National Heavy Duty Truck Transportation Efficiency Macroeconomic Impact Analysis

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May 2010

Summary of Findings

Implementing policies to accelerate the development and adoption of medium and heavy-duty truck fuel efficiency technologies between 2010 and 2030 (above a reference case scenario) will result in increased truck investment costs and net fuel cost savings. The investments and savings are detailed in the Union of Concerned Scientists' Climate 2030: A National Blueprint for a Clean Energy Economy. Utilizing these investments and savings, this current study analyzed the net macro economic impacts that result; including the change in national employment, wage and salary income, and national gross domestic product. The key findings include,

- Significant fuel cost savings by trucking companies and consumer savings on product shipping costs
- a net increase of 63,000 jobs economy-wide in 2020 and 124,000 in 2030;
- wage and salary income increases of $3.4 billion in 2020 and $8.4 billion in 2030
- GDP increases of $4.2 billion in 2020 and $10.4 billion in 2030.
- Service, manufacturing, retail, insurance and real estate, and financing sectors see the largest employment increases while petroleum-related employment decreases.
- A state-by-state breakdown shows employment gains are distributed widely throughout the country, with net job growth shown in every state.

Introduction

In this analysis, the impacts on the US economy from investments in fuel efficiency technologies in the medium and heavy-duty trucking sector are evaluated. The Union of Concerned Scientists (UCS) published a comprehensive national blueprint in May of 2009 evaluating the potential to reduce global warming emissions through 2030 across all sectors of the US economy, including those from medium and heavy-duty vehicles. The study assumes additional national and/or state policies, such as standards, are put in place to support the development and adoption of fuel efficiency technologies for trucks. The medium and heavy-duty truck investment costs and fuel savings from the UCS study are used as the inputs for this economic analysis. Table 1 shows the incremental investment costs and fuel savings for truck efficiency technologies that occur above the reference case (no standards) scenario in 2020 and 2030.

Table 1. National Transportation Analysis
Technology Investment Costs and Savings for Medium and Heavy-Duty Trucks
(Above the Reference Case)

	2020 Medium and Heavy-Duty Trucks ($Billion)	2030 Medium and Heavy-Duty Trucks ($Billion)
Incremental Investments in Fuel Efficiency	$4.7	$13.5
Fuel Cost Savings	$14.6	$37.0

Source: Union of Concerned Scientists, *Climate 2030: A National Blueprint for a Clean Energy Economy*, May 2009. All figures are in billions of 2006 dollars.

Methodology for Deriving National Macro Economic Impacts

To derive the economic and employment impacts from the UCS Blueprint Heavy Duty Truck Transportation scenario we began with the actual investments in vehicle efficiency and the changes in motor fuel expenditures brought about by these investments. Once the gains and losses were sorted out in each industry sector, we then evaluated the net benefits or impacts to the nation's overall economy. This includes: 1) the net contribution to the employment base (jobs); 2) the net gain in wage and salary compensation, measured in millions of year 2006 dollars; and 3) the net contribution to Gross Domestic Product (GDP), also measured in millions of year 2006 dollars.

These three impacts were evaluated using data derived from the IMPLAN V3.0 software. IMPLAN is an input-output (I-O) model that identifies interactions between all sectors of the economy. The model incorporates interactions among 440 industrial sectors to trace supply linkages and evaluate how changes in spending affect employment, wages, and gross domestic product (GDP). For each of the benchmark years (2020 and 2030), each change in an industry's spending pattern is matched to an appropriate industry multiplier.

Input-output models were initially developed to trace supply linkages in the economy. Thus, the impacts generated from the UCS Blueprint Heavy Duty Truck Transportation Scenario depend on the structure of the economy. For example, I-O models can show how increasing purchases of more efficient trucks not only directly benefit the truck manufacturers, but also benefit those industries that provide inputs (i.e., goods and services) to these manufacturers. I-O models can also be used to show the benefits from indirect economic activity that occurs as a result of these transactions (e.g., banking and accounting services, among others) and the spending of fuel savings throughout the economy. Therefore, spending on more fuel efficient trucks has an effect on total employment, income (i.e., wage and salary compensation), and GDP.

For each industry sector within the economy we utilized multipliers that identify the employment and economic activity generated from a given level of spending in each sector. Changes in expenditures are matched with appropriate multipliers. For instance, employment multipliers show the number of jobs that are directly and indirectly supported for each one million dollars of expenditure in a specific sector. For this analysis, a job is defined as sufficient wages to employ one person full-time for one year in a given sector.

The analysis in this study includes several assumptions and adjustments to the methodology of matching expenditures and multipliers.

First, it was assumed that fuel efficiency improvements are a part of all new truck purchases.

Second, we made an adjustment in the employment impacts to account for future changes in labor productivity in specific sectors. Utilizing data from the Bureau of Labor Statistics *Economic and Employment Projections 1998, 2008 and 2018*, we developed productivity trends for our analysis. These trends suggest that productivity rates are expected to vary widely among sectors. Annual productivity gains are forecast to range from little if any change in the education sectors to over 4.0 percent annual productivity gain in the medium and heavy-duty truck manufacturing sectors.

Third, we assumed that 80 percent of the investments in new more fuel-efficient vehicles will be financed by bank loans carrying an average 6 percent interest rate over a five year period.[1] No parameters were established to account for changes in interest rates or in labor participation rates. While a demand for labor may tend to increase the overall level of wages (and potentially lessen economic activity), the employment benefits from the scenario are relatively small compared with the national level of unemployment or underemployment.

Fourth, we distributed the projected fuel savings (dollars) between the trucking industries and fleets (where the fuel savings are occurring) and consumers. Fuel prices from UCS's Blueprint modeling were used for calendar years 2020 and 2030These savings are then available for investment and spending in the economy. The analysis assumes 50 percent of the savings benefit the trucking industry and fleets directly and 50 percent are passed on in the form of lower shipping costs and the resulting lower costs of goods. The lower costs for goods represent savings for consumers and ultimately more disposable income. A sensitivity analysis, described later in this document, was performed to quantify the impact of different assumptions about retention of fuel savings.

[1] No industry-wide financing references were found. However an internet search revealed interest rates for individual truck buyers in the range of 7 to 12 percent. Individual truck buyers generally pay higher interest rates on truck purchases while larger fleets may have access to more financing options and lower interest rates. The 6 percent rate was chosen to reflect this.

Methodology for Deriving State-by-State Employment Impacts

The distribution of the national employment impacts across the states is difficult to predict. Some impacts are associated with the direct expenditures made for more fuel-efficient medium and heavy-duty trucks while others are associated with the spending of fuel savings associated with driving these trucks.

To take these factors into account, we developed indicative estimates of the distribution of the net national jobs gained across the fifty states and the District of Columbia. Absent a more detailed analysis of each individual state or region, the authors utilized a methodology incorporating the national impacts and a weighting of key variables to accomplish an overall state-by-state assessment. The key variables associated with the fuel savings analysis include: differences in distillate fuel oil energy prices in each state and the level of transportation energy consumed for each dollar of economic activity in the state. . The key variables associated with the direct expenditure analysis include: the number of state jobs in the respective industries as a percent of national employment projected for the respective years.

With the inherent uncertainties related to making these types of projections and then distributing national impacts to individual states, the methodology employed in this study reflects an averaging of two procedures. The first is a scaling of the national net employment changes for the respective years for each state and industry sector analyzed. We utilize employment projections from the Bureau of Labor Statistics to derive the results. This analysis assumes the impacts are distributed based on each state's industry share of employment. It captures the approximate supply impacts on energy producing states as well as industry demand for goods and services from the spending on higher efficiency vehicles and spending of fuel savings.

The second procedure relies more heavily on motor fuel use and price parameters to allocate net energy savings and then estimate the net employment changes. First, we derive the changes in diesel fuel consumption for each of the states as a function of energy/gross state product and average energy prices in 2007. Then, utilizing the proportional shares of the national ratios for this same data, and the overall employment impacts from the national analysis, we apply coefficients from a regression analysis of these factors to derive the net jobs for each state.

Given the significant transportation related energy and economic differences among the states and the strengths and weaknesses associated with the two procedures, we then average the two results. Similar to the national impacts, the state specific impacts are not intended to be precise forecasts of what will occur, but rather approximate estimates of overall impact. To further assess the industry sector-specific job impacts for each of the states would require significantly more analysis, well beyond the scope of the present study.

Macroeconomic Results

The investment and savings data from the national transportation scenario were used to estimate three sets of impacts for the years 2020 and 2030. These included: net

employment impacts, net change in wage and salary income (in 2006 dollars) and net change in gross domestic product (in 2006 dollars). Table 1 provides a summary of the national impacts. The impacts are positive in each year, in each of the categories. Employment gains range from 63,380 in 2020 to 123,540 in 2030. Income and GDP show similar gains, reaching $8.4 billion and almost $10.4 billion (in 2006 dollars), respectively in 2030.

Table 2. National Transportation Analysis
Summary Impacts - Medium and Heavy-Duty Trucks

Year	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
2020	63,380	$3,361	$4,236
2030	123,540	$8,406	$10,377

Note: All figures are in millions of 2006 dollars.

Tables 2 and 3, on the following pages, show how each of the major industry sectors are affected in 2020 and 2030. As noted previously, the results are not intended to be precise forecasts, but rather approximate estimates of the overall impact.

Table 3. National Transportation Analysis 2020 Impacts
Medium and Heavy-duty Trucks

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Services	31,130	$1,542	$2,009
Other Manufacturing	12,800	$1,456	$1,990
Retail	9,590	$371	$609
Insurance/Real estate	5,870	$257	$1,342
Finance	4,570	$600	$923
Education	3,000	$95	$105
Transportation, Communication, and Public Utilities	2,170	$190	$314
Durable Metals	1,800	$124	$190
Agric/Forestry	1,790	$38	$95
Food	1,000	$57	$105
Trucking	870	$48	$67
Primary Metals	700	$67	$105
Pulp and Paper	260	$29	$38
Electric Utilities	220	$48	$162
Mining	170	$19	$38
Stone, Glass and Clay	150	$10	$19
Natural Gas Utilities	80	$10	$29
Petroleum Refining	(70)	($29)	($38)
Construction	(610)	($29)	($29)
Government	(1,190)	($86)	($105)
Wholesale Trade	(3,000)	($314)	($533)
Oil & Gas Extraction	(7,920)	($1,142)	($3,199)
Total	63,380	$3,361	$4,236

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding.

Table 4. National Transportation Analysis 2030 Impacts
Medium and Heavy-Duty Trucks

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Services	67,790	$3,856	$5,008
Other Manufacturing	22,010	$3,684	$5,007
Retail	17,380	$942	$1,552
Insurance/Real estate	13,170	$647	$3,389
Finance	8,270	$1,618	$2,485
Education	7,610	$238	$257
Transportation, Communication, and Public Utilities	4,160	$486	$771
Agric/Forestry	3,660	$95	$228
Durable Metals	2,930	$238	$371
Food	2,180	$152	$257
Trucking	1,640	$124	$171
Primary Metals	1,070	$124	$190
Pulp and Paper	510	$57	$86
Electric Utilities	410	$114	$381
Mining	270	$29	$67
Stone, Glass and Clay	260	$19	$29
Natural Gas Utilities	190	$29	$76
Petroleum Refining	(130)	($67)	($105)
Construction	(1,650)	($76)	($86)
Government	(2,870)	($209)	($267)
Wholesale Trade	(5,330)	($800)	($1,380)
Oil & Gas Extraction	(20,090)	($2,894)	($8,111)
Total	123,540	$8,406	$10,377

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding.

As might be expected, the oil and gas extraction industries and the petroleum related industries (including wholesale trade which delivers bulk petroleum and government which receives tax revenues from petroleum sales) incur losses in jobs, income and contribution to GDP. These negative employment impacts and the economic losses must be tempered somewhat as the industries and the overall economy undergo restructuring and there is a redistribution of jobs and future occupational tradeoffs.

The tables also show five industries that incur significant gains both in 2020 and 2030 and others that incur more modest gains. The services industry has the largest gain (approximately 45% of the total gains - of those industries showing gains in 2030) because it is the industry that benefits the most from both the trucking industry spending of their fuel savings and consumers spending their savings from lower costs of goods. The other industries that show significant gains include: other manufacturing (which includes a broad array of manufacturing industries including heavy duty truck manufacturing), retail, and insurance/real estate. The retail and insurance/real estate industry gains are primarily from consumer spending. The large gains in manufacturing are primarily associated with spending from the trucking industry and fleets.

Sensitivity Analysis

As with any analysis of this type and scope the assumptions used play an important role in influencing the results. Similarly, there is some uncertainty regarding exactly who will ultimately benefit directly from fuel savings in the trucking industry and in fleets and how the dollar savings will be spent. To better understand how changes in spending influence the results of the efficiency analysis we ran a sensitivity analysis of the macroeconomic impacts derived in this study.

The first sensitivity assumes all fuel savings are retained and spent by the trucking industry and fleets. In this case the analysis assumes the trucking companies and fleets need the added profit to stay in business and/or do not need to lower their costs to remain competitive; thus fuel savings are not passed on as lower transportation costs or as lower cost of goods.

The second sensitivity assumes all fuel savings are passed on. In this case the analysis assumes the trucking companies and fleets pass on the savings to remain competitive. This results in lower costs for goods (reflecting lower transportation costs) and then additional spending by consumers. The two effects were modeled separately with the results shown in Table 4.

Table 4 indicates that regardless of who receives and spends the fuel savings, the analysis results in positive benefits for the national economy. In 2030, the benefits range from an employment gain of 68,270 (with 100 percent spending by the trucking industry) to 178,810 (with 100 percent spending by consumers). Spending of fuel savings by the trucking industry results in gains in almost all industries (with the exception of the petroleum related as noted previously) although three industries show the largest gains. These include: other manufacturing, services, and durable metals manufacturing.

Spending of all fuel savings by consumers results in significantly larger gains and in more sectors of the economy. This is due to the varied consumer spending patterns relative to that of the trucking industry. Similar to the results reported in this study, the services and retail sectors show the most significant gains; however, in this sensitivity analysis, these two industries combined account for a larger share, over 75 percent of the total gains (i.e., all industries showing gains, not including those showing losses). Among other industries showing gains well above those of the trucking industry only spending analysis, are the education sectors, the agricultural sectors and food manufacturing industries.

Table 5. Sensitivity Analysis of National Transportation Analysis Medium and Heavy-duty Trucks

Scenario	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Results Reported in this Study			
Shared Spending of Fuel Savings (50% Trucking Industry 50% Consumers)			
2020	63,380	$3,361	$4,236
2030	123,540	$8,406	$10,377
Sensitivity Analysis A			
Consumers Only Spending of Fuel Savings (100%)			
2020	87,720	$3,646	$5,360
2030	178,810	$9,073	$13,280
Sensitivity Analysis B			
Trucking Industry Only Spending of Fuel Savings (100%)			
2020	39,090	$3,113	$3,104
2030	68,270	$7,768	$7,492

Note: All dollar values are 2006 dollars.

See Appendix for sensitivity results by industry.

State-by-State Employment Impacts

With the national impacts established from the medium and heavy-duty truck transportation efficiency base analysis, we see significant net employment gains. Providing state-by-state estimates of state level impacts provides additional insight into the benefits of these policy and investment initiatives. In Table 6 we see that the benefits are widely distributed throughout the country and the employment gains are positive in all states for both years analyzed. In those states with a large share of the nation's oil and petroleum related industries the industry losses (noted earlier) are offset by gains from spending of fuels savings primarily in other industry sectors. In 2020, the gains range from a low of 110 jobs in Vermont to a high of 6,820 jobs in California. By 2030, the gains range from a low of 230 jobs in Vermont to a high of 13,650 jobs in California.

Table 6. National Transportation Analysis
State-by-State Employments Impacts

State	Net Job Gain 2020	Net Job Gain 2030	State	Net Job Gain 2020	Net Job Gain 2030
Alabama	1,090	2,120	Montana	330	640
Alaska	190	330	Nebraska	490	970
Arizona	1,120	2,240	Nevada	480	970
Arkansas	750	1,440	New Hampshire	220	450
California	6,820	13,650	New Jersey	1,660	3,330
Colorado	850	1,640	New Mexico	440	820
Connecticut	700	1,400	New York	3,000	6,010
Delaware	140	280	North Carolina	1,910	3,720
District of Columbia	150	330	North Dakota	250	490
Florida	3,260	6,570	Ohio	2,980	5,730
Georgia	1,990	3,960	Oklahoma	750	1,240
Hawaii	310	630	Oregon	870	1,720
Idaho	320	640	Pennsylvania	2,680	5,300
Illinois	2,770	5,440	Rhode Island	170	340
Indiana	2,140	4,080	South Carolina	960	1,880
Iowa	810	1,590	South Dakota	210	410
Kansas	550	1,000	Tennessee	1,540	3,020
Kentucky	1,210	2,350	Texas	4,570	8,150
Louisiana	810	1,420	Utah	620	1,230
Maine	260	530	Vermont	110	230
Maryland	1,000	2,020	Virginia	1,640	3,260
Massachusetts	1,190	2,430	Washington	1,490	2,970
Michigan	2,130	4,040	West Virginia	320	590
Minnesota	1,230	2,430	Wisconsin	1,390	2,700
Mississippi	710	1,350	Wyoming	290	520
Missouri	1,500	2,940	U.S. Total	63,380	123,540

References (noted in text):

Minnesota IMPLAN Group Inc., IMPLAN V 3.0 software, *(http://implan.us/v3/), 2009.*

U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Output by Industry, 1998, 2008, and Projected 2018.* 2009.

U.S. Department of Commerce, Bureau of Economic Analysis (BEA), Gross State Product, 2007. 2009.

U.S. Department of Energy, Energy Information Administration, *Transportation Sector Energy Consumption Estimates 2007*. 2009.

U.S. Department of Energy, Energy Information Administration, *Transportation Sector Energy Expenditure Estimates by Source, 2007*. 2009

Union of Concerned Scientist, *Climate 2030: A National Blueprint for a Clean Energy Economy*, 2009

Appendix A: Sensitivity Analysis Industry Data Tables.

Table A1. National Transportation Analysis 2020 Summary Results
100% of Fuel Savings Retained by Trucking Companies

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Other Manufacturing	22,750	$2,580	$3,580
Services	10,040	$495	$647
Durable Metals	7,020	$476	$762
Primary Metals	3,030	$305	$457
Finance	2,930	$381	$590
Transportation, Communication, and Public Utilities	1,180	$105	$171
Trucking	1,050	$67	$86
Mining	680	$67	$152
Stone, Glass and Clay	570	$38	$67
Agric/Forestry	540	$10	$29
Insurance/Real estate	440	$19	$105
Pulp and Paper	400	$38	$57
Retail	230	$10	$19
Electric Utilities	190	$38	$133
Natural Gas Utilities	130	$19	$48
Food	90	$10	$10
Education	10	$0	$0
Petroleum Refining	(80)	($29)	($48)
Construction	(510)	($29)	($29)
Government	(1,310)	($95)	($114)
Wholesale Trade	(2,360)	($248)	($419)
Oil & Gas Extraction	(7,930)	($1,142)	($3,199)
Total	39,090	$3,113	$3,104

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding. All fuel savings spent by Trucking industry.

Table A2. National Transportation Analysis 2030 Summary Results
100% of Fuel Savings Retained By Trucking Industry

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Other Manufacturing	39,590	$6,531	$9,035
Services	21,140	$1,200	$1,561
Durable Metals	14,100	$1,133	$1,809
Primary Metals	6,010	$724	$1,085
Finance	5,480	$1,066	$1,647
Transportation, Communication, and Public Utilities	2,200	$257	$409
Trucking	1,990	$152	$200
Mining	1,440	$171	$352
Stone, Glass and Clay	1,220	$95	$152
Agric/Forestry	1,070	$29	$67
Insurance/Real estate	970	$48	$248
Pulp and Paper	820	$95	$133
Retail	390	$19	$38
Electric Utilities	340	$95	$314
Natural Gas Utilities	320	$57	$124
Food	180	$10	$19
Education	20	$0	$0
Petroleum Refining	(140)	($76)	($124)
Construction	(1,380)	($67)	($76)
Government	(3,170)	($238)	($295)
Wholesale Trade	(4,210)	($638)	($1,085)
Oil & Gas Extraction	(20,110)	($2,894)	($8,121)
Total	68,270	$7,768	$7,492

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding. All fuel savings spent by Trucking industry.

Table A3. National Transportation Analysis 2020 Summary Results
100% of Fuel Savings Passed to Consumers

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Services	52,220	$2,589	$3,361
Retail	18,940	$733	$1,209
Insurance/Real estate	11,300	$495	$2,580
Finance	6,210	$819	$1,257
Education	6,000	$190	$200
Transportation, Communication, and Public Utilities	3,170	$286	$457
Agric/Forestry	3,050	$67	$152
Other Manufacturing	2,850	$333	$409
Food	1,920	$114	$200
Trucking	700	$38	$57
Electric Utilities	260	$57	$181
Pulp and Paper	110	$10	$19
Natural Gas Utilities	30	$10	$10
Petroleum Refining	(60)	($19)	($38)
Stone, Glass and Clay	(270)	($19)	($29)
Mining	(350)	($38)	($76)
Construction	(720)	($38)	($38)
Government	(1,060)	($76)	($95)
Primary Metals	(1,620)	($162)	($248)
Durable Metals	(3,410)	($228)	($371)
Wholesale Trade	(3,640)	($371)	($647)
Oil & Gas Extraction	(7,910)	($1,142)	($3,189)
Total	87,720	$3,646	$5,360

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding. All fuel savings spent by consumers.

Table A4. National Transportation Analysis 2030 Summary Results
100% of Fuel Savings Passed to Consumers

Industry	Net Jobs (Actual)	Net Change in Wage and Salary Income ($Million)	Net Change in Gross Domestic Product ($Million)
Services	114,430	$6,512	$8,444
Retail	34,370	$1,866	$3,065
Insurance/Real estate	25,360	$1,257	$6,531
Education	15,200	$476	$514
Finance	11,060	$2,161	$3,332
Agric/Forestry	6,260	$171	$390
Transportation, Communication, and Public Utilities	6,110	$714	$1,133
Other Manufacturing	4,630	$838	$990
Food	4,190	$295	$495
Trucking	1,300	$95	$133
Electric Utilities	470	$133	$447
Pulp and Paper	200	$29	$38
Natural Gas Utilities	70	$10	$29
Petroleum Refining	(110)	($57)	($95)
Stone, Glass and Clay	(710)	($57)	($86)
Mining	(900)	($105)	($219)
Construction	(1,920)	($95)	($105)
Government	(2,580)	($190)	($238)
Primary Metals	(3,880)	($466)	($704)
Wholesale Trade	(6,440)	($971)	($1,666)
Durable Metals	(8,240)	($657)	($1,057)
Oil & Gas Extraction	(20,060)	($2,885)	($8,092)
Total	178,810	$9,073	$13,280

Note: All dollar values are 2006 dollars. Individual column totals may not add up due to independent rounding. All fuel savings spent by consumers.