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Why Warner-Lieberman Failed and How to Get America's Working Families behind the Next Cap-and-Trade Bill

By David Wheeler

Abstract

Among partisans of greenhouse gas emissions regulation, the Senate's failure to pass the Warner-Lieberman cap-and-trade bill is often attributed to rampant denial, fueled by diehard political conservatism, energy-company propaganda, and government suppression of evidence on global warming. If so, the solution to the problem is electoral change, exposure of the propaganda, and public education. However, public concern is already so widespread that even leaders of the Southern Baptist Convention have acknowledged the need for action. In this paper, I consider two additional forces that have stymied carbon emissions regulation in developing countries. The first is the perception that costly carbon regulation promoted by the rich will inflict an unjust burden on the poor. The second is hostility to taxation of critical fossil-fuel resources that were developed long before climate risk was identified. My econometric analysis suggests that these same forces have significantly affected senators' votes on Warner-Lieberman. By implication, Congress is not likely to approve cap-and-trade legislation unless Americans with below-median incomes are compensated for expected losses. My analysis supports recent proposals for direct distribution of emissions permit auction revenues to American families on an equal per-capita basis.

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Why Warner-Lieberman Failed and How to Get America's Working Families behind the Next Cap-and-Trade Bill

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This paper is dedicated to the people of West Virginia and Alabama, my parents' home states. We won't solve the climate problem without them. For valuable comments and suggestions, many thanks to Nancy Birdsall, Bill Cline, Richard Cooper, Robin Kraft, Lawrence MacDonald, Joel Meister, Darius Nassiry, Brad Parks, Vijaya Ramachandran, Kevin Ummel and Dave Witzel. All remaining errors are my own.

1. Introduction

The climate crisis is mounting, but America is at a standstill. On June 6, 2008, domestic cap-and-trade legislation was declared dead for this term when the Warner-Lieberman bill failed a critical cloture vote in the Senate.[1] Even if the next President supports carbon regulation, he will be hard-pressed to ensure Congressional passage before the US delegation goes to the Copenhagen climate-change negotiations eleven months after Inauguration Day. Without binding regulation in the US, developing-countries will simply refuse to accept any limitation on carbon emissions. In summary, we are still headed straight for a climate crisis and the failure of Warner-Lieberman is potentially tragic.

How did this happen? Partisans of greenhouse emissions regulation frequently cite rampant denial, fueled by diehard political conservatism, energy-company propaganda, and government suppression of evidence on global warming (Gore, 2007). In this view, the solution to the problem is electoral change, exposure of the propaganda, and public education. While there is undoubtedly some truth in these propositions, they fail to acknowledge the rapid deepening of concern about climate change – so rapid, in fact, that even leaders of the Southern Baptist Convention have recently acknowledged the threat and the need to act (Banerjee, 2008).

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[1] The Democrats introduced a cloture vote, attempting to prevent a Republican filibuster of the proposed legislation. The US Senate defines the cloture rule as follows: "The only procedure by which the Senate can vote to place a time limit on consideration of a bill or other matter, and thereby overcome a filibuster. Under the cloture rule (Rule XXII), the Senate may limit consideration of a pending matter to 30 additional hours, but only by vote of three-fifths of the full Senate, normally 60 votes." (http://www.senate.gov/reference/glossary_term/cloture.htm). The cloture vote record is available from the U.S. Senate at http://www.senate.gov/legislative/LIS/roll_call_lists/roll_call_vote_cfm.cfm?congress=110&session=2&vote=00145#state

In this paper, I look elsewhere for plausible explanations. Specifically, I consider two forces that have stymied carbon emissions regulation in developing countries. The first is a perceived climate of injustice, in which carbon regulation promoted by the rich will inflict a disproportionate burden on poor regions that are not responsible for the problem and least able to bear the cost of solving it (Roberts and Parks, 2006), The second, in regions with heavy fossil-fuel dependence, is hostility to taxation of critical resources that were developed long before climate risk was identified. This paper uses an econometric analysis of the June 6 cloture vote to test the impacts of the same two forces on proposed carbon regulation in the US.

The remainder of the paper is organized as follows. In Section 2, I examine variations in income and fossil-fuel dependency across US senators' home states, along with the degree of conservatism in their voting records. Section 3 estimates the relationship between these variables and senators' votes on the cloture motion of June 6, with additional controls for party affiliation, gender, campaign contributions from the energy sector, and an index of state-level climate threats. In addition, Section 3 uses two simulation exercises to assess the independent impacts of states' income, fossil-fuel dependency and conservatism. In Section 4 I discuss the implications for legislative design, while Section 5 provides a summary and conclusions.

2. American Diversity and Its Implications

Although students of economic development stress the importance of *absolute* inequality, a broad literature also documents the political importance of *relative* inequality. Wounded perceptions of fairness can undermine policy reform when it threatens to impose a costly, uniform burden on people whose coping resources are

very different (Henrich, et al., 2006; Maslach and Leiter, 2008). Cap-and-trade regulation provides an example, because it will significantly raise the cost of fossil energy. Poor families spend a much higher portion of their incomes on energy than rich families (IEA, 2008; Table 10 in this paper), and some regions of the US are much more dependent on fossil energy sources than others. At the same time, of course, many Americans are hostile to government regulation on political or philosophical grounds.

Table 1 illustrates American diversity in income, fossil energy dependence and political conservatism. States' per capita incomes in 2007 varied from $28,846 to $54,117; their fossil-fuel dependency in the power sector from 0% to 98.5%; and their senators' conservatism ratings from 0 to 100 on a scale developed by the American Conservative Union. In light of my previous discussion, cap-and-trade legislation seems likely to face more resistance from states that are poorer and more dependent on fossil fuels, as well as those which lean toward political conservatism.

I analyze the effects of these factors on the Warner-Lieberman cloture vote, which failed to override a threatened filibuster by opponents of the bill. The data seem appropriate for statistical tests because senators' cloture votes were not constrained by individual factors. Table 2 displays minimum and maximum values by vote for all three variables. For fossil-fuel dependency, both yes and no votes span the range from very small percentages to nearly 100 percent. Conservative ratings demonstrate a similar range, with minimum values of 0 for yes and no votes and values above 90 for both votes. Income ranges are also very broad, with nearly-identical minimum incomes for both votes and a maximum value of $43,226 for no

votes cast by the senators from Wyoming, which ranks sixth in income among American states (after Connecticut, New Jersey, Massachusetts, New York and Maryland). Under these conditions, statistical analysis can credibly test for independent effects.

3. Econometric Estimation

3.1 Data

I draw state-level indicators of income, fossil-fuel dependency and political conservatism from the sources cited in Table 1.[2] I also allow for the possible effects of party affiliation, gender, campaign contributions from the energy sector, and an index of state-level climate threats. Party affiliation figures prominently in press accounts of the cloture vote, so it would be plausible to assert a significant role for partisan voting. I test this proposition with a dummy variable for Republican Party membership. Senators' votes may also be influenced by campaign contributions from vested interests. I test this by introducing controls for campaign contributions to each senator during the 2006 and 2008 electoral cycles, from contributors in five energy-related sectors identified by the Center for Responsive Politics (CRP, 2008): electric utilities, oil and gas, coal mining, transportation and transport unions. Sectoral diversity makes some of these categories problematic. For example, electric utilities include low-carbon energy firms (e.g. providers of nuclear, hydro and renewable energy) whose relative market position would improve in a cap-and-trade regime. I therefore test the effects of contributions from individual energy-related sectors, as well as total contributions from these sectors. I also consider energy-sector

[2] The full dataset is included in Appendix B.

contributions relative to a senator's total contributions. This allows for the potential importance of small energy-related contributions for senators whose total contributions are also small.

I also test the impact of perceived climate threats on senators' support for Warner-Lieberman. To construct a threat index, I draw on state-level information about climate disasters and emergencies declared by the Federal Emergency Management Agency (FEMA, 2008). I limit the sample to the past five years, the period in which public awareness of climate change has rapidly increased.[3] Any index of perceived threat is problematic, because no consistently-measured damage estimates are available for all relevant categories. I test three variants on FEMA-declared disasters and emergencies for individual states: total counts for five categories -- floods, rain storms (including tornadoes), hurricanes, droughts and fires; separate category counts for composite floods and storms (which are often reported together), hurricanes and fires; and counts divided by state areas. The latter measure seems plausible from a technical standpoint (larger states will have more disaster events, other things equal), but less so from a political standpoint (senators from larger states will get more calls from climate-affected constituents, but they may not take individual calls less seriously than their colleagues from smaller states).

I specify the following probability model to assess the importance of these factors in determining the June 6 cloture vote:

[3] Significant events in this context include Hurricane Katrina (2005); the widely-publicized climate change lectures of Vice President Al Gore, culminating in the film "An Inconvenient Truth" (2006); and publication of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (2007 - http://www.ipcc.ch/).

(1) $p(Yes)_{ij} = \beta_0 + \beta_1 Y_j + \beta_2 F_j + \beta_3 C_{ij} + \beta_4 R_{ij} + \beta_5 G_{ij} + \beta_6 P_{ij} + \beta_7 D_j + \varepsilon_i$

Where:

Yes_{ij} = Yes vote on cloture (pro-cap-and-trade) by senator i from state j
Y_j = Per capita income in state j (2007)
F_j = Fraction of power provided by fossil fuels in state j (2007)
C_{ij} = American Conservative Union rating of senator i from state j (2007) [4]
R_{ij} = Party affiliation of senator i from state j (1=Republican)
G_{ij} = Gender of senator i from state j (1=female)
P_{ij} = Energy-sector campaign contributions to senator i from state j (2006-2008)
D_j = FEMA-declared climate disasters and emergencies in state j (2004-2008)
ε_j = A random error term

Predicted effects are $\beta_1>0$, $\beta_2<0$, $\beta_3<0$, $\beta_4<0$, $\beta_6<0$, $\beta_7>0$: The probability of a yes vote should increase with the per capita income of the senator's state and the number of FEMA-declared climate disasters and emergencies. It should decrease with the fraction of power provided by fossil fuels and a senator's conservative rating, Republican party status and energy-sector campaign contributions. I have no prior prediction for the effect of gender.

3.2 Model Estimation

I estimate the model by probit for voting senators, predict the yes-vote probabilities, translate these to 1-0 outcomes using a threshold probability of 0.6, and evaluate the prediction accuracy of the model.[5]

Table 3 reports results for the core regression (column (1) - income, fossil fuel dependency and conservative rating), as well as selected experiments with the other variables. The estimated coefficients for income per capita, fossil fuel dependency and conservative rating all have the expected signs, and all are significant at the 5% or 1% level. After controlling for these variables, I find no significant effects in any

[4] Senator Wicker of Mississippi does not yet have an ACU rating, so I have used the average rating for Senator Cochran and Senator Lott, Senator Wicker's predecessor.
[5] Probit estimation techniques constrain predicted probabilities to the range 0-1.

regression for party affiliation, gender, campaign contributions or climate disasters. The three core variables, on the other hand, retain their significance and impact magnitudes in all the regressions. Experiments with interactions and alternative functional forms for the three core variables did not yield improvements in the regression fit.

3.3 Vote Predictions

Using the core regression results in Table 3, column (1) I translate the predicted probabilities into discrete predictions using a conservative rule that assigns a yes vote to probabilities greater than or equal to 0.6. I present detailed results for correctly-predicted votes in Appendix A. As Table 4 shows, the model predicts senators' votes with 92.9% accuracy (6 predicted votes in 84 are incorrect). Table 5 tabulates the incorrect votes. Notable outliers among the yes votes are Senators Dole of North Carolina (p(yes) = .062) and Martinez of Florida (.211); outliers among the no votes are Senators Johnson of South Dakota (p(yes)=.979) and Brown of Ohio (.873).

The prediction results suggest that the yes-no vote split would have been 55-45 if all senators had voted.[6] Table 6 presents predicted probabilities and votes for the 16 Senators who were missing. As predicted by the model, Senators Obama and Clinton have since stated that they would have voted yes (Eilperin, 2008). Senator McCain has also stated that he would have voted yes on cloture, despite his very small prediction probability (0.12). Some question remains, since he added that he would have opposed the bill on nuclear-related issues. However, McCain's strong

[6] This is extremely close to the full result (54 – 46) suggested by a related Washington Post story (Eilperin, 2008). However, the story relies on statements by senators who did not have to reveal their votes, while the model's prediction is based on actual behavior and its determinants. For the full set of correct predictions, see Appendix A.

support for climate change legislation suggests that he would probably have voted yes.

3.3 Simulation Experiments

To assess the independent effects of the three core variables, I conduct simulation experiments with all combinations of minimum, median and maximum sample values of state per-capita incomes, fossil fuel dependencies and conservatism ratings. Using the probit results in Table 3, column (1) I simulate a hypothetical senator's yes-vote probability in each of the 27 cases. Table 7 reports the full results, which indicate large impacts for all three variables. To illustrate the impact of conservatism, the table's first three rows predict yes-vote probabilities for a hypothetical senator with varying degrees of conservatism in a poor state with zero dependence on fossil power. For the maximum conservative rating (100), the model predicts a .16 probability of voting yes. When the conservative rating drops to the Senate's median (30), however, the yes-vote probability jumps to .92.

For the same hypothetical senator from the same poor state, variations in fossil fuel dependency also have powerful effects. To see this, hold the conservative rating constant at its median value of 30 and vary fossil fuel dependency from the minimum of 0 (row 1), to the national median (.69 – row 5) and the national maximum (.98 – row 8). Holding the state's income and the senator's conservatism constant, these changes decrease the probability of a yes vote from .92 to .41, and then to .17.

Table 8 focuses on the impact of income, since it is particularly important for this analysis. The table reports the distribution of simulation results as state per-capita income shifts from the US minimum ($29,000) to the median ($36,000) and

the maximum ($54,000). Each table row summarizes results for all combinations of fossil-fuel dependencies (min-median-max) and conservative ratings (min-median-max). The powerful impact of income is evident in the results. For the lowest state income, variations in fossil fuel dependency and conservatism generate a range of voting probabilities from 0 to .99, with a median probability of .41. Shifting to the median state income leaves the minimum yes-vote probability basically unchanged, but the rest of the distribution shifts sharply upward. The lower-quartile yes-vote probability is now .49, the median .76 and the third quartile .96. Finally, a shift to the maximum income has a radical effect on the entire distribution. Now the minimum probability of a yes vote is .53, and the other quartile points are .99 or higher.

These income results support the proposition that aversion to the regressive cost burden of Warner-Lieberman is a powerful deterrent to a yes vote by senators from poor states. In another experiment, I progressively equalize state incomes and tabulate the predicted effect on senators' votes. In this experiment, I raise the income floor for American states in increments of $5,000. As the floor rises, no state falls below it but incomes in states above it are unaffected. Both fossil fuel dependency and the conservative rating remain the same for each senator. Table 9 reports the results, starting with the predicted votes of 100 senators at current state per capita income, fossil fuel dependency, and the senator's conservative rating. The current distribution of votes (counting predictions for 16 senators who did not vote on June 6) is 55 yes – 45 no. Raising the income floor by $5,000 shifts the vote to 57-43; another $5,000 increase is sufficient to achieve cloture (60-40); another $5,000

ensures a veto-proof majority (68-32); and additional increases to the current maximum income raise the majority to 93-7 and 100-0.

4. Implications of the Results

My results suggest strong, independent impacts of income and fossil fuel dependency on cloture votes, regardless of senators' relative conservatism on other issues. The results support the hypothesis that the votes of senators from states that are relatively poor and dependent on fossil fuels are strongly affected by their constituents' aversion to the differential costs imposed by a cap-and-trade system.

The political implication is clear: Serious cap-and-trade regulation is unlikely to pass the Senate without explicit compensation for differential costs. This is particularly true now, since escalating fossil fuel prices have already increased the burden on families with below-median incomes (everywhere for transport, and particularly in states whose power sectors are more fossil-dependent). The most straightforward measure, recently proposed by Robert Reich, would be a direct rebate from cap-and-trade auction revenues to American families on a per-capita basis (Reich, 2008).[7] Recently, the US Energy Information Agency has estimated that a 100% auction of emissions credits under Warner-Lieberman would yield about $150 billion/year by 2020 (EIA, 2008). Divided equally among 300 million Americans, this would provide an annual payment of $500 per person, or $2,000 for a family of four.

Table 10 provides data on 2001 energy and fuel expenditures for families in three ranges below the US median family income: $0-$9,999, $10,000-$29,999 and

[7] For an equivalent global proposal, see Barnes, et al. (2008).

$30,000-$49,999 (EIA 2001, 2005).[8] Their energy and fuel expenditures by group were $1,878, $2,306 and $3,022, or 37.6%, 11.5% and 7.6% of total income, respectively.[9] According to the EIA's assessment, enactment of Warner-Lieberman would raise total energy and fuel expenditures by 7% to 24% in all three income groups. However, enactment of cap-and-trade with auction payments of $2,000 to families in these groups would actually increase their incomes, even after subtracting the extra energy and fuel costs. I calculate the following percent increases in household income: 30.9-37.5% ($0-$9,999); 7.2-9.2% ($10,000-$29,999); 3.2-4.5% ($30,000-$49,999). I conclude that distributing all auction proceeds to American families would result in a significant income increase for families with incomes of $50,000 or less.[10] Even a distribution of 30% of the proceeds would leave their total incomes unchanged, while emissions reduction would be promoted by the increased prices of carbon-intensive energy and fuels relative to the prices of other goods. This would align households with the overall emissions reduction goal, which would be enforced by a mandated decline in the national emissions cap over time.

The program would probably have more popular appeal if claims on auction revenues were represented by share certificates that would be issued to individuals on request, or held in trust by a public corporation chartered to manage the funds. Appendix C provides an illustrative Certified Atmospheric Share (CASH) certificate payable from United States Carbon Account Proceeds (USCAP). The CASH

[8] According to the US Department of Housing and Urban Development, the US median family income in FY 2008 is $61,500 (http://www.huduser.org/datasets/il/il08/Medians_2008.pdf).
[9] This calculation uses interval midpoint incomes: $5,000, $20,000, $40,000.
[10] These results are corroborated by a recent Congressional Budget Office study. For details, see CBO (2008).

certificate represents the automatic claim on auction revenue by an individual US citizen, paid into the individual's specified account by the Internal Revenue Service.

This illustration assumes that permits are auctioned annually, with revenues divided equally among US citizens. CASH certificates (and the associated payment claims) could be tradable, enabling families to realize the capitalized value of expected future payments if they chose to do so. The registered sale of a CASH certificate would automatically transfer its annual payment stream to the buyer. Assuming a competitive risk-free interest rate of 5%, a CASH certificate with expected future payments of $500 each year could be sold for $10,000, and ownership of CASH certificates would add $40,000 to the liquid assets of a four-person family.

5. Summary and Conclusions

In this paper, I have used econometric analysis to assess senators' support for the Warner-Lieberman cap-and-trade bill as a function of their conservative ratings, and their states' per capita incomes and degrees of fossil-fuel dependency. My results include three findings of particular interest. First, each of the three factors varies across most of its full range, regardless of the values of the other two. This establishes a credible foundation for statistical experiments under the assumption of independent variation. Second, all three variables are determinants of senators' votes at high levels of statistical significance. This finding is robust to the inclusion of controls for party affiliation, gender, energy-sector campaign contributions and state-level climate disasters. Third, each of the variables has a very powerful, independent effect.

Holding any two variables constant, within-sample variation in the third is generally sufficient to move the probability of a yes vote between very low and very high.

The impact is particularly striking for income, with great significance for the topic of this paper. As the June 6 cloture vote revealed, the Senate cannot achieve filibuster-proof support for cap-and-trade legislation under current conditions. Undoubtedly, the recent sharp increase in fossil fuel prices has aggravated the situation. Neither fossil-fuel dependency nor senators' innate conservativism is likely to change much in the near term (although a few conservative senators may lose to liberals in the fall election), so there is no reason to hope that these variables will propel a significant change in the voting pattern.

Income, however, is another matter. My results suggest that poor states' aversion to a differential cost burden has significantly weakened support for Warner-Lieberman. However, my results also suggest that more senators from states with below-median incomes will support Warner-Lieberman, regardless of their conservatism or their states' fossil-fuel dependency, if direct payments from emissions permit auctions make below-median households better off. Assuming that permits are fully auctioned, break-even for below-median families appears to require direct payments of 30% of total auction revenues. This could be doubled to ensure support, however, while still leaving a vast sum ($60 billion/year for an annual $150 billion auction) to compensate displaced US workers (particularly coal miners and processors) and promote investment in clean technology. The direct payment system could be vested in a trust fund that is separate from standard government accounts, and distribution could be delegated to the Internal Revenue Service. This would be

no more difficult than the administration's current $600 distribution to individuals for macroeconomic stimulus.

The direct-payment system would not have much effect on the overall distribution of income, but it would have a powerful effect on the margin where household energy expenditures are determined. Simply allocating a large share of the permit auction proceeds on an equal basis to all Americans will actually turn a large profit for poorer Americans, even after the impact of Warner-Lieberman on energy and fuel costs is taken into account. This will make many below-median Americans absolutely better off and – a critical factor for perceptions of fairness – better off relative to more affluent Americans as well. My econometric and simulation results for income strongly suggest that these payments will shift the votes of many senators whose conservatism and states' fossil dependency would otherwise keep them from supporting Warner Lieberman. Given the urgency of the climate problem, Congress should consider such a direct payment system as soon as possible.

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Table 1: State-Level Indicators of Income, Fossil-Fuel Dependency and Conservatism

	State-Level Indicators, 2007		
	Income Per Capita[a]	Fossil-Fuel Fraction of Power[b]	Senator's Conservative Rating[c]
Minimum	$28,845	0.0076	0
Quartile 1	$33,457	0.5264	4
Median	$35,567	0.6872	30
Quartile 3	$40,480	0.8057	84
Maximum	$54,117	0.9845	100

Sources:
[a] US Bureau of Economic Analysis (http://www.bea.gov/newsreleases/regional/spi/2008/xls/spi0308.xls)
[b] Carbon Monitoring for Action database (www.carma.org)
[c] American Conservative Union, Ratings of Congress (http://www.acuratings.org/)

Table 2: Min and Max Values of Voting Determinants by Cloture Vote

	Income		Fossil Fuel % of Power		Conservative Rating	
Vote	Min	Max	Min	Max	Min	Max
No	$28,845	$43,226	0.1051	0.9801	0	100
Yes	$29,537	$54,117	0.0076	0.9845	0	92

Table 3: Probit Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable (Probability)	yes	yes	yes	yes	yes	yes	yes	yes
% Correct Predictions	93%	93%	86%	90%	93%	90%	92%	93%
Income per Capita 2007 ($10,000)	0.136 (2.02)*	0.135 (2.01)*	0.149 (2.10)*	0.140 (2.03)*	0.152 (2.08)*	0.145 (2.04)*	0.145 (2.07)*	0.155 (2.00)*
Fossil Fuel % of Power 2007	-2.379 (2.15)*	-2.288 (2.02)*	-2.151 (1.84)	-2.512 (2.14)*	-2.466 (2.06)*	-2.520 (2.15)*	-2.429 (2.14)*	-2.912 (2.28)*
ACU Conservative Rating 2008	-0.034 (5.55)**	-0.039 (2.71)**	-0.042 (2.51)*	-0.034 (5.52)**	-0.038 (5.16)**	-0.038 (5.17)**	-0.034 (5.55)**	-0.036 (4.90)**
Republican		0.444 (0.41)	0.624 (0.50)					
Female			0.981 (1.45)					
FEMA [Disasters & Emergencies] (Droughts, Floods, Storms, Fires, Hurricanes)				0.035 (0.41)				
FEMA Hurricanes					0.156 (1.20)	0.159 (1.28)		
FEMA Fires					-0.359 (0.59)			
FEMA Floods and Storms					-0.016 (0.15)			
Total Contributions From Electric Utilities, Oil & Gas, Coal Mines, Transport, Transport Unions							0.068 (0.57)	
Contributions from Electric Utilities								-0.156 (0.35)
Contributions from Oil & Gas Companies								-0.024 (0.06)
Contributions from Coal Mine Companies								1.398 (1.17)
Constant	-1.513 (0.64)	-1.535 (0.65)	-2.239 (0.88)	-1.751 (0.71)	-2.082 (0.79)	-1.872 (0.74)	-1.957 (0.78)	-1.753 (0.67)
Observations	84	84	84	84	84	84	84	84

Absolute value of z statistics in parentheses
* significant at 5%; ** significant at 1%

Table 4: Model Prediction Accuracy

Prediction	Frequency	%
Correct	78	92.9
Incorrect	6	7.1
Total	84	100.0

Table 5. Incorrectly-Predicted Votes

Probability of Yes Vote	Predicted Vote	Actual Vote	Senator	State
0.9788	Yes	No	Johnson	South Dakota
0.8730	Yes	No	Brown	Ohio
0.7172	Yes	No	Dorgan	North Dakota
0.4542	No	Yes	Rockefeller	West Virginia
0.2107	No	Yes	Martinez	Florida
0.0623	No	Yes	Dole	North Carolina

Table 6: Predicted Votes for Missing Senators

Probability of Yes Vote	Predicted Vote	Senator	State
0.9999	Yes	Clinton	New York
0.9997	Yes	Kennedy	Massachusetts
0.9933	Yes	Obama	Illinois
0.9850	Yes	Biden	Delaware
0.8332	Yes	Specter	Pennsylvania
0.7906	Yes	Gregg	New Hampshire
0.7172	Yes	Conrad	North Dakota
0.5919	No	Coleman	Minnesota
0.5164	No	Stevens	Alaska
0.4758	No	Murkowski	Alaska
0.4542	No	Byrd	West Virginia
0.2794	No	Craig	Idaho
0.1170	No	McCain	Arizona
0.0775	No	Graham	South Carolina
0.0532	No	Cornyn	Texas
0.0336	No	DeMint	South Carolina

Table 7: Simulated Warner-Lieberman Votes

State Indicators			Projected Votes	
Per Capita Income	Fossil Fuel % of Power	Conservative Rating	P(Yes)	Vote
$29,000	0	100	0.1653	No
$29,000	0	30	0.9202	Yes
$29,000	0	0	0.9924	Yes
$29,000	0.69	100	0.0045	No
$29,000	0.69	30	0.4070	No
$29,000	0.69	0	0.7837	Yes
$29,000	0.99	100	0.0004	No
$29,000	0.99	30	0.1713	No
$29,000	0.99	0	0.5282	No
$36,000	0	100	0.4911	No
$36,000	0	30	0.9908	Yes
$36,000	0	0	0.9996	Yes
$36,000	0.69	100	0.0481	No
$36,000	0.69	30	0.7629	Yes
$36,000	0.69	0	0.9587	Yes
$36,000	0.99	100	0.0087	No
$36,000	0.99	30	0.5007	No
$36,000	0.99	0	0.8465	Yes
$54,000	0	100	0.9923	Yes
$54,000	0	30	1.0000	Yes
$54,000	0	0	1.0000	Yes
$54,000	0.69	100	0.7826	Yes
$54,000	0.69	30	0.9992	Yes
$54,000	0.69	0	1.0000	Yes
$54,000	0.99	100	0.5268	No
$54,000	0.99	30	0.9928	Yes
$54,000	0.99	0	0.9997	Yes

Table 8: Impact of State Income Per Capita
Yes-Vote Probabilities For 27 Simulations

	Probability of Yes Vote				
Per Capita Income	Minimum	Quartile 1	Median	Quartile 3	Maximum
$29,000	0.00	0.17	0.41	0.78	0.99
$36,000	0.01	0.49	0.76	0.96	1.00
$54,000	0.53	0.99	1.00	1.00	1.00

Table 9: Projected Warner-Lieberman Votes

Minimum State Income	Projected Cloture Vote		
	No	Yes	Total
$29,000 (Current)	45	55	100
$34,000	43	57	100
$39,000	40	60	100
$44,000	32	68	100
$49,000	7	93	100
$54,000	0	100	100

Table 10: Projected Impacts of Warner-Lieberman (EIA, 2008)

		Family Income Range		
		$0 - $9,999	$10,000 - $29,999	$30,000 - $49,999
Midpoint Income		$5,000	$20,000	$40,000
Household Spending				
Energy		1,039	1,260	1,456
Transport		839	1,046	1,566
Total		1,878	2,306	3,022
Income Share		0.3756	0.115313	0.07555
Cost Increase				
Energy				
Low	5%	51.9	63.0	72.8
High	27%	280.5	340.2	393.1
Transport				
Low	9%	75.5	94.2	140.9
High	21%	176.2	219.7	328.9
Projected Cost Increases				
Low Increase		127.46	157.16	213.74
High Increase		456.72	559.91	721.98
% Cost Increases				
Low Increase		6.79%	6.81%	7.07%
High Increase		24.32%	24.28%	23.89%
Total Revenue ($Billion)	150			
Population (Million)	300			
Family Payment		2,000	2,000	2,000
Percent Allocated	100.00%			
Family Size	4			
Net Gain				
Low Increase		1,873	1,843	1,786
High Increase		1,543	1,440	1,278
Income Increase				
Low Increase		37.5%	9.2%	4.5%
High Increase		30.9%	7.2%	3.2%

Appendix A
Correctly-Predicted Votes

Correctly-Predicted Yes Votes			Correctly-Predicted No Votes		
State	Senator	P(Yes)	State	Senator	P(Yes)
Connecticut	Dodd	1.0000	Louisiana	Landrieu	0.5627
Connecticut	Lieberman	1.0000	Ohio	Voinovich	0.3117
New Jersey	Lautenberg	1.0000	Idaho	Crapo	0.3027
New Jersey	Menendez	1.0000	Nebraska	Hagel	0.2034
New York	Schumer	0.9999	Nevada	Ensign	0.2012
Washington	Murray	0.9999	South Dakota	Thune	0.1679
Washington	Cantwell	0.9998	Tennessee	Alexander	0.1586
Vermont	Leahy	0.9997	Wyoming	Enzi	0.1081
Vermont	Sanders	0.9995	Tennessee	Corker	0.1079
Massachusetts	Kerry	0.9994	Indiana	Lugar	0.1065
Maryland	Mikulski	0.9992	Texas	Hutchison	0.0897
Maryland	Cardin	0.9992	Colorado	Allard	0.0860
California	Feinstein	0.9987	Wyoming	Barrasso	0.0849
California	Boxer	0.9980	Alabama	Sessions	0.0766
Illinois	Durbin	0.9967	Kansas	Roberts	0.0678
Oregon	Wyden	0.9938	North Carolina	Burr	0.0623
Minnesota	Klobuchar	0.9885	Iowa	Grassley	0.0595
Nevada	Reid	0.9880	Kansas	Brownback	0.0555
Virginia	Webb	0.9853	Alabama	Shelby	0.0550
Rhode Island	Reed	0.9852	Georgia	Chambliss	0.0510
Rhode Island	Whitehouse	0.9852	Louisiana	Vitter	0.0404
Pennsylvania	Casey	0.9800	Missouri	Bond	0.0387
Hawaii	Akaka	0.9713	Georgia	Isakson	0.0383
Hawaii	Inouye	0.9713	Arizona	Kyl	0.0308
Delaware	Carper	0.9711	Mississippi	Cochran	0.0186
Florida	Nelson	0.9624	Mississippi	Wicker	0.0164
Colorado	Salazar	0.9480	Utah	Bennett	0.0159
Wisconsin	Kohl	0.9457	Utah	Hatch	0.0146
Michigan	Levin	0.9332	New Mexico	Domenici	0.0137
Wisconsin	Feingold	0.9290	Oklahoma	Inhofe	0.0095
Michigan	Stabenow	0.9137	Oklahoma	Coburn	0.0095
Iowa	Harkin	0.8473	Kentucky	Bunning	0.0035
Oregon	Smith	0.8429	Kentucky	McConnell	0.0035
Maine	Snowe	0.8266			
Montana	Tester	0.8115			
Arkansas	Lincoln	0.8059			
Arkansas	Pryor	0.7867			
Missouri	McCaskill	0.7832			
Nebraska	Nelson	0.7788			
Montana	Baucus	0.7726			
Virginia	Warner	0.7521			
Maine	Collins	0.7483			
New Hampshire	Sununu	0.6556			
Indiana	Bayh	0.6504			
New Mexico	Bingaman	0.6347			

Appendix B
State and Senator Data

State	Per Capita Income	Fossil Fuel Percent	Senator	ACU Rating	Party	Gender	P(Yes)	Vote	Senator	ACU Rating	Party	Gender	P(Yes)	Vote
Alabama	$32,404	0.6286	Sessions	83	R	M	0.0766	No	Shelby	88	R	M	0.0550	No
Alaska	$40,352	0.7361	Stevens	64	R	M	0.5164	Missing	Murkowski	67	R	F	0.4758	Missing
Arizona	$33,029	0.6069	McCain	80	R	M	0.1170	Missing	Kyl	100	R	M	0.0308	No
Arkansas	$30,060	0.5747	Lincoln	10	D	F	0.8059	Yes	Pryor	12	D	M	0.7867	Yes
California	$41,571	0.4733	Feinstein	0	D	F	0.9987	Yes	Boxer	4	D	F	0.9980	Yes
Colorado	$41,042	0.9096	Salazar	8	D	M	0.9480	Yes	Allard	96	R	M	0.0860	No
Connecticut	$54,117	0.4208	Dodd	0	D	M	1.0000	Yes	Lieberman	8	I	M	1.0000	Yes
Delaware	$40,608	0.7706	Biden	0	D	M	0.9850	Missing	Carper	8	D	M	0.9711	Yes
Florida	$38,444	0.7538	Nelson	4	D	M	0.9624	Yes	Martinez	80	R	M	0.2107	Yes
Georgia	$33,457	0.6470	Chambliss	92	R	M	0.0510	No	Isakson	96	R	M	0.0383	No
Hawaii	$39,239	0.8057	Akaka	0	D	M	0.9713	Yes	Inouye	0	D	M	0.9713	Yes
Idaho	$31,197	0.1051	Crapo	88	R	M	0.3027	No	Craig	90	R	M	0.2794	Missing
Illinois	$40,322	0.5264	Durbin	0	D	M	0.9967	Yes	Obama	7	D	M	0.9933	Missing
Indiana	$33,616	0.9494	Bayh	12	D	M	0.6504	Yes	Lugar	60	R	M	0.1065	No
Iowa	$35,023	0.8186	Harkin	8	D	M	0.8473	Yes	Grassley	84	R	M	0.0595	No
Kansas	$36,768	0.7759	Roberts	92	R	M	0.0678	No	Brownback	95	R	M	0.0555	No
Kentucky	$31,111	0.9595	McConnell	92	R	M	0.0035	No	Bunning	92	R	M	0.0035	No
Louisiana	$34,756	0.7105	Landrieu	40	D	F	0.5627	No	Vitter	96	R	M	0.0404	No
Maine	$33,722	0.4938	Snowe	28	R	F	0.8266	Yes	Collins	36	R	F	0.7483	Yes
Maryland	$46,021	0.6601	Cardin	0	D	M	0.9992	Yes	Mikulski	0	D	F	0.9992	Yes
Massachusetts	$49,082	0.7376	Kennedy	0	D	M	0.9997	Missing	Kerry	4	D	M	0.9994	Yes
Michigan	$35,086	0.6796	Levin	4	D	M	0.9332	Yes	Stabenow	8	D	F	0.9137	Yes
Minnesota	$41,034	0.6947	Klobuchar	4	D	F	0.9885	Yes	Coleman	64	R	M	0.5919	Missing
Mississippi	$28,845	0.7011	Cochran	83	R	M	0.0186	No	Wicker	84.5	R	M	0.0164	No
Missouri	$34,389	0.8840	McCaskill	8	D	F	0.7832	Yes	Bond	83	R	M	0.0387	No
Montana	$32,458	0.6173	Tester	16	D	M	0.8115	Yes	Baucus	20	D	M	0.7726	Yes
Nebraska	$36,471	0.6662	Nelson	32	D	M	0.7788	Yes	Hagel	79	R	M	0.2034	No
Nevada	$40,480	0.7269	Reid	0	D	M	0.9880	Yes	Ensign	91	R	M	0.2012	No
New Hampshire	$41,512	0.3656	Gregg	72	R	M	0.7906	Missing	Sununu	84	R	M	0.6556	Yes
New Jersey	$49,194	0.4402	Lautenberg	0	D	M	1.0000	Yes	Menendez	0	D	M	1.0000	Yes

State	Per Capita Income	Fossil Fuel Percent	Senator	ACU Rating	Party	Gender	P(Yes)	Vote	Senator	ACU Rating	Party	Gender	P(Yes)	Vote
New Mexico	$31,474	0.9591	Bingaman	4	D	M	0.6347	Yes	Domenici	79	R	M	0.0137	No
North Carolina	$33,636	0.6156	Dole	92	R	F	0.0623	Yes	Burr	92	R	M	0.0623	No
North Dakota	$34,846	0.9406	Conrad	12	D	M	0.7172	Missing	Dorgan	12	D	M	0.7172	No
Ohio	$34,874	0.8757	Brown	0	D	M	0.8730	No	Voinovich	48	R	M	0.3117	No
Oklahoma	$34,153	0.8706	Coburn	100	R	M	0.0095	No	Inhofe	100	R	M	0.0095	No
Oregon	$34,784	0.2411	Wyden	4	D	M	0.9938	Yes	Smith	48	R	M	0.8429	Yes
Pennsylvania	$38,788	0.6007	Casey	8	D	M	0.9800	Yes	Specter	40	R	M	0.8332	Missing
Rhode Island	$39,463	0.7023	Reed	0	D	M	0.9852	Yes	Whitehouse	0	D	M	0.9852	Yes
South Carolina	$31,013	0.4752	Graham	88	R	M	0.0775	Missing	DeMint	100	R	M	0.0336	Missing
South Dakota	$33,905	0.4470	Johnson	0	D	M	0.9788	No	Thune	88	R	M	0.1679	No
Tennessee	$33,280	0.5986	Alexander	76	R	M	0.1586	No	Corker	83	R	M	0.1079	No
Texas	$37,187	0.7942	Hutchison	88	R	F	0.0897	No	Cornyn	96	R	M	0.0532	Missing
Utah	$31,189	0.9756	Bennett	75	R	M	0.0159	No	Hatch	76	R	M	0.0146	No
Vermont	$36,670	0.0076	Leahy	0	D	M	0.9997	Yes	Sanders	4	I	M	0.9995	Yes
Virginia	$41,347	0.5811	Webb	16	D	M	0.9853	Yes	Warner	60	R	M	0.7521	Yes
Washington	$40,414	0.1475	Murray	0	D	F	0.9999	Yes	Cantwell	4	D	F	0.9998	Yes
West Virginia	$29,537	0.9845	Byrd	8	D	M	0.4542	Missing	Rockefeller	8	D	M	0.4542	Yes
Wisconsin	$36,047	0.7478	Kohl	0	D	M	0.9457	Yes	Feingold	4	D	M	0.9290	Yes
Wyoming	$43,226	0.9801	Enzi	96	R	M	0.1081	No	Barrasso	100	R	M	0.0849	No

Appendix C

Model Certified Atmospheric Share (CASH) Certificate
Payable From United States Carbon Account Proceeds (USCAP)

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