Energy Efficiency and Job Creation

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Executive Summary: Numerous studies have examined the energy, economic, and environmental impacts of a national energy strategy that emphasizes greater energy efficiency. *America's Energy Choices*, for example, showed that vigorous adoption of cost-effective energy efficiency and renewable energy measures could reduce national energy intensity in 2030 by nearly 50%, dramatically reduce our nation's petroleum dependence, save consumers more than $2 trillion net over the next 40 years, and cut carbon dioxide emissions in 2030 by more then 70% relative to emissions in 1988.[1] However, *America's Energy Choices* and similar studies only consider direct economic impacts -- the cost of energy efficiency measures and the value of the energy savings.

The purpose of this study is to build on *America's Energy Choices* by analyzing the indirect economic benefits of a high efficiency energy strategy -- the impacts on employment and income that could result from shifting economic activity away from the energy supply sectors of our economy and from reducing the cost of energy services. We compare a High Efficiency scenario for all end-use sectors of the economy to a Reference, business-as-usual scenario.[2]

We also examine the employment and income impacts that result solely from improving the fuel economy of automobiles and light trucks.

The analysis is conducted using an input-output economic model. Dividing the economy into 25 sectors, the input-output model estimates the overall employment and income effects from changes in spending patterns in particular sectors.[3] The changes consist of investments in energy efficiency measures and reductions in energy consumption and thus energy bills. The model accounts for direct (i.e., on-site) effects, indirect (i.e., supplier) effects, and induced (i.e., respending) effects from investments and expenditures at all levels.

The High Efficiency scenario assumes extensive efficiency improvements in all sectors of the economy--more efficient vehicles, improved appliances, better insulated buildings, more efficient lighting, manufacturing improvements, and the like. All of the efficiency measures are cost effective on a life-cycle basis considering only direct energy costs (i.e., without quantifying and taking into account externalities). The additional investment in energy efficiency measures in the High Efficiency scenario averages about $46 billion per year during 1992-2010. These investments result in about 20% less energy consumption in 2010 compared to the Reference scenario, with absolute energy consumption rising slightly during 1992-2000, but then declining slightly during 2001-2010. Energy use per unit of GDP falls 2.4% per year on average during 1990-2010 in the High Efficiency scenario. This rate nearly matches the decline in energy intensity in the United States during 1973-86. We also estimate a 24% reduction in carbon dioxide (CO_2) emissions, 14% reduction in nitrogen oxides (NO_x) emissions and 5% reduction in sulfur dioxide (SO_2) emissions in 2010 in the High Efficiency scenario relative to the Reference scenario.

Based on our input-output analysis, the High Efficiency scenario leads to more jobs, higher personal income, and marginally higher GDP throughout the twenty-year period (see Table S-1). We estimate that about 293,000 new jobs could be created by 1995, 471,000 new jobs by 2000, and nearly 1.1 million jobs by 2010 on a net basis. The addition of 1.1 million jobs in 2010 represents approximately a 0.7% increase in the projected employment level that year (see Figure S-1). Likewise, the rise in personal income during the twenty-year period in the high efficiency case reaches 0.5% by 2010, while the increase in GDP is less than 0.1%.

The positive employment and income results are due primarily to the relatively low labor intensity of the energy sectors (coal, oil and gas extraction, fuel refining, and electric and gas utilities) compared to the economy as a whole. Conserving energy reduces the energy bills paid by consumers and businesses, thereby enabling greater purchase of non-energy goods, equipment, and services. The result is a shift of economic activity away from energy supply industries and towards sectors of the economy which employ more workers per dollar received. Regarding the different effects, less than 10% of the net jobs created are associated with direct investment in efficiency measures while more than 90% are associated with energy bill savings and respending of those savings.

Most sectors of the economy gain jobs and generate additional income while a few sectors lose jobs and generate less income in response to widespread energy efficiency improvements (see Table S-2). Our analysis shows the largest absolute increase in jobs is in the construction, retail trade, and services industries. These sectors install energy efficiency measures and gain new business orders from the respending of energy bill savings.

As expected, the energy supply industries employ fewer workers in the High Efficiency scenario as compared to the Reference scenario. The oil and gas extraction industries and gas utilities lose the most workers in percentage terms. It is important to recognize that the projected job losses in Table S-2 are based on comparison with the Reference scenario. Considering the projected change in the actual employment levels between 1990 and 2010, a total of about 200,000 jobs

could be lost in the five energy sectors by 2010 in the High Efficiency scenario. These potential job losses are due primarily to expected productivity improvements, not to changes in absolute energy use during 1990-2010. In addition, individual companies may be able to reduce any adverse jobs impacts by diversifying into the energy efficiency field (e.g., if utilities hire workers to implement energy efficiency programs).

Efficiency improvements solely in automobiles and light trucks also yield favorable jobs and income results. In the Vehicle Efficiency scenario, we assume that the average rated fuel economy of new cars increases from 28 miles per gallon in 1990 to 40 miles per gallon in 2000 and then to 50 miles per gallon by 2010, with equivalent percentage improvements in the fuel economy of light trucks. Compared to the Reference scenario, the Vehicle Efficiency scenario produces 72,000 and 244,000 more jobs in the overall economy by 2000 and 2010, respectively. About 20% of the net increase in jobs is within the motor vehicle industry itself. Furthermore, we find that there is a net gain in jobs in the nation as a whole even if there is either a moderate increase in the fraction of vehicles that are imported or a slight drop in vehicle sales at the same time that fuel economy increases. Conversely, a decrease in import share or an increase in vehicle exports would yield even more new jobs than indicated above.

The results of this study are consistent with other input-output studies that examine how energy efficiency improvements affect employment levels. These other studies, which consider more limited efficiency investments and/or geographic coverage, indicate that specific energy efficiency measures or programs create more jobs at the regional or state level as compared to energy supply projects.

In conclusion, this study adds a new dimension to the national debate over energy priorities. Energy efficiency improvements lead to more jobs and higher personal income at the national level, in addition to saving consumers money, reducing energy imports, and cutting pollutant emissions associated with energy supply. In terms of energy policy objectives, it is unnecessary to choose either economic benefits and jobs on the one hand or environmental protection on the other. We can create more jobs **and** better protect the environment by adopting policies that enhance energy efficiency. Given the economic, energy, and environmental challenges that our nation faces, can we afford not to act?
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Table S-1. Summary of Input-Output Analysis

	1990	1995	2000	2005	2010
Reference Scenario					
GDP (Billion 1990$)	$5,514	$6,205.6	$6,993.0	$7,889.7	$8,911.1
Jobs (Thousands)	122,600	129,273	136,494	144,273	152,650
Income (Billion 1990$)	$3,290	$3,712.4	$4,192.9	$4,741.0	$5,366.3
Energy (Quads)	85.02	90.49	95.61	101.20	106.10
Btu/GDP (1990$)	15,419	14,582	13,672	12,827	11,906
High Efficiency Scenario					
GDP (Billion 1990$)	$5,514	$6,206.6	$6,993.8	$7,891.2	$8,914.8
Jobs (Thousands)	122,600	129,566	136,965	145,049	153,737
Income (Billion 1990$)	$3,290	$3,719.0	$4,203.6	$4,761.2	$5,394.8
Energy (Quads)	85.02	87.14	88.07	87.06	85.35
Btu/GDP (1990$)	15,419	14,040	12,593	11,033	9,574
Net Efficiency Gains					
GDP (Billion 1990$)	n/a	1.0	0.8	1.5	3.7
Jobs (Thousands)	n/a	293.0	471.0	776.0	1,087.0
Income (Billion 1990$)	n/a	6.6	10.7	20.2	28.5
Energy (Quads)	n/a	-3.4	-7.5	-14.1	-20.8
Btu/GDP (1990$)	n/a	-542.0	-1,079.0	-1,794.	-2,332.0

Table S-2. Differences in Employment Levels in 2010, High Efficiency vs. Reference Scenario

Sector	Net Job Changes	Percent Change
Subtotal Gains	1,503,088	n/a
Construction	342,101	4.4%
Retail Trade	197,491	1.1%
Services	152,264	0.3%
Agriculture	118,569	3.6%
Restaurants	105,259	1.3%
Health Services	91,651	0.8%
Finance, Insurance, Real Estate	77,931	0.8%
Non-Durable Goods	73,589	0.8%
Other Manufacturing	72,824	1.1%
Motor Vehicles	53,587	6.2%
Wholesale Trade	44,644	0.5%
Hotels and Lodging	34,404	1.4%
Food Processing	27,270	1.8%
Stone, Glass, Clay	26,403	4.1%
Primary Metals	23,417	2.3%
Transportation/Communications	22,873	0.4%
Chemicals	22,018	1.8%
Pulp and Paper	10,958	1.5%
Miscellaneous Mining	3,943	2.1%
Water/Sewer Utilities	892	0.4%
Subtotal Losses	(416,309)	n/a
Refining	(8,095)	(5.4%)
Coal Mining	(20,300)	(11.9%)
Gas Utilities	(71,090)	(31.0%)
Oil and Gas Extraction	(139,080)	(30.4%)
Electric Utilities	(177,744)	(21.6%)
Net Employment Gain	1,086,779	n/a