

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

2393 SCOMM 101. LONG RANGE FINANCIAL PLANNING COMMISSION, 1995 687

limited entry program for Bering Sea crab fisheries will be counterproductive, possibly ruinous to the industry and detrimental to the long term sustainability of the fisheries sector of the Alaska State economy. The business management of Bering Sea crab vessels is high risk and high cost, presently exacerbated by dramatic overcapitalization pressures and declining quotas and revenues.

However, the ACC will support a royalty fee of up to 2% within the context of a market based individual vessel quota program--for Bering Sea crab fisheries. A well designed program adds market value to a vessel owner's business, reduces the loss of vessels and most of all, reduces the loss of lives because it slows down the race for fish. The hazards and the mortality rates involved in the race for the Bering Sea crab quotas have become notorious in international fishing circles. The permit system is not the final solution for Bering Sea crab fisheries in the sense that it has been for the less hazardous Alaska inshore salmon and herring fisheries. The race for fish intensifies under a permit style program. All available capital is reinvested in technology to continuously improve a vessel's competitive position and boats and lives are lost in the pursuit. The pace of the fishery has become almost unbelievable.

Although fishing vessel quota programs are controversial amongst some Alaskan small boat owners, the limited entry permit program is widely accepted. These permits add considerable equity to a vessel owner's business and in some of the more lucrative fisheries, the permit values equal the value of the fishing vessels. The permits are fully transferrable in the market place and differ only in a matter of degrees from transferrable vessel quotas. Vessel quotas have the distinct advantage of providing a built-in industry buyback of excess fishing capacity that avoids costly government funded buyback programs.

In published testimony before the U.S. Senate Subcommittee on Oceans and Fisheries in March of 1995 in Anchorage, the ACC publicly supported a royalty fee of up to 2% of gross revenues of Bering Sea crab landings, to be dedicated to conservation and management and for economic adjustment assistance, within the context of a fishing vessel quota program. In 1994 this would have generated over \$5 million--three times the program costs for conservation and management of Bering Sea crab fisheries. In essence, a fishing vessel quota program can form the basis for a quasi privatized fisheries management program for the crab fisheries.

This concludes ACC's recommendations for sustainable revenue production for two renewable resources, Bering Sea and Aleutian Islands king and tanner crabs.

ALASKA CRAB COALITION

OVERCAPITALIZATION IN BERING SEA CRAB FISHERIES

	12/31/89 BOATS 1989	12/31/93 BOATS 1993	INCREASE SINCE 1/1/90	% INCREASE
BAIRDI	109	289	180	165%
OPILO	168	246	78	46%
B BAY RKC	211	302	91	43%

AVERAGE NUMBER OF BOATS FOR THE BAIRDI, OPILO & KING CRAB FISHERIES

	1989	1993	INCREASE	INCREASE
	162	279	117	72%

FISHING DAYS

	1989	1993	DECREASE	DECREASE
BAIRDI	110	50	60	
OPILO	112	60	52	
B BAY RKC	12	9	3	
AVERAGE	234	119	115	49%

Reference: ADF&G, Westward Region reports

Prepared: 5/12/94

— BOX SCORE —

Entry Permit Prices (as of 4-1-95)

Area	Salmon/ Herring	Gear	Market Range*	State Value*	Offers*
Southeast	H	Seine (SN)	200+	173.8	180+
P.W.Sound	H	SN	65+	80.2	63.5+
Cook Inlet	H	SN	70	61.2	69.5+
Kodiak	H	SN	90	75+	85
Southeast	H	Gillnet (GN)	31-	33.4	29-
P.W.Sound	H	GN	55	74.8	50
Kodiak	H	GN	29	23.3	26
Norton Sound	H	GN	12-	13.2	12
P.W.Sound	H	Pound (PN)	20+	27.2	16+
Southeast	S	SN	75+	75	72+
P.W.Sound	S	SN	67.5	47.1+	67+
Cook Inlet	S	SN	45	134.5	N/A
Kodiak	S	SN	52+	38.1	50+
Chignik	S	SN	210	238.3	200
False Pass	S	SN	180	193.4	N/A
Puget Sound	S	SN	ARO	N/A	N/A
Southeast	S	GN	72+	64.4+	70+
P.W.Sound	S	GN	68+	59.7+	65+
Cook Inlet	S	GN	115+	67.6+	100+
False Pass	S	GN	320+	329.8	310+
B. Bay	S	GN	225+	180.9+	215+
Puget Sound	S	GN	ARO	N/A	N/A
Yakutat	S	Set Net (SGN)	50	42.5	40
P.W.Sound	S	SGN	65	75	55
Cook Inlet	S	SGN	32+	24-	29+
Kodiak	S	SGN	105	90	100+
False Pass	S	SGN	110+	107.9	105+
B. Bay	S	SGN	47.5+	36.4	45+
Norton Sound	S	SGN	ARO	7.8	N/A
Southeast	S	Hand Troll	8.5	7.4+	8
Southeast	S	Power Troll	28-	27.4+	27.5
Chatham	B-Cod	Lg-Ln	N/A	175.5+	180+
Clarence	B-Cod	Lg-Ln	N/A	120	140+
Southeast	Crab	King/Tanner (KTA)	165+	106.3	135+
Southeast	Crab	King/Tanner (KTA)	190+	153.1	170+
Puget Sound	Crab	Pots	8	N/A	7

Prices may vary in accordance with market conditions.

+ denotes an increase from last month.
- denotes a decrease from last month.

* in thousands

N/A denotes No Activity.
ARO denotes Any Reasonable Offer.

■ Buyers trying to purchase primary salmon cards are stymied as they now face the possibility of missing this year's fishing season. Secondary salmon fisheries have turned into shark feeds as buyers scramble in last-ditch efforts to engage in any fishery this summer.

■ A number of sellers have decided to take their permits off the market and go fishing this summer, with ex-vessel prices continuing to look encouraging.

By John F. Mitchell with GRAVES & SCHNEIDER, INC.

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A Position Paper
(Mercifully Short)
from
The Alaska Support Industry Alliance
on
The Preliminary Report
of the
Alaska Long-Range Financial Planning Commission

We of the Alliance commend you of the Commission on your energy. Unfortunately, we cannot say as much for your Preliminary Report. It's not a report. It has no sense of direction. It has no focus. It is a grab-bag of everything. Its only contribution is a credible case on the realness of the fiscal gap.

But we of the Alliance have known of that phenomenon for almost a dozen years; since, that is, January 1984 when at our first Meet Alaska Conference Harold Heinz, then President of Arco Alaska, laid out a prognosis of the gap rapidly coming our way. The tragedy is that little, if anything, of consequence has been done about it by our Alaskan legislative leaders or governors. And the greater tragedy is that now, twelve years too late, your Commission cannot find the key to the solution.

Your report almost comes to grips with the solution but lets it slip away. On page 4, you ask the question, "What can be done to close the fiscal gap?" Your unhappy answer comes in thirty words in six sub-sections. Two of those words advise: *cut spending*; the remaining twenty-eight advise: *raise revenue*. You've got it all wrong. You need to reverse that to twenty-eight to two to cut spending.

That great bonanza of sudden wealth that came into the Alaska state government treasury was used to build a megagovernment, for some time and still much larger than we need or than we can sustain. But your report seeks to do just that, raise lots of revenue from the private sector to hold on to the excess that we unwisely created when the cash was flowing in.

You seem intent upon granting Alaska's political leaders license to tax away private earnings needed for investment to create a robust private economy. Don't. To the contrary, you need to advise them to trim the Alaska state government back to a reasonable and sustainable size without adding more burden to the private economy by taxing away its limited resources. Alaska needs basic government, providing public safety, a judicial system, infra-structure, and public education. Those need to be delivered effectively and economically. Young punks who commit crimes need to be jailed and high school graduates need to read at the twelfth grade level. However, throwing more money at these challenges has proven ineffectual. Wise management is needed. Finally, we need a modest level of environmental and business regulation that is simple, effective, and relatively non-intrusive. If our leaders can deliver these things, we the people will yield some of our sovereignty to our government. You will recall that Machiavelli, a renowned political consultant, advised the Prince to avoid violating his subjects' wealth or their women. We expect no less from the Alaska state government.

To achieve this kind of economical and effective government, our leaders need to move quickly to substantial downsizing of Alaska's government. They need to reduce the number of departments, consolidating functions. They need to eliminate the hundreds of special programs, and combine the remaining ones into a much smaller number of entities. And of what remains they need to reduce most budgets by twenty to thirty percent annually for the next four or five years. Only by such bold action will they reduce our government expenditures by the better part of a billion dollars.

Get real, Commissioners. For 615,900 residents, Alaska's government is rich. Alaska does not have a revenue problem; it has a spending problem. Unless you address that head-on, the economic future for the people of Alaska will be grim. But if our government officials will go boldly where few have gone before and reduce spending sharply without picking clean the pockets of Alaskans, the new century can know a great Alaskan prosperity

rec. 9/13/85
LRFP

**Energy Efficiency and Job Creation:
The Employment and Income Benefits from
Investing in Energy Conserving Technologies**

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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 percent, 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 than 70 percent 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

1. *America's Energy Choices: Investing in a Strong Economy and a Clean Environment*, Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, and Union of Concerned Scientists, Washington, D.C., 1991.

2. The high efficiency scenario used in this study is based on the Market case scenario in *America's Energy Choices*.

3. The IMPLAN input-output model was updated and modified for conducting this study. The IMPLAN model was originally developed by the U.S. Forest Service.

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 percent 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 percent 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 percent reduction in carbon dioxide (CO₂) emissions, 14 percent reduction in nitrogen oxides (NO_x) emissions and five percent reduction in sulfur dioxide (SO₂) 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 percent 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 percent by 2010, while the increase in GDP is less than 0.1 percent.

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 percent of the net jobs created are associated with direct investment in efficiency measures while more than 90 percent 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 percent 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?

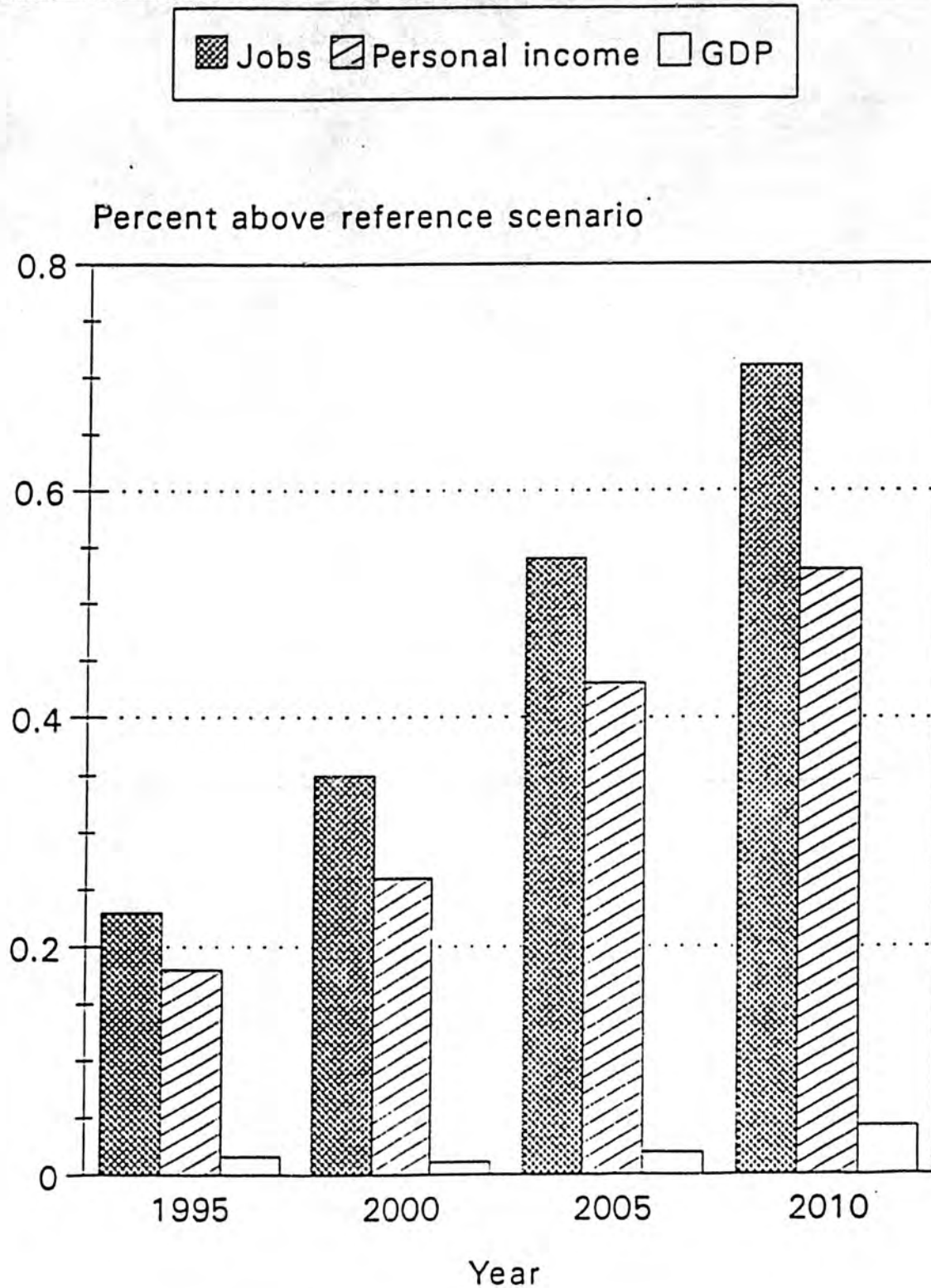
TABLE S-1. SUMMARY OF INPUT-OUTPUT ANALYSIS

	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	-1,794.0	-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

Figure S-1
Net increase in jobs, personal income, and GDP
in the High Efficiency scenario



I. INTRODUCTION

In many respects, the United States is still the world's most powerful economy. Per capita economic output is greater in the United States than in any other industrialized country when purchasing power parity is used to calculate gross domestic product. But with the lingering recession and unemployment approaching the eight percent mark, community and business leaders increasingly worry about the nation's ability to generate economic growth and new employment opportunities. Their concern is reinforced by a productivity growth rate that slipped from a robust 2.8 percent per year in the 1960's to a lackluster one percent per year in the 1980's. Under these circumstances, development strategies are being stretched in new directions to find a way back to the growth plane.

The prevailing economic development models are somewhat like a three-legged stool which supports our nation's material well-being. One leg might be thought of as the factories and equipment needed to produce the nation's goods and services. The second leg is the labor force required to operate the factories and the equipment, while the third leg is the influx of natural resources which becomes the material basis for goods and services. Unfortunately, most development theorists focus on only two of the three legs: that is, the nation's factories and equipment (which they refer to as *capital*) and its work force (or *labor*). The third leg, America's resource flow, is often ignored.

Instead, it is assumed that if stockholders receive sufficient compensation for their investment in capital, if production workers are reasonably educated, and if wages are paid at a rate sufficient to maintain the skills of the work force, the economy will always find the resources it needs to continue the nation's production efforts. This is not the case. The continuing failure to restore the nation's rate of productivity growth to the levels of the 1960's, coupled with the unexpected successes of the Japanese and West German economies, has prompted a serious reexamination of conventional development strategies. Among the issues being looked at more closely is the relative inefficiency of American energy use.

A. THE ROLE OF RESOURCES IN ECONOMIC ACTIVITY

When viewed from a materials and energy perspective, the American economy is perhaps only 10 to 15 percent efficient.¹ Some observers suggest that it may be this level of resource inefficiency which constrains the effective use of capital and labor. Electricity, typically thought of as being 100 percent efficient at the end use, is a case in point. It takes energy to explore, mine and produce the coal, natural gas and oil needed to power electrical turbines. It takes energy to build transmission lines and power plants. And, of course, there are large losses of useful energy in the power generation, transmission and distribution systems of a utility.

Once the electricity reaches a building or factory, there are other losses that occur in the end use or manufacturing process. Motors that power pumps, assembly lines and fabrication equipment dissipate energy, particularly under variable loads. Steam, water, and other forms of process heat are lost to the air. And inefficient heating, air-conditioning and ventilation systems in the factory use more energy, partly to compensate for the process losses. In buildings, inefficient lighting generates more heat than useful light while appliances consume much more electricity than is necessary.

Inefficient production and use of electricity, as well as other forms of energy, can inhibit economic growth in a number of ways. First, substantial amounts of capital must be devoted to energy supply investments — in fact, energy supply represented 40 percent of new plant and equipment expenditures as of 1982.² Second, net oil imports — \$57 billion as of 1990 — are a major contributor to our trade deficit already and are expected to increase substantially with "business-as-usual" policies during the next 20 years.³ In short, inefficient energy use diverts dollars from other productive investments and from the U.S. economy as a whole.

1. Richard S. Claassen and Louis A. Girifalco, "Materials for Energy Utilization," *Scientific American*, October 1986, pages 103-117.

2. J. Goldenberg, T.B. Johansson, A.K.N. Reddy, and R.H. Williams, *Energy for a Sustainable World*, Wiley Eastern Limited, 1988, page 27.

3. The U.S. Department of Energy projects that net oil imports will cost the United States \$94 billion in 2000 and \$142 billion in 2010. See *Annual Energy Outlook 1992*, DOE/EIA-0383(92), Energy Information Administration, U.S. Department of Energy, 1992.

B. THE ONGOING ENERGY DEBATE

During the last 20 years, the United States has experienced three major political and economic crises related to energy use and especially to our dependence on imported petroleum. Despite those painful lessons, U.S. dependence on imported oil exceeds seven million barrels per day. Moreover, our current wasteful use of energy inflicts heavy damage on the environment and threatens the nation's ability to compete in the global marketplace. When measured in terms of energy use per dollar of gross domestic product (GDP), the U.S. is about twice as energy intensive as West Germany, Switzerland, Denmark and Japan.⁴ Part of this difference is due to the efficiency of energy use, part is due to different energy services, and part is due to structural differences among countries.

In 1986, the United States consumed 74.3 Quads of primary energy, almost identical to the amount of energy consumed in 1973.⁵ Even more remarkable, the nation's real GDP grew by 35 percent during this same period. As a result, our energy intensity — measured by energy use over gross domestic product, or *E/GDP* — declined by 26 percent, or 2.3 percent annually.⁶ Indeed, despite relatively stable energy use during this period, population grew by 14 percent, industrial production (measured in real dollars) increased by 29 percent and the number of passenger cars increased by 33 percent. Efficiency improvements in all sectors explain about two-thirds of this gain. Structural changes and interfuel substitution explain the balance.⁷

In the 1980's, energy conservation fell from political favor. Oil prices plummeted in 1986. Since 1986, energy use has been rising at about the same rate as GDP. At the same time, there has been growing concern about urban smog, global warming and other environmental problems linked to energy use. These concerns, together with a slumping economy, have triggered a protracted debate about the need for revising our national energy policies.

4. These comparisons are taken from 1988 data contained in *Energy Balances of OECD Countries, 1987-1988*, Organisation for Economic Cooperation and Development, Paris, France, 1990.

5. One Quad is equal to 10^{15} Btus of energy. This is equal to about 170 million barrels of crude oil, or about 26 days of U.S. motor gasoline consumption (based on 1990 figures).

6. *Annual Energy Review 1991*, DOE/EIA-0384(91), U.S. Energy Information Administration, U.S. Department of Energy, Washington, D.C., June 1992.

7. Office of Technology Assessment, *Energy Use and the U.S. Economy*, OTA-BP-E-57, Congress of the United States, June 1990, page 4. See also, Lee Schipper, Richard B. Howarth, and Howard Geller, "United States Energy Use From 1973 to 1987: The Impacts of Improved Efficiency," *Annual Review of Energy*, Volume 15, 1990, pages 455-504.

Characterizing one side of the debate is President Bush's National Energy Strategy (NES)⁸, which emphasizes a continued reliance on fossil fuels and nuclear power. With only limited support for energy efficiency, energy consumption is projected to grow from 85 Quads in 1990 to over 126 Quads in the year 2030 under the NES policy scenario.⁹

On the other side of the debate are studies and strategies that emphasize increased investments in energy efficiency and renewable energy technologies. According to these studies, the potential for cost-effective energy savings is very significant.¹⁰ In the midst of this debate, a group of four energy and environmental groups launched a new technical study, known as *America's Energy Choices*, in order to examine the role that energy efficiency and renewable energy technologies can play in meeting the nation's economic and environmental challenges.¹¹

8. U.S. Department of Energy, *National Energy Strategy: Powerful Ideas for America*, Washington, D.C., 1991.

9. What is especially revealing about the lack of support for energy efficiency in the NES is that DOE performed analysis indicating that widespread efficiency improvements are feasible. For example, one working document outlined a scenario that would reduce U.S. energy consumption in the year 2030 by 31 percent over current policies. Ironically, the analysis indicated a strengthening of GNP as a result of increased energy efficiency. See, Energy Information Administration, *Very High End-Use Conservation Excursion, Energy Consumption and Conservation Potential: Supporting Analysis for the National Energy Strategy*, SR/NES/90-02, U.S. Department of Energy, Washington, D.C., 1990.

10. There now exists a large body of literature describing cost-effective technologies to improve overall energy efficiency. Examples include Howard S. Geller, Eric Hirst, Evan Mills, Arthur H. Rosenfeld and Marc Ross, "Getting America Back on the Energy-Efficient Track: No-Regrets Policies for Slowing Climate Change," American Council for An Energy-Efficient Economy, Washington, D.C., October 1991; Office of Technology Assessment, *Building Energy Efficiency*, U.S. Congress, OTA-E-518, Washington, D.C., May 1992; Roger S. Carlsmith, *et al.*, "Energy Efficiency: How Far Can We Go?," Oak Ridge National Laboratory, Oak Ridge, TN, January 1991; ICF Incorporated, *Preliminary Technology Cost Estimates of Measures Available to Reduce U.S. Greenhouse Gas Emissions by 2010*, Fairfax, VA, August 1990; Marc Ross, Marc Ledbetter, and Feng An, "Options for Reducing Oil Use by Light Vehicles: An Analysis of Technologies and Policy," American Council for An Energy-Efficient Economy, Washington, DC, December 1991; and Office of Technology Assessment, *Energy Efficiency in the Federal Government*, U.S. Congress, OTA-E-492, Washington, D.C., May 1991.

11. See, Union of Concerned Scientists, *et al*, *America's Energy Choices: Investing in a Strong Economy and a Clean Environment*, Washington, D.C., 1991, page 1.

The study relied on a computerized modeling system known as the Long-Range Energy Alternative Planning (LEAP) model to investigate the implications of four energy futures through the year 2030.¹² The four scenarios include a:

Reference Case, a business-as-usual scenario which reflects current energy policies and trends;

Market Case, which selects energy technologies based on the goal of minimizing the cost of energy services;

Environmental Case, which assigns monetary values to the environmental impacts of energy use;

Climate Stabilization Case, which seeks to meet predetermined targets for reduction of carbon dioxide emissions to the atmosphere.

Each of these four cases assumes successively greater reliance on energy efficiency and renewable energy technologies.

The Reference Case, built on assumptions published by the U.S. Department of Energy,¹³ indicated a 41 percent rise in the nation's energy use by the year 2030 (from 1988). Perhaps more importantly, carbon dioxide emissions were projected to rise 58 percent by that same year. Each of the three efficiency and renewable energy investment strategies demonstrated a dramatic reduction in both energy use and pollutant emissions.

Based upon data used for the most aggressive scenario (the Climate Stabilization Case), by the year 2030 the nation's energy requirements would be cut nearly in half from the Reference scenario. The carbon dioxide emissions would actually be reduced by more than 70 percent from 1988 levels in that same year.

Perhaps the most intriguing result of the *America's Energy Choices* study is that consumers would enjoy a net energy bill savings of some \$2.3 trillion over the 40-year period ending in 2030.¹⁴ This result arises from efficiency measures that save energy at lower cost than producing equivalent amounts of energy from new conventional sources such as fossil-fuel power plants.

12. LEAP was designed by the Stockholm Environment Institute-Boston Center at the Tellus Institute, Boston, MA 02110.

13. *1990 Annual Energy Outlook*, DOE/EIA-0383(90), Energy Information Administration, U.S. Department of Energy, 1990.

14. *America's Energy Choices*, op. cit., page 2.

II. ECONOMIC IMPACTS

Until recently, one of the less appreciated benefits of energy efficiency investments is their ability to promote new employment opportunities throughout all levels of the economy. A number of studies have shown that as energy efficiency is more widely implemented, economic well-being is also strengthened. This, in turn, enhances job opportunities (see Part IV of this study).

While the direct economic impacts of energy efficiency and renewable energy options were analyzed in *America's Energy Choices* (AEC), the study did not explore the employment and income benefits of the more aggressive efficiency scenarios. The model used in the study was not designed to estimate the indirect impacts which result from improvements in energy productivity.

To understand the full opportunity for employment and income benefits from energy efficiency improvements, this current project was launched. More specifically, this report explores the changes in gross domestic product (GDP), jobs, and employment compensation that result from the Market Case efficiency investments found in *America's Energy Choices*. To distinguish the results of this inquiry from the AEC findings, we use the term **High Efficiency scenario** which connotes investments in energy-efficient technologies as prescribed for all sectors in the AEC Market Case.

A. ENERGY EFFICIENCY INVESTMENTS

The starting point of *America's Energy Choices* was to track, in detail, exactly how energy is used within the residential, commercial, industrial and transportation sectors. From there the AEC report explored a variety of assumptions and technologies to determine an appropriate mix of investment opportunities that might fit within different energy efficiency scenarios.

The analysis included applications that ranged from commercial lighting and residential appliances to the movement of freight and people on the nation's highways, railroads and airlines. It examined space heating and cooling, industrial motor drives, and the development of renewable energy technologies such as solar water heating, solar electricity generation, and biomass fuel production.

Table II-1 provides a list of representative energy efficiency technologies (or bundles of technologies) examined in the AEC study, together with their respective cost of conserved energy (1990\$).¹⁵ The purpose is to illustrate the range of costs and technologies associated with the type of investments recommended in the Market Case.¹⁶ The efficiency investments save energy at much lower cost than supplying energy in today's marketplace.

Table II-1. Costs of Energy Efficiency Investments ¹⁷	
Technology	Average Cost of Conserved Energy (\$/MBtu)
Engine Controls for Heavy Trucks	\$2.24
Office Building Improvements	\$2.71
Efficient New Office Buildings	\$2.74
Hospital Building Improvements	\$2.88
Efficient New Retail Buildings	\$3.51
High Efficiency Gas Furnace	\$3.68
Retail Building Improvements	\$4.15
Improved Automobile Efficiency	\$4.24
Residential Lighting Improvements	\$6.83
Commercial Lighting Improvements	\$6.85
Efficient Industrial Motors	\$7.33
High Efficiency Refrigerators	\$10.35
Source: These representative technologies or technology bundles are taken from the "Technical Appendixes" of <i>America's Energy Choices</i> , op. cit.	

15. The cost of conserved energy is the incremental cost of the technology necessary to save a given amount of energy. The investment is amortized over the useful life of the technology using a three percent real discount rate. The three percent rate is intended to reflect the cost of capital to society based on the long-term average yield on U.S. Treasury bonds. This discount rate does not represent the cost of capital to consumers or businesses in the marketplace.

16. More than 100 separate technologies were evaluated for the complete study. For a complete recitation of costs and other assumptions about each of the scenarios and technology applications, see the technical appendices associated with *America's Energy Choices*, op. cit.

17. For comparison, the average 1990 residential electric price was \$22.96/MBtu, the average 1990 residential natural gas price was \$5.62/MBtu, while the average price of gasoline was \$9.74/MBtu (including taxes).

With a Reference Case established to show how the economy would likely behave through the year 2030, the AEC analysis then developed a scenario that included energy efficiency and renewable energy technologies that appeared to be cost effective for consumers using market energy prices. The resulting forecasts yielded the Market Case of *America's Energy Choices*. The projected total energy requirements and carbon dioxide emissions associated with these two scenarios are highlighted in Table II-2.

Table II-2. Summary Results of the Reference and Market Scenarios of America's Energy Choices				
Data	1988	2000	2010	2030
Gross National Product (Billion 1990\$)	5,292	7,090	8,941	12,792
Reference Case				
Primary Energy (Quads)	85.3	96.4	105.0	120.2
Energy/GNP (kBtu/\$)	16.1	13.6	11.7	9.4
CO ₂ Emissions (Billion Tons)	5.3	6.0	6.8	8.3
Market Case				
Primary Energy (Quads)	85.3	88.5	83.4	82.2
Energy/GNP (kBtu/\$)	16.1	12.5	9.3	6.4
CO ₂ Emissions (Billion Tons)	5.3	5.4	4.7	3.8

As the information from Table II-2 illustrates, both the AEC's Reference Case and Market Case assume the same level of economic growth as measured by the projected levels of Gross National Product (GNP), expressed in billions of 1990 dollars. The difference between the two cases is the level of energy consumption associated with each. In the Reference Case, energy intensity declines from 16,100 Btus per dollar of GNP in 1988 to 9,400 Btus in the year 2030.

By comparison, the Market Case shows a much steeper decline in energy intensity, dropping to 6,400 Btus per dollar of GNP by 2030. The difference in energy intensities results from a cumulative \$1.2 trillion investment in energy efficiency and renewable energy technologies in the period 1988 through the year 2030 (net present value based on a three percent real discount rate). The investment is projected to reap a cumulative energy bill savings of \$3.1 trillion in that same period, yielding a net savings of \$1.9

trillion (once again in terms of a net present value based on a three percent real discount rate).

For comparative purposes, the carbon dioxide emissions associated with each case are also shown in the above table. As might be expected, the added investment in efficiency and renewable technologies in the Market Case lowered projected emissions by 54 percent over the Reference Case in the year 2030. While the Reference Case indicates an absolute increase in emissions, moving from 5.3 to 8.3 billion tons in the years 1988 to 2030, the Market Case shows an absolute decline in emissions to only 3.8 billion tons in 2030.

B. FRAMEWORK OF ANALYSIS

While the Reference and Market Case found in *America's Energy Choices* were used as the starting point for the employment and income analysis in this study, four significant changes were made. The first change was to shorten the time frame from the years 1988 through 2030 to the years 1990 through 2010. The second change was to move the starting year from 1988 in the Market Case to the actual economic profile for 1990. The efficiency investments were not assumed to begin until 1992, however. A third point was to report national output as the Gross Domestic Product (GDP) rather than GNP as done in the original study. This change was done to incorporate the revised reporting format of the federal government. The fourth change was to consider only vehicle efficiency improvements in the transportation sector. Structural and behavioral changes that lead to reduced vehicle use were not included in this analysis because of the uncertainty surrounding their cost, lead time, and energy impacts.

The major economic parameters for 1990 are summarized in Table II-3.¹⁸ The 1990 data form only the starting point for comparison between the Reference and the High Efficiency scenarios developed in this study. The projections for the year 2010 in the Reference scenario are based upon a variety of data sources.¹⁹ As will be discussed

18. The 1990 GDP and income (i.e., employee compensation) data was obtained from the *Survey of Current Business*, U.S. Department of Commerce, Bureau of Economic Analysis, July 1992. The 1990 employment data were provided by the Office of Employment Projections, Bureau of Labor Statistics, U.S. Department of Labor. Employment includes both wage and salary workers, the self-employed and unpaid family members. Energy forecasts and prices were taken from the *Annual Energy Outlook 1992*, DOE/EIA-0383(92), Energy Information Administration, U.S. Department of Energy, January 1992.

19. Energy forecasts and prices were taken from the *Annual Energy Outlook 1992*, DOE/EIA-0383(92), Energy Information Administration, U.S. Department of Energy, January 1992. Forecasts for GDP growth were taken from *America's Energy Choices*, which, in turn, was based on Department of Energy projections as of 1991. Two other reports, *Outlook 2000*, Bureau of Labor Statistics, U.S. Department of Labor, April 1990, and *BEA Regional Projections to 2040*, Bureau of Economic

later in this report, an input-output model was calibrated to the 1990 economy and projected forward to 2010 based upon these economic forecasts.

Table II-3. 1990 U.S. Economic Profile Data

GDP (Billion 1990\$)	\$5,514
Total Employment	122,584,000
Income (Billion 1990\$)	\$3,290
Energy (Quads)	85.02
Energy/GDP (kBtu/\$)	15.4

Costs and Savings Compared to Reference Scenario

Once the economic and energy consumption trends were established in the Reference scenario, changes were introduced in the model to reflect new energy efficiency investments. Based upon the original data in *America's Energy Choices*, the efficiency investments and cumulative energy savings for the years 1995, 2000, 2005 and 2010 are presented in Table II-4. The data are reported for each of the major end-use sectors in billions of 1990 dollars.

Using the year 2010 totals as the focal point, for example, we note in Table II-4 that about \$60 billion of efficiency improvements will be made in that year. At the same time, the energy bill savings in 2010 from all efficiency measures in the economy that year is estimated to be \$167 billion. These energy savings accrue from efficiency investments made in the years 1992 through 2010. These include savings for all fuel types and end-uses.²⁰

Analysis, U.S. Department of Commerce, June 1990, also were used to select economic growth assumptions.

20. Again, for a complete review of the assumptions behind the efficiency and renewable energy investments, see the Technical Appendices for *America's Energy Choices*. It should be noted that while the energy prices by fuel, end-use and year were adapted from the DOE *Annual Energy Outlook*, they were modified to reflect assumptions about fixed and variable cost components as well as the responsiveness of the prices to reduced energy demand. See the discussion on this point found in section II-D.

Table II-4. Summary of Annual Efficiency Investments and Energy Savings of the High Efficiency Scenario (Billions of 1990\$)								
End-Use	1995		2000		2005		2010	
	Invest	Save	Invest	Save	Invest	Save	Invest	Save
Residential	11.98	6.77	12.19	15.37	19.45	28.75	19.87	42.48
Commercial	2.33	2.29	2.33	5.17	7.83	15.41	7.83	25.76
Industrial	15.12	4.59	15.11	12.47	13.36	20.49	13.36	29.16
Transportation	5.14	8.60	5.48	21.83	18.33	45.22	18.60	69.56
Total	34.57	22.25	35.11	54.84	58.97	109.86	59.65	166.96

The data for 1995 (Table II-4) show that the efficiency investments exceed the savings during the early and mid-1990's. This occurs because each investment occurs once with the installation of the new efficient equipment, while the energy savings from that equipment will occur in subsequent years. After several years of such investments, the total annual energy savings from all prior investments begin to exceed that year's new investment total.

By 2000, the energy savings from investments in efficiency measures in previous years are worth \$55 billion while an additional \$35 billion is spent on new efficiency improvements that year. By 2010, the savings are nearly 2.8 times the investment for that year. The cumulative investment in energy efficiency measures from 1990 through 2010 is about \$835 billion (1990\$). The cumulative energy savings during that same period of time is estimated to be about \$1.4 trillion (1990\$). This results in a net savings of nearly \$600 billion for consumers and businesses relative to the Reference scenario (net present value at three percent real discount rate). Once again, this is a first order assessment. It only considers the direct cost of efficiency measures and the value of the resulting energy savings. Also, additional energy savings will occur after 2010 from investments made prior to that date. These savings are excluded from this study, making our results conservative in terms of the overall benefits from energy efficiency improvements.

Establishing an Economic Model

Each sector of the economy — whether agriculture, construction, health or electric utility services — supports different levels of total economic activity, employment and personal

income. As the level of expenditures are increased or decreased, the level of employment supported by a given sector will rise or fall by some amount. In the case of the High Efficiency scenario, we want to know whether investing \$835 billion over an 18-year period (1992 through 2010) yields enough energy cost savings to end up with significantly more jobs than might otherwise occur.

Given a pattern of efficiency investments and their resulting energy savings (Table II-4), the question can now be asked: "What are the *net benefits*, if any, from those efficiency investments?" One tool that can assist in the evaluation of the job and income benefits is known as input-output analysis, sometimes called multiplier analysis.

Input-output analysis can be used to evaluate the job and income benefits (i.e., the "outputs") which are likely to result from the changes in spending patterns (the "inputs") created by the investment in particular technologies or sectors. Changes in each sector will actively affect all other sectors that are linked to it. Using input-output analysis, the impact of a dollar spent in different sectors of the economy can be traced and measured.

For example, let us suppose (in a highly simplified example) that a 10-horsepower motor in a pulp and paper mill has burned out. By paying an extra \$100 for a more efficient model, it is possible to save about \$50 per year in lower electric bills. In purchasing the premium model, the first impact will be to pay the motor vendor an extra \$100 for a new motor. The vendor will in turn pay the manufacturer a premium, possibly through an intermediate distributor. The manufacturer, in turn, will pay his or her parts suppliers, and, perhaps, an extra bonus to the salesperson. Those effects represent economic gains from the efficiency improvement.

In the meantime, until the pulp and paper mill recoups its initial investment, it will have 100 dollars less money to spend on other goods or services. That may be translated as a delay in the purchase of a new copier for the office, for instance. That \$100 motor investment, while providing economic gains to the vendor and manufacturer, represents an interim economic loss to the paper mill.

But once the new motor is installed, the business will be able to spend about \$50 each year for other goods, equipment and services. That \$50 savings represents a second benefit to the local economy. At the same time, the local utility may lose \$50 in revenues which represents a loss to the overall economic activity. At this point, then, we have identified four separate changes in normal purchase patterns. Two were positive and two were negative.

But there are more effects than simply those directly created, for example, by the money paid to a motor vendor for a high efficiency unit. To determine the total economic outcome of the efficiency investment, three separate effects must be examined:

Direct Effect: These are the on-site jobs created by an expenditure. In the case of installing a more efficient electric motor, the direct effect would be the on-site jobs of the electrical contractor hired to carry out the work as well as the vendor who sold the new motor to the paper mill.

Indirect Effect: When a contractor or motor vendor receives payment for goods or services delivered, he or she is able to pay others who support their businesses. This is the indirect effect and includes such people as the banker who finances the contractor, the accountant who keeps the books for the vendor, and the wholesale suppliers who keep both well-stocked with material goods.

Induced Effect: As the people who are directly and indirectly employed by the efficiency upgrade spend their weekly paychecks, they are said to "induce" other activity. This refers to money received by the grocer, for instance, who hires people to work in his or her store.

The sum of these three effects yields a **Total Effect** that results from a single expenditure, in this case the extra \$100 spent to buy the more efficient motor. Even at this point the analysis is incomplete since it only deals with the direct, indirect and induced effects of the efficiency investment itself. To understand the full range of economic influences, a total of four impacts must also be examined for their direct, indirect and induced, or total effects. They are the:

Investment Impact: This is the efficiency investment, including both equipment and labor costs. In the case just described, it is the \$100 additional cost for the purchase of the high efficiency motor.

Revenue Impact: This refers to the transfer of funds from one place to another which must be recorded as a loss in the overall set of transactions. In the case of the motor purchase, while the motor vendor receives an extra \$100, the pulp and paper mill will initially have \$100 less to spend elsewhere.

Substitution Impact: With the premium motor now installed, the efficiency improvements are effectively "substituted" for some amount of the energy use. If that amount generates a net savings, the result is increased local spending equal to some portion of the energy savings. In the motor example, the paper mill owner may have extra funds to complete other upkeep or maintenance. He or she may buy another piece of office machinery, or provide a Christmas bonus to employees.

Displacement Impact: Any money saved by the efficiency improvements may create a loss of income for the local energy supplier. If it occurs, such displacement may create an economic loss to the community, which will also have

indirect and induced effects. Again, in the case of the motor efficiency improvements, a local utility may find revenues sufficiently reduced so that open jobs slots are unfilled, or that some employees are asked to retire early.

From a discussion of these terms, it can be seen that a complete multiplier analysis captures the direct, indirect and induced effects of each major change in local expenditure patterns. Thus, there are two major tasks in completing an employment and income analysis of this type. The first is to understand just how the expenditure patterns affect each of the sectors of the economy. The second is to identify and calibrate an appropriate economic model to reflect the total impacts of those four spending changes, both positive and negative.

There are many different analytical tools that can be used to estimate the full range of these spending impacts. One is the U.S. Department of Commerce's Regional Input-Output Modeling Systems (RIMS II), a 531-sector input-output model designed and used by the U.S. Bureau of Economic Analysis.²¹ A number of state energy offices, for instance, have adapted the RIMS model for use in their own policy analysis.

A second analytical tool often used is the 528-sector IMPLAN model originally developed for mainframe computers by the U.S. Forest Service. It is now available for use in personal computers and has recently been used for such things as estimating the economic impacts of oil and gas exploration and the conversion of midwestern farmland into a national forest.²²

Both models produce comparable results if the framework of analysis is properly established. However, the data provided by the RIMS model largely consists of just the multipliers themselves. IMPLAN, on the other hand, contains actual output, employment and income data as well as the input-output multipliers. This allows the user to more easily adapt it for use in a particular analysis. Therefore, the IMPLAN model was chosen for conducting this analysis.²³

21. For more information on the use of this database and model, see, Bureau of Economic Analysis, *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II)*, (Washington, DC: U.S. Department of Commerce, 1992).

22. IMPLAN is short for "IMPact Analysis for PLANning." Originally an analytical model used on the U.S. Forest Service's mainframe computers, it is now available for microcomputers from the University of Minnesota's Department of Agricultural and Applied Economics, 1994 Buford Avenue, St. Paul, MN 55108.

23. The I-O model used in this study is a "static model" because the multipliers are assumed to remain constant in the future (except for specific changes in multifactor productivity which the user can introduce at the time of analysis). Some of the limitations inherent with this type of model are discussed in section II-D. Dynamic I-O models have been developed and used to analyze issues such as how technological

With the baseline information downloaded from the IMPLAN model, the next step in the analysis was to make the information easier to manage. This was done by aggregating the 528 sectors down to a total of 25 sectors.

Since IMPLAN is benchmarked to a 1985 economic database, the second step in the analysis was to calibrate the model to fit within the 1990 framework referenced in Table II-3. This was done using 1990 employment and income information for each of the relevant economic sectors. With this step complete, a series of multipliers were generated for each of the 25 sectors (see Table II-5). While updated as much as possible to economic conditions in 1990, the multipliers shown in Table II-5 still represent underlying relationships within the U.S. economy as of 1985.²⁴

change has affected capital and labor markets in the United States. See, F. Duchin, "International Trade and the Use of Capital and Labor in the U.S. Economy," *Economic Systems Research*, 1(3), 1989, pages 345-350. Also, F. Duchin and G.M. Lange, "Technological Choices, Prices and Their Implications for the U.S. Economy, 1963-2000," *Economic Systems Research*, 4(1), 1992.

24. Technically, the 1985 IMPLAN model is updated from the 1977 benchmark tables developed by the U.S. Department of Commerce. The 1982 benchmark tables, the most recent available, were released in 1992 but have not yet been incorporated into IMPLAN. While the RIMS multipliers have been updated from 1977 using the 1982 tables, any results generated from the earlier tables will continue to provide useful insights at the level of U.S. policy analysis referenced in this study. As with any analytical tool like IMPLAN, however, a proper analysis must anticipate these shortcomings and make any needed adjustments. One example of such an adjustment is the annual increase in productivity. A variety of sources project a growth in productivity of between 1.0 and 1.5 percent for the next 20 years. Using an assumed productivity growth rate of 1.4 percent coupled with the projected 2.4 annual percent growth in GDP used in *America's Energy Choices*, the IMPLAN model forecasts a year 2000 employment level of 136.5 million jobs. BLS forecasts to 136.2 million jobs, which is reasonably close to the IMPLAN results.

Table II-5. Multipliers for the United States (1990)

Industry	Output (Total Sales Per Dollar Spent)	Jobs (Total Per Million \$ Expenditure)	Wages/Salaries (Total Earnings per Dollar Spent)
Agriculture	2.1198	26.86	0.3451
Other Mining	1.8170	13.51	0.5672
Coal Mining	1.8690	12.88	0.5431
Oil and Gas Extraction	1.3438	7.02	0.2546
Construction	1.9228	20.97	0.5674
Metal Durables	1.9390	17.28	0.6469
Food	2.4489	19.77	0.4650
Other Manufacturing	2.0310	20.75	0.5884
Paper	2.1011	14.29	0.5476
Chemicals	2.1282	13.06	0.5340
Refining	2.0209	7.14	0.2617
Stone, Glass, Clay	1.9051	17.25	0.5732
Primary Metals	2.0150	13.05	0.5489
Motor Vehicles	2.1871	13.70	0.5426
Transportation/Communication	1.5777	16.37	0.5487
Electric Utilities	1.7821	9.54	0.3341
Gas Utilities	1.9921	7.41	0.2442
Water/Sewer Utilities	1.5943	14.00	0.4163
Wholesale Trade	1.4668	20.43	0.6730
Retail Trade	1.5984	32.24	0.6590
Finance, Insurance, Real Estate	1.4220	10.10	0.2959
Hotels and Lodging Places	1.5815	36.13	0.6048
Other Services	1.3726	26.45	0.7048
Eating and Drinking Places	1.9766	37.78	0.5389
Health Services	1.5853	23.15	0.6740

Three types of multipliers are shown in Table II-5.²⁵ The first is referred to as **output multipliers**. This refers to the total change in economic activity generated for each dollar of final demand delivered to a given economic sector. In the case of electric utilities, for instance, each dollar of additional revenue collected by the utilities will generate, directly and indirectly, a total of \$1.78 in total sales activity throughout the U.S. economy. Economic output contributes directly to GDP; in other words, expenditures that result in higher net output contribute to economic growth.

The second set of ratios refers to **jobs multipliers**. Here, the reference is to the total change in employment for each one million dollars of final demand delivered to a given economic sector. Again referring to electric utilities, a one million dollar increase in revenues will support a total of 9.54 jobs, both directly and indirectly. Beginning with its 1985 data, IMPLAN defines a job as a person-year equivalent.

Finally, the third set of ratios refer to employee compensation in the form of **wage and salary multipliers**. The reference, in this case, is to the total change in income for each dollar of final demand delivered to a given economic sector. Continuing with the previous example, each dollar of revenue collected by the electric utilities will increase employee compensation by a total of \$0.33.

A quick review of the Table II-5 reveals an important point. When looking at the jobs column, the five energy-related sectors (coal mining, oil and gas extraction, refining, electric utilities and gas utilities) have some of the smallest employment multipliers. In other words, these traditional energy supply sectors are relatively capital intensive in contrast to more labor intensive businesses that might be found in the various service sectors. This insight offers an early hint of the likely results of the economic impact analysis to come — that is, by lowering energy bills in all sectors of the economy, the savings will likely be spent in a way that supports a stronger employment base for the country.

Changes in Final Demand

Two major steps in the input/output analysis have been completed — setting up the initial dollar amounts associated with the efficiency investments, and developing the initial set of multipliers. We can understand how these steps fit together within an analysis by setting up a simple problem to solve.

25. Strictly speaking, the multipliers on this page are what are known as Type I multipliers. That is, they include only the direct and indirect effects of a given expenditure. The induced effect is simulated by including changes in personal consumption expenditures as part of the final demand column rather than as part of the production process.

Let us again use the example of a purchase of a more efficient electric motor by a pulp and paper mill. In this case, the local planner wants to know what the net benefit would be to the economy — based upon the \$100 incremental cost of the premium motor, and the anticipated energy savings of \$50 per year.

The multipliers found in Table II-5 already reflect the direct and indirect effects of an expenditure made for each sector of the economy. At this point all we need to do is match the proper change in spending with the correct multiplier found in Table II-5. In this example there are four such calculations to be made and summed. The steps for the first year in which the efficient motor is purchased and operated are shown next:

$$(1) \text{ Investment Impact} = \$100_{\text{motor purchase}} * 2.0310_{\text{manufacturer}} = \$203.10_{\text{gain}}$$

$$(2) \text{ Revenue Impact} = -\$100_{\text{budget loss}} * 2.1011_{\text{paper mill}} = -\$210.11_{\text{loss}}$$

$$(3) \text{ Substitution Impact} = \$50_{\text{utility bill savings}} * 2.1011_{\text{paper mill}} = \$105.06_{\text{gain}}$$

$$(4) \text{ Displacement Impact} = -\$50_{\text{revenue loss}} * 1.7821_{\text{electric utility}} = -\$89.11_{\text{loss}}$$

$$\text{Net Impact} = \$8.99_{\text{net gain in year one}}$$

In this example, total economic activity will be strengthened by about \$8.99 compared to buying a less-expensive and less-efficient motor. This includes both the direct and indirect effects of all four sets of expenditures. Similar calculations would be done for both employment and wage and salary multipliers to generate estimates of job and income benefits.

By year two, because of the assumption that the motor is paid for with current earnings, the net gain to the economy will be even larger since equations (1) and (2) would be dropped from the analysis. In that case, the year two net benefit would be \$105.06 less \$89.11, or \$15.95. Thus, as energy savings begin to accumulate, the net gains to the economy also grow.

Each of the changes in spending shown in the calculations above represent changes in final consumer demand. Each change in the final demand, created by the efficiency upgrade, needs to be matched with its appropriate multiplier. The products are then summed to determine whether the upgrade produces net benefits or not.

As this point we move to the next step of the analysis — to determine the sector-by-sector changes in expenditures resulting from the efficiency investments summarized in

Table II-4. This becomes the basis on which to predict employment and income benefits in the U.S. using the modified IMPLAN model.

The assumption used here is that each sector that benefits from efficiency improvements will also carry the cost of paying for the improvements. In other words, there is no cross subsidy in utility bills or tax incentives. A further premise is that the savings enjoyed by each sector, proportionate to the level of investment made, will be respent in the same manner as other funds available to it.

For instance, if households dedicate five percent of their income to savings, then we assume five percent of the energy bill savings will be saved as well. Similarly, if a manufacturing sector spends about 25 percent of its revenues for employee compensation, then about 25 percent of the energy bill savings will end up as employee compensation. We do not assume that businesses would use energy bill savings to reduce overall price levels. If we did, there would be more indirect economic benefits in other sectors, which would still lead to substitution impacts.

C. RESULTS

Table II-6 presents the results for the High Efficiency scenario in 1995, 2000, 2005, and 2010. Compared to the Reference scenario, primary energy use is reduced by 7.5 Quads (8 percent) in 2000 and 20.8 Quads (20 percent) in 2010. Absolute energy consumption rises slightly during 1990-2000 but then declines during 2001-2010 in the High Efficiency scenario. Energy use per unit of GDP declines by 2.4 percent per year on average during the twenty-year period, nearly matching the rate of energy intensity reduction in the United States during 1973-86.²⁶

The IMPLAN model does not directly track consumption of different types of fuel on a primary basis. We can, however, estimate energy savings by fuel type and the corresponding reductions in pollutant emissions in the High Efficiency scenario by referring to the Market Case analysis in *America's Energy Choices*. Adjusting for the small difference in energy savings between the two analyses as well as the accelerated implementation of renewable energy sources in *America's Energy Choices*, we estimate that the 20.8 Quads of energy savings in our High Efficiency scenario in 2010 would be comprised of about 7.0 Quads of oil, 4.7 Quads of natural gas, and 9.1 Quads of coal. We also estimate about 1.7 billion tons of avoided carbon dioxide emissions in 2010 in the High Efficiency scenario, a 24 percent reduction relative to emissions in the Reference scenario. Likewise, NOx emissions would be reduced by about 14 percent and SO2 emissions by about 5 percent in 2010 in the High Efficiency scenario.

26. Projected energy use and energy intensity in 2010 are about three percent higher in the High Efficiency scenario as compared to the Market Case in *America's Energy Choices*.

TABLE II-6. SUMMARY OF INPUT-OUTPUT ANALYSIS

	1990	1995	2000	2005	2010
Reference Case 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	-1,794.0	-2,332.0

The High Efficiency scenario results in more jobs, higher personal income, and marginally higher GDP throughout the twenty year period. It is estimated that about 293,000 new jobs are created by 1995, 471,000 new jobs by 2000, and nearly 1.1 million new jobs by 2010 on a net basis. The net increase in jobs by 2010 represents about approximately a 0.7 percent rise in the projected employment level that year (see Figure II-1). Likewise, the rise in personal income during the twenty-year period reaches about 0.5 percent by 2010, while the increase in GDP is less than 0.1 percent that year.²⁷

Table II-7 presents the sectoral changes in employment that are expected in 2010 in comparing the High Efficiency and Reference scenarios. The table shows both the anticipated job gains or losses as well as the percent change from the Reference Case scenario. Negative values are shown in parentheses. In the High Efficiency scenario, a total of 1.5 million new jobs are added in 2010 in the twenty "gaining" sectors, while about 0.4 million jobs are lost in the five "losing" sectors.

The construction, retail trade and service sectors gain the most new jobs in absolute terms in the High Efficiency scenario, while the motor vehicles and stone, clay, and glass industries also gain significantly in percentage terms. Energy efficiency technologies are installed by builders, vehicle manufacturers and electrical and special trade contractors. Building contractors will begin to use more architectural and engineering services and other technical skills in the construction of new homes and business, as well as in the renovation of the existing building stock. All of these activities will increase demand for manufactured goods such as energy efficient motors, lights and space conditioning systems. And as the energy bill savings begin to mount, consumers and businesses will have increased buying power that further adds to the job gains throughout the economy.

As might be expected from the drop in energy consumption, the energy sectors could face significant employment loss. It is important to recognize that the projected job losses in Table II-7 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. This represents about a 12 percent drop in total employment in these industries between 1990 and 2010. 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

27. A study by the Energy Information Administration of the U.S. Department of Energy indicates that energy efficiency improvements on the scale envisioned in our High Efficiency scenario could have a somewhat greater impact on total economic output. By reducing primary energy consumption in 2010 by about 18 Quads compared to a base case, the "Very High Efficiency Scenario" developed by the EIA resulted in an 0.84 net increase in GNP by 2010. See, *Energy Consumption and Conservation Potential*, op. cit., pages 18-21.

Figure II-1
Net increase in jobs, personal income, and GDP
in the High Efficiency scenario

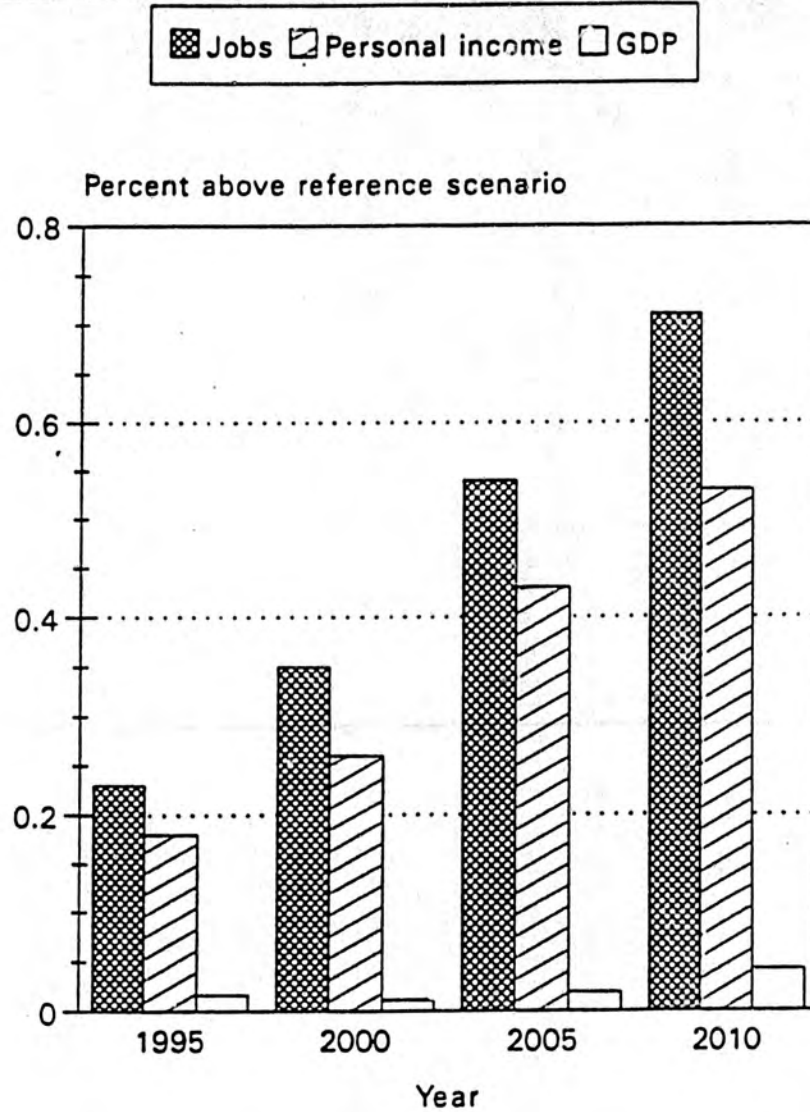


**Table II-7. Differences in Employment Levels in 2010:
High Efficiency vs. Reference Scenario**

Sector	Net Job Changes	Percent Change
<i>Subtotal Gains</i>	<i>1,503,088</i>	<i>n/a</i>
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%
<i>Subtotal Losses</i>	<i>(416,309)</i>	<i>n/a</i>
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%)
<i>Net Employment Gain</i>	<i>1,086,779</i>	<i>n/a</i>

Table II-8. Source of Employment Changes for Year 2010			
Effect	GDP (Billion 1990\$)	Jobs	Income (Billion 1990\$)
Investment Impact	\$64.62	1,093,000	\$40.20
Revenue Impact	(\$63.33)	(1,009,000)	(\$34.32)
Substitution Impact	\$153.84	2,471,000	\$82.61
Displacement Impact	(\$151.43)	(1,468,000)	(\$59.99)
Net Impacts	\$3.70	1,087,000	\$28.50

impacts by diversifying into the energy efficiency field (e.g., if utilities hire workers to implement energy conservation programs).

Table II-8 offers yet another view of the dynamics of job creation associated with energy efficiency improvements. The net increases found in the High Efficiency scenario in 2010 are reviewed according to the four separate impacts — the investment, revenue, substitution and displacement impacts. The investment and substitution impacts are positive influences while the revenue and displacement impacts are negative influences.

Table II-8 indicates that the net job and income benefits of the High Efficiency scenario result largely from the energy bill savings. We can observe this influence by examining the net outcomes of the efficiency investment versus the net impact of the energy bill savings.

Combining the (positive) efficiency investment impacts and the (negative) efficiency revenue impacts for the year 2010 shows only a modest gain in GDP, jobs, and wage and salary income. In the case of jobs, for instance, the investment impact shows a gain of 1,093,000 jobs in 2010. But subtracting the 1,009,000 jobs lost through the revenue impact — the diversion of funds from other normal purchases to pay for the efficiency improvements — yields only a small gain of 84,000 jobs in that year.

Turning to the two impacts associated with the energy savings, the substitution impact, which represents the respending of the money saved through lower energy bills, will lead to an estimated 2,471,000 new jobs in 2010. On the other hand, the displacement impact, which represents lost revenues to energy supply companies, reduces overall

employment by 1,468,000 jobs. The net jobs gain from the energy bill savings is, therefore, 1,003,000 jobs.

Adding the 84,000 job gains from the investment and revenue impacts to the 1,003,000 jobs supported by the energy bill savings leaves a total net increase of 1,087,000 jobs. In other words, the investments and revenue impacts yield about eight percent of the net employment creation, while the energy savings and responding impacts yield about 92 percent of the new jobs on a net basis. This result makes sense when we recall the earlier discussion about the large difference in job multipliers between the various energy sectors on one hand and all other sectors of the economy on the other. By diverting a large sum of money (\$167 billion in year 2010 as shown in Table II-4) from energy spending with its small job multipliers, a positive net employment impact results. These considerations explain, for example, why there is a positive job gain in 1995 even though efficiency expenditures are larger than energy bill savings that year. While the investment impact is largely offset by the revenue impact, the substitution impact produces the net positive jobs gain through the responding of the energy bill savings in 1995.

D. ISSUES AFFECTING THE RESULTS

The results of this analysis are not surprising given the cost effectiveness of energy efficiency improvements and the low labor intensity of energy production. Nevertheless, it is important to review the limitations of this type of input-output analysis in order to place the results in perspective. There are five areas that merit particular attention.

Static, Scale Independent Modeling

Input-output models such as the IMPLAN model are based upon an accounting of the nation's economic activity at a given point in time. These are termed *static* models of economic activity. This notion refers to the premise that the relationships among the many different businesses and industries in one year will remain unchanged over the time period analyzed. In the case of IMPLAN, the data is "benchmarked" to the 1977 national I-O tables available from the U.S. Department of Commerce. The tables are then adjusted to the 1985 economic profile for the U.S.²⁸

For this project, 1990 data was substituted in the IMPLAN model for the 1985 data. This includes actual sectoral data for output, GDP, jobs and employment compensation

28. For a discussion of how the adjustments are made to the "benchmark" tables, see, M. Planting, "The History and Development of the U.S. Annual Input-Output Accounts," Interindustry Economics Division, Bureau of Economic Analysis, U.S. Department of Commerce, Washington, DC, March 1988.

(i.e., wages and salaries and associated benefits). To establish a Reference scenario for 1990-2010, each of the sectors was grown or contracted according to the projected annual growth rates for GNP found in *America's Energy Choices*. The assumption in AEC was that through the year 2010 the economy would grow at about 2.4 percent annually. Implicit in this approach is the premise that the relationships among the sectors through the year 2010 would be adequately represented by the relationships that existed in 1990. This assumption appears to be reasonable given that the U.S. economy is relatively stable; i.e., relationships among sectors are not changing very rapidly.²⁹

Input-output models such as IMPLAN also assume that the average relationships among the industries are independent of the scale of investment. This means that the relationships apply equally to both very small and very large changes in spending. For example, let's assume that, on average, it takes \$250,000 worth of labor to produce \$1,000,000 worth of a specific type of manufactured good. A static input-output model assumes that the same labor ratio of 25 percent will apply to a \$1,000 purchase or to \$100,000,000 purchase throughout the time period analyzed.

A strict I-O model, such as IMPLAN, also does not analyze how the assumed pattern of investments and expenditures affect other macroeconomic parameters such as interest rates or inflation. There should be some interaction between these parameters and the effects that are estimated by IMPLAN (i.e., GDP, jobs, and employment compensation). However, the magnitude of the changes in GDP, employment and income due to greater energy efficiency in this study are moderate enough that significant changes in other variables are unlikely. For example, unemployment by the year 2010 is projected to run at about five or six percent of the labor force. That means about 8-10 million people will be unemployed in that year. It is unlikely that the introduction of about one million new jobs from efficiency improvements will significantly increase the average wages and thus raise the rate of inflation.

Nonetheless, for the reasons described above, static models cannot precisely forecast changes in future employment and income levels from particular actions over a long period of time. The strength of the input-output model as it is used here is that it provides useful insights about how different investment strategies can expand the nation's

29. One economist recently examined the differences between the two sets of benchmark tables and concluded that, at the level applied in this analysis, there was very little change between 1977 and 1982. Personal communication, Peter Blair, Energy and Materials Program, Office of Technology Assessment, Washington, DC, September 1992. Similarly, 1989 RIMS multipliers for the U.S. based either on the 1977 or the 1982 benchmark tables also showed little overall difference. Finally, an analysis done for the Electric Power Research Institute, comparing a 1972 benchmark table to a dynamically created table for the year 2000, concluded that only relatively small changes occurred in the resulting multipliers. See, Resources for the Future, Inc. *An Energy-Oriented Input-Output Model*, EPRI EA-3625, Electric Power Research Institute, Palo Alto, CA, August 1984, page 4-21.

overall employment and income opportunities, and which sectors of the economy will be affected either positively or negatively.

The conclusion that should be drawn from this analysis is not that the High Efficiency scenario will provide exactly 1.1 million jobs in the year 2010, but that energy efficiency can provide significantly greater employment opportunities while continuing to meet other critical economic and environmental needs. In fact, there are other positive impacts in the High Efficiency scenario which indicate that the resulting analysis may actually understate the employment and income benefits.

The multipliers used in this study are based upon the import levels in the 1985-1990 time period. Because of the static model and related assumptions, any oil savings due to energy efficiency improvements are assumed to reduce both domestic and imported oil consumption in proportion to their use in 1990. But in reality, oil savings at the margin primarily lead to less imports, rather than less domestic production. Thus, by investing in technologies that reduce the nation's dependence on petroleum, especially imported oil, the tendency will be to increase the average sectoral multipliers compared to those generated by the IMPLAN model for this analysis. In this sense, the results presented here tend to understate the economic gains of the High Efficiency scenario.

Energy Prices

This analysis primarily relies on the energy prices published in the *Annual Energy Outlook* to estimate the monetary values of anticipated energy savings. While these prices form a reasonable starting point, there are two issues which will significantly alter how those prices translate into energy bill savings.

The first issue is the problem of fixed costs. For all fuels, and especially for electricity, reduced consumption means that there are fewer units of energy over which to recover previous investments in power plants, transmission lines, pipelines, production wells, and the like. This leads to price increases, at least in the short run.

To correct for the problem of fixed capacity, the analysis assumes that electricity prices have a fixed cost component equal to about 40 percent of the published DOE prices.³⁰ Information on the fixed cost components for natural gas and petroleum, while less capital-intensive than electricity, is difficult to generate. The premise used here is that they have a fixed cost component of 20 and 10 percent, respectively. The implication

30. Information from the U.S. Department of Energy indicates a 1990 capital cost component of 44 percent of the average electricity price, dropping to 31 percent in 2010. The 40 percent figure was used throughout the analysis as a conservative estimate. See, *Annual Energy Outlook 1992: With Projections Through 2010*, DOE/EIA-0383(92), Energy Information Administration, U.S. Department of Energy, Washington, DC, January 1992.

of these assumptions is that energy bill savings will, in fact, be equal only to the non-capital costs of energy.

The second issue affecting energy prices is how reduced energy consumption in the High Efficiency scenario will affect the price of energy. DOE reports indicate that all energy prices are reasonably sensitive to significantly reduced demand. In other words, as demand falls, there will be a downward pressure on energy prices. There is not a consistent body of published literature that supports one response rate over another. For purpose of this analysis, therefore, it was assumed that the variable (non-capital) cost component of all energy prices would have an elasticity of 0.4 with respect to demand. More specifically, for every 10 percent drop in consumption, the premise was adopted that the variable energy costs would drop by four percent over their otherwise published values.³¹

Utility and Other Energy Investments

As the High Efficiency scenario begins to show significant energy savings, reduced energy use either postpones or eliminates the need for a variety of future energy supply investments. While there is a strong database on how electricity investments will be affected, notably through the work of Tellus Institute, there is little information on the investment patterns for the other major fuels.

Because of this uncertainty, it was decided to hold at zero the energy investment factor in the analysis presented here. In other words, the analysis assumes no savings from a lower investment in other energy resources such as new oil and gas wells or new power plants. However, a number simulations were run to test the influence of reduced energy investments on the overall employment picture.

It turns out the energy savings from lower energy investments did not appreciably affect the overall outcome. For example, in the year 2010, employment levels generated in scenarios which reflected the investment savings remained within three percent of those scenarios which did not include the investment savings. The reason appears to be that as the savings are reallocated back to the other sectors, their weighted labor intensities

31. In estimating the impacts of the Very High End-Use Conservation Excursion on energy prices and costs, the Department of Energy notes that in the year 2010 world oil prices will drop 7.2 percent (in real terms) compared to the reference scenario. Similarly, wellhead natural gas prices will drop 26.1 percent and average electricity prices will also drop 5.7 percent in real terms. This implies a long-run elasticity of 0.32 for petroleum, 1.25 for natural gas and 0.36 for electricity. See, *Energy Consumption and Conservation Potential*, op cit, pages 18-21. To maintain a consistency in the analysis, this study adopts an average elasticity of 0.4. Since this applies only to the non-capital portion of the energy costs, the effective elasticities are, therefore, 0.24 for electricity, 0.32 for natural gas, and 0.36 for petroleum.

were approximately equal to the construction multipliers. Nonetheless, this issue should be refined in future studies, particularly as it affects the non-electric investment patterns.

Consumer Decisions

An important question that needs to be explored is how businesses and consumers will respent any savings realized through their lower energy bills. In other words, how much of the savings will households use to buy more goods, how much will they add to savings, how much will be spent out of the country, and how much will they use to retire debt. The literature is not especially strong concerning this issue. For purposes of this study, it was assumed that households would spend their savings in the same pattern as their personal consumption expenditures. It was further assumed that businesses would spend their savings much as they would any additional revenues earned through their normal course of doing business. In other words, additional inputs would be purchased and investments made, thereby enabling output to grow.³² Absent better information, the premise was adopted that savings would be respent in an average rather than marginal fashion.

Making different assumptions about how consumers spend or use energy bill savings could lead to moderately different results from those reached in this study. While the implications of different assumptions should be examined, we are confident that our fundamental results will not be altered because: a) saving energy is more labor intensive than supplying energy; b) increasing energy efficiency will increase overall economic efficiency and raise multi-factor productivity; and c) the savings will be respent eventually in ways that tend to employ more people than supplying energy.

Expensing Versus Financing

The issue of expensing versus financing energy efficiency improvements is not addressed in this study. The assumption used is that the investment would be expensed (i.e., paid for immediately). However, financing all or part of the investment is possible. Making this assumption should yield similar if not more positive results because the banking and finance industries have reasonably high multipliers. By taking money from businesses and consumers in the form of interest payments, a similar level of employment would be created as leaving the money in the hands of the consumer. Nonetheless, since there are numerous ways to underwrite and finance the High Efficiency scenario, this issue should be explored in subsequent studies.

32. The energy bill savings computed in *America's Energy Choices* already reflect a so-called "rebound" effect — that is, the fraction of energy savings that is sacrificed for increased levels of comfort or service. An example of this effect is a household which previously kept its indoor temperature at 68 degrees during the winter but after adding insulation, decides to maintain a 72 degree indoor temperature.

III. VEHICLE EFFICIENCY SCENARIO

Light duty vehicle (car and light truck) efficiency improvements were identified as one of the major opportunities for cost-effective fossil fuel (namely, petroleum) energy savings in the *America's Energy Choices* study. Vehicle efficiency improvements account for 4.1 Quads (20 percent) of the overall 20.8 Quads reduction in primary energy use obtained in the High Efficiency scenario relative to the Reference scenario.

The issue of potential employment impacts has been frequently raised in the course of policy discussions regarding vehicle efficiency improvement, for example, through strengthened Corporate Average Fuel Economy (CAFE) standards. To directly address the issue, we developed a scenario including only vehicle efficiency improvements in order to isolate the employment impacts associated with these measures.

A. ECONOMIC PARAMETERS FOR THE VEHICLE EFFICIENCY SCENARIO

Light vehicles (including only cars and light duty trucks such as pickups and vans) now represent about 89 percent of motor vehicle sector output in the U.S. economy.³³ The average price increase for an automobile obtaining 40 miles per gallon instead of 28 miles per gallon is about \$600 relative to current new car prices. At this level of improvement, the average incremental cost of conserved energy is \$0.53 per gallon.³⁴ These estimates are based on a detailed analysis of the fuel economy improvements and costs of a wide range of available vehicle efficiency measures.³⁵ Fuel economy improvement cost estimates vary; the automotive industry in particular has cited much higher costs. Important determinants of cost include assumptions regarding the scale of production and whether efficiency improvements cause premature plant or equipment retirement (i.e., requirements for new retooling investments prior to the end of the useful

33. Total 1990 vehicle output is estimated at \$202 billion based on figures of truck and car sales published by the *Survey of Current Business*, Bureau of Economic Analysis, U.S. Department of Commerce, Washington, DC, August 1992. Cars have a 70 percent share and light trucks have a 30 percent share of the light vehicle market, based on R.M. Heavenrich, J.D. Murrell and R.K. Hellman, *Light-Duty Automotive Technology and Fuel Economy Trends through 1991*, EPA/AA/CTAB/91-02, U.S. Environmental Protection Agency, Ann Arbor, MI, May 1991. Assuming a light truck-to-car price ratio of 88 percent yields an 89 percent share estimate for light vehicles in the motor vehicle sector. Heavy trucks and buses account for the remaining 11 percent of motor vehicle output on a dollar basis.

34. *America's Energy Choices*, op. cit., Table C-8 of the technical appendixes.

35. M. Ross, M. Ledbetter, and F. An, *Options for reducing oil use by light vehicles: an analysis of technologies and policy*, American Council for an Energy-Efficient Economy, Washington, DC, December 1991.

life of older tooling investments). The \$600 estimate is adopted here under assumptions of a full scale of production and avoidance of premature plant retirements.

In order to increase fuel economy beyond 40 miles per gallon during 2001-2010, we assume the cost of automotive efficiency improvements will rise further. However, we do not assume static technology and so the additional price increase is modest, with the average incremental cost of \$700 per vehicle (1990\$) for an increase in fuel economy from 28 miles per gallon to 50 miles per gallon.³⁶ In effect, we assume that innovation will allow a rightward shift of the conservation supply curve, so that greater energy savings are achieved at a given level of avoided fuel costs. However, the efficiency investments made in vehicles in the beginning years of the scenario must be repeated in later years to account for vehicle replacement. Thus, the investment costs shown in Table III-1 rise sharply after 2000, but most of the rise is due to replacement costs, not higher incremental vehicle costs.

Table III-1. Summary of Annual Investments and Energy Savings of the Vehicle Efficiency Scenario (Billions of 1990 Dollars)				
Expenditure	1995	2000	2005	2010
Technology Investment	4.8	4.8	17.3	17.3
Fuel Savings	5.5	14.0	33.4	53.8

As with the main analysis described in Chapter II of this report, the Vehicle Efficiency scenario is based upon the projected annual efficiency investments and energy bill savings. These values for 1995, 2000, 2005 and 2010, are shown in Table III-1. By 1995, the fuel savings are comparable in magnitude to annual investments in fuel economy for new cars and light trucks. However, the annual savings grow as the improved vehicles come to dominate the on-road vehicle stock. Thus, by 2010, the fuel cost savings exceed annual investments by a factor of three.

The cumulative energy cost savings during the period 1992 through 2010 amount to \$415 billion while the cumulative vehicle efficiency investments are about \$204 billion.

36. Based on an average added cost of conserved energy of \$0.63/gallon, for increasing from 40 MPG to 50 MPG. See *America's Energy Choices*, *op. cit.*, pp.C-26,27 and J-2.

Consumers and businesses directly realize a net savings of \$211 billion.³⁷ This stream of investments and savings for light vehicle efficiency, then; provided the economic drivers to evaluate changes in GDP, jobs and personal income compared to the Reference scenario.

B. VEHICLE EFFICIENCY RESULTS

Table III-2 summarizes the results of the Vehicle Efficiency scenario for 1995, 2000, 2005 and 2010. As might be expected, the lower level of investment (29 percent of that in the complete High Efficiency scenario in 2010) yields a portion (32 percent) of the energy cost savings and therefore a smaller increase in GDP, jobs and income compared to the complete High Efficiency scenario. But because the investments are cost-effective and the savings still quite significant, and because there is a shift away from the petroleum supply sector with its very low labor intensity; there are net gains in employment in the Vehicle Efficiency scenario, rising steadily from 25,000 new jobs in 1995 to 244,000 new jobs in 2010 on a net basis.

Similar to Table II-7 in the main analysis, Table III-3 lists the net employment gains and losses by economic sector in 2010 for the Vehicle Efficiency scenario. Since vehicle efficiency improvement saves mainly petroleum, the petroleum extraction and refining industries face the largest percentage drops in employment. There is, however, one surprising result in Table III-3. Service sector job losses are the largest in absolute terms (although only 0.2 percent of the total sectoral employment). The reason is that government employees are aggregated within this sector. As oil consumption declines, so do the revenues associated with the various taxes on gasoline. Since our analysis incorporates no offset for the reduced tax revenue, the result is a projection of reduced employment within government agencies throughout the country.

All but three of the 25 sectors show job gains, primarily due to the redirection of expenditures away from the capital-intensive and import-dependent petroleum industry. The motor vehicle industry itself is projected to increase employment by as many as 47,000 jobs. The increase in employment is a function of the retooling needed to provide the more efficient vehicles, the increased costs and therefore larger sales revenues associated with light vehicles, and the significant responding effect resulting from the energy bill savings, which enables greater overall consumption of non-energy goods, including cars and light trucks.

37. As in the main analysis, all monetary values are expressed in 1990 dollars with the net present value established using a three percent real discount rate.

TABLE III-2. SUMMARY OF INPUT-OUTPUT ANALYSIS FOR THE VEHICLE EFFICIENCY SCENARIO

	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
Vehicle Efficiency Scenario					
GDP (Billion 1990\$)	\$5,514	\$6,205.7	\$6,993.5	\$7,890.5	\$8,912.8
Jobs (Thousands)	122,600	129,298	136,566	144,424	152,893
Income (Billion 1990\$)	\$3,290	\$3,713.4	\$4,194.7	\$4,745.7	\$5,372.8
Energy (Quads)	85.02	89.96	94.43	98.57	102.03
Btu/GDP (1990\$)	15,419	14,496	13,502	12,492	11,448
Net Efficiency Gains					
GDP (Billion 1990\$)	n/a	0.1	0.5	0.8	1.7
Jobs (Thousands)	n/a	25.0	72.0	151.0	244.0
Income (Billion 1990\$)	n/a	1.0	1.8	4.7	6.5
Energy (Quads)	n/a	-0.5	-1.2	-2.6	-4.1
Btu/GDP (1990\$)	n/a	-86.0	-170.0	-335.0	-458.0

**Table III-3. Differences in Employment Levels in 2010:
Vehicle Efficiency vs. Reference Scenario**

Sector	Net Job Changes	Percent Change
<i>Subtotal Gains</i>	<i>410,645</i>	<i>n/a</i>
Retail Trade	80,372	0.5%
Agriculture	59,090	1.1%
Motor Vehicles	47,216	5.5%
Restaurants	34,373	0.4%
Health Services	31,921	0.3%
Metal Durable Goods	25,188	0.3%
Finance, Insurance, Real Estate	24,182	0.3%
Construction	23,240	0.3%
Other Manufacturing	19,994	0.3%
Hotels and Lodging	11,997	0.5%
Food Processing	10,168	0.7%
Transportation/Communications	8,634	0.1%
Chemicals	7,390	0.6%
Wholesale Trade	6,989	0.1%
Primary Metals	6,500	0.8%
Electric Utilities	3,790	0.5%
Stone, Glass, Clay	3,704	0.6%
Pulp and Paper	2,565	0.4%
Gas Utilities	1,210	0.5%
Coal Mining	851	0.5%
Water/Sewer Utilities	654	0.3%
Miscellaneous Mining	619	0.3%
<i>Subtotal Losses</i>	<i>(167,660)</i>	<i>n/a</i>
Refining	(6,275)	(4.0%)
Oil and Gas Extraction	(68,543)	(15.0%)
Services	(92,842)	(0.2%)
<i>Net Employment Gain</i>	<i>243,985</i>	<i>n/a</i>

C. SENSITIVITY TO VEHICLE IMPORTS

Automobile imports now account for about 30 percent of the total sales of new cars in the United States.³⁸ Projections by the Bureau of Labor Statistics indicate that this relationship is unlikely to change over the next decade.³⁹ A constant import share was assumed in the analysis presented in Tables III-2 and III-3. But what if the level of imports were to change, either positively or negatively, over the 20-year time frame of our analysis? This issue was examined through a series of sensitivity analyses. Table III-4 presents the net change in jobs in the economy as a whole in 2010 with imports increasing or decreasing by 15 and 30 percent from their current levels together with the vehicle efficiency improvements explained above.

We do not believe that measures to promote vehicle efficiency improvement are likely to affect the import market share one way or the other. The level of imports is primarily dependent on broader competitiveness considerations and is further complicated by the significant and growing inter-relationships among automakers. U.S. automakers are presently competitive in all vehicle classes. There are continuing negotiations and agreements regarding motor vehicle trade levels and supply arrangements, particularly for imports from and exports to Japan and within North America. These factors have far greater bearing on net vehicle imports than U.S. domestic energy and environmental policies. Because these competitiveness and trade factors could induce volatility in market shares, an import share sensitivity analysis is of interest.

Under the scenario of a 30 percent rise in imports (that is, automobile import market share rising from 30 percent to 39 percent) together with the assumed efficiency improvements, employment in the U.S. could drop by 6,000 jobs in 2010. On the other hand, reducing the level of imports from 30 percent to 21 percent could increase the employment gain from 244,000 jobs to 492,000 jobs by 2010. A similar beneficial impact might result if the improved efficiency of domestically produced cars enables an increase in U.S. automotive exports to regions (e.g., Latin America) where efficient vehicles are likely to be more competitive than the less efficient cars typical of the present U.S. market.

The results in Table III-4 indicate that unless there is a further large shift towards imported vehicles, there are net U.S. job gains because of the energy savings that accrue

38. L.S. Williams and P.S. Hu, *Highway Vehicle MPG and Market Shares Report: Model Year 1990*, ORNL-6672, Oak Ridge National Laboratory, Table 4, April 1991.

39. *Outlook 2000*, op. cit.

from vehicle efficiency improvements. Furthermore, if energy efficiency improvements occur throughout the economy as in our High Efficiency scenario, the employment and income benefits resulting from the even larger nationwide energy savings would more than offset any such job losses from a hypothetical shift towards imported vehicles.

Table III-4. Employment Impacts in 2010 Associated with Different Automobile Import Levels

Automobile Import Assumption	Import Market Share	Net Job Gain
30% rise over Baseline	39.0%	(6,000)
15% rise over Baseline	34.5%	118,000
Baseline Vehicle Efficiency Scenario	30.0%	244,000
15% drop from Baseline	25.5%	368,000
30% drop from Baseline	21.0%	492,000

D. SENSITIVITY TO VEHICLE SALES LEVELS

Motor vehicle manufacturers have expressed a concern that, if new car prices rise because of efficiency improvements, then sales will decline. This could, in turn, lead to reduced employment. This concern about lower automobile sales became the focus of a second sensitivity analysis conducted with the modified IMPLAN model.

There are two reasons why a price increase from technology improvement may not result in a proportionately-sized loss of jobs. First, the price rise reflects value added: jobs are involved in supplying the technology used to improve efficiency. Second, the price increase associated with efficiency improvement does represent a value to consumer, namely, that of lower operating costs.

There could, nevertheless, still be a drop in sales from consumers responding to the assumed price increase. A consensus estimate of the long-run light vehicle sales price elasticity is a value of -1.0; that is, for each percentage increase in the price of a car,

sales could decline by one percent.⁴⁰ A price elasticity of -1.0 generally implies that a supply-side price increase results in no change in the overall consumer expenditures on vehicles (that is, the marginal revenue for manufacturers is zero). With new automobiles prices averaging about \$16,000,⁴¹ the extra \$600 per vehicle needed to raise average fuel economy from 28 miles per gallon to 40 miles per gallon corresponds to a price increase of about four percent. This means, in turn, new car sales would decline by about four percent with a price elasticity of -1.0. A four percent sales decline forms the boundary for this sensitivity analysis.

A more moderate response also is examined because price increases associated with higher vehicle efficiency reflect real value to the consumer in the form of future energy savings. In other words, rational consumers would be willing to pay a certain amount more for an efficient car because of the future fuel savings. A review of econometric studies indicates that there is indeed some willingness to pay for efficiency improvement, although the apparent value to consumers is quite uncertain and the discounting of the future operating cost savings can be quite high.⁴² For example, the present value of fuel savings for a 40 mpg car versus a 28 mpg car, discounted at 30 percent, is \$336. This is just over one-half of the \$600 incremental cost for the car. Thus, the average consumer purchase decision would be based on a net incremental cost of only \$264, or about two percent of the initial price. Thus, a two percent decline in sales is also tested in this sensitivity analysis.

Table III-5 presents the results of this sensitivity analysis. While the added cost of technology-based vehicle efficiency improvements might result in lower vehicle sales, the effect on jobs is not large enough to negate the overall job gains associated with the investments in efficient vehicle technology and the resulting energy savings. Even if consumers have no willingness to pay more for a car to save fuel (as in the 4 percent sales decline case), there are still net job gains for the economy as a whole relative to the Reference scenario.

40. D.L. Greene and K.G. Duleep, *Costs and Benefits of Automotive Fuel Economy Improvement: A Partial Analysis*, Report ORNL-6702, Center for Transportation Analysis, Oak Ridge National Laboratory, Oak Ridge, TN, March 1992.

41. *MVMA Motor Vehicle Facts and Figures 1991*, Motor Vehicles Manufacturers Association, Washington, DC, 1991.

42. D.L. Greene, "A note on implicit consumer discounting of automobile fuel economy: reviewing the available evidence," *Transportation Research* 17B(6):491-499, 1983.

Table III-5. Employment Impacts in 2010 Associated with Different Sales Levels

Assumption	Net Job Gain
Baseline Vehicle Efficiency Scenario	244,000
Two Percent Decline in Sales Over Baseline	171,000
Four Percent Decline in Sales Over Baseline	98,000

IV. COMPARISONS TO OTHER STUDIES

There have been several regional or state analyses of the employment and income effects of energy efficiency programs. The models used for regional or state-based studies vary widely. But all of these studies point in the same direction — that improved energy and resource efficiency can strengthen local employment and income opportunities.

In part this conclusion is reached because most studies pertain to energy-importing regions where some of the job losses in the energy sectors occur outside the boundaries considered. Yet, these studies also illustrate some general points of interest, such as the relationship between direct, indirect and respending effects, or the relative impacts from specific energy efficiency and energy supply projects.

To better understand the results that have been obtained by this project, we reviewed the results of six regional or state studies.

A. BONNEVILLE POWER ADMINISTRATION

In 1984, the Bonneville Power Administration (BPA) wanted to evaluate the employment effects of residential weatherization programs compared to the construction of a major power plant in the Pacific Northwest. The study used an input-output model to simulate the employment effects of saving or supplying one million kWh through either

weatherization of electrically-heated homes or construction of new coal-fired or nuclear power plants.⁴³

The study found that conservation produces more direct jobs and much more favorable employment impacts when all effects are accounted for. Both coal-fired and nuclear power production results in a net loss of jobs because they lead to rate increases and, thus, less consumer spending for other goods and services. The resulting job losses more than offset the job creation in power plant construction and operation, including indirect and induced jobs. For example, the study found that for each million kWh provided over a 30-year period by nuclear power, 31 jobs would be lost.⁴⁴

Efficiency improvements as represented by residential weatherization also lead to rate increases according to this study, but the resulting job loss is less than the total job creation resulting from conservation activities. Therefore, the overall employment impacts from energy efficiency is slightly positive — 2 jobs created over a 30-year period per million kWh saved.

This example shows that "supplying power" through conservation has a more favorable impact on employment than supplying power through building power plants. The absolute job impact from conservation is not very significant, however, because conservation measures in this study are viewed as a cost to society, leaving less money for spending on other goods and services. If conservation were viewed as an alternative to capacity expansion, and thus a way to reduce total expenditures on energy services, the positive effect on employment would appear to be much larger.

B. BRITISH COLUMBIA

In a 1991 study, two Canadian economists reviewed the employment effects of energy efficiency and hydroelectric power in British Columbia.⁴⁵ A total of 17 residential, commercial and industrial conservation programs initiated by BC Hydro in 1988 were extrapolated over a 20-year period. The impacts of these programs were then compared

43. Charles River Associates, *Employment Effect of Electric Energy Conservation*, prepared for the Bonneville Power Administration, Portland, OR, May 1984.

44. It should be noted that this study assumed relatively low power production costs from coal-fired power plants (42 mills per kWh) and nuclear power plants (50 mills per kWh). Use of higher costs would lead to even greater net job losses from these options.

45. Mark Jaccard and David Sims, "Employment Effects of Electricity Conservation: The Case of British Columbia," *Energy Studies Review*, volume 3:1, 1991, pages 35-44.

to a proposed hydroelectric facility known as the Site C Dam using a static I-O model for British Columbia.

This study concludes that the efficiency programs would increase net employment over the next 20 years by about 11,000 job-years, or about 600 jobs a year for the next 20 years. The investments in conservation measures (direct, indirect, and induced) provide an estimated 6,400 job-years, the displacement impact from not building the hydro plant is an estimated loss of 3,600 job-years, while the substitution impact from responding energy bill savings is an estimated 9,100 job-years of additional employment in British Columbia.

In this example it was assumed that saving electricity cost society 1.9 cents per kWh on average while the cost of supplying electricity from the new hydro plant would be 5.0 cents per kWh. Even without considering the responding effect, electricity conservation would create nearly twice as many jobs as hydropower production for an equivalent amount of energy produced or saved.

C. LONG ISLAND, NY

In 1979, the Council on Economic Priorities (CEP) completed an analysis of the employment impacts for various energy options for Long Island, New York.⁴⁶ The study examined the effects of 32 residential energy conservation and solar energy measures implemented at a cost of \$4.0 billion over a 38-year period. It compared these options to the construction of a new nuclear power plant proposed for the region. It also compared the impacts from conservation and solar energy measures and the equivalent energy output from the use of oil, natural gas and conventional electricity sources. Employment impacts were estimated for both the region and the U.S. economy as a whole.

The CEP study used two different I-O models to evaluate the overall impacts of each scenario, the RIMS model and the national Economic Growth Model developed by the Bureau of Labor Statistics. The study found that the conservation and solar options would create up to 1.4 times as much national employment, and 2.2 times as much regional employment per unit of energy supplied or saved, compared to the proposed nuclear power plant. Moreover, the study indicated that conservation and solar technologies would create 2.4 to 2.7 times more employment nationally than would the equivalent use of oil, natural gas and electricity. The net effect would be the creation of 10,000 to 13,000 more jobs nationally with about 90 percent of the added employment occurring in the Long Island region.

46. S. Buchsbaum, et al., *Jobs and Energy*, Council on Economic Priorities, New York, NY, 1979.

D. CALIFORNIA ENERGY COMMISSION

The California Energy Commission (CEC) conducted a study to determine total state and national employment created by investments made in a variety of energy technologies.⁴⁷ These included the use of nuclear, coal and oil-fired power plants, as well as solar water heating systems and a conservation program involving building insulation. The study also contrasted the total statewide employment from these energy options with their resulting national impacts.

An I-O model was used for the analysis with the direct labor requirements derived from detailed cost estimates for each of the energy alternatives. The impacts were described in terms of both jobs per million dollars of expenditure and jobs per billion kilowatt-hours of energy produced or saved.

In comparing the labor requirements for the construction and operation of different energy facilities, the study found that fewer workers are employed in California for power production than for providing an equivalent amount of energy through building insulation or solar water heating. This result is due to the fact that California imports more of the goods and services associated with power plants than those associated with conservation and renewable energy technologies. At the national level, however, where differences in the import levels among the major energy options vary only slightly, all energy facilities produce a comparable level of employment per unit of energy saved or supplied according to the CEC study.

When the energy options were compared on the basis of expenditures rather than energy saved or produced, none of the technologies supported more employment than the "average dollar" spent for personal consumption, investment or government expenditures (see Table IV-1). The reason for this result, the study noted, was that much of the "average dollar" is spent in the service sectors which employ relatively large numbers of people per dollar.

Table IV-1 summarizes the jobs impacts from expenditures on the construction and operation of the energy facilities (i.e.; without considering substitution and displacement impacts). When looking at the responding effect, the study found that energy bill savings from building insulation would create five times as many jobs as would be created by power plant expenditures. This finding underscores the importance of pursuing least-cost energy strategies since, by definition, lower utility bills would facilitate responding.

47. California Energy Commission, *The Comparative Effects of Energy Technologies on Employment*, Sacramento, CA, 1979.

Table IV-1. Job-Years Per Million Dollars of Expenditure according to the California Energy Commission		
Energy Facility	California	United States
Power Plants	14-51	101-105
Insulation	56-60	99-102
Solar Water Heating	56-69	113-134
Average Consumer Expenditures	77	150

The CEC study reached the same conclusion as our study; namely that the responding of energy bill savings from energy efficiency improvements would be the dominant factor behind significant increases in local or national employment.

E. MISSOURI'S ECONOMIC MATRIX

In mid-1992, the Missouri Environmental Improvement and Energy Resources Authority completed a seven volume report on the links between energy production and consumption and the Missouri environment and economy. As part of this in-depth review, Economic Research Associates evaluated the cost, employment and environmental impacts associated with more than 140 different energy technologies, including energy efficiency technologies in all end-use sectors, renewable energy options, as well as more traditional supply-side alternatives such as coal-fired power plants.⁴⁸ Input-output analysis was performed as part of this study.

Using only conservation resources that are cost-effective, the analysis indicated that Missouri has the potential to reduce its energy consumption by 100 trillion Btus in the year 2000. This represents an eight percent reduction over the projected energy demand for that year, or about a two percent reduction compared to energy use in 1990. The total investment in energy efficiency measures would be on the order of \$5 billion, but

48. See S. Laitner, "The Missouri Energy Matrix Model: A User's Guide," Economic Research Associates, Eugene, OR, March 1992.

this would be less than the fuel and capital costs that would be needed if the conservation measures are not adopted.⁴⁹

The analysis also concluded that the conservation measures would actually strengthen the state's employment base, providing between 8,000 and 13,000 new jobs for the state, if the conservation target is reached. Wage and salary earnings were projected to rise by as much as \$300 million annually. The study also found that the quicker the payback, the stronger the economic benefits to the state. Conversely, the study also indicated that new conventional energy supply technologies would result in a net reduction in employment statewide.

F. MAINE DSM PROGRAMS VERSUS A COAL-FIRED POWER PLANT

In 1991, the Conservation Law Foundation and the Natural Resources Council of Maine sponsored a study to compare the employment impacts of a proposed coal-fired power plant with demand-side management (DSM) programs.⁵⁰ The plant was to provide 1,183 gigawatt-hours of electricity annually. The study concluded that for an equivalent amount of electricity supplied or saved, the DSM programs would support substantially more employment than the power plant.

Based upon a survey of DSM programs and other data, the Maine study estimated that DSM programs would result in two to five times more jobs than the proposed power plant. Over the life of the DSM programs, the energy efficiency measures would create about 227 jobs in Maine, compared to the power plant which would provide an average of only 75 jobs over its 30-year lifetime.

G. MACROECONOMIC STUDIES USING OTHER MODELING TECHNIQUES

Some recent energy-economic studies examine the overall macroeconomic impacts from widespread energy efficiency improvements in the United States. One study that is underway is analyzing the employment and income impacts from electricity conservation measures using a combined input-output and general equilibrium model.⁵¹ This study

49. S. Laitner, "Missouri's Two-Percent Solution: Energy Efficiency for Economic Development and the Environment," Summary Report, Economic Research Associates, Eugene, OR, November 1991.

50. See, The Goodman Group, "A Comparison of the Employment Creation Effects of the AES-Harriman Cove Coal-Fired Generating State and Maine Demand-Side Management," Boston, MA, May 1992.

51. For further information, contact Eric Heitz, The Energy Foundation, San Francisco, CA.

also uses the data on energy efficiency measures developed for the *America's Energy Choices* report.

Other studies have examined the implications of greater energy taxes and/or lower greenhouse gas emissions on GDP. These studies employ general equilibrium models or macroeconomic forecasting models.⁵² Such studies usually find that higher energy taxes lead to energy efficiency improvements as well as a net reduction in GDP. For example, one model estimates that a carbon tax of \$17 per ton would reduce fossil fuel use significantly and lower carbon emissions in 2020 by 20 percent, but would also lower GDP that year by 0.5 percent.⁵³ Some macroeconomic studies consider much larger taxes and conclude that there would be even a greater drop in GNP if such taxes are adopted.⁵⁴ However, studies that assume the carbon tax revenue is used to offset other taxes (e.g., payroll or income taxes) conclude that there is a negligible or even positive impact on GDP.⁵⁵

The macroeconomic studies discussed above have certain critical flaws, namely that they do not account for the net economic savings that result from energy efficiency improvements. They usually do not explicitly consider technological change in energy efficiency options or other areas; and they do not quantify the environmental and social benefits associated with reducing energy consumption.⁵⁶ The first point is a fundamental difference with our study. Although we do not look explicitly at carbon or other energy taxes, we do recognize the net economic savings that result from energy efficiency improvements. In fact, this aspect of the analysis is essential for realizing positive employment, personal income, and GDP impacts.

52. For a discussion of the different types of models, see M.B. Zimmerman, "Assessing the Costs of Reducing Greenhouse Gas Emissions: Comparing Modelling Approaches," Alliance to Save Energy, Washington, D.C., July 1992.

53. Dale W. Jorgenson and Peter Wilcoxon, "Reducing U.S. Carbon Emissions: The Cost of Different Goals," Center for Science and International Affairs, Harvard University, Cambridge, MA, October 1991.

54. Alan S. Manne and Richard G. Richels, "CO2 Emissions Limits: An Economic Cost Analysis for the USA," *The Energy Journal* 11 (2), April 1990. Also, Richard A. Bradley, Edward C. Watts, and Edward R. Williams, "Limiting Net Greenhouse Gas Emissions in the United States," U.S. Department of Energy, Washington, D.C., December 1991.

55. Roger C. Dower and Mary Beth Zimmerman, "The Right Climate for Carbon Taxes: Creating Economic Incentives to Protect the Atmosphere," World Resources Institute, Washington, D.C., August 1992.

56. Ibid.

V. CONCLUSION

The United States now uses about 85 Quads of primary energy annually which translates to a national energy bill of over \$500 billion per year. The U.S. Department of Energy projects that with "business-as-usual" trends and policies, primary energy use will increase to about 106 Quads per year by 2010. With rising energy consumption and energy prices, our national energy bill in 2010 is projected to reach about \$950 billion.⁵⁷ Increasing energy use presents a host of other problems besides higher energy bills, including greater oil imports (DOE forecasts a 68 percent increase between 1990 and 2010) and greater pollutant emissions (DOE forecasts a 23 percent increase in carbon dioxide emissions between 1990 and 2010).

Vigorous energy efficiency improvements would lower consumers' energy bills and reduce the cost of energy services, cut oil imports, reduce pollutant emissions, and provide other benefits. Studies such as *America's Energy Choices* document the specific energy conserving technologies that are available and the favorable direct impacts they could have.

This study adds a new dimension to the case for improving energy efficiency. By shifting economic activity away from energy supply and by saving consumers and businesses money that will be respent throughout the economy, energy efficiency improvements will result in a net increase in jobs and personal income. We estimate that efficiency improvements consistent with a 2.4 percent annual reduction in national energy intensity could create nearly 500,000 new jobs 2000 and nearly 1.1 million new jobs by 2010 on a net basis.

A rate of energy intensity reduction similar to that in our High Efficiency scenario was achieved in the United States during 1973-86. This rate of energy intensity reduction can be achieved again. However, it is not occurring now and it will not occur without new policies aimed at increasing energy efficiency in all regions and end use sectors. The policies needed to reduce national energy intensity by nearly 40 percent during the next eighteen years are beyond the scope of this study, but such policies have been described elsewhere.⁵⁸

Substantial improvements in the efficiency of cars and light trucks, without considering other efficiency improvements, also could result in a net increase in jobs and personal

57. See *Annual Energy Outlook 1992*, op. cit.

58. *America's Energy Choices*, op. cit., pp. 97-122; "Getting America Back on the Energy-Efficiency Track: No-Regrets Policies for Slowing Climate Change", op. cit.

income. In this case, we estimate that 70,000 new jobs could be created by 2000 and about 240,000 new jobs by 2010, all on a net basis. By incorporating energy efficiency measures into their products, vehicle manufacturers could employ nearly 50,000 additional workers by 2010 and could realize the largest percentage increase in employment among sectors of the economy. These gains in employment could be moderated somewhat if increasing efficiency is accompanied by either a shift towards imported vehicles or a reduction in vehicle sales, although we do not believe that increasing vehicle efficiency need raise import levels.

Before concluding, a few caveats are necessary. In particular, this study deals with complex economic relationships, it is based on many data and modeling assumptions, and it looks eighteen years into the future. For these reasons, our results should be viewed as indicative rather than precise estimates of future impacts. But despite these caveats, all indicators point towards positive results. Energy efficiency improvements save consumers money, reduce pollutant emissions associated with energy production, and result in a net increase in jobs. Given the economic, energy, and environmental challenges facing our nation, can we afford not to act?

Good evening. My name is Anne Marie Holen and I am project manager for a statewide tobacco control program at the Alaska Native Health Board. I am here to express my strong support, and the support of the Alaska Native Health Board, for a significant increase in state tobacco tax rates. I want to mention that ANHB also supports an increase in alcohol taxes, but I will confine my testimony tonight to tobacco taxation.

I know you have already heard how tobacco taxes in the United States are lower than in almost any other developed country, and how current taxes in Alaska are below than the national average—even though we have one of the highest rates of tobacco use in the country. You have also received information on both the revenue benefits and public health benefits of tobacco tax increases. I realize this commission is not looking at public health issues per se, but given the amount of state dollars spent on health care in Alaska, it certainly would make sense to try to reduce preventable causes of disease. Tobacco use is the leading cause of preventable death and disease in the nation. And in case anyone is thinking, "smokers die younger and therefore save the state money," it's not true. Even though smokers die younger—an average of 15 years younger—than non-smokers, their lifetime medical expenditures are still significantly higher than those of non-smokers.

There are just two additional points I want to make. One is that dramatic price increases will produce the most revenue, obviously, and also the most dramatic reductions in tobacco use. I know the Commission has looked at the benefits of a tax increase of \$1 per pack, which would be fantastic. Even better would be an increase of \$2 per pack. Keep in mind that even at that rate, cigarettes in Alaska would still be less expensive than in the Yukon Territory or British Columbia. Alaska is in an enviable position in that the potential for cross-border smuggling simply isn't an issue.

The second recommendation I want to make is not to forget other forms of tobacco besides cigarettes. Loose tobacco, chew, and snuff are very appealing to youngsters, thanks to the efforts of the tobacco companies, and taxes on those products should be comparable to taxes on cigarettes. Obviously this will lead to even more revenue for the state while also discouraging behavior that leads to drug addiction and high health care costs.

In closing I want to point out that tobacco taxation enjoys strong bipartisan support around the country. (I know the Commission is trying to keep politics out of your discussions, and I commend you for that, but in case anyone was wondering—) A survey done in Anchorage last spring, prior to the public vote on a 12-cent increase in tobacco tax there, found that 68% of Republicans and 72% of Democrats supported the tax increase. The fact is that a tobacco tax increase is one of the few measures the Legislature can enact that will have strong public support. It's a win-win solution.

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**Testimony of Kym Swift - Executive Director for Common Sense for Alaska
On Alaska's Growing Fiscal Gap
Before the Long-Range Financial Planning Commission
September 13, 1995**

Hello, my name is Kym Swift. I am the Executive Director for Common Sense for Alaska, and on behalf of its more than 500 members want to thank the Committee for the opportunity to provide comments on the Committee's preliminary report on Alaska's Growing Fiscal Gap.

Common Sense for Alaska was formed in 1976 as a nonpartisan, non profit organization. Our mission is to inform and educate the public on state fiscal matters. We believe in the need for prudent state spending and that private sector growth can be achieved best when investment capital is left in the hands of Alaska's private sector, not when it is recycled through state government.

Common Sense applauds the Committee's efforts to address the state's fiscal problems. We recognize that your preliminary report is the product of many hours of hard work and that its creation was not an easy task. However, we at Common Sense feel the report does not focus enough on the state's basic problem - over spending.

Closing the ever widening fiscal gap should be the primary concern of the Committee and of every Alaskan. Yet the majority of the Committee's report focuses on the need for the state to increase revenues. The State of Alaska does not have a revenue problem - it has a spending problem. The focus of the Committee should be on closing the fiscal gap, not merely trying to fill it.

History shows that the spending habits of the State of Alaska have no apparent correlation to Alaska's population growth. From fiscal year 1976 to fiscal year 1996, Alaska's operating budget, unadjusted for inflation, has increased by 322 percent while the population of the state has only increased by approximately 50 percent.

Each aspect of the state's budget and in particular the way it is administered should be scrutinized as the fiscal gap grows. For example, the state has spent over \$400 million building new schools in rural Alaska, even when in some cases the number of pupils which would use a new school would be less than ten. The state must stop spending its dwindling resources on items which are more elaborate than are necessary.

In addition, community, business, and individual subsidies are other examples of state spending that should be considered excessive in light of Alaska's fiscal woes. Many of the subsidies, including the longevity bonus, are administered on the basis of entitlement and not need.

In other states, increases in state government costs are required by the expansion of the private sector. Yet the Alaska state government spending policy seems to be rooted in the notion that an expansion of state government will induce the growth of the private sector. Alaska's government not only feeds on itself, but has created private sector addiction as well.

As with any addiction, the artificial stimulant needs to be removed so that a healthy long-term solution can be found. The increase of taxes or user fees, the creation of dedicated funding, or the spending of Alaska's reserves will only serve to feed spending without accountability.

We at Common Sense urge the Committee to focus its attention on the state's fiscal problem - over spending - and not merely on its symptoms. The Committee was created by Governor Knowles. We suggest you adhere to his words, "Until we put our house in order, I will not introduce new taxes."

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Education and the Economy

Foreword

This study, prepared for the National Education Association by the Corporation for Enterprise Development, examines the linkage between state education spending and economic development. What follows is an exploration--using economic development "lenses." It examines new research frontiers, which we as an Association may not have touched upon and which may, in some cases, run counter to our traditional way of thinking.

In examining the linkage between education spending and economic development, the research may also link education finance and education performance. Consider for a moment what is taking place in this area:

-->State legislatures are mandating education performance.

-->The public approves of required standards of education performance.

-->Experts see improved education performance as a way to increase education funding.

-->Private companies are guaranteeing education performance for a fee.

-->Goals 2000 sets standards for student learning and evaluation.

The purpose of this research report is to stimulate thinking and explore new ways to enhance education funding and the work of our members.

Ron Henderson
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Introduction

What Is Economic Development?

Is Education Important to Economic Development?

Does Education Spending Affect Economic Development?

Questions About the Impact of Education Spending on Student Achievement

What Are the Consequences of Underspending on Education?

How Can States Best Use Education Investments to Promote Economic Development

Conclusion

INTRODUCTION

Legislators have long struggled with the allocation of limited resources. The classic formulation of this dilemma is the "guns vs. butter" trade-off. In our era, the challenge of resolving these trade-offs persists and is made all the more complicated by tight budgets and a growing anti-tax sentiment that was, in part, responsible for the Republican Party's stunning victory in the 1994 mid-term elections. Yet, what happens when, faced with these pressures, states

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cut taxes and curtail spending on essential services, such as education, human services, and infrastructure? California provides a good example:

California is at a crossroads. Over the past 20 to 30 years, there has been a profound state disinvestment in such areas such as education and infrastructure, where sufficient public investment is a necessary underpinning for a strong private sector. California has slid from its post World War II position as a leader among the states in human resource and infrastructure investment to its current status as a state whose public investments are distinctly sub-par. . . . The average amount California spends to educate each student fell from 21 percent above the average in all other states in the school year 1959-60 to three percent points below the average in 1989-90. The recent fiscal crisis accelerated this trend, lowering per-pupil spending in California in 1992-93 to 14 percent below the average spent in other states. . . . By 1990, the average California class was the second largest in the nation and nearly one-third larger than the national average. . . . Indicators of the quality of education in California raise concerns. The state has the ninth lowest high school graduation rate in the country, and California students in the fourth and eighth grades rank below the national average on math achievement tests.(1)

Yet, resource shortfalls such as these come at a time when our knowledge-based economy demands a different and higher set of skills than those traditionally provided by public education and when increasing numbers of our public school students are minorities or new immigrants. While simple justice has always demanded that race or family background not serve as a predictor of educational achievement--that each student attain what his or her individual potential permits--the demand for skilled workers in a successful America of the coming decade now makes this objective an economic necessity. Unless more economically disadvantaged youngsters enter the work force with skills in proportion to their more affluent peers, we will not be able to achieve the level of work force skills required to be a high-wage, Information Age economy.

The purpose of this paper is to examine more closely the connection between education spending and economic development. In doing this, we will explore the issue from a variety of angles and draw some conclusions that will be helpful to an audience not necessarily versed in the intricacies of economic development. In other words, this is an "issue brief" that provides educators, policy makers, legislators, and citizens with a better understanding of the relationship between education spending and economic development. In the end, we hope to show that a state's or region's economic health is best served by a common sense view that seeks out a "middle way" between two extremes--one a simplistic interpretation that money does not matter, the other a naive conclusion that money is everything.

The Corporation for Enterprise Development's (CFED) interest in education stems from education's standing as one of the primary building blocks of economic health. The analytical framework of our annual Development Report Card for the States, one of the most widely used benchmarking tools for measuring state economic performance, is based on the assumption that investment for the long term in technology, physical infrastructure, appropriate financial resources, and education are the building blocks for sustained economic health. Thus, what follows is an exploration--using economic development "lenses"--of the connection between education spending and economic development.

Yet, the connection between the two is not a direct one, but rather one which involves a series of complex interrelationships. Therefore, this issue brief explores the link between education spending and economic development from a number of different angles. We begin with a discussion of economic development--what it is and what some of the principles of successful economic development are. Then we examine in what way education (described in terms of human capital) is important to economic development and how we know this. We examine the link between education spending and economic development and describe how education spending has been shown to have a positive impact on a variety of economic development outcomes, including jobs and earnings. Following this, we explore the important relationship between education spending and student achievement by looking at both sides of the debate over whether "money matters." Then we return to the relationship between education spending and economic development and examine the economic development consequences of acting as if money does not matter. Finally, we present our conclusion that increased spending on education can have a significant impact on a city's, region's or state's economy, if done properly, and suggest ways that communities can make education investments to achieve this impact.

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WHAT IS ECONOMIC DEVELOPMENT?

At its most basic, economic development is the process by which wealth is created--or how a society increases its level of material and social well-being over time. In a developing economy, employment increases, incomes rise, innovation occurs, and the rate of economic growth rises.

Yet economic development is more than just growth; it also implies changes in technology and in the institutions controlling production. This includes a rise in entrepreneurship, the development of skilled labor, the building of roads and transportation facilities, the creation of financial institutions, and the channeling and accumulation of savings. Together, these advances allow an economy to increase productivity, thereby enabling the production of more outputs with fewer inputs over the long haul.

Moreover, in today's new economy, the real agenda for development is to achieve a widely shared and sustainable quality of life. "Shared growth" means that there is broad distribution of opportunities for meaningful participation in the economy and enjoyment of the benefits of an increased standard of living. This also ensures that no one group in our society will act as a drag on growth. "Sustainable growth" means that the above goals are achieved in a manner that does not detract from--but rather enhances--the economy's ability to accomplish the same goals in the future.

By looking at the challenge in this way, there is no inherent conflict between business, social, and environmental goals. After all, standard of living comprises a number of dimensions--both material and nonmaterial, quantitative as well qualitative. Thus, economic development has to do with the flow of money and goods to individuals over time. But it also includes improvements in the quantity and quality of public goods, that is, in our ability to obtain goods that cannot be purchased directly, but are necessary to most people's sense of well-being. These "goods" include clean air and water, freedom from fear of crime, and a sense of community.

Unfortunately, much of what goes on in the name of development is not driven by such a framework. Faced with economic dislocation caused by continued corporate downsizing, stubbornly high unemployment, and fear of job security even on the part of those in the work force, many political leaders have taken unwise actions that equate economic development solely with lowering taxes and rolling back government. This traditional approach to economic development often ends up being "penny wise and pound foolish." A more effective economic development approach is guided by the following principles:

>Strong economies compete on the basis of high value, not low cost.

While at one time developing countries based their development on low wage rates, quality and other non-cost factors are the new turf for business competition. According to author Peter Drucker, "the main competition for American manufacturing industry--for instance, in automobiles, in steel and in machine tools--has come from countries such as Japan and Germany, where wage costs have long been equal to, if not higher than, those in the United States. The comparative advantage that now counts is in the application of knowledge.(2)

This is not to say that business costs--such as wages, taxes, energy rates, and social insurance premiums--do not matter at all to investors

selecting a plant or office location. It is to say that what matters to investors is not how low those rates are, but rather how much they buy in the benefits--such as a skilled labor force, nearness to markets, infrastructure capacity, and good quality of life--central to a firm's success.

In short, the relevant context to use when comparing business costs is value, not cheapness.(3) Cheaper is only better when the benefits offered by competing locations are the same. Indeed, companies desire the most profitable location, not the least expensive one.

>Government is an essential partner in the development process.

It is commonly held that the private marketplace is the best producer of the resources our people and companies require to be internationally competitive. But the private marketplace, however efficient, needs some resources and institutional relationships that can best be produced and organized with public involvement.

In some cases the private sector does not provide a needed service or product because, despite the need for it, the private sector cannot claim all the value from providing the good. Roads are one such example--the private sector needs roads to ship its goods to consumers, yet private firms are not in a position to provide a network of roads themselves. In other cases, private businesses may be focusing on narrow interests or specialties and thus miss new product or institutional alliance opportunities. In both of these instances, government, because of its larger perspective, is in a unique position to organize the production of "public goods" or to bring interested parties to the table to help forge new alliances.

>There is no inevitable conflict between equity and efficiency.

Although some would argue that, when it comes to development, cities and states must choose between economic growth and equity, the two are not mutually exclusive. Other world-class economies achieve high Gross National Product growth rates with much less income inequality than the United States, and with more social benefits--such as more available and less expensive health care, child care, and education. For example, when compared to the six largest Organization for Economic and Cooperative Development (OECD) countries and Sweden, the United States ranked second lowest in social welfare spending in 1990 and also ranked second lowest in annual per capita growth between 1979 and 1989. The two countries that ranked highest in social welfare spending in 1990 (France and Sweden) grew as fast as or faster than the United States during the same period.(4)

In a recently published book entitled *Growth with Equity*, Brookings Institution economists Martin Baily, Gary Burtless, and Robert Litan maintain, "There are good reasons to believe that appropriate policies for raising economic growth and improving the distribution of economic rewards are inextricably intertwined." (5) For example, Baily, Burtless, and Litan point out that the economy can grow faster if workers with the least skills--often those with the lowest incomes--receive training to improve their skills. In addition, devoting resources to serious social problems that put a drag on the economy, such as drug abuse, crime, and lack of access to medical care, will also help the economy to grow faster. In other words, economic competitiveness is enhanced by creating greater opportunity for all members of society to participate in the economy.

>Investments in development "capacity" (human, technological, financial, and infrastructure resources) provide the basis for future economic health.

Every year, CFED's Development Report Card for the States compares the economies of the 50 states and examines to what extent each state provides its citizens with economic benefits and opportunities. One of the key findings from CFED's 1994 Development Report Card for the States was that a state's economic performance is highly correlated to its past investments in "development capacity" (investments in human, financial, technological, and infrastructure resources). Of the eleven states with the highest grades in development capacity (6) from the 1990 report card, all but three (73%) received an A or B in economic performance (7) in the 1994 report card and none received a D or F. The reverse is true for the ten states that received the worst grades in development capacity in the 1990 report card--all but three states received a D or F on economic performance in the 1994 report card and none attained either an A or B. (8)

In addition to the evidence from CFED's Development Report Card, more scholarly research on the economic impact of investments in public services and infrastructure has come to similar conclusions. For example, a recent study by researcher Alicia Munnell of the Federal Reserve Bank of Boston found that states that have invested more in public infrastructure (including education) tend to have greater output, more private investment, and more employment growth. Specifically, Munnell's research finds that "\$1000 more of public infrastructure per capita in the initial period contributes roughly 0.2 percent to the average annual rate of employment growth." (9)

Moreover, in a review of 30 business location studies conducted since 1979 that include some measure of investment in public services, researcher Timothy Bartik found that 60 percent of the studies had at least one public service variable that demonstrated a positive and statistically significant effect on business growth. (10) What's more, while most studies of public services and economic development provide little information to indicate what would happen if taxes were increased to pay for an expansion in public services, Bartik addresses this question as well. He notes that three particular studies (including Munnell's study cited above) provide evidence that "state and local business tax increases, if used for particular public services, will encourage more business activity." (11)

IS EDUCATION IMPORTANT TO ECONOMIC DEVELOPMENT?

As noted above, there seems to be a strong relationship between investments in human resources and economic growth. Yet, if education is important to development, in what way is it important and how do we know this? In this section, we will explore these two questions by examining the role of education as a key component in the development process.

Human Capital Theory

According to classical economic theorists, land, labor and capital were the three factors of production that determined economic growth and output. People used machines and tools to transform raw materials (such as cotton) into finished goods (such as clothing). Yet, in this classic model, all labor was viewed as identical; increasing the amount of labor in production was one strategy for increasing output and helping the economy to grow.

Beginning in the 1960s, however, economists (led by Nobel laureate Theodore W. Schultz) began to reassess the role of labor in the economy and assigned much greater significance to the skills and knowledge of the labor force. "Human capital theory," the name for this new outlook, argues that people can be viewed as an economic asset in which increased investment in health, skills, and knowledge provide future returns to the economy through increases in labor productivity.

While human capital theory helped focus attention on the role labor skills play in economic growth, more recent theories of economic development take an even more comprehensive view of the impact of human inputs on economic growth. For example, based on evidence that the birth of new firms and the growth of existing firms have a significant impact on economic development, economic development theorists have increasingly recognized the role that entrepreneurial activity plays in economic growth.(12) Other development theorists have explored the importance of knowledge and technology in regional economic development.(13)

Together, these development theories suggest four ways that human resources influence economic development:

>Labor force skills. The skills of a region's work force are the most basic component of its human capital resources. One important aspect of labor force skills is diversity -- a diversified industrial and service economy requires a labor force with a broad array of skills, such as computational and manual skills, construction trade skills, industrial trade skills, engineering expertise, computer expertise, and management skills. Another aspect of labor force skills is the attitudes and work habits that affect productivity and innovation. Increasingly, the attitudes and habits required in today's economy include an ability to work on teams and a willingness to participate in quality circles. A final aspect of labor skills is adaptive and allocation skills. These skills relate to a worker's ability to learn new technologies, to adjust to changes in the production process and to identify and change misallocations of resources in the workplace.

>The development and application of knowledge. As noted above, considerable attention has been devoted to the role of technology in economic development. However, most discussion of this issue overlooks that progress in research and technology is fundamentally based on

human capacities. Increasing society's knowledge relies on research, teaching, and thinking by scientists. It is both a process of accumulation and a conceptual breakthrough based on human intelligence, skills, and creativity. Moreover, applying knowledge to particular economic purposes, i.e., technology, is also a human activity in which the training, skills, intelligence, and creativity of a larger segment of the work force, including engineers, professionals, and skilled workers, is the driving force. Knowledge may differ from skills in that it is not embodied in a person. However, since the production, dissemination, and application of knowledge is largely through investments in human capital, it is appropriate to consider the contribution of knowledge and technology to economic development as an extension of human resources.

>Entrepreneurial talent. A significant part of the human resources that enhance a state's capacity for economic development is the presence of people to initiate, organize, and manage businesses. Entrepreneurs are a particularly important subset of human capital because they are a major driving force behind innovation and new business formation. Entrepreneurs do this by uncovering and creating new sources of wealth and new economic activities that add to the productivity and income-generating capacity of a region. Since entrepreneurs must also manage the enterprises they undertake, their human capital contribution includes bringing management skills to ventures.

>Agglomeration of human resources. Labor force skills, knowledge and technology, and entrepreneurial talent are not only essential human resources for economic development, but concentrations of such human capital in a state or region can attract or stimulate a high level of economic development. The effects of such agglomeration include the following:

- Attracting firms that seek access to the resources and the lower costs that improved access will bring
- Attracting immigration of workers who add to the human capital base (and preventing out-migration)
- Stimulating development through new business creation, productivity increases, and applications of new technologies

With the advent of the Information Age, two additional aspects of human capital have become critically important to a state's or region's economic success. First, an educated work force is now more vital than ever. In the America of the 1950s, for example, many jobs required few or no skills. In fact, 73 percent of all manufacturing jobs in 1950 were classified as unskilled. Skill requirements in the workplace are rising, however, and by the year 2000, the percentage of unskilled jobs is expected to drop to as low as 15 percent.(14) Thus, in order to attain a high wage/high skill economy, more young people will have to enter the work force with skills than ever before.

Second, the kind of knowledge required by the Information Age will be different from what has been required in the past. A recently completed study by New York State of the skills needed for entry level employment revealed significant shifts in the kind of learning required.(15) For example, in the area of mathematics, employers reported much greater needs for skills in logic, probability, measurement, and statistics than for the traditional training in algebra, geometry, and trigonometry. Similarly, the study found greater demand for the ability to read for information and for critical analysis and evaluation than was provided by the current New York

reading curriculum.

Of course, a more highly educated work force alone will not ensure success in the competitive global economy of the Information Age. Indeed, critics of the notion that education and training are the key to higher standards of living argue that, at present, there are a limited number of jobs that require high skills. Faced with competitive pressure, firms are just as likely to cut costs, substitute de-skilling forms of capital, and contract out as they are to make the kinds of productivity investments that can lead to more output, better work environments, and more pay. In other words, education alone simply leads to a reshuffling of the job queue. Thus, while increased skill levels are critical to success in the global economy, their impact will be limited without corresponding investments by the private sector in the kinds of technology and production processes that will enable workers to make the best use of their skills.(16)

How Do We Know That Human Capital Is Important to Development?

Empirical Evidence

From a macroeconomic perspective, several studies have attempted to account for the contribution of education to total economic growth. In reviewing these, Roland Sturm of the Rand Corporation concludes that "regardless of the particular calculation, education and its effect through labor quality are generally found to be among the most important contributors to economic growth." (17) One such study by Brookings Institution scholar Edward Denison attributes 14 percent of our nation's economic growth between 1929 and 1982 to improvements in education and 27 percent to higher levels of education among those employed.(18)

From a microeconomic perspective, other researchers (beginning with the first human capital theorists) have attempted to measure the economic returns to the individual from education and training. While not a direct measurement of the contribution of education to total economic growth, measuring returns to individuals from education gives an indication of how people are valued in the development process. In a review of literature on returns to education across 44 countries, World Bank economist George Psacharopoulos estimates internal rates of return to education of 14 percent and 12 percent for secondary and higher education, respectively, in developed countries. In developing countries, the rates of return are even higher, particularly for primary education (32% in Asia, for example).(19)

Moreover, as education increases in importance in the workplace, there is a clear trend of increasing returns to education.(20) A recent report by the National Commission for Employment Policy finds that "the new skill and technical requirements characteristic of the new economy are driving a wedge in the earnings distribution between those with access to skill and technology and those without access. . . . In the 1970s, college-educated men earned 56 percent more on average than those with just a high school diploma. In the 1980s, this premium increased to 74 percent."(21)

Evidence from Business Location Studies

Another way to measure the importance of human capital to economic development is to examine the relative value placed on education by businesses making location decisions. Fortunately, the issue of factors in industrial location has been explored in great depth in the economic development literature. In one review of the literature on industrial location, researchers John Blair and Robert Premus found

that "the traditional economic factors of location [labor, markets, transportation] are becoming, as a group, quantitatively less significant. For example, unlike studies written in the 1940s and 1950s, most of the recent location studies we reviewed found noneconomic factors to have at least some influence on location. Education, unionization, personal reasons, business climate, energy, and familiarity with local conditions have been added to the 'must-and-want' list." (22)

Yet, evidence of the overall importance of human capital in business location decisions should not mask the fact that different industries may place differing values on the importance of education. For example, a recent study by the U.S. Department of Agriculture of the factors associated with the growth of local and regional economies found "limited, and sometimes contradictory, evidence for the effects of educational attainment on economic growth." (23) These findings likely reflect that, while many industries seek to locate in areas of high educational attainment, certain industries may still be attracted to areas with lower education levels. Among such firms and sectors are the following:

- The most likely to relocate to lower cost sites abroad
- As currently structured, those incapable of providing better employment opportunities for their workers
- Those likely to continue to operate in the United States by demanding wage and benefit concessions from their employees, speeding up production lines, and moving to less affluent areas.

Nonetheless, most companies value a more highly trained work force.

Indeed, recent research indicates that, more than just on the must-and-want list, an educated work force has become one of the primary location factors for growing companies. A 1994 survey of the nation's leading corporate real estate professionals by the accounting firm of Ernst & Young found that an educated labor force was the second highest ranking selection factor, behind only low lease rates. (24) In one of the more recent studies, *Entrepreneurial Hot Spots: The Best Places in American to Start and Grow a Company*, economist David Birch et al. conclude that the most attractive locations for entrepreneurs are not those that offer cheap wages and low taxes, but rather those that offer world-class universities, good roads, and access to airports. (25) Further, economist Bennett Harrison argues that, although multinational corporations are demonstrating less and less loyalty to particular countries or communities as a result of the "global economy," newer thinking indicates that a "home base of mutually supportive institutions" is now more important than ever to a company's competitiveness. These mutually supportive institutions include those that insure access to capital and trained workers, as well as those that insure the provision of appropriate infrastructure. (26)

In addition to the general industrial location literature, one recent study by Ronald Swager of the University of Southern Mississippi examines the particular relationship between education and business location. Based on a survey of location consultants and real estate executives, Swager found that, for half of all respondents, education was judged to have been very important or critical in site selection decisions over the past ten years. What's more, almost 75 percent predicted that education would be a very important or critical location factor in the next ten years. (27)

Further evidence of the importance of a well-trained work force to businesses making location decisions comes from more popular literature. A November 1994 article in Money magazine on the top 20 locations for small businesses found an educated work force to be one of the chief characteristics that contribute to the entrepreneurial vitality of an area.(28) The Money study was based on data provided by CFED, which ranked the 779 "commuting zones"(29) in the United States based on a variety of indicators important to small businesses, including overall job growth, growth in proprietorships, per capita income, and proprietors' average earnings. After identifying the top locations, Money staff interviewed more than 50 experts, from economists to local business leaders in the top ranking areas, to identify what makes an economy attractive to small firms. Based on these interviews, the Money study identified an educated work force as one of the top five characteristics common to "winning cities."

DOES EDUCATION SPENDING AFFECT ECONOMIC DEVELOPMENT?

The case is clear--human capital is critically important to economic development. Moreover, with the advent of the Information Age, the role of human capital will continue to increase in importance for our economy. This implies that if, as many predict, acquiring and applying knowledge will become the key competitive factor in the future economy, the primary strategy for enhancing economic growth will be through increases in human capital that increase labor productivity.

Thus, investments in education should have a beneficial effect on long-term economic health. Indeed, several studies confirm this relationship. What follows is a review of some of the more convincing studies. The first takes a microeconomic perspective and examines the relationship between education spending and future earnings. The second two are studies of the factors that influence aggregate economic growth and are notable in that each includes an education spending variable. In addition, a review of additional statistical work conducted by CFED examines the relationship between education spending and performance on CFED's annual Development Report Card for the States.

Microeconomic Literature

Given their preference for tangible, market-based outcomes measures, as well as the limitations of measuring human capital on the basis of standardized achievement tests, several economists have examined the value of schooling inputs by studying the relationship between school quality (measured on the basis of expenditures per student or the pupil-teacher ratio) and student outcomes (measured in terms of future earnings). This approach assumes that, since workers with higher skills tend to earn more, school quality can increase future earning potential (holding parental education, race, and IQ constant) either by helping students to learn more per year of schooling or by increasing the number of years students stay in school.

In a review of this literature on school quality and earnings, David Card and Alan Krueger of Princeton University summarize the findings from 13 different studies based on eight different data sets on earnings. Based on their review, Card and Krueger find "a high degree of consistency across studies regarding the effect of school quality on students' subsequent earnings. The studies typically find that a 10 percent increase in school expenditures is associated with a 1 to 2 percent increase in annual earnings for the students later in life." (30) In most cases, these studies control for level of education, meaning that the estimated income increase represents an increase for a given level of schooling. In addition, Card and Krueger also find that increases in school resources are positively associated with significantly higher education attainment. As noted above, both of these avenues (staying in school longer and learning more in a given year of schooling) increase students' skills and, thus, tend to increase future earning potential.

MACROECONOMIC LITERATURE

Public Services and Economic Development

In a forthcoming Economic Policy Institute report, (31) Timothy Bartik of the W.E. Upjohn Institute for Employment Research concludes that spending on state and local public services, including primary,

secondary, and higher education spending, can have a positive impact on private sector productivity and output.

Bartik uses a model that estimates the effects of increases in public services that are financed by an increase in taxes and finds, for example, that "a property tax financed increase in higher education spending of one percent of a state's personal income would increase state manufacturing output in the long-run by 8.3%." (32) Yet, most of the findings from this study show rather modest effects of public services expenditures on economic growth. As a result, Bartik concludes that "the most important policy implication of these results is that, in most cases, increased taxes and increased public services spending will not cause [a] jurisdiction to suffer an economic disaster. In most cases, the negative effects of taxes on manufacturing output, and the positive effects of public services spending on manufacturing output, will be offsetting." (33)

Business Climate and Employment Growth

In a report on the effect of a series of business climate variables on employment growth in the 48 contiguous states between 1973 and 1980, Michael Wasylenko found a significantly positive relationship between education spending and total employment growth. (34) Wasylenko's research indicated that a 1 percent increase in spending on education relative to income was associated with a 0.72 percent increase in total employment over the period. Based on these findings, Wasylenko concluded that "higher expenditure on education relative to income has positive effects on overall employment growth, and budget-cutters should not reduce education expenditures very much, if at all." (35)

New Statistical Analysis Using CFED's Development Report Card

Given CFED's findings from the 1994 Development Report Card for the States showing a relationship between investments in development capacity (human resources, technology resources, financial resources, infrastructure, and amenity resources) and economic performance discussed above, CFED compared the 50 states' rankings on the Development Report Card's Economic Performance Index over the past ten years with state per pupil spending on education in prior years. (36)

In conducting this study, CFED performed two sets of analysis--one with a lag of five years between spending figures and economic performance grades, and one with a lag of ten years, all over an eleven-year period ending in 1993. In using this lag between education spending and economic performance grades, our assumption was that the returns from investments in education will not appear immediately, but rather will emerge in the long run as students complete school and enter the work force. Indeed, it is possible that even a ten-year lag is still too short of a period in which to capture the full benefits from investments in education. Yet, in the case of both the five-year and the ten-year lag, we found a statistically significant relationship between per pupil spending and economic performance grades.

In addition, we attempted to capture the impact of additional spending over and above the average level on a state's chances of receiving an honor grade (A or B) in economic performance. (37) The results indicate that those states spending the average amount per pupil (\$4,510 in 1990-1991 dollars) (38) increase their chances of receiving an A or B five years later by 1.0 percent with an additional \$100 in spending per pupil (2.2% increase in per pupil spending).

While not guaranteeing improved grades, this finding indicates that a spending increase of this level slightly improves a state's chances of receiving an honor grade.

The results with a ten-year difference between spending and economic performance grades indicate that, at the spending mean (\$3827 in 1990-91 dollars), states can increase the probability of receiving an A or B grade by 1.3 percent with an additional \$100 in spending per pupil (2.6% increase in per pupil spending). Again, these results, while not large, show a statistically significant positive relationship between education spending and economic performance grades on CFED's Development Report Card.

We also found that, for those states below the spending mean, the same \$100 per pupil spending increase leads to a slightly larger increase in the probability of receiving an honor grade. This increased probability levels off at a per pupil spending level of between \$4,000 and \$5,000. In other words, a state spending below the national average is likely to experience increasing returns to scale, on average, for additional per pupil spending; a state spending above the national average is likely to experience quickly decreasing returns to scale, on average, for additional per pupil spending.

In addition, CFED sought to evaluate the relationship between education spending and the three subindexes of the Economic Performance Index. Two subindexes demonstrated a statistically significant relationship:

--The Earnings and Job Quality Subindex, which measures pay and benefits. This subindex had a positive and statistically significant relationship to education spending -- increasing per capita spending on education by \$100 at the mean increases the probability of a state's receiving an A or B on this subindex by 1.4 percent.

--The Equity Subindex, which measures the poverty rate and income distribution. This subindex also had a positive and statistically significant relationship to education spending--increasing per capita spending on education by \$100 at the mean increases the probability of a state's receiving an A or B on this subindex by 1.8 percent.

These results confirm what one might expect, given the earlier discussion about the importance of education for economic development. First, due to high and increasing returns to education, education's greatest economic impact is in decreasing poverty and in generating a more equitable distribution of income. Second, due to these same factors, education also has a positive impact on earnings. Third, because educated workers are a critical factor in high-skill, high-performance companies, but not necessarily in all companies, it is understandable that we did not find a statistically significant relationship between education spending and the Employment Subindex (the third subindex of the Economic Performance Index). In other words, the impact of education on employment tends to vary from state to state, depending in part on each state's mix of employers.

It should also be noted that, given our earlier discussion about the nature of economic development and how it encompasses more than just jobs and wages, these findings concerning the relationship between education spending and grades on the Development Report Card for the States may understate the overall impact of education spending on economic development. In the following section, we will explore further the relationship between education spending and other non-market measures of economic development.

QUESTIONS ABOUT THE IMPACT OF EDUCATION SPENDING ON STUDENT ACHIEVEMENT

Given the evidence discussed above, one might be led to conclude unambiguously that in order to improve economic performance cities and states should increase education spending across the board. Yet, while human capital plays a critical role in economic development and while research indicates that spending on education has a positive effect on economic development, those who support increased education spending must account for a vexing problem--doubt remains about whether there is any relationship between education spending and educational performance.

Therefore, in the section that follows, we present a review of the "Does Money Matter?" debate, examining the arguments on both sides of the question. Since education, when viewed through economic development lenses, is both the primary input in efforts to create a high skill/high wage economy as well as one of many investments seeking scarce public funds, we hope to show that a state's or region's economic health is best served by a common sense view that seeks out a middle way between a simplistic interpretation that money does not matter and a naive conclusion that money is everything.

THE DEBATE: DOES MONEY MATTER?

The Hanushek Argument

As with most questions of social science, measuring the relationship between education spending and educational performance is difficult and complicated by a range of factors, both inside and outside the school house, that influence student performance. Perhaps the most commonly used technique for examining this relationship, adapted from the world of economics, is the "production function." For years, economists have used production functions to study the relationship between inputs (land, labor, capital) and products or outputs produced by industry.

A 1966 report entitled Equality of Educational Opportunity (more commonly referred to as the Coleman Report) was the first to employ an "educational production function" to examine the relationship between the inputs to the educational process (such as class size, length of school day, teacher experience, teacher pay) and outcomes. The Coleman Report found that differences in student achievement (measured in terms of standardized test scores) had little to do with differences in schools. Rather, family background and the characteristics of other students in the school were found to be much more important.

More recently, in a seminal article entitled "The Economics of Schooling: Production and Efficiency in the Public Schools," Eric Hanushek of the University of Rochester examined the findings from 147 separate studies of educational production functions and confirmed the findings of the Coleman Report. Hanushek concluded:

"The results are startlingly consistent in finding no strong evidence that teacher-student ratios, teacher education, or teacher experience have an expected positive effect on student achievement. According to the available evidence, one cannot be confident that hiring more educated teachers or having smaller classes will improve student performance. Teacher experience appears only marginally strong in its relationship. . . . There appears to be no strong or systematic relationship between school expenditures and student performance." (39)

Hanushek's work has been cited widely, not only in educational circles, but in the political arena, as well. In fact, in order to support the Reagan administration's position that the problems of America's schools were not the result of insufficient funds, former Secretary of Education William Bennett made frequent reference to Hanushek's conclusions.

Since many have attempted to politicize Hanushek's conclusions and to assert simply that "money doesn't matter," it is important to clarify Hanushek's position. In a more recent article, Hanushek writes: "most economists, including myself, would readily accept that differences in spending would be directly related to the education provided if schools were operating efficiently. The previously presented evidence [Hanushek's review of past education production function studies] indicates clearly, however, that assuming efficiency in spending is entirely inappropriate. . . . In other words, equity and efficiency are inextricably linked. It is not possible to ignore efficiency issues under the guise of being concerned solely with equity." (40)

Thus, Hanushek is not claiming that more money does not ever matter, rather that money is not everything. Moreover, more money spent wisely could make a difference.

The Response--New Thinking and Research

Partly in response to Hanushek's findings and partly as a result of improvements in education production function research (including new statistical techniques that can account for some of the problems with the data used by Hanushek), a number of different studies have been undertaken in recent years that challenge Hanushek's conclusions. In certain cases, these studies question Hanushek's finding of no relationship between education spending and student performance. In other cases, the studies seem to demonstrate that spending does have an effect on student achievement. Yet, in none of these studies do the findings suggest more education spending across the board. Some of the more interesting of these studies are discussed below.

Research Using "Meta Analysis"

In a re-analysis of the data used by Hanushek, researchers Larry Hedges, Richard Laine, and Rob Greenwald suggest that the data from these previous education production function studies do not support Hanushek's conclusions. (41) To start with, Hedges et al. question Hanushek's use of "vote counting" (42) as a procedure for analyzing the results of past studies. Because it may fail to detect statistically significant relationships, vote counting lacks statistical power. Moreover, vote counting is unable to give an indication of the magnitude of relationships that may exist.

To overcome these problems, Hedges et al. undertook a re-analysis of the data used by Hanushek, using a more sophisticated synthesis method known as "meta-analysis." (43) Using meta-analysis and starting with the 187 education production function equations used by Hanushek in his work, Hedges et al. produced the following conclusions:

--With the exception of teacher/pupil ratio and facilities, there are "at least some positive relations between each of the types of educational resource inputs studied and student outcome." (44) Those

inputs showing a positive relationship to student outcomes included per pupil expenditures, teacher experience, teacher education, teacher salary, and administrative inputs.

--In terms of the magnitude of the impact of various resources, per pupil expenditures and teacher experience demonstrate the greatest effect on student outcomes. The impact of other inputs (teacher salary, administrative inputs, facilities, class size, etc.) is more mixed.

Although it may seem contradictory that overall per pupil expenditure has such a clearly positive impact, while the effect of the inputs that make up overall spending (teacher salary, class size, etc.) is more mixed, Hedges et al. explain this. They argue that "this pattern of results is consistent with the idea that resources matter, but allocation of resources to a specific area (such as reducing class size or improving facilities) may not be helpful in all situations. That is, local circumstances may determine which resource inputs are most effective." (45)

In summary, Hedges et al. assert that "the question of whether more resources are needed to produce real improvement in our nation's schools can no longer be ignored. Relying on the data most often used to deny that resources are related to achievement, we find that money does matter after all." (46)

Research on Class Size

In a large scale, four-year study conducted during the late 1980s, researchers with Tennessee's Project STAR (Student/Teacher Achievement Ratio) (47) tested the effect of class size reductions on student achievement. By making use of a controlled experiment (rather than existing data), Project STAR was able to avoid some of the limitations of previous education production function research. (48)

Initially, students in 328 kindergarten classes across 79 schools were randomly assigned to either classes whose size had been reduced by approximately one-third (small classes) (49) or to a control group (regular classes). For four years (kindergarten through grade 3), Project STAR followed this large cohort of students and tested their achievement levels. Students remained in the same treatment group (class size) through the duration of the study; teachers were randomly assigned to classes each year. Project STAR's researchers found the following:

--Each of the four years, small class students scored significantly higher than students in regular classes in reading and math.

--The small class achievement advantage is found in all kinds of schools: inner city, suburban, rural, and urban. However, the small class advantage is largest, on the average, in inner-city schools as compared with other types of schools.

--The effect of a small class increases from kindergarten to first grade, but beyond first grade there is no cumulative effect.

Because reducing class size is a relatively costly intervention, John Folger and Carolyn Breda of Vanderbilt University have concluded that "even the greater class size effects gained in Project STAR do not make across-the-board class size reduction an attractive or cost-effective strategy for improving student achievement." (50) They recommend

instead targeted class size reductions combined with other proven instructional techniques for improving student achievement.

Research on Teacher "Characteristics"

Using a comprehensive education database from Texas, Ron Ferguson of Harvard's Kennedy School of Government has provided new insights into the relationship between skilled teaching and student achievement.

Ferguson's research makes use of a database from Texas that includes not only achievement test scores for all students in odd-numbered grades (Texas Educational Assessment of Minimum Skills--TEAMS), but also literacy skills scores for all teachers and administrators (Texas Examination of Current Administrators and Teachers--TECAT). This large and unique data set enables Ferguson to overcome some of the methodological deficiencies in previous education production function studies.

Based on his research, (51) Ferguson finds the following:

--Better literacy skills (i.e., higher TECAT scores) among teachers, fewer large classes, and more teachers with five or more years of experience all predict better TEAMS scores.

--Teachers' test scores are by far the most powerful of the school quality measures--TECAT scores explain roughly 25 percent of the variation among Texas school districts in students' average TEAMS scores for reading and math.

--Higher salaries attract better teachers.

In addition, Ferguson finds that, for districts in Texas, a threshold exists at a districtwide ratio of 18 students per teacher. Adding teachers to achieve a teacher/pupil ratio below this level does not typically raise test scores; adding teachers to achieve a ratio closer to the threshold typically does raise test scores.

Ferguson concludes that "since more and better teachers can help to improve students' test scores and higher salaries attract more and better teachers, money matters for raising test scores." (52) However, recognizing that increasing salaries across-the-board while holding teaching methods constant is unlikely to increase teacher performance in the short run, Ferguson notes: "To insure that salary enhancements foster improvements in teaching, salary increases need to be supplemented by efforts to assist existing teachers in upgrading their skills; measures to persuade talented and experienced teachers to stay in the profession; and campaigns to attract academically stronger candidates of all races into primary and secondary school teaching." (53)

The results of this newer research into the relation between education spending and student performance can best be summarized in the words of Johns Hopkins education researcher Robert Slavin: "It is clear (and obvious) that increased dollars do not magically transform themselves into greater learning. But it is just as clear (and just as obvious) that money can make a difference if spent on specific programs or other investments known to be effective." (54)

Legal Arguments

One final way to look at the debate about whether education spending has an effect on student performance is to examine the legal challenges to state systems for funding public education. In fact, while the question of whether money matters has attracted a great deal of interest in scholarly journals, it has become the focus of even greater attention in the courtroom.

In states across the country, courts have been asked to rule whether the method of funding public education (typically a reliance on local property taxes) fails to provide equal educational opportunity for all children. At the center of this question lies the debate about whether money matters. If money does matter, and if equal opportunity to education is constitutionally guaranteed, then states with spending disparities between districts are not meeting their constitutional requirements. If money doesn't matter, then spending differences are also of little consequence.

Of course, the courts have not been asked to rule directly on the question of whether money matters. Yet, their decisions represent, from a legal perspective, an evaluation of the arguments on both sides of the issue. The landmark ruling in this type of case comes from *Serrano v. Priest*, in which the California State Supreme Court ruled that equal access to education required equal funding: "Although an equal expenditure level per pupil in every district is not educationally sound or desirable because of differing educational needs, equality of educational opportunity requires that all school districts possess an equal ability in terms of revenue to provide students with substantially equal opportunities for learning." (*Serrano v. Priest*, 1977)

Since *Serrano*, 23 states have faced legal challenges to their systems of education finance.⁽⁵⁵⁾ While each challenge involves complex legal issues, three important trends emerge. First, courts are increasingly likely to overturn state school finance systems because of funding disparities between districts. As education finance expert Allan Odden has noted: "in the 1990's almost all the courts, when these decisions come before them, are overturning State school finance systems. The batting record in the 1970's and 1980's was about .330. In the 1990's it is about .900, so it looks like if you get a court case filed, it is very likely that the system will be overturned."⁽⁵⁶⁾ In other words, the courts are increasingly likely to imply that money does matter.

Second, in the 12 states in which the system was found to be constitutional, the courts typically based their decisions not on a finding that education spending disparities are unimportant, but rather on a finding that education was not a fundamental right in that particular state or on arguments for local control of education. In other words, in none of those 12 states (whose education finance systems were found to be constitutional) did the courts imply that "money doesn't matter."

Third, recent court decisions in states such as Kentucky, Alabama, and New Jersey have moved beyond mere spending adequacy to require states to provide equality in the depth, breadth, and quality of educational opportunities. Typically, these cases have referred to the need to teach students the kind of problem-solving and critical-thinking skills that will be demanded increasingly in the job market of the future. Summarizing this, Allan Odden notes that "the court trend seems to be towards more equal spending per pupil and at a level that would allow all districts and schools to educate students to

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a high level of academic achievement." (57)

WHAT ARE THE CONSEQUENCES OF UNDERSPENDING ON EDUCATION?

If increased spending on education can produce positive economic development outcomes, is the opposite also true? In other words, are there economic development consequences for under-investing in human capital? The economic development literature, as well as evidence of gross under-investment in public schools, provides insight on this question as well.

To begin with, advocates for more equitable funding of schools (58) have argued for years that extreme underfunding of education for certain populations of children can have drastic consequences on their ability to achieve success, both socially and economically, later as adults. In *Shortchanging Children: The Impact of Fiscal Inequity on the Education of Students at Risk*, William Taylor and Dianne Piche note that some of the programs that have been shown to make a difference in the life chances of children are too frequently denied to children in the poorest school districts: (59)

--Preschool. A number of the poorest districts in Texas could not participate in a state-funded preschool program because they lacked facilities and matching funds. In Maryland, the vast majority of children in affluent Montgomery County had the opportunity to attend either public or privately sponsored preschool programs, while in Baltimore City, at least half the children did not attend preschool.

--Class Size. In Montana, teacher student ratios in wealthy districts were as low as 1:13, while in poorer districts they were in the 20s or low 30s.

--Curriculum. In the wealthy Princeton, New Jersey, school district, there was one computer for 8 children, while the city of Camden's schools had one computer for 58. In Texas, many poor districts offered no foreign language, chemistry, calculus, college preparatory, or honors programs.

--Prevention of Early Reading Failure. In Maryland in 1979, 70 percent of the third-grade children in the property-poor district of Baltimore City had below-level reading scores while only 7 percent of the children in the wealthy district of Montgomery County fell below grade level in reading. Yet the wealthier district was able to provide a special reading teacher for those few students having reading difficulties, while the property-poor districts could not afford an additional teacher.

Clearly, these stark contrasts argue against a simplistic conclusion that money doesn't matter. In cases such as these and in Texas, where in 1990 the court found the average per pupil expenditure in the 100 wealthiest districts was \$7,233 compared with \$2,978 in the 100 poorest (60) (a difference of around \$4,250, which for a class of 30 translates into a difference of \$127,500 annually), money could buy a lot.

While it seems obvious that such extreme underfunding will have a significant impact on the labor market chances of children in resource-poor districts, it is also becoming clear that such limited opportunity affects economic opportunity for all. For example, preliminary research conducted by Larry Ledebur and William Barnes for the National League of Cities shows that, among metropolitan areas, those areas with greater city-suburban income disparities tend to have lower rates of employment growth. (61)

This would seem to indicate that the converse of the education spending-economic development link is also true. Namely, that a lack of adequate spending in inner cities on education (through the relationship between school quality and earnings--see Card and Krueger) leads to lower overall economic growth. (62)

Moreover, as noted above, economic development is more than just income or employment growth. In addition to these measures, successful economic development includes measures of overall quality of life, such as the health of the natural environment, the availability of quality living environments, personal health, and personal security. Thus, another way to look at the issue of the impact on economic development of lack of investment in human capital is to examine what happens to the quality of life in communities that underinvest in human capital. According to the Committee for Economic Development:

--About 82 percent of all Americans in prison are high school dropouts, and it costs an average of \$20,000 annually to maintain each prisoner.

--Investing \$4,800 per child in preschool education can reduce teenage arrests by 40 percent.

In addition, according to researchers Gordon Berlin and Andrew Sum, (63) there is a strong relationship between low basic skills and welfare dependency--60 percent of out-of-wedlock births among women 19 to 23 years old are to those who score in the lowest 20 percent in basic skills tests. Further, as compared with young people with above average basic skills, those with low basic skills are nine times more likely to drop out of school, eight times more likely to become mothers out of wedlock, and four times more likely to become welfare dependent.

Berlin and Sum estimate that raising the mean of the basic skills tests of 19- to 23-year-olds by the equivalent of one grade would increase lifetime earnings by 3.6 percent, reduce the likelihood of births out of wedlock by 6.5 percent, welfare dependency by 5.3 percent, and arrests by 6.2 percent.

HOW CAN STATES BEST USE EDUCATION INVESTMENTS TO PROMOTE ECONOMIC DEVELOPMENT?

There are no easy answers to the question of the relationship between education spending and economic development. On the one hand, it is clear that money does make a difference, particularly for students in schools with woefully inadequate resources. On the other hand, there is enough concern about how education monies are spent to warn against simply allocating more money to schools. In other words, common sense seems to indicate that economic health is best served by an understanding that lies somewhere between a simplistic interpretation that money does not matter and a naive conclusion that money is everything.

In many ways, this finding should come as no surprise. In the United States, where we spend almost 6 percent of our Gross National Product and roughly 18 percent of total tax collections on primary, secondary, and higher education, (64) there seems to be some consensus already that money does matter.

Given this, the real issue is whether spending more on education will improve economic development. From an economic development perspective, the answer is a qualified "yes." On the one hand, it seems clear that many students need more help to meet standards; that standards are changing; that competition for qualified teaching professionals is hot (i.e., teachers' salaries will have to go up some just to keep up); and that it will be politically difficult to meet the needs of at-risk youth via redistribution alone. All of this suggests the need for additional education spending. On the other hand, given both the growing anti-tax feelings across the country and the legitimate concerns about how efficiently schools are operating, new funds for education should be spent on what works and should be allocated with stronger accountability.

Thus, we would argue that increased spending on education can have a significant impact on a city's, region's, or state's economy, if done properly. Cities and states can do this by looking at education spending as one of the most critical investments in long-term economic health and by applying the following design principles that define overall best practice for state economic development policy: (65)

Impact: Increased investments in education should seek to identify the most pressing needs and support programs with the potential to meet the full scale of those needs.

After 20 years of equity litigation, students in resource-poor school districts across the country, many of them "at-risk" of leaving the education system unprepared for further education or work, still do not have access to some of the basic educational resources that children in wealthier districts take for granted. Moreover, according to this year's Department of Education back-to-school forecast, of the roughly 50 million children expected to attend elementary and secondary schools this year, almost 32 percent will be from minority backgrounds. This is an increase of more than five percentage points in just one decade (in 1984, 26.7 percent of elementary and secondary students came from minority families). Failing to invest properly in these students, many of whom come from backgrounds that leave them less prepared to do well in school, will have dire consequences for our competitiveness in an Information Age economy that demands increasing levels of skilled workers.

Thus, one obvious strategy for achieving significant economic impact with increased education investments would be to invest in proven techniques as well as promising reform approaches that will help to improve the performance of low achievers. These might include the following: (66)

- Preschool and other early childhood development programs
- Targeted class-size reductions, particularly for children in the early grades and children from low-income families
- School-based reform approaches (such as Accelerated Schools, the Comer School Development Program, and the "Success for All" model) that combine consistently high expectations for at-risk children with school-wide support systems to help students meet these expectations
- Experienced teachers assigned to teach subjects in which they have been well-trained
- Investments in staff development to help teachers (a) learn the most up-to-date information on curriculum and instruction and (b) incorporate these learnings into their daily lessons.

Accountability: Increased investments in education should be made based on the extent to which they can help solve the problem they were created to address.

In return for more resources, schools must be held accountable for improving student performance. Long a rallying cry of those critical of the performance of America's schools, this notion is gaining increasing acceptance within the education establishment. For example, in calling for a fundamental change in the federal Chapter 1 program, (67) an independent Commission on Chapter 1 made up of a diverse group of educators, child advocates, researchers, and concerned citizens concluded that, among other things, "rather than accounting for dollars, schools should be held accountable for results." (68)

One promising model for increasing accountability is the series of initiatives unleashed by the Kentucky Education Reform Act of 1990 (KERA). KERA was initiated after Kentucky's whole educational system and financing mechanisms were found unconstitutional. Thus, KERA addresses both gross spending inequities and restructuring.

Specifically, along with a 20 percent increase in the overall funding base for schools and a plan to have every school under school-based decision-making by 1996, KERA includes a variety of measures to enhance the accountability of individual schools, such as the following:

- An Office of Education Accountability, which verifies school performance, exercises sanctions against officials guilty of misconduct, and specifies school funding recommendations.
- Impact Evaluations--beginning in 1992, students in grades 4, 8, and 12 are tested every two years under a new performance-based assessment system that is keyed to 75 performance outcomes. These and other performance measures are used to determine whether individual schools are successfully making progress toward achieving a set of six overarching goals.

While it is still early to assess fully such a massive restructuring effort, it appears that the KERA effort, which involves increased funding, combined with reform and greater accountability, is on track. For instance, the Kentucky Institute for Education Research conducted three statewide surveys that polled the opinions of 954 school administrators and teachers and 535 parents and the general public regarding Kentucky's four-year-old reform initiative. Polling results

showed that four of five school leaders and two of three teachers believe that schools have improved during this period. In addition, school professionals, as a whole, and school administrators, in particular, do not want to return to the way schools were before KERA.

New test data suggest that KERA has had a positive effect on learning as well. Kentucky's 4th, 8th, and 12th grade students demonstrated dramatic improvement on the 1993-94 version of the annual statewide educational tests. In these grades, the percentage of students performing at or above the proficient level in mathematics, reading, science, and social studies has increased.

In the end, this massive restructuring and increased investment in Kentucky's education system will not guarantee improved economic performance in the future. Yet, the evidence from both CFED's Development Report Card for the States and other scholarly work on the relation between investment in public services and economic development would indicate that Kentucky is on the right track. The state's enhanced investments in human capital, guided by KERA, improve the state's chances for future growth.

Responsiveness to Customer Needs: Increased investments in education should be focused on improving program quality by placing greater emphasis on the needs of customers.

Over the next decade, the United States must organize its education resources to prepare its young people of all races with the learning and social skills required for economic and civic success in an increasingly knowledge-based society. Furthermore, the skills demanded by today's and tomorrow's economy are increasingly different from the skills provided by the public education system of the past 30 years. Both what young people learn and the way they learn it will have to undergo substantial change if investments in education are to help young people meet the requirements of the new economy.

To succeed in accomplishing this lofty mission will not be easy. Additional experimentation in a host of areas will be needed:

- Introducing learning technology into schools necessary to enable K-12 pupils to pursue a substantial part of their learning on an individualized and customized basis

- Creating learning environments that treat the student as an active participant or worker and the teacher as coach, so that the students will be better prepared for today's work and civic settings

- Encouraging teachers, parents, administrators, and the private sector to establish new options such as "schools-within-schools" (and other approaches) that allow parents and teachers to choose the learning setting that best meets their and their children's needs

- Making progress on critical challenges, such as lowering the dropout rate, smoothing the transition between school and work, and enhancing literacy, science, and mathematics skills

Performance-Based Management: Increased investment allocations in education should be based on performance.

Educational practices must be profoundly rethought if they are to work in the United States in the rest of this century and the beginning of the next. The old methods provide no solution. As Robert Woodson of the National Center for Neighborhood Enterprise, talking about another policy arena, put the matter: "If we keep on doing what we're doing, we're gonna keep on getting what we've got." (69)

Yet, in our increasingly anti-tax and anti-government America, additional resources will not likely be forthcoming unless they are tied to performance in improving the quality of education. This is another aspect of accountability and involves clarifying what children should learn, designing assessments that accurately measure how well students are learning, improving information sharing about what works and does not, providing adequate resources so that teachers are able to help students meet expectations, and developing appropriate rewards and sanctions for schools for their performance.

Of course, determining how to measure performance is a difficult issue. Schools help students develop many different skills, and not all of them are easily measured. In order to insure the development of performance standards that are appropriate and that do not encourage teachers simply to help students "beat the test," school districts should consider developing performance measures in collaboration with teachers and school administrators. (70)

One example of developing this kind of collaborative, performance-based management system can be found in the San Diego City Schools. Based on the recommendations of a Student Achievement Accountability Committee, the San Diego City Schools began implementing an accountability system in early 1993. This system consists of four primary elements: establishing standards, assessing performance, recognizing superior performance/intervening in the case of poor performance, and creating a public reporting process. As part of the standard-setting procedure, each school (including teachers, administrators, and other stakeholders) is involved in a process of identifying the particular standards against which it will be assessed.

In return for high achievement, current plans call for outstanding schools to be "recognized" with an in-kind bonus of up to 30 days of staff development time. (71)