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# TECHNICAL APPENDIX

## State-by-State Fact Sheets: ACCF/NAM High-cost Case Forecasts of U.S. Cap-and-trade Legislation

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April 2009

Several organizations have developed econometric models in an effort to forecast the effects of a carbon emissions cap on the overall economy, in particular the Lieberman-Warner Climate Security Act (S. 2191). These organizations include the Environmental Protection Agency (EPA), the Energy Information Administration (EIA), Clean Air Task Force (CATF), Massachusetts Institute of Technology (MIT), CRA International (CRA) and a joint project of the American Council on Capital Formation and the National Association of Manufacturers (ACCF/NAM). The most pessimistic forecasts of the effects of Lieberman-Warner type cap-and-trade legislation on U.S. economic growth are those published by ACCF/NAM.[1]

The ACCF/NAM publications presenting their forecast results are also distinct in that they have produced a series of two-page fact sheets, showing the results of their forecasts as they apply to each of the fifty U.S. states and the District of Columbia.[2] Our own two-page fact sheets are derived on the basis of the ACCF/NAM forecast results and publications. Our fact sheets present the ACCF/NAM forecast results for the year 2030 for each of the states, or small variations on these ACCF/NAM forecasts. We describe here in detail the calculations we have made to generate the figures in the fact sheets for each state.

As we explain here, the variations on the ACCF/NAM results that we present in our fact sheets do not depart in any significant way from the core results of the ACCF/NAM 2030 forecasts. In all cases, we have produced variations on their core forecast results only for the purpose of illustrating their main findings in readily understandable terms. In all cases, the results we report in our fact sheets are derived from what

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[1] The models and results published by these various organizations are clearly summarized and compared in Pew Center on Global Climate Change, "Insights from Modeling Analyses of the Lieberman-Warner Climate Security Act (S. 2191), May 2008, http://www.pewclimate.org/docUploads/L-W-Modeling.pdf

[2] The full ACCF/NAM analysis is here: http://www.accf.org/media/dynamic/1/media_190.pdf. The state-by-state fact sheets are here: http://www.accf.org/media/dynamic/2/media_270.pdf. Strictly speaking, the analysis for the ACCF/NAM model was "conducted by" Science Applications International Corporation (SAIC), according to the cover page of the study. ACCF/NAM are providing "a report" on the SAIC results.

ACCF/NAM refers to as the "high-cost case" of how a Lieberman-Warner type cap-and-trade measure would impact the growth of the U.S. economy.

In this technical appendix to our state fact sheets, we begin by briefly addressing some methodological issues related to the ACCF/NAM model and similar exercises. We then consider the most significant overall findings of the ACCF/NAM model, which are their forecasted figures for GDP levels as of 2030 (and other years) under two sets of economic circumstances: one in which there has been no cap-and-trade mandate in place, and the other in which the U.S. economy has been operating with a Lieberman-Warner type cap-and-trade mandate in place since 2007.[3]

## METHODOLOGICAL ISSUES

Conducting economic forecasts through formal econometric models can produce useful information and predictions. However, by necessity, all such models must work with strong simplifying assumptions, since the actual operations of the U.S. economy are far too complex to be represented in full by any model. The difficulties in working with such models are compounded by the attempt not merely to describe the economy as it functions at present, but to attempt to predict how its operations will evolve into the future. The reason this is so difficult is because basic features of the economy's future growth path are simply unknowable at the time the forecasts are produced.

Consider two highly relevant and interrelated cases in point. First, few, if any, economic forecasting models predicted that, by June 2008, crude oil would be selling at $140 a barrel. This would include forecasts generated less than one year before crude hit $140 a barrel.[4] Once the price of crude oil did rise to $140 a barrel, few, if any forecasters then predicted that the price would collapse to $35 a barrel only six months later. More generally, almost no economic forecasts predicted that the U.S. economy would enter into a recession in December 2007 of historic severity. This includes even the forecasts that were published after the recession had already begun.[5]

These problems deepen in the case of attempting to forecast the effects of cap-and-trade legislation on the U.S. economy over time. This is because the impact of any cap-and-trade policy will depend, first of all, on the overall policy agenda focused on counteracting global warming. For example, the 2009 Obama stimulus program includes roughly $80 billion in direct public spending to advance energy efficiency and the commercialization of renewable sources of energy. It also includes roughly another $150 billion in incentives—tax credits, public matching funds for private investments, and loan guarantees—for private businesses to invest in clean energy projects. Policy measures on this large a scale will certainly accelerate energy efficiency measures and the lowering of renewable energy prices such that they become increasingly competitive with fossil fuel energy sources. However, we cannot know in advance the pace at which this process advancing energy efficiency and lowering the price of renewable energy will pro-

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[3] In fact, the authors of the ACCF/NAM study do not make clear which year is the beginning date for their forecasting exercise. Nevertheless, all figures in the study are reported in 2007 dollars. We therefore assume that 2007 is the starting point for their forecasting exercises.

[4] Three prominent forecasts published in 2007 of where crude oil prices would be in 2008 include JP Morgan, in August 2007, estimating $59.75 a barrel; Goldman Sachs, in September 2007, estimating $85 a barrel; and the U.S. Energy Information Agency, also in September 2007, estimating $71.17 a barrel. Crude oil prices in the U.S. market are reported at: http://tonto.eia.doe.gov/dnav/pet/hist/wtotworldw.htm

[5] This general problem of making accurate economic forecasts was captured well by former Federal Reserve Chair Alan Greenspan's unintentionally amusing observation made at the 1999 annual meeting of the International Monetary Fund and World Bank that "The fact that our econometric models at the Fed, the best in the world, have been wrong for fourteen straight quarters does not mean they will not be right in the fifteenth quarter" (Martin Mayer (2001), *The Fed*, p. 180).

ceed. We also cannot know how long such supportive measures for energy efficiency and renewable energy will be forthcoming from government policy. As such, we cannot accurately forecast the rate at which advances in energy efficiency and renewable energy will affect the overall market for energy within the U.S. economy.

## PRESENTATION OF ACCF/NAM KEY FORECAST RESULTS

As noted above, the forecasts presented by the ACCF/NAM model are substantially more pessimistic than other such models in predicting the effects on U.S. economic growth of a Lieberman-Warner type cap-and-trade measure. Part of the reason is that their model incorporates highly pessimistic assumptions as to the availability of alternative energy sources into the future.[6] But beyond this, what is not generally recognized, and is not mentioned at all in the ACCF/NAM report itself, is the single most significant finding of their study. This is that ACCF/NAM actually forecasts a relatively favorable long-term growth trajectory for the U.S. economy, even with a cap-and-trade law in place, and even under their high-cost case as to how such a cap-and-trade law will impact U.S. economic growth. Moreover, under the ACCF/NAM model, greenhouse emissions generated within the United States will have fallen by 36 percent as of 2030 relative to the 2007 emissions level through the cap-and-trade law. In the absence of cap-and-trade legislation, ACCF/NAM forecasts that greenhouse gas emissions in 2030 will have risen by 17 percent relative to the 2007 level.[7] At the same time, their model does not allow that this substantial improvement in environmental quality will have any positive impact on U.S. GDP.

We can see this readily by referring to the ACCF/NAM forecast for U.S. GDP for 2030 (p. 8). According to the ACCF/NAM high cost case, U.S. GDP in 2030 will be $24.0 trillion. What the ACCF/NAM study does not report is that, if this forecast is accurate, it means that U.S. GDP in 2030—under their high-cost case with a cap-and-trade law—will grow by 75 percent relative to the actual 2007 U.S. GDP of $13.7 trillion. This is an average annual growth rate of 2.5 percent.

To illustrate this finding in more readily understandable terms, the ACCF/NAM 2030 GDP forecast means, on a per capita basis, that the average income in the U.S. in 2007 was $45,614, while in 2030, it will rise to $66,023. That is, the average U.S. resident will be about 45 percent richer in 2030 relative to 2007, while greenhouse gas emissions will have fallen by 36 percent.[8] This, again, is the ACCF/NAM high-cost case under a cap-and-trade law. It also allows for population growth, as estimated by the U.S. Census Bureau.

Despite this central finding of their study, ACCF/NAM summarizes their GDP forecast as follows: "Due to the higher projected energy expenditures in different sectors of the economy, the ACCF/NAM model projects a loss of household income, lower commercial and industrial output, and lower employment over the projection period that results in reduced gross domestic product (GDP)" (p. 17).

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[6] For example, their model assumes "build limits" on wind energy capacity as of 2030 at a maximum of 3 GW/year under their "high cost scenario" and 5 GW/year in their "low cost scenario" (p. 6). However, for the year 2007, the actual amount of wind power capacity built was 5.2 GW, i.e. an amount higher than ACCF/NAM's optimistic figure for 2030 (see Pew Center report, op. cit., p. 7).

[7] In 2007, energy-related carbon dioxide generated greenhouse gas emissions in the United States were 5,991 million metric tons. ACCF/NAM predicts that under the Lieberman-Warner cap-and-trade measure, this figure will fall to 3,856 million metric tons. But in the absence of any cap-and-trade measure, ACCF/NAM predicts that energy-related greenhouse gas emissions in the U.S. will rise to "almost 7,000" millions of metric tons of carbon dioxide by 2030 (pp. 7 of ACCF/NAM report).

[8] We are using the categories GDP, an output measure of aggregate U.S. economic activity, and Gross Domestic Income, the equivalent income measure of aggregate activity, interchangeably. This is not strictly accurate, as explained in the U.S. Bureau of Economic Analysis reference, "Measuring the Economy: A Primer on GDP and the National Income and Product Accounts," http://www.bea.gov/national/pdf/nipa_primer.pdf. However, for our purposes, the differences are trivial, and do not affect at all the broad empirical observations we are presenting.

What this unfavorable assessment refers to is their "baseline" forecast that, in the absence of a cap-and-trade mandate, the U.S. economy would grow slightly faster than their high-cost case forecast. Specifically, they find that, in the absence of cap-and-trade, U.S. GDP between 2007 and 2030 would grow to $24.67 trillion as opposed to $24.0 trillion under their high-cost case. In terms of an average annual growth rate, the ACCF/NAM forecast is for a 2.6 percent GDP growth rate under their baseline conditions as opposed to a 2.5 percent growth rate under their high-cost case. On a per capita basis, their baseline scenario predicts that the average U.S. resident will receive $67,863 in income in 2030, a 49 percent improvement over 2007, as opposed to $66,023, a 45 percent improvement, under their high-cost case. In terms of average annual growth in per capita income between 2007 and 2030, the ACCF/NAM prediction is for a 1.7 percent growth rate under the baseline, as opposed to a 1.6 percent rate under their high-cost case. Again, these GDP predictions are also presented in the context of U.S. greenhouse gas emissions having fallen by 36 percent in 2030 under the high-cost case, while under the ACCF/NAM baseline forecast, U.S. greenhouse gas emissions will have risen by about 17 percent by 2030.

Their report also does not explain the implication of their finding within the context of a growing economy. Given their prediction that the U.S. economy will grow between 2007 and 2030 at an average annual rate of 2.5 percent under their high-cost case, this means that, under their high-cost case, for the level of national income to achieve the baseline 2030 figure—i.e. the figure attained assuming no cap-and-trade mandate—will take 14 months longer than it would under their baseline forecast. That is, under the high-cost case, ACCF/NAM predicts that, over a span of 23 years, U.S. households would need to wait fourteen months longer to become 49 percent richer than they were in 2007 than would be the case in their baseline scenario of no cap-and-trade mandate.[9]

We have reviewed above the inherent problems faced by all such long-term forecasting models. Because of these difficulties, we have no basis for assuming that the figures derived from the ACCF/NAM model are accurate. In the exercises we describe here and the results we report in our state fact sheets, we are simply re-expressing the ACCF/NAM's own forecast results themselves in terms other than those chosen by ACCF/NAM. *We are not, in any way, vouching for the accuracy of these forecasts.* In particular, we note that under both ACCF/NAM's baseline forecast with no carbon cap and the high-cost case with cap-and-trade, their projection is that the U.S. economy will be growing at a significantly slower rate than the economy's historic growth trajectory. That is, from 1948 to 2008, average actual U.S. GDP growth was 3.3 percent. The ACCF/NAM forecasts for 2007-2030, are, again, an average GDP growth rate of 2.6 percent under their baseline scenario of no carbon cap and 2.5 percent with a high-cost impact of cap-and-trade. ACCF/NAM offers no explanation as to why they project a historically slow growth path for the U.S. economy through 2030, irrespective of whether a carbon cap is implemented.

## DERIVATION OF FIGURES PRESENTED IN FACT SHEETS[10]

The ACCF/NAM study presents forecasts on "Loss in Gross State Product" (p. 22; we use what is now the official term used by the U.S. Bureau of Economic Analysis, "State GDP" as synonymous with what was its previous official term "Gross State Product"). However, unlike with their forecasts for national GDP, ACCF/NAM does not present forecasted levels of State GDP in their study. Yet obviously a level of State GDP under the ACCF/NAM high-cost case must first be calculated before one can subsequently estimate a State GDP loss under the high cost case relative to their baseline forecasted level. Thus, we use the following procedures to convert their figures for State GDP *loss* to State GDP *levels*.

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[9] This calculation does also take into account the Census Bureau's forecast of U.S. population growth between 2030 and 2031.

[10] The calculations, as detailed in this appendix, may produce slightly different numbers from the actual results due to the fact that we round figures for presentation purposes.

**ACCF/NAM U.S. GDP forecast.** Our starting point is the ACCF/NAM forecast of national GDP level in 2030. As noted above, in their high-cost case, the forecast for national 2030 GDP is $24.0 trillion assuming the U.S. economy has been operating with a Lieberman-Warner cap-and-trade regulation as of 2007.

**Apportioning 2030 U.S. GDP forecast to states.** We follow the methodology used by ACCF/NAM to apportion on a state-by-state basis this national forecasted 2030 GDP of $24.0 trillion. The ACCF/NAM study explains that they generated their state-specific GDP loss figures as follows: "To prepare the state-specific analyses, the regional NEMS/ACCF/NAM results were post-processed based on historical trends/relationships and population projections from the Census Bureau to get population and gross state product weighted results for economic growth, household income, jobs, industrial production, emissions, and prices at the state" (p. 19). In practice, their procedure is to calculate each state's average share of GDP over a historic trend. They do not specify which years they are using to establish their "historical trends/relationships." We have used the time period 1997 – 2007 for calculating the historic trend line. Using these years, we are able to reproduce the figures reported by ACCF/NAM for state-by-state shares of national GDP loss in the years in which they report GDP loss, including 2030. For example, Alabama's share of U.S. GDP between 1997 and 2007 was 1.21 percent. Thus, within their 2030 forecast, Alabama's share of U.S. GDP loss is 1.21 percent (p. 22). This implies that the ACCF/NAM forecast for Alabama's state GDP in 2030 is $290.4 billion (i.e. $290.4 billion = $24 trillion * 0.0121).

**Impact of differential population growth.** The U.S. Census Bureau's population growth projections vary significantly by state. For example, the Census Bureau projects that Alabama's population will grow between 2007 and 2030 from 4.63 to 4.87 million people, an increase of 5.2 percent, whereas, for California, the projected growth from 2007 to 2030 is from 36.38 to 46.44 million, a 27.7 percent increase. Any such differences in a state's rate of population growth will also influence the economic growth rate within the state. As such, we adjust our estimate of State GDP for 2030 according to each state's relative population growth rate. Through this adjustment, a state such as California, whose population is growing relatively quickly would also experience a faster rate of GDP growth relative to previous historical patterns. States with relatively slower population growth would correspondingly experience relatively slower economic growth. To make this adjustment in our state GDP and per capita GDP figures, we therefore performed the following calculation:

$$\frac{\text{state population as share of U.S in 2030}}{\text{state population as share of U.S. in 2007}} * \text{state projected 2030 GDP}$$

For Alabama, this calculation yields the following:

$$\frac{\text{Alabama population as share of US in 2030} = 1.3\%}{\text{Alabama population as share of US in 2007} = 1.5\%} = 0.87$$

*0.87 * $290.4 billion = $253 billion*

Our population-growth adjusted forecasted level for Alabama's GDP in 2030 is therefore $253 billion. Figure 1 of our Alabama fact sheet, based on the ACCF/NAM High Cost scenario, thus reports Alabama's forecasted state GDP for 2030 as $253 billion.

## STATE GDP PER CAPITA CALCULATION

To present the forecasted High-cost 2030 state GDP figures in readily understandable terms, we calculate state GDP figures on a per capita basis. In general, the expression for per capita GDP is simply = GDP level/Population. For our purposes therefore, the forecasted state per capita GDP figures equals:

*forecasted 2030 State GDP / forecasted 2030 population.*

For this exercise, we use the high-cost 2030 state GDP population adjusted figures, such as the $253 billion figure for Alabama. Our population figures are those that come directly from the U.S. Census Bureau. Again, considering the case of Alabama, the Census Bureau projects the state's population for 2030 at 4.87 million people. Based on this population figure, the per capita GDP for Alabama in 2030 is then $51,899 (= $253 billion/4.87 million people). The figure for 2007, based on actual data, is:

*$166 billion Alabama GDP / 4.63 million population = 2007 Alabama per capita income = $35,835*

The rise in forecasted per capita income in Alabama between 2007 and 2030 is therefore 44.8 percent.

## STATE AND LOCAL GOVERNMENT REVENUE PROJECTIONS

We assume state and local fiscal revenues and services for 2007 and 2030 will follow their historical pattern over the years 1997-2006. Specifically, this means that we calculated the average state and local revenues/GDP for each state over the years 1997 – 2006 (excluding 2001 and 2003 due to lack of complete local revenue data for those years). For Alabama, this ratio is 21.5 percent. Thus, for 2007, since Alabama's GDP that year was $166 billion, this implies a level of state and local revenues for 2007 at $35.7 billion. In addition, given that we derive Alabama's state GDP for 2030 as $253 billion, based on the ACCF/NAM high-cost case forecast, this implies that Alabama's state and local fiscal revenues for 2030 will be $54.4 billion. We then calculate this revenue figure for each state as a share of the state's forecasted population for 2030. Following these procedures, we therefore calculate Alabama's fiscal resources for 2007 as being $7,702 per person in 2007 (= $35.7 billion/4.63 million people). For 2030, our figure for per person share of Alabama's state revenue is $11,155 (= $54.4 billion/4.87 million people). These are the data we report in Figure 3 of our Alabama fact sheet.

## CALCULATION OF FUNDS AVAILABLE FOR K-12 PUBLIC EDUCATION: REDUCING AVERAGE CLASSROOM SIZES

We conducted this exercise to provide a concrete example as to how the increase in average public services in each state could translate into specific benefits for state residents under the ACCF/NAM high-cost case. The example we have considered is for states to prioritize lowering average classroom size by 20 percent.

To generate these estimates, we worked with the following set of assumptions, which we illustrate for the case of Alabama.

1. We begin with figures for most recent figures for each state for teachers' salaries, number of teachers employed, and number of K-12 students.

- Alabama average salaries: $43,390
- Alabama number of teachers: 47,922
- Alabama budget for teacher salaries: $2.1 billion

- Alabama K-12 public school student enrollment: 735,000
- Alabama average student teacher ratio: 15.3 (= 735,000/47,922)

2. For the year 2030, we assume K-12 student enrollment grows at the average population growth rate, and that the average salary for state teachers rises at the rate of average per capita income growth.

- Alabama student enrollment projection for 2030: 773,220 students (= 735,000 * 1.052)
- Alabama average teacher salary for 2030: $62,830 (= $43,390 * 1.448)

3. We calculate the student/teacher ratio for 2030 needed to achieve a 20 percent fall from its 2007 level. This also assumes that average teachers' salaries rise by the state's average per capita income growth.

- Alabama's average student/teacher ratio falls from 15.3 to 12.3 (= 15.3 * 0.8)
- Alabama's projected 2030 student enrollment is 773,220 students. The number of teachers needed to achieve a 12.3 student/teacher ratio is therefore 62,863.
- Assuming an average teacher salary in Alabama of $62,830, this implies a budget for teachers in 2030 of just under $4.0 billion.
- Thus, overall budget increase needed to reduce student/teacher ratio to 12.3 in 2030 from 15.3 in 2007 is $1.9 billion (= $4.0 billion for 2030 salaries - $2.1 billion for 2007 salaries).

4. We calculate total budget increase for teachers for 2030 in each state assuming total budget rises at the same rate as the state's overall revenues.

- For Alabama, overall state revenues rise by 52 percent. This would imply that Alabama's budget for teachers in 2030 would rise from the 2007 figure of $2.1 billion to $3.2 billion.

5. We calculate the difference between the budget for teachers' salaries assuming budgets rise at rate proportional to state revenue increases versus the budget necessary to reduce student/teacher ratio by 20 percent.

- For Alabama, the proportionate increase in the budget for teachers' salaries is $3.2 billion. Assuming a reduction in student/teacher ratio by 20 percent implies a budget for teachers' salaries of $4.0 billion. The difference is therefore $800 million (= $4 billion - $3.2 billion).

6. We assume that the more than proportionate rise in teachers on staff will also require an equivalent more than proportionate increase in the support staff, building space, and teaching materials, to enable this higher level of teaching staff to operate effectively. We assume this increase in support resources for teachers is equal to the increase in teaching staff budget needed to generate a 20 percent reduction in student/teacher ratio in 2030 relative to the budget needed to maintain a constant student/teacher ratio in 2030.

- For Alabama, the budgetary difference in teacher salaries to achieve a 20 percent reduction in the student/teacher ratio by 2030 is $800 million—i.e. the teacher salary budget with a 15.3 student/teacher ratio would be $3.2 billion, and with 12.3 student/teacher ratio would be $4 billion. We add an equivalent amount—i.e., another $800 million—for support resources for teachers. Thus, the budgetary increase to reduce the student/teacher ratio from 15.3 to 12.3 is equal in total to $1.6 million: an $800 million increase in the teacher salary budget plus an $800 million increase in the budget for support resources. .

7. We convert the results obtained for student/teacher ratios into figures on classroom size, to provide a more readily understandable metric of the improvement in educational services. To do so, we assume that the average size of classrooms will vary proportionately with student-teacher ratios. Thus, since we are estimating budgetary impacts of reducing the average student/teacher ratio by 20 percent, this means that we are equivalently estimating the effects of reducing average classroom sizes by 20 percent. To calculate average classroom sizes for K-12, we take the mean of the average size classrooms for "elementary" and "secondary" schools reported on a state-by-state basis by the U.S. Department of Education.

- For Alabama, the most recent 2007 tables from the Department of Education reports the average classroom sizes at 18.4 for elementary schools and 23.8 for secondary schools. The mean figure for both is therefore 21.1. This is the figure we report in Table 4 of the Alabama fact sheet.
- Reducing average classroom size in Alabama by 20 percent therefore would mean an average classroom size in 2030 of 16.9.

8. We adjust the remainder of the overall government revenue increase to reflect the increased proportionate allocations for public school teachers. On that basis, we then recalculate the proportionate gains in state services for all other items in the state budget other than lowering student/teacher ratios and distributing more scholarship funds.

- For Alabama, the overall budget increment to hire more teachers and to increase scholarship support as noted is $1.6 billion (= $800 million for teachers + $800 million for support staff and resources).
- This implies that the remaining funds available for improving the remainder of state services in Alabama in 2030 will fall from $54.4 billion to $52.8 billion.

*Data sources:* Statistical Abstract of the United States *for student enrollment; American Federation of Teachers (2008) for FTE teachers and teacher salaries; U.S. Department of Education Digest of Education Statistics,* http://nces.ed.gov/Programs/digest/d07/tables/dt07_064.asp *for average classroom size.*

## EMPLOYMENT PROJECTIONS

**2030 Employment under High Cost Case.** The ACCF/NAM baseline employment forecast for employment in 2030—i.e. assuming no cap-and-trade measures are implemented at any time through 2030—is that 166.96 million people will have jobs in the U.S. in 2030 (p. 8). This is an average annual increase in employment of 0.58 percent over the actual 2007 level of 146.0 million people employed, as measured by the U.S. Bureau of Labor Statistics Household Survey.[11]

ACCF/NAM then reports the difference in their employment forecasts between their baseline and high-cost cases. Under their high-cost case, they forecast U.S. employment in 2030 at 162.9 million. This is an increase of 16.9 million jobs, a 0.48 percent average annual increase over the actual 2007 employment level of 146.0 million. ACCF/NAM uses the term "employment loss" to represent the difference in the employment gain that they forecast between their high-cost case of 0.48 average annual employment growth and the baseline case of 0.58 average annual growth. In fact, under both scenarios, employment

[11] ACCF/NAM does not state whether, in making their employment forecasts, they are working with either the BLS household or establishment survey. These two surveys do report significantly different figures. For 2007, the establishment survey figure is 137.6 million people employed. For purposes of this exercise, we work with the higher 2007 figure derived from the household survey.

grows relative to 2007, only at moderately different rates. ACCF/NAM then distributes this overall "employment loss" on a state-by-state basis. For example, for Alabama, they report an "employment loss" of 60,000 jobs relative to their baseline forecast. They do not report their baseline forecasted employment level directly.

To generate state-by-state employment level estimates under the ACCF/NAM high cost scenario, we begin with the initial simple assumption that baseline employment growth in all states is equal to the overall national employment growth rate of 14.3 percent. We work with this assumption based on three considerations:

1. The economic growth paths of the various states will vary in terms of their relative rates of productivity growth, with some states experiencing more rapid productivity growth than others. All else equal, states with relatively rapid productivity growth will experience slower than average employment growth.

2. The economies of the various states will also vary over time in terms of their GDP growth. All else equal, states with faster than average GDP growth will experience faster than average employment growth.

3. The states that tend to have faster than average productivity growth are also the states that tend to experience faster than average GDP growth. As such, these factors—productivity growth rates versus GDP growth rates—tend to balance out one another.[12]

Working with this initial assumption that all states experience baseline employment growth of 14.3 percent between 2007 and 2030, this means, for Alabama, that their employment between 2007 and 2030 would grow from 2.10 million to 2.40 million. From this baseline 2030 forecast, we then subtract whatever ACCF/NAM reports as the employment loss experienced by each state relative to the baseline forecast. Thus, for Alabama, we subtract 60,000 jobs from their baseline 2030 forecast. This yields a high cost employment forecast for Alabama of 2.34 million jobs in 2030. This is the second employment figure we report in Table 5.

Note that by incorporating the ACCF/NAM figures for "employment loss" by state, we are accounting for any effects on state employment levels that the ACCF/NAM is including, as regards each state's sensitivity to the effects of a cap-and-trade mandate on employment in each state's fossil fuel sectors.

**2030 Employment assuming 25 percent clean energy investments.** We assume for this projection that by 2030, each state transfers 25 percent of what it would otherwise have spent on fossil fuels onto clean energy investments. By making this transfer of spending from fossil fuels to clean energy, the state increases employment. This is because, on average, spending a given amount of money on clean energy projects creates about 3.5 times more employment than spending within the fossil fuel industries.

To perform this estimate on a state-by-state basis, we first assume that in 2030, the proportion of direct and indirect employment created by the fossil fuel industries remains at its 2007 level. We then assume that this proportion of employment falls by 25 percent. We then shift the level of spending implied by the employment in fossil fuels into clean energy activities. This increases the level of employment for these activities by 3.5 times the level had been when spending was used within the fossil fuel industries.

We are assuming with this exercise that the productivity levels for clean energy activity remains in 2030 at roughly the same level relative to that for fossil fuels. This assumption is necessary in order to assume that in 2030, clean energy investments will continue to generate about 3.5 times more jobs than the same level of spending within the fossil fuel industries. In our view, this is a reasonable assumption. The single largest source of direct employment growth in clean energy will be the construction industry.

[12] The Pearson rank correlation coefficient between state-level productivity growth and GDP growth between 1992 and 2007 is 0.51.

Productivity growth in construction is not likely to increase relative to fossil fuels. In addition, there will almost certainly be substantial reductions in the cost of renewable energy technologies. But these cost reductions will derive mostly through the more effective transmission of an energy source into usable energy—e.g. of sunlight and wind into electricity. The productivity gains in the manufacturing of the equipment for transmitting renewable energy are not likely to increase at rates significantly greater than those attained within the fossil fuel industries.

We conduct these calculations for Alabama as follows:

- For 2007, total direct and indirect employment in the fossil fuel industries in Alabama was 24,600, equal to 1.17 percent of the 2.10 million in total state employment that year.
- For 2030, assuming Alabama employment is 2.34 million, that would imply that fossil fuel employment would be 27,420 (= 2.34 million * 0.0117).
- Assume that fossil fuel employment in Alabama in 2030 falls by 25 percent, and that the total amount of money that had been used to employ this 25 percent of fossil fuel industry-linked workers is shifted to clean energy projects.
  - Fossil fuel employment falls to 20,570 (= 27,420 * .75)
  - Clean energy employment rises by 23,990 (= 6,855 jobs reduced in fossil fuels * 3.5 clean energy employment multiplier)
  - Overall fossil fuel plus clean energy employment rises to 44,560 (= 20,570 + 23,990).
  - The net increase in 2030 projected employment rises by 17,140 (= 44,560 – 27,420).

Total 2030 projected Alabama employment thus rises from 2.34 to 2.36 million. This is the figure reported on the far right-hand bar of Figure 5 of the Alabama fact sheet.

*Data sources: IMPLAN, for fossil fuel employment by state; authors' calculations from IMPLAN for clean energy employment relative to fossil fuel employment. Methodology for calculating clean energy employment described in* R. Pollin et al., Green Recovery *(www.peri.umass.edu/green_recovery).*

## GREENHOUSE GAS REDUCTIONS

*Data for Figure 6 are from the Energy Information Agency: www.eia.doe.gov/oiaf/1605/ggrpt/ for 2007 emission levels and from the ACCF/NAM study (p. 7) for 2030 projected level.*

## FORECASTING THE COSTS OF ENVIRONMENTAL REGULATIONS

The first paragraph of our fact sheet states that: "It is well documented that the actual costs to U.S. businesses of complying with the Clean Air Act, the Acid Rain Act and other environmental laws have been dramatically lower than what had once been estimated by opponents of these measures." The sources for that sentence are: Hart Hodges, (1997) *Falling Prices: Cost of Complying with Environmental Regulations Almost Always Less than Advertised*. Washington, D.C.: Economic Policy Institute. Available at: www.epi.org/briefingpapers/bp69.pdf; Winston Harrington, Richard D. Morgenstern, and Peter Nelson (2000) "On the Accuracy of Regulatory Cost Estimates." *Journal of Policy Analysis and Management* 19(2):297-322; and Frank Ackerman (2006). *The Unbearable Lightness of Regulatory Costs*. Medford, MA: Global Development and Environment Institute. Available at: http://ase.tufts.edu/gdae/Pubs/wp/06-02UnbearableLightnessReg.pdf

The authors are grateful for comments and assistance from Frank Ackerman, Pete Altman, James Barrett, Heidi Garrett-Peltier, James Heintz, Laurie Johnson, Jeannette Wicks-Lim, and Debbie Zeidenberg.