Comments

on the documents titled

"Analysis of The Lieberman-Warner Climate Security Act (S. 2191) Using The National Energy Modeling System (NEMS/ACCF/NAM)"

"Alaska Economic Impact on the State from the Lieberman-Warner Proposed Legislation to Reduce Greenhouse Gas Emissions"

ISER Working Paper 2008.1

prepared by

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11 April 2008

Introduction

The Lieberman-Warner Climate Security Act (hereafter LW or "the Act") aims to cover 87% of total U.S. greenhouse gas (GHG) emissions.[2] It aims to reduce the emissions of those gases by 4% below year 2005 levels in 2012 and by 17% below 2005 levels in 2020. The Act would impose a cap-and-trade mechanism on most energy-using activities. The number of emissions allowances would be limited in order to keep total emissions in each year below the predetermined cap. The interaction of buyers and sellers of emissions allowances would determine a market price per ton of CO_2 equivalent. The Act allows emitters to trade, save, and borrow allowances, so that the most cost-effective GHG emissions reductions can be made where and when they are available.

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[2] U.S. GHG emissions in year 2006, measured in terms of CO_2-equivalent warming potential, consisted of carbon dioxide (CO_2, 83.0%), unburned methane (CH_4, 7.5%), nitrous oxide (N_2O, 7.5%), and others – chiefly hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (HFCs, PFCs, and SF_6, totaling 2.1%). (U.S.E.P.A. 2008). [percentages do not add exactly due to rounding].

The American Council for Capital Formation and the National Association of Manufacturers (ACCF/NAM) recently issued a report[3] that projects some of the economic effects of implementing LW. Both effects on the U.S. economy and effects on individual states are projected. The analysis was conducted by Science Applications International Corporation using the National Energy Modeling System (NEMS). NEMS is a set of interlinked computer models that project energy supply and demand and key macroeconomic outcomes such as gross domestic product and employment. Many assumptions are required as inputs into NEMS. The assumptions driving the ACCF/NAM results were provided by ACCF and NAM. They were not chosen by the consultants who ran the model. Two sets of assumptions were used to generate two set of projections: a "Low Cost" scenario and a "High Cost" scenario.

Scope of these comments

My comments will address the following two questions:

1. According to these NEMS/ACCF/NAM projections, how will the Lieberman-Warner bill affect the Alaska economy?
2. How should one interpret the results of these NEMS/ACCF/NAM projections, generally?

1. How will Lieberman-Warner affect the Alaska economy?

According to NEMS/ACCF/NAM, Lieberman-Warner will significantly increase the wellhead value of North Slope gas

Alaska is a major oil and gas producer. Lieberman-Warner will greatly increase the demand for Alaska North Slope gas. That's because natural gas contains only 55% as much CO_2 per unit of energy as coal. Switching from coal to natural gas is one sure way for electric utilities to reduce GHG emissions. Economic theory predicts that the more stringent is the cap on emissions, the more the demand for natural gas will be stimulated.

The ACCF/NAM projections show that the blended[4] market price of natural gas would increase by about \$6 per mcf[5] in 2020 and by about \$20 per mcf in 2030. This market price premium far exceeds the projected cost of CO_2 allowances, meaning that the "netback" wellhead value of North Slope gas would be higher -- by between \$3 and \$6 per mcf -- during the expected life of an Alaska gas pipeline (from 2018 to 2047). The wellhead price increase is highest in the "High Cost" scenario, which creates strong incentives to substitute gas for coal.

The wellhead price premium for Alaska North Slope gas translates into between \$4 billion and \$9 billion per year of additional wellhead value. The total additional wellhead value over a 30-year pipeline life ranges from \$150 billion to \$230 billion. If discounted back to year 2008 at 5%, the discounted present value ranges from \$50 billion to \$74 billion.

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[3] American Council for Capital Formation and National Association of Manufacturers. [no date given, but presumed to be April 2008.] http://www.accf.org/publications/reports/lieberman-warner.html

[4] A simple average of industrial and residential projected prices.

[5] "mcf" stands for thousand cubic feet. One mcf of natural gas contains about 1 million british thermal units (btus) or energy.

While the gas producers would likely receive the largest share of this additional value, the State of Alaska would also benefit directly. Assuming a 25% share, the State of Alaska would receive between $1 billion and $2.2 billion per year of additional gas revenue under Lieberman-Warner, based on these NEMS/ACCF/NAM projections. The discounted (at 5%) present value – today -- of these revenues would be between $12 billion and $18 billion.

The details of these calculations are shown in Table 1.

Table 1. Additional natural gas wellhead value and revenue to State of Alaska due to Lieberman-Warner, based on NEMS/ACCF/NAM projections.

			2014	2020	2030
Natural gas price from NEMS (2007$/mcf)					
	Baseline Scen		5.96	6.30	7.44
	Low Cost Scen	Industrial	8.10	9.38	20.87
		Residential	12.87	14.25	26.33
		Average	10.49	11.82	23.60
	High Cost Scen	Industrial	8.34	10.48	25.61
		Residential	13.18	15.40	31.13
		Average	10.76	12.94	28.37
Total Price difference (2007$/mcf)					
	Low Cost Scen		4.53	5.52	16.16
	High Cost Scen		4.80	6.64	20.93
Allowance price (2007$/mton CO2-e)					
	Low Cost Scen		36.69	54.59	227.52
	High Cost Scen		38.36	64.28	271.27
Conversion coefficient (mton/mcf)			0.0547	0.0547	0.0547
Allowance price (2007$/mcf)					
	Low Cost Scen		2.01	2.99	12.45
	High Cost Scen		2.10	3.52	14.84
Price premium net of allowance cost (2007$/mcf)					
	Low Cost Scen		2.52	2.53	3.71
	High Cost Scen		2.70	3.12	6.09

		2014	2020	2030	NPV @5% in 2008
Alaska gasline throughput @ 4 bcf/day (bcf/yr)		1,460	1,460	1,460	
Additional wellhead value (million 2007$)					
	Low Cost Scen	3,676	3,692	5,423	49,793
	High Cost Scen	3,944	4,561	8,894	74,150

Addtional State of Alaska revenue @ 25% state share, in millions of 2007$		**2014**	**2020**	**2030**	**NPV**
	Low Cost Scen	919	923	1,356	12,448
	High Cost Scen	986	1,140	2,223	18,537

It is important to keep in mind that the above calculations are based on full payment of the emissions allowance cost by gas consumers for every unit consumed, which is consistent with a 100% auction of emissions allowances. If, however, significant amounts of CO_2 emissions allowances were allocated at no charge to ANS gas producers or to the buyers of ANS gas, it is likely that the increases in ANS wellhead gas value would be even higher, as some of the capital gain from free allowances for "grandfathered" emissions would be passed back to wellhead prices through competition.

Lieberman-Warner might also increase the wellhead value of ANS crude oil by billions of dollars

According the NEMS/ACCF/NAM projections, the market price of crude oil is likely to also increase significantly more than the cost of an emission allowance. While the report does not provide direct projections of projected changes in crude oil prices, the projections shown in Figure 8 (p 12) for home heating oil, when combined with gasoline price projections, indicate that the market price of crude would rise by more than the allowance cost. Assuming that this crude oil price premium equates to a higher "netback" wellhead value, and using the spring 2008 Alaska Department of Revenue production forecast,[6] ANS crude would be worth between $500 million and $9 billion more per year under LW.

Assuming a 25% share, the State of Alaska is therefore projected to receive between $100 million and $2 billion per year of additional oil revenue under Lieberman-Warner, based on these NEMS/ACCF/NAM results. The discounted (at 5%) present value – today -- of these revenues would be between $1.2 billion and $19.6 billion.

Table 2. Additional ANS oil wellhead value and revenue to State of Alaska due to Lieberman-Warner, based on NEMS/ACCF/NAM projections.

	2014	2020	2030	NPV @5% in 2008
ANS production (million barrels/yr)	246	191	114	
(AK DOR 2008 + 5% decline after 2018)				
Estimated wellhead price premium (2007$/bbl)				
Low Cost Scen	1.72	2.97	5.27	
High Cost Scen	37.27	47.84	66.40	
Additional wellhead value (million 2007$)				
Low Cost Scen	423	566	602	4,876
High Cost Scen	9,168	9,132	7,589	78,463
	2014	**2020**	**2030**	**NPV**
Addtional State of Alaska revenue				
@ 25% state share, (millions of 2007$)				
Low Cost Scen	106	142	151	1,219
High Cost Scen	2,292	2,283	1,897	19,616

[6] http://www.tax.alaska.gov/programs/documentviewer/viewer.aspx?1338f. The DOR forecast extends until 2018. After 2018 I have assumed a 5% annual decline rate. I have assumed no oil production after 2030.

Lieberman-Warner will increase consumer energy prices, but Alaska is a net seller of energy by a ratio of 9 to 1.

Alaska currently exports nine times as much fossil fuel as it uses. With a gas pipeline, that ratio will increase. According to these ACCF/NAM projections, the value of Alaska's energy exports would increase by billions of dollars under LW. Alaska could use these funds to stimulate new hydro, wind, tidal, and other zero-fuel energy sources. As these sources come online, Alaska consumers would stop paying for greenhouse gas allowances. In addition there would be sufficient additional oil and gas revenue flowing to the state under the ACCF/NAM scenarios to easily offset any increases in consumer prices through increased permanent fund dividends or other vehicles for recycling oil and gas revenues.

Lieberman-Warner is likely to boost Alaska employment under the NEMS/AACF/NAM scenarios

As I discuss below, it is not at all clear how NEMS generates national employment numbers as a function of energy prices. However, it is clear that Alaska is an oil and gas state in which more than one-third of current jobs are based on petroleum. As I have shown above, the NEMS/ACCF/NAM projections imply that Lieberman-Warner would stimulate the construction of the gas pipeline and increase the value of ANS oil and gas by billions of dollars. Alaskans know that a gas pipeline sooner rather than later and high wellhead prices are the best thing possible for more jobs. In addition, under these projections there would be strong additional economic incentives to develop Alaska's vast wind and geothermal resources and to use them for energy-intensive export industries. This development would also create many new jobs.

2. How should one interpret the results of these NEMS/ACCF/NAM projections, generally?

Notwithstanding the boost that LW would provide to the Alaska economy under these ACCF/NAM scenarios, it is important to critically appraise the overall results from a broader perspective appropriate to informing national policy. Here I focus on two aspects of the results: A) employment projections and B) GHG allowance prices and their relationship to technology innovation.

NEMS projects unreasonably negative employment impacts for both the U.S. and Alaska

NEMS is described by its creators as a midterm model applicable only through 2025:

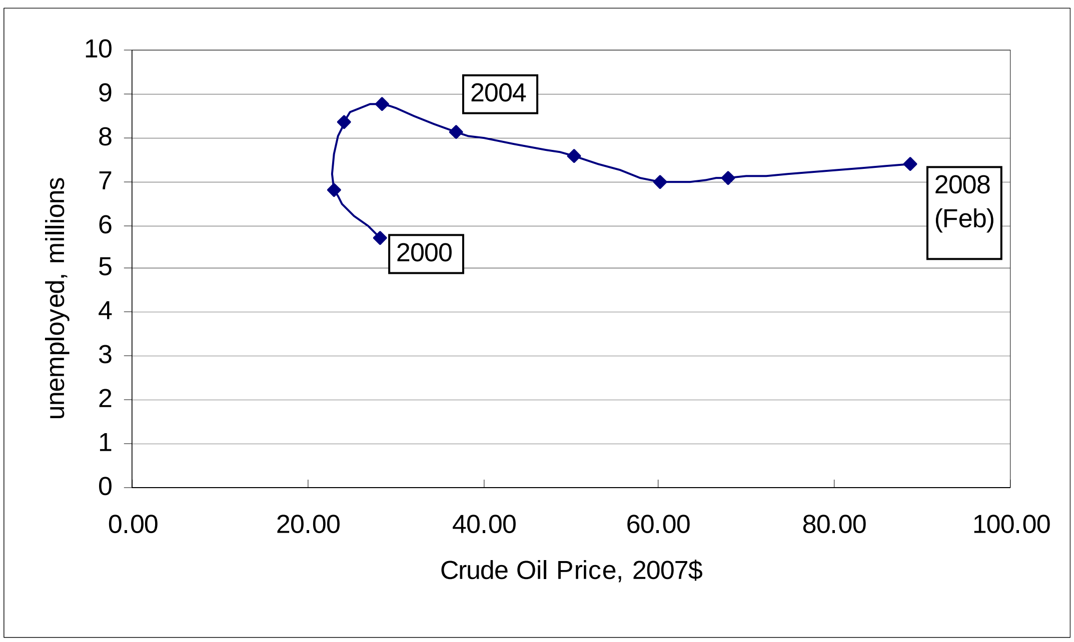
> The National Energy Modeling System (NEMS) is a computer-based, energy-economy modeling system of U.S. energy markets for the midterm period through 2025. NEMS projects the production, imports, conversion, consumption, and prices of energy, subject to assumptions on macroeconomic and financial factors, world energy markets, resource availability and costs, behavioral and technological choice criteria, cost and performance characteristics of energy technologies, and demographics. NEMS was designed and implemented by the Energy Information Administration (EIA) of the U.S. Department of Energy (DOE).[7]

[7] EIA, NEMS Model Overview, 2003. www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2003).pdf

NEMS contains a macroeconomic model that appears to use a hybrid of several forecasting approaches (Energy Information Administration 2007). However, the documentation is silent on exactly how the model determines employment.[8] Presumably it uses some sort of modified Phillips curve or aggregate supply/aggregate demand approach that relates employment to inflation or to output. In other words, the NEMS macro model seems to relate employment to cyclical economic conditions. While this approach is appropriate for a short-term forecasting model, it is clearly not appropriate for a long-term policy analysis model. In the long run, full employment is maintained by appropriate monetary, fiscal, and regulatory policies and cannot be permanently depressed by the high price of one type of energy.

Figure 1 shows that a dramatic increase in crude oil prices need have no discernible effect on overall U.S. unemployment, even in the short run. Between 2000 and 2003, crude oil prices remained low while unemployment increased by 4 million. Then, unemployment dropped by about 2 million while the price of crude skyrocketed to unprecedented levels. If the NEMS logic were valid, we should have seen a dramatic increase in unemployment during the oil price run-up, rather than a 2 million job decrease in unemployment.

Figure 1. U.S. unemployment vs. real crude oil price, 2000-2008



Sources: unemployed persons from U.S. Bureau of Labor Statistics. Crude oil price (refiner acquisition cost) from Energy Information Administration.

The greenhouse gas allowance prices projected by NEMS/ACCF/NAM are unreasonably high

Allowance prices in these projections reach or exceed $50 per metric ton of CO_2-equivalent by 2020. This amount is well within the ballpark of informed projections using different models (MIT 2007, Stern Review 2006). However, prices projected by NEMS/ACCF/NAM exceed $250

[8] I searched the EIA macro model documentation (EIA 2007) for all instances of the word “employment” and “unemployment” and could not find any specific discussion of the algorithm for determining employment.

per metric ton by 2030. These prices are inconsistent with the costs of both known and emerging low-carbon or zero-carbon technologies.

The best example of this price-technology disconnect is the cost of coal-fired electricity with carbon capture and storage (CCS). The MIT study on the future of coal (MIT 2007) projects that an allowance price of $30 per metric ton CO_2 would be sufficient to render IGCC coal-with-CCS competitive with conventional coal. The actual number might be more like $50 per metric ton, allowing for the optimism of the MIT authors and for setbacks in final development and large-scale deployment. However, it is very hard to conceive of how a $250 per ton price could fail to elicit massive deployment of coal-with-CCS technology.

A second example comes from Alaska data. Foster (2007) developed cost estimates for several generation options for the Alaska Railbelt region. Foster found that with CO_2 priced in the range of $30 to $50 per metric ton, efficiency, landfill gas, wind, small hydro, large hydro, IGCC coal *with carbon capture*, natural gas, and tidal technologies could all produce cheaper electricity than a new conventional 100-MW fluidized bed coal plant. If all of these technologies are competitive at $30-50 per metric ton, it is, again, very hard to see how a $250 price could begin to develop without stimulating massive new investments in low-carbon or zero-carbon energy sources both for use within Alaska or for export.[9]

The reason that NEMS/ACCF/NAM projects such unrealistically high carbon prices is that the model has been forced by assumption not to build wind, nuclear, or coal-with-CCS capacity beyond rigid limits. For example, wind capacity additions are required by assumption never to exceed 5 GW[10] per year in the "Low cost" scenario and never to exceed 3 GW per year in the "High cost" scenario. Given that actual additions to U.S. wind capacity in 2007 exceeded 5 GW,[11] when the price of CO_2 allowances was zero, one might wish to reconsider this assumption.

Finally, it is important to remember that the NEMS modeling system has essentially zero capability to project technological progress. NEMS relies on specific assumed technologies that can be constructed for specific assumed costs. However, history demonstrates that technological progress is the dominant engine of economic growth and that high prices are a powerful stimulus to both invention and innovation by enterprising people out to make a profit. The 1990 Clean Air Act amendments imposed a cap-and-trade system on sulfur dioxide. The market responded in a completely unanticipated way -- with a massive shift to low-sulfur coal from the Rocky Mountain West. Wyoming enjoyed an economic boom. The potential for progress and profits in a U.S. or global carbon market dwarfs that of all previous cap-and-trade regimes. Alaska could be a prime beneficiary of significant carbon prices.

[9] The example of Iceland shows how it is possible to export geothermal and hydropower embodied in the form of energy-intensive products such as aluminum.
[10] GW= gigawatt = 1 billion watts. A large new coal power plant would typically produce about 1 GW of power.
[11] American Wind Energy Association.
http://www.awea.org/newsroom/releases/AWEA_Market_Release_Q4_011708.html

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