Executive Summary

This report summarizes key economic issues surrounding climate change legislation and regulation and considers potential implications for Nebraska, a state with a large agricultural sector and a focused manufacturing industry. The key findings are listed below.

- While economic theory supports the imposition of taxes or other costs on polluters, effective policy requires the choice of an appropriate tax. Choice of an appropriate tax can be difficult in the case of greenhouse gas emissions because there is uncertainty about the economic costs of these emissions. There are two sources of uncertainty. First, there is uncertainty about the magnitude of the manmade contribution to global warming. Second, there is uncertainty about the extent to which global warming will harm the economy.
- The public may still choose to regulate and reduce greenhouse gas emissions in order to reduce the risk of a severe economic outcome. However, when making such a decision, there is a need to understand the economic cost of climate change legislation or regulation.
- For our analysis, we used the example of two recent climate change bills in the United States House of Representatives (Waxman-Markey) and in the United States Senate (Kerry-Lieberman). Our review of literature and analysis found that these examples of cap and trade legislation would be most likely to lead to an approximate 2% reduction in U.S. GDP by the year 2030 relative to a reference scenario without climate change legislation. Losses in U.S. GDP may be less severe in the decades leading up to 2030, but would remain severe after 2030. The magnitude of the GDP loss could be less if there is a rapid adoption of new nuclear or renewable power capacity.
- Retail electric prices also are expected to rise by 30% to 70% by 2030 under climate change legislation. The manufacturing sector will be especially hard-hit, with a 5% to 7% decline in industrial output and manufacturing employment.
- The economic consequences may be more muted in Nebraska given that the state is less dependent on the type of energy-intensive, internationally competitive

manufacturing sectors that are expected to be hardest hit by increases in energy prices. Nebraska also has a large agricultural sector that could be just lightly affected if it is exempted from regulation and would benefit from the opportunity to sell carbon offsets. However, it is uncertain as to whether these conditions would prevail.

Table of Contents

List of Tables and Figures

Chapter 1: Introduction

While the future of climate change policy in the United States is far from clear, it is fair to say that there has been a lively and active debate on the subject over the last decade, and even proposed legislative changes at the national and state level. For example, several versions of climate change legislation were introduced in either the U.S. Senate or U.S. House of Representatives during the 111th Congress. No version of climate change legislation became law, but the magnitude of the efforts during the last Congress suggest that our country will continue to debate potential approaches to limiting greenhouse gas emissions in the years to come. Future legislation is likely to be proposed, and, while political support for large-scale regulatory efforts may have waned in Washington, potential for regulatory action exists even in the near term. Specifically, the Environmental Protection Agency also has considered directly regulating carbon emissions. Enactment of such legislation or EPA action would have consequences for the national and Nebraska economies. Further, there are active efforts in many states to mandate renewable power use, a practice that would have many of the same economic features as the climate change legislation recently considered in Congress.

This document is an effort to summarize key economic issues surrounding climate change and consider the potential implications of climate change legislation or regulation for Nebraska. We begin with a discussion of economic theory and principals that pertain to climate change regulation (or air pollution in general). Such a theoretical discussion by its nature would reveal criteria for identifying an economically efficient approach to addressing externalities (i.e., pollution) from greenhouse gas emissions. We also consider difficulties in measuring the magnitude and timing of any costs to the economy from greenhouse gas emissions. Measuring the characteristics of external costs is an obvious first step in designing an economically efficient policy response.

We then consider the concrete proposals that have been developed to regulate greenhouse gas emissions. We consider the impact on the economy from legislation introduced in both the U.S. House of Representatives and the U.S. Senate during the 111th Congress. This legislation did not become law, but it provides a useful framework in which to consider the national economic consequences from a cap and trade system to reduce greenhouse gas emissions. Specifically, we review analyses that have been conducted by the U.S. Department of Energy's Energy Information Administration (EIA), as well as by private companies and business associations. We consider the consequences of regulation on a number of key economic variables such as energy prices, carbon prices, gross domestic product, and industrial production. In our analysis, we place an emphasis on the impacts of legislation or regulation on the electric power generation, agriculture, and manufacturing sectors. Following the planned scope of our study, we spend less time considering the specific impacts of climate change legislation and regulation on the transportation sector (although such impacts are included in some of the aggregated economic impacts we identified in the literature).

Part of the reason for our interest in manufacturing and agriculture is that we also examine the potential economic consequences of climate change legislation or regulation on the Nebraska economy. Nebraska has a large and active agricultural sector that will face energy and input cost increases under climate change legislation, but will also have substantial potential to provide offsets for greenhouse gas emissions. Further, Nebraska's mix of energy producing assets is different than the national average, so that the impact on utilities and energy prices may differ as well. Nebraska also has a lower concentration of the types of heavy industries that will be most disadvantaged competitively by climate change legislation.

Chapter 2: Economic Theory

This chapter considers the consequences of climate change legislation and regulation from an economics perspective. We examine the basic economic issues related to pollution externalities, i.e., the types of pollution that sometimes accompany the production process and may impact other members of society. We then consider issues regarding the measurement of external costs for the case of greenhouse gas emissions, that is, the extent to which these costs can be defined and measured. We conclude by examining a variety of points of emphasis from the analysis. For example, the issue of discounting, or the process of putting the costs and benefits of future events back into current terms. This is an important issue in the case of a type of pollution that will have effects over the very long term. Another point of emphasis is the issue of policy coverage. In other words, what are the economic consequences when a regulatory policy is imposed on only a portion of the market? This is relevant in the case of U.S. climate change legislation and regulation to the extent that new regulation primarily will be imposed in the United States.

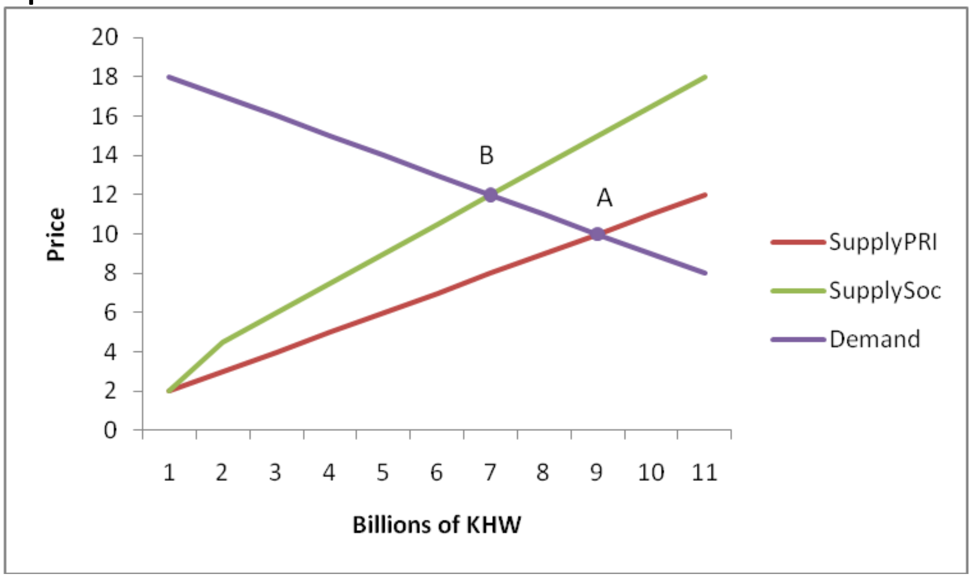
A. Basic Theory

An externality is generated when a transaction that occurs between a buyer and seller also impacts a third party. In the case of a negative externality produced by the activity of a seller (we will use the term externality to imply negative externality in this report), the seller typically does not consider the costs being imposed on a third party. Therefore, the price at which the seller is willing to supply a good or service does not consider the full costs to society. The full social costs would include both the private production costs and these external costs. This situation is illustrated below in Figure 2.1, which shows both the private supply curve and the social supply curve for a seller who produces and sells a good that also generates a negative externality during the production process. Assume the example in Figure 2.1 represents U.S. electricity production. Electric power producers generate power using a variety of fuels and technologies, but many modes of generation also create pollution that impact households located around the country. In this example, the electric power plant is the supplier, regional households, commercial businesses, and industrial firms are the customers, and the third party is households throughout the nation who face more pollution. The private supply curve for the electric power producer reflects the private costs for producing electric power, such as labor costs or the costs of purchasing fuel. The social supply curve reflects these private costs as well as the cost imposed on the third party: the households who face greater pollution. Note that in the example in Figure 2.1, these pollution costs rise faster than the cost of electricity generation, so the difference between the social supply curve and the private supply curve grows over time (Van den Berg, 2011(forthcoming)). This could occur if the externality costs of pollution grow rapidly as the pollution concentrates.

Left on its own, the electric power generating industry would choose to produce at the point A. This is the price where the private supply curve meets the demand curve. However, if the private producers are required to consider the costs imposed on the third party (i.e., if these external costs are "internalized" through some mechanism, such as a tax on production), then the private producers will supply electric power according to the social supply curve and will choose point B where the social supply curve meets the demand curve. Note that the quantity of electricity produced is lower and the price is higher in the social equilibrium (point B) compared to the private equilibrium (point A). Internalizing externalities from production raises prices and also reduces the quantity produced, though both production and pollution continue at this lower, economically efficient level.

Lower levels of electricity production also may imply changes in the output of the economy. Faced with higher prices, segments of the economy that utilize electricity, such as households, commercial businesses, and industrial businesses, may reduce the quantity of electricity they demand through adopting more energy efficient practices. For example, some households may switch to energy-efficient appliances, while some commercial businesses switch to energy-efficient lighting, and a manufacturing firm uses an energy audit to produce in a more energy-efficient manner. This switch may reduce electricity consumption, but also may raise costs and limit sales for these businesses. Business sales and activity also may decline to the extent that businesses curtail energy use simply by producing less of their own goods and services. In other words, the output of the economy would decline along with inputs into production, including labor. This is the often-stated concern that efforts to reduce pollution in electric power generation will raise energy prices and lower the output of the economy.[1]

Figure 2.1
Equilibrium Production and Price With and Without Internalized Costs of Pollution



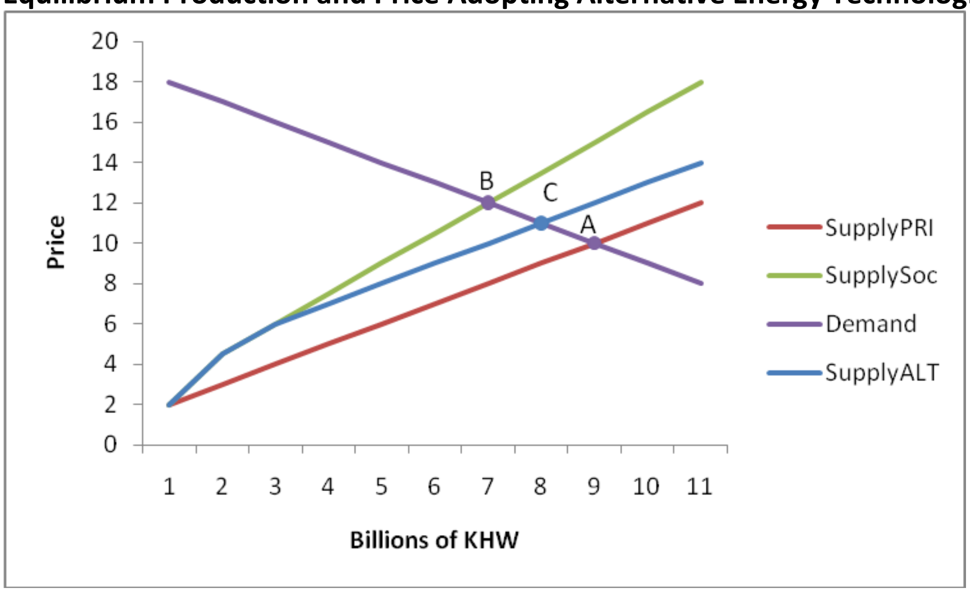
The loss in economic activity, however, could be less if alternative technologies exist that can generate electric power without also generating pollution. In particular, electric power producers may find that it is less costly to adopt this non-polluting method of power generation. This alternative method would be more expensive (otherwise, it would have been chosen initially), but could be less expensive than the combined cost of generating electricity with the existing technology and paying a tax equal to the social cost of pollution.

This situation is depicted in Figure 2.2. In Figure 2.2, as the zero pollution technology is adopted, the new private supply curve is the equivalent of the new social supply curve (since there is no pollution externality). This private supply curve using the alternative, non-polluting

[1] Note that social welfare would still be higher at point B even if the measured output of the economy declines. This is because households would face fewer negative impacts from pollution (such as negative impacts on health), which would raise the quality of life. Further, there may be other, positive impacts on measured economic output; for example, a healthier population may miss fewer days of work due to illness.

technology is the curve SupplyALT. SupplyALT intercepts the demand curve at point C. Point C represents a higher level of electricity generation and a lower price than point B. The more modest increase in energy prices and the more modest decline in electricity production would reflect a more modest decline in the output of the economy and related concepts, such as employment. The amount of pollution also would decline much more than at point B given that a large share of electric power would now be produced using the non-polluting technology. An outcome such as point C would therefore be preferable to point B. But, the key issue is whether a non-pollution technology exists that is sufficiently cost effective. If not, the SupplyALT curve would lie above the original social supply curve and firms would prefer to continue to use the polluting technology and pay the full social costs of pollution (i.e., point B), perhaps through a tax or some other method to internalize the pollution externality.

Figure 2.2
Equilibrium Production and Price Adopting Alternative Energy Technologies



B. Another Example

What other methods might exist to internalize a pollution externality besides levying a tax on electric power production or a cap and trade system (See Chapter 3)? One method that is championed by economists to internalize pollution externalities is to assign property rights for the entity that is polluted. In the case of air pollution from electric power generation, it is impractical to assign property rights to the atmosphere; however, we consider another example below where assigning property rights for the polluted entity may be feasible. The advantage of assigning property rights for the polluted entity is that the owner of the polluted entity would have standing to demand payment for the damage done to their asset. Economists expect that this act would lead to an economically efficient outcome, assuming that transaction costs are modest.

Consider the recreational lake that is being polluted by an adjacent factory. The pollution limits the value of the lake for recreational purposes. This is the negative externality resulting from the pollution.

If someone is permitted to purchase the lake, then the owner of that lake would have standing to require a payment from the polluter for the ability to continue to pollute. That payment would compensate for the loss in revenue to the lake in the form of admissions fees by day visitors and the decline in the value of adjacent land for hotels and second homes bordering a polluted lake. Such a payment would be subject to negotiation, but would need to at least equal the damage that is being done to the recreational value of the lake. This would lead to three possible outcomes:

1) First, the polluter can make such a payment and continue to operate profitably. Continued pollution and factory production would be the socially optimal outcome.
2) Second, the polluter may find that it is less expensive to install pollution abatement equipment than to pay for the damage done to the lake. Continued factory production without pollution would be the socially optimal outcome.
3) Third, the polluter may not be able to pay the cost of their pollution in terms of damage to the lake and continue to operate profitably. In this case, the cessation of factory production (i.e., a reduction in economic activity) would be the socially optimal outcome.

Note that in all three outcomes overall economic activity is maximized (depending on the relative costs of the pollution and the value factory output) due to the imposition of costs on the polluter. If the factory output is valuable relative to the lost activity at the lake as in outcome 1), then overall economic activity is larger if factory production continues and lake activity is lower due to pollution. Or, the factory owner may find it cheaper to install pollution abatement equipment as in outcome 2). Finally, if factory output is not valuable relative to the lost economic activity at the lake as in outcome 3), then overall economic activity is larger if factory production ceases and lake activity increases to a higher level.

On the other hand, if pollution costs are not imposed on the polluter, then overall economic activity will only be larger by coincidence, if it happens that outcome 1) is correct. This is why the assignment of property rights provides a way to internalize an externality that leads to an efficient outcome from an economics perspective.

As was noted earlier, however, it is not always feasible to assign property rights. In such cases, the task of internalizing externalities may fall to regulators. In theory, the goal of the regulator would be the same as the owner of the property. The goal would be to require the polluter to make a payment equal to the costs imposed by their pollution as they continue to both produce an output and pollute.[2]

In the case of greenhouse gas emissions, one would expect that all three types of outcomes could occur if the costs of pollution, once measured (see Section A.), are imposed on greenhouse gas emitters. Some emitters will continue to produce and pay for the right to continue to produce. Some emitters will change technology, adopting over time low- or no-emissions technologies, and continue to produce but without emitting greenhouse gasses. Some emitters will cease production and the production of their product (usually energy, a factory output, or transportation services) will decline. All three of these occur in the example presented in Figure 2.2, at the equilibrium point C.

Such an outcome might be beneficial to the economy. Nonetheless, it is important to note a key issue: it is not clear how much cost to impose on electrical power generators or other emitters of greenhouse gases. This is because there is uncertainty about the cost of greenhouse gas emissions to society.

---

[2] More precisely, the polluter should pay the marginal cost of pollution at their current level of production.

C. What is the Cost of Greenhouse Gas Emissions?

From the preceding theory it is evident that it is critical to be able to measure the size of the external costs of pollution. This is never easy or precise, but methods do exist in many cases. For example, the more immediate health effects of smog can be measured in terms of health outcomes for older citizens, children, and asthmatics. In other words, the size of the social costs of the externality can be measured with some accuracy (though there is certainly debate and disagreement on the magnitude of this externality). But, having some amount of clarity about the size of the external effect gives policy-makers the ability to choose the efficient level of tax per unit of pollution, that is, the level of the taxation that is estimated to lead to the economically-efficient level of economic activity.

Precise measurement is substantially more difficult in the case of greenhouse gas emissions. The precise marginal influence of greenhouse gases in the atmosphere on climate change is not clearly understood and is a subject of considerable debate. The timing of these impacts is also a point of substantial uncertainty. In other words, to what extent do additional greenhouse gas emissions at the current time relate to a change in climate now, in the decades to come, and in the more distant future?

Even if these questions could be precisely answered, another uncertainty is the economic costs associated with climate change. The climate may change but how would this influence the economy? Some coastal cities may need to be moved or perhaps reinforced as global temperatures rise, and factors such as quality of life, agricultural productivity, and water supply may change in different regions of the globe. At the same time, costs may rise if weather becomes violent or extreme in certain regions. More generally, if humans have settled and concentrated in regions with a beneficial climate and environment, then factors that change climate and environment may create a mismatch that is expensive to remedy.

The concern is that the marginal contribution of manmade factors to climate change could produce significant costs. Manmade contributions to climate change could impose future costs either directly by making our economy less productive or indirectly by curtailing future economic growth as a substantial share of future investment must be devoted to mitigating the impacts of climate change.

If the costs of the manmade contribution to climate change are substantial, there could be substantial future economic benefits from minimizing or reducing greenhouse emissions. Yet, as was noted earlier, there is uncertainty about the marginal contribution of greenhouse gases and other manmade activities to climate change. There is also uncertainty as to whether climate change resulting from manmade actions will lead to a modest future economic cost or to a very significant economic cost, or to a moderate economic cost somewhere in between.

The implication is that efforts to regulate greenhouse gases and reduce the manmade contribution to climate change will lead to a broadly uncertain outcome. Such an investment could lead to relatively few benefits, or the investment could generate substantial future benefits. The situation is a bit like the purchase of automobile insurance. A driver who chooses not to purchase insurance may bear no cost or may bear a very substantial cost. Faced with this reality, many drivers choose to bear a significant cost for insurance to avoid the risk of a catastrophic outcome even though they may never need to file a claim. Drivers choose to do so because they believe it is a rational decision, or because they simply do not have the financial wherewithal to risk the catastrophic outcome.

Along the same lines, nations may choose to purchase "insurance" against the uncertain impact of greenhouse gas emissions on the climate and the economy by regulating and significantly reducing greenhouse gas emissions. However, any decision to purchase "insurance" also depends on the size of the premium. How costly will regulation of greenhouse gas emissions be to the economy? Societies may choose not to purchase this insurance if the premium is too costly.[3] We consider these costs to the economy in Chapters 3 and 4 of this report.

Finally, it is also true that the public may have a preference for avoiding climate change due to manmade sources on purely environmental grounds, even if there is no concrete cost to

[3] Such a purchase of "insurance" by reducing greenhouse gas emissions would make little economic sense if one is certain that the marginal contribution of greenhouse gas emissions to climate change and economic losses is small.

the economy. Even in this case, the public still needs to understand the economic costs of pursuing such an environmental goal. Once again, it would be useful to measure the costs to the economy in terms of lower per capita income, gross domestic product, employment, and farm and manufacturing activity from actions to limit greenhouse gas emissions, and we will do so later in the report.

D. Points of Emphasis

This section features several points of emphasis that were mentioned earlier in this Chapter, but require further discussion. We believe it would be useful for the reader to keep these points of emphasis in mind when reading the specific analysis in Chapters 3 and 4.

Discounting of Future Events

Policy analysis often must consider the time value of money. This is because public policies often impose costs and yield benefits that occur at different points in time. For example, the costs of regulations to reduce greenhouse gas emissions would begin in the present but might primarily influence climate change and economic consequences decades in the future. To consider the relevant trade-offs, policymakers and the public must have a way to compare future benefits with current costs. In particular, benefits in the future must be discounted by the time value of money.[4] The time value of money is often quite substantial. For example a 7% annual discount rate effectively "halves" the value of benefits every decade. One dollar of benefits occurring 10 years in the future would be worth $0.50 today, while $1 of benefits 20 years in the future would be worth $0.25 today. Looking further into the future, $1 of benefits 50 years in the future would be worth $0.034 today, and benefits 100 years in the future would be worth $0.001 today. Such discounting implies that economic benefits from avoiding manmade contributions to climate change decades in the future will be heavily discounted relative to current costs. The costs of manmade contributions to climate change would have to be catastrophic to be comparable after discounting. However, some have argued

[4] Costs over the next few decades also would need to be discounted but for fewer years.

that regulating greenhouse gas emissions would make economic sense even with such discounting. The argument centers around the uncertainty about the economic consequences of climate change (Weitzman, 2007). Distributions under uncertainty tend to have “fat tails,” meaning that the probability of an extreme outcome such as severe economic consequences (or of very minimal consequences) is larger than in a typical risk distribution. In such a situation, the present value of future economic consequences could be quite large even with heavy discounting over time (Weitzman, 2007). In other words, bearing significant costs to reduce greenhouse gas emissions could pass a benefit cost analysis even under the types of heavy discounting described above.

Rearrangement of Global Industrial Production

Regulation of greenhouse gas emissions has substantial potential to lower the returns to private capital investment in industry, particularly in “heavy” industries that use energy intensely or that directly release greenhouse gases in their own production (Interagency Report, 2009). As noted earlier, production may decline in these industries with regulation of greenhouse gas emissions. This is especially true because many such heavy industries compete in an international market. Key competitors for these heavy industries may be located in developing countries that do not currently regulate greenhouse gas emissions. U.S. producers will face higher energy costs and perhaps their own pollution abatement costs after the introduction of regulations on greenhouse gas emissions. U.S. firms in heavy industries will operate at a competitive disadvantage as a result, and a larger share of heavy industrial activity may shift overseas to countries that do not directly regulate greenhouse gas emissions.[5] To be more precise, production in these heavy industries, and the power plants that produce energy for these industries, may shift overseas to countries without greenhouse gas regulations. Heavy industries and associated power production may in this way avoid the greenhouse gas regulations. Similar phenomenon may also occur in other manufacturing or resources based

[5] Some countries such as China that do not directly regulate greenhouse gas emissions do have programs to promote the use of more costly renewable energy resources. This raises energy prices and has many of the same impacts on the economy, and heavy industries within the economy, as direct greenhouse gas regulation.

industries. The net result is that greenhouse gas emissions are not reduced as much as hoped and the negative impacts on the U.S. economy are larger than expected.

Chapter 3: National Economic Consequences

This Chapter examines the potential consequences for the national economy from proposed climate change legislation. Specifically, in this Chapter we focus on the major climate change initiatives that were proposed in the 111th Congress, and note the potential for direct regulation of greenhouse gas emissions by the U.S. Environmental Protection Agency.

A. Legislative and Regulatory Proposals

Climate and energy legislation similar to what was proposed in the 111th Congress could have a substantial impact on energy and greenhouse gas emission prices. An analysis of the proposed legislation from the U.S. House of Representatives and the U.S. Senate provides a baseline from which to consider the economic impact of climate and energy policies.

The *American Clean Energy and Security Act of 2009* (H.R. 2454) was introduced by Representatives Henry Waxman of California and Edward Markey of Massachusetts and proposed a comprehensive set of provisions on clean energy, energy efficiency, and the transition to a clean energy economy. Specifically, the legislation proposed to set a combined energy efficiency and renewable electricity standard, to develop an energy productivity goal and strategic plan, and to establish a cap and trade system for greenhouse gas emissions with goals for reducing U.S. emissions from covered sources by 83% of 2005 levels by 2050. The legislation would have required emissions reductions or purchases of emissions offsets by all sources covered in the legislation. The Waxman-Markey bill passed the House on June 26, 2009 by a 219-212 roll call vote.

On the other side of Capitol Hill, Senator John Kerry of Massachusetts introduced S. 1733, the *Clean Energy Jobs and American Power Act* on September 30, 2009 with co-sponsor Barbara Boxer of California. The bill, as reported from the Senate Committee on Environment and Public Works on February 2, 2010, included provisions to establish a system for greenhouse gas emissions with goals for reducing U.S. emissions by 83 of 2005 levels by 2050, to establish goals and standards for transportation-related emissions reductions including vehicle and engine emissions, and to establish standards for new coal-fueled power plants. Similar to the House legislation, the Senate legislation would have required emissions reductions or purchases of emissions offsets by all sources covered in the legislation. The Senate legislation was not addressed on the floor and further efforts of Senator Kerry and Senator Joseph Lieberman of Connecticut to develop a comprehensive energy and climate proposal have died in this session of Congress.

In the absence of Congressional action on energy and climate legislation, the Environmental Protection Agency (EPA) has indicated its plans to proceed with climate regulation. A 2007 Supreme Court ruling in Massachusetts v. EPA, 549 U.S. 497 (2007) found that greenhouse gases are air pollutants covered by the Clean Air Act, providing EPA the mandate to address greenhouse gas emissions under its existing authority. In December 2007, the EPA Administrator published two findings regarding greenhouse gas emissions.

- **Endangerment Finding:** The atmospheric concentrations of six specific greenhouse gases - carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) - endanger public health and welfare.
- **Cause and Contribute Finding:** The emissions of these greenhouse gases from new motor vehicles and motor vehicle engines contribute to atmospheric concentrations and hence to the endangerment of public health and welfare.

The endangerment finding provides EPA the rationale for greenhouse gas regulations and presents the pathway for a regulatory approach to greenhouse gas emissions in lieu of any new legislation. This approach could move forward in the coming months even as Congress tables comprehensive climate legislation. Potential EPA regulations could require targeted sectors (initially large industrial emitters such as power plants, etc.) to control emissions. There have been discussions of legislative proposals to prevent EPA from acting on the endangerment finding, but none of those proposals have moved forward through Congress thus far and don’t appear likely to in the remaining days of the current session.

B. Structure of Recent Climate Change Legislation

The major climate change legislation from the 111th Congress included the Waxman-Markey legislation (H.B. 2454), which ultimately was passed by the U.S. House of Representatives, and the proposed Kerry-Lieberman legislation in the U.S. Senate. Both efforts were complex legislation with many specific requirements but the core of both bills was a "cap and trade" system for setting (and over time decreasing) the aggregate amount of greenhouse gas emissions from covered sources in the United States. In a cap and trade system, the primary approach of government regulators is not to cap the particular level of greenhouse emissions at a particular power plant, factory, or other covered emitter at a point in time. Rather, the approach of regulators is to distribute (either freely or through auctions) a specific number of emissions allowances at each point in time. The emissions allowances are set to meet regulatory goals for the total greenhouse gas emissions from covered sources in the United States in any given year. Once distributed, the emissions allowances can then be traded among parties. Further, these allowances are supplemented by offsets. Offsets can be purchased from non-covered emitters of greenhouse gases (who would agree to reduce their emissions), or from entities that sequester carbon. The end result is that covered emitters of greenhouse gasses such as utilities can continue to make their own decisions about their level of greenhouse gas emissions, but must submit allowances or offset credits equal to their amount of greenhouse gas emissions.

Cap and trade legislation may provide flexibility to individual utilities, factories, or other covered emitters, but cap and trade legislation imposes significant costs on the economy. Essentially, over time utilities, factories, and other covered emitters must switch to alternative methods of production that emit little or no greenhouse gases but are more expensive. This substitution in the production process ultimately raises prices and reduces the size of the U.S. economy. For example, higher prices in the utility industry reduce the quantity of electricity demanded by households, commercial businesses, and industrial customers. This leads not just to less energy production but to a curtailment of economic activity throughout the economy. The reduction in economic activity is particularly large for manufacturers and others that are intensive users of electricity. Manufacturers, of course, also may be covered emitters subject to cap and trade regulation and also may face by competition with manufacturers from countries who do not regulate greenhouse gas emissions.

Both versions of cap and trade regulations propose to provide emissions allowances for free to impacted parties such as utility companies and manufacturers in the first two decades of the system before moving towards auctions to distribute the allowances. The distribution of free allowances to utility companies permits the companies to limit the energy price increases that curtail economic activity in these early decades. Similarly, free allowance distribution to the most energy-intensive manufacturing sectors limits losses in these sectors in the first decade of the program. The notion is that utilities and factories will have time to phase in low- or no-emission power plant capacity during the first two decades (EIA, 2009), and that new technologies will be developed during that period. The time also can be used for producers to identify and negotiate with potential providers of emissions offsets.

The cap and trade system also attempts to mitigate its consequences for the economy by steadily reducing the number of emissions allowances over time, rather than immediately. The amount of potential offsets, however, is fixed over time so the net effect of declining allowances and fixed offsets is that the total amount of greenhouse gas emissions in the United States falls over time. Emissions-allowance caps limit total annual carbon emissions to a percentage of emissions in a previous year (typically 2005), and then incrementally reduce that percentage over time. For example, the Waxman-Markey legislation capped greenhouse gas emissions at 83% of 2005 emissions levels in the year 2020, to 58% of 2005 emissions levels in the year 2030, and to 17% of 2005 emissions levels in 2050. The Kerry-Lieberman legislation in the Senate follows a similar schedule. While there were differences, both pieces of legislation also followed a similar system for the free allocation of allowances in earlier decades and the use of offsets. These similarities mean that the economic consequences of the Waxman-Markey legislation and the Kerry-Lieberman legislation are broadly similar. In fact, the projected economic consequences of both pieces of legislation vary more based on the particular economic scenario (such as how cost-effectively low- or no-emissions technologies can be implemented by utilities) than by the specifics of either the Waxman-Markey or Kerry-Lieberman legislation. Thus, in our analysis, we focus more on how the economic consequences of the two pieces of legislation will vary depending on key economic variables than on how economic consequences vary between Waxman-Markey and Kerry-Lieberman. This is particularly appropriate since it is highly unlikely that either piece of legislation would become law, at least in the near future.

C. Economic Scenarios under Climate Change Legislation

Cap and trade legislation has consequences for the whole of the U.S. economy. Analysis of the legislation therefore requires a flexible, comprehensive model of the U.S. economy, including a very detailed modeling of the energy industry. The Energy Information Administration's (EIA) *National Energy Modeling System* (EIA-NEMS) is such a model. EIA-NEMS tracks economic output, wages, prices, and employment in dozens in of industries and is used to produce the Department of Energy's periodic energy sector outlooks. Such an outlook, in the absence of regulation, forms the reference case for EIA analysis using the EIA-NEMS model. The EIA-NEMS model also was utilized to model the expected impacted of climate change legislation on the U.S. economy. Economic activity and energy prices under climate change regulation could be compared with similar values in the reference case scenario, in order to isolate the consequences of climate change regulation on the economy. Specifically, the EIA conducted analysis of both the Waxman-Markey legislation in the U.S. House of Representatives and the Kerry-Lieberman legislation in the U.S. Senate.

The baseline regulated scenario in the EIA modeling assumes that low-emissions technologies (renewables, nuclear power) are "developed and deployed on a large scale" during the study period, and that there is ample supply of both domestic and international offsets available for purchase (EIA, 2009). The model also assumed that polluters would curtail emissions at a greater rate than required in order to amass a bank of emissions allowances that could be used at later date. This behavior is anticipated because the requirements and costs for reducing greenhouse emissions become even stricter in the future (EIA, 2009). In the baseline model, most of the reductions in greenhouse gas emissions through 2030 are achieved by reducing emissions in energy production, and the vast majority of these reductions occur in electric power through a decline in conventional coal power electricity production (EIA, 2009). This occurs as low- or no-emissions technologies replace conventional coal capacity or as declines in demand for electric power are met by reducing conventional coal production.

The Energy Information Administration in its analysis considered multiple alternative scenarios. In its analysis of the Waxman-Markey legislation, the following were 5 alternative scenarios (EIA, 2009). The first alternative scenario is the “No Bank Case,” which releases the assumption that polluters bank pollution allowances for later use. The second case is the “High Offset” case which assumes that international offsets can be quickly identified and used by polluters. Both of these alternative scenarios should allow less costly compliance and lead to a smaller decline in economic activity under the Waxman-Markey legislation. By contrast, the “High Cost” case assumes that it is 50% more costly to utilize no- or low-emissions technologies, while the “No International” case assumes that international offsets are not available to U.S. polluters. The last scenario, the “No International/Limited” case assumes there are no international offsets and no marginal improvement in the adoption of no- or low-emissions technology. It will be particularly expensive to the economy to meet emissions caps under this scenario. Note that a similar set of alternative scenarios also were considered in the EIA analysis of the Kerry-Lieberman Senate legislation (EIA, 2010). Note also that the EIA models did not consider any economic benefits from climate change legislation for the period under study. As was discussed earlier, such benefits are more uncertain and are difficult to quantify. The focus of the EIA modeling, as discussed in Chapter 2 of this report, was to consider the economic “price” of regulating greenhouse gas emissions.

Looking across all of these scenarios, the two most important cost factors are: 1) the availability of cost effective low- or no-carbon production technologies; or 2) the cost of purchasing offsets that allow continued production using more carbon-intense technologies. Thus, among the alternative scenarios, the “No International/Limited” scenario will by far have the greatest potential to raise energy costs and reduce the size of the U.S. economy.

Table 3.1 shows results from the EIA's analysis of the Waxman-Markey legislation and the Kerry-Lieberman legislation. All impacts are reported relative to the reference case scenario, which factors in normal expectations for inflation. Recall that this reference scenario represents projections for the economy and the energy industry in the absence of climate change legislation. Therefore, results show how much each scenario affects the economy relative to this unregulated reference case. Results are presented as percentage changes in GDP, the price of electricity, electricity generation, and industrial production.

Table 3.1
Economic Consequences of Cap and Trade Programs by Scenario in the EIA-NEMS Reports

Variable	**Base Case**	**High Cost**	**No Int'l/Limited**	**Base Case**	**High Cost**	**No Int'l/Limited**
		2020			**2030**	
Waxman-Markey						
Electricity Price	2.6%	4.1%	15.3%	19.5%	29.2%	77.4%
Electricity Generation	-2.4%	-2.7%	-5.9%	-7.1%	-9.3%	-16.6%
Gross Domestic Product	-0.3%	-0.5%	-0.7%	-0.8%	-1.1%	-2.3%
Industrial Shipments	-1.0%	-1.0%	-2.8%	-2.5%	-2.7%	-6.8%
		2020			**2035**	
Kerry-Lieberman						
Electricity Price	4.4%	5.7%	20.9%	25.7%	32.8%	84.8%
Electricity Generation	-1.3%	-1.7%	-5.8%	-4.5%	-5.9%	-13.7%
Gross Domestic Product	0.0%	-0.1%	-0.7%	-0.4%	-0.6%	-1.8%
Industrial Activity	-0.6%	-0.7%	-2.7%	-2.8%	-3.2%	-7.7%

Source: EIA 2009 and EIA 2010

Analysis of the Waxman-Markey legislation runs through the year 2030. This was as far out into the future that EIA-NEMS extended as of that year. By the year 2010, the EIA-NEMS model was expanded to run through 2035. As a result, the analysis of the Kerry-Lieberman legislation, which occurred during 2010, ran through the year 2035.

Note that the size of the estimated economic consequences varies more by scenario than between the two pieces of legislation. With the exception of electricity prices, results are relatively modest in both the Base Case and High Cost scenarios, whether these scenarios were used to analyze the Waxman-Markey legislation or the Kerry-Lieberman legislation. Economic costs rise substantially, however, when comparing the economic consequences of the No International/Limited scenario. This scenario, with both limited access to offsets and limited ability to substitute towards no- or low-emissions production technologies, generates relatively large consequences for energy prices, energy generation, GDP, and Industrial Shipments whether under the Waxman-Markey or Kerry-Lieberman legislation. Results also grew substantially from 2020 to either 2030/2035. As argued below, the larger results in these latter years may be the most instructive findings.

In particular, when examining model results it is important to focus on results from the year 2030 or year 2035. Rather than representing an outlier at the end of the analysis period, the results for 2030/2035 may be the most representative of the cost of greenhouse gas regulation. Results for the year 2030/2035 occur after the expiration of free-allowances. As a result, economic impacts in 2030/2035 more accurately reflect the regulatory costs determined by the availability of offsets and the potential to substitute towards renewable energy, nuclear energy, or other no- or low-emissions technologies. This is especially true because after 2030 an increasing share of the greenhouse gas emissions reductions will need to come from outside of the electricity generation sector, and there is even less technological progress in this area (EIA, 2009). The practical implication of this is that the reader should put substantial weight on 2030/2305 cost estimates when evaluating EIA-NEMS model outputs for the 2015 to 2030/2035 period.

The lost economic activity, whether electricity generation, GDP, or Industrial Shipments, doubles or more than doubles under the No International/Limited scenario compared to the Base Case scenario. The loss in electricity generation is between 13.7% and 16.6% in 2030/2035 in the No International/Limited scenario. The overall decline in gross domestic product under this scenario is 1.8% to 2.3% in 2030/2035. Industrial Shipments decline by 6.8% to 7.7% in

2030/2035 in the No International/Limited scenario. These are substantial declines. In terms of GDP, these declines are roughly equal to a year of GDP growth. Greenhouse gas regulation has the potential to cause a loss of 1-year of GDP growth by 2030/2035. Declines in electric generation and industrial shipments are much more severe. The larger effect occurs for industrial shipments since this industry is among the largest and most intense users of energy. While not listed in the Table, we note that the price of emissions allowances in 2030 under the No International/Limited scenario is 190.5 2007$ per metric ton of CO_2 equivalent under the Waxman-Markey legislation, and 184.8 2008$ per metric CO_2 equivalent under the Kerry-Lieberman legislation.

D. Other Studies and Impact on U.S. Manufacturing

Besides the EIA analysis, we reviewed private sector studies examining proposed climate legislation. One was the American Council for Capital Formation/National Association of Manufacturers study (ACCF/NAM, 2009). The ACCF/NAM study utilized two additional scenarios to analyze the Waxman-Markey legislation using the EIA-NEMS model. The study then reported the resulting economic consequences. The ACCF/NAM study developed a “Low” and “High” scenario for examination. However, in the context of the *Energy Information Administration Report*, the assumptions of both the Low and High scenario in the ACCF/NAM are both similar to the No International/Limited scenario in the EIA study (EIA-NEMS, 2009). In particular, the ACCF/NAM assumes that there will be fewer offsets available to greenhouse gas emitters than under the EIA-NEMS Base Case scenario and limits on the adoption of no- or low-emissions technologies, as in the No International/Limited scenario. This was the scenario that included two developments that were not part of the baseline analysis. The ACCF-NEM Low and High Cost scenarios differ in assumptions about the adoption of these technologies. The High Cost scenario is more restrictive in assumptions about the adoption of nuclear, biomass, and wind energy.

Table 3.2 shows the projected economic consequences of the Waxman-Markey legislation using the ACCF/NAM Low and High Cost scenarios. Results are presented for a similar set of economic measures as in Table 3.1, though the ACCF/NAM report also provides estimates for the projected impacted on manufacturing employment. The ACCF/NAM report shows smaller increases in residential energy prices than in the EIA No International/Limited scenario, but still shows substantial prices increases by the year 2030 of 31.4% in the Low Cost scenario and 50.0% in the High Cost scenario. The consequences for GDP are a 1.8% decline in 2030 under the Low Cost scenario and 2.4% under the High Cost scenario. These losses also are similar to those found in the No International/Limited Case in the EIA analysis.

Results in Table 3.2 also show how much more severe the expected impact of comprehensive climate change legislation is on the U.S. manufacturing sector. For example, in 2030, total employment is expected to be 1.1% to 1.5% less than in the reference scenario under the Waxman-Markey legislation. By contrast, manufacturing employment would be 5.8% to 7.3% less under the Waxman-Markey legislation compared to the reference scenario. The employment impact would be concentrated in the manufacturing sector. This is particularly evident if you consider that manufacturing employment accounts for around 10% of all employment. The 5.8% to 7.3% decline in manufacturing employment would reflect a 0.6% to 0.7% decline in total employment, or about half of the total decline.

The significant decline in manufacturing activity is also evident in results for the industrial output variable. In 2030, the ACCF/NAM report anticipates a 5.3% to 6.5% decline in industrial output under the Waxman-Markey legislation compared to the reference scenario. Similar declines were anticipated for industrial activity in the EIA analysis under the No International/Limited scenario (the scenario most comparable to the ACCF/NAM analysis). The EIA predicted a 6.8% decline in industrial activity in 2030 as a result of the Waxman-Markey legislation and a 7.7% decline in industrial activity under the Kerry-Lieberman legislation.

Looking across all of the measures, analysis has predicted a decline of manufacturing ranging from 5.8% to 7.7% under the comprehensive climate change regulation. This result makes sense given that many manufacturing businesses use production methods that are energy-intensive, manufacturing businesses have an intensive demand for transportation services, manufacturers are exposed to significant international competition, and some manufacturing plants have their own greenhouse gas emissions.

Table 3.2

Economic Consequences of Cap and Trade Programs by Scenario in the ACCF/NAM Report

Variable	Low Cost	High Cost	Low Cost	High Cost
	2020		2030	
Waxman-Markey				
Employment	0.0%	0.0%	-1.1%	-1.5%
Gross Domestic Product (Millions 2007$)	-0.2%	-0.4%	-1.8%	-2.4%
Retail Electricity Price ($/KWH)	4.9%	7.9%	31.4%	50.0%
Industrial Output	-1.8%	-2.2%	-5.3%	-6.5%
Manufacturing Employment	-1.8%	-2.3%	-5.8%	-7.3%

Source: American Council for Capital Formation and National Association of Manufacturers

E. Impact on U.S. Agriculture

The impact of comprehensive climate legislation or regulations on U.S. agriculture is substantial and widespread, but is also very dependent on the exact provisions that may be enacted. Climate legislation or regulation would generate new costs for agriculture but may also generate benefits. The exact magnitude of these costs and benefits depends on the exact provisions of legislation or regulation. This section reviews the potential costs, potential benefits, and the net costs of climate legislation for U.S. agriculture.

Potential Costs

Regulations on greenhouse gas emissions that drive up costs in carbon-intensive industries and inputs such as transportation and energy could have a substantial effect on agricultural input costs. Increased production and marketing costs would hurt the agricultural sector in both the short and long run. The increased costs could also reduce production over time and drive up agricultural commodity prices, partly offsetting the increased costs to agriculture, but also passing on increased costs to consumers. Regulations could also directly affect agriculture if the sector is subject to emissions controls or costs for greenhouse emissions from either crop or livestock operations. Both the Waxman-Markey and Kerry-Lieberman legislative bills exempted agriculture from emissions regulations, and the initial target of any EPA regulations appears to not be agriculture, but potential regulations on agriculture in the future are unknown under either approach.

Two studies of the initial House legislation provide an estimate of the potential impact of climate legislation and higher energy prices on agriculture. These studies predicted impacts out to the year 2050, and therefore offer a longer timeframe than the EIA analysis. The Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri used increased energy cost estimates from CRA International to calculate the impact of climate legislation on agricultural input costs. The estimated increased energy prices from CRA International included motor fuel that is 4% higher than current baseline projections by 2020 and 11% by 2050; natural gas that is 11% higher relative to baseline by 2020 and 34% higher by 2050; and electricity that is 16% higher relative to baseline by 2020 and 45% by 2050. The FAPRI analysis used several Missouri representative farms as the point of comparison and showed resulting increases of 3-7% on fertilizer costs by 2020 and 9-19% by 2050 relative to a 2009 baseline level. Fertilizer costs for corn are at the high end of the range, while soybeans are at the low end of the range. The differences in cost increase are primarily based on the differences in fertilizer use, particularly nitrogen. Natural gas is the predominant cost component in the production of anhydrous ammonia, which is a primary source of nitrogen fertilizer and natural gas price increases would be passed on through nitrogen fertilizer price increases. Machinery, drying, and irrigation energy costs rise in line with motor fuel and natural gas costs and increase 4% and 12% over 2009 baseline levels by 2020 and 2050 respectively. Adding these increased fertilizer and energy costs to other operating costs shows an increase in total operating costs of approximately 2-4% by 2020 and 4-10% by 2050 relative to 2009 baseline levels.

Analysis by Bruce Babcock at the Center for Agricultural and Rural Development at Iowa State University calculates potential costs on Iowa corn and soybean farms by estimating the carbon cost equivalent for various farm inputs. At a CO_2 price of $20 per ton (a short-run price level), the emissions costs of diesel fuel usage amounts to about $0.80 per acre per year. Emissions from natural gas usage as the primary energy source in fertilizer production similarly passed through as an increased cost of $2.85 per acre. And, and propane usage for grain drying resulted in an emissions cost that averaged $0.87 per acre ($1.75 per acre for corn and $0 per acre for soybeans). The total increased cost for fuel and fertilizer of $4.52 per acre represents about a 1.5% increase from operating cost levels of around $300 per acre.

Both studies suggest small overall changes in crop production costs in the short run due to climate legislation and greenhouse gas emissions costs. Increased energy costs imply similar modest increases in livestock production costs as well. Several other studies generally confirm the expected costs increases and their relatively minor levels of increase, but applying expected energy cost changes to aggregate U.S. farm cost data shows the significance of even small changes in costs. Farm income and cost data from the United States Department of Agriculture (USDA) Economic Research Service shows the impact of cost changes relative to 2009 baseline levels for three energy-sensitive cost categories and total farm costs and income.

Table 3.3
U.S. Aggregate Farm Cost Estimates

	2009	**2020 (Short Run)**		**2050 (Long Run)**	
Category	**Baseline Level (Million 2009 $)**	**Assumed Increase (%)**	**Cost Increase Above Baseline (Million 2009$)**	**Assumed Increase (%)**	**Cost Increase Above Baseline (Million 2009$)**
Fertilizer	$20,136	6%	$1,208	15%	$3,020
Fuel and Oil	$12,716	4%	$508	11%	$1,399
Electricity	$4,590	16%	$727	45%	$2,045
Total Energy-Intensive Costs	$37,441		$2,444		$6,464

Source: U.S. Department of Agriculture and author's calculations

The estimated cost increases of $2.4 billion (2009$) in the short run and $6.4 billion (2009$) in the long run relative to baseline levels amount to about 0.9% of all farm costs (purchased inputs, labor, land, capital, and taxes) by 2020 and 2.3% by 2050, but this also represents 3.9% and 10.4% of net farm income in the short run and long run respectively. This cost analysis overstates the negative impact on agricultural profitability of energy price increases due to climate legislation. As noted in the explanation of potential costs, the increased costs will lead to some contraction of supply and result in higher commodity prices that are passed on to the consumer and offset some of the increased costs to agriculture. In addition, EPA analysis of the proposed legislation suggests smaller increases in fertilizer prices in the short run due to transitional allowances provided to energy-intensive and trade-exposed industries. On the other hand, the cost estimates above do not consider the long-run effects of changes in crop or enterprise mix due to energy price changes or the relative changes in costs across countries that adopt similar climate legislation. Countries that do not adopt similar climate regulations could gain a significant competitive advantage in production costs that translates into some international shifts in agricultural production. And, the analysis assumes agriculture is affected by climate legislation only through the impact on energy prices and energy inputs in agriculture. Direct regulation of emissions in agriculture could add substantial costs for the industry. Finally, the cost analysis does not consider any potential changes on productivity or costs due to changes in climate associated with greenhouse gas emissions, nor does it consider any productivity losses or costs avoided due to climate legislation or regulation. Some studies have attempted to address the potential impact of increasing greenhouse gas concentrations on agricultural productivity, but this analysis is confined to a static assessment of marginal cost changes under potential legislation or regulation.

Potential Benefits

Regulations on greenhouse gas emissions could also benefit the agricultural sector if increased costs on emissions translated into increased demand for reduced-emission biofuels such as ethanol (both starch-based and cellulosic-based) or biodiesel. The biofuels industry has grown substantially in the past few years, thanks in part to a complex mix of changing technology and economics along with substantial government policies focused both on financial and environmental aspects of the industry. Greenhouse gas regulations that impose caps or costs on emissions could further impact growth in the sector, with or without additional policies. Regulations on greenhouse gas emissions may also benefit agriculture by rewarding carbon sequestration efforts that include management practices such as conservation tillage, nutrient management, or animal waste management, as well as land use practices such as the establishment or maintenance of grassland or forest. These agricultural practices could be directly rewarded through the value of carbon emission offsets in a carbon market (such as through cap and trade). In addition, an increase in land devoted to grassland or forestry could reduce other U.S. agricultural production and drive up agricultural commodity prices. Lower U.S. production and higher commodity prices could encourage agricultural production increases worldwide, partially offsetting the price effect, but constraints on U.S. production would likely lead to lower total global agricultural output and higher commodity prices.

The proposed legislation would have provided major benefits to agriculture through an opportunity to provide carbon offsets in the carbon market established by cap and trade provisions along with no direct regulation of agricultural emissions. The EPA analysis considered only some potential agricultural opportunities to provide carbon offsets. It showed a 50% increase in amount of conservation tillage on cropland by 2020 based on an initial allowance price of $15-per-ton CO_2 rising at a real rate of 5% per year. Further analysis and testimony by Joseph Glauber, Chief Economists for the United States Department of Agriculture (USDA), before the U.S. House Committee on Agriculture Subcommittee on Conservation, Credit, Energy, and Research confirms the primary opportunity for agriculture to earn carbon offset income is in forestry. The USDA analysis is based on models of agricultural and forestry responses to the potential changes in greenhouse gas emissions regulations and the market for emissions offsets. Projected increases in prices for emissions offsets suggest an increase of 16.6 million acres in forest by 2020 and 59 million acres by 2050, with approximately 35 million acres coming from existing cropland and 24 million acres from pasture. The afforestation changes would generate $2 billion per year in agricultural offset income by 2020 and $24 billion year by 2050 (2004$), representing more than 80% of all agricultural offset income. The analysis conducted by USDA discusses shifts from cropland and pasture to forestry, but does not discuss the fate of land enrolled in the Conservation Reserve Program CRP). Approximately 31 million acres are currently enrolled in the CRP, a federal program that pays producers an annual rental payment to temporarily retire cropland and other high-priority land from production. This land could be a target for additional carbon sequestration activities or it could return to cropping as other acres shift to forestry. But, current USDA policy appears focused on maintaining enrollment in the CRP near its 32 million acre authorization, thus substantial acreage shifts out of the CRP are not projected in the analysis.

In addition to the direct income from carbon sequestration practices, the predicted reduction in agricultural production due to the combination of higher energy prices, changes in production practices, and changes in land use are significant. Major field crop production rises for one crop (grain sorghum, likely due to acreage tradeoffs with corn), but falls for the rest by 0.4-11.4% by 2020. By 2050, production falls by 10.2-31.5% for all of the major field crops. As a result, crop prices rise from 8.1-56.5% by 2050 relative to a baseline scenario. Livestock production suffers as well, falling 0.7-7.9% by 2020 and 2.1-22.7% by 2050 relative to the baseline scenario. Corresponding livestock and livestock product prices increase by 2.2-9.0% by 2020 and 14.9-33.1% by 2050 relative to the baseline scenario. The reduced production in the United States could be partially offset by increased production worldwide in response to higher prices and potential competitive production differences based on different costs or regulatory requirements. But, as noted above, constraints on U.S. production would likely lead to lower total global agricultural output and higher commodity prices. These higher prices would provide further benefits to U.S. agriculture, but once again would pass on increased costs to consumers.

Net Impact on U.S. Agriculture

The net impact of potential climate legislation or regulation on the profitability of agriculture is very dependent on the exact provisions of proposed rules as well as the assumptions and modeling parameters used to study the sector. Studies in general have found relatively small increases in production costs due to higher energy costs and through higher energy costs passed through in higher fertilizer costs. Studies that model the resulting production adjustments show small decreases in production and increases in price that partially offset the higher energy costs. More significantly, the studies of potential legislation or regulation assume large gains for agriculture based on the assumption that agriculture will not be subject to regulations, but instead will be eligible to provide carbon offsets and earn income from carbon sequestration activities. The USDA testimony by Glauber estimated the overall annualized value on producer surplus or farm income from proposed climate regulations at $22 billion per year (in 2004 inflation-adjusted dollars). Adjusting to 2009 for reference, the $22 billion would be equal to approximately $25 billion in 2009 dollars, which is approximately 40% of the 2009 U.S. net farm income of $62 billion.

In summary, this analysis of existing research generally confirms that U.S. agriculture would benefit from climate legislation and regulation. The analysis does not consider potential costs if agriculture is regulated instead of exempted. Nor does the analysis address the potential benefits to agriculture or to society in general of taking actions that may mitigate climate change or maintain agricultural productivity. But, the economic analysis does suggest the gains are largely dependent on carbon offset revenues and increased commodity prices from reduced U.S. agricultural production. And these gains to U.S. agriculture come at the expense of consumers in the form of reduced supplies and higher prices.

F. Economic Consequences under Direct Environmental Protection Agency Regulation

The precise nature of planned EPA regulation of greenhouse gas emissions is not known. The EPA has discussed plans to regulate a group of larger greenhouse gas emitters, but a specific formal set of procedures has not been announced. Plans that have been discussed suggest significant actions to reduce emissions by major current emitters. This implies that there would be some of the economic costs identified above for cap and trade legislation, including a reduction in generating capacity for conventional coal and increases in other types of electric power capacity. There also would likely be an associated increase in electricity prices with a negative impact on economic activity. However, it is unclear whether the magnitude of these changes will be smaller, the same, or even larger than the changes anticipated under the Waxman-Markey or Kerry-Lieberman climate change legislation. As a result, we do not provide specific estimates of economic consequences for the case of direct EPA regulation.

Chapter 4: Economic Consequences in Nebraska

Nebraska has a diversified economy, so in many ways the impacts of climate change legislation and regulation on the Nebraska economy will be similar to their impacts on the national economy. However, the Nebraska economy differs from the national economy in a number of important ways that will cause impacts to diverge. The first is that Nebraska has a large agricultural sector that may have substantial opportunities to provide emission offsets. The second is that Nebraska's mix of energy producing assets is different than the national average, so that the impact of climate change legislation on Nebraska utilities and energy prices may differ as well. The third is that Nebraska has a lower concentration of the types of heavy manufacturing industries that are most disadvantaged by climate legislation. This Chapter addresses each of these issues and then examines several studies that have directly estimated the impact of proposed cap and trade legislation on the state of Nebraska or regions within the state.

A. Generating Capacity

As noted earlier, caps on or regulation of greenhouse gas emissions will curtail or encourage various modes of generating electric power. In particular, analyses, whether from the Energy Information Administration (EIA) or the American Council for Capital Formation/National Association of Manufacturers (ACCF-NEMS), expected a significant decline in conventional coal generating capacity under climate change legislation relative to the reference case scenario. However, declining conventional coal generation also would be replaced by other types of generation capacity. The ACCF-NEMS analysis, which generally assumed limited growth in nuclear or renewable fuels capacity, predicted steep increases in natural gas generating capacity. The EIA analysis reached a similar conclusion under its scenarios that assumed limited growth in nuclear or renewable fuels capacity. Under EIA scenarios that assumed rapid adoption of nuclear or renewable generation capacity, however, the EIA predicted rapidly growing shares for nuclear power and renewables and little change in natural gas capacity.

With the movement away from conventional coal capacity, a natural question for Nebraskans is whether generating capacity in this state is likely to be more or less impacted by climate change legislation or other efforts to limit greenhouse gas emissions? This will depend on the particular features of Nebraska generating facilities, but a rough analysis is possible by looking at the current structure of generating capacity in Nebraska and the United States. This is done in Table 4.1, which shows the share of generating capacity by type for the United States and for Nebraska. Looking at broad categories, Nebraska and the United States have just under 70% of generating capacity in fossil fuels (such as coal or natural gas), and just over 30% in nuclear power, hydroelectric, and renewable sources such as wind, solar, or biomass. The primary difference between Nebraska and the United States is that Nebraska has a relatively large share of capacity in conventional coal and a relatively small share of electric power capacity in natural gas. The larger share of conventional coal production in Nebraska suggests that a larger share of Nebraska generating capacity will be at risk of closure or reduced activity under climate change legislation. This may even imply that electricity prices would be impacted more in Nebraska than the nation as a whole, though electricity price increases will ultimately result from the complex interaction of many factors.

Table 4.1
2008 Sources of Electric Power Generating Capacity in the United States and Nebraska

	Percentage of Generation Megawatt Hours	
Energy Source	**United States**	**Nebraska**
Coal	48.2%	66.3%
Natural Gas	21.4%	2.3%
Nuclear	19.6%	29.3%
Hydroelectric	6.2%	1.1%
Wind, Solar, Biomass, Geothermal	3.1%	0.9%
Other	1.5%	0.1%

Source: Energy Information Administration

The impact on electricity prices is critical for households and energy-intensive industries of all kinds. The impacts may be especially critical for manufacturing businesses, since a significant share of manufacturing businesses are intensive users of energy. The impact on manufacturing in Nebraska is discussed in more detail in the next section.

B. Economic Consequences for Nebraska Manufacturing

Nebraska has a smaller share of its gross state product in manufacturing than the United States overall. Manufacturing accounted for 10.7% of Nebraska gross state product in 2009 versus 11.1% of U.S. gross domestic product. This point alone suggests that economic consequences of climate change legislation and regulation on the Nebraska economy may be somewhat less severe than nationally. More importantly, Nebraska also has a smaller share of its manufacturing activity in industries most vulnerable to decline as a result of cap and trade legislation, or other efforts to regulate greenhouse gas emissions, as is evident in Tables 4.2 and 4.3 below.

Table 4.2 contains data from the American Council for Capital Formation/National Association of Manufacturers (ACCF-NEM) study. That study included an estimate of the decline in industrial activity, as measured by shipments, in 20 specific manufacturing industries. Table 4.2 presents the projected loss in industry shipments in 2030 due to the Waxman-Markey legislation. Manufacturing industries are ranked according to the severity of the loss. All but 3 of 20 industries lose shipments. Primary metals lose nearly 30% of shipments under the High Cost scenario and stone, clay, and glass products losses nearly 20% of shipments. Altogether, the ACCF-NEM report expects that 7 of 20 industries will lose more than 10% of shipments in 2030, at least in the High Cost Scenario. Note that Nebraska has a smaller share of employment in 6 of these 7 industries. Altogether, these 7 industries account for 35.5% of all manufacturing employment in the United States, compared to 27.1% of Nebraska manufacturing employment. At the same time, Nebraska has 37.4% of employment in food products, more than three times the national average. Shipments in this manufacturing industry are expected to decline by just 3.4% in 2030, even in the High Cost scenario.

Table 4.2
Nebraska Manufacturing Employment in Hard Hit Manufacturing Industries

	Percent Loss in Industrial Shipments		Percentage of Manufacturing Jobs	
Manufacturing Industry	**Low Cost**	**High Cost**	**Nebraska**	**United States**
Primary Metals Industry	-22.5%	-29.2%	1.8%	3.3%
Stone, Clay, and Glass Products	-14.1%	-18.2%	2.8%	3.5%
Machinery	-12.4%	-15.5%	10.4%	8.8%
Apparel	-11.2%	-15.4%	0.1%	1.3%
Electrical Equipment	-9.3%	-11.8%	2.4%	3.1%
Transportation Equipment	-8.1%	-11.1%	7.5%	11.7%
Wood Products	-8.0%	-10.9%	2.1%	3.8%
Petroleum and Coal Products	-8.9%	-9.2%	0.1%	0.8%
Fabricated Metal Products	-6.2%	-7.8%	8.9%	12.1%
Chemical Manufacturing	-5.8%	-7.3%	3.6%	6.2%
Computers and Electronics	-5.8%	-6.9%	4.2%	7.7%
Paper Products	-5.1%	-6.5%	1.4%	3.2%
Textile Mills and Products	-4.2%	-5.7%	0.5%	2.3%
Beverages and Tobacco Products	-3.2%	-4.0%	0.4%	1.2%
Food Products	-2.5%	-3.4%	37.4%	11.2%
Miscellaneous Manufacturing	-1.0%	-1.0%	5.0%	5.0%
Printing	-0.1%	-0.1%	3.6%	4.8%
Leather and Leather Products	0.0%	0.0%	0.2%	0.2%
Furniture and Related Products	2.9%	4.4%	2.2%	3.7%
Plastics and Rubber Products	7.5%	5.2%	5.4%	6.3%

Source: ACCF-NEM (2009) and *County Business Patterns 2008*

Table 4.3 lists Nebraska and United States employment in a group of manufacturing and mining industries thought to be "Energy-Intensive, Trade-Exposed Industries"(Interagency Report, 2009). These manufacturing and mining industries were identified to be especially vulnerable to decline under the Waxman-Markey legislation. As the name suggests, these industries would face significant cost challenges due to rising energy prices and would face significant competition from rivals located in countries without such comprehensive greenhouse gas regulation. Firms in such industries are scheduled to receive additional emissions allowances in the first 15 years of Waxman-Markey implementation, but would ultimately face rising costs.

Table 4.3
2008 Nebraska and U.S. Employment in Energy-Intensive, Trade-Exposed Industries

NAICS Code: Description	Nebraska Employment 2008	United States Employment 2008
212210: Iron Ore Mining	0	5,018
212234: Copper Ore and Nickel Ore Mining	0	9,379
312213: Malt manufacturing	0	900
311221: Wet Corn Milling	0	11,279
311613: Rendering and Meat Byproduct Processing	440	9,451
314992: Yarn Spinning Mills	60	22,668
314992: Tire Cord and Tire Fabric Mills	0	3,318
321219: Reconstituted Wood Product Manufacturing	0	18,536
322110: Pulp Mills	0	7,030
322121: Paper (except Newsprint) Mills	10	74,115
322122: Newsprint Mills	10	4,804
322130: Paperboard Mills	10	37,419
325110: Petrochemical Manufacturing	0	9,084
325131: Inorganic Dye and Pigment Manufacturing	0	7,324
325181: Alkalies and Chlorine Manufacturing	0	7,500
325182: Carbon Black Manufacturing	0	1,696
325188: All Other Basic Inorganic Chemical Manufacturing	156	37,916
325192: Cyclic Crude and Intermediate Manufacturing	0	3,335
325199: All Other Basic Organic Chemical Manufacturing	140	72,332
325211: Plastic Material and Resin Manufacturing	69	72,878
325212: Synthetic Rubber Manufacturing	0	9,638
325221: Cellulosic Organic Fiber Manufacturing	0	1,474
325222: Noncellulosic Organic Fiber Manufacturing	0	15,423
325311: Nitrogenous Fertilizer Manufacturing	60	3,943
327111: Vitreous China Plumbing Fixtures and China	10	4,081
327112: Vitreous China, Fine Earthenware, and Other	10	7,947
327113: Porcelain Electrical Supply Manufacturing	0	5,387
327122: Ceramic Wall and Floor Tile Manufacturing	100	6,444
327123: Other Structural Clay Product Manufacturing	0	1,456
327125: Nonclay Refractory Manufacturing	0	4,860
327211: Flat Glass Manufacturing	0	10,403
327212: Other Pressed and Blown Glass and Glassware	37	21,171
327213: Glass Container Manufacturing	0	17,500
327310: Cement Manufacturing	175	17,648
327410: Lime Manufacturing	0	4,562
327992: Ground or Treated Mineral and Earth	0	6,735
327993: Mineral Wool Manufacturing	0	17,856

Source: *2008 County Business Patterns*

Table 4.3 (Continued)
2008 Nebraska and U.S. Employment in Energy-Intensive, Trade-Exposed Industries

NAICS Code: Description	**Nebraska Employment 2008**	**United States Employment 2008**
331111: Iron and Steel Mills	392	107,066
331112: Electrometallurgical Ferroalloy Products	0	2,518
331210: Iron and Steel Pipe and Tube Manufacturing	0	18,275
331311: Alumina Refining	0	1,625
331312: Primary Aluminum Production	0	9,176
331411: Primary Smelting and Refining of Copper	0	1,580
331419: Primary Smelting and Refining of Nonferous Metal	0	7,608
331511: Iron Foundries	244	49,276
335991: Carbon and Graphite Product Manufacturing	0	8,598
Total Energy-Intensive, Trade-Exposed Industry Employment	1,918	778,231
All Manufacturing	104,997	13,096,157
All Mining	884	629,271
Share of Manufacturing and Mining	1.8%	5.7%

Source: *2008 County Business Patterns*
**Numbers have been rounded*

Employment figures from the 2008 County Business Patterns Report of the U.S. Department of Commerce are reported in Table 4.3 for both Nebraska and the United States. Table 4.3 also shows Nebraska and United States employment in these energy-intensive, trade-exposed industries as a share of all manufacturing and mining employment. These industries account for just 1.8% of Nebraska manufacturing and mining employment, but 5.7% of United States manufacturing and mining employment. The share is more than 3 times as high for the U.S. than for Nebraska.

Both Tables 4.2 and 4.3 suggest that the losses in manufacturing activity due to cap and trade legislation or other regulation of greenhouse gases will not be as severe in Nebraska as nationwide. That said, rising energy prices and direct cost impacts will be quite significant for many individual Nebraska manufacturers, particularly in hard hit industries such as primary metals production, glass production, and machinery manufacturers. Overall, however, the decline in manufacturing activity relative to the unregulated case in 2030 may be more in the

4% to 6% range rather than the 6% to 8% range projected nationally from sources such as EIA and ACCF-NEM.

C. Economic Consequences for Nebraska Agriculture

The estimated impact of climate legislation or regulation on U.S. agriculture provides some insight into the potential effects of legislation or regulation on Nebraska agriculture.

Potential Costs

Regulations on greenhouse gas emissions that drive up transportation and energy costs will in turn drive up agricultural input costs in Nebraska in both the short and long run. The studies and cost estimates referenced in the analysis of U.S. agricultural impacts also provide some guidance on the scale of impacts on Nebraska. Nebraska costs for 2009 for selected energy-intensive input categories were pulled from the same USDA Economic Research Service database as used for national analysis. Assuming the same percentage increases from the earlier analysis, projected cost increases relative to baseline levels in Nebraska in the short and long run are shown in Table 4.4.

Table 4.4
Nebraska Aggregate Farm Cost Estimates

	2009	2020 (Short Run)		2050 (Long Run)	
	Baseline Level	Assumed Increase	Cost Increase Above Baseline	Assumed Increase	Cost Increase Above Baseline
Category	**(Million 2009$)**	**(%)**	**(Million 2009$)**	**(%)**	**($ Million 2009$)**
Fertilizer	$1,210	6%	$73	15%	$182
Fuel and Oil	$596	4%	$24	11%	$66
Electricity	$166	16%	$31	45%	$87
Total Energy-Intensive Costs	$1,971		$128		$334

Source: U.S. Department of Agriculture and author's calculations

The estimated cost increases of $128 million (2009$) in the short run and $334 million (2009$) in the long run relative to baseline levels amount to about 0.9% of all farm costs (purchased inputs, labor, land, capital, and taxes) by 2020 and 2.3% by 2050, the same percentage as U.S. aggregate farm cost levels. This represents 4.5% and 11.7% of Nebraska's $2.9 billion in 2009 net farm income when analyzing the short run and long run respectively. Both percentages are higher than in the U.S. aggregate net farm income comparison earlier. A greater concentration in Nebraska of general commodity production and a large livestock production sector that operates on smaller profit margins relative to value of production means Nebraska generally lives with smaller net farm income margins. Thus, cost increases in Nebraska that are similar to U.S. numbers can result in a greater percentage impact on Nebraska agriculture's bottom line.

As with the U.S. analysis, these cost estimates likely overstate the negative impact of climate legislation or regulation on Nebraska agriculture. At the U.S. level, there are projected downward adjustments for both fertilizer usage and major crop acreage. The fertilizer usage may fall in Nebraska as well, particularly with the concentration of high-fertilizer-use corn acreage in the state. Still, major acreage shifts are likely to occur outside of Nebraska in states that are at the margin of major crop production regions. Eastern and Central Nebraska remain in the heart of corn and soybean production while Western Nebraska remains in the heart of the High Plains wheat production region. The crop acres in Nebraska are not likely to be the first to shift out of production, so the increased energy costs will largely be passed on to Nebraska producers. The primary offset to these costs will be the projected increase in agricultural prices consistent with declines in production primarily in other regions of the country.

There are other limitations to the analysis that are similar to the discussion of U.S. impacts. Potential changes in crop or enterprise mix due to energy price changes or relative changes in costs across countries are not assessed. Potential direct regulations of agricultural emissions are also not considered, but could be substantial, particularly for Nebraska's large livestock industry. Also, the analysis focuses on changes in profitability due to changes in energy prices. The analysis does not consider any potential changes in productivity or costs due to changes in climate associated with greenhouse gas emissions nor does it consider any productivity losses or costs avoided due to climate legislation or regulation.

Potential Benefits

Nebraska agriculture is also in line to benefit from some of the potential climate legislation or regulations. Nebraska is the second leading producer of ethanol in the United States, with nearly 15% of the nation's current 13.1 million gallons of operating production capacity (Renewable Fuels Association and Nebraska Ethanol Board). Any growth in demand for reduced-emission biofuels such as ethanol as a result of tighter regulations or higher costs on emissions could help Nebraska's biofuels industry and Nebraska agriculture as the provider of feedstocks to the industry.

The other primary benefit for Nebraska agriculture is the opportunity to provide carbon credits or offsets in a market for greenhouse gas emission allowances. While proposed legislation would have established an opportunity for agriculture to provide carbon credits, it is not clear whether such an opportunity would be part of any proposed EPA regulations. Regardless, an analysis of the potential impact on Nebraska if carbon offsets from agriculture are allowed provides some insight in the potential benefits. At the national level, EPA analysis of the climate legislation assumed no net increase in carbon sequestration on agricultural lands - increased conservation efforts were offset by shifts in land use out of agriculture and into forestry. Yet, if the conclusion above regarding minimal shifts in Nebraska acreage holds, then Nebraska producers may be able to enhance their management practices to sequester more carbon and earn credits for sale in an emissions allowance market. While there are several practices that could generate carbon credits, a look at the adoption and maintenance of conservation tillage practices and the transition of cropland to permanent grassland provides the most insight for this analysis.

Research and literature on carbon sequestration through agricultural practices provides varied estimates of potential sequestration. A paper from 2002 published in *the Journal of Soil and Water Conservation* by Eve, et al. identified potential sequestration rates for different practices in the major U.S. agricultural growing regions. The study estimated potential carbon sequestration in converting conventional tillage to conservation tillage at 0.40 metric tons (MT) of CO_2 per acre per year in the Northern Plains region including Nebraska, with a higher rate of 0.54 MT CO_2 per acre per year in the Corn Belt states east of Nebraska. A separate source of carbon sequestration rate estimates comes from the contractual standards used by the Chicago Climate Exchange (CCX). While the exchange's trading volume for voluntary offsets has declined in the past year, the established protocols that exist for offset contracts sold on the exchange provide standard sequestration rates for different practices across the country. For conservation tillage, the CCX sets a rate of 0.6 MT CO_2 per acre per year for much of the eastern United States as well as central and eastern Nebraska and irrigated crop production systems in the rest of the state. For the remaining dryland production systems in the state, the rate varies between 0.2 and 0.4 MT CO_2 per acre per year (assumed at 0.3 MT CO_2 per acre per year). Nebraska has approximately 18.3 million acres of cultivated crop and hay acres in the state (National Agricultural Statistics Service). The breakout of these acres by region is shown in Table 4.5 along with an estimate of existing conservation tillage practice adoption (based on Horowitz, et al.) and calculated carbon sequestration levels.

In calculating potential carbon sequestration on Nebraska cropland, one complicating factor is whether only new sequestration will be credited or whether existing sequestration achieved by "good actors" will also earn credits. Rewarding only new sequestration would apply credits only to actual new reductions in emissions, and not rewarding existing efforts would create a perverse incentive to till existing conservation acres and then re-introduce them as "new" acres that earn credits, while releasing substantial stored carbon in the process. If new and existing efforts are rewarded, Nebraska could theoretically earn up to 9.967 million MT CO_2 credits per year. In the short run at an assumed real price of $20 per ton, those credits could be worth up to $199 million. In the long run at an assumed real price of $70 per ton, the credits could be worth $698 million. In both cases, the carbon offsets would be sufficient to more than offset the losses associated with higher energy costs and higher agricultural input costs. However, the potential credits are a theoretical ceiling and actual credits could be substantially less based on whether existing practices get any credits and based on the reality that not all acres could be effectively converted to conservation tillage to earn carbon credits.

There are other credits potentially available. Converting cropland to permanent grassland is credited at 1.0 MT CO_2 per acre per year in Nebraska in the CCX contract standards. If we assume from the earlier discussion that not many Nebraska acres would be converted from cropland, then this potential benefit is small. But, Nebraska does have 1.1 million acres currently enrolled in the CRP. Of that acreage, approximately 788,000 acres are established in grassland. At the CCX rate, those CRP acres could be worth an additional $16 million per year in the short run (at the assumed real price of $20 per ton) and $55 million per year in the long run (at the assumed real price of $70 per ton).

Table 4.5
Crop Acres, Conservation Tillage, and Carbon Sequestration in Nebraska

Category	**Acres**	**Assumed Existing Conservation Tillage (Percent)**	**Carbon Sequestration Assumed Rate (MT CO_2/ acre/year)**	**From Existing Practices (MT CO_2 / year)**	**From Potential New Practices (MT CO_2 / year)**
Cultivated Crop Acreage					
Irrigated	7,684,000	75%	0.6	3,457,800	1,152,600
Dryland - West	1,762,500	75%	0.3	396,563	132,188
Dryland - Central and East	6,104,100	75%	0.6	2,746,845	915,615
Hay Acreage					
Irrigated	330,000	100%	0.6	198,000	0
Dryland - West	1,514,000	100%	0.3	454,200	0
Dryland - Central and East	856,000	100%	0.6	513,600	0
Total	18,250,600			7,767,008	2,200,403

Source: U.S. Department of Agriculture and author's calculations

Finally, the biggest potential sequestration nationally is assumed to come from afforestation; however, the Eve, et al. study of sequestration rates does not even estimate potential carbon sequestration from afforestation in the Northern Plains presumably due to a lack of suitability for establishment of forestry in the region. Thus, there is little expectation of substantial credits earned in Nebraska. The biggest impact in Nebraska from the afforestation will be the impact on commodity prices due to acreage shifts in other parts of the country. The decline in U.S. crop acreage and the corresponding increase in crop prices could offer substantial benefits to Nebraska agriculture, especially if the acreage shifts in Nebraska are small as was assumed earlier. However, the gains will be partially offset by the increased feed prices to Nebraska's livestock sector and the expected reduction in livestock production as a result.

Net Impact on Nebraska Agriculture

As with the national analysis, the net impact of potential climate legislation or regulation on Nebraska agriculture is very dependent on the exact provisions of proposed rules as well as the assumptions and modeling parameters used in the studies. In general, Nebraska agriculture would see modestly higher production costs in the short run and somewhat greater cost increases in the long run relative to baseline levels, but those cost increases are a larger share of net farm income in the state and therefore represent a significant economic shock to the sector. Limited acreage shifts in Nebraska likely mean these costs are largely realized, but they will be offset to some extent by cuts in fertilizer usage and acreage nationally that drive up commodity prices. Nebraska agriculture could benefit from climate legislation or regulation if new rules lead to increased demand for biofuel production, of which Nebraska is a leading producer. Nebraska agriculture could also benefit by sequestering carbon and earning carbon credits if agriculture is allowed to do so and if "good actors" are rewarded for carbon already sequestered through existing practices. The carbon credits earned by Nebraska agriculture could exceed the increased input costs under analyzed scenarios. While costs are projected to increase $128 million over baseline estimates in the short run, carbon credits from conservation tillage could be worth as much as $199 million in the short run. In the long run, costs are projected to increase $334 million over baseline estimates while carbon credits from conservation tillage could be worth as much as $698 million. In addition, land use changes nationally away from cropland and grassland to forestry could benefit Nebraska agriculture by driving up commodity prices, although the Nebraska livestock sector would also have to absorb higher feed costs in the process.

In summary, Nebraska agriculture could benefit from climate legislation or regulation based on the analysis above, but, as with the national results, the gains are largely dependent on carbon offset revenues and increased prices from reduced agricultural production. The analysis does not consider potential costs to Nebraska agriculture if agriculture is regulated instead of exempted and the analysis does not consider the cost to consumers of reduced production and higher commodity prices.

D. Economic Consequences for Nebraska

Several of the national studies of cap and trade legislation broke out estimated economic consequences to the State level. For example, the American Council for Capital Formation-National Association of Manufacturers (ACCF-NEM) study produced an estimate of the impact of the Waxman-Markey legislation for each of the 50 states. These estimates were broken out from the national estimates in the ACCF-NEM report, which were discussed in Chapter 3. Table 4.6 below summarizes the estimated impact of that legislation for major economic indicators for Nebraska. Once again, results are presented for the Low Cost and High Cost scenarios developed by ACCF-NEM. Recall that both of these cases corresponded roughly to the No International/Limited scenario in the Energy Information Administration (EIA) analysis. This was the highest cost scenario developed by EIA.

Table 4.6
Economic Consequences for Nebraska of Cap and Trade Programs by Scenario in ACCF/NAM Report

Variable	Low Cost	High Cost	Low Cost	High Cost
	2020		2030	
Waxman-Markey				
Employment	90	-610	-14,420	-19,630
Gross State Product (Millions 2007$)	-$71	-$122	-$750	-$1,023
Residential Electricity Prices ($/KWH)	$0.007	$0.001	$0.023	$0.028

Note: Results presented in $/MMBTU and converted to $/KWH by authors
Source: ACCF/NAM (2009).

Results show that there are also substantial impacts at the state level. This can be seen most clearly in the estimated impact on employment. Results show modest employment losses for the year 2020, but then economic consequences grow between 2020 and 2030, just as in the national analysis as emissions allowances become more costly. Nebraska is expected to have between 14,400 and 19,600 fewer jobs in 2030 with the Waxman-Markey legislation, depending on the scenario. In other words, employment will continue to grow in Nebraska between 2010 and 2030, but it will grow by 14,400 to 19,600 fewer jobs. This is the equivalent of 1 to 2 years of "lost" employment growth.

Results in Table 4.6 indicate meaningful economic consequences for the State of Nebraska, just as was found at the national level, but the key issue is: will losses be more or less severe in Nebraska than nationwide? This issue is examined in Table 4.7, where the losses in Table 4.6 are put in terms of the percentage of the Nebraska economy. Once in percentage terms, state losses can be compared with the percentage losses at the national level examined in Chapter 3.

Results suggest that the percent increase in retail electricity prices increases would be similar in Nebraska and the United States under ACCF-NEM's lower cost scenario. However, Nebraska price increases would be less severe than national price increases in the High Cost scenario. The 2.3 cents/kwh to 2.8 cents/kwh price increases predicted for 2030 residential electricity prices in Nebraska in the ACCF-NEM analysis of the Waxman-Markey legislation represent a 27.6% to 33.6% price increase over the base case/reference scenario.[6] Further, even these substantial increases may be on the low end of possible price changes. Analysis by the Omaha Public Power District estimates that retail rates (including residential, commercial, and industrial customers) would rise by 97% by 2030 under Waxman-Markey legislation and by 89% under the Kerry-Lieberman legislation.

Looking at other measures, ACCF-NEM estimates of job loss in Nebraska are very similar to national losses. In 2030, Nebraska employment would be 1.2% to 1.7% lower compared to the reference case under the Waxman-Markey legislation, similar to the percentage decline nationwide. ACCF-NEM estimates for GDP loss, however, would be less severe in Nebraska than nationwide. This result is at odds with the findings for employment and residential electricity rates. This may occur in part because business activity losses under Waxman-Markey (outside of energy sectors) are most severe in the manufacturing sector, and the Nebraska manufacturing sector has a lower share of business activity in the portions of the manufacturing sector that are hardest hit by the Waxman-Markey legislation. This result also may occur given that Nebraska has a large agricultural sector that could be lightly impacted by climate change legislation or regulation.

[6] For baseline scenarios, we assumed that employment, gross state product, and electricity prices grew at the same rate in Nebraska between 2007 and 2030 as each grew nationally under the reference scenario in the ACCF-NEM report.

Table 4.7
Percent Economic Consequences for Nebraska and United States of Cap and Trade Programs by Scenario in ACCF/NAM Report

Variable	Low Cost	High Cost	Low Cost	High Cost
	2020		2030	
Nebraska				
Employment	0.0%	-0.1%	-1.2%	-1.7%
Gross Domestic Product (Millions 2007$)	-0.1%	-0.1%	-0.5%	-0.7%
Residential Electricity Price ($/KWH)	8.8%	1.3%	27.6%	33.6%
United States				
Employment	0.0%	0.0%	-1.1%	-1.5%
Gross Domestic Product (Millions 2007$)	-0.2%	-0.4%	-1.8%	-2.4%
Residential Electricity Price ($/KWH)	4.9%	7.9%	31.4%	50.0%

Source: ACCF/NAM (2009).

Chapter 5: Summary

This document summarized key economic issues surrounding climate change legislation and regulation and considered the potential implications for Nebraska. We began with a discussion of economic theory and principles that pertain to climate change policy, and then proceeded to evaluate the economic consequences of climate change legislation and regulation for the nation in general, and Nebraska in specific.

We demonstrated that economic theory suggests that a tax can be used to ensure that polluters consider the negative externalities of pollution on society. Such a tax, or alternative approach such as a cap and trade system, however, must be set at the appropriate level to reflect externality costs. The difficulty in the case of any type of pollution is that there is often uncertainty about the true social costs of emissions. This issue is particularly difficult in the case of greenhouse gas emissions, given that there is uncertainty as to the precise manmade contribution to global warming and to how much this increase in global warming will impact the economy. Economic consequences also may occur decades in the future, and thus will be heavily discounted. Despite this uncertainty, the public may choose to regulate and reduce greenhouse gas emissions, either in order to reduce the chances of a severe economic outcome, or out of a concern for the environment that is unrelated to economic issues.

When making such a decision, however, it is critical to understand the cost to the economy of the proposed regulation. As a result, we considered the potential economic consequences of recent proposed legislation to limit greenhouse gas emissions. For our analysis, we used the example of recent climate change legislation in the United States House of Representatives (Waxman-Markey) and in the United States Senate (Kerry-Lieberman). Our review of literature and analysis found that either of these versions of cap and trade legislation would likely lead to a 2% reduction in U.S. GDP by the year 2030 relative to a reference scenario without climate change legislation. Losses in U.S. GDP may be less severe in the decades leading up to 2030, but also may be just as severe after 2030. Retail electric prices also are expected to rise by 30% to 70% by 2030 under the climate change regulation, depending on the scenario. The manufacturing sector will be especially hard-hit, with a 5% to 7% decline in industrial output and manufacturing employment, given that the energy-intensive, internationally competitive manufacturing sector is expected to be hard-hit by increases in energy prices.

The economic consequences might be expected to be more modest in Nebraska, however. The state has a smaller share of manufacturing activity in the hardest-hit segments of the industry. And, the state has a large agricultural sector which may be impacted lightly or even benefit from climate change legislation or regulation. Based on analysis of production agriculture and gross state product, agriculture has produced an average of about $5 billion in net value added in the past five years out of an average gross state product of about $77 billion for a 6.5% share. This compares to a 1.1% share nationwide.

References

American Council for Competiveness and National Association of Manufacturers, 2009. *Analysis of the Waxman-Markey Bill "The American Clean Energy and Security Act of 2009" (HR 2454) using the National Energy Modeling System (NEMS/ACCF/NAM 2).*

Babcock. B.A., 2009. "Costs and Benefits to Agriculture From Climate Change Policy." Center for Agricultural and Rural Development, Iowa State University. *Iowa Ag Review* 15,3 (Summer 2009).

Chicago Climate Exchange. 2010. "Continuous Conservation Tillage and Conversion to Grassland Soil Carbon Sequestration Offsets." Available at: http://www.chicagoclimatex.com/content.jsf?id=781 Accessed November 22, 2010.

Economic Research Service. 2010. "U.S. Farm Income Data." United States Department of Agriculture. Available at http://www.ers.usda.gov/Data/FarmIncome/Finfidmu.htm. Accessed November 22, 2010.

Energy Information Administration, 2009. *Energy Market and Economic Impacts of H.B. 2454, the American Clean Energy and Security Act of 2009*. (August), SR/OAIF/2009-05.

Energy Information Administration, 2010. *Energy Market and Economic Impacts of the American Power Act of 2010*. (July), SR/OAIF/2010-01.

Environmental Protection Agency, 2009. "EPA Analysis of the American Clean Energy and Security Act of 2009: H.R. 2454 in the 111th Congress." Published on June 23, 2009. Available at: http://www.epa.gov/climatechange/economics/economicanalyses.html.

Environmental Protection Agency, 2009. "Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act." *Federal Register* 74,239(2009):66496-66546. Published on December 15, 2009.

Eve, M.D., M. Sperow, K. Howerton, K. Paustian, and R.F. Follett. 2002. "Predicted Impact of Management Changes on Soil Carbon Storage for Each Cropland Region of the Conterminous United States." *Journal of Soil and Water Conservation* 57,4 (July/August):196-204.

Food and Agricultural Policy Research Institute. 2009. "The Effect of Higher Energy Prices form H.R. 2454 on Missouri Crop Production Costs." University of Missouri. FAPRI-MU Report #05-09. Published in July 2009.

Horowitz, J., R. Ebel, and K. Ueda. 2010."'No-Till' Farming is a Growing Practice." United States Department of Agriculture, Economic Research Service. Economic Information Bulletin No. 70. Available at: http://www.ers.usda.gov/Publications/EIB70/.

Interagency Report, 2009. *The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries* An Interagency Report Responding to the Request from Senators Bayh, Specter, Stabenow, McCaskell, and Brown.

National Agricultural Statistics Service. 2010. "Quick-Stats." United States Department of Agriculture. Available at: http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats_1.0/index.asp. Accessed on November 22, 2010.

Nebraska Ethanol Board. 2010. "Nebraska Ethanol Industry: Ethanol Plants in Nebraska." Available at: http://www.ne-ethanol.org/industry/ethplants.htm.

Omaha Public Power District, 2010. *Cost Comparison Between the Kerry-Lieberman "American Power Act" and HR 2454 the Waxman-Markey "American Clean Energy and Security Act of 2009" on Omaha Public Power District's (OPPD) Retail Customers*

Renewable Fuels Association. 2010. *2010 Ethanol Industry Outlook*. Available at: http://www.ethanolrfa.org/bio-refinery-locations/.

United States Congress, 2009. *American Clean Energy and Security Act of 2009*. 111th Congress, 1st Session. House of Representatives Bill 2454. Passed in the House, June 26, 2009. Available at: http://thomas.loc.gov/cgi-bin/bdquery/z?d111:h.r.02454:.

United States Congress, 2009. "Statement of Joseph Glauber, Chief Economist, U.S. Department of Agriculture Before the House Agriculture Committee, Subcommittee on Conservation, Credit, Energy, and Research." Testimony on December 2, 2009. Available at: http://agriculture.house.gov/hearings/hearingDetails.aspx?NewsID=482.

United States Congress, 2009. "Statement of Joseph Glauber, Chief Economist, U.S. Department of Agriculture Before the House Agriculture Committee, Subcommittee on Conservation, Credit, Energy, and Research." Testimony on December 3, 2009. Available at: http://agriculture.house.gov/hearings/hearingDetails.aspx?NewsID=481.

United States Congress, 2010. *Clean Energy Jobs and American Power Act*. 111th Congress, 1st Session. Senate Bill 1733. Reported from Senate Committee on Environment and Public Works, February 2, 2010. Available at: http://thomas.loc.gov/cgi-bin/bdquery/z?d111:s.01733:.

United States Department of Agriculture Economic Research Service, 2010. "U.S. Farm Income Data." Available at http://www.ers.usda.gov/Data/FarmIncome/Finfidmu.htm. Accessed November 22, 2010.

United States Department of Commerce, 2010. County Business Patterns 2008. Available on-line at http://www.census.gov/econ/cbp/.

U.S. Supreme Court. "Massachusetts et al. v. Environmental Protection Agency et al." *United States Reports* 549(2007):497. Decision on April 2, 2007.

Van den Berg, Hendrick, 2011 (forthcoming). *International Economics: A Heterodox Perspective*. M.E. Sharpe.

Weitzman, Martin, 2007. *Structural Uncertainty and the Value of Statistical Life in the Economics of Catastrophic Climate Change*. NBER Working Paper 13490. Cambridge, Massachusetts: National Bureau of Economic Research.