Clean Energy Development for a Growing Economy:

Employment Impacts of the Clean EDGE Act

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Table of Contents

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Executive Summary

A national commitment to develop clean, renewable energy would not only enhance our security and protect the environment, it could restore American technological leadership, create jobs, protect our living standards, and save consumers money.

A study prepared by Dr. Robert E. Scott of the Economic Policy Institute from analysis provided by Brian A. Siu of the Apollo Alliance tests the economic benefits of a comprehensive clean energy strategy by examining the likely employment impacts of the proposed Clean Energy Development for a Growing Economy (Clean EDGE) Act. One of the most comprehensive clean energy bills now before Congress, the Clean EDGE Act would:

- Promote alternatives to oil by requiring that half of new vehicles be gas-ethanol capable by the year 2020, requiring that 10 percent of gas stations sell ethanol by 2015, and providing incentives for the manufacture and purchase of advanced fuel efficient vehicles.

- Ensures the federal government reduces its petroleum consumption by 40 percent by 2020, increases its renewable electricity use to 10 percent by 2013, and uses advanced, efficient and renewable technology to help drive innovation while providing additional bonding authority to encourage states to invest in efficient vehicles, alternative fuels and transit.

- Diversifies America's energy sources by requiring that 10 percent of electric power comes from renewable sources by 2020, creating an Advanced Research Project Agency for Energy to develop cutting-EDGE technologies, and establishing a Clean Energy Investment Administration to provide federal loan guarantees for deployment of clean energy technologies, and

- Levels the playing field for clean energy technologies by revoking subsidies for major oil companies and ensuring they pay adequate royalties for extracting oil from public lands and waters while using these savings to promote development of clean energy alternatives.

The EPI/Apollo study finds that the Clean EDGE Act would increase public and private investment in clean and renewable energy technologies by as much as $49 billion and create approximately 530,000 US jobs when the program is fully implemented in 2009. The Act's wind energy provisions would generate nearly half the total or 245,000 jobs. Clean EDGE would generate the majority of new jobs in manufacturing (251,000 jobs, 47.3% of the total) and construction (62,000, 11.7%). Compensation in these sectors is approximately 13% and 10%

higher, respectively, than in the rest of the economy, improving the wages and benefits of hundreds of thousands of workers who move into these jobs. In addition, this analysis finds:

- The Clean EDGE Act would generate jobs in every state and the District of Columbia. The leading job winners include: California (54,000), Texas (38,000) and the industrial states of the Midwest and Northeast, including Michigan (29,000), New York (27,000), Pennsylvania (26,000), Illinois (26,000), Ohio (26,000), Florida (23,000) and Indiana (20,000) (see Table 4).

- The 10 states where Clean EDGE spending would have its biggest impact, as a share of total state employment, are Indiana (about 20,000 jobs, or 0.7% of total employment in 2004), Michigan (29,000 jobs, 0.7%), Wisconsin (17,000 jobs, 0.6%), South Carolina (11,000 jobs, 0.6%), Missouri (14,000 jobs, 0.5%), New Hampshire (3,000 jobs, 0.5%), Ohio (26,000 jobs, 0.5%) Arkansas (5,000 jobs, 0.5%), Vermont (1,400 jobs, 0.5%) and Kentucky (8,000 jobs, 0.5%) (see Table 5).

The Clean EDGE Act would bring about a significant increase in the production of energy from renewable and alternative sources and the production of high-efficiency vehicles and other products. It would reduce the environmental impact of energy production and transportation in the U.S. It would also generate 531,000 jobs, most of them in sectors that would support good jobs with good benefits. The Clean EDGE Act alone would generate enough jobs to replace 8% of the manufacturing jobs lost since 2000 in the U.S., and generate an additional 62,000 jobs to help offset the expected decline of the construction industry. It is a powerful example of the benefits to the economy from large scale commitments to the vision outlined in the Apollo energy program.

Clean Energy Development for a Growing Economy:

Employment Impacts of the Clean EDGE Act[1]

Analysis

Robert E. Scott
Economic Policy Institute

The proposed "Clean EDGE Act," would dramatically increase public investment in clean and renewable energy technologies and create incentives for increased private spending in these areas. It would yield many important benefits for the economy including improvements in environmental quality, reductions in green-house gas emissions, reduced reliance on imported oil and improvements in the U.S. trade balance. This analysis estimates that spending resulting from this program would generate approximately 531,000 jobs in the domestic economy when the program is fully implemented in 2009, as shown in Table 2.[2]

Design and production of new technologies, equipment and products (such as bio-fuels) will increase the output of manufactured goods and employment in these industries in the U.S. Average wages in manufacturing industries are 12.5% higher than those in other (non-manufacturing) sectors of the economy.[3] Many workers moving into Clean EDGE-related jobs would be leaving jobs in other sectors of the economy which typically have lower pay and benefits than jobs in manufacturing. One of the most important benefits of the Clean EDGE Act and other Apollo-type programs is that they would improve the wages and benefits received by hundreds of thousands of workers who move into these jobs. This analysis finds:

- The Clean EDGE Act would generate jobs in every state and the District of Columbia. The leading job winners, in numeric terms are: California (54,000), Texas (38,000) and the industrial states of the Midwest and Northeast, including Michigan (29,000), New York (27,000), Pennsylvania (26,000), Illinois (26,000), Ohio (26,000) and Indiana (20,000), as well as Florida (23,000) (see Table 4).

- The 10 states where Clean EDGE spending would have its biggest impact, as a share of total state employment, are Indiana (about 20,000 jobs, or 0.7% of total employment in 2004), Michigan (29,000 jobs, 0.7%), Wisconsin (17,000 jobs, 0.6%), South Carolina (11,000 jobs, 0.6%), Missouri (14,000 jobs, 0.5%), New Hampshire (3,000 jobs, 0.5%), Ohio (26,000 jobs, 0.5%) and Arkansas (5,000 jobs, 0.5%), Vermont (1,400 jobs, 0.5%) and Kentucky (8,000 jobs, 0.5%) (see Table 5).

[1] http://www.epinet.org/workingpapers/wp278.pdf
[2] This estimate includes both direct jobs in the industry where spending takes place (e.g. purchase of hybrid vehicles) and "indirect" employment in the sectors which supply parts and materials to that sector. It does not include any "multiplier" effects and is thus a conservative estimate of the employment impacts of this legislation.
[3] This estimate compares average manufacturing wages, weighted by import and export trade flows with Mexico and Canada in 2004, with wages of workers in the rest of the economy (Faux, Campbell, Salas and Scott 2006).

Investment, employment and the Clean EDGE Act

The U.S. lost 3 million manufacturing jobs between 2000 and 2005. Growing U.S. trade deficits were responsible for a significant share of these job losses (Bivens 2006).[4] Likewise, the construction industry is threatened by a collapse in the housing sector in 2006 and 2007. Private building permits declined 20.8% in July 2006 from a year earlier and housing starts were off 7.7%. Increased public and private spending resulting from the passage of the Clean EDGE Act would generate hundreds of thousands of jobs in the economy, and many of those jobs would be concentrated in the manufacturing and construction sectors of the economy, as shown below.

The proposed Clean EDGE Act would support $49 billion in spending in 2009, when it is fully implemented, as shown in Table 1. The estimates in Table 1 include both direct program spending and induced spending in the private sector for investments in new production capacity and purchases of renewable and alternative energy sources (Appendix).[5] About half of projected spending resulting from implementation of the Act would be for wind energy investments, followed by Hybrid and Advanced Diesel (HAD) vehicles, biomass and solar with 9–11% each, and lesser amounts for other technologies and activities.

More than 90% of the spending would take place in the manufacturing and construction industries (industrial breakdown not shown). Spending under the program would ramp up quickly and would be sustained at high levels between 2007 and 2011, as shown in Table 1. This spending could help offset the projected decline in both of these sectors, as shown below. After 2011, it is assumed that private spending on the technologies developed would continue, but at reduced levels.

It is estimated that the Clean EDGE Act spending would generate approximately 531,000 jobs in 2009, when the program is fully implemented, as shown in Table 2. Employment generated would remain at that level (that is, approximately 500,000 people would be continuously employed between 2007 and 2011) for the period of spending authorized under the Act. After that time, employment supported could decline, depending on the level of domestic spending induced after 2011 by the Act. The employment impacts of each program element are roughly proportional to projected spending, with 245,000 jobs generated by wind energy programs alone (nearly half of the total). Hybrid and Advanced Diesel projects, or HADs, would generate about 53,000 (10%) of the jobs generated, and lesser amounts would be generated by the remaining program elements.

The majority of jobs would be generated in manufacturing (251,000 jobs, 47.3% of the total) and construction (62,000, 11.7%) as shown in Table 3. Compensation in these sectors was

[4] Other significant causes of manufacturing job loss included rapid productivity growth and slow recovery of demand for manufactured goods after the 2001 recession.

[5] This estimate assumes that the bulk of public spending authorized by the Clean EDGE Act would take place in the first five years of the legislation. Thereafter spending (and employment) supported by the bill would drop sharply unless private spending on clean energy technologies and products increased rapidly, and/or public spending under the legislation was renewed. "Induced spending" refers to the private sector spending required by provisions in the legislation as matches for authorized federal spending or incentives.

approximately 12.5% and 7.5% higher, respectively, than in the rest of the economy in 2005.[6] A number of indirect jobs would also be generated in high-income sectors such as information (38.5% higher compensation) and finance, insurance and real estate (25.3% higher), where a total of 22,000 jobs would be generated.[7]

The employment impacts of the spending outlined in Tables 2 and 3 (and Tables 4 and 5, below) were estimated using an employment requirements table prepared by the Bureau of Labor Statistics, as outlined in the methodology section below. This analysis estimated both the direct effects of spending by industry (e.g., the purchases of advanced diesel vehicles), and the indirect effects of spending on supplier industries (e.g., auto parts, steel and rubber).

Job gains in every state

The Clean EDGE Act would generate jobs in every state and the District of Columbia, as shown in Table 4, where states are ranked by the total number of jobs generated. States are ranked by job impact (jobs generated as a share of total state employment in 2004) in Table 5. About 54,000 jobs would be generated in California. Texas (38,000) and the industrial states of the Midwest and Northeast, including Michigan (29,000), New York (27,000), Pennsylvania (26,000), Illinois (26,000), Ohio (26,000) and Indiana (20,000), as well as Florida (23,000) would also see large gains.

The employment impacts of the Clean EDGE Act, as a share of total employment, would be highest in the broad swath of industrial states running from New England to the Midwest and the South, regions hardest hit by the collapse of manufacturing jobs. The states that would benefit most heavily include Indiana (about 20,000 jobs, or 0.7% of total employment in 2004), Michigan (29,000 jobs, 0.7%), Wisconsin (17,000 jobs, 0.6%), South Carolina (11,000 jobs, 0.6%), Missouri (14,000 jobs, 0.5%), New Hampshire (3,000 jobs, 0.5%), Ohio (26,000 jobs, 0.5%) and Arkansas (5,000 jobs, 0.5%).

Conclusion

The Clean EDGE Act would bring about a significant increase in the production of energy from renewable and alternative sources and the production of high-efficiency vehicles and other products. It would reduce the environmental impact of energy production and transportation in the U.S. It would also generate 531,000 jobs, most of them in sectors that would support good jobs with good benefits. The Clean EDGE Act alone would generate enough jobs to replace 8% of the manufacturing jobs lost since 2000 in the U.S., and generate an additional 62,000 jobs to help offset the expected decline of the construction industry. It is a powerful example of the

[6] Based on average hourly compensation in construction, manufacturing and the total economy (Mishel, Bernstein and Allegretto 2006, 167, Table 3.27). Average compensation in the rest of the economy was estimated using average weekly hours of production workers (BLS 2006, "Historical B Tables") to calculate total industry compensation in each sector, and then calculating average compensation in the rest of the economy as a residual (residual compensation/residual average weekly hours). It was assumed that average weekly hours in the total economy (including public sector workers) was equal to average weekly hours of production workers in the private sector (data on average weekly hours for non-production and public sector workers were not available). These estimates compare wages in each sector to those in the rest of the economy.

[7] *Ibid.*

benefits to the economy from large scale commitments to the vision outlined in the Apollo energy program.

Methodology

This report estimates the direct and indirect effect of Clean EDGE Act spending using an input-output based employment requirements table developed by the U.S. Bureau of Labor Statistics. This analysis was based on a detailed, industry-based study of the relationships between changes in trade flows and employment for each of 200 sectors of the U.S. economy. The North American Industry Classification System (NAICS) was initially used to classify the spending included in this study at the 4-digit NAICS level (SIU 2006). The BLS model uses a slightly different system of industries which consolidates some 4-digit NAICS sectors, while preserving industry detail for most manufacturing activities. The spending included in this analysis, as summarized in Table 1, includes both direct government expenditures and induced expenditures that the Act would generate in the private sector. *Sources for these spending numbers are provided in an Appendix to this report.* For further details of the approach used in this analysis see Ratner (2006).[8]

Multiplier effects not included

The estimates presented in Tables 2-5 do not include any estimates of the multiplier impacts of the spending and jobs supported or induced by the Clean EDGE Act. They are a measure of the *gross* direct and indirect employment generated by the program. This spending is also likely to result in a *net* increase in total U.S. employment in most circumstances. When the economy is not at full employment[9], the Clean EDGE program would likely contribute to growth in total employment and reductions in the unemployment rate. In that case, some of the 531,000 jobs generated will go to people on the unemployment rolls. In addition, some workers who have dropped out of the labor force will get new jobs as manufacturing employment rises, and others will move from other industries where pay and benefits are lower. All of these workers will be able to increase their spending, raising demand and employment economy-wide. These secondary impacts would further stimulate the economy and generate additional employment. The net increase in employment resulting from the Clean EDGE Act would be determined by a confluence of factors that determine the overall level of employment and unemployment in the economy and in particular industries. Other factors affecting employment trends include changes in the U.S. trade balance, technological change and productivity growth, government spending and taxation, and the Federal Reserve's monetary policies.

Full employment, defined as an unemployment rate of 4.0 percent or less of all persons in the labor force over age 16, has been an extremely rare occurrence over the last 35 years. Since 1970, average annual unemployment was 4.5% or less for only 3 years (1998-2000), and reached

[8] Ratner (2006) is an Appendix to the U.S. section of Faux, et al (2006), by Scott.
[9] The Humphrey-Hawkins "Full Employment and Balanced Growth Act" of 1978 called for unemployment of all persons aged 16 and over to be reduced to 4%. http://thomas.loc.gov/cgi-bin/bdquery/z?d095:SN00050:@@@D&summ2=m&

4.0 percent only in 2000.[10] If the economy is not at full employment when the Clean EDGE Act is implemented, the net employment effects would be substantial (Bureau of Labor Statistics 2006). Although (seasonally adjusted) unemployment has dipped below 5% during the past year, it could rise sharply if the economy slips into a recession, as a growing number of economists now expect (Delong, 2006). Nouriel Roubini (2006) places the odds of a recession in 2007 at 70%.

The Clean EDGE Act employment estimates reported in Tables 2-5 are conservative because they exclude any multiplier employment effects of the legislation's likely effect on the economy. At a minimum, the Act would result in increased demand for manufactured goods and manufacturing workers. This would, at a minimum, allow workers from other sectors of the economy with lower wages and benefits to move up (or back) into manufacturing jobs. Even in this case, the higher wages earned by these workers would likely result in some additional, economy-wide demand for labor. However, if the economy were at full employment, and if every worker who wanted a job had one, then the primary impact of Clean EDGE Act spending would be to move workers from lower-paying sectors of the economy to jobs with higher pay and better benefits. Even in that unlikely event, the income effects of the program would be substantial. And the development of renewable and alternative energy sources and more efficient vehicles would generate many long run benefits for the economy in terms of increased production of renewable and alternative energy supplies, reduced energy consumption and improvements in the environment.

[10] The BLS reported unemployment rate also underestimates actual unemployment because it does not include workers who have dropped out of the labor force or are otherwise underemployed. Underemployment includes the unemployed and also discouraged workers, involuntary part-time workers and other marginally attached workers. The underemployment rate, which includes all these workers increased from 7.0% in 2000 to 8.4% in the first quarter of 2006 (Mishel, *et al 2006 Table 4.6, p 230*.

Tables

Table 1: Clean EDGE Act, estimated federal and private spending

(billions of dollars)

	2007	2008	2009	2010	2011
Wind Energy	$23.1	$23.5	$23.5	$23.5	$23.5
Solar Energy	4.9	4.6	4.6	4.6	4.6
Geothermal Energy	2.8	2.8	2.8	2.8	2.8
Biomass	4.1	4.2	4.2	4.2	4.2
Coal Gasification/ IGCC/ Advanced Coal	3.3	3.3	3.3	2.4	2.1
Flex Fuel Conversion Tax Credit	0.1	0.2	0.2	0.3	0.3
Renewable Refueling Stations	0.2	0.2	0.2	0.2	0.2
Transit Investments	2.3	2.3	2.3	2.3	2.3
Research into Energy and Advanced Vehicle Technologies	1.7	2.6	2.6	2.6	2.6
Hybrid and Advanced Diesel Investment Incentives (HAD)	1.9	3.7	5.6	5.6	5.6
Total Program Spending	**$44.2**	**$47.2**	**$49.2**	**$48.3**	**$48.1**

Source: Appendix, Siu 2006

Table 2: Employment impacts of Clean EDGE Act by program element

	jobs	percent
Wind Energy	244,654	46.1%
Solar Energy	43,798	8.2%
Geothermal Energy	33,993	6.4%
Biomass	47,693	9.0%
Coal Gasification/ IGCC/ Advanced Coal	37,497	7.1%
Flex Fuel Conversion Tax Credit	2,585	0.5%
Renewable Refueling Stations	2,194	0.4%
Transit Investments	36,963	7.0%
Research into Energy and Advanced Vehicle Technologies	29,134	5.5%
Hybrid and Advanced Diesel Investment Incentives (HAD)*	52,747	9.9%

Source: EPI analysis of Bureau of Labor Statistics data and Table 1

*the HAD employment impacts are job opportunities relative to a base case in which the U.S. would forego between "38,000 and 207,000 jobs" (or job opportunities) due to rising import market share and off shoring of U.S. auto production to Mexico, Canada and other countries (Hammet, Flynn, Sims and Luria 2004, 36).

Table 3: Employment impacts of Clean EDGE Act by major industry

	jobs	percent
Agriculture, Forestry, Fishing and Hunting	1,779	0.3%
Utilities	1,823	0.3%
Mining	2,441	0.5%
Government	14,985	2.8%
Other services	19,778	3.7%
Information, Finance Insurance and Real Estate	21,905	4.1%
Professional, Scientific, and Technical Services	40,721	7.7%
Management and Administration	41,487	7.8%
Construction	62,237	11.7%
Wholesale & Retail Trade, Transport & Warehousing	72,759	13.7%
Manufacturing	251,343	47.3%
TOTAL	**531,258**	**100.0%**

Source: EPI analysis of Bureau of Labor Statistics data and Table 1

Table 4: Employment impacts of Clean EDGE Act by state

California	53,751	**Oregon**	6,748
Texas	37,566	**Connecticut**	6,290
Michigan	29,318	**Louisiana**	5,669
New York	27,154	**Iowa**	5,632
Pennsylvania	25,965	**Arkansas**	5,451
Illinois	25,863	**Oklahoma**	5,342
Ohio	25,634	**Kansas**	5,318
Florida	23,064	**Utah**	4,045
Indiana	19,727	**Mississippi**	3,952
North Carolina	17,459	**Nevada**	3,328
Georgia	16,995	**West Virginia**	3,076
Wisconsin	16,586	**New Hampshire**	3,071
Missouri	13,782	**Nebraska**	2,769
Virginia	13,425	**New Mexico**	2,235
New Jersey	13,214	**Rhode Island**	1,960
Massachusetts	13,072	**Idaho**	1,952
Tennessee	11,976	**Maine**	1,867
South Carolina	10,705	**South Dakota**	1,553
Minnesota	10,379	**Vermont**	1,411
Montana	10,379	**Delaware**	1,259
Kentucky	8,287	**Hawaii**	1,181
Arizona	8,172	**North Dakota**	852
Washington	8,092	**Wyoming**	831
Alabama	7,815	**Alaska**	806
Colorado	7,504	**District of Columbia**	685
Maryland	7,262		
	TOTAL		540,430

Source: EPI analysis of Bureau of Labor Statistics data and Table 1

*Total differ from Table 3 due to rounding errors

Table 5
Employment impacts of Clean EDGE Act by state
(ranked by number of jobs generated as a share of total employment)

State	*jobs*	*share of total employment in 2004*	*State*	*jobs*	*share of total employment in 2004*
Indiana	19,727	0.7%	**Connecticut**	6,290	0.4%
Michigan	29,318	0.7%	**Virginia**	13,425	0.4%
Wisconsin	16,586	0.6%	**California**	53,751	0.4%
South Carolina	10,705	0.6%	**Utah**	4,045	0.4%
Missouri	13,782	0.5%	**Oklahoma**	5,342	0.4%
New Hampshire	3,071	0.5%	**Mississippi**	3,952	0.4%
Ohio	25,634	0.5%	**Colorado**	7,504	0.3%
Arkansas	5,451	0.5%	**Arizona**	8,172	0.3%
Vermont	1,411	0.5%	**Idaho**	1,952	0.3%
Kentucky	8,287	0.5%	**New Jersey**	13,214	0.3%
Pennsylvania	25,965	0.5%	**Wyoming**	831	0.3%
North Carolina	17,459	0.5%	**New York**	27,154	0.3%
Illinois	25,863	0.4%	**Florida**	23,064	0.3%
Tennessee	11,976	0.4%	**Maine**	1,867	0.3%
Georgia	16,995	0.4%	**Nebraska**	2,769	0.3%
Oregon	6,748	0.4%	**Washington**	8,092	0.3%
West Virginia	3,076	0.4%	**Delaware**	1,259	0.3%
Massachusetts	13,072	0.4%	**Louisiana**	5,669	0.3%
Alabama	7,815	0.4%	**Nevada**	3,328	0.3%
South Dakota	1,553	0.4%	**Maryland**	7,262	0.3%
Kansas	5,318	0.4%	**New Mexico**	2,235	0.3%
Rhode Island	1,960	0.4%	**Montana**	10,379	2.5%
Texas	37,566	0.4%	**Alaska**	806	0.3%
Minnesota	10,379	0.4%	**North Dakota**	852	0.3%
Iowa	5,632	0.4%	**Hawaii**	1,181	0.2%
			District of Columbia	685	0.1%
			TOTAL	**540,430**	

Source: EPI analysis of Bureau of Labor Statistics data and Table 1

*Total differ from Table 3 due to rounding errors

References

Bivens, L Josh. 2006. "Trade deficits and manufacturing job loss: Correlation and causality." Washington, DC: Economic Policy Institute. BP 171. ***http://www.epi.org/content.cfm/bp171***

Bureau of Labor Statistics. 2006. "Access to the historical data for the Employment Situation News Release," http://stats.bls.gov/data/home.htm.

Delong, Brad. 2006. The odds of economic meltdown: With interest rates and oil prices rising and consumers spending beyond their means, we may be headed for recession -- and worse. *Salon*. August 3.

Faux, Jeff, Bruce Campbell, Carlos Salas and Robert Scott. 2006. "NAFTA – Still not working for North America's Workers." Washington, D.C.: Economic Policy Institute. Briefing Paper. Forthcoming.

Mishel, Lawrence, Jared Bernstein and Sylvia Allegretto. 2006. *The State of Working America: 2006/2007*. Washington, D.C.: Economic Policy Institute, forthcoming.

Ratner, David. 2006. "Appendix: Methodology and Data Sources," in Scott (2006). Forthcoming.

Roubini, Nouriel. 2006. "The world must prepare for America's recession," *Financial Times.* August 10, 13.

Scott, Robert E. 2006. "NAFTA Lessons: Agreement's legacy includes rising trade deficits leading to significant job displacement and declining job quality" in Faux, et. al. (2006). Forthcoming

Appendix on Clean EDGE Act Investment Data

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This appendix explains how we calculated the total public and private investment generated by the proposed Clean EDGE Act and allocated these investment figures across industrial sectors using the North American Industry Classification System (NAICS) codes. Our spending calculations focused strictly on sections of the bill with well defined appropriations or reliably predictable outcomes. In this sense, our data are conservative and likely to underestimate total employment benefits.

Methodology

In each provision, federal appropriations were divided by their maximum share of capital cost to assess total investment. For instance, if a particular tax credit could cover a maximum of 20% qualified capital costs, the appropriations were divided by 20%. In some cases, such as bond finance, cost sharing requirements were not specified. We conservatively assumed that there would be no additional investment from the private sector.

In several cases, Clean EDGE provided a goal supported by incentives. Rather than undertaking legislative critique, this study assumes that the incentives will produce the desired outcome. Modeling only federal activity, and not market response, would substantially understate the results.

Once these spending figures were determined, they were annualized using the bill's appropriations guidelines as a basis. Annual spending was estimated to prepare a baseline for comparison with current levels of output and employment in the economy. This report is based on an analysis of spending that would be stimulated by the bill as either appropriations or induced private sector spending. Estimates in 2009, when the program is fully in effect, are used for illustration in this report. This annual spending was allocated to the corresponding NAICS industries to provide inputs for modeling done by the Economic Policy Institute (EPI) of the likely employment impacts of this legislation. EPI used an input-output model developed by the U.S. Bureau of Labor Statistics.

A review of the provisions examined in this study follows.

1. Renewable Energy

The Clean EDGE Act provides many incentives for renewable energy development. This exercise examined just three provisions: The Clean Energy Investment Administration, Clean Renewable Energy Bonds, and an extension of the Section 45 Production Tax Credit. These were chosen because of their clear appropriations or demonstrated history of induced investment. For year 2009, these three programs will leverage over $35 billion in industry investment.

- **The Clean Energy Investment Administration.** This program establishes an independent unit of government instructed to finance renewable energy projects and component manufacturing. The Administration employs loan guarantees as its primary tool, with a $25 billion annual volume cap. The guarantees cover up to 80% of the project costs. Assuming maximum success, the CEIA could attract $31.25 billion into the renewable energy industries each year.

- **The Section 45 Production Tax Credit (PTC).** The Clean EDGE Act extends the $.019/ kWh[1] production tax credit through 2014. This incentive continues to be crucial to clean energy development, particularly for wind. Based on current growth patterns, this study assumes that a Section 45 extension will stimulate an addition of roughly 3,000 MW of wind capacity per year, at a cost of about $3 billion annually. This estimate is conservative for two reasons. First, it only includes wind energy, which can be clearly linked to the PTC. Furthermore, it is based on predicted growth in year 2006. Under an extended PTC scenario, growth in 2009 will likely be larger.

- **Clean Renewable Energy Bonds**. The Clean EDGE Act provides an extension for the Clean Renewable Energy Bonds program, initially established in the Energy Policy Act of 2005. Originally this program provided $800 million in bond finance for tax exempt utilities. The federal government services the bond debt with tax credits, essentially providing interest free loans for renewable energy development.[2] Beginning in 2008, Clean EDGE extends the program through 2013. Each year, $800 million will be available for renewable energy development.

Using these figures, the study turned to analysis by the Renewable Energy Policy Project to estimate the likely distribution between contributing NAICS industries. REPP's work traces investment dollars as they flow to various component and subcomponent manufacturers.[3] Construction was not included the REPP breakouts. For wind construction, we used estimates supplied by construction firm, DH Blattner.[4] Geothermal[5], solar[6], and biomass[7] construction costs were provided through literature review.

2. Flexible Fuel Vehicles

The flex fuel vehicle calculation is based on an interaction between two separate Clean EDGE provisions. The first provides a tax credit for domestically manufactured flex fuel vehicles. The credit can be up to $150 per vehicle. This study uses $100 as a midrange figure. The incentive works in tandem with a second provision which requires increasing market penetration of flex fuel vehicles. By 2020, market penetration must reach 50%. This report assumes that in the early years, the incentive assists domestic manufacturers in meeting the requirement.

To calculate total investment, the study uses the Energy Information Administration's 2009 forecast for new light duty vehicle sales- 17.45 million.[8] Assuming linear progress towards the 2020 goal, Clean EDGE would require 19.5% of new vehicle sales to be flex fuel in 2009. These 1.45 million vehicles were multiplied by 68%, to determine the amount domestic vehicles which would be eligible for the incentive. Finally, this number was multiplied by $100 to measure the added investment for flex fuel components. This produced a $231 million investment for 2009.

3. Renewable Fuel Infrastructure

Estimates of spending associated with development of the renewable fuel infrastructure were provided by the Natural Resources Defense Council (NRDC).[9].

The Clean EDGE Act allows refueling stations which install renewable fuel dispensaries to receive a tax credit of 50% the capital costs with a goal of converting 10% of all filling stations by 2015. This exercise assumes that the incentives are successful and models the result. NRDC reported that there are 167,340 filling stations in the United States. If the goal is met, 16,734 will ultimately begin selling renewable fuel, at a cost of $1.47 billion. Assuming this spending is spread evenly over this period, yields and estimated cost of $180 million in per year. Insufficient information was available to determine whether the extent to which flex-fuel would require major tank replacements or more limited replacements of pumps and related equipment. Therefore, all expenditures for renewable fuel infrastructure were allocated to the construction sector.

4. Integrated Combined Cycle and Gasification/ Advanced Coal

Like renewable energy, total investments for IGCC and advanced coal projects were drawn from several different provisions. Together, these provisions leverage $3.25 billion in annual spending.

- **Clean Energy Coal Bonds.** Section 341 establishes a program which dedicates a total of $1 billion to IGCC and advanced coal projects. While there are no drawdown guidelines, the application period expires in 2010. To that extent, the study assumes that Clean Energy Coal Bonds will provide $250 million each year in funding. No induced spending was assumed for this provision.

- **Extension and Expansion of the Qualifying Advanced Coal Project Credit.** This provision establishes incentives for IGCC, advanced coal and carbon sequestration enabled IGCC. Incentives for sequestration enabled IGCC phase in during 2010 and are not reflected by this analysis. From 2007 through 2009, the provision allocates $800 million in tax credits for construction of IGCC facilities. The incentive covers a maximum of 20% capital costs. Over the three year period, the program also provides $500 million in credits for advanced coal, covering a maximum of 15% of capital costs. In total, these programs will stimulate $7.3 billion in investment or $2.4 billion per year.

- **Expansion of the Qualifying Gasification Credit**. This section provides $1 billion in tax credits for biomass, coal, and petroleum gasification projects. The credits cover up to 20% of project spending. Total spending is therefore assumed to be $5 billion. While the program does not contain annual spending guidelines, the application period runs for ten years. It is therefore assumed that the program stimulates $500 million in economic activity each year.

- **Coal to Liquids**. Section 344 establishes a $300 million grant program for facilities which convert coal to liquid transportation fuels. No cost share is specified and no calculation for induced spending has been attempted. The program is assumed to invest $100 million per year into the industry until expended.

Determination of target industries was accomplished through literature review. Specifically, it was based on prior analysis by the Wadley-Donovan Group. That publication identified top economic opportunities for a tri-county area in Wyoming. The area, consisting of Campbell, Crook, and Weston Counties supplies 25% of the nation's coal. Its combination of human and natural resources make it an ideal location for coal gasification projects.[10] Under the assumption that gasification projects would gravitate towards regions with similar characteristics, the NAICS industries identified in the report were chosen for our scenario. The Wadley-Donovan report did not include construction firms in its analysis. Prior modeling by the Perryman Group[11] suggests that much of the investment costs for advanced coal technologies are directed towards construction. To that extent, the study incorporates construction activity as well.

*5. **Transit Investments***

Transit investments were derived through Section 421. That section provides $3 billion per year in bond finance for a variety of fuel reduction measures. Transportation activities make up a significant portion of these. A number of other activities such as renewable fuel infrastructure are already supported by other provisions in this Act. This study therefore directs 75% ($2.25 billion) of Section 421's bond finance to transit activities. No cost share is assumed.

The associated NAICS industries were attained from 2006 analysis for South Florida.[12] For FY 2006, Broward County Mass Transit Division identified, by NAICS industry, the universe of businesses which could participate in mass transit projects. The Division also estimated the percentage of total funding that each NAICS industry would capture. It is understood that extrapolating these regional estimates to the nation will not produce exact results. However, this study assumes that there are sufficient similarities between the nation's transit systems to yield a sense of what might be achieved.

6. Research and Design

Research and design funding is well defined by the bill. This study examines three separate R&D programs which include clean energy research, vehicle research, and coal research. The provisions include:

- **The Office of Advanced Energy Research, Technology Development and Deployment**. Established in Section 501, the Office of Advanced Energy Research, Technology Development and Deployment funds research into clean energy, electrical reliability, petroleum reduction, energy efficiency and greenhouse gas reduction. The provision will provide $2 billion in research funding for 2009.

- **The Near Term Vehicle Technology Program.** Section 505's vehicle technology research program funds R&D for advanced batteries, charging components, plug-in

hybrid vehicles, drive train components, electrical refueling infrastructure, and fuel cell technology. It is funded at $600 million each year.

Collectively, these programs establish $2.6 billion in 2009 R&D funding. The sum was directed to NAIC industries 5417 and 5413. These sectors represent energy research and engineering development respectively. It is highly likely that a significant research initiative will also drive demand for new facilities. To estimate the construction requirements for similar activities, we examined the annual budget for the Department of Energy's Basic Energy Sciences research program for three consecutive years. On average, 23% of total budget was directed towards construction.[13] This study assumes similar demands for facilities construction. The remaining funds were divided equally between NAIC industries 5417 and 5413.

7. Hybrid and Advanced Diesel (HAD) Retooling and Production Incentives

The Clean EDGE Act encourages manufactures which retool their plants for advanced vehicle production. The incentives directed towards these activities are found in two separate provisions.

- Section 511 provides an investment tax credit for manufactures which convert their facilities to produce advanced vehicles. The credit can equal up to one third of the qualified investment.

- Section 421 establishes Freedom from Fossil Fuels Bonds. Collectively, these bonds provide $3 billion per year for a variety of oil savings activities. This study assumes that $75 million annually.

Investments in HAD vehicle retooling and production that would be stimulated by measures in the Clean EDGE Act were derived from estimates in a study prepared by the University of Michigan's Transportation Research Institute (Tables referenced below refer to the UMTRI study).[14] This study assumes that sales of HAD vehicles will rise from 77,408 units in 2003 to 1,143,400—1,843,400 units in 2009. The vast majority of these vehicles and components would be imported in the (79% to 82%) UMTRI baseline, reducing demand for U.S. labor (Table 10).

The UMTRI study assumed that retooling and other incentives would switch production of 210,370 units to the U.S. by 2009 (Table 23). These vehicles would be produced in a mix of domestic and foreign-owned transplant facilities. Approximately 13.4% of these vehicles would be hybrids and the remainder (86.6%) would be diesels (Tables 5 and 8).[15] Mid-range estimates for the full incremental cost of the HAD powertrains were $3,625 for Hybrids and $4,360 for advanced diesel units (Tables 11 and 12). It was estimated that the full value of these vehicles was approximately 7.5 times the cost of the advanced powertrain.[16] Thus the full value of a hybrid vehicle was estimated as $26,438, and the advanced diesel was $32,700 per unit.

The production shares cited above were used to calculate the numbers of each type of vehicle that would be produced in the U.S., rather than abroad, with the HAD vehicle incentive program. Assuming 70% weighted average vehicle content (p. 35), the full annual value of domestic output (domestic content only) was a projected $4.7 billion. In addition, the UMTRI study

estimated that annual capital expenditures induced by the program would range between $300—$600 million. Taking an average of those two yields expected capital expenditures of $450 million per year. Of this, it was assumed that the retooling expenditures ($450 million) would take place in the machine tool industry (NAICS 3332), and the vehicle output would originate in the motor vehicle sector motor vehicle manufacturing sector (NAICS 3361).[17]

Appendix Endnotes

[1] 26 USC 45. An overview of the incentive and its history can be found at the Database of State Incentives for Renewable Energy. http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=US13F&State=Federal&currentpageid=1&ee=1&re=1

[2] For legislative language, see section 1303 of EPAct 2005. http://frwebgate.access.gpo.gov/cgi-bin/useftp.cgi?IPaddress=162.140.64.21&filename=h6enr.pdf&directory=/diskb/wais/data/109_cong_bills

[3] George Sterzinger and Matt Svrcek. Component manufacturing: Ohio's Future in the Renewable Energy Industry. Renewable Energy Policy Project. 2005.

[4] Personal communications with Windustry, a wind energy development group. Pursuant to communications, Windustry obtained information from DH Blattner.

[5] Cédric Nathanaël Hance. Factors Effecting Cost of Geothermal Power Development. Geothermal Energy Association. 2005.

[6] George Sterzinger and Matt Svrcek. Solar PV Development: Location of Economic Activity. Renewable Energy Policy Project. 2005.

[7] Wayne Curtis et al. *The Feasibility of Generating Electricity from Biomass Fuel Sources in Georgia.* University of Georgia Department of Agricultural and Applied Economics. 2003.

[8] http://www.eia.doe.gov/oiaf/aeo/excel/yearbyyear.xls

[9] Private Communication, Mark Seaman, NRDC.

[10] Primary Target Industries, Wyoming Zone 1. Wadley-Donovan Group. 2005.

[11] The Apollo Alliance. New Energy for America. CAF/ COWS. 2004.

[12] Broward County Mass Transit Division. Goals/ Methodology FY 2006.

[13] Department of Energy. FY 2005 Statistical Table by Appropriation.

[14] Hammet, Patrick, Michael Flynn, Maitreya Kathleen Sims and Daniel Luria. 2004. "Fuel-Saving Technologies and Facility Conversion: Cost, Benefits and Incentives." Ann Arbor, MI: University of Michigan's Transportation Research Institute. 2004.

[15] The assumptions and analysis of scenarios discussed here were not transparent in the UMTRI report. In many cases are range of estimates were cited that were not fully explained. A number of simplifying assumptions were made here in order to develop the estimates used in this report.

[16] UMTRI, op cit. Note 12, p. 28 estimates that the full value of an assembled vehicle is "3 to 12 times that of a HAD powertrain." A midpoint estimate was used here.

[17] While a small portion of the value of the incremental vehicle production would take place in other sectors such as batteries and electric motors, there was insufficient information to provide further breakdowns of the incremental spending in those sectors.