing asymmetric uncertainty estimates from the component terms, and cannot be obtained by simple addition. Additional forcing factors not included here are considered to have a very low LOSU. Volcanic aerosols contribute an additional natural forcing but are not included in this figure due to their episodic nature (IPCC 2007a).

Direct Observation of Warming

There is no question that the global climate has been warming.[49] The current warming is apparent through global average temperatures, patterns of snow and ice melt, and rising sea levels. There has been a temperature increase of 0.76°C (1.44°F) between the periods of 1850-1899 and 2001-2005. Based on the instrumental record, eleven of the last twelve years are among the warmest twelve since 1850 (IPCC 2007a). Over the past century, global surface temperatures have increased at an average rate of 0.06°C (0.108°F)/decade. However, in the past 25 to 30 years, that average rate increases to 0.18°C (0.324°F)/decade, which is an acceleration of the rate of warming (National Climatic Data Center 2007). New balloon data from the middle troposphere has shown a similar trend of rising temperatures which resolves a discrepancy from the Third Assessment that the middle troposphere was not warming (National Climatic Data Center 2007).

[49] There is some debate about the degree to which this warming trend is an anomaly in terms of the paleoclimatic record.

The warming has also affected ice and snow cover. Mountain glaciers and ice caps have declined in both hemispheres and the melt has contributed to the rise in sea level. Greenland and Antarctica have also lost net mass due to melting which has contributed to sea level rise. The average arctic sea ice has declined by 2.7% per decade overall, and 7.4% per decade during the summer since observations began in 1978 (IPCC 2007a).

The oceans have warmed up to a depth of at least 3000 m. They are estimated to have absorbed 80% of the additional heat added to the climate. Through thermal expansion—warmer water taking up more space than denser colder water—this has contributed to the rise in sea levels. Melting of glaciers, ice caps, and ice sheets have also added to the sea level rise creating a total increase in sea level of 0.17 m. Table 2 details the contributions of different factors to the rise in sea levels. There is high confidence that the rate of sea level rise has also increased from the 19th to the 20th century (IPCC 2007a).[50] Furthermore, the ocean has become more acidic due to the uptake of anthropogenic carbon (IPCC 2007b).[51]

Paleoclimatic data suggests that the warming the earth is currently experiencing is unusual when compared with temperature proxy data from the past 1300 years. The IPCC finds that the temperatures in the past 50 years are very likely (90% chance) higher than any other 50-year period in the past 500 years and likely (66% chance) higher than any 50-year period in the past 1300 years (IPCC 2007a). There is some controversy surrounding the assessment that the 1990s was the warmest decade in the past millenium.[52] During the last interglacial period, about 100,000 years ago, temperatures were 3°C to 5°C (5.4°F to 9.0°F) higher than they are now due to differences in the Earth's orbit. With these higher temperatures, the sea level was likely 4 m to 6 m higher than the 20th century average (IPCC 2007a).

New observational evidence has shown that natural and physical systems have already been influenced by recent climate changes. Effects are being seen in hydrologic systems, earlier greening in spring, changes in migration, range shifts in both plant and animal species, Arctic and Antarctic ecosystems, and marine and freshwater ecosystems. The IPCC evaluated 29,000 data sets from 75 studies around the world, and more than 89% are consistent with expected changes that would result from planetary warming (IPCC 2007b).

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[50] High confidence translates to an 80% level of certainty.

[51] When carbon dioxide dissolves in water, carbonic acid forms.

[52] In order to provide an unbiased analysis of this controversy, the National Academy of Sciences convened a study to assess the methods and available data used to reconstruct the temperature records of the past 2000 years. They concluded that a relatively warm period occurred around A.D. 1000, often referred to as the Medieval Warm Period, and a relatively cold period occurred between 1500 and 1850, often referred to as the Little Ice Age. They assert that high confidence can be placed in the statement that the late 20th century is the warmest period in the past four centuries, but less confidence can be placed in temperature reconstructions of the time period between 900 and 1600 A.D. Available data supports the claim that the late 20th century is the warmest in the past millennium, but there are large uncertainties due to the lack of comprehensive proxy data. They also conclude that very little confidence can be given to reconstructions of temperatures prior to 900 A.D because the uncertainties are too great (National Research Council 2006).

Source of sea level rise	Rate of sea level rise (mm per year) 1961 – 2003	1993 – 2003
Thermal expansion	0.42 ± 0.12	1.6 ± 0.5
Glaciers and ice caps	0.50 ± 0.18	0.77 ± 0.22
Greenland ice sheet	0.05 ± 0.12	0.21 ± 0.07
Antarctic ice sheet	0.14 ± 0.41	0.21 ± 0.35
Sum of individual climate contributions to sea level rise	1.1 ± 0.5	2.8 ± 0.7
Observed total sea level rise	1.8 ± 0.5[a]	3.1 ± 0.7[a]
Difference (Observed minus sum of estimated climate contributions)	0.7 ± 0.7	0.3 ± 1.0

Table note:
[a] Data prior to 1993 are from tide gauges and after 1993 are from satellite altimetry.

Table 2: The contributions of different sources to the rise in sea level (IPCC 2007a).

Projections of Climate Change

For the next two decades, the IPCC predicts a warming of 0.2°C (0.36°F) per decade. Had the greenhouse gas concentrations been frozen at the level in 2000, the warming would have continued at 0.1°C (0.18°F) per decade largely due to the slow response of the oceans (IPCC 2007a). If emissions of greenhouse gases continue at the current rate or increase, warming and climatic changes are expected to accelerate beyond the pace seen in the 20th century.

In order to account for the uncertainty in the global development of economies, social systems, population growth, and emissions reductions, the IPCC has developed six different scenarios of the future for climate modeling purposes.[53] Figure 3 shows the average global temperature projections for each of these scenarios as well as the predicted course of temperature under 2000 constant concentrations. Between all of these different scenarios, the likely range of temperature change from 1980-1999 and 2090-2099 is between 1.1°C and 6.4°C (1.98°F and 11.52°F) with best estimates ranging from 1.8°C (3.24°F) in the B1 scenario and 4.0°C (7.2°F) in the A1FI scenario. The sea level rise predicted by these models ranges from 0.18m and 0.59m in 2090-2099 relative to 1980-1999 (IPCC 2007a).

[53] SRES Scenarios: Economic growth is the focus in the A scenarios while the B scenarios emphasize efforts towards environmental protection. The 1 variations portray a world that has become more globalized while the 2 scenarios describe differentiated regional development. The three different A1 scenarios describe different approaches to energy: A1FI is fossil fuel intensive, A1T uses non-fossil fuel sources, and A1B has a balance of energy sources. Population growth is highest in A2, then B2, and then A1 and B1 (Tol et al. 2005).

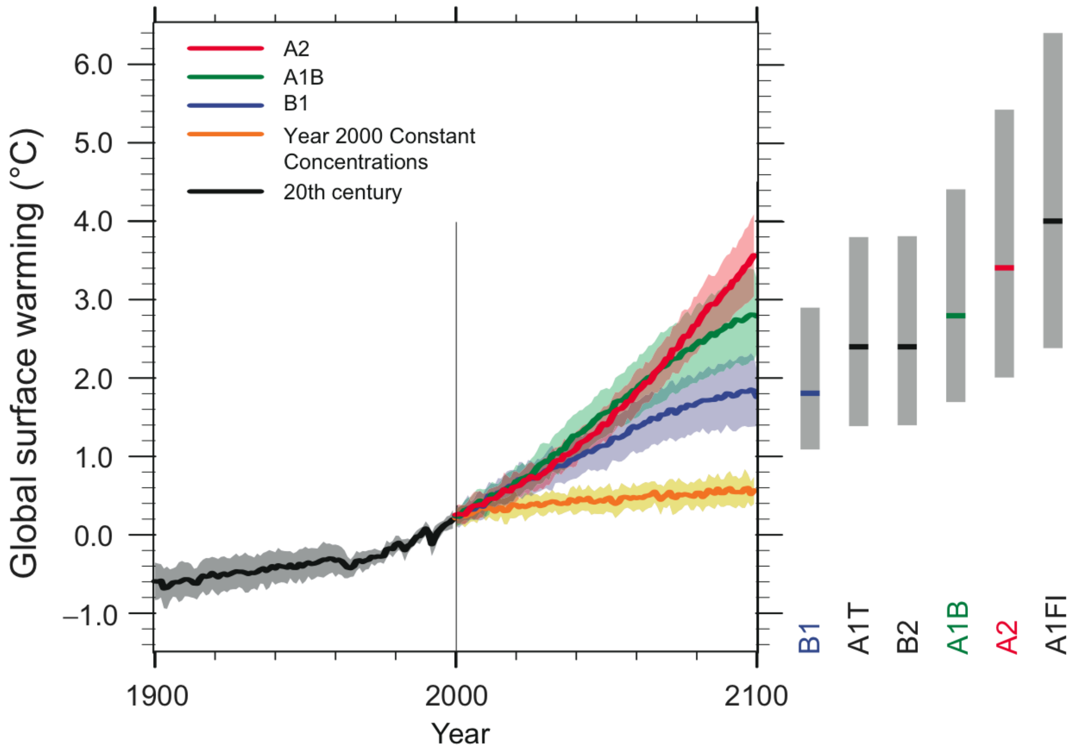

Figure 3: Solid lines are multi-model global averages of surface warming (relative to 1980-99) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the plus/minus one standard deviation range of individual model annual averages. The gray bars at right indicate the best estimate (solid line within each bar) and the *likely* range assessed for the six SRES marker scenarios. The assessment of the best estimate and *likely* ranges in the gray bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints (IPCC 2007a).

The global averages of temperature increase do not reveal the widespread variation in the effects on different parts of the world. High northern latitudes are expected to have the most intense warming, and warming will be greater over land than over oceans. Figure 4 shows modeling predictions of surface temperatures across the globe.

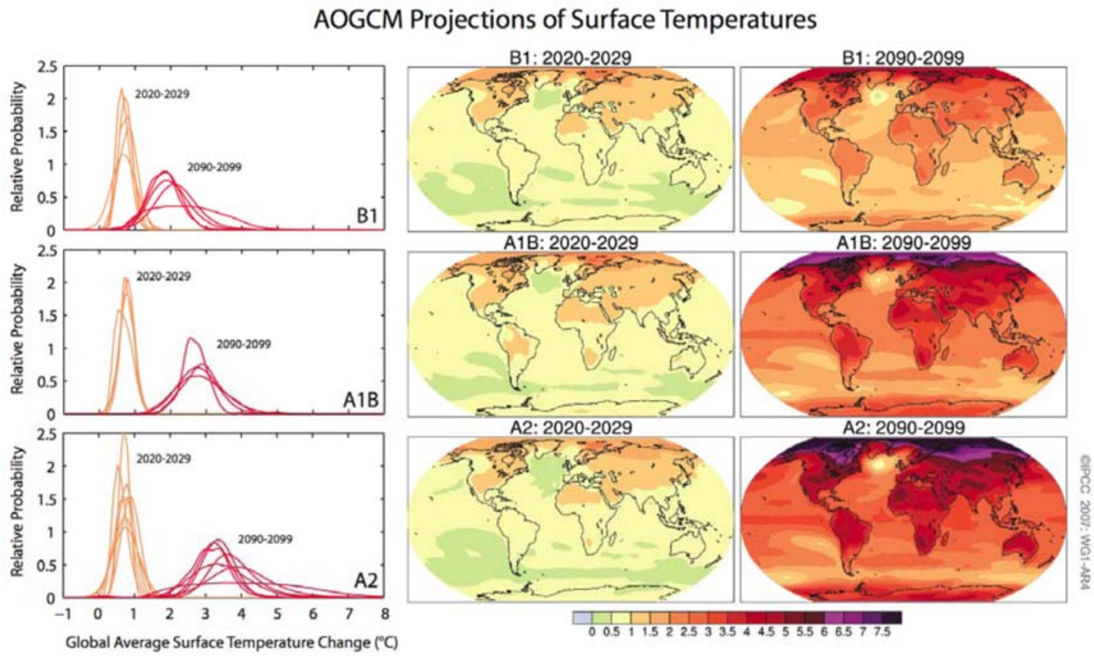

Figure 4: Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the Atmosphere-Ocean General Circulation multi-Model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over decades 2020–2029 (center) and 2090–2099 (right). The left panel shows corresponding uncertainties as the relative probabilities of estimated global average warming from several different AOGCM and EMICs studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves, shown in the lefthand panels, is due only to differences in the availability of results (IPCC 2007a).

Effects of Climate Change

In the words of Yale climate change economist, Robert Mendelsohn, when it comes to the effects of global climate change, "We are not in it together" (Revkin 2007b). The lower latitudes will bare a disproportionate share of the negative effects of climate change, while the higher latitudes will have some significant positive effects that may help balance the negative impacts. This inequality seems particularly unjust when most of the heaviest greenhouse gas emitters will be least impacted, while those who have contributed very little to climate change will suffer the most. Figure 5 summarizes some of the major effects of climate change in different areas of the world.

Africa is one of the most vulnerable continents and is expected to be hardest hit. Water stress is expected to affect between 75 and 250 million people in Africa by 2020. Due to temperature and precipitation changes, land that is suitable for farming is likely to decrease, yields from rain-fed agriculture could be cut in half, and fisheries are expected to decline. These severe impacts combined with the lack of adaptive capacity for most African countries and communities will seriously affect food security and malnutrition (IPCC 2007b).

North America, on the other hand, will be much less adversely affected. By some accounts, high and mid-latitude countries may actually have a net benefit with moderate warming, although even those models predict negative effects as warming becomes more severe (Mendelsohn 2006b). The IPCC predicts increases between 5% and 20% in agricultural yields with moderate climate change in the first few decades (IPCC 2007b). However, regions that are in the warm end of a crop's range or that depend heavily on water resources will face difficult challenges. Due to expected decreases in mountain snowpacks and increased water demand, competition for over-allocated water resources will increase. Forests will likely be adversely affected by pests, diseases and fire. Coastal areas will face severe challenges if tropical storm intensity increases. In cities that are vulnerable to heat waves, the frequency and intensity are expected to increase which will have negative health impacts, especially on the elderly (IPCC 2007b).

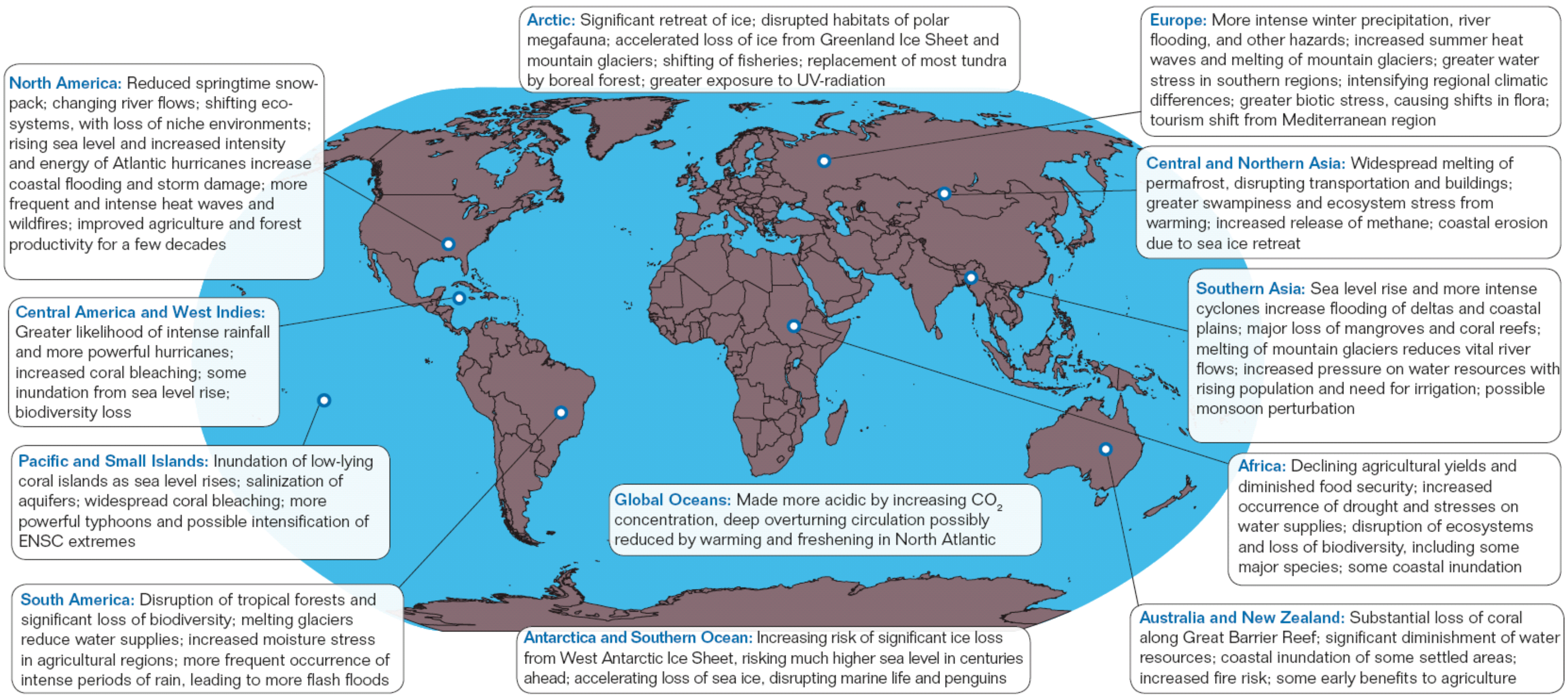

Figure 5: Major impacts of climate change that are likely to occur in the 21st centrury (UN Foundation 2007).

Appendix 2: Greenhouse Gas Emissions Inventories

Carbon Dioxide

Carbon dioxide is the most significant greenhouse gas due to its high concentration in the atmosphere and the large amount that has been added to the atmosphere due to human activity. Before the industrial revolution, carbon dioxide was at a level of 280 ppm (parts per million). The atmospheric concentration has increased 35% to a level of 379 ppm in 2005 (IPCC 2007a, U.S. EPA 2006a). From 1990 to 2004, carbon dioxide emissions have increased by 20% (U.S. EPA 2006a). Fossil fuel use is by far the most significant source of carbon dioxide. Figure 6 details other sources and their quantities of emissions. In terms of end uses in the U.S., the transportation sector creates the most emissions, followed by the industrial sector, the residential sector, and the commercial sector.

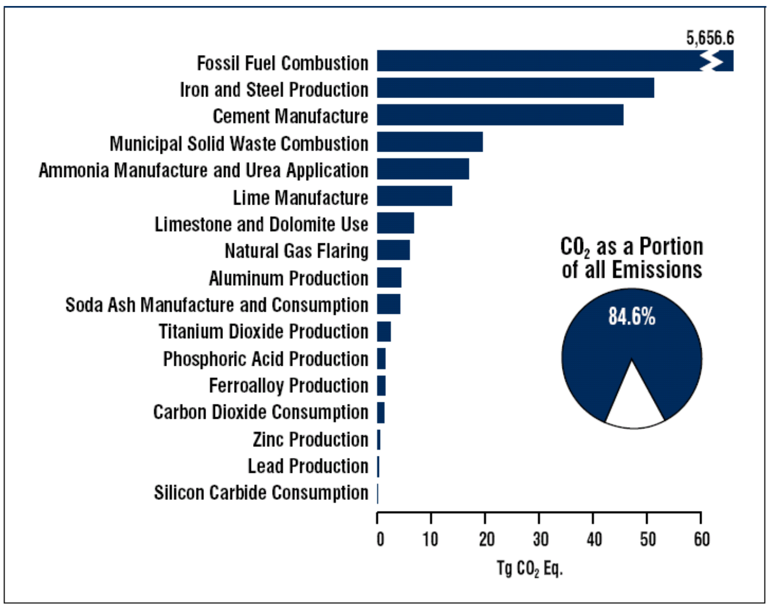

Figure 6: All major sources of carbon dioxide in the United States in 2004 (U.S. EPA 2006a).

Methane

While methane is present in the atmosphere in smaller concentrations than carbon dioxide, it is twenty times more potent per unit as a greenhouse gas (U.S. EPA 2006a). Methane has more than doubled in concentration in the atmosphere from a pre-industrial level of 715 ppb (parts per billion) to the 2005 level of 1774 ppb (148% increase) (IPCC 2007a). Over half of this increase is due to such human activities as the decomposition of wastes in landfills, natural gas systems, and enteric fermentation (cow digestion) (U.S. EPA 2006a). From 1990 to 2004, there has been a 10% decrease in methane emissions. The largest source of methane is landfills, accounting for 25% of methane emissions in 2004. Even as solid waste has increased, the amount of methane emitted from landfills has decreased 18% from 1990 to 2004 due to the increasingly widespread use of methane capture methods. Natural gas emissions have fallen 6% with improvements in technology and the replacement of older equipment. Methane released from cattle operations has declined by 4% due to fewer cows and better feed quality (U.S. EPA 2006a).

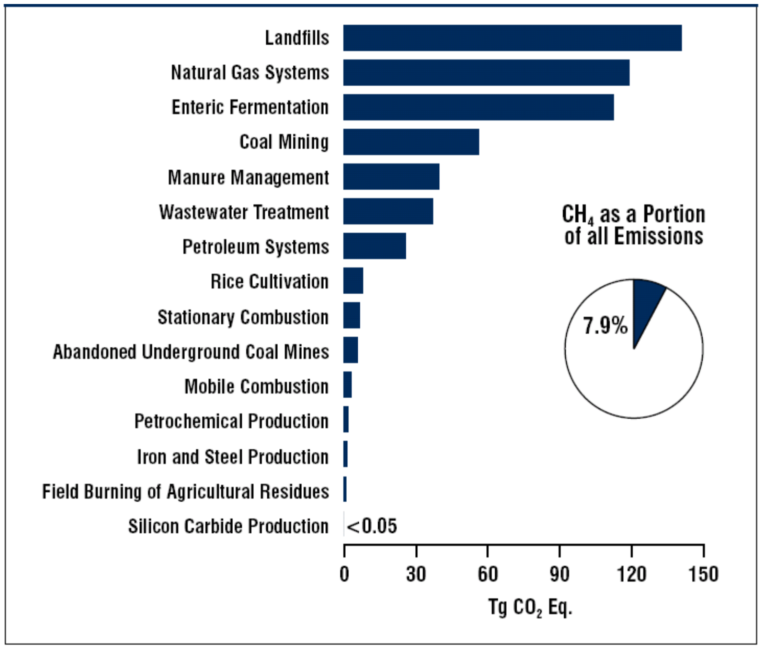

Figure 7: Sources of methane in the U.S. in carbon dioxide equivalence (U.S. EPA 2006a).

Nitrous Oxide

Nitrous oxide is three-hundred times more potent than carbon dioxide as a heat trapping gas (U.S. EPA 2006a). Since pre-industrial times, there has been an 18% increase in the concentration of nitrous oxide in the atmosphere from 270 ppb to 319 ppb in 2005 (IPCC 2007a). From 1990 to 2004, the total U.S. emissions of nitrous oxide have decreased 2%, partially due to new control technologies for mobile combustion that began in 1998. The largest source is agricultural soil management practices such as the use of nitrogen fertilizers and other cropping techniques which accounts for 68% of N_2O emissions. No long-term trend has emerged from agricultural nitrous oxide emissions as it appears that the high sensitivity of emissions to factors such as temperature and precipitation have generally outweighed changes in the amount of fertilizer applied (U.S. EPA 2006a). However, improved management practices such as the targeting of fertilizers, the type of fertilizer, the best time of year for application, and reduced or no tillage farming may reduce nitrous oxide emissions that result from fertilizer use (Mahli et al. 2006, Hao 2001).

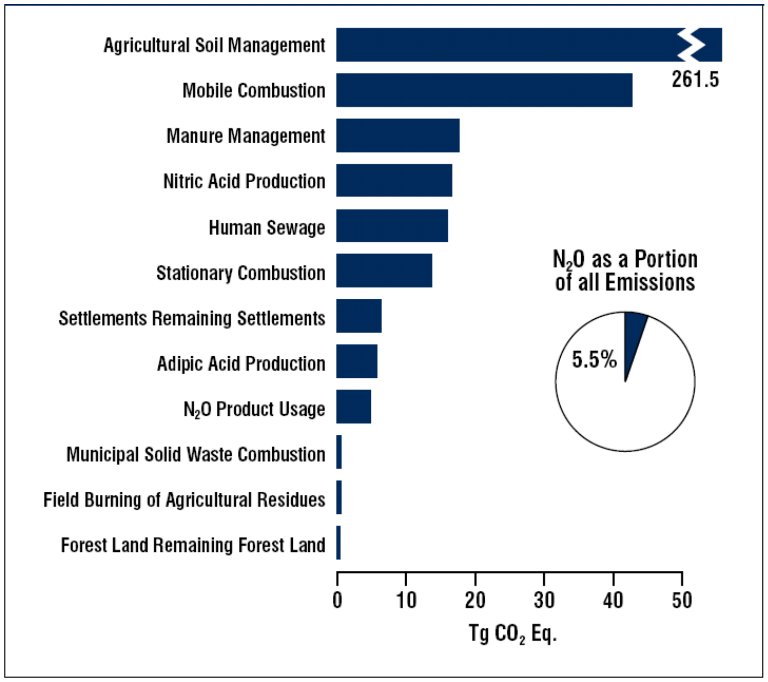

Figure 8: Sources of Nitrous Oxide in the U.S. in carbon dioxide equivalence in 2004 (U.S. EPA 2006a).

Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexachloride

Although this group of greenhouse gases receives much less emphasis than carbon dioxide, methane, and nitrous oxide, they are important contributors to climate change and they are growing in atmospheric concentrations (U.S. EPA 2006a). Hydrofluorocarbons (HFC) are substitutes for ozone-depleting chemicals such as chlorofluorocarbons (CFC) that were largely phased out in the 1990's. Perfluorocarbons (PFC) are generated as a byproduct of semiconductor manufacturing and primary aluminum manufacturing. Sulfur Hexachloride (SF_6) is emitted from electrical transmission and distribution systems. All three of these gases have extremely high global warming potentials, with SF_6 having the highest. PFC and SF_6 remain in the atmosphere for an extremely long time, making their accumulation essentially irreversible. Emissions of these three gases has increased 58% from 1990 to 2004, due largely to the substitutions away from ozone-depleting chemicals.

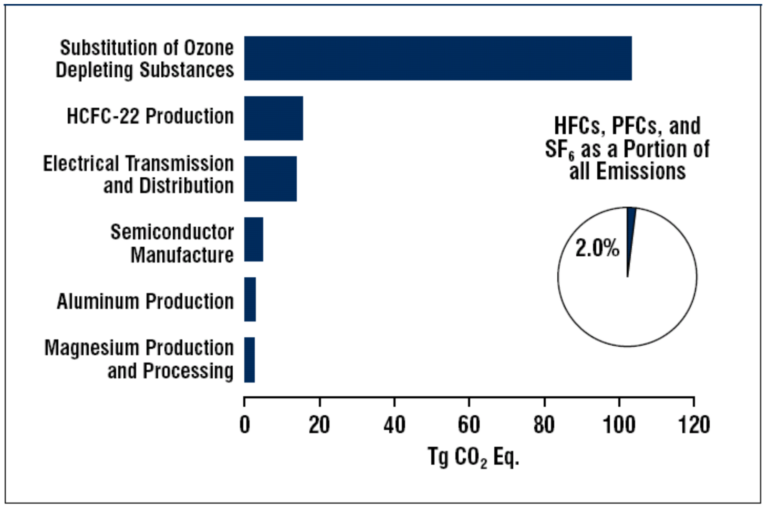

Figure 9: Sources of HFCs, PFCs, and SF_6 in the U.S. in carbon dioxide equivalence in 2004 (U.S. EPA 2006a).

Emissions trends with Economic and Population Growth

While emissions have increased 15.8% from 1990 to 2004, GDP has increased 51% and population has increased 18% (US EPA 2006a).[54] This indicates that emissions per capita have decreased slightly and the emissions per dollar of GDP have decreased rather significantly. Figure 10 shows these trends by normalizing the statistics to the 1990 base year.

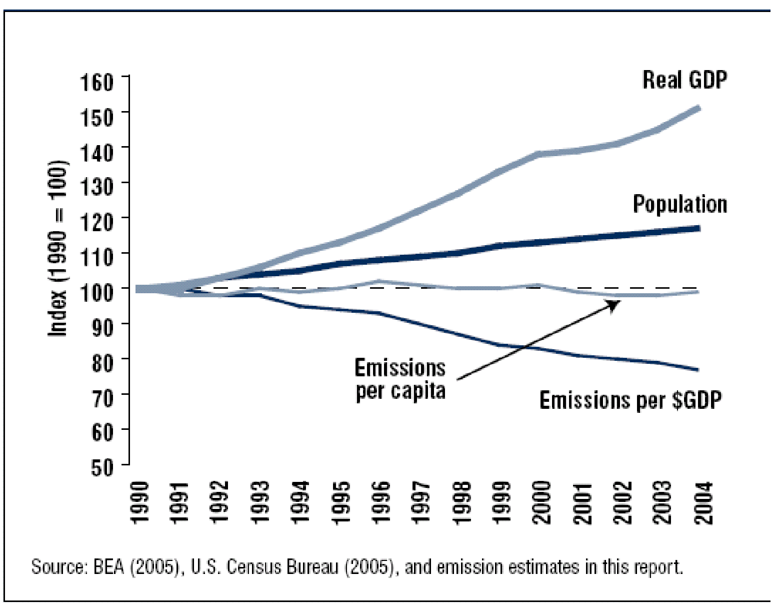

Figure 10: Greenhouse gas emissions, real GDP, and population normalized to 1990 data (U.S. EPA 2006a).

[54] Based on 1990 population estimate of 248,709,873 (U.S. Census Bureau 2004) and 2004 population estimate of 293,638,158 (U.S. Census Bureau 2006). Formula: (293,638,158 - 248,709,873) / 248,709,873.

Kansas Greenhouse Gas Emissions

The last greenhouse gas emissions inventory for Kansas was completed in 1990. The inventory found that 20.8 million metric tons of carbon equivalent (MMTCE) were emitted in 1990. Carbon dioxide accounted for 17.8 MMTCE, methane for 2.1 MMTCE (0.4 million metric tons), and nitrous oxide for 0.09 MMTCE (0.07 million metric tons) (U.S. EPA 2000).

The EPA has developed estimates for carbon dioxide emissions from energy use for each state from 1990 to 2003 (US EPA 2006b). These estimates are based on data from the Department of Energy's Energy Information Administration and emissions factors from the U.S. Emissions Inventory 2006. (This data for Kansas is shown in Table 3.)

The Kansas Department of Health and Environment is considering plans to conduct a new greenhouse gas emissions inventory and has recently joined a multi-state greenhouse gas registry (Hammerschmidt 2007).

	Commercial	**Industrial**	**Residential**	**Transportation**	**Electric Power**	**Total**
1990	3.22	15.96	4.04	19.05	26.85	69.12
1991	3.38	15.53	4.3	17.78	26.98	67.96
1992	3.12	16.37	3.99	17.53	24.39	65.4
1993	3.31	16.2	4.7	17.88	29.63	71.71
1994	3.08	18.1	4.17	16.96	29.67	71.97
1995	3.21	14.62	4.37	18.79	28.63	69.63
1996	3.51	14.83	4.97	18.64	32.87	74.82
1997	2.54	15.81	4.23	18.46	30.65	71.68
1998	2.55	14.12	4.27	18.48	30.3	69.72
1999	2.42	14.05	4.48	19.57	32.15	72.67
2000	2.54	14.15	4.36	18.54	35.12	74.71
2001	2.47	12.82	4.22	17.31	33.8	70.61
2002	2.42	13.35	4.26	17.59	37.11	74.73
2003	2.48	14.19	4.43	19.28	36.95	77.33

Table 3: Carbon dioxide emissions from energy use by sector in Kansas in million metric tons from 1990 to 2003 (U.S. EPA 2006b).

Appendix 3: Environmental Tax Programs

Carbon Taxes Around the World

Following Sweden's lead, Finland, Norway, and the Netherlands enacted carbon taxes. Japan also has a carbon tax (Komanoff and Rosenblum 2007). In 2005, New Zealand made plans to enact a carbon tax of U.S. $10.67[55] per ton of carbon. The tax would have been revenue neutral as the proceeds were to be used to reduce other types of taxes (Hodgson 2005). However, after a new government was elected, it was decided that the carbon tax would not cut emissions enough to justify the costs, so the idea was abandoned (Myer 2005). Quebec will implement a new carbon tax on October 1, 2007 affecting hydrocarbon fuels such as petroleum, coal, and natural gas. The tax is equivalent to about $4.26 per ton of carbon ($1.16 per ton of carbon dioxide) and will add 3.4 cents to a gallon of gasoline (Komanoff and Rosenblum 2007).

U.S. Tax on Ozone-Depleting Chemicals

In response to the growing concern over the depletion of the ozone layer, the United States enacted a tax on twenty different ozone-depleting chemicals in 1989. This tax accompanied a cap and tradable permit system. The rationale behind this was that the cap would cause rising prices that would increase the profits of producers of ozone-depleting chemicals. The increased profits would decrease the incentive to develop alternatives to the harmful chemicals. The tax was designed to capture these "windfall" profits (Anderson 1999, International Institute for Sustainable Development).

The tax was first put into place in 1989 and was revised in 1990 and 1992. By 1995, the tax was $5.35 per pound and was to increase by $0.45 a year thereafter. In order to prevent U.S. companies from falling into a competitive disadvantage from foreign companies that were unregulated, imports were subject to the tax and taxes paid on exports were rebated (U.S. Code Title 26, Sec. 4681).

This program of taxes and caps successfully led to a rapid phase-out of these chemicals (The New Rules Project). In the first year of the tax, consumption fell from 318,000 metric tons in 1989 to 200,000 metric tons in 1990 (Anderson 1999).

BTU Tax

In 1993, President Clinton and Vice President Gore led an effort to enact an economy-wide energy tax based on the heat content, or BTUs, of a fuel. The measure would have included coal, natural gas, liquefied petroleum gas, natural gas, nuclear, hydroelectric, and imported electricity. It was introduced as part of a deficit reduction proposal and was estimated to generate $70 billion between 1994 and 1998. The proposed base rate was 25.7 cents per million BTUs. The Treasury department estimated that the tax would increase manufacturing costs by 0.1%, increase agricultural costs by 0.4%, and impact customers at an average of $110 annually per capita (Bredehoeft 1995).

[55] Conversion rate of USD 1.00 = NZD 0.71. Based on currency conversion rate given by the Bank of New Zealand on April 5, 2007. http://www.bnz.co.nz/Personal_Solutions/1,1184,1-1-122-814,FF.html

Oil companies, aluminum manufacturers, and farmers lobbied heavily against the proposal. Surprisingly, the issue that caused the most division within Congress was on the point of collection of the tax: upstream or downstream. This point affected the equity of the tax, the tax burden, and, most strongly, the administrative costs. This issue cost the support of a key Democrat, vital to its passage. In the end, Congress passed a watered-down version called the Transportation Fuel Tax, which imposed a 4.3 cent tax increase on a gallon of gasoline, diesel, and special motor fuels (Bredehoeft 1995).

Boulder, Colorado

The city of Boulder enacted the nation's first tax on carbon emissions from electricity on April 1, 2007. The tax is approximately equivalent to just $7 per ton of carbon and will cost the average household about $1.33 per month, depending on electricity use (Komanoff and Rosenblum 2007, Brouillard and Pelt 2007). Residents who use renewable energy will receive a discount on the tax. The City of Boulder expects the tax will generate about $1 million annually until it expires in 2012. The revenues will be used to fund the Boulder's climate action plan to further reduce energy use and to come into compliance with the Kyoto Protocol (Kelley 2006).

Appendix 4: Current GHG Emissions Trading Programs

European Union Emissions Trading Scheme

The EU ETS began on January 1, 2005 and included 25 countries. The program began with a "warm-up" phase ending December 31, 2007. During this phase, only carbon dioxide is regulated and only four sectors—iron and steel, minerals (cement, glass, etc.), energy, and pulp and paper—are included in the emissions trading. The second phase will run from 2008 to 2012. Thereafter, phases will run in five year increments. Each country was required to submit an allocation plan for approval by the European Commission to ensure that permit allocation requirements were met. The EU ETS also included guidelines for monitoring and registries largely on a national level. Clean Development Mechanisms and Joint Implementation credits established by the Kyoto Protocol can be converted into allowances suitable for trading. Banking and borrowing is allowed within periods and between periods, with the flexibility for each country to restrict banking between the first and second phases. Finally, penalties for exceeding allowances were set at €40 per ton of CO_2 during the first phase and €100 per ton in the second phase, in addition to requiring the offset of excess emissions in the phase subsequent to the violation (Kruger and Pizer 2004).

The EU ETS functioned successfully until it became apparent that there was surplus of allowances in the first phase. In addition to the 74.1 million metric ton surplus, mild weather also brought down demand for fuel and thus emissions permits. This precipitated a dramatic crash in the price of carbon permits: below €0.30 in May of 2007, compared with €31.50 in April 2006 (Point Carbon 2007a, 2007b). However, 2008 allowances have fared much better. After a crash from a high of €32.15 in April of 2006, prices stabilized around €16.00 per ton (Point Carbon 2007a). As 2008 is the first year of phase two, this bodes well for a major improvement over phase one. Moreover, the market has functioned well with growing liquidity. Even with the price crash, no firms have lost huge sums of money from trading. The European Commission responds to criticism by saying that nothing better could really be expected from a "test phase" (Argus Media 2007a).

Chicago Climate Exchange

The Chicago Climate Exchange (CCX) is a voluntary, but legally binding emissions trading system for all six greenhouse gases. During Phase I, members pay a fee to join the exchange and agree to reduce emissions by 4% relative to a baseline of 1998-2001. Phase II calls for a further reduction of 6%. Members include the states of New Mexico and Illinois, a few counties, and numerous cities (including Melbourne, Australia), businesses, NGOs, universities, and offset providers. The trading prices of the "Carbon Financial Instruments" (CFI) have been rising slowly but steadily since the CCX began. As of April 4, 2007, the closing price was $3.45, compared to $1.00 when the exchange opened in December 2003. Carbon credits are issued for offset projects including methane destruction, agricultural practices, forestry practices, mitigation in Brazil, renewable energy, and Clean Development Mechanisms established in the Kyoto Protocol (Chicago Climate Exchange 2007a).

CCX membership has grown rapidly; in 2006 the CCX grew from 127 to 237 members. Trading volume has also vastly increased—one record day in February 2007 equaled to nearly half of all the trading in 2005 (Chicago Climate Exchange 2007b).

However, critics question whether emissions markets such as the CCX do anything other than create profits for traders and delay real changes that could slow global warming (Hotz 2007). Because CCX membership is equivalent to imposing a tax on oneself, there are obvious incentives not to join. Voluntary action invites "free ridership," meaning that many entities who will join are those that probably would have made those reductions with or without a trading system. Depending on the standards of emissions reporting, it may be possible to establish a baseline which ensures that the required reductions will be met.

Currently, there is the problem of having many more sellers than willing buyers because the majority of members have met their initial emissions reduction targets (Beales 2007). Furthermore, there is a question about the nature of some of the offsets available for purchase: whether they are actually "additional" offsets—those that would not otherwise be undertaken.

Appendix 5: Existing International, National, and Regional Policies

International Policies

Developed in 1997, the Kyoto Protocol is an international treaty designed to reduce greenhouse gas emissions in developed nations. The Kyoto Protocol was ratified by 165 nations. The United States and Australia, while signatories to the Protocol, declined ratification. While the Protocol may have been a first step to reduce global greenhouse gas emissions, it was widely criticized for a number of weaknesses. The Protocol would have reduced global emissions by 0.75% if all countries had ratified it and come into compliance (Shapiro 2007).

One issue was its complete exclusion of certain countries from any reduction in emissions, including those who are major producers of carbon dioxide. While there may be a good argument for excluding poor nations with low GDP per capita such as China, India, Brazil, and Mexico, major producers of greenhouse gases with high GDP per capita such as Singapore, Taiwan, Korea, and Hong Kong were also excluded from emissions reduction requirements. Other wealthy nations such as Qatar, the United Arab Emirates, Kuwait, and Brunei were also exempted from reductions (Shapiro 2007).

The Kyoto Protocol chose 1990 as the year on which to base all reductions in emissions. Because emissions are affected by such factors as economic growth or decline and weather, the base year choice can have a significant effect on the actual emissions reductions required from each nation (Shapiro 2007). For example, economic production in Russia and Eastern European countries peaked in 1990. By 1997, their economies were smaller than it was in 1990, so it was no surprise that their emissions were also smaller (World Bank 2007). Because of the choice of the base year, these countries not only did not need to make any actual reductions, they also had a huge excess of tradable permits. The base year choice also benefited Germany and the United Kingdom; they could increase their current emissions and still meet their goal of 8% below 1990 emissions. Conversely, countries that had experienced major growth since 1990 such as the United States, Ireland, and Scandinavian countries were effectively penalized by the selection of Kyoto's base year. Moreover, countries that had made major reductions before 1990 were also effectively penalized (Shapiro 2007).

Additionally, there were a number of concerns of how the Kyoto Protocol and its emissions trading would affect various aspects of the global economy. With the large reductions required from a few countries and large surpluses in others, substantial emission permit trading would occur between countries. This involves large transfers of wealth between countries—sums that could dwarf current U.S. international aid. This could affect the financial markets by drastically changing the balance of trade between countries which would in turn create increased volatility in exchange rates. Additionally, individual governments would have little incentive to enforce agreed upon limits (McKibben and Wilcoxen 2002). As economist Joseph Kruger bluntly points out, "If oil ministers in corrupt countries pocket oil export revenues, why would they not pocket emissions permits as well" (2005).

While Kyoto still has some strong supporters, it is generally recognized that these major flaws weakened the agreement considerably. Even though Kyoto was heavily flawed and the United States may have been justified in rejecting it, domestic policy to reduce emissions was promised and that promise has not yet materialized (Hayes 2007).

National Policy

While the Bush administration has not been particularly supportive of measures to reduce greenhouse gases, the administration has somewhat changed its tone on global climate change. In an open letter signed by the director of the White House Office of Science and Technology Policy and the chairman of the White House Council on Environmental Quality, the administration acknowledges that "climate change is occurring and humans are contributing to the problem" (Reynolds and Gerstenzang 2007). Additionally, Bush declared that climate change is a "serious problem" in the most recent State of the Union address (Revkin 2007a). While the Bush administration is unlikely to propose serious cuts in greenhouse gas emissions, it is significant that President Bush appears to have shifted his stance on this issue.

There are numerous bills in Congress this session that are related to greenhouse gas emissions. For most of them, the cap-and-trade system is central to the policy. See Figure 11 for a summary of five major senate cap-and-trade bills that were proposed. The "Save Our Climate Act" proposed by Congressman Pete Stark would place a $10 per ton of carbon tax on coal, petroleum, and natural gas and increase $10 per year until carbon dioxide emissions were reduced by 80% (Cohen 2007).

Regional Actions

While national policy is being debated, definitive steps are being taken on a regional and state level to curb greenhouse gas emissions. In February 2007, California, Washington, Oregon, Arizona, and New Mexico established the Western Regional Climate Action Initiative. Although the details of the Initiative have not yet been finalized, it will include a regional goal for emissions reductions, a regional market-based, multi-sector mechanism to reach their reduction goal, and a regional greenhouse gas registry (Western Regional Climate Action Initiative 2007).

The Regional Greenhouse Gas Initiative was launched in 2003 and includes Massachusetts, New Hampshire, Maine, Vermont, Connecticut, Delaware, New York, New Jersey, Rhode Island, and Maryland (Regional Greenhouse Gas Initiative, Maryland Department of Environment 2007). The agreement takes effect in 2009, and by 2019 the states plan to reduce their emissions 10% below current levels (Kaplan 2006). The plan requires each state to auction at least 25% of their permits and use that revenue to contribute to public benefits funds. Four states (Massachusetts, New Jersey, New York, and Vermont) plan to auction 100% of their permits (Argus Media 2007b). Currently, the initiative is only addressing carbon dioxide from the electrical power sector, but it may be expanded to include additional greenhouse gases and sectors (Kruger 2005).

Cities have also been joining forces to reduce carbon dioxide by becoming "Cool Cities" in an initiative sponsored by the Sierra Club. The U.S. Mayors Climate Protection Agreement has been signed by mayors in 49 states. Each signatory pledges to reduce carbon dioxide emissions to 7% below their 1990 levels (Sierra Club 2006a). Kansas has two "Cool Cities": Lawrence and Topeka (Sierra Club 2006b).

Bill	Scope of Coverage	2010-2019 Cap	2020-2029 Cap	2030-2050 Cap	Offsets	Allocation	Other Cost Controls	Early Action	Technology and Misc.
Bingaman Discussion draft As evaluated by EIA on 1/11/2007	All 6 GHGs Economy-wide, upstream	2.6%/year reduction in emissions **intensity** from 2012-2021	2.6%/year **intensity** reduction from 2012-2021. 3%/year **intensity** reduction starting 2022.	3.0%/year reduction in emissions **intensity** starting in 2022.	5% set-aside of allowances for agricultural sequestration	Increasing auction: 10% in 2012; 20% in 2021; 65% in 2044. Some sectors' allocation specified; 29-30% to states.	\$7/ton CO_2 "safety valve," increasing 5%/year (adjusted for inflation) *Safety valve projected to be triggered in 2026, causing emissions to continue to rise.*	From 2012-2021, 1% set-aside of allowances	Funds and incentives for technology R&D. Target subject to 5-year review of actions by other nations.
Feinstein-Carper S.317 Introduced on 1/17/2007	All 6 GHGs Electricity sector, downstream	2006 level in 2011. 2001 level in 2015, 1%/year reduction from 2016-2019.	1.5%/year reduction starting in 2020 (may be adjusted by Administrator)	1.5%/year reduction starting in 2020 (may be adjusted by Administrator)	Certain categories of bio seques and industrial offsets; 5% limit on forest mgmt; 25% limit on intl.	Increasing auction: 15% in 2011; 60% in 2026; 100% in 2036. Output-based allocation to generators.	If economic harm, potential for borrowing and/or increased intl offsets. Borrowing of offsets.	Credit for reductions from 2000-2010, limit 10% of cap	Funds for tech R&D, habitat protection, and adaptation. Bills expected on industry, efficiency, fuels, and vehicles.
Kerry-Snowe Introduced on 2/1/2007	All 6 GHGs Economy-wide, point of regulation not specified	2010 level in 2010	1990 level in 2020. 2.5%/year reduction from 2020-2029.	3.5%/year reduction from 2030-2050. 65% below 2000 level in 2050. *(Equivalent to 60% below 1990 level in 2050.)*	Not specified	Determined by the President	Not specified	Goal to "recognize and reward early reductions"	Funds for tech. R&D, consumer impacts, adaptation. Standards for vehicles, efficiency, renewables.
McCain-Lieberman S.280 Introduced on 1/12/2007	All 6 GHGs Economy-wide, large sources downstream, fuels upstream	2004 level in 2012	1990 level in 2020	20% below 1990 level in 2030. 60% below 1990 level in 2050.	30% limit on use of intl credits and domestic reduction or seques offsets	Administrator determines; considering consumer impact, ability to pass through costs, competitiveness, etc.	Borrowing for 5-year periods with interest	Credit for reductions before 2012	Incentives for advanced tech., adaptation, transition assistance
Sanders-Boxer S.309 Introduced on 1/15/2007	All 6 GHGs Economy-wide, point of regulation not specified	2010 level in 2010. 2%/year reduction from 2010-2020.	1990 level in 2020	27% below 1990 level in 2030. 53% below 1990 level in 2040. 80% below 1990 level in 2050.	Not specified	Cap and trade permitted but not required. Allocation criteria include transition assistance and consumer impacts.	"Technology-indexed stop price" freezes cap if prices high relative to tech options	Not specified	Standards for vehicles, power plants, efficiency, renewables

Figure 11: Greenhouse Gas Cap-and-trade Senate Bills in the 110[th] Congress (Pew Center on Global Climate Change 2007c).

Appendix 6: Existing State Policies

States are implementing a huge variety of policies that run the gamut of energy issues from renewable energy to GHG emissions caps. More often then not, Governors have been taking the lead on these issues by setting goals and creating climate action plans. The following section summarizes some of the legislative and executive efforts of the states.

Greenhouse Gas Emissions Reduction Targets

Fourteen states have adopted emissions reduction targets, most using 1990 as the base year, mimicking the Kyoto Protocol reduction targets.[56] While goals are important to set the framework for policy development, they are not an end in and of themselves. Setting goals is the easy part, but the challenge is enacting the policies that must be put into place to reach those goals.

	Short-term Goal*	Mid-Term Goal*	Long-Term Goal*
Arizona		2000 levels	50% below 2000 levels
California	2000 levels	1990 levels	80% below 1990 levels
Connecticut	1990 levels	10% below 1990 levels	75-85% below 2001 levels
Illinois		1990 levels	60% below 1990 levels
Massachusetts	1990 levels	10% below 1990 levels	75-85% below 2001 levels
Maine	1990 levels	10% below 1990 levels	75-80% below 2001 levels
New Hampshire	1990 levels	10% below 1990 levels	75-85% below 2001 levels
New Jersey		1990 levels	80% below 2006 levels
New Mexico	2000 levels	10% below 2000 levels	75% below 2000 levels
New York	5% below 1990 levels	10% below 1990 levels	
Oregon	Stabilize	10% below 1990 levels	75% below 1990 levels
Rhode Island	1990 levels	10% below 1990 levels	
Vermont	1990 levels	10% below 1990 levels	75-85% below 2001 levels
Washington		1990 levels	50% below 1990 levels

Table 4: Greenhouse gas emissions targets set by each state (Pew Center on Global Climate Change 2007a).[57]

The Transportation Sector

After the Supreme Court decision on Massachusetts v. EPA clarified the legal responsibilities of the EPA to regulate carbon dioxide under the Clean Air Act, California was permitted by the EPA to move forward with their new greenhouse gas emissions

[56] See discussion of problems with the 1990 date on p. 56.

[57] *Short term goals are by 2010 in all cases except New Mexico which uses 2012. Mid-term goals are by 2020. Long-term goals are by 2040 for Arizona, 2050 for California, New Jersey, New Mexico, Oregon, and Washington; the remaining states did not define a year to meet the long term target.

standards from mobile sources (Young 2007). These new regulations apply to passenger vehicles and light duty trucks beginning with the 2009 model year and are supposed to "achieve the maximum feasible and cost-effective reduction in greenhouse has emissions from motor vehicles." The standards address all greenhouse gases produced by vehicles (CO_2, CH_4, N_2O, and HFC) by focusing on technology advances such as improving valves, transmissions, and air conditioning systems, and turbocharging to boost power while reducing engine size. GHG emissions are to be reduced by 22% for 2012 model years and 30% by 2016 model years. These improvements will add to the initial cost of the vehicle, but when the savings in operating costs are factored in, an average monthly savings of $3.50 to $7.00 is expected (California EPA Air Resources Board 2004).

There are a dozen additional states that plan to adopt the standards set by California: New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Vermont, Maine, Washington, Oregon, New Mexico, and Arizona. If all of these states adopt California's standards, then over one third of the U.S. automobile market will be subject to the standards (Fialka 2007b).

States have also focused heavily on renewable fuels. Twenty-four states, including Kansas, currently provide incentives for ethanol fuels. Seven states have renewable fuel standards requiring a certain percentage of the motor fuel sold in their state to come from renewable sources such as ethanol. Iowa has the highest standard at 25% (Pew Center on Global Climate Change 2007d).

The Building Sector

During the 2007 legislative session, Kansas upgraded its standard for commercial and industrial buildings to the 2006 IECC standards (though the law does not provide any enforcement mechanism). Although thirty-six states have energy efficiency residential building codes, Kansas currently does not mandate them statewide. However, a disclosure form is presented to new home buyers which provides information on the energy efficiency features of the new home compared to the 2006 IECC standards.

Kansas has been recognized for excellence for its energy savings contracting program, known as the Facility Conservation Improvement Program (FCIP). Governor Sebelius has directed the state to use the FCIP to make improvements in all of its state-owned buildings by 2010.

Two green building standards—the Leadership in Environmental Design (LEED) and Green Globes–are required or recommended for new state-owned buildings in some states. Thirteen states require LEED certification; three states recommend them (Pew Center on Global Climate Change 2006a).[58]

A number of states have also sought waivers from the U.S. Department of Energy to establish minimum efficiency standards for appliances that are not covered by federal standards. California, Washington, Arizona, Maryland, New Jersey, Connecticut, Rhode Island, and New York have set efficiency standards for various products. Rhode Island

[58] Washington, California, Nevada, Arizona, New Mexico, Colorado, Hawaii, Wisconisn, Michigan, Maine, Connecticut, Rhode Island, and Maryland require new state-owned building to be LEED certified and New York, New Jersey, and Arkansas recommend them to be LEED certified.

has the largest number of standards, covering twenty-one products. Savings in energy costs resulting from the standards are estimated to be between $284 million (New York) to $3 billion (California) over the next 15 years (Pew Center on Climate Change 2006d).

The Energy Sector

States have adopted different kinds of policies to encourage renewable energy and energy efficiency in the electricity sector. These include public benefit funds, net metering, green pricing, renewable portfolio standards, and other mandates.

Renewable portfolio standards are in place for twenty-four states and the District of Columbia (Pew Center on Global Climate Change 2007b). While Kansas does not have an official RPS, Governor Sebelius set a goal to have 10% of the State's total nameplate capacity from wind power by 2010 and 20% by 2020, which could be considered an informal RPS.[59]

Public benefits funds are financed by small charges on utility bills or direct payments from utility companies (which are passed on as costs to the consumer) that support energy efficiency programs and projects, renewable energy development, or both. Twenty-three states have public benefits funds (Pew Center on Climate Change 2006e).

Net metering is a program for customers who produce some of their own energy through solar panels or wind turbines to pay only for the net amount of energy they use from the grid – what they use minus what they produce. Thirty one states require net metering, and eight additional states have utilities that offer net metering (Pew Center on Climate Change 2006b). Kansas does not require net metering, but requires utilities to pay customers who have renewable energy generation systems 150 percent of the utility's monthly system average cost of energy per kilowatt hour for the any additional energy they have to sell (K.S.A. 66-1,184).[60]

Green pricing is a policy that allows customers the option of paying a premium for renewable energy. Five states (Washington, Montana, Minnesota, Iowa, and New Mexico) mandate green pricing statewide, and thirty-four additional states have utilities that offer green pricing (Pew Center on Climate Change 2005). In 1999, Westar offered its Kansas customers green pricing for $0.05/kWh. The program was discontinued because of low participation.[61]

Energy Efficiency Resource Standards (EERS) apply to the efficiency of energy generation, transmission, and use of electricity and natural gas. Energy savings targets are set and can be met through improvements or through a market-based trading system. These standards can include end-use improvements, distribution system efficiency, combined heat and power systems, and efficient distributed generation systems. California, Nevada, Colorado, Texas, Pennsylvania, Connecticut, and Vermont currently

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[59] Nameplate capacity is the maximum capacity of a generator.

[60] Unless the renewable generation capacity is more than 200 kilowatt hours in which case 100 percent of the utility's monthly system average cost of energy per kilowatt is reimbursed to the energy producing customer.

[61] Personal communication with Dr. John Cita and Dr. Robert Glass, staff economists of the Kansas Corporation Commission.

have EERS, and New Jersey and Illinois are in the process of putting them into place (Pew Center on Global Climate Change 2006c).

Nine states have goals for the state government to purchase a portion of their energy from renewable sources ranging from 6% to 100% of the state government's total energy use: Connecticut (100% by 2050), Iowa (10% by 2010), Illinois (15% by 2020), Maryland (6%), Maine (50%), New Jersey (10%), New York (20% by 2010), Pennsylvania (20%), and Wisconsin (20% by 2011) (Pew Center on Global Climate Change 2006f).

Five states require power plants to either cap GHG emissions or have offset requirements for emissions. California has an emissions cap on electricity producers and will have caps on natural gas utilities in the future. Massachusetts has caps for six of their older fossil fuel plants and requires new plants to offset 1% of their carbon dioxide emissions. New Hampshire caps emissions from existing power plants at 1990 levels. Oregon requires new power plants to offset 17% of their emissions, and Washington requires a 20% offset (Pew Center on Global Climate Change 2006g).

Appendix 7: Support for Mandatory Greenhouse Gas Reductions

Many large corporations have publicly announced support for climate change policy. Energy groups, businesses, economists, politicians, evangelicals, and the rest of the general public are showing a stronger support than ever for mandatory reductions in greenhouse gases. When such a diverse group of unlikely members from Wal-Mart to DuPont comes together, it leads one to wonder whether Jim Rogers, the CEO of Duke Energy might be right when he says, "We are going to address this issue and it is the right time" (Watts 2007, Timiraos 2007).

Businesses and Industry

Businesses that believe mandatory controls on GHG emissions are inevitable are coming out in support for these controls. Uncertainty makes investment and other business decisions more difficult to make, and the sooner these controls are established the less uncertainty they will face. In addition, states are creating a huge variety of emission control policies. When faced with the choice of federal policy and state policy, federal action is much easier to comply with than a patchwork of state actions, so they are finding it in their advantage to support national policies. Moreover, if they endorse controls early on, they are more likely to have a voice in how the policy is crafted (Fialka 2007a).

However, the fact that businesses may be working in their best interests by supporting mandatory controls does not necessarily mean they are trying to create a soft policy that does little to truly make a dent in U.S. greenhouse gas emissions. The United States Climate Action Partnership (USCAP), comprising businesses and environmental groups, has put forth a comprehensive policy proposal (Resources for the Future 2006).[62] Another partnership currently developing is the U.S. Climate Policy Forum, which will attempt to provide policymakers with detailed policy options through discussions with the think tank, Resources for the Future, and twenty-five companies from "auto manufacturers, electric utilities, oil and gas producers, and transportation and chemical industries, as well as large energy consumers and insurance, technology, and financial services firms" including Exxon Mobil and Chevron (Resources for the Future 2006, Dinesh 2007).

However, not all industry leaders are enthusiastic about mandatory policies on GHG emissions. Although ConocoPhillips and General Motors recently joined USCAP and BP America was a founding member, other oil companies as well as automakers are not supportive of mandatory emissions reductions. The American Iron and Steel Institute and The National Association of Manufacturers have also come out against an emissions cap (Selko 2007).

[62] United States Climate Action Partnership 2007. Members include: AIG, ConocoPhillips, BP, General Electric, Alcoa, Caterpillar, Duke Energy, DuPont, FPL Group, Lehman Brothers, PG&E, PNM Resources, General Motors, Environmental Defense, Natural Resources Defense Council, Pew Center on Global Climate Change, and World Resources Institute

Public Opinion

With increased media attention and the impact of Al Gore's documentary, *The Inconvenient Truth*, public awareness of and concern about global climate change has increased. A survey by the Yale Center for Environmental Law and Policy found that 83% of Americans felt that global warming is a serious problem, up from 74% two years ago (2007). In addition, the survey found that 63% of Americans agreed that the country "is in as much danger from environmental hazards such as air pollution and global warming as it is from terrorists" (Yale Center for Environmental Law and Policy 2007).[63] However, when the public is asked questions about higher costs associated with emissions control strategies, the polling results take a definitive turn. For example, an ABC News/Time/Stanford University Poll found 85% of respondents believed global warming is already occurring, 83% said they felt it was a serious problem, and 68% believed the government should do more to deal with global warming. But when asked whether taxes should be increased on electricity and gasoline, only 19% and 31%, respectively, said they would favor such a measure to reduce global warming. Requiring by law or encouraging (through tax breaks) automakers, power plants, and other manufacturers to produce more efficient products and reduce greenhouse gas emissions was much more popular, with the combined support for each over 80% (ABC News/Time/Stanford University 2006).[64]

Public support for various initiatives reveals a preference for policies that hide costs, such as tax breaks or emissions caps, over policies that have transparent costs like a GHG tax. In the end, policies with hidden costs are likely to cost the public more money through higher product prices, higher overall taxes, or decreases in other public services like education and health care. In order to truly evaluate public opinion on how to address the issue of global warming, the public needs to be better informed about the true costs of the options. Deliberative polling, in which randomly selected citizens participate in multi-day informational sessions with opinion polling to determine their actual concerns, is one effective way to do this (Rabe 2002).

[63] N = 1,000 adults nationwide. Margin of Error ± 3.1%
[64] N=1,002 adults nationwide. Margin of Error ± 3%

Appendix 8: Executive Directive 07-373

EXECUTIVE DIRECTIVE NO.07-373
Energy Conservation And Management

By virtue of the authority vested in the Governor as the head of the Executive Branch of the State of Kansas, the following actions are hereby directed:

There is no more effective or environmentally appropriate way to address energy shortages, increasing costs, air pollution and climate change than using less energy. Therefore, energy efficiency and conservation will be priorities of this administration for the next four years. While some Kansas energy conservation efforts are nationally recognized as best practices, there is much more that must be done. Good leadership requires good stewardship. The following initiatives will provide the foundation of a vigorous efficiency and conservation effort that will place Kansas State Government at the forefront of appropriate and effective energy and environmental practices.

First, I am directing the Department of Administration, in cooperation with the Kansas Energy Office and the Energy Steering Committee, to conduct a survey of all state employees requesting energy saving suggestions specific to their agency, or to the whole of state government. I fully expect to expand the issues outlined in this document based on suggestions from the workforce. My goal is to complete the survey by July 1,2007.

2. I am directing the Department of Administration to adopt a policy to require an energy audit on any facility being considered as leased space and require the landlord to either make the necessary improvements on the property or make them a condition of the lease before it is executed. Further, I am directing the Department of Administration to collect energy data associated with state-owned and leased space and identify locations appearing to use excessive energy.

3. I am directing the Department of Administration and the Kansas Corporation Commission to immediately initiate an evaluation of the advantages for the State to become a member of the Chicago Climate Exchange (CCX). The CCX membership would require a commitment on the part of the state to reduce carbon dioxide emissions to an agreed upon goal through energy conservation practices and/or the increased use of clean and renewable sources of energy. Failure to meet agreed upon goals would result in financial penalties.

4. I am directing the Department of Administration to take necessary measures to assure that the average EPA mileage rating for automobiles purchased in 2010 is at least 10% higher than the 2007 average.

5. I am directing the Department of Administration negotiate the next contract with an auto leasing company to assure that the average EP A mileage rating for cars provided under the 2010 lease is at least 10% higher than the average for cars provided under the current lease.

6. I am directing the Department of Administration to review its purchasing practices to assure 100% compliance with existing requirements related to energy conservation and to develop or increase standards for such products as appliances, light bulbs, and computers using Energy Star© as a minimum standard.

7. I am directing that all computers not having a technical or operational need, be turned off at work stations when not in use for a period of four or more hours.

8. I am directing the Department of Administration to establish an Energy Auditor position charged with oversight of the initiatives set out in this order. The Auditor shall submit an annual status report to the Governor and present the report to the Governor's Cabinet at a special meeting focused on energy conservation at least once a year. The Auditor shall be a professional architect or engineer with experience in energy/utility management.

9. I am pleased that the Department of Health and Environment has initiated a recycling program in state government. Currently only a few buildings are participating and I am directing the KDHE and the Department of Administration to expand that program to every state office by December 2007.

10. I am directing the Department of Revenue to include information on fuel efficiency in the operation of vehicles and include questions on this topic in the examination for all classes of operator licenses.

11. Kansas is recognized by other states as having one of the best energy savings performance contracting programs in the country, known as the Facilities Conservation Improvement Program (FCIP). The Kansas Corporation Commission's Energy Office has facilitated the implementation of energy efficiency improvements in nearly half of the 40 million square feet of state-owned buildings. These improvements not only pay for themselves with reduced energy bills, but significantly reduce the emission of greenhouse gases. I expect to implement improvements in the remaining state-owned buildings by December of 2010.

12. The FCIP is also available to local governments and school districts and some have utilized the program. I am directing the Kansas Energy Office to accelerate efforts to market the FCIP to school districts and local governments. Kansas taxpayers should not be paying the bill for wasted energy in any of our public institutions.

13. I will request the legislature to require the Kansas Energy Office review all state construction projects, both new and remodeling, that exceed $100,000 for possible inclusion in the FCJP. This will include Regent's facilities. I will oppose any funding for deferred maintenance that is not subject to this requirement.

THE GOVERNOR'S OFFICE