Prepared for:

National Black Chamber of Commerce

Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R.2454)

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TABLE OF CONTENTS

INDEX OF FIGURES AND TABLES

LIST OF ACRONYMS

ACESA - American Clean Energy and Security Act of 2009	FTE - Full-Time Equivalent
ACP - Alternative Compliance Payment	GDP - Gross Domestic Product
AEO - Annual Energy Outlook	GHG - Greenhouse Gas
BAU - Business As Usual	GW - Gigawatt
CAGR - Compound Annual Growth Rate	HHV - Higher Heating Value
CCS - Carbon Capture and Storage	kWh - Kilowatt-hour
CGE - Computable General Equilibrium	MMBtu - Million British Thermal Units
CRA - CRA International	MRN - Multi-Region National Model
EIA - Energy Information Administration	MS-MRT - Multi-Sector, Multi-Region Trade Model
EISA 2007 - Energy Independence and Security Act of 2007	NEEM - North American Electricity and Environment Model
EPA - Environmental Protection Agency	RES - Renewable Electricity Standard
EU-ETS - European Union Emissions Trading Scheme	VMT - Vehicle Miles Traveled
FOM - Fixed O&M	VOM - Variable O&M

DISCLAIMER

This report describes the conclusions of the individual authors and does not necessarily represent a position of CRA International or of its clients.

1. EXECUTIVE SUMMARY

CRA International (CRA) is a global consulting firm that has provided economic, financial, strategy and business management advice to public and private sector clients since 1965. CRA serves clients from offices on three continents.

As requested by the National Black Chamber of Commerce, CRA has used its proprietary, state-of-the-art MRN-NEEM and MS-MRT modeling systems to analyze the potential economic impacts of the proposed energy and climate legislation released by Reps. Waxman and Markey (hereafter referred to as American Clean Energy and Security Act of 2009, ACESA or H.R.2454)[1] currently being considered in the House Energy and Commerce Committee. This report is intended to help decision makers and the public understand some of the impacts the legislation could have on the U.S. economy and energy markets. These costs in turn need to be compared to the benefits of the specific proposal, and to the costs and benefits of alternatives, in order to make an informed policy choice.

To help with this comparison of approaches, the report also discusses alternative approaches that could increase or decrease the costs of meeting comparable environmental objectives. All projections in this analysis are based on the aforementioned CRA models, using publicly-available data for key input assumptions. The study examines key sections of the bill included in Title I – Clean Energy and Title III – Reducing Global Warming Pollution, particularly those provisions related to greenhouse gas (GHG) cap-and-trade, renewable energy, and offsets. The analysis focuses on how these could affect performance of the U.S. economy.

The most important conclusion is that, contrary to some claims that have been made recently, policies such as ACESA will have a cost.[2] Therefore the judgment about what action to take cannot be made simply on the grounds that a cap-and-trade program will create additional jobs and stimulate economic growth – it will not – but on whether the benefits are worth the cost. And it needs to be recognized that the benefits of any action by the United States alone are limited because of the relatively small share that the United States will contribute to global emissions over the next century.

This analysis reveals that businesses and consumers would face higher energy and transportation costs under ACESA, which would lead to increased costs of other goods and services throughout the economy. As the costs of goods and services rise, household

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[1] Bill released May 15, 2009.

[2] Claims to the contrary include, for example, House Speaker Nancy Pelosi's statement, "There should be no cost to the consumer." *Wall Street Journal*, April 24, 2009, in "Democrats Weigh Break for Utilities in Climate-Change Bill," Greg Hitt and Stephen Power, available at http://online.wsj.com/article/SB124050061773748291.html.

disposable income and household consumption would fall. Wages and returns on investment would also fall, resulting in lower productivity growth and reduced employment opportunities. Impacts would differ across regions of the economy, depending on how local energy costs will change, whether local industries will be favored or harmed, and allocation formulas.

It is not possible to avoid these costs through any free distribution of carbon allowances.[3] Although the wise use of revenues from an auction or carbon tax can ameliorate impacts to some segments of the economy, the cost of bringing emissions down to levels required by the caps cannot be avoided. It is this cost of bringing down emissions that the present analysis estimates, in terms of reductions in GDP and household consumption. Allocations do shift who bears the burden across industries, regions, and income groups, as do decisions about how to spend or return to taxpayers the revenues from allowance auctions.

Just as it is impossible to eliminate the cost of reducing emissions to levels consistent with the cap through allocations or revenue recycling, it is impossible to bring about a net increase in labor earnings through measures that impose a net cost on the economy. The present study finds that the cap-and-trade program would lead to increases in spending on energy efficiency and renewable energy, and as a result that significant numbers of people would be employed in “green jobs” that would not exist in a no carbon policy world. However, any calculation of jobs created in these activities is incomplete if not supplemented with a calculation of the reduced employment in other industries and the decline in the average salary that would result from the associated higher energy costs and lower overall productivity in the economy. This study finds that even after accounting for green jobs, there is a substantial and long-term net reduction in total labor earnings and employment. This is the unintended but predictable consequence of investing to create a “green energy future.”

The costs estimated in this study would be much higher if it were not for the assumed use (and *availability*) of international offsets authorized by the bill. Full use of these international offsets would allow U.S. total emissions over the period from 2012 to 2050 to exceed the cap by about 30%.[4] The difference would be made up by paying for offsets that are deemed to represent emission reductions occurring in other countries. However, in light of the difficulties in measuring, verifying, and ensuring the permanence of these offsets, international negotiations have stressed domestic sources of emission reductions over international offsets. The actual rules to be developed for international offsets might allow far fewer than the authorized amount. This would drive costs up substantially.

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[3] Estimates of impacts on consumers are based on the assumption that all auction revenues are returned to households on a per capita basis and that the value of allocated allowances is also returned in the form of utility rebates and increased investment income from companies receiving allocations.

[4] If domestic offsets are not fully utilized thereby allowing international offsets to increase to as much as 1.5 billion tons per year then the effective increase in the cap from international offsets would exceed 30%.

An important set of provisions in the bill, some of which neither this analysis nor any other has been able to model fully, are regulatory measures that go beyond the cap-and-trade program to require a certain percentage of electricity generation to come from renewable sources (included in this analysis) and mandate specific improvements in a number of standards for building energy efficiency, lighting and appliances. This analysis includes extensive improvements in energy efficiency, consistent with the amount of efficiency improvement implicit in these mandates. However, much of that efficiency improvement may come from a different mix of actions than the specific mandated actions in ACESA. ACESA's mandates approach will constrain the options of households and businesses as to how best to reduce their carbon footprints in light of the incentive provided by the cap-and-trade system. Therefore, the energy user (and electricity generator) may not be able to choose the most cost-effective technology or method to reduce their emissions. To the extent that the consumer and business person are the best judges of how to manage their own affairs and choose ways of dealing with higher energy prices, the regulatory measures in ACESA will increase costs to the U.S. economy beyond what we have estimated.

No model can capture all these costs, because to do so would require as much information as the individual household or business has about its own affairs. Thus any attempt to quantify the costs of command-and-control regulations of this type is likely to significantly underestimate their costs, though even these regulations can be designed in ways that do more or less harm. Indeed, if it were possible to model all the costs of regulatory measures, there would be enough information centrally available that government regulators might actually have sufficient information to tell households and businesses how to do better jobs of managing their affairs. But government agencies do not, in fact, have any better information than analysts trying to assess costs of new legislation, so that neither is likely to understand the impacts of the kinds of mandates included in ACESA. In contrast, a program that puts a uniform and predictable price on GHG emissions provides the incentive for households and businesses to use their own information and judgment to choose the most cost-effective ways to reduce emissions, and thereby to achieve the lowest possible cost for the economy as a whole.

1.1 ECONOMIC IMPACTS

Specific economic impacts resulting from ACESA include the following:[5]

- Carbon Allowance Costs – ACESA would reduce GHG emissions through decreased use of conventional energy. As the cap progressively tightens with time, the cost of reducing emissions becomes more expensive and as a result, the cost of CO_2 allowances increases. In 2015, the cost of a CO_2 allowance is estimated to be $22

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[5] All costs in this report are expressed in terms of 2008 dollars, unless otherwise specified. In this report, when carbon or CO_2 allowance prices are discussed these prices are measured as dollars per metric ton of CO_2 equivalent (CO_2e). For GHG emissions the relevant measure is metric tons of CO_2e.

per metric ton of CO_2. By 2030, the allowance cost could increase to $46 per metric ton of CO_2 and by 2050, the allowance cost could reach $124 per metric ton of CO_2.

- Utility Rates and Utility Bills – Energy cost impacts consider the combined effect of changes in the prices of the fundamental energy commodities and the added cost of limiting carbon emissions. In the case of electricity and natural gas supplied through companies regulated by utility commissions, free allowance allocations will mitigate some of the total cost borne by retail customers. ACESA provides free allocations to such local distribution companies, but requires that the full cost of carbon still be reflected in the rates per unit of energy each customer uses. Relative to energy costs in the *Annual Energy Outlook (AEO) 2009* Baseline level, retail natural gas rates would rise by an estimated 10% ($1.20 per MMBtu) in 2015, by 16% ($2.30 per MMBtu) in 2030, and by 34% ($5.40 per MMBtu) in 2050. Retail electricity rates are estimated to increase by 7.3% (1.1 cents per kWh) relative to baseline levels in 2015, by 22% (2.8 cents per kWh) in 2030 and by 45% (6.1 cents per kWh) in 2050. To the extent that utilities return the value of their free allocations under ACESA to customers through reductions in fixed charges, actual total *bills* for electricity and natural gas will not rise as much as the *rates*. Total utility bills may even decline in the first years of the policy if there is also substantial investment in end-use efficiency and/or conservation in response to the higher energy rates. We estimate that given the allocations in ACESA, average U.S. electricity utility bills would decline by about 0.5% in 2015, and then rise by about 4% to 5% in the 2020 to 2025 time period. Post-2025, as the allocations are phased out bills would rise more dramatically. We estimate that given the allocations in ACESA, average U.S. natural gas utility bills would increase by about 2.5% in 2015, and then rise by about 5% to 6% in the 2020 to 2025 time period, then rise more dramatically as the allocations are phased out.

- Transportation Fuel Costs - After an estimated 12 cents per gallon increase in 2015, costs of using motor fuels are estimated to increase by 5% (23 cents per gallon) in 2030 and increase by 11% (59 cents per gallon) in 2050, relative to baseline levels. These cost impacts consider the combined effect of changes in the market prices of the fundamental energy commodities, the added cost of limiting carbon emissions, and projected shifts towards a lower-carbon mix of energy sources used to fuel the average vehicle.

- Employment – A net reduction in U.S. employment of 2.3 million to 2.7 million jobs in each year of the policy through 2030. These reductions are net of substantial gains in “green jobs.” While all regions of the country would be adversely impacted, the West, Oklahoma/Texas and the Mississippi Valley regions would be disproportionately affected.

- Wages – Declines in workers’ wages will become more severe with time. The earnings of an average worker who remains employed would be approximately $170 less by 2015, $390 less by 2030, and $960 less by 2050, relative to baseline levels.

- Household Purchasing Power - The average American household's annual purchasing power is estimated to decline relative to the no carbon policy case by $730 in 2015, by $830 in 2030, and by $940 in 2050. These changes are calculated against 2010 income levels (the median U.S. household income in 2007 is approximately $50,000). They would be larger if stated against projected future baseline income levels.

- Overall Economic Activity - In 2015, gross domestic product (GDP), a commonly-used measure of total economic activity, is estimated to be 1.0% ($170 billon) below the baseline level driven principally by declining consumption. In 2030, GDP is estimated to be roughly 1.3% ($350 billon) below the baseline level. In 2050, GDP is estimated to be roughly 1.5% ($730 billon) below the baseline level.

1.2 RELATED ISSUES

Implementation of ACESA would result in a number of other significant issues:

- Uncertainty - Rigid caps on GHG emissions achieve certainty in the precise amount of emissions reductions over several decades, at the cost of large uncertainties about long-run carbon prices and costs to the economy, as well as short-term volatility in carbon prices. Policymakers have to decide how tightly to set a cap while the best estimates of cost to constituents differ by about a factor of two. The uncertainty and volatility also are deterrents to investment, because under different and equally plausible scenarios for carbon prices, investors will want to make different investment choices (*e.g.*, about new electric generation capacity). Potential volatility in carbon prices will impose risk-bearing costs on companies with a compliance obligation, and for industries like utilities and refineries the costs of managing trading risk could erode a significant percentage of their profit margin. Businesses and consumers already have to live with substantial volatility in commodities markets, such as for fuels. Companies are generally able to cope with unavoidable volatility in natural commodities; but that is no reason to intentionally create volatility in a new, major input (i.e., allowances) given that policymakers can establish the same carbon price incentive without any volatility at all. No matter how manageable carbon price volatility is, it has a cost, and no benefits are derived from that cost. Therefore, it is desirable to minimize carbon price volatility wherever possible. Carbon policy is one of the rare situations where carbon price volatility can be eliminated altogether while still having a clear price signal.

- Green jobs versus effects on total employment - Despite the promise of green jobs, ACESA would, if enacted, inevitably depress total employment from baseline levels. The bill would divert resources now used to produce additional goods and services into the work of obtaining energy from sources that are more costly than fossil fuels. It would, therefore, lower the sum of goods and services produced by the economy and hence the output per unit of labor. Worker compensation will decline as productivity falls. Although part of the decline in total compensation will show up as a decrease in earnings per worker, many factors inhibit decreases in average compensation. Another result of lowered productivity is likely, therefore, to appear in the form of lower employment levels.

- R&D - Technology advances sufficient to achieve the Reference or Low Cost cases will only come with a much more effective commitment to R&D. The stimulus package and ACESA almost exclusively address deployment of known technologies and large-scale demonstration of well-developed new technologies, and do not provide the level of support for the types of basic and applied research necessary to create the breakthroughs on which game-changing technologies can be built.

- Costs of a duplicate regulatory system – ACESA establishes both a GHG cap-and-trade and a series of command-and-control mandates. In some cases, the regulations may not appear to be binding; *i.e.*, the cap might, by itself, motivate all of the actions needed to meet the standard. In these instances, the standards would waste resources on needless monitoring, measuring, enforcement, and compliance, but they would not affect the pattern of GHG reductions. In other cases, the standards would change the allocation of abatement resources by mandating different choices. However, the cap sets the total GHG cutback. If the regulations mandate more change in one area, less will take place somewhere else. Standards, therefore, will force the economy to substitute more expensive GHG emission decreases for decreases of the same amount that could have been made elsewhere at lower cost.

- Wealth transfers abroad - ACESA contains provisions that will transfer wealth from the U.S. to other nations. These include allocations of allowances to overseas entities for international adaptation and purchases of offsets from foreign projects. We estimate that these provisions of ACESA would result in a transfer of U.S wealth to other countries varying from $40 billion to $60 billion per year in the years 2012 through 2030. Some possible circumstances can cause these amounts to be even larger.

Overall, ACESA is designed to raise the cost of using conventional energy by requiring emission allowances for the use of that energy, which effectively restricts the use of lower cost energy in the U.S. economy. Higher energy costs would likely reduce total consumption, employment, and economic output. The link between energy supply and its cost, and economic performance is the key to understanding the pattern of the study results and central to an assessment of the implications of ACESA. Table 1-1 provides a summary of economic impacts.

Table 1-1: Summary of projected economic impacts (change from projected baseline)

	2015	**2020**	**2030**	**2040**	**2050**
CO_2 Allowance Price (2008$/metric ton)	$22	$28	$46	$74	$124
Change in U.S. jobs (Millions)	-2.3	-2.7	-2.5	-2.5	-3.0
Change to Average Worker's Annual Wages: *Assumes Partial Wage Adjustment* ($2008)	-$170	-$270	-$390	-$600	-$960
Change in U.S. Purchasing Power ($2008 per Household)	-$730	-$800	-$830	-$850	-$940
Percentage Change in U.S. GDP	-1.0%	-1.2%	-1.3 %	-1.3 %	-1.5%
Percentage Change in Natural Gas Retail Rates*	10% ($1.20/MMBtu)	14% ($1.60/MMBtu)	16% ($2.30/MMBtu)	25% ($3.70/MMBtu)	34% ($5.40/MMBtu)
Percentage Change in Motor Fuel Cost	3% (12¢/Gallon)	4% (14¢/Gallon)	5% (23¢/Gallon)	7% (37¢/Gallon)	11% (59¢/Gallon)
Percentage Change in Electricity Retail Rates*	7.3% (1.1¢/ kWh)	16% (2.0¢/ kWh)	22% (2.8¢/ kWh)	34% (4.5¢/ kWh)	45% (6.1¢/ kWh)

* Percentage increases in utility bills will be smaller to the extent there are free allowance allocations to load-serving entities and natural gas local distribution companies and/or reduced energy consumption.

2. BACKGROUND

2.1 THE AMERICAN CLEAN ENERGY AND SECURITY ACT OF 2009

ACESA would, if enacted, impose sweeping changes on virtually all parts of the U.S. energy system. These changes would reverberate through much of the national economy. The two major provisions of the bill are a combined efficiency and renewable electricity standard and a greenhouse gas cap-and-trade system.

ACESA requires retail electric utilities to meet specified percentages of their annual load through renewable electricity generation and energy efficiency savings. The combined standard is initially set to 6% of load in 2012 and rises to a maximum of 20% by 2039. Up to one-quarter (or 5% of 2020 load) of the requirement can be met with savings from energy efficiency, and state governors can petition to increase the proportion of compliance met through energy efficiency to up to two-fifths of the combined percentage requirement. As an alternative to procuring renewable energy credits, retail electric utilities can purchase a $25 (adjusted for inflation) alternative compliance payment (ACP), the funds from which will flow back to state-led research and development of renewable electricity generation technologies and cost-effective energy efficiency programs.

Title III establishes a U.S. national cap on total GHG emissions. The cap would apply to electric utilities, oil companies, large industrial sources, and other covered entities. Entities covered by the act collectively contribute about 85% of U.S. greenhouse gas emissions, which are, in turn, approximately 17% of current global emissions. The program is designed to reduce covered emissions by 3% below 2005 levels in 2012, 17% below 2005 levels in 2020, 42% below 2005 levels in 2030, and 83% below 2005 levels in 2050.

Title III also provides for alternative compliance with the GHG emissions cap through offset credits and international emission allowances. However, it restricts the use of these measures. For international offset credits, an entity must submit five offset credits for every four tons of CO_2 that it emits, except for during the first five years of the cap. For international emission allowances, an entity may submit allowances issued by a foreign program that meets certain criteria. The total quantity of emissions that may be covered by rendering offsets to meet compliance obligations is limited to 2 billion metric tons of CO_2 in each year, split evenly between domestic and international offsets. Given the five offsets for four tons requirement for international offsets (after the first five years of the cap), this would mean that up to 2.25 billion offsets credits may be demanded under the cap each year.[6]

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[6] In addition, if domestic offsets are not fully utilized, additional international offsets may be used (up to a total of 1.5 billion international offsets, but total offsets still cannot exceed 2 billion).

2.2 PROVISIONS MODELED

The text of ACESA is more than 900 pages in length. The Congress has yet to fully determine some key features, making it impossible to model their impact. Many provisions that are provided have too little an economic impact, or their effect is too speculative, to warrant modeling. In other cases, provisions are economically consequential, but modeling them would require time and resource constraints that exceed those available for this initial effort. Detailed energy efficiency standards and mandates are consequential and are likely to raise costs and economic impacts if they change the decisions that households and businesses would make in response to the incentives created by the cap-and-trade program. However, modeling the full costs of these provisions requires a more detailed representation of individual decisions than any comprehensive economic model can encompass.

Thus, it is important to understand which aspects of ACESA have been addressed, which will be addressed later, and which lie beyond the scope of the analysis. Table 2-1 summarizes the primary provisions included in this analysis

Table 2-1: ACESA provisions modeled

Provision	**Details**
Combined efficiency and renewable electricity standard	Required specified percentages of a baseline level of electricity sales to be met with qualified renewable resources; baseline level excludes certain existing hydroelectric generation, sales from small LDCs and generation from new nuclear and carbon, capture and storage units
Greenhouse gas cap & trade	Cap on covered emissions from 2012-2050, allows banking/borrowing, annually allows for up to 2 billion in offsets (split between domestic and international offsets)
Allowances for carbon capture and storage (CCS)	Funds from allowances are used to bring online 3 GW of new CCS in 2020
Allocations provisions and revenue recycling	Regional and U.S. welfare impacts reflect ACESA's provisions for free allocations to industries and for investments in CCS and adaptation. All auctioned revenues are recycled to U.S. consumers.

Our analysis of the cap-and-trade program includes offset provisions, banking and borrowing, and the strategic reserve, all measures meant to ease the burdens expected to result from allowance price fluctuations. We have not included any of the costs of volatility in our estimates of the economic costs of the cap-and-trade program, either with or without these measures. Therefore, we are unable at this time to estimate how much these measures could reduce volatility or the costs that any remaining volatility would add to those estimated in this study.

Our analysis also estimates the impact of allowance allocations on the regional distribution of impacts and on average utility bills. These allowance allocations include free allocations to the electric sector, energy-intensive industries, natural gas distributors, automotive sector and refining sector. In addition, there are allocations made to spur investment in CCS, prevent tropical deforestation and aid in domestic and international adaptation. Remaining allowances are auctioned with proceeds being used to assist low and moderate-income households, assist states in increasing renewable energy and energy efficiency, increase research and development, assist workers and maintain budget neutrality. Our analysis also accounts for the full recycling of auction revenues in these ways.

2.3 STUDY OBJECTIVES

This study evaluates the potential economic consequences of the key provisions of ACESA. Because these provisions interact and because different elements of the economy are interconnected, the task requires the use of comprehensive and detailed economic models. These models simulate the operations of major features of the economy, so that it is possible to trace the many pathways through which legislation can affect various economic sectors and activities. CRA used its proprietary, state-of-the-art MRN-NEEM and MS-MRT modeling systems to analyze the potential impacts from ACESA on domestic energy markets and the economy. The models are described more fully in Appendix D.

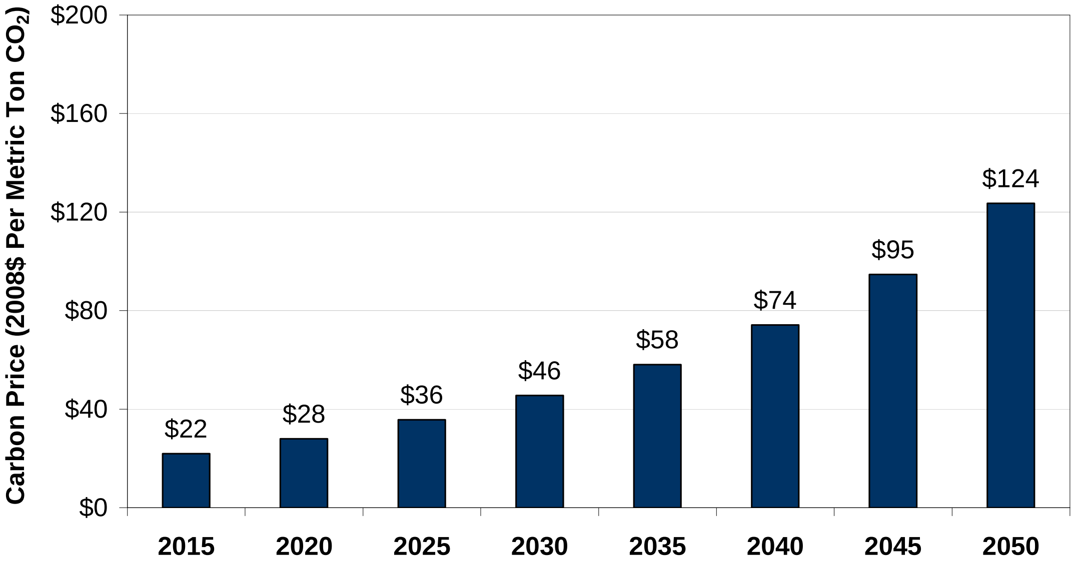
Like all other economic impact studies by EPA, EIA, and MIT, we assess only the costs of meeting the provisions of a policy, ACESA, in this case. These costs of the policy are to be compared to the benefits of whatever change in *global* atmospheric concentrations is projected to result from this single policy that affects U.S. emissions only. If a benefits calculation were to include emissions reductions from presently non-existent policies in other countries, then a different cost analysis would be required which would consider the additional costs on the U.S. economy of those additional assumed policies.

3. RESULTS

One of the primary objectives of ACESA is to implement a GHG cap-and-trade policy that would reduce greenhouse gas emissions by decreasing the use of conventional energy, which is carbon-emitting. This would be achieved by creating a limited supply of “allowances” required for the use of carbon-emitting energy, thereby increasing energy costs to the U.S. economy. As the cap progressively tightens with time (*i.e.*, allowances become scarcer), the marginal source of reducing emissions becomes more expensive as lower-cost sources of emissions reductions are exhausted. As a result, the price of an allowance increases with time as the cap becomes more stringent.

Figure 3.1 presents estimates of the CO_2 allowance price during the forecast period.[7] In 2015, the price of a carbon allowance is estimated to be $22 per metric ton of CO_2. By 2020, the allowance price would increase to $28 per metric ton of CO_2. By 2030, the allowance price would increase further to $46 per metric ton of CO_2. By 2050, the allowance price would reach $124 per metric ton of CO_2. The price pattern reflects the banking of permits that occurs in this policy. That is, permit prices increase by the annual discount rate of 5%.

Figure 3.1: Projected CO_2 allowance prices due to ACESA



Source: CRA Model Results, 2009

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[7] All allowance prices are stated in terms of 2008 dollars per metric ton of CO_2e.

The economic impacts resulting from the increasing CO_2 allowance prices would be expected to cascade throughout the economy and would likely increase energy costs and decrease production and consumption across a wide array of goods and services. The size of the projected impacts varies by region but the direction does not. The projected impacts increase throughout the period analyzed (2010 through 2050) as the measures become more stringent, with the largest changes projected over the 2030 to 2050 time period.

3.1 ECONOMIC IMPACTS

3.1.1. Costs to consumers

Consumers ultimately bear the added costs projected to result from the cap-and-trade policy. The cap-and-trade provision is projected to result in fuel switching away from less costly conventional fuels (*e.g.*, coal), towards more costly lower carbon alternatives (including natural gas) due to tightening GHG emission caps. Further, costs for all carbon-based energy sources (*e.g.*, coal, oil, and natural gas) are projected to increase as allowances would need to be purchased for the emissions associated with the use of these fuels. In the case of electricity and natural gas supplied through companies regulated by utility commissions, free allowance allocations will mitigate some of the total cost borne by retail customers. ACESA provides free allowance allocations to such load-serving entities, but requires that the full cost of carbon still be reflected in the rates per unit of energy each customer uses. The ACESA allowance allocations are also accounted for in the impacts presented in this section.

Figure 3.2 reports how the cost per unit of energy consumed by businesses and households is projected to increase relative to energy costs in the AEO 2009 baseline level:[8]

- For transportation fuels, after an estimated 12 cents per gallon increase in 2015, costs of using motor fuels are estimated to increase by 5% (23 cents per gallon) in 2030 and increase by 11% (59 cents per gallon) in 2050 relative to baseline levels. These cost impacts consider the combined effect of changes in the market prices of the fundamental energy commodities, the added cost of limiting carbon emissions, and projected shifts towards a lower-carbon mix of energy sources used to fuel the average vehicle.
- Retail natural gas *rates* (*i.e.*, the price consumers pay per unit of gas energy used) would rise by an estimated 10% increase ($1.20 per MMBtu) by the year 2015, by 16% ($2.30 per MMBtu) by the year 2030, and by 34% ($5.40 per MMBtu) by the year 2050.

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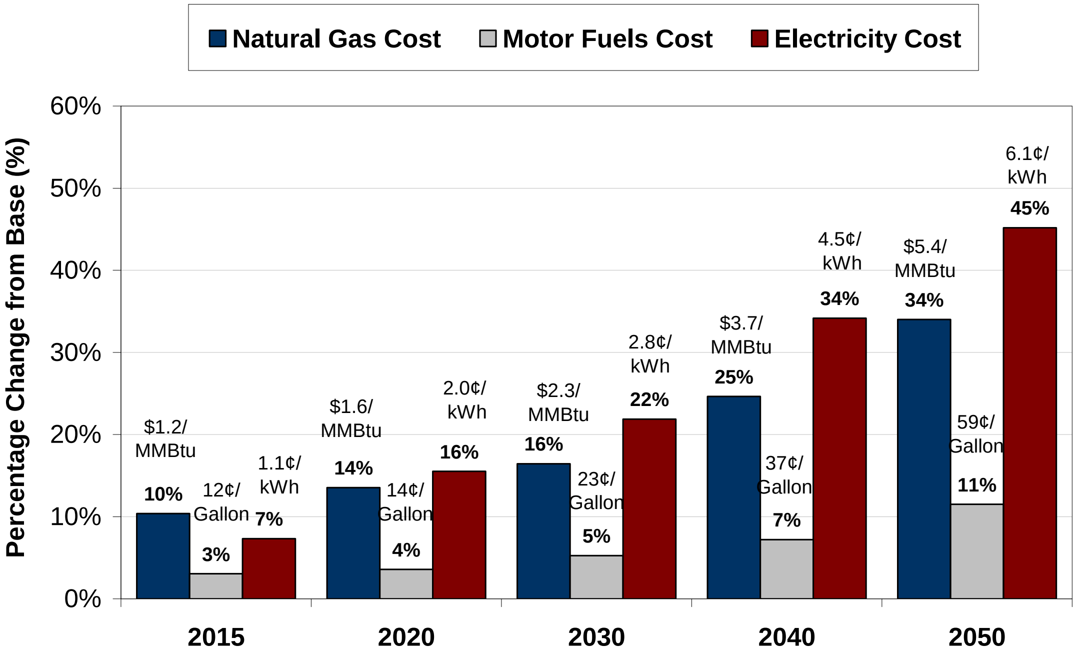
[8] Results herein are reported as changes from the EIA Annual Energy Outlook 2009 Early Release Reference Case.

- Retail electricity *rates* are estimated to increase by 7% (1.1 cents per kWh) relative to baseline levels in 2015, by 22% (2.8 cents per kWh) in 2030 and by 45% (6.1 cents per kWh) in 2050.

These increases in retail energy rates to customers of electricity and natural gas utilities are projected to occur even when accounting for ACESA's provision for free allocations of 30% of the allowances to electricity load-serving utilities, and 9% to gas utilities through 2025. This is because ACESA does not allow the value of those allocations to be returned to customers in proportion to the amount of energy that they use. The purpose of this provision is to ensure that consumers' incentives to conserve and to invest in energy efficiency are not undermined by attempts to mitigate their energy costs through free allocations. Instead, the allocation value will have to be returned to utility customers either through utility spending programs on energy efficiency or demand-side management, or through fixed rebates or credits on their bills. To the extent that utilities return the value of their free allocations under ACESA to customers through reductions in fixed charges, actual total *bills* for electricity and natural gas will not rise as much as the *rates* will. Total utility bills may even decline in the first years of the policy if there is also substantial investment in end-use efficiency and/or conservation in response to the higher energy rates.

We estimate that given the allocations in ACESA, average U.S. electricity utility bills would decline by about 0.5% in 2015, and then rise by about 4% to 5% in the 2020 to 2025 time period. Post-2025, as the allocations are phased out, bills would rise more dramatically. We estimate that given the allocations in ACESA, average U.S. natural gas utility bills would increase by about 2.5% in 2015, and then rise by about 5% to 6% in the 2020 to 2025 time period, with more dramatic increases after that as the allocations are phased out.

Figure 3.2: Projected U.S. household increases in costs inclusive of carbon costs for natural gas, motor fuels and electricity due to ACESA, relative to baseline costs



Source: CRA Model Results, 2009

3.1.2. Investment, employment and productivity growth

Claims that GHG cap-and-trade can boost total employment have become commonplace. This contention has become a central point in the national debate about climate policy. That it has is understandable; the U.S. economy is undergoing both a cyclical downturn and a structural adjustment. Unemployment is high, and so is political pressure to respond to both the short-term cyclical and to the long-term structural aspects of the challenge. Not surprisingly, this pressure has led to claims and hopes that GHG cap-and-trade might somehow solve both problems.

These claims are incorrect, and the hopes that spring from them are destined to lead to disappointment. ACESA can have no impact on the unemployment arising from the current cyclical downturn because its provisions will not take effect soon enough. In the longer run, its net effects on employment will be negative, for the reasons explained in this section.

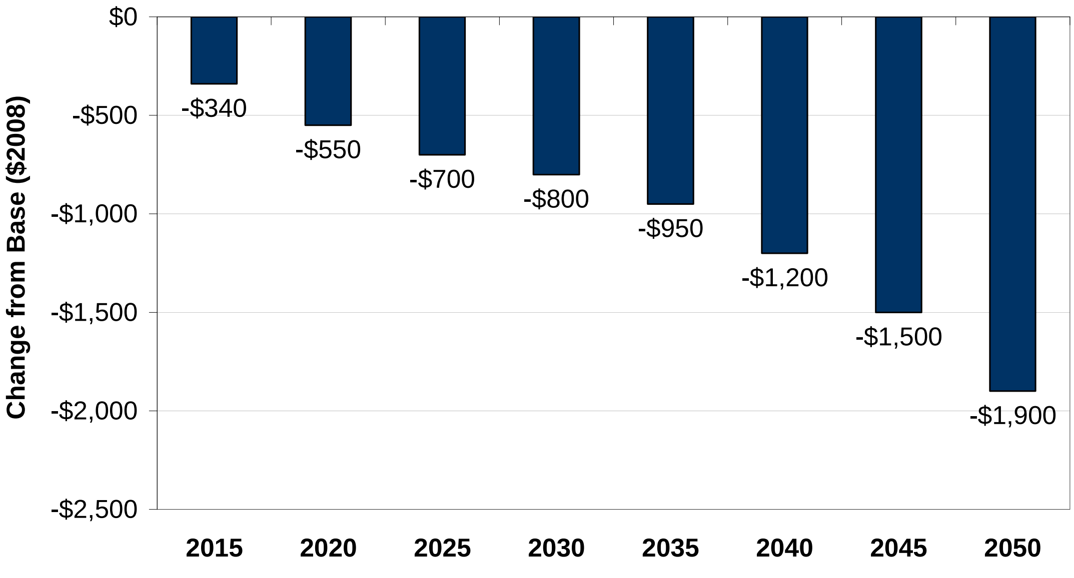
Investment diversion and impacts to productivity growth

If enacted, ACESA would divert resources now used to produce goods and services into the task of obtaining energy from sources that are more costly than fossil fuels. If consumers and businesses are forced to spend more on energy due to its higher costs, they would have less to spend on other goods and services causing decreases in demand for the quantities of goods and services produced by the economy. In addition, as the resources are diverted to more expensive energy sources, the productivity of labor will fall. Business activity is likely to contract relative to the levels that would have prevailed without policy-induced energy cost hikes. The demand for labor would weaken because employers would need to spend less on labor in order to supply the reduced amount of goods and services demanded by consumers. As a result, payments to labor are projected to decline relative to that which would have prevailed without the higher energy costs. This will be reflected in a combination of less employment, and lower wages for those workers not losing their job.

Reductions in employment and wages due to reduced productivity growth

If actual wages were to decline to their lower equilibrium level instantaneously when the equilibrium wage rate falls as a result of the lower productivity caused by the policy, then full employment would remain in effect, but workers would immediately experience reduced incomes. Figure 3.3 presents the decline in the average annual salary paid to workers that would occur under an assumption that actual wages are fully responsive to the new, lower equilibrium wage rate.

Figure 3.3: Projected impact on average annual wages due to ACESA, assuming wage rates decrease instantly to lower equilibrium



Source: CRA Model Results, 2009

Empirical experience suggests, however, that wages do not immediately respond to new equilibrium levels, particularly if that entails a decline in wages. If real wages do not immediately fall to the new, lower market-clearing level, then there will be an excess supply of labor in the economy relative to what employers are willing to hire at those overly-high wage rates, and this leads to lay-offs and an increase in unemployment. The degree of unemployment that will occur depends on how much wages actually do fall towards the new market-clearing level. An exceedingly high amount of unemployment would be estimated under ACESA if we were to assume that there would be no decline at all in real wages to the levels shown in Figure 3.3 above. And, as noted, if we assume that workers would immediately absorb the full wage decline shown in that figure, there would be no involuntary job losses.

Figure 3.4 illustrates the employment impacts if only half of the decline in the market-clearing wage rate is absorbed by workers immediately. In this case, the other half of the reduction in payments to labor has to be achieved by eliminating job positions. The actual number of job positions that would have to be shed depends on whether higher-paying or lower-paying jobs are the ones that are eliminated. In our calculation in the figure, we assume that jobs would be shed in equal proportions across the entire wage distribution, and report the loss in "average jobs." (The precise number of jobs would be lower if ACESA would disproportionately affect the relatively higher-paid positions, and it would be higher if ACESA would cause a disproportionate loss of lower-paid types of jobs.) Figure 3.4 shows that in 2015, the number of people on the unemployment rolls is estimated to be approximately 2.3 million higher than in the baseline. It also shows that there would remain between about 2.5 to 3 million fewer average jobs in the economy far into the future relative to what would otherwise have been possible but for the requirements of ACESA.

Because these estimated employment impacts are based on the general equilibrium requirement that total payments to labor must fall to the new, lower level that can be supported by the reduced overall productivity of the entire economy, *they are necessarily inclusive of all increases in so-called "green jobs" that will be created as a result of the proposed legislation*.[9]

Also, because these average losses in employment assume that workers do absorb some of the reductions in equilibrium payments to labor, there is still some depression in the average salaries to those who would retain their jobs. The decline in average annual wages that is consistent with the employment reductions in Figure 3.4 is shown in Figure 3.5.

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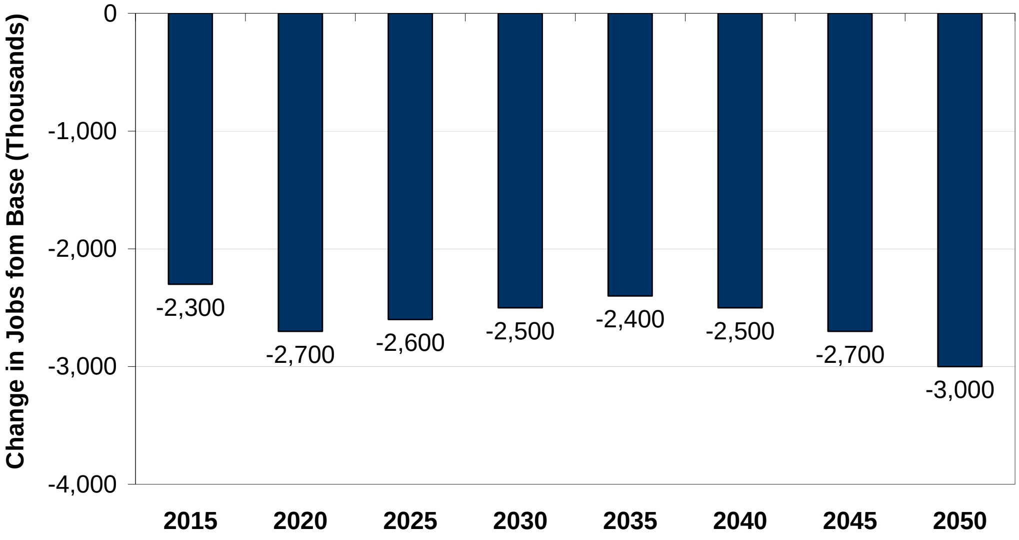
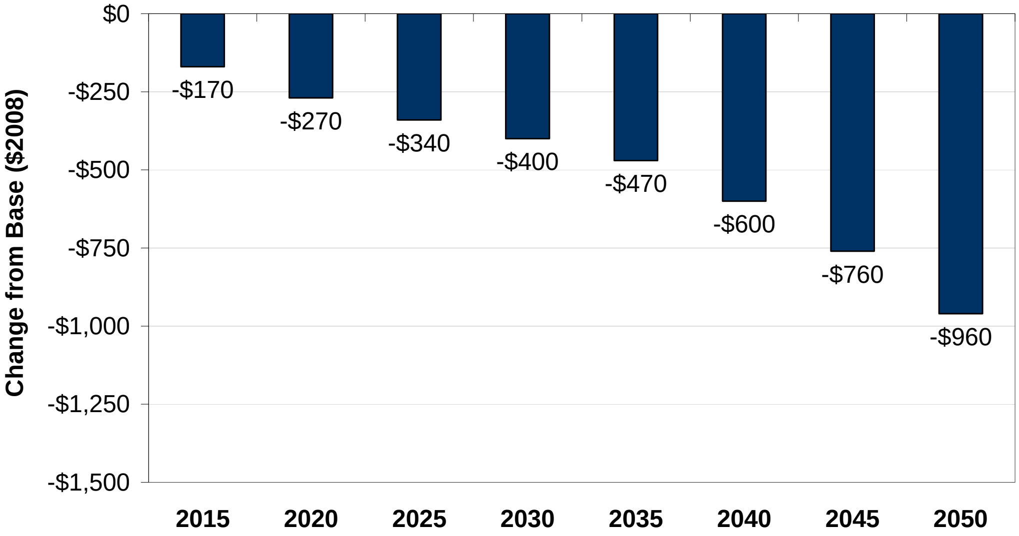
[9] CRA has made preliminary estimates of the number of average jobs directly associated with the increased payments to labor for increased renewable electricity, more efficient automobiles, biofuels, and energy efficiency improvements in its model scenario of ACESA. The preliminary estimate ranges from 1 million in 2015 to almost 2 million by 2030. The creation of a green job does not always mean the creation of a "new" job. For example, moving an autoworker from producing a vehicle powered by conventional fuels to a vehicle powered by a hybrid engine would not constitute a "new" job. Instead, it is a job transfer to what one might call a green job. Our estimate of green job creation includes green jobs that are both "new," which are incremental to a business as usual scenario, and "transfers," which are jobs shifted from part of an industry negatively impacted by a policy to another part of the industry that is positively impacted by the policy. Our net job loss estimates above are derived from the same model run that simultaneously contains this large number of implicit employment in "green jobs."

Figure 3.4: Projected changes to employment due to ACESA, assuming partial wage rate adjustments



Source: CRA Model Results, 2009

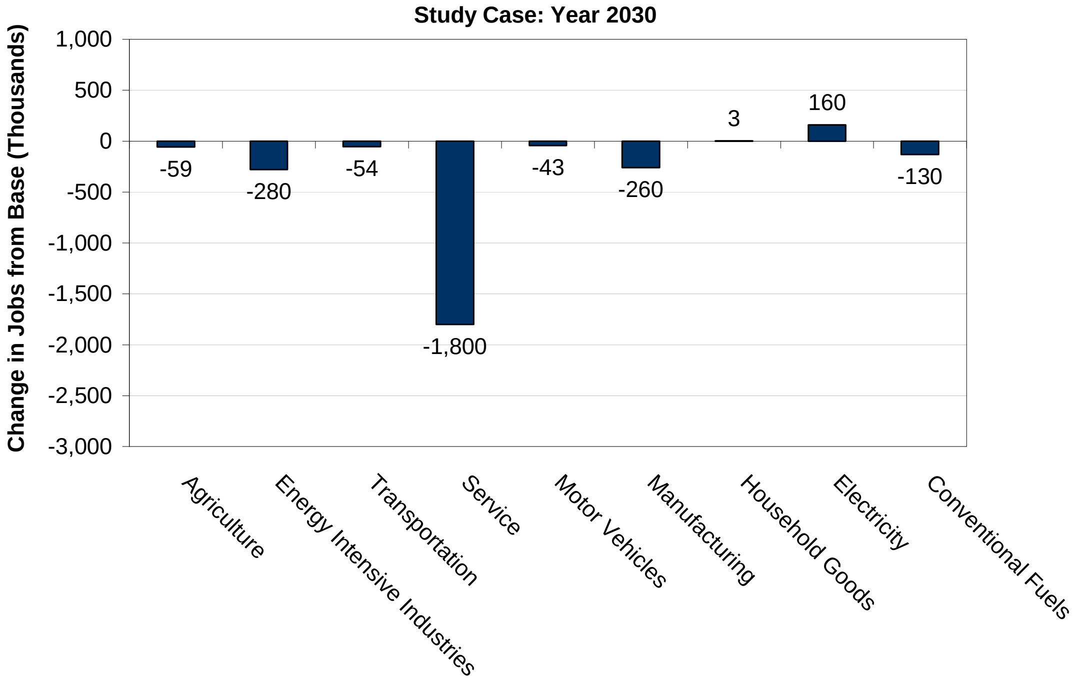
Figure 3.5: Projected impact on average annual wages due to ACESA for workers who remain employed, assuming partial wage rate adjustments



Source: CRA Model Results, 2009

It is noteworthy that the impact of a policy such as ACESA is not a short-term phenomenon that consists of a few years of belt-tightening, after which the economy will be on a different (lower-carbon) track. Rather, getting to the lower-carbon future will require a long-term, sustained effort to continue growing the investment in more costly forms of energy, and this will mean that payments to workers will remain lower for many decades than would be the case if we were to continue to rely on the cheaper but higher-carbon conventional sources of energy. The growing decline in real wages is due to a slowdown in productivity growth that is a direct consequence of the success of the cap-and-trade program in transforming the U.S. economy into one with nearly zero carbon emissions.

Figure 3.6: Projected impact by sector to employment in 2030 due to ACESA



Source: CRA Model Results, 2009

Employment impacts will also vary by industrial sector. Figure 3.6 shows the job loss in 2030 by sector. About 65% of the job losses that would accompany ACESA are projected to be in employment opportunities in the services and commercial sectors. Service sector employment reductions reflect the cumulative impact of businesses having to pay more for their energy services, and facing higher costs for goods and services generally, almost all of which are made using more expensive energy. These will tend to be “silent” losses of opportunity in the relatively low-wage portions of the economy that are least often associated with either the emitting sectors who will face the direct cost of the policy or the activities where the most overt examples of new “green jobs” will be found. Energy-intensive industries will also be affected as their competitiveness relative to other producers’ declines due to the increases in energy costs. Conventional fuels decline because of reduced demand for fuels in general and the substitution to various forms of biofuels. The electricity sector gains as a result of the need to replace existing generation plants with zero and low carbon emitting technologies, and also due to general equilibrium effects.

Discussion of green jobs prospects

To be sure, by mandating the use of the newer, more expensive energy sources and systems ACESA would create some new jobs. The difficulty is that the number of these new "green jobs" will be lower than the number of the other jobs that the bill would destroy elsewhere in the economy. The apparent discrepancy between our finding and estimates of large numbers of green jobs arises because the latter estimates are answering the wrong question. Those who claim there will be a job-creating attribute to a policy such as ACESA have asked whether it will require workers to carry out energy efficiency projects and produce biofuels and build and operate power plants using renewable energy. It will, but it will also require that those workers come from employment in other industries, some of which are directly targeted by a cap-and-trade program – such as fossil fuels production – and some of which will shrink because consumers can no longer afford their full production. The question that we have addressed is whether the balance of the many economic effects of a GHG cap is to increase or decrease total labor income in the United States, and the answer is that total labor income will decrease.

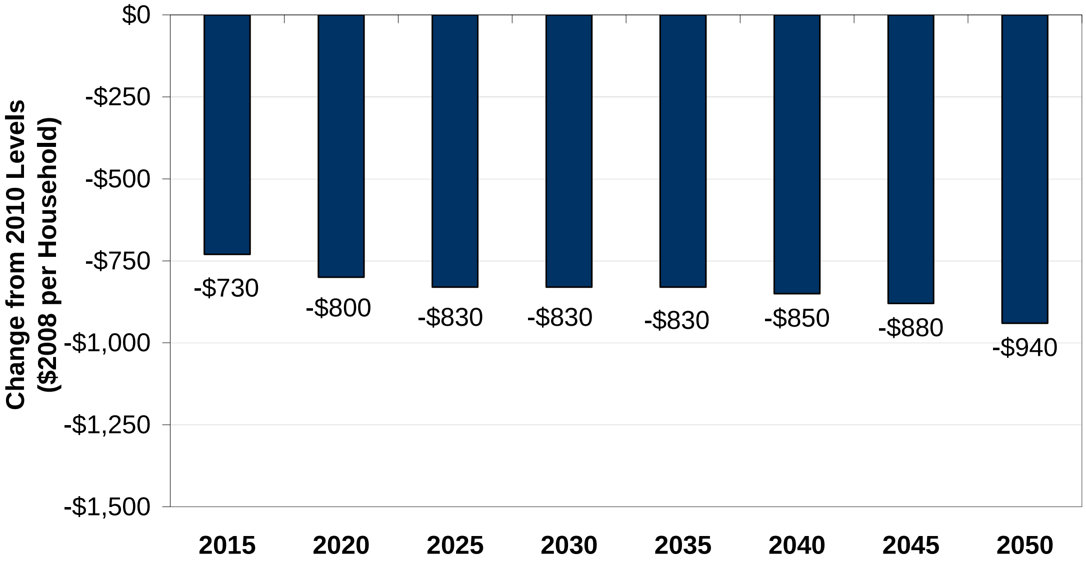
Whether green jobs will be lower-paying than the jobs they replace and require more labor per unit of output does not change the generally depressing effect of the cap-and-trade program on total labor income. It might lead to two low-paid workers moving out of unemployment while one worker who was earning more than twice their wages becomes unemployed. Only if this were to be the predominant pattern of the impact of the policy could one argue that there would be a net increase in total jobs under the policy concomitant with the inevitable decrease in total payments to workers. Whether that would be a desirable goal of social policy cannot be answered by economic analysis.

The debate is further confused by the lack of a clear definition of a "green job." For example, how would one classify a job supporting coal-fired power with carbon capture, or nuclear generation? How does one even tell if a given construction job is in "green" construction or not? Regardless of these definitional concerns, however, the fact remains that workers in aggregate will face lowered earnings potential under a policy that drives carbon emissions to much reduced levels. The net effect of lower productivity also ultimately translates into overall losses in average household spending power, and into reductions in GDP relative to what they would be if no such policy were in place. We turn to those cumulative macroeconomic effects in the next two sections.

3.1.3. Impacts on household consumption

Higher energy costs generally mean that consumers must spend a larger percentage of their income to maintain their current level of household energy services. At the same time, significant quantities of energy are needed to produce and transport the many non-energy goods and services. The projected higher costs of these goods and services would be expected to magnify the loss in household purchasing power associated with the direct purchase of energy services. At the same time, higher energy costs across the economy as a whole would lower income. We have already discussed how average labor income would be reduced. Similarly, lower returns on investment would reduce household income from savings and retirement funds. Figure 3.7 shows the increasing erosion of household purchasing power that is projected as a result of ACESA, due to the combination of all these factors. These estimates of changes in household purchasing power are based on the assumption that all auction revenues are returned to households on a per capita basis and that the value of allocated allowances are also returned to households in the form of utility rebates and increased investment income from companies receiving allocations.

Figure 3.7: Projected impact on household purchasing power due to ACESA, stated in terms of 2010 income levels



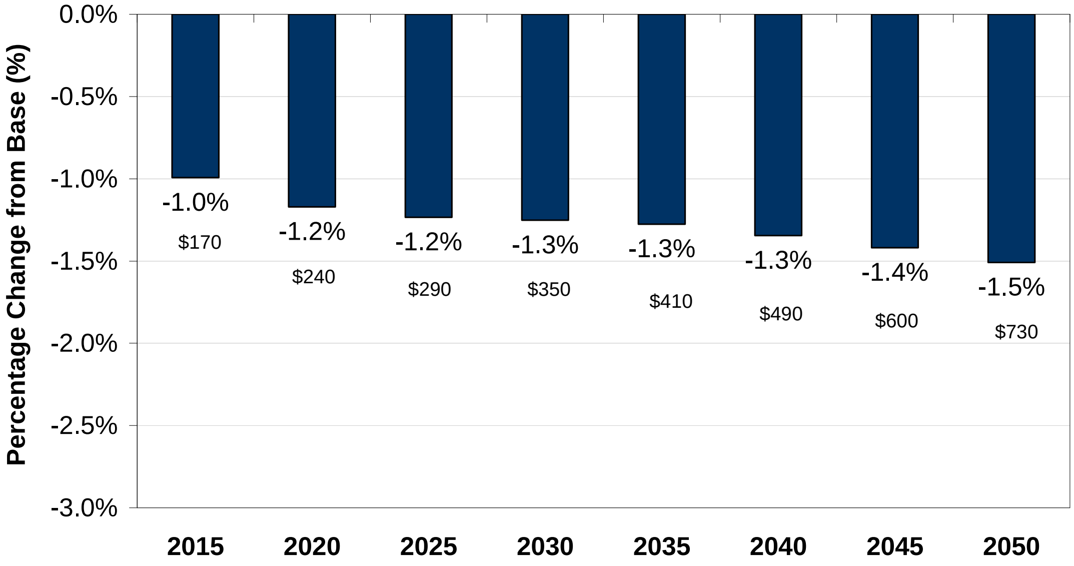
Source: CRA Model Results, 2009

Stated in terms of 2010 income levels, in 2015 the average household in the U.S. is estimated to experience a loss in purchasing power of roughly $730. This loss grows over time to $800 per household in 2020. In 2030, the estimated impact is projected to decline by roughly $830, and in 2050, the estimated impact reaches $940. A very large portion of the losses per household can be traced to the fact that a large fraction of total compliance is met by purchasing offsets from international sources. While these offsets lower the price of allowances, they also cause U.S. wealth to be given to other countries. More expensive compliance from domestic suppliers would at least keep that wealth from being transferred out of the pocketbooks of the average U.S. household.

3.1.4. Gross domestic product

The estimated impacts on GDP would follow the pattern already evident in the estimated results for consumption and employment. Higher production costs and lower household purchasing power interact; employment and consumption would fall; total economic activity, measured as GDP, would also decline. In 2015, the GDP is projected to decline by 1.0% ($170 billion) below the baseline level. In 2030, it is projected to decline further to 1.3% ($350 billion) below the baseline, reflecting the investment needed to build the infrastructure necessary to comply with future more stringent emission caps, and in 2050 the decline is 1.5% ($730 billion). Figure 3.8 illustrates the pattern of estimated GDP losses through time.

Figure 3.8: Projected impact on GDP due to ACESA, relative to the baseline

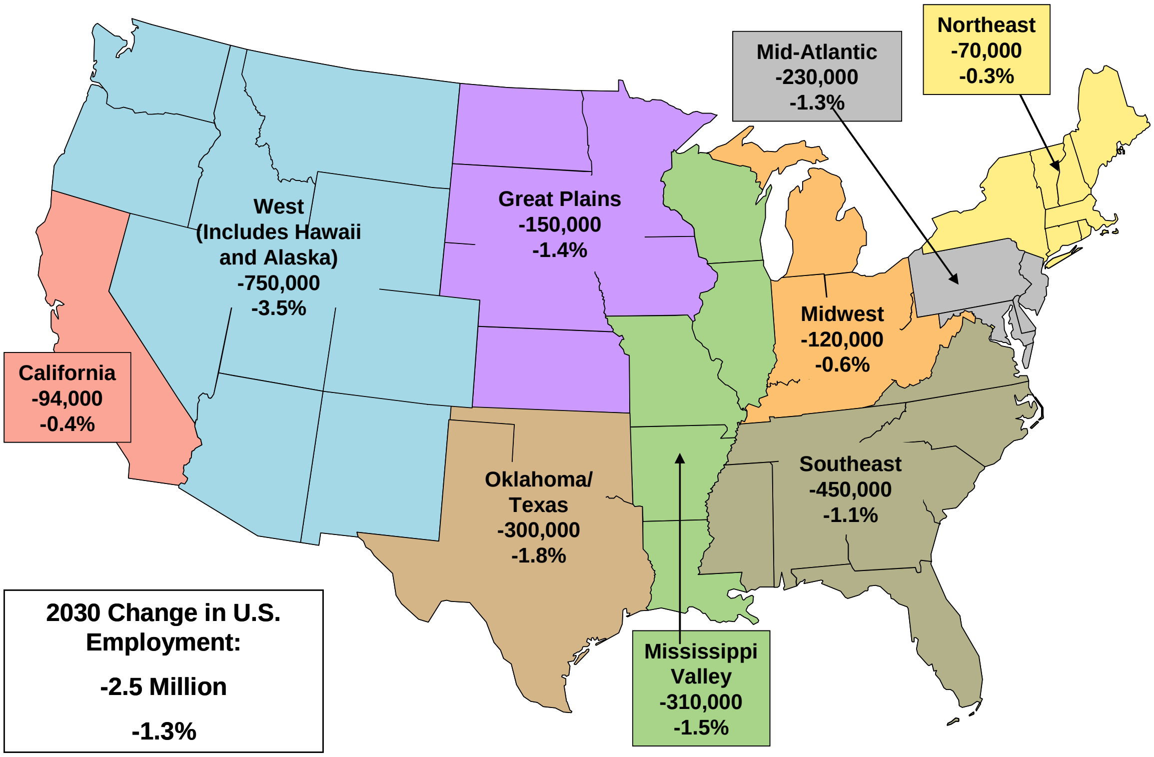


Source: CRA Model Results, 2009 *Values in Billions of $2008*

3.1.5. Impacts by Region

Figure 3.9 indicates that the projected job losses would be distributed throughout the country. Regions that experience a larger decline in employment relative to the U.S. average are the West, Oklahoma/Texas and the Mississippi Valley; regions that suffer a smaller decline than the U.S. average are the Midwest, Northeast, and California. Losses in the Great Plains, Mid-Atlantic, and the Southeast are near the national average for the U.S. as a whole.

Figure 3.9: Projected regional distribution of changes to employment in 2030 due to ACESA

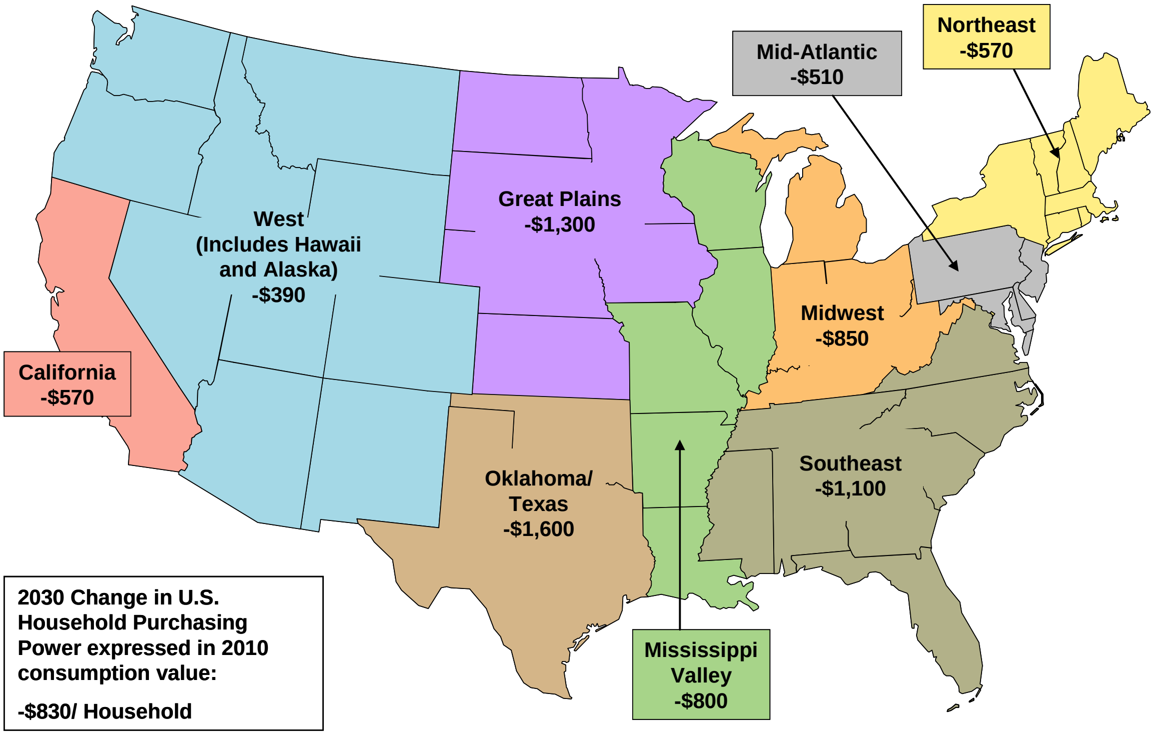


Source: CRA Model Results, 2009

A region's industrial impacts, and hence employment effects, strongly correlate with the region's composition of industries and the energy-intensity of these industries. The Northeast and California fare better than other regions because of their initial economic circumstances. Namely, these regions' industries are less energy-intensive, as is the overall composition of industry. At the other end of the spectrum are the Mississippi Valley, Oklahoma/Texas and West regions, which are more concentrated in conventional energy production activities and energy-intensive industries.

Figure 3.10 shows the loss in purchasing power by the regional household in 2030. Regions that experience a larger decline in purchasing power relative to the U.S. average are Oklahoma/Texas, Great Plains, and the Southeast; regions that suffer a smaller decline than the U.S. average are the West, California, Mid-Atlantic, and the Northeast. Losses in the Midwest and Mississippi Valley are near the national average for the U.S. as a whole. In general, households in regions that have to import higher-cost energy and those that face loss of domestic production incur the largest loss of purchasing power. (Changes in the regional distribution of permits could mitigate some of these disproportionate impacts, if designed effectively.)

Figure 3.10: Projected regional distribution of changes to 2030 household purchasing power due to ACESA, stated in terms of 2010 income levels



Source: CRA Model Results, 2009

Some of the distribution of regional impacts depends on the proposed permit allocation scheme. The West is an interesting case because it is on the low end of household impacts but on the high end in terms of job losses. This result illustrates the importance of permit allocations on welfare. The West receives a disproportionate share of the permits relative to its emissions. This wealth from permits mitigates this region’s household impacts. The initial allocation of permits also greatly aids the Mid-Atlantic region. On the other end of the spectrum, the Great Plains region experiences greater household impacts because of its proportionately smaller allocation of emission allowances. These results highlight the great care that must be taken in deciding on the initial allocation of permits so that the policy equitably treats all concerned.

3.2 UNCERTAINTIES OF CARBON PRICES AND ECONOMIC IMPACTS

Rigid caps on greenhouse gas emissions achieve certainty in emission levels over a period of time at the cost of large uncertainties about long-run carbon prices and costs to the economy, as well as short-term volatility in carbon prices.

3.2.1. Uncertainty about carbon prices and cost

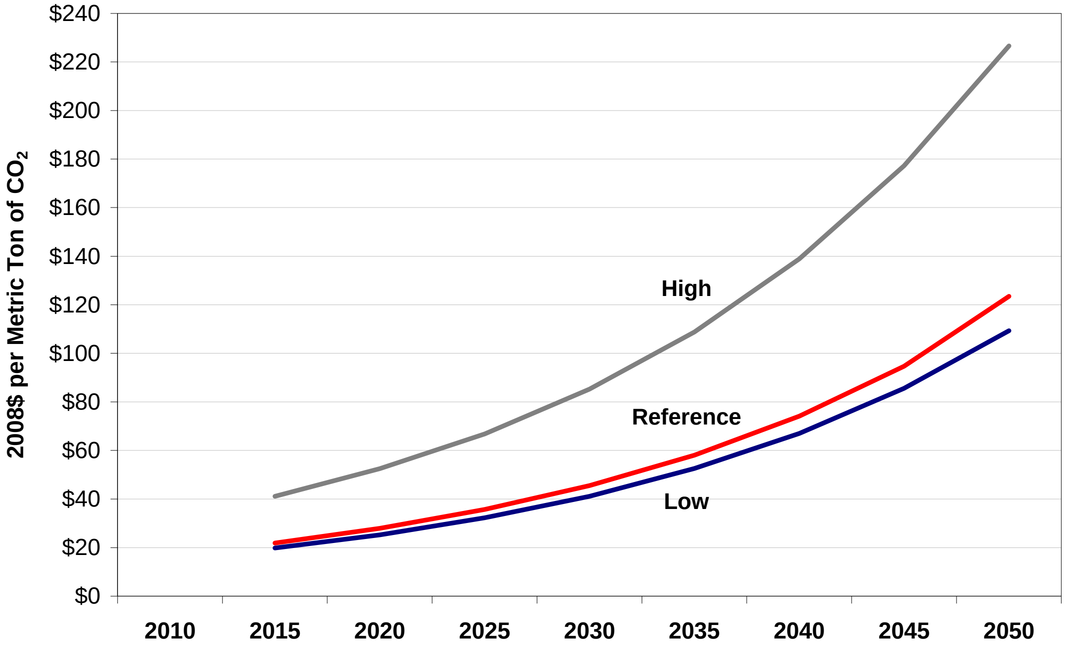
The uncertainty of outcomes from a rigid cap is illustrated by a pair of cases. These High and Low Cost cases were constructed by developing a range of assumptions about specific future economic and technology factors that will influence the level of carbon emissions and costs but cannot be predicted accurately in advance. Table 3-1 below describes the range of assumptions used to define the High and Low Cost cases, compared to Reference case assumptions.

Table 3-1: Range of assumptions in Low and High Cost cases compared to Reference case

	Low Cost	Reference	High Cost
Electricity Demand	AEO 2009 April Release (0.90% 2010-2030 CAGR)	AEO 2009 Early Release (1.00% 2010-2030 CAGR)	AEO 2009 Early Release + Difference b/w Early & April Release
Natural Gas Prices	Same as Reference	AEO 2009 Early Release through 2030, with a 2050 wellhead target of $9/MMBtu (in 2003$)	Same as reference
Demand Elasticity	Higher demand elasticity	CRA Standard	Lower demand elasticity
Low-Carbon Fuel Transportation Technology	Reduce zero- and low-carbon alternative fuels down to cost parity with motor gasoline	CRA Standard	Assume no zero-carbon fuel
Capital Costs for New Generating Technologies	Same as reference	AEO 2009 Early Release, save for nuclear (public filings) and geothermal (EPA NEEDS 2006)	Flat-line costs at first-year AEO 2009 Early Release
CCS Capacity Limits	270 GW by 2050	180 GW by 2050	Same as reference
Nuclear Capacity Limits	EPA W-M (266 GW by 2050)	206 GW by 2050	Allow existing nuclear fleet (103 GW) to be replaced, but no more
Offsets	Same as reference	Wealth transfers out of U.S. from international offset purchases priced at marginal cost of international offsets	Wealth transfers out of U.S. from international offset purchases priced at CO_2 allowance price, no international avoided deforestation offsets

Each of these factors represents a true uncertainty, about future growth in the economy and energy demand, about how energy use will respond to higher prices derived from the cap-and-trade system, about future developments in the performance and cost of electricity generation and transportation technologies, and about limits that may be imposed on key technologies due to regulatory action or litigation. These factors cannot be known in advance, and the assumptions chosen for the sensitivity analysis represent quite reasonable outcomes that many observers would see as likely. Figure 3.11 shows the range of carbon prices that this range of underlying uncertainty makes likely.

Figure 3.11: Carbon allowance prices by model scenario



Source: CRA Model Results, 2009

The analysis reveals that the chance of higher prices and costs appears much larger than the chance of lower costs. In 2015 the High Cost assumptions lead to a carbon price about 90% higher than the Reference case, a percentage difference that is maintained out to 2050 because of the assumption that banking is utilized to minimize the overall cost of the cap. The Low Cost case only leads to carbon prices a few dollars lower, suggesting that the Reference case assumptions are about as favorable a set of relevant assumptions as it is possible to make about the factors considered, given current knowledge. (Some unanticipated, major breakthrough in technology might result in a lower cost than this range, but this would require very specific technology assumptions that are simply not justifiable with any current information. Such breakthroughs are unlikely without more emphasis on game-changing R&D than is found in ACESA and the stimulus package, which both concentrate on deployment of more mature technologies.)

Figure 3.12 and Figure 3.13 show differences in generation mix through 2050 and Figure 3.14 and Figure 3.15 show differences in technologies chosen for new capacity. The higher carbon allowance prices in the High Cost case (approximately double the carbon prices in the Low Cost case) call for considerably more renewables generation over the entire modeling horizon, and particularly for increased renewables investment from 2015 through 2020. The disparity in carbon allowance price projections makes investment planning for generators much more difficult in a cap-and-trade system that leaves future carbon allowance prices uncertain than it would be under an alternative, such as a carbon tax, that fixed the price in advance.[10] Investors who believed that carbon prices would follow the high track could find themselves with stranded renewable assets in the event lower carbon prices come about, and investors in other assets in the lower price cases could find themselves regretting the decision not to invest in renewables.

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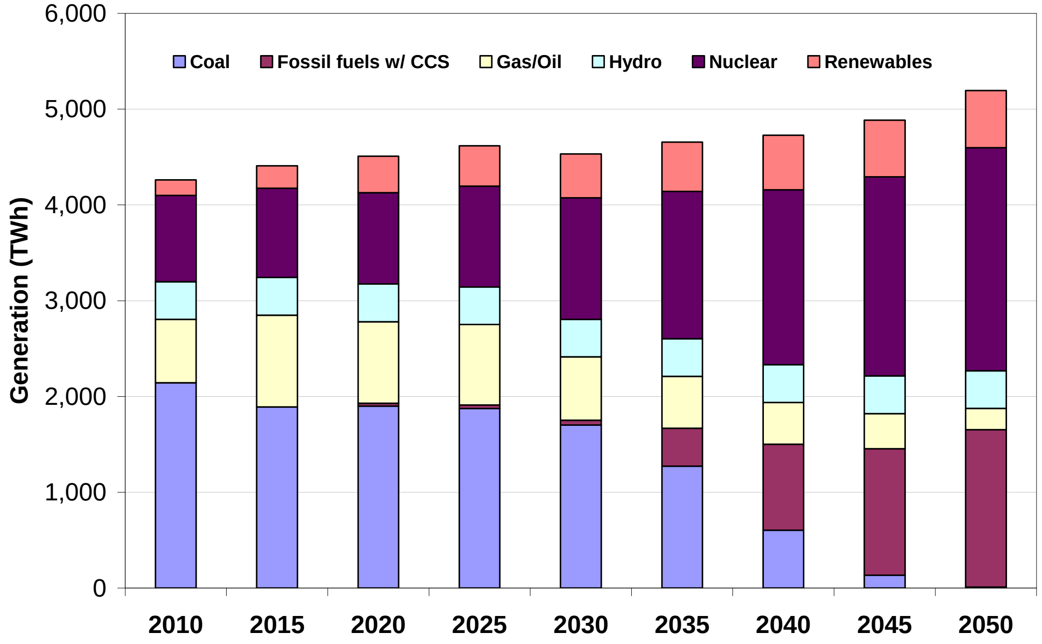
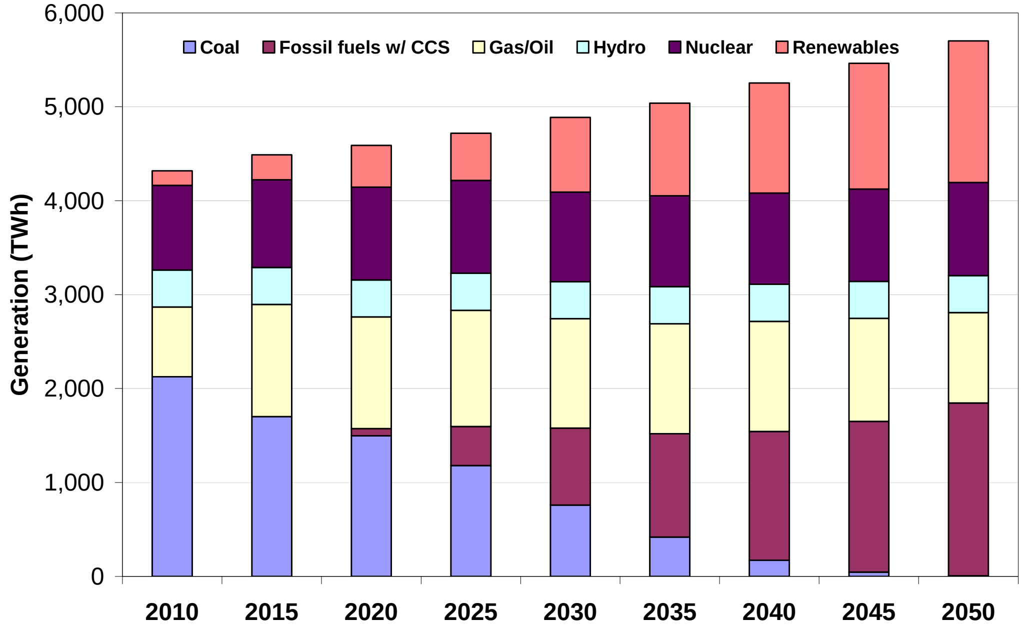
[10] Under a tax approach, there would also be uncertainties about long-run carbon price levels, because regulators would need to periodically reset the tax rate based on observed progress towards reducing emissions under initial tax rates. The tax policy approach offers short-term pricing stability, however, which helps with investment decisions, even though the long-term costs are unknown.

Figure 3.12: Generation by technology for the Low Cost case



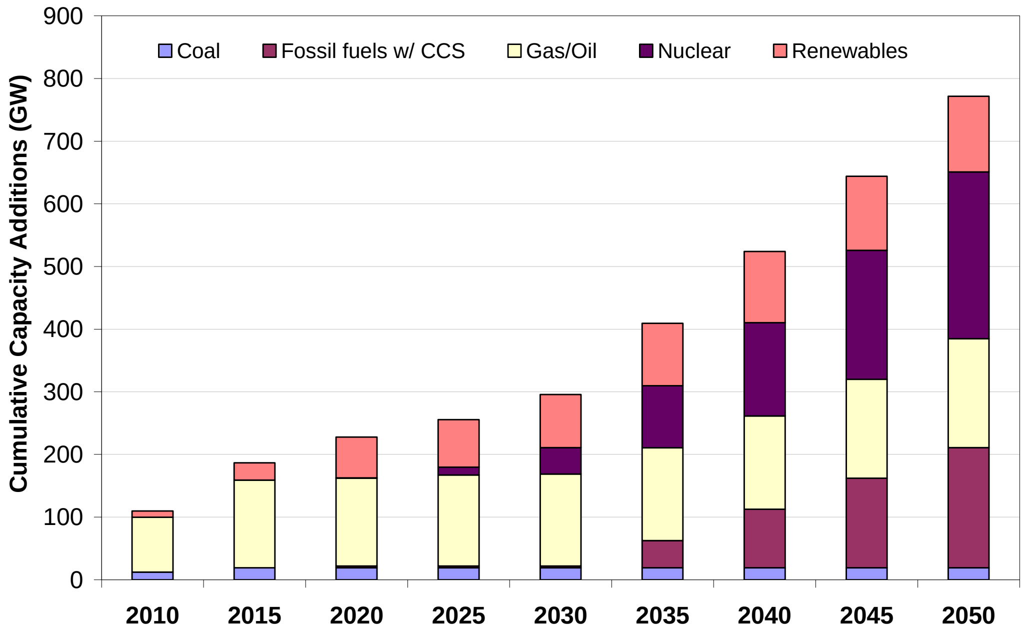
Source: CRA Model Results, 2009

Figure 3.13: Generation by technology for the High Cost case



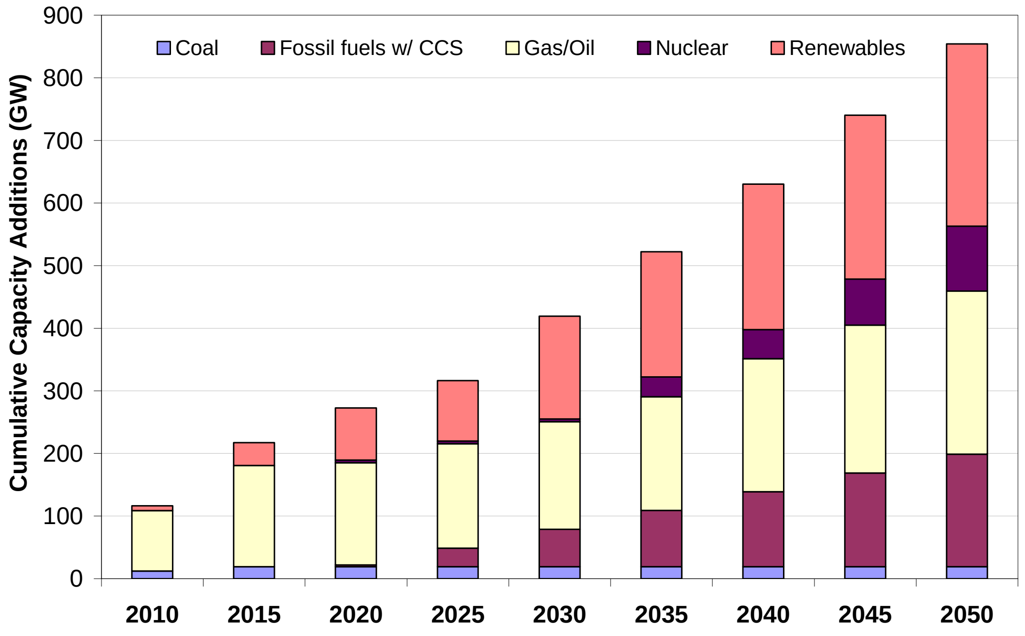
Source: CRA Model Results, 2009

Figure 3.14: Cumulative capacity additions by technology for the Low Cost case



Source: CRA Model Results, 2009

Figure 3.15: Cumulative capacity additions by technology for the High Cost case



Source: CRA Model Results, 2009

Moreover, investors' mistakes can contribute to volatility. If, for example, investors were convinced that carbon prices would remain at levels estimated in the Reference case for a decade, then they would build limited renewables. Later if it became clear that carbon prices were more similar to those in the High Cost case, then carbon prices could spike well above the estimated High Cost case levels until sufficient renewable generation is built to catch up with the High Cost case projection.

If, in contrast, the carbon price is known in advance – including how it can be expected to change many years into the future – covered emitters can plan compliance more easily and efficiently. They will be far more willing to undertake major capital investments in advanced, low-carbon technologies if they have some confidence that the carbon price level will either rise to or continue to remain at levels that make such investments cost-effective. They may also find it easier to obtain funding for such investments, if they are subject to less market risk.

The EU-ETS experience has also demonstrated that even very high carbon prices do not necessarily translate into a willingness of the private sector to make investments in new, lower-carbon technologies. Despite the fairly high average prices in the EU-ETS, there has been no serious degree of private sector investments in cleaner technologies.[11] The usual explanation for the failure of the EU-ETS to motivate investments in clean energy technologies is the uncertainty in its carbon price levels and the potential impermanence of the scheme. Even if investments in some clean technologies might be justifiable under the average carbon prices of about €20 per ton that have been experienced over the past four years, they have not been forthcoming. Uncertainty on what the carbon price level will be – not just for the next few years but for 10 to 20 years into the future – appears to be inhibiting private sector investments in low-carbon technologies.

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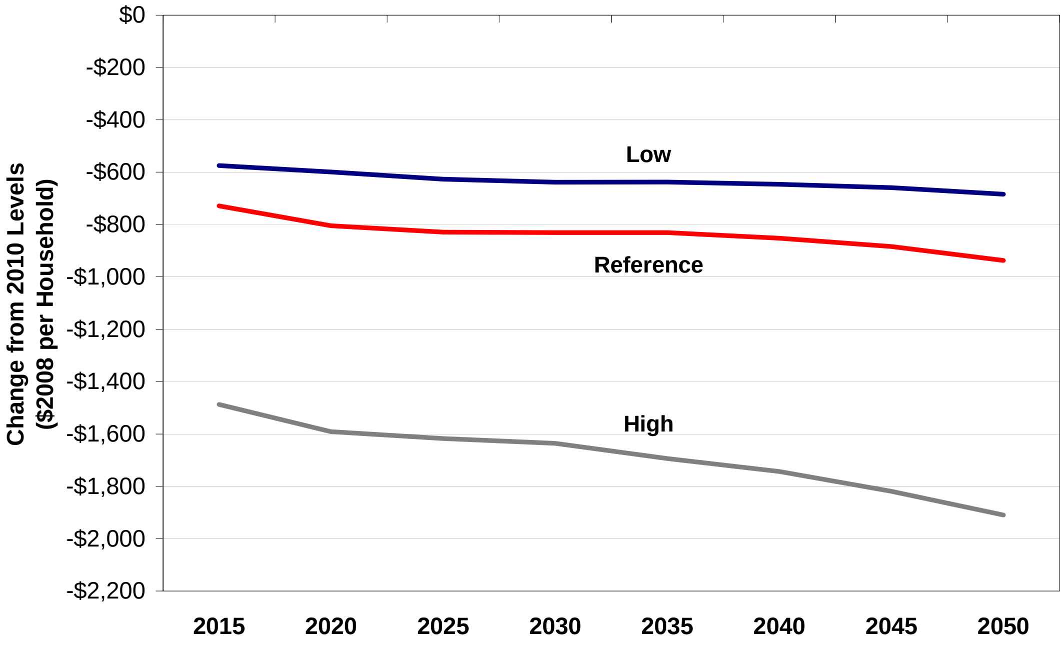
[11] The fairly high rate of investment in renewables such as wind and solar in Germany is traceable to the very high guaranteed returns known as "feed-in tariffs" for such generation, and is not attributed to carbon prices.

Figure 3.16 shows the differences in household purchasing power under the three cases. These reveal that costs per household to meet the targets could be from $600 in the low case to $1,600 in the high case in 2020, depending on uncertain future developments. This is the kind of unavoidable uncertainty about impacts on their constituents that policymakers face in deciding on whether to adopt a cap-and-trade system and where to set the caps. Again, alternatives such as a carbon tax can greatly narrow the range of costs and economic impacts that a policymaker must deal with.

Figure 3.16: Impact on household purchasing power by model scenario based on 2010 consumption levels



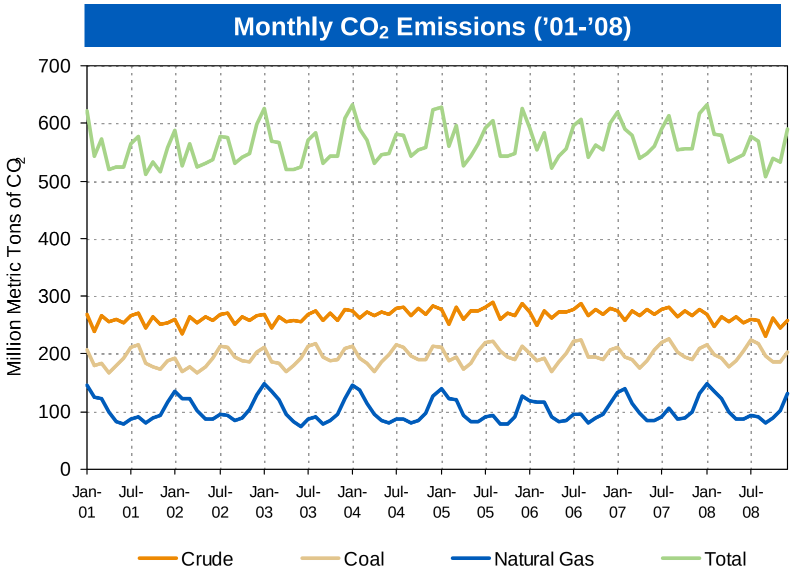
Source: CRA Model Results, 2009

3.2.2. Carbon price volatility

It is also quite likely that prices will move up and down within the range of possible futures, rather than settling down to one clear track after a few years. A major reason is that the banking provisions, relied on in many minds to reduce costs and uncertainty, themselves introduce significant additional uncertainty into near-term prices. Banking connects expected market conditions in the future to current willingness to pay for allowances, so that different or changing expectations about future technology costs, availability of offsets, or policy changes will be communicated immediately into current prices.

Carbon price volatility can also come from the normal factors that lead to swings in oil, natural gas and electricity demand and to volatility in refined product, natural gas and coal prices. Figure 3.17 shows monthly changes in emissions from oil, natural gas and coal consumption over the past decade, and the resulting monthly movements in total carbon emissions. This volatility in use is driven by changes in weather, overall economic activity, and fuel prices. These factors will continue to drive carbon emissions up and down unpredictably even with a cap on emissions, and carbon prices can be expected to rise when events that led to high CO_2 emissions in the past recur and to fall when events that led to low emissions occur. This volatility will be smoothed by the ability to bank allowances and by compliance periods of a year or more, but experience in other energy markets in which storage is possible, such as natural gas, and in Title IV sulfur dioxide markets demonstrates that even with such smoothing mechanisms volatility will appear.

Figure 3.17: Monthly CO_2 emissions from oil and gas and coal combustion



Summary Statistics	
Min:	507 MM tonnes
Max:	633 MM tonnes
Mean:	564 MM tonnes
Std Dev.:	32 MM tonnes
Volatility:	22.1%

Source: Energy Information Administration, CRA Analysis

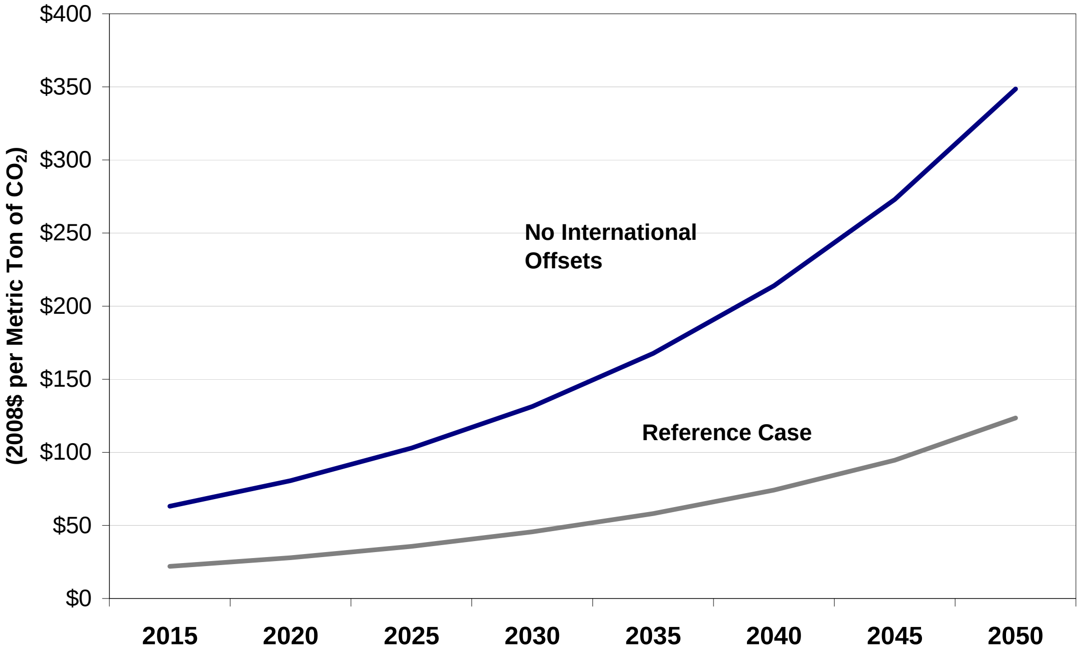
In all, a cap-and-trade program is effectively another market on which financial institutions can bet. Though the cap-and-trade program does not allow borrowing from the government, an over-the-counter market could conceivably arise where one could trade swaps and hence borrow. In addition, squeezes could occur near dates where entities need to true up their emissions and permits. All of this increases volatility and the costs of a cap-and-trade program.

Businesses and consumers already have to live with substantial volatility in commodities markets, such as for fuels. Companies are generally able to cope with unavoidable volatility in natural commodities; but that is no reason to intentionally create volatility in a new, major input (i.e., allowances) given that policymakers can establish the same carbon price incentive without any volatility at all. No matter how manageable carbon price volatility is, it has a cost, and no benefits are derived from that cost. Therefore, it is desirable to minimize carbon price volatility wherever possible. Carbon policy is one of the rare situations where price volatility can be eliminated altogether while still having a clear price signal.

3.2.3. Sensitivity: no international offsets

The cost and availability of international offsets is perhaps the most uncertain of all the factors influencing the cost of the policy. To understand how large a role international offsets play, we analyzed an alternative scenario to the Reference case in which no international offsets were allowed. Results from this scenario reveal that without use of the full amount of international offsets allowed by the bill, carbon prices would more than double. The reasons why international offsets might not be available at as low a cost and in as large quantities as assumed in the Reference case are discussed in Section 3.3.4.

Figure 3.18: Comparison of carbon allowance prices with and without international offsets



Source: CRA Model Results, 2009

3.2.4. Alternatives to reduce costs of uncertainty

The uncertainty of carbon prices under a cap-and-trade program imposes real economic costs. The uncertainty exemplified by the High and Low cases leads to an absence of clear signals for investors in low-carbon fuels and energy efficiency, as well as related R&D. This will slow progress toward developing efficient new technologies and raise overall economic costs.

Uncertainties that are expected to be resolved, such as rules implementing certain standards or offset calculations, could create a significant option value to an entity if it were to delay investments until uncertainties are reduced.[12]

There is also a potentially significant cost of bearing or mitigating the risks that carbon price volatility creates for companies with a compliance obligation. When companies need to buy allowances to cover their emissions, as with a full auction, their new expenditure may be large compared to their current net revenue. For example, the cash needed by an electricity generating company that has a diversified mix of coal, gas and zero-carbon generation similar to the U.S. average would face new outlays for allowance purchases of $35 per ton that are approximately 20% of its gross revenues, and perhaps 200% of its net revenues. Any delays in the pass-though of such costs to customers could seriously disrupt their financial position. Volatility exacerbates this situation by causing continual variations in cash flow needs. For example, fluctuation in the allowance price between $15 per ton and $50 per ton would mean that the cash flow requirements might vary from 85% to 350% of pre-policy cash flows. Even after price pass-through has occurred, delays in adjustments of the retail rates could translate into see-sawing profitability.[13]

Oil refiners, who are responsible for emissions from the fuels they sell and not just facility emissions, would be in a similar but probably more risky situation. Refiners could face even larger cash flow requirements relative to their profit margins to purchase their required allowances (refiners are to receive 2% of the total allowances from 2014 through 2026). Similarly, if a company has any substantial bank of allowances, it could face large swings in its balance sheet situation. Conditions such as these could translate into companies facing reduced credit ratings and more difficulties in raising capital. This possibility has not been studied at all yet, but certainly requires some careful investigation, including gaining an understanding of the extent to which trading in futures contracts and other derivatives could reduce risks, and what the cash flow and balance sheet effects of such trading might be.

Proposals to limit this uncertainty include safety valves and carbon taxes. A carbon tax would allow emissions to fluctuate year by year rather than prices and economic costs, but if chosen to match the Reference case carbon price would be expected to lead to the same cumulative emissions as the Reference case caps by 2050 (given the realization of other key assumptions). If uncertainties about some of the factors were reduced over time, such that it became clear that emissions were coming in higher or lower than expected at the chosen price, then the tax rate could be adjusted at intervals to aim for the desired cumulative emissions budget. Such tax rate adjustments would not be as disruptive to planning and operations as the volatility likely under a hard cap.

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[12] *Climate Policy Uncertainty and Investment Risk*, William Blyth, Ming Yang and Richard Bradley, International Energy Agency, 2007. Available at http://www.iea.org/textbase/nppdf/free/2007/Climate_Policy_Uncertainty.pdf.

[13] Smith, Anne E., “Auctioning under Cap and Trade: Design, Participation and Distribution of Revenues,” Statement to the U.S. Senate Committee on Finance, May 7, 2009.

3.3 DISCUSSION OF KEY ISSUES

3.3.1. Costs should be considered in relation to benefits

ACESA is estimated to raise domestic energy costs. The objective of the policy is to reduce greenhouse gas emissions by creating a mandated ceiling for these emissions. In so doing, it forces energy producers to either purchase allowances in order to continue to produce using their current practices or alter their production technologies through added costs in order to reduce their emissions. In either case, the cost of providing energy would increase and a portion of these costs would likely be borne by consumers.

The benefits of ACESA take the form of a reduced contribution of the United States to global concentrations of greenhouse gases, and the damages from climate change that these reduced concentrations would avoid. Because of the large share of GHG emissions over the next century that will come from other countries, particularly rapidly developing countries like China and India, any action by the U.S. will avoid only a small portion of the damages that have been attributed to global warming. The magnitude of the costs estimated in this study can only be judged to be large or small in comparison to these benefits, not by comparisons to other government programs.

3.3.2. Allowance allocations

This analysis includes the allowance allocation provisions in ACESA. Highlights include allocating 35% of allowances to the electricity sector, 15% of allowances to the energy-intensive industries, and smaller allocations to natural gas distributors, automotive companies and oil refiners. These allocations have a significant impact on the regional distribution of impacts, and could affect how regressive the overall impacts will be on different income groups.

Based on stated intentions in the bill, CRA’s analysis has assumed that, except for allocations to industries, the value of all allowances would be rebated to households on a per capita basis. Allowances to oil refining, trade exposed industries, merchant coal generators, and the automobile industry serve to offset losses to businesses in those industries. Since any gains or losses ultimately affect share values, these amounts are assumed to be distributed among the population in proportion to ownership of financial assets, for which consumption is taken as a surrogate.

Changes in allowance allocations decisions will change the regional distribution of impacts, but will not materially change overall national economic impacts.

3.3.3. Costs of a duplicate regulatory system

ACESA establishes both a GHG cap-and-trade and a series of command-and-control mandates. The latter are, at best, redundant to the cap-and-trade. They regulate activities that are also subject to the proposed GHG cap. These include the RES and the coal-fired power plant performance standard, which are included in this analysis, as well as a series of more detailed and specific energy efficiency standards and programs that it was not possible to model due to their narrow application. The more detailed provisions are listed below:

TITLE II—ENERGY EFFICIENCY
Subtitle A—Building Energy Efficiency Programs
Sec. 201. Greater energy efficiency in building codes.
Sec. 202. Building retrofit program.
Sec. 203. Energy efficient manufactured homes.
Sec. 204. Building energy performance labeling program.

Subtitle B—Lighting and Appliance Energy Efficiency Programs
Sec. 211. Lighting efficiency standards.
Sec. 212. Other appliance efficiency standards.
Sec. 213. Appliance efficiency determinations and procedures.
Sec. 214. Best-in-Class Appliances Deployment Program.

Subtitle C—Transportation Efficiency
Sec. 221. Emissions standards.

PART B—MOBILE SOURCES
Sec. 821. Greenhouse gas emission standards for mobile sources.
Sec. 222. Greenhouse gas emissions reductions through transportation efficiency.

PART D—PLANNING REQUIREMENTS
Sec. 841. Greenhouse gas emissions reductions through transportation efficiency.
Sec. 223. SmartWay transportation efficiency program.
Sec. 822. SmartWay transportation efficiency program.
Sec. 224. State vehicle fleets.

Subtitle D—Industrial Energy Efficiency Programs
Sec. 241. Industrial plant energy efficiency standards.
Sec. 242. Electric and thermal waste energy recovery award program.
Sec. 243. Clarifying election of waste heat recovery financial incentives

The rationale of cap-and-trade is that it allows the market to select the lowest cost means, whatever they may be, for reaching a given GHG reduction target. By superimposing regulatory mandates on that system, Congress substitutes its own judgment for that of the market.

The provisions that were modeled, in particular the RES, appear to be binding only in a few years (*i.e.*, the cap might, by itself, motivate all of the actions needed to meet the standard). In these instances, the standards would have no effect on emissions. They would waste resources on needless monitoring, measuring, enforcement and compliance, but they would not affect the pattern of GHG reductions.

When efficiency or other standards are binding, they would affect the allocation of abatement resources. They would compel industry to buy more renewable energy, say, or to invest more in CCS than it would otherwise do to comply with the total GHG cap. However, while the pattern of emission reductions would change, the total amount reduced would not. The cap sets the total GHG cutback. If the regulations mandate more change in one area, less will take place somewhere else. Standards, therefore, can add costs but they will not add to the program's environmental benefits. They can only substitute more costly GHG cuts for those that could have been made at lower cost.

For the detailed standards mandated in Title II, it is impossible to tell by examining aggregate levels of energy efficiency whether or not the standards are binding. Even if the cap-and-trade program would be sufficient on its own to lead to similar or larger reductions in energy use in the specified sectors, the standards are very likely to mandate a different set of changes in energy use than consumers and businesses would choose on their own. This can only increase costs of complying with the overall cap, unless businesses and consumers are consistently making wrong decisions and the government agencies put in charge of the regulations can consistently make better decisions by substituting their regulatory authority for the decisions of those who know their own situations and alternatives.

These added costs are beyond what can be addressed in CRA's models -- or EPA's models used to produce their analysis of the draft Waxman-Markey bill -- at this point. But that implies that any bill including a significant number of detailed efficiency standards will have a cost greater than these modeling systems estimate.

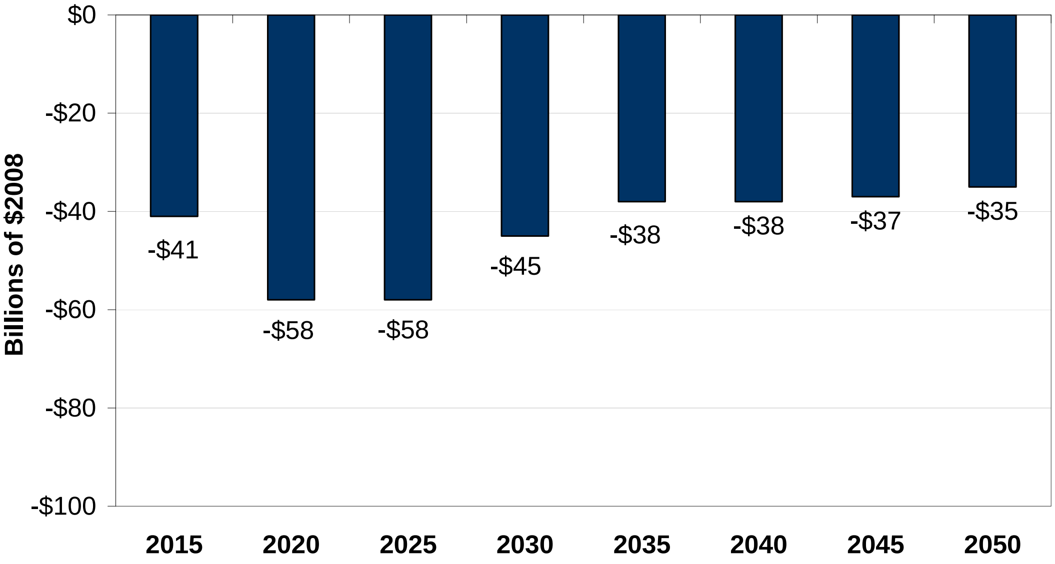
3.3.4. Wealth transfers abroad

ACESA contains several provisions that entail wealth transfers from the U.S. to other nations. For example, it would sell "strategic reserve allowances" to covered entities, and use the revenues to purchase international offset credits issued for reduced deforestation. The strategic reserve will comprise 1% of each year's total allowance pool from 2012 through 2019, 2% of each year's total allowance pool from 2020 through 2029, and 3% of each year's total allowance pool from 2030 through 2050.

The bill mandates minimum auction prices for the strategic reserve allowances. In 2012 the minimum strategic reserve auction price will be double the EPA-modeled allowance price for that year. Minimum strategic reserve auction prices in 2013 and 2014 will rise by the rate of inflation plus 5%. For 2015 and thereafter, the minimum strategic reserve auction price will be 60% above the rolling 36-month average of the daily closing price for that year's allowances, calculated in constant dollars. EPA is to issue regulations governing both strategic reserve credits and private sector purchases of offsets.

The largest wealth transfers from the U.S. to other countries will be associated with purchases of international offsets. In effect, avoided deforestation becomes another U.S. import in an economy that has been struggling with a chronic structural trade deficit. As such, foreign offsets would be an added drag on U.S. terms of trade with the rest of the world. The transfers that they entail lower the prices that U.S. exporters can obtain and raise the prices that Americans must pay for imports. The result is a further decline in U.S. standard of living that is reflected in the results reported in this study. The annual wealth transfer is shown in Figure 3.19.

Figure 3.19: Wealth transfer overseas from purchases of international offsets and internationally-allocated allowances under ACESA



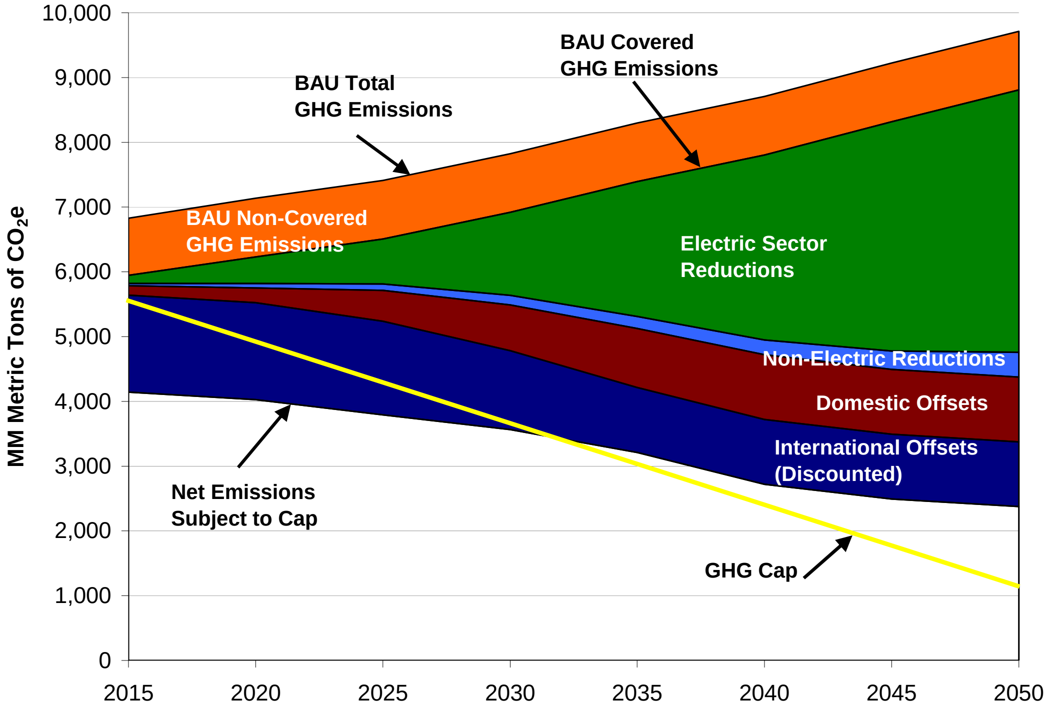
Source: CRA Model Results, 2009

While it is true that international offsets increase the potential supply of allowances and, hence, hold down allowance prices, the wealth transfer is a net loss to the U.S. Further, the bill’s effective discounting of offsets, and the artificially high prices imposed on the strategic reserve allowance auction will rob offsets of much of their potential to control costs.

It is also possible that the U.S. will find it difficult to obtain the volume of offsets that this study estimates would be economic to purchase if their prices were reflective of only the cost of the associated emissions reduction projects in other countries. Based on experience in oil and mineral leasing, those countries that could sell permits are likely to want a substantial margin above cost to agree to supply offsets. That would increase the magnitude of wealth transfers, as well as the cost of meeting the domestic policy’s requirements. One of the serious limits on production of oil resources worldwide is that in addition to insisting on a very large share of the economic rents from oil production, host countries are frequently politically unstable with unreliable legal systems, making long-term contracts difficult to rely on. Exactly the same conditions can be expected to prevail in many countries that could provide offset credits.

ACESA is so generous in its ceilings on international allowances that a significant amount of the required reduction will come from that source. Figure 3.20 shows the distribution of emission reductions between the electric sector, transportation, other energy use, domestic offsets and international offsets. International offsets provide 83% of the realized reduction in 2015, 36% in 2030 and 16% by 2050.

Figure 3.20: GHG emission reductions



Source: CRA Model Results, 2009

The large quantity of international offsets is at variance with the very strong sentiment in international negotiations – and reiterated in the most recent meetings of the ad hoc working group on long term cooperation – that developed countries should achieve most of their emission reductions through domestic measures. Combined with the observed wealth transfers and desire of host countries to maximize their take, the prospect of tightening the limits on international offsets seems plausible.

EPA regulation casts another cloud over offsets as a means of keeping policy costs down. Under ACESA, EPA would have a great deal of discretion to limit the effective supply of allowances. The effectiveness of measures to prevent deforestation and forest degradation are notoriously difficult to measure, and EPA may be very reluctant to (and face much external pressure not to) approve a very large share of the potential supply of these types of offsets that are assumed to be fully available in EPA's and our cost analyses.

Institutions greatly compound the scientific difficulties. In many developing countries, large disparities can exist between statute books and *de facto* practice. These disparities can cause gaps in the system of property rights. Thus, the ownership of forest land, let alone that of any value in the carbon content of standing trees, is often unclear.[14] There are often strong economic temptations to over-exploit resources that fall within lacunae in the system of property rights. Since governments can find it costly to define property rights and to enforce those that it has created, the task of curtailing this resource over-use is intractable.[15] In such cases laws intended to establish clear property rights and curb forest decline may have little real world effect. It would, then, not be surprising for EPA to adopt a highly skeptical attitude toward claims of avoided deforestation emissions. That stance, however, could well make forestry offsets very scarce despite the large potential for emission reduction that exists in principle. If this happens, estimated costs of ACESA would be greatly increased.

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[14] Cotula, L. and Mayers, J., *Tenure in REDD – Start-point or afterthought?,* Natural Resource Issues No. 15. International Institute for Environment and Development, London, UK, 2009.

[15] Libecap, Gary D., “Contracting for Property Rights” in *Property Rights: Cooperation, Conflict and Law*, Terry L. Anderson and Fred S. McChesney editors, Princeton University Press, Princeton, 2003.

4. UNFINISHED BUSINESS

The results presented in this report represent our initial estimate of the economic impact resulting from ACESA. It represents our best efforts to model the provisions of the proposed legislation with the information and time available to us. At the time that we performed this analysis, information on the particulars of the proposed legislation was still evolving. Provisions of the bill are still being negotiated. When the bill becomes more definitive, we will review its final provisions and may revise this analysis.

In addition, there are a number of issues related to ACESA that are not included in this report due to time limitations, but which we hope to address in a follow-on report:

- We will extend the regional results by providing estimates of key state-level impacts.
- In a future report, we intend to analyze in more detail the uncertainty about carbon prices and costs that is inherent in any policy that sets rigid caps on emissions that must be met over a relatively short measurement period, and discuss the likely volatility of GHG allowance prices given the normal fluctuations in economic activity and energy supply.
- We also intend to estimate impacts by income group of the cap-and-trade program under different allocation systems and approaches to recycling auction or carbon tax revenues. We will also look at how these impacts vary by regions and the reasons for the variation.

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APPENDIX A: REPRESENTATION OF ACESA IN MRN-NEEM

This analysis measures the effects of certain provisions in the ACESA bill released by Reps. Waxman and Markey.[16] ACESA contains several provisions aimed at reducing emissions of greenhouse gases. This appendix describes the provisions of ACESA that we have modeled in this study.

ACESA includes several provisions aimed at reducing emissions of greenhouse gases. Some of these provisions are relatively well defined, while others only specify future regulations to be determined at a later date. This initial report focuses on two of the most important provisions of the proposed bill, including:

- Economy-wide cap-and-trade for greenhouse gases (GHGs) and
- Federal renewable electricity standard (RES).

A.1 A CAP-AND-TRADE POLICY FOR GREENHOUSE GASES

Title III of the proposed ACESA calls for imposition of an economy-wide cap-and-trade policy for GHGs. A cap-and-trade policy sets a total limit on emissions of GHGs. To legally emit GHGs that are subject to such a cap, a source must submit to the government a permit for each ton that it emits. In any given year, the government auctions or allocates only the number of greenhouse gas emission permits that equals the target set by the cap. Once the government has auctioned or allocated the emission permits, the permits can be freely traded among entities.

In the case of ACESA, the GHG cap would initially apply in 2012. At its onset, it would limit emissions to 3% below the level that had prevailed in 2005. By 2020, the cap on emissions would fall to 17% below the 2005 level, and by 2050, the cap on emissions would fall to 83% below the 2005 level. ACESA's cap-and-trade provisions include offsets and allow permits to be banked from one year to the next. The offsets provisions allow a quantity of offsets to be used to meet each emitter's compliance obligation. This annual offset limit is 2 billion tons, split evenly between domestic offsets and international offsets. There is a discounting of international offsets defined in the bill such that the purchase of 5 tons of offsets is allowed to meet 4 tons of compliance obligations (the discounting does not apply before 2018 and does not apply to domestic offsets). Therefore, nationally there would need to be purchases of 2.25 billion tons of offsets to achieve 2 billion tons of reductions from offsets.

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[16] The version of the bill analyzed within this report is one that was released on May 15, 2009.

CRA has included these detailed offsets provisions in our analysis of ACESA. The analysis also includes unlimited banking of allowances.

Table A-1 includes the annual caps specified in the bill.

Table A-1: GHG cap (MM metric tons of CO_2)*

Year	Cap	Year	Cap	Year	Cap
2012	4,627	**2025**	4,294	**2038**	2,534
2013	4,544	**2026**	4,142	**2039**	2,409
2014	5,099	**2027**	3,990	**2040**	2,284
2015	5,003	**2028**	3,837	**2041**	2,159
2016	5,482	**2029**	3,685	**2042**	2,034
2017	5,375	**2030**	3,533	**2043**	1,910
2018	5,269	**2031**	3,408	**2044**	1,785
2019	5,162	**2032**	3,283	**2045**	1,660
2020	5,056	**2033**	3,158	**2046**	1,535
2021	5,903	**2034**	3,033	**2047**	1,410
2022	4,751	**2035**	2,908	**2048**	1,285
2023	4,599	**2036**	2,784	**2049**	1,160
2024	4,446	**2037**	2,659	**2050**	1,035

* CRA's MRN-NEEM models every five years and the first year in which the cap is in place in the model is 2015. In 2015, local distribution companies' emissions associated with natural gas are not covered, but coverage of these emissions begins in 2016. For simplicity, CRA has assumed that these emissions are covered in 2015. To account for this change in coverage we also increased the cap in 2015 to 5,589 MM metric tons, which was derived as the 2016 cap plus the change in the 2016 and 2017 caps.

A.2 FEDERAL RENEWABLE ELECTRICITY STANDARD

Title I of ACESA includes the establishment of a combined Federal RES and energy efficiency standard. The combined standard requires retail electricity suppliers to meet a certain percentage of their customer load with electricity generated from qualified renewables resources or from electricity savings gained through energy efficiency programs. This percentage increases from 6.0% in 2012 to 20.0% in 2020 through 2039, when the program ends.

The percentage requirement is applied to a base amount that is total sales less sales from non-qualified hydroelectric power and municipal solid waste. Also, smaller retail electricity suppliers (less than 4 million MWh) are not required to comply. The types of renewable resources that are eligible to meet the requirements include: wind energy, solar energy, geothermal energy, biomass/landfill gas, qualified hydropower, and marine/hydrokinetic renewable energy. In addition, as new nuclear units and units with CCS are built their generation is also subtracted from the base amount.

In addition to the RES requirements, ACESA specifies an ACP whereby suppliers can purchase an ACP in lieu of holding a renewable energy credit. The price of the ACP is $25/MWh (in 2009$) growing with inflation. In addition, up to 25% of the requirement (*e.g.*, 5% of the 20% in 2020) can be met with energy efficiency savings. Table A-2 includes the annual percentage requirements that are applied to the base amount.

Table A-2: Federal renewable electricity standard

Year	% Requirement
2012-2013	6.0%
2014-2015[17]	9.5%
2016-2017	13.0%
2018-2019	16.5%
2020-2039	20.0%

A.3 ALLOWANCE ALLOCATION METHODOLOGIES

ACESA specifies allowance allocations to certain sectors and groups to help in mitigating the cost increases they are likely to incur, while also assisting these industries in making a transition to a lower-carbon economy.

The electric sector is slated to receive 35% of the allowances through 2025, with the allowance allocation declining to 0% by 2030. This allocation is given to merchant coal-fired generators (5%) and local distribution companies (LDC). The allocation to local distribution companies is based on both sales and historical emissions. The LDC allocation cannot be used to reduce rates based on quantity of electricity consumed, but is intended to be used to rebate consumers based on some fixed portion of bills.

The other sectors that receive allocations are: energy-intensive industries, natural gas distributors, the automotive sector and oil refiners. All of these allocations decline to zero by 2030.

Allowances are also allocated to spur investments in CCS. In our analysis, these allowances help to bring about 3 GW of new CCS in 2020 and assist in the capital cost declines over time.

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[17] In 2015, CRA modeled a 8.5% requirement, which was the requirement in the earlier March 31, 2009 draft of the bill, rather than a 9.5% requirement. The 8.5% requirement was not binding and it is unclear if increasing the requirement to 9.5% would result in a binding limit.

ACESA also specifies that some allowances are to be used to prevent tropical deforestation and assist in international adaptation. We have assumed that the value of these allowances would accrue to countries other than the United States, and therefore these dollars are wealth transfers from the United States.

Remaining allowances are allocated to a number of other areas including renewable energy and efficiency, research and development, low- and moderate income households, users of home heating oil, domestic adaptation, and worker assistance and job training. Also, any remaining allowances are used to ensure that ACESA is budget neutral. All of these allowances are grouped in Table A-3 as “Auction.”

Table A-3: ACESA allowance allocations

	2015	2020	2025	2030	2035	2040	2045	2050
Total Electricity	35%	35%	35%	0%	0%	0%	0%	0%
Natural Gas	9%	9%	9%	0%	0%	0%	0%	0%
EIS Sector	15%	15%	15%	0%	0%	0%	0%	0%
Automotive Sector	3%	1%	1%	0%	0%	0%	0%	0%
Oil Refiners	2%	2%	2%	0%	0%	0%	0%	0%
CCS Investment	2%	5%	5%	5%	5%	5%	5%	5%
Preventing Tropical Deforestation	5%	5%	5%	3%	2%	2%	2%	2%
International Adaptation	1%	1%	2%	4%	4%	4%	4%	4%
Clean Technology Transfer	1%	1%	2%	4%	4%	4%	4%	4%
Auction	27%	26%	24%	84%	85%	85%	85%	85%
Total	100%	100%	100%	100%	100%	100%	100%	100%

APPENDIX B: BASELINE ASSUMPTIONS

The effects of the provisions that we have modeled are presented relative to a base case without any of these provisions. The base case is built upon many of the projections of the 2009 *Annual Energy Outlook* (AEO) Early Release produced by the Energy Information Administration (EIA) of the U.S. Department of Energy.[18] Several of the key baseline assumptions are described in this Appendix.

B.1 COST AND PERFORMANCE CHARACTERISTICS

The first-year technology capital cost assumptions (*i.e.*, the year in which a technology is first available) were based mainly on costs provided in EIA's AEO 2009 Electricity Market Module. In general, we found that EIA's capital costs assumptions for AEO 2009 fairly represented the capital costs being quoted in the trade press and in public filings. The exceptions were nuclear and geothermal. For nuclear, we relied upon capital cost data extracted from public filings that showed costs to be approximately 16% higher than EIA's estimates. For geothermal, we extracted data from Table 4.17 of EPA's NEEDS 2006 data source documentation, which provides capital cost by region and by potential capacity as opposed to the point estimate provided in EIA's Electricity Market Module. All capital costs include adders for fuel delivery infrastructure, transmission interconnection, and owners costs.[19]

For future capital costs, we trended costs downward to the AEO 2009 capital cost twenty years after the first-year. We then kept the technology's capital costs flat in subsequent years. For example, the first-year that Combined Cycle with CCS is available in MRN-NEEM is 2020. In 2040 and thereafter, the Combined Cycle with CCS capital costs are based upon the 2030 capital costs in AEO 2009 plus the adders described above (see Table B-1).

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[18] Energy Information Administration, *Annual Energy Outlook 2009, Early Release with Projections to 2030*, prepared by U.S. Department of Energy, Energy Information Administration, December 2008.

[19] Owner's costs includes, but is not limited to land acquisition and right-of-way, permits and licensing, royalty allowances, economic development, project development costs, legal fees, and owner's engineering.

Table B-1: Total overnight capital costs excluding interest during construction (2008$/kW)

Technology	2010	2015	2020	2025	2030	2035	2040	2045	2050
Super Critical Pulverized Coal	2,404	2,296	2,187	2,079	1,970	1,970	1,970	1,970	1,970
IGCC	2,742	2,593	2,443	2,293	2,144	2,144	2,144	2,144	2,144
IGCC w/ CCS	N/A	N/A	3,952	3,711	3,470	3,229	2,988	2,988	2,988
Nuclear	N/A	N/A	4,800	4,625	4,450	4,275	4,100	4,100	4,100
Combustion Turbine	845	814	784	754	693	693	693	693	693
Combined Cycle	1,151	1,094	1,037	980	867	867	867	867	867
Combined Cycle w/ CCS	N/A	N/A	2,167	2,022	1,878	1,733	1,588	1,588	1,588
Biomass	4,265	3,988	3,711	3,435	2,881	2,881	2,881	2,881	2,881
Landfill Gas	3,082	2,948	2,813	2,678	2,408	2,408	2,408	2,408	2,408
Wind Cost Class 1-3	2,457	2,399	2,341	2,283	2,167	2,167	2,167	2,167	2,167
Wind Cost Class 4	3,932	3,839	3,746	3,653	3,467	3,467	3,467	3,467	3,467
Wind Offshore		4,590	4,339	4,087	3,836	3,585	3,585	3,585	3,585
Geothermal	Ranges from $3,155/kW to $8,783/kW depending on location								
Photovoltaic	6,228	5,706	5,184	4,663	4,141	4,141	4,141	4,141	4,141
Solar Thermal	6,034	5,732	5,430	5,129	4,827	4,827	4,827	4,827	4,827

Variable operating and maintenance (VOM) costs, fixed operating and maintenance (FOM) costs, and plant net heat rates on a higher heating value (HHV) basis are based mainly upon the AEO 2009 Early Release. FOM includes ‘going-forward’ costs that are required to maintain plant performance. For nuclear, we include levelized cost adders in the FOM for in-core carrying charges and for the spent nuclear fuel removal fee. The geothermal FOM is based on data from EPA NEEDS 2006. See Table B-2 which shows VOM, FOM, and heat rate assumptions by technology.

Table B-2: Operating and maintenance costs and plant efficiency

Technology	VOM (2008$/MWh)	FOM (2008$/kW-y)	Heat Rate – HHV (Btu/kWh)
Super Critical Pulverized Coal	4.4	41.8	9,200
IGCC	2.8	52.5	8,765
IGCC w/ CCS	4.3	62.0	10,781
Nuclear	0.5	111.8	10,434
Combustion Turbine	3.0	16.3	10,810
Combined Cycle	2.0	18.1	7,000
Combined Cycle w/ CCS	3.1	27.1	8,613
Biomass	7.1	83.3	13,000 (2010) 9,646 (2030)
Landfill Gas	0.0	109.6	13,648
Wind Cost Class 1-3	0.0	29.1	0
Wind Cost Class 4	0.0	29.1	0
Wind Offshore	0.0	94.3	0
Geothermal	0.0	134.3 – 292.1	0
Photovoltaic	0.0	11.2	0
Solar Thermal	0.0	54.5	0

B.2 LIMITS ON CUMULATIVE CAPACITY ADDITIONS

The cumulative capacity constraints in MRN-NEEM are based on a variety of public resources and CRA's own estimates and are shown in the table below. These limits serve as a ceiling on how much can be built over time as a matter of reasonableness. However, MRN-NEEM decides whether to build up to these limits, and may project much lower builds than these maxima.

Table B-3: Limits on U.S. cumulative capacity additions (GW)

Technology[20]	2010	2015	2020	2025	2030	2035	2040	2045	2050
SCPC and IGCC	12	30	90	150	210	270	330	390	450
Coal/gas with CCS	0	3	10	30	60	90	120	150	180
Nuclear	0	0	2	17	46	86	126	166	206
Offshore Wind	0	6	34	62	90	90	90	90	90
Total Wind	17	70	124	177	231	231	231	231	231
Biomass	6	33	60	87	113	113	113	113	113
Landfill Gas	0.3	2	3	4	5	5	5	5	5
Geothermal	1	3	6	10	15	15	15	15	15
Solar Thermal	No cumulative limits, but there are total capacity limits by region								
Photovoltaic	No cumulative limits, but there are total capacity limits by region								

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[20] Sources of these capacity penetration rates are as follows: SCPC/IGCC (CRA), Coal/Gas with CCS (CRA and EPA analysis of Waxman-Markey), Nuclear (EPA analysis of Waxman-Markey), Offshore Wind (National Renewable Energy Lab), Total Wind (NREL, EIA, NYISO), Biomass (NREL, EIA), Landfill Gas (EPA NEEDS 2006), Geothermal (CRA), Solar Thermal (EPA NEEDS 2006), and Photovoltaic (CRA).

B.3 OTHER MAJOR INPUT ASSUMPTIONS

We calibrated our model baseline to closely match the outputs of EIA's *AEO 2009 Early Release*. The following table provides the major baseline indicators to which we calibrate:

Table B-4: Other major input assumptions

Indicator	Units	2010	2015	2020	2025	2030	2035	2040	2045	2050
Growth Rates										
GDP	%	2.0%	3.1%	2.5%	2.5%	2.7%	2.6%	2.6%	2.6%	2.6%
Electricity Demand	%	1.70%	0.88%	1.00%	1.00%	1.05%	1.02%	1.02%	1.02%	1.02%
Consumption										
Crude	Quads	34.6	33.8	32.1	31.9	33.0	33.9	34.8	36.4	36.9
Gas (Non-Electric Sector)	Quads	16.6	17.3	17.8	18.3	18.7	19.0	19.3	19.7	20.0
Oil	Quads	37.2	37.7	37.0	36.9	38.2	39.5	40.8	41.7	42.8
Transport Fuels	Quads	29.8	30.5	31.2	31.9	33.6	34.8	36.0	36.9	38.1
Driving Statistics										
VMT from Light Duty Vehicles (LDVs)	billions of miles	2,752	2,887	3,165	3,489	3,807	4,049	4,263	4,467	4,693
MPG of LDV Stock	MPG	20.3	21.9	25.0	29.0	32.2	33.4	34.1	35.1	36.5
Fuel Prices										
Natural Gas (Henry Hub)	2008$/MMBtu	$6.68	$7.06	$7.62	$8.25	$9.48	$9.98	$10.52	$11.08	$11.67
Natural Gas (Wellhead)	2008$/MMBtu	$5.90	$6.24	$6.73	$7.29	$8.37	$8.82	$9.29	$9.78	$10.30
Low Sulfur Crude	2008$/MMBtu	$13.41	$18.91	$19.89	$20.89	$22.44	$25.52	$29.03	$33.02	$37.56
Nuclear Fuel	2008$/MMBtu	$0.74	$0.74	$0.78	$0.81	$0.79	$0.79	$0.79	$0.79	$0.79
Biomass	2008$/MMBtu	$6.29	$6.29	$6.29	$6.29	$6.29	$6.29	$6.29	$6.29	$6.29
Coal	2008$/MMBtu	Computed endogenously in the model								

APPENDIX C: COMPARISON OF CRA RESULTS TO OTHER ANALYSES

At the time of this analysis there has been one other publicly-released, relevant analysis to which we can compare our results. EPA released an analysis of the cap-and-trade provisions of the draft Waxman-Markey bill.[21] EPA's study is based on the March 31, 2009 draft of the bill, which contains some slightly different provisions.

EPA's core analysis of the draft Waxman-Markey bill resulted in CO_2 allowance prices in 2015 of between \$13 and \$17 per metric ton of CO_2 (in 2005\$). The high end of EPA's range of CO_2 allowance prices is only slightly below the CO_2 allowance prices in this study, based on the reference case assumptions.

This similarity in prices, however, is somewhat misleading. The provisions that EPA modeled within the cap-and-trade portion of the bill contain some important differences from the provisions modeled in this analysis. In particular, there are three key differences:

1. EPA's analysis did not include the RES provisions, which could lower their modeled allowance prices slightly.
2. The cap modeled by EPA is slightly tighter than that modeled in this study. H.R.2454 increased the cap in 2020 such that the cap is a 17% reduction from 2005 levels. This also changed the cap from 2012 through 2029. The cumulative cap from 2012 through 2050 in H.R.2454 is almost 2% higher than that in the draft Waxman-Markey bill that EPA modeled.
3. H.R.2454 includes a provision that allows for up to 1.5 billion metric tons of offsets from international sources, if domestic offsets are not fully utilized (up to 1 billion tons). In this analysis, this provision led to an increase in international offsets of 500 million metric tons in 2015 and 2020, 440 million metric tons in 2025 and 220 million metric tons in 2030. The availability of these international offsets effectively loosened the cap by almost 10% over the period from 2015 through 2030. This likely put significant downward pressure on the CO_2 prices in this analysis.

If EPA were to have modeled these three provisions as they are in H.R.2454, each would likely result in lower CO_2 allowance prices, and we would see a greater divergence between their CO_2 allowance prices and those included in this study. Therefore, it is important to understand the sources of the differences.

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[21] EPA's study is available at: http://www.epa.gov/climatechange/economics/economicanalyses.html#wax.

On May 17, 2009, EPA released a qualitative assessment of the revisions to ACESA, relative to what they modeled. Their conclusion is, "On balance, compared to the draft bill, H.R. 2454 would likely result in lower allowance prices, a smaller impact on energy bills, and a smaller impact on household consumption, based on EPA's preliminary reading of the bill."[22] EPA focused on four areas that had changed to support their conclusion. The four areas of change are: 1) Cap level, 2) Offsets provisions, 3) Allowance allocations for protection from electricity price increases, and 4) Incentives for CCS. EPA did not list the RES provisions, which it did not model from the draft bill.

With respect to item 3, we believe that EPA has mischaracterized the provisions on the allowance allocations to electric local distribution companies. The specific provisions on the use of the allowances do not allow the use of the allowances for rebates based "solely on the quantity of electricity delivered to such ratepayer."[23] Since the rebate is not to be based on electricity use it should not distort the incentive for consumers to conserve electricity.

Both EPA's analysis and this analysis show significant reductions in the electric sector, limited reductions in the non-electric sectors and significant uptake of offsets (including the full utilization of international offsets in all years). CRA's analysis utilizes more domestic offsets than EPA.

A detailed review of EPA's results reveals the primary source of the difference leading to EPA's low CO_2 allowance prices. EPA's analysis was performed with two different economy-wide models – ADAGE and IGEM. EPA did sensitivity analysis using results from the ADAGE model so we will focus on that model. The ADAGE model is a similar model to CRA's older MRN model in that both are computable general equilibrium (CGE) models. ADAGE lacks a detailed technology representation of the electric sector. MRN suffered from the same problem and this weakness led CRA to develop the MRN-NEEM model which pairs the CGE framework for the non-electric sectors (MRN) with a detailed electric sector model (NEEM).

Without a detailed technology representation for the electric sector CGE models forecast too great of an ease of making reductions from the sector. This is demonstrated by EPA's own modeling. To validate its modeling of the electric sector, EPA took the CO_2 allowance prices and percentage changes in electricity demand and ran its detailed electric sector model, IPM.[24] EPA's analysis using the detailed technology representation (IPM) yields significantly

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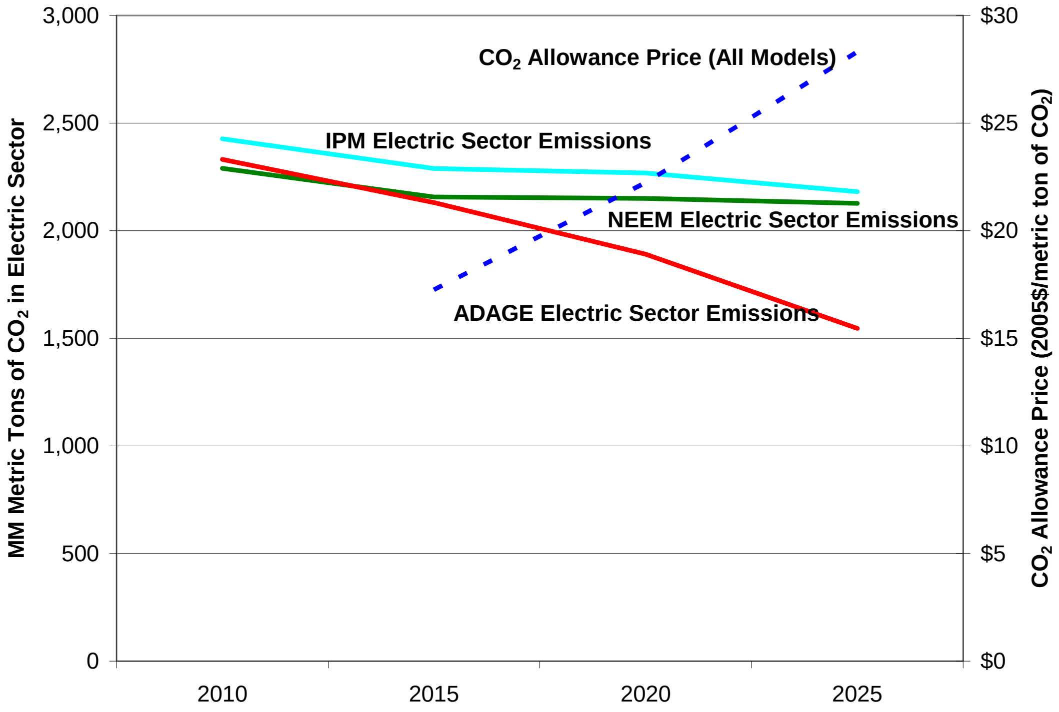
[22] "Ways in Which Revisions to the American Clean Energy and Security Act Change the Projected Economic Impacts of the Bill," U.S. EPA, May 17, 2009, available at: http://www.epa.gov/climatechange/economics/pdfs/EPAMemoonHR2454.pdf.

[23] H.R.2454, p. 559.

[24] See slides 19-25 in *EPA Preliminary Analysis of the Waxman-Markey Discussion Draft*, for a detailed discussion of EPA's approach.

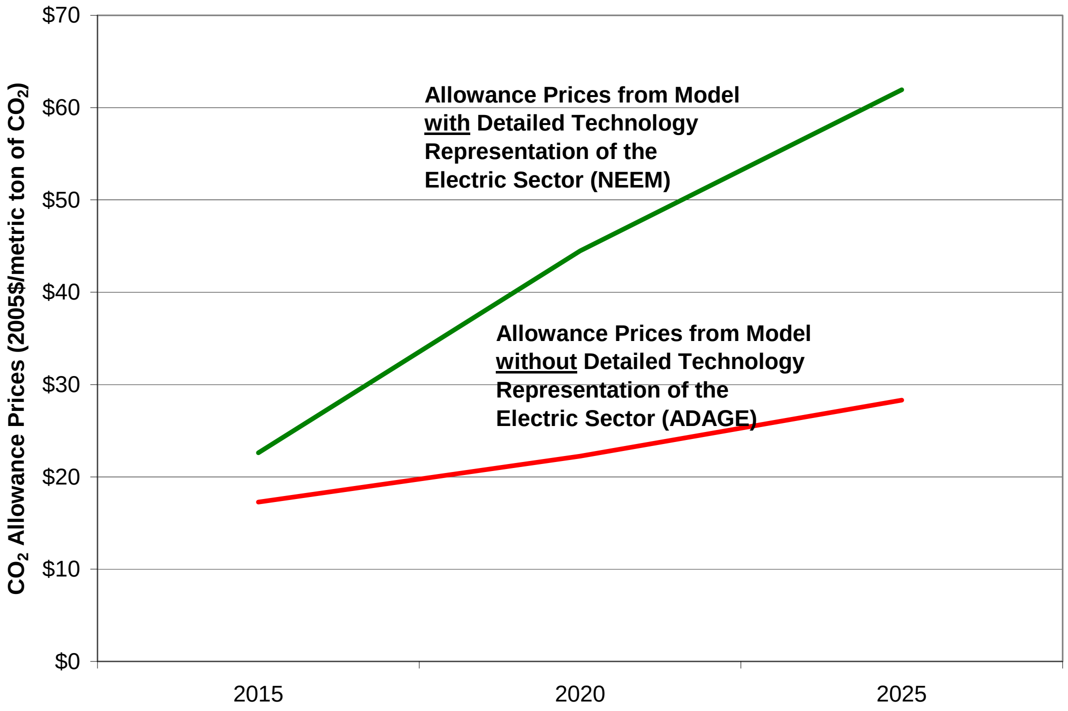
fewer CO_2 reductions from the electric sector as compared with a model without a detailed technology representation (ADAGE), at given CO_2 price levels. CRA used its NEEM model to do the same test that EPA did using IPM. We took the same CO_2 allowance prices and the percentage changes in electricity demand that EPA used in IPM. Our results were similar to those from EPA's analysis using IPM, as seen in Figure C.1. (Note that EPA's analysis using IPM only continued through 2025.)

Figure C.1: Comparison of electric sector emissions – ADAGE, IPM and NEEM



To evaluate just how much the ADAGE model might be overstating the ease with which electric sector reductions could be achieved, we used the resulting electric sector emissions from EPA's ADAGE analysis of the draft Waxman-Markey bill and implemented them as an electric sector cap in the NEEM model. Given the electric sector caps, NEEM then produced the marginal costs of abatement in the electric sector to achieve the level of electric sector emissions from ADAGE.

Figure C.2: Comparison of CO_2 allowance prices – ADAGE and NEEM



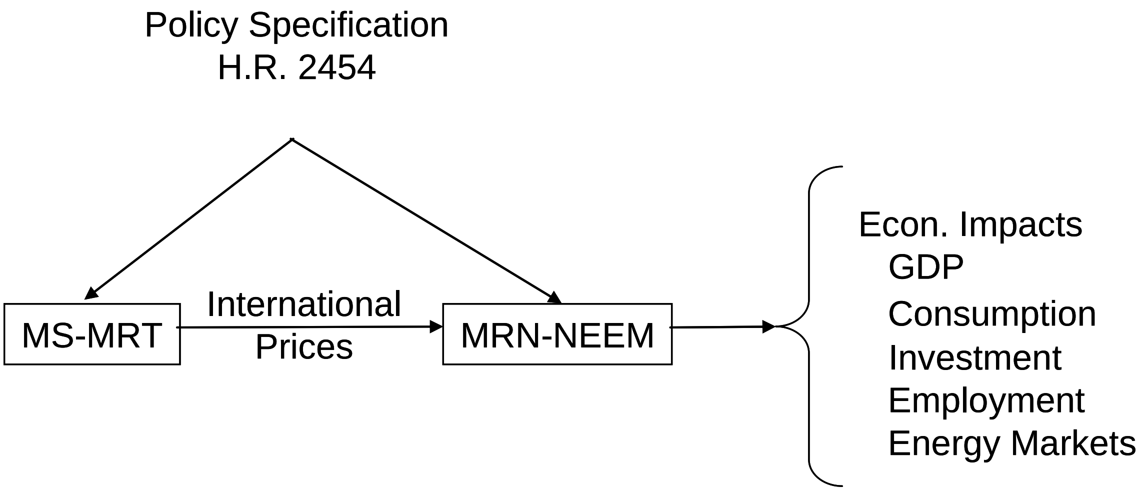
As seen in Figure C.2, the cost of achieving the electric sector emissions projected using ADAGE is significantly higher when evaluated with a model that contains a detailed technology representation of the electric sector. Thus, if EPA had coordinated its IPM and ADAGE models to produce consistent electric sector results, we would expect that EPA would have found significantly higher CO_2 prices for ACESA than they are currently reporting. Given that EPA says the IPM model is more “realistic” for the near-term, one can conclude that its ADAGE-based impact estimates are “not realistic” until they are made consistent with their IPM model projections.

APPENDIX D: MODEL DESCRIPTION

D.1 MODEL FRAMEWORK

In conducting this analysis for the National Black Chamber of Commerce, CRA combined three of its widely accepted state-of-the-art economic models: the Multi-Sector, Multi-Region Trade (MS-MRT) model, the Multi-Region National (MRN) model, and the North American Electricity and Environment Model (NEEM). The linked model approach accounts for the international feedback effects of the U.S. adopting ACESA. As Figure D.1 illustrates, MS-MRT is used to compute the effect on international prices from the U.S.'s adoption of ACESA. These prices are fed into the MRN-NEEM modeling system, which has a much more detailed representation of the U.S. economy and hence allows for more detailed analysis of the effects of ACESA.

Figure D.1: Linkage between MS-MRT and the MRN-NEEM modeling framework



This section briefly describes the three models: MS-MRT, MRN, and NEEM. It also provides more information on how the models are linked.

Overview of the MS-MRT sub-model

MS-MRT represents the entire world at an extremely aggregated level. It is built upon the GTAP6-IEA database,[25] which includes 83 countries/regions and 23 industries. For this project, we aggregated the dataset into the following regions: USA, Europe, Other OECD, Eastern Europe and Former Soviet Union, Middle East, China and India, high income East Asia, and the rest of the world. To be consistent with the MRN model, the dataset included the following sectors: coal, crude oil, electricity, natural gas, refined petroleum products, agriculture, energy-intensive sectors, manufacturing, services, and commercial transportation.

The model is fully dynamic, which means the agents in the model have perfect foresight and therefore perfectly anticipate all future policies. In other words, there are no surprises in the model, and saving and investment decisions are based on full inter-temporal optimization. MS-MRT belongs to the class of models referred to as general equilibrium.

Conceptually, as a fully dynamic general equilibrium model, the MS-MRT model computes a global equilibrium in which supply and demand are equated simultaneously in all markets for all time periods. There is a representative agent in each region, and goods are indexed by region and time. The incorporated budget constraint implies that there can be no change in any region’s net foreign indebtedness over the time horizon of the model. Changes in the prices of internationally traded goods produce changes in the real terms of trade between regions. All markets clear simultaneously, so that agents correctly anticipate all future changes in terms of trade and take them into account in making saving and investment decisions. The model computes, among other variables, investment, industry output, changes in household welfare, gross domestic product, terms of trade, wage impacts, and commodity price changes.

In order to capture some of the short-run costs of adjustment, elasticities of substitution between different fuels and between energy and other goods vary with time. The model is benchmarked to assume baseline rates of economic growth based on official government statistics and a common rate of return on capital in all countries. The rate of growth in the effective labor force (population growth plus factor-augmenting technical progress) and the consumption discount rate are calibrated to be consistent both with the assumed rates of growth and return on capital, and with zero capital flows between regions on the balanced growth path.

ACESA was analyzed under the assumption that the U.S. economy would evolve in accordance with the Energy Information Agency’s *Annual Energy Outlook 2009*’s reference case. These forecasts provide the baseline growth rate, energy consumption, energy

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[25] Dimaranan, Betina V., “The GTAP 6 Data Base: (Global Trade, Assistance, and Production).” Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, December 2006.

production, and energy prices to which the model is benchmarked. The macro economic sub-model MS-MRT is benchmarked to the same economic forecast used in the MRN sub-model to maintain consistency between the models.

MS-MRT includes the markets for three fossil fuels and their products. Electricity and all other non-energy sectors (*e.g.*, agriculture) are produced using these fuels, capital, labor, electricity, and materials as inputs. The model allows for complete bilateral trade in all goods produced by all industries.[26] The MS-MRT model uses an Armington structure in its representation of international trade in all goods except crude oil, which is treated as a homogeneous good perfectly substitutable across regions. The Armington structure assumes that domestically produced goods and imports from every other region are differentiated products. Domestic goods and imports are combined into Armington aggregates, which then function as inputs into production or consumption.

Because crude oil is treated as a homogeneous good, it trades internationally under a single world price. Conversely, representing natural gas and coal as Armington goods allows the model to approximate the effects of infrastructure requirements and high transportation costs between some regions. World supply and demand determine the world price of fossil fuels in the model. Current taxes and subsidies are included in each country’s prices.

MRN-NEEM accounts for the added costs to U.S. refiners of the requirement that U.S. refineries hold allowances to cover their direct GHG emissions. This creates a competitive disadvantage relative to foreign refineries in countries not subject to emission limits. Since refined product imports are treated as Armington goods in the CRA model, that cost disadvantage does not lead to wholesale shutdown of U.S. refineries. If it were possible to obtain refined product imports meeting U.S. standards at a constant price lower than the cost of continued operation of U.S. refineries, there could be a larger switch from crude oil imports to refined product imports and further loss of jobs in the refining industry.

Overview of the MRN sub-model

The top-down component of the integrated MRN-NEEM model is tailored from CRA International’s Multi-Region National (MRN) model, which is similar to MS-MRT in structure. MRN is a forward-looking, dynamic computable general equilibrium (CGE) model of the United States. It is based on the theoretical concept of an equilibrium in which macro-level outcomes (*e.g.*, consumption and investment) are driven by the decisions of self-interested consumers and producers. The basic structure of CGE models, such as MRN, is built around a circular flow of goods and payments between households, firms, and the government, as illustrated in Figure D.2.

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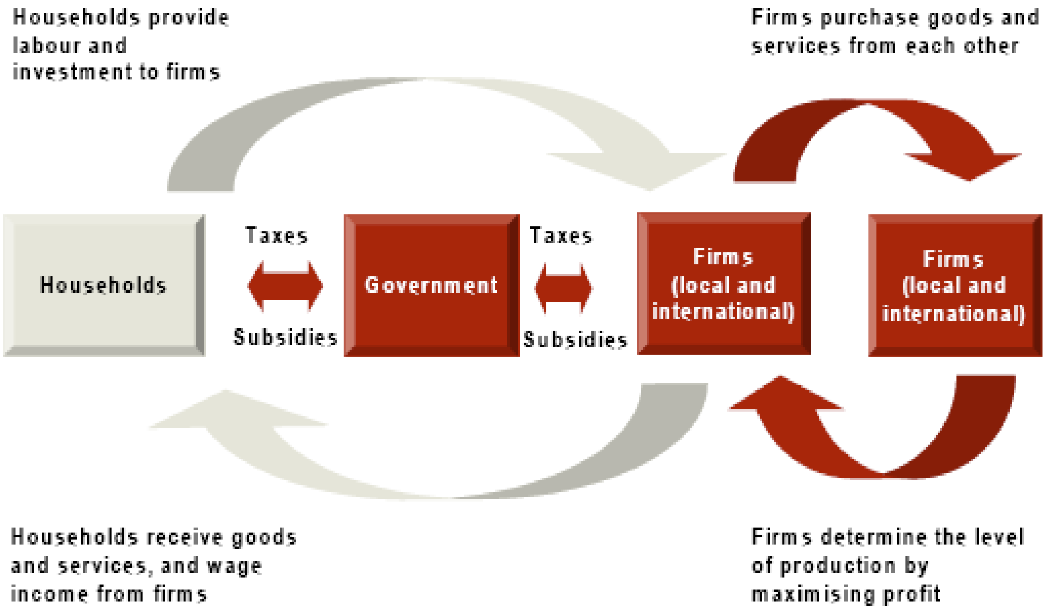
[26] Where the data show no trade in a particular good occurs between two regions, such as electricity between Europe and the U.S., the model ensures that no trade can occur in the future.

Figure D.2: Circular flow of goods and services and payment figure



Overview of the NEEM sub-model

The North American Electricity and Environment Model (NEEM) fills the need for a flexible, bottom-up partial equilibrium model of the North American electricity market that can simultaneously model both system expansion and environmental compliance over a 50-year time frame.

The model employs detailed unit-level information on all of the generating units in the United States and large portions of Canada. In general, coal units over 200 MW are represented individually in the model, and other unit types are aggregated. NEEM models the evolution of the North American power system, taking account of demand growth, available generation, environmental technologies, and environmental regulations both present and future. The North American interconnected power system is modeled as a set of regions that are connected by a network of transmission paths.

D.2 INTEGRATION METHODOLOGY

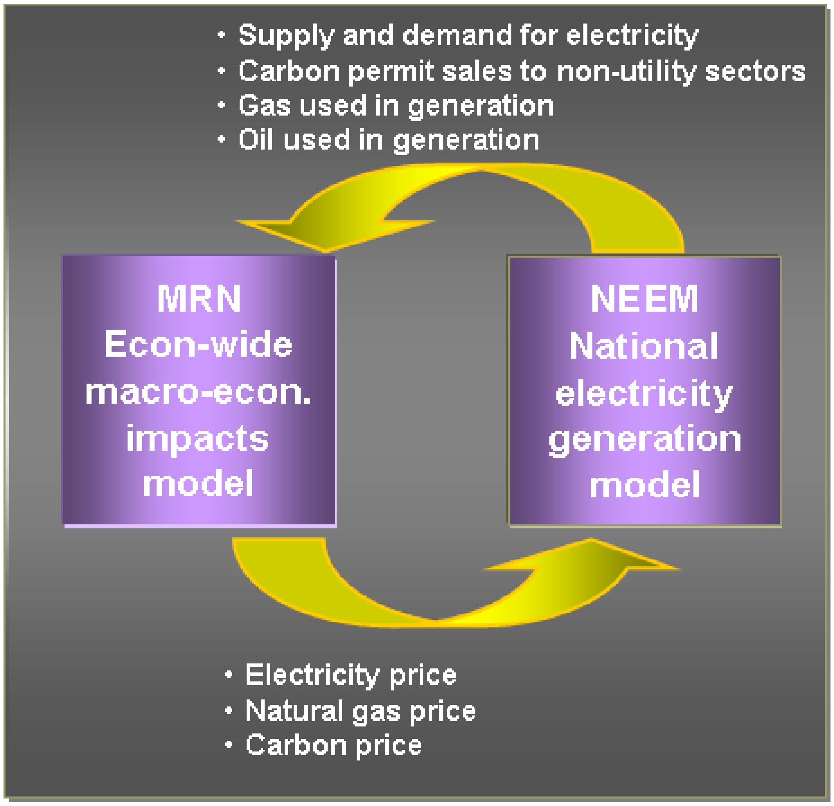
Linking MS-MRT and MRN-NEEM

There is a one-way link between the MS-MRT and MRN-NEEM models. The change in international prices from the U.S. adopting ACESA becomes an input to MRN-NEEM. This model represents the U.S. and assumes perfectly elastic supply and demand curves for imports and exports. The prices for these curves are determined by MS-MRT.

Linking MRN and NEEM

The MRN-NEEM integration methodology links the top-down and bottom-up models. The linking method utilizes an iterative process where the MRN and NEEM models are solved in succession, reconciling the equilibrium prices and quantities between the two. The solution procedure, in general, involves an iterative solution of the top-down general equilibrium model given the net supplies from the bottom-up energy sector sub-model followed by the solution of the energy sector model based on a locally calibrated set of linear demand functions for the energy sector outputs. The two models are solved independently using different solution techniques but linked through iterative solution points (see Figure D.3).

Figure D.3: MRN-NEEM iterative process



- Supply and demand for electricity
- Carbon permit sales to non-utility sectors
- Gas used in generation
- Oil used in generation

MRN
Econ-wide
macro-econ.
impacts
model

NEEM
National
electricity
generation
model

- Electricity price
- Natural gas price
- Carbon price

A more complete documentation of the MRN-NEEM model is available on CRA's website.[27]

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[27] http://www.crai.com/uploadedFiles/RELATING_MATERIALS/Publications/BC/Energy_and_Environment/files/MRN-NEEM%20Integrated%20Model%20for%20Analysis%20of%20US%20Greenhouse%20Gas%20Policies.pdf.

APPENDIX E: ESTIMATION OF GREEN JOBS IN MRN-NEEM RESULTS

This appendix summarizes the methods CRA has developed to estimate the number of "green jobs" implicit in the MRN-NEEM results. These estimates of green jobs are preliminary and subject to further review and refinement, as they were very recently developed as an analytical component of CRA's modeling capability. All of our estimates of green jobs created are still consistent with the estimated net job losses that we have reported for the economy as a whole.

Estimating Employment Impacts of ACESA 2009 on the Renewable Electricity Industry

The imposition of a binding cap on GHG emissions incentivizes the deployment of renewable electricity sources such as wind and solar power, leading to an increase in employment in the sectors associated with the construction and operation of those technologies. Our analysis relies upon publicly-available data to estimate the number of direct jobs that would be created from the expanded use of renewable sources for generating electricity. Our methodology estimates new jobs associated with the manufacturing, construction, installation, and operation of five different technologies: wind, photovoltaic, solar thermal, biomass, and geothermal. Using CRA's MRN-NEEM modeling system to forecast new capacity additions along with public estimates of the relationship between new capacity and employment, we are able to estimate the number of full-time employment (FTE) years created as a result of ACESA 2009 in the renewable energy industry.[28,29] We also compared our results to those produced by the Department of Energy's Job and Economic Development Impact (JEDI) models for wind and solar and obtained similar results.[30]

It should be noted that there are limitations to estimating such employment impacts. The number of jobs associated with building and operating any industrial facility will vary by project, so applying a uniform assumption to all new projects represents a "best-guess" of the impacts.

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[28] "The Work That Goes Into Renewable Energy," Renewable Energy Policy Project (2001), Virinder Singh and Jeffrey Fehrs, Washington, D.C.

[29] Daniel M. Kammen, Kamal Kapadia, and Matthias Fripp (2004) *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* RAEL Report, University of California, Berkeley.

[30] See http://www.nrel.gov/analysis/jedi/.

Estimating Employment Impacts of ACESA 2009 on the Biofuels Industry

Using MRN-NEEM results, we are able to estimate the number of jobs created as a result of ACESA 2009 in the biofuels industry. The model is capable of estimating the amount of biofuels – including corn ethanol and cellulosic ethanol – demanded annually in the U.S. in the future. We then use publicly-available sources to estimate the number of employees needed to operate a 40-million-gallon per year ethanol plant operating at 95% capacity and extrapolate to estimate overall employment impacts on a national level.[31]

The ACESA scenario predicts the same amount of biofuels being consumed in a business-as-usual scenario as in a policy scenario with a binding carbon cap. This is not surprising given the ambitious biofuels production mandate set forth Energy Independence and Security Act of 2007 (EISA 2007) and the duplicative nature of adding a carbon policy on top of pre-existing standards. EISA 2007 mandates the production of 36 billion gallons of corn and cellulosic ethanol by 2022.[32] The model results show that these mandates – even though the EIA estimates that they will not be met[33] – drive the amount of biofuels consumed and, therefore, employment levels in the industry. As a result, we have projected no change in biofuels employment as a direct result of ACESA.

Estimating Employment Impacts of ACESA 2009 on the Automobile Industry

We used an approach similar to the biofuels methodology to estimate the employment impacts of ACESA 2009 on the “green” automobile industry. We considered vehicles that run on biofuels to be included in this “green” classification. However, because very few vehicles currently run solely on biofuels, we estimated the number of “biofuel car equivalents” that would be needed to consume the biofuels produced in MRN-NEEM. To do this, we used public data to determine the average annual vehicle miles traveled (VMT) per vehicle in the U.S. and assumed that this would remain constant over time.[34] Then, by using MRN-NEEM to estimate total U.S. VMT in each year, along with modeled biofuels production estimates, we are able to estimate the number of “biofuel car equivalents” sold in a given year. This information, combined with an estimate of the average productivity of a U.S. automotive worker,[35] leads to an estimate of the number of jobs created in the “green” automobile sector.

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[31] “Economic Impacts of Ethanol Production,” Ethanol Across America (2006), Washington, D.C.

[32] The biofuels in the baseline are calibrated to the levels in AEO 2009 Early Release.

[33] *Annual Energy Outlook 2009, Early Release with Projections to 2030*, prepared by the U.S. Department of Energy, Energy Information Administration, January 2009.

[34] *Annual Energy Outlook 2009, Early Release with Projections to 2030*, prepared by the U.S. Department of Energy, Energy Information Administration, January 2009.

[35] “Wages and Employment of Workers in Automobile Manufacturing,” U.S. Bureau of Labor Statistics, Jeffrey Holt, 2005, Washington, D.C.

Since the use of biofuels, and therefore the production of biofuel and hybrid vehicles, is driven by the production mandates in EISA 2007, we again find that the impact of ACESA on employment in the “green” automobile industry will be small relative to a business-as-usual, no-policy scenario.

Estimating Employment Impacts of ACESA 2009 from Energy Efficiency

The vast majority of the green jobs that we have estimated in our ACESA scenario are associated with increased energy efficiency-related spending. As the carbon costs force energy cuts in production, firms will react by including more non-energy inputs, which are relatively cheaper. The general equilibrium effects show that output decreases as the cost of production rises and income drops, suggesting lower employment as the end result of the policy. If we assume that output remains at the same (baseline) level, we can determine how many more jobs would be needed to work with less energy in producing the same level of output given the relative changes in prices of energy and non-energy inputs.

It should be noted that the jobs created in relation to the energy efficiency in this study refer to the increase in employment when less energy is used to produce the same level of output. We do not distinguish between the increases in employment due to the energy-efficient technical/behavior changes from the increases due to the substitution of energy with more employment of labor from a pure cost perspective.

Results

CRA has made preliminary estimates of the number of average jobs directly associated with the increased payments to labor for increased renewable electricity, more efficient automobiles, biofuels, and energy efficiency improvements in its model scenario of ACESA. The preliminary estimate ranges from 1 million in 2015 to almost 2 million by 2030. The creation of a green job does not always mean the creation of a "new" job. For example, moving an autoworker from producing a vehicle powered by conventional fuels to a vehicle powered by a hybrid engine would not constitute a "new" job. Instead, it is a job transfer to what one might call a green job. Our estimate of green job creation includes green jobs that are both "new," which are incremental to a business as usual scenario, and "transfers," which are jobs shifted from part of an industry negatively impacted by a policy to another part of the industry that is positively impacted by the policy. Our net job loss estimates above are derived from the same model run that simultaneously contains this large number of implicit employment in “green jobs.”

H.R.2454 - American Clean Energy and Security Act of 2009111th Congress (2009-2010). Bill. Hide Overview.Â (a) Short title.â€”This Act may be cited as the â€œAmerican Clean Energy and Security Act of 2009â€. (b) Table of contents.â€”The table of contents for this Act is as follows: Sec. 1. Short title; table of contents.Â 453. State programs to build resilience to climate change impacts. Subpart bâ€”public health and climate change. Sec.