Climate Change Legislation and U.S. Job Growth: A Review of the Evidence

By
Margo Thorning, Ph.D.
Senior Vice President and Chief Economist
American Council for Capital Formation

Before the
Committee on Finance
United States Senate
November 10, 2009

Executive Summary

Climate Change Policy and Economic Models: As policymakers study options for reducing GHGs, they need to understand the individual strengths and weakness of the economic different models used. In addition, they need to evaluate the reasonableness of the assumptions used in the models on the availability of new technologies, offsets, banking and other parameters of the modeling process. Most experts conclude that macroeconomic models are better at predicting the impact of cap and trade legislation to reduce GHGs than are Input/Output models.
Impact of Climate Change Bills on U.S. Economic and Job Growth: An analysis by the American Council for Capital Formation and the National Association of Manufacturers of H.R. 2454 using a version of DOE: EIA's National Energy Modeling System showed that the bill would reduce total U.S. employment (net of new jobs created in green industries) by 80,000 jobs in the high cost case in 2020 and by between 1,790,000 to 2,440,000 jobs in 2030. Manufacturing is hard hit; it absorbs between 59 to 66 percent of the job losses over the 2012-2030 period. GDP declines by as much as 0.2 to 0.4 percent in 2020 and by up to 2.4 percent relative to the baseline forecast in 2030.
Energy Use Critical for Economic Growth: Each 1 percent increase in U.S. GDP is accompanied by a 0.2 percent increase in energy use. Substituting more expensive renewable energy for cheaper fossil energy through H.R. 2454's cap and trade provisions, national renewable portfolio standards for electricity generation, and mandating increases in energy efficiency across all sectors of the economy slows productivity growth and has a negative effect on overall U.S. employment.
Environmental Benefits of House and Senate Climate Bills Negligible: U.S. climate change policies will have virtually no environmental benefits unless developing countries, whose emissions are growing strongly, also participate. As noted in the 2009 Council of Economic Advisers' Report to the President, global concentrations of CO2 in 2100 will be almost unaffected by U.S. emission reductions.
Conclusions: To be effective, policies to reduce global GHG emission growth must include both developed and developing countries. Polices that enhance technology development and transfer are likely to be more widely accepted than those that require sharp, near- term reductions in per capita energy use.

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Introduction

Mr. Chairman and members of the Committee on Finance, my name is Margo Thorning, senior vice president and chief economist, American Council for Capital Formation (ACCF),* Washington, D.C. I am pleased to present this testimony to the Committee.

The American Council for Capital Formation represents a broad cross-section of the American business community, including the manufacturing and financial sectors, Fortune 500 companies and smaller firms, investors, and associations from all sectors of the economy. Our distinguished board of directors includes cabinet members of prior Democratic and Republican administrations, former members of Congress, prominent business leaders, and public finance and environmental policy experts. The ACCF is celebrating over 30 years of leadership in advocating tax, regulatory, environmental, and trade policies to increase U.S. economic growth and environmental quality.

Chairman Baucus, Ranking Member Grassley and the members of the Committee on Finance are to be commended for their focus on how policies to reduce U.S. greenhouse gas emissions so as to mitigate the threat of human-induced climate change may affect U.S. economic recovery and job growth. Given the extremely weak state of the U.S. economic recovery and an unemployment rate of 10.2 percent last month, a cautious approach to reducing U.S. Greenhouse gas emissions are clearly warranted. The questions we need to ask are first, what are the likely impacts of bills such as the "American Clean Energy and Security Act" (H.R. 2454) or the

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"The Clean Energy Jobs and American Power Act" (S.1733) on U.S economy, job growth and competitiveness and second, what are cost-effective strategies to slow both U.S. and global GHG growth? My testimony will address these key issues.

Climate Change Policy and Economic Models: What Should We Look For

The debate about the economic and job impacts of the current climate change bills before Congress has focused on the results of economic modeling from various government agencies, think-tanks and academia. As policymakers study options for reducing GHGs, they need to understand the individual strengths and weakness of the different models used. . In addition, they need to evaluate the reasonableness of the assumptions used in the models on the availability of new technologies, offsets, banking and other parameters of the modeling process. The impacts of most interest are on GDP, employment, labor productivity, investment and savings. Policymakers also are interested in what leverage they may have on these impacts, for example how to implement climate policy in ways that minimize economic costs. Most of the recent studies of the impact of the Waxman Markey bill rely on one of two types of models: macroeconomic models and input-output models.

Strengths and Weakness of Economic Models

- **Macroeconomic models**

According to a report by Dr. Michael Canes of LMI, macroeconomic models have significant advantages over other types of models for understanding the near-term impacts of policies to limit GHG emissions. (http://www.iccfglobal.org/pdf/EconomicModeling2002.pdf). He notes that macro- economic models are dynamic and capture interactive effects between the energy and other sectors of the economy. They also capture international trade effects by accounting for an economy's relationship with other economies. Macroeconomic models do not assume instantaneous full market adjustment but rather allow an economy to suffer involuntarily unemployed resources for a period as market participants adjust to a policy shock. In this way they capture near and intermediate-term adjustment costs as well as longer-term adjustment costs. Dr. Canes concludes that macroeconomic models are the most appropriate models to use when analyzing the impacts of a change in energy prices.

For example, the Global Insight model used by organizations such as the U.S. Department of Energy: Energy Information Administration is an example of a macroeconomic model... The Global Insight model starts by assuming an economy is on a long-run growth path, but then allows policy initiatives (i.e. a cap and trade system) to shock it in such a way that it deviates from the path while adjustment takes place. In other words, resources become involuntarily unemployed while they seek their new most valuable uses, and the economy produces below its potential. The length of adjustment depends on the magnitude of the shock and the flexibility of a country's internal markets, and can take quite a few years to fully work itself out. The Global Insight model contains a financial sector as well a real sector and therefore allows for changes in monetary or fiscal policy, which can mitigate or exacerbate energy policy initiatives through changes in interest rates and their economy-wide effects on savings and investment.

- **Input -Output Models**

An input-Output (I/O) model depicts inter-industry relations of an economy, that is, it shows how the output of one industry is an input to each other industry. An I/O model uses a matrix representation of a nation's (or a region's) economy to predict the effect of changes in one industry on others and by consumers, government, and foreign suppliers on the economy.

While most uses of the input-output analysis focuses on the matrix set of inter-industry exchanges, the actual focus of the analysis from the perspective of most national statistical agencies use input-output tables to assist in benchmarking of gross national product .Input/output tables therefore are an instrumental part of national accounting systems, including that of the U.S.

While useful for national accounting purposes or for studying relationships between industrial sectors, I/O models are static and cannot capture the effects of rising energy prices on U.S. industries' investment, employment decisions or international competitiveness. Because of this weakness, most government agencies, think tanks and academics rely on macroeconomic models when estimating the impact of a policy shift such as a cap and trade system to reduce GHG emissions.

Role of Assumptions in interpreting Economic Model Results

Since the assumptions employed in a macroeconomic model largely determine the effects that a simulation of a policy changes such as a cap and trade system for GHGs) will have on the economy and on job growth, policymakers need to examine them carefully. In modeling climate policy changes, the key assumptions are the projections for economic growth under the baseline forecast as well as factors like how quickly new technology can be deployed for nuclear electric generating capacity, for carbon capture and store for coal and natural gas electric generation ,and for alternative energy sources such as biomass, wind and solar power. Other key assumptions involve the cost of new construction for electric generating capacity and the amount of offsets and banking allowed.

Recent Analyses of the Impact of Climate Change Bills on U.S. GDP and Job Growth

- **Macroeconomic Analysis Results**

Recent private and government macroeconomic analyses of the impact of cap and trade proposals such as the Waxman-Markey bill (H.R. 2454), which requires reductions in covered GHGs to 17 percent below 2005 levels by 2020, 42 percent by 2030 and to 83 percent below by 2050, show that there are likely to be significant adverse consequences for the U.S. economy and job growth.. For example, an analysis by the American Council for Capital Formation and the National Association of Manufacturers of H.R. 2454 using a version of DOE: EIA's National Energy Modeling System showed that by 2020 the cost of an emission allowance that industry would need to purchase that year for each ton of CO2 emitted would range from $47 to $61 dollars and $123 to $158 in 2030(see **Table 1**). The assumptions used in the low and high cost cases in the ACCF/NAM analysis are in Appendix A.

The results of the ACCF/NAM analysis as well as those of other modeling efforts from CRA/NBCC, EIA and CBO show allowance prices rising to significant levels by 2030, especially when the availability of carbon capture and storage and new nuclear generation capacity are constrained to realistic levels(see **Table 2**). (See full study at http://www.accf.org/media/dynamic/3/media_387.pdf) Other macroeconomic studies from CBO, DOE's EIA and the National Black Chamber of Commerce(NBCC) a (see **Table 2)** show emission allowance prices ranging from $23 to $93 in 2020 and $49 to $190 by 2030.

Higher energy prices slow economic growth and industrial production. The ACCF/NAM study shows that GDP declines by as much as 0.2 to 0.4 percent in 2020 and by up to 2.4 percent relative to the baseline forecast in 2030(**see Table 1**). GDP losses in the other studies reported in **Table 2** show losses of up to 0.8 percent in 2020 and as much as 2.3 percent in 2030.

Substituting more expensive renewable energy for cheaper fossil energy through H.R. 2454's cap and trade provisions, national renewable portfolio standards for electricity generation, and mandating increases in energy efficiency across all sectors of the economy slows productivity growth and has a negative effect on overall U.S. employment. The ACCF/NAM analysis shows that the drag of higher energy prices caused by H.R. 2454 reduces total U.S. employment (net of new jobs created in green industries) by 80,000 jobs in the high cost case in 2020 and by between 1,790,000 to 2,440,000 under the low and high cost cases in 2030 compared to the baseline forecast. Manufacturing is hard hit; it absorbs between 59 to 66 percent of the job losses over the 2012-2030 period in the ACCF/NAM analysis (see **Table 1**). In other analyses cited in **Table 2**, job losses range from 81,480 to 1,800,000 in 2020 and up to 2,317,000 by 2030. By 2030, economic and job impacts are large, due to the tightening of emission reduction targets, increased demand and U.S. population growth according to the results of various macroeconomic analyses cited in Table 2.

Table 1. Summary of the ACCF/NAM Macroeconomic Analysis of the Waxman/Markey bill (H.R. 2454) for the United States

	Baseline (ACCF-Ref)			Low Cost Case (WM)			High Cost Case (WM)		
	2020	2025	2030	2020	2025	2030	2020	2025	2030
GDP (Billion 2007$)	$ 18,443	$ 21,016	$ 23,802	$ 18,403	$ 20,905	$ 23,384	$ 18,374	$ 20,853	$ 23,231
Loss in GDP (Billion 2007$)				$ 40	$ 112	$ 419	$ 68	$ 164	$ 571
% Loss				0.2%	0.5%	1.8%	0.4%	0.8%	2.4%
Employment (Millions)	157.2	160.7	165.8	157.2	160.4	164.0	157.1	160.2	163.4
Job Loss (Millions)				-0.01	0.33	1.79	0.08	0.52	2.44
% Loss				0.0%	0.2%	1.1%	0.0%	0.3%	1.5%
Industrial Output (Billion 2007$)	$ 7,962	$ 8,570	$ 8,839	$ 7,817	$ 8,305	$ 8,368	$ 7,790	$ 8,254	$ 8,263
Loss in Industrial Output (Billion 2007$)				$ 144	$ 265	$ 471	$ 172	$ 316	$ 575
% Loss				1.8%	3.1%	5.3%	2.2%	3.7%	6.5%
Coal Mining Output (Billion 2007$)	$ 27.4	$ 28.6	$ 29.2	$ 17.6	$ 12.9	$ 7.5	$ 17.0	$ 12.8	$ 7.0
Loss in Coal Mining Output (Billion 2007$)				$ 9.8	$ 15.7	$ 21.7	$ 10.4	$ 15.8	$ 22.2
% Loss				36%	55%	74%	38%	55%	76%
Primary Metals (Billion 2007$)	$ 188	$ 187	$ 164	$ 176	$ 166	$ 127	$ 171	$ 158	$ 116
Loss in Primary Metals Output (Billion 2007$)				$ 12	$ 21	$ 37	$ 17	$ 29	$ 48
% Loss				6%	11%	23%	9%	15%	29%
Carbon Allowance Price (2007 $/metric ton CO2e)				$ 47.50	$ 76.50	$ 123.21	$ 61.24	$ 98.63	$ 158.85
Average Household Income (2007$)	$ 98,929	$ 110,009	$ 121,731	$ 98,811	$ 109,670	$ 121,001	$ 98,679	$ 109,445	$ 120,483
Loss (2007$)				118	339	730	250	564	1248
% Change				-0.1%	-0.3%	-0.6%	-0.3%	-0.5%	-1.0%
Energy Expenditures (Billion 2007$)	$ 1,480	$ 1,549	$ 1,682	$ 1,538	$ 1,652	$ 1,996	$ 1,584	$ 1,728	$ 2,136
Increase(2007$)				$ 57	$ 103	$ 313	$ 104	$ 179	$ 454
% change				3.9%	6.7%	18.6%	7.0%	11.6%	27.0%
Retail gasoline prices (2007 $/gallon)	$ 3.61	$ 3.69	$ 3.85	$ 3.92	$ 4.13	$ 4.62	$ 4.01	$ 4.28	$ 4.86
% Change				8.4%	12.1%	20.0%	11.1%	16.1%	26.1%
Residential Electricity Price (2007 Cents/Kwh)	11.10	11.22	11.69	11.66	11.77	15.36	11.98	12.51	17.54
% change				5.0%	4.9%	31.4%	7.9%	11.5%	50.0%
Industrial Electricity Prices (2007 Cents/Kwh	6.45	6.57	6.91	7.26	7.78	10.30	7.84	8.68	12.17
% change				12.5%	18.4%	48.9%	21.5%	32.0%	76.0%
Residential Natural Gas Prices (2007 $/Mcf)	$ 12.88	$ 12.93	$ 14.27	$ 12.46	$ 13.55	$ 22.31	$ 12.90	$ 14.24	$ 24.75
% change				-3.3%	4.8%	56.3%	0.1%	10.1%	73.5%
Industrial Natural Gas Prices (2007 $/Mcf)	$ 7.65	$ 7.62	$ 8.85	$ 10.19	$ 12.26	$ 16.55	$ 11.56	$ 14.19	$ 18.89
% change				33.3%	61.0%	87.1%	51.1%	86.3%	113.5%
Electric Utility Coal Prices (2007 $/Ton)	$ 38	$ 39	$ 40	$ 124	$ 180	$ 269	$ 151	$ 224	$ 345
% change				224%	359%	565%	295%	472%	755%
Manufacturing Employment (Millions)	12.0	11.6	10.1	11.8	11.2	9.5	11.7	11.1	9.4
Job Loss (Millions)				0.21	0.38	0.58	0.28	0.49	0.74
% Loss				1.8%	3.3%	5.8%	2.3%	4.2%	7.3%

- **Input/Output Model Results**

Two recent analyses using static input/output models state that bills such as Waxman/ Markey would have a net positive impact on U.S. employment (see **Table 3**). For example, the Center for American Progress/Political Economy Research Center report claims that there would have been be a net gain of 1,700,000 jobs in 2008 if policies like Waxman Markey had been in place.

Table 2. Economic Impact of the Waxman-Markey Bill: Summary of Key Macroeconomic Modeling Results

	2020		
	Allowance Prices (2007$ per metric ton)	GDP Impact (% Change from BAU)	Impact on Jobs (Change from BAU)
ACCF/NAM-Low Cost[1]	$47.5	-0.2%	10,000
ACCF/NAM-High Cost[1]	$61.24	-0.4%	-80,000
CRA/NBCC[2]	$30	-0.8%	-1,800,000
EIA- NEMS Basic[3]	$31.7	-0.3%	-81,480
EIA- NEMS Limited[3]	$93.3	-0.7%	-355,210
CBO[4]	$23	-0.2 to -0.7%	N/A

	2030		
	Allowance Prices (2007$ per metric ton)	GDP (% Change) (% Change from BAU)	Impact on Jobs (Change from BAU)
ACCF/NAM-Low Cost[1]	$123.21	-1.8%	-1,790,000
ACCF/NAM-High Cost[1]	$158.85	-2.4%	-2,440,000
CRA/NBCC[2]	$49	-1.0%	-2,200,000
EIA- NEMS Basic[3]	$64.8	-0.8%	-597,000
EIA- NEMS Limited[3]	$190.5	-2.3%	-2,317,000
CBO[4]	N/A	-0.4 to -1.1%	N/A

1. "Analysis of The Waxman-Markey Bill "The American Clean Energy and Security Act of 2009" (H.R. 2454) Using The National Energy Modeling System" (NEMS/ACCF-NAM 2) A Report by the American Council for Capital Formation and the National Association of Manufacturers, August 2009.
2. " Impact on the Economy of the American Clean Energy and Security Act of 2009 (H.R.2454)" National Black Chamber of Commerce, August 2009.
3. "Energy Market and Economic Impacts of H.R. 2454, the American Clean Energy and Security Act of 2009," by the Energy Information Administration, U.S. Department of Energy, August 2009.
4. "The Economic Effects of Legislation to Reduce Greenhouse-Gas Emissions", Statement of Douglas W. Elmendorf," CBO, October 2009.

The CAP/PERI report identifies some of the problems with its analysis. The report states, "there are certainly weaknesses with our use of the input-output model. The most important are that it is a static model, a linear model, and a model that does not take into account structural changes in the economy………Our model also assumes that a given amount of spending will have a proportionate effect on employment no matter how much the level of spending changes, either up or down. For example, the impact of spending $1 billion on an energy efficiency project will be exactly 1,000 times greater than spending only $1 million on the exact same project." Thus, as the CAP/PERI report admits, its analysis is incapable of reflecting real-world changes in prices, human and physical resource constraints, productivity, saving and investment, productivity, etc. That would occur when a cap and trade system is put in place. As a result of the inadequacy of the I/O model approach, the report's finding that net U.S. Jobs would increase under Waxman-Markey can not be taken seriously.

Table 3. Economic Impact of the Waxman-Markey Bill: Summary of Key Input/Output Modeling Results

	Allowance Prices ($ per metric ton)	GDP (% Change) (% Change from BAU)	Impact on Jobs (Change from BAU)
CAP/PERI[1]	N//A.	N//A. Concludes from various studies "the impact of a cap and trade system on U.S. GDP will be negligible"	1,700,000(2008)
ACEEE[2]	$47	0%	424,000(2030)

1. "The Economic Benefits of Investing in Clean Energy," Robert Pollin, James Heintz, and Heidi Garrett-Peltier, Department of Economics and Political Economy Research Institute (PERI), June 2009.
2. "Climate Change Policy as an Economic Redevelopment Opportunity: The Role of Productive Investments in Mitigating Greenhouse Gas Emissions," John A. Laitner, American Council for an Energy-Efficient Economy, October 2009.

Similarly, a new report by the American Council for an Energy-Efficient Economy, which also uses a static I/O model, states that overall employment would increase by 424,000 jobs in 2030. The ACEEE analysis is plagued by the same weaknesses as the CAP/PERI report.

Energy Prices and U.S. Job Growth and Competitiveness

The results of the macroeconomic analyses cited in Table 1 above suggest that legislation like the Waxman/Markey bill (H.R. 2454) will, by raising U.S energy prices, make it harder to keep the U.S. economic recovery going and to reduce the unemployment rate. Each one percent increase in U.S. GDP growth is accompanied by a 0.2 percent increase in energy use: therefore, the higher the price of energy, the slower the rate of economic recovery.

A real world example of the effect that increased energy prices have on U.S. industry and employment can be observed by examining trends in the U.S. chemical industry. For example, chlorine is an essential chemical building block used in the production of pharmaceuticals, medical devices, safety equipment, computers, automobiles, aircraft parts and crop protection chemicals. Chlorine production in based on electro-chemistry and is one of the most energy-intensive production processes. In recent years, U.S. chlorine capacity has been shut down because of record high electricity costs arising from high natural gas prices, according to the American Chemistry Council. In addition, a report by SRI Consulting indicates that ammonia capacity fell from 14.8 million tons in 1999 to 13.6 million tons in 2007, an 8% reduction. Data on global natural gas prices for the third quarter of 2008 show that U.S. producers faced much higher prices than many other countries. Thus it is not surprising that much chemical production has migrated to lower cost locations.

Similarly, nitrogenous fertilizers play a major role in boosting crop yields and ammonia is the key raw material for these fertilizers. Ammonia production has also been affected by sharply rising natural gas prices. According to The Fertilizer Institute, from 1999-2007, 25 ammonia plants have been closed and a report by SRI Consulting indicates that ammonia capacity fell from 15.5 million metric tons in 1999 to 9.8 million metric tons in 2003, a 37% reduction. Approximately 120,000 jobs have been lost in the U.S. chemical industry since 1999, when natural gas prices began their sharp rise, according to the American Chemistry Council.

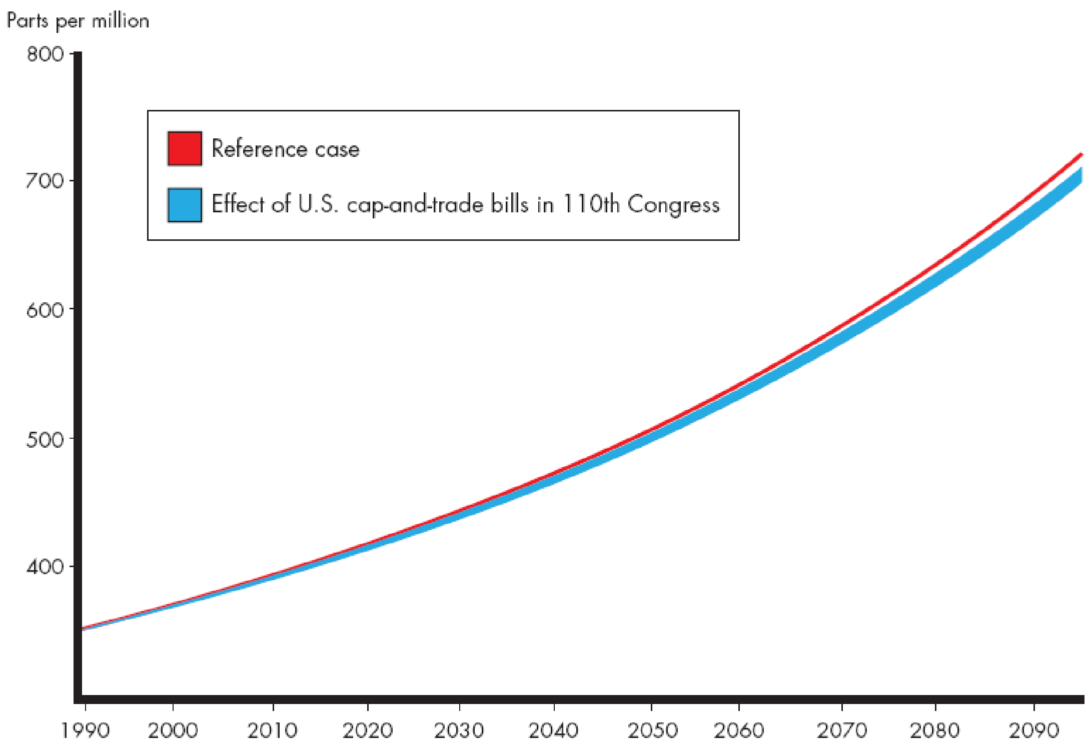
In addition, policymakers should consider proposals to remove restrictions faced by the domestic oil and gas industry regarding access to both onshore and offshore reserves. Promoting U.S. energy supplies could lessen dependence on foreign sources while enhancing U.S. job growth. Further policymakers should avoid increasing taxes on the oil and gas industry to avoid raising the cost of capital for needed new investment. Improving the tax treatment for U.S. energy investments would also help pull through cleaner, less emitting technologies in the U.S. An analysis prepared by Ernst&Young for the ACCF showed that U.S. firms face much higher taxes on new investment than do their competitors in other countries(see study at http://www.accf.org/media/dynamic/8/media_82.pdf)

- **Environmental Impact of Mandatory U.S. GHG Emission Reductions**

As described above, meeting the mandatory reduction targets of proposed legislation such as the Waxman/Markey or the Kerry/Boxer bill (S.1733) are likely to have a significant impact on U.S. economic and job growth due to the sharply higher energy prices needed to bring down emissions. However, the U.S. climate change policies will have virtually no environmental benefits unless developing countries, whose emissions are growing strongly, also participate. As noted in the 2009 Council of Economic Advisers' Report to the President, global concentrations of CO2 in 2100 will be almost unaffected by U.S. emission reductions. (See **Figure 1).**

The difficulties of getting major emitters in the developing world to accept binding emission limits is noted in an analysis by Lee Lane and David Montgomery, *Political Institutions and Greenhouse Gas Controls,* for the AEI Center for Regulatory and Market Studies (December 2008), concludes that institutions limit the extent to which efficient policies to reduce GHGs are likely to be adopted. The authors note that there are no third parties to enforce climate policy agreements and nations differ widely in their interest in restricting GHG emissions. Therefore, high transaction costs will attend efforts to reach and maintain broad GHG controls. So far, these transactions costs have blocked agreement and there seems little reason to expect that these constraints will soon vanish. The most likely course for future climate policy is drift and fragmentation, the authors conclude.

Figure 1. Global CO2 Concentrations:
Carbon emissions are projected to rise over the next several decades



Source: Economic Report of the President, Annual Report of the Council of Economic Advisers, January 2009, Chart 3-6, pg 124.

Thus, without strong international participation to reduce GHGs, the slower U.S. economic and job growth that would result from the emission reduction targets being debated by U.S. policymakers would yield little environmental benefit.

- **Conclusions**

To be effective, policies to reduce global GHG emission growth must include both developed and developing countries. Polices that enhance technology development and transfer are likely to be more widely accepted than those that require sharp, near- term reductions in per capita energy use. Extending the framework of the Asia Pacific Partnership on Clean Development and Climate and other international partnerships will allow developed countries to focus their efforts where they will get the largest return, in terms of emission reductions for the least cost.

Finally, if the United States does adopt a mandatory greenhouse gas emissions reduction program, serious consideration should be given to implementing a carbon tax rather than an EU style cap and trade system. A key component of any mandatory U.S. program should be allowing emissions to increase as both economic growth and U.S. population increase.

APPENDIX A.
ACCF-NAM SCENARIO SPECIFICATIONS

	CASE #1 High Cost Scenario	CASE #2 Low Cost Scenario
NEW TECHNOLOGY CAPACITY CONSTRAINTS (2030 Build Limits)		
NUCLEAR[a]	10 GW	25 GW
IGCC with CCS (2020 start year)	15 GW	30 GW
Biomass	Max 3 GW/year	Max 5 GW/year
Wind (onshore)	Max 5 GW/year	Max 10 GW/year
NGCC with CCS (2020 start year)	15 GW	30 GW
TECHNOLOGY OVERNIGHT CAPITAL COST[b] (2009 $/kW)		
All Capital Costs	AEO2009 BASIS	AEO2009 BASIS
Advanced Pulverized Coal	1985	1985
Advanced IGCC	2294	2294
Advanced IGCC with CCS	3273	3273
Advanced NGCC	905	905
Advanced NGCC with CCS	1736	1736
Advanced Nuclear	2964	2964
Advanced Combustion Turbine	623	623
Onshore Wind	1855	1855
Offshore Wind	2609	2609
Photovoltaic	4391	4391
Solar Thermal – Concentrating	4843	4843
Hydropower - Large	1708	1708
Biomass Combined Cycle	3446	3446
Geothermal	2882	2882
OTHER KEY MODELING ASSUMPTIONS		
Projected Crude Oil Price Profile	AEO2009 BASIS	AEO2009 BASIS
Allowance Price Ceiling (cap on annual increase)	10% Max	10% Max
H.R. 2454 ASSUMPTIONS		
Offsets	1,000 MMT Limit (Split 95% Domestic and 5% International)	1,000 MMT Limit (Split 95% Domestic and 5% International)
Banking	5,000 MMT	5,000 MMT
Strategic Reserve	Modeled Indirectly	Modeled Indirectly
Title I Combined Efficiency/ Renewable Electricity Standard	Modeled – See Appendix 2	Modeled – See Appendix 2
Title II Energy Efficiency	Modeled – See Appendix 2	Modeled – See Appendix 2
Title III Cap and Trade Provisions	Modeled – See Appendix 2	Modeled – See Appendix 2
Title IV – Transition to a Clean Energy Economy	Not Modeled	Not Modeled

a Net added capacity; accounts for 3.4GW uprates to existing plants and 4.4 GW of retirements.
b Overnight cost does not account for the following factors: 1) Location and elevation; 2) Contingency; 3) Interest during construction; Optimism and learning. The model accounts for these factors for the purposes of capacity addition.