Energy Efficiency and Job Creation in Colorado

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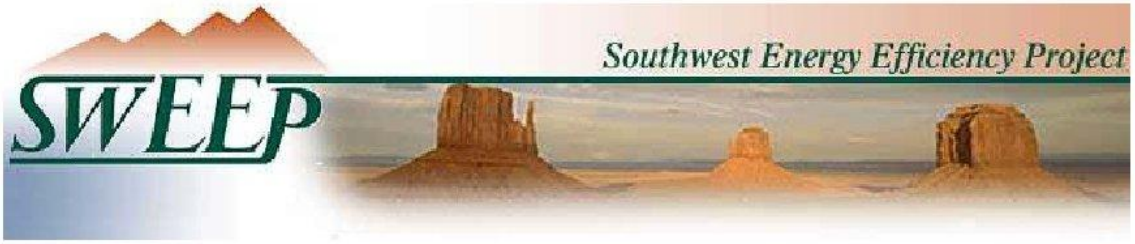

EXECUTIVE SUMMARY

In 2002, SWEEP published a study titled *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*. The study analyzed the potential economic and environmental benefits from increasing the efficiency of electricity use in six southwest states during 2003-2020. The study found that reducing electricity use in Colorado by 31 percent after an 18-year effort would increase statewide employment by 6,900 jobs and personal income by $280 million per year.

This report updates and expands upon the Colorado analysis included in *The New Mother Lode* study. It examines the impacts that increasing the efficiency of electricity, natural gas, and gasoline use could have on jobs and personal income in Colorado by 2015, 2020 and 2025. The energy efficiency policies and key assumptions for those policies are based mainly on the energy efficiency initiatives included in the Colorado Climate Action Plan issued by Governor Bill Ritter in November 2007. The energy efficiency policies included in this study are consistent with those proposed in the American Clean Energy and Security Act of 2009, the comprehensive energy and climate change legislation introduced by Representatives Waxman and Markey.

The following policies and programs are included in this study:

1. **Expand Electric Utility DSM Programs** – assumes that electric utilities, other than very small utilities, save the equivalent of 1 percent of their electricity sales from energy efficiency programs each year starting in 2010.

2. **Expand Gas Utility DSM Programs –** assumes that gas utilities save the equivalent of 1 percent of gas sales to their full service gas customers each year by 2011.

3. **Update and Enforce Building Energy Codes** – assumes that energy codes result in 5 percent electricity savings and 10 percent natural gas savings in all new buildings starting in 2007, with 5 percent additional savings realized every three years starting in 2010.

4. **Implement Lamp Efficiency Standards** – accounts for the lamp standards in the Energy Independence and Security Act of 2007 which will eventually eliminate ordinary incandescent lamps.

5. **Undertake an Industrial Energy Efficiency Program** – assumes that industries increase their investment in energy efficiency measures and practices with electricity and natural gas savings reaching 6.5 percent by 2015, 11.5 percent by 2020, and 16.5 percent by 2025.

6. **Adopt the Clean Car Standards** – assumes that Colorado joins other states in adopting and enforcing these standards, or that the Administration harmonizes the federal CAFE standards and the Clean Car Standards. In addition, we consider the

impact of the strengthened federal CAFE fuel efficiency standards included in the 2007 Energy Independence and Security Act.

METHODOLOGY

To analyze the employment and other economic impacts of the energy efficiency policies, we used an input-output model which accounts for interactions between all sectors of the economy. In particular, the model relies on Colorado specific industry coefficients derived from the IMPLAN Professional model. The coefficients were updated in 2007 (the most current year available). The modeling examines the direct, indirect and induced impacts of increased investment in energy efficiency.

Table ES-1 shows the cumulative energy efficiency investments and energy savings achieved as a result of these investments by sector for each of the Scenarios examined in this study. In the Overall Efficiency Scenario, we consider all six energy efficiency initiatives described above in combination. In addition, we separately consider initiatives that save electricity, natural gas, and gasoline. The investment values shown in Table ES-1 are for the 19 year period 2007-2025. The energy savings are the annual savings in 2025. The energy efficiency investments will result in energy savings well beyond 2025; however these savings were not considered in the study.

Table ES-1. Energy Efficiency Investments and Energy Savings

	Residential	Commercial	Industrial	Transportation	Total
Overall Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$3,530	$3,201	$1,730	$3,940	$12,401
Energy savings in 2025 (trillion Btu)	120.2	95.4	73.3	86.6	375.5
Electricity Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$2,375	$2,361	$1,286	--	$6,021
Energy savings in 2025 (GWh)	89.9	81.1	51.8	--	222.8
Natural Gas Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$1,155	$840	$444	--	$2,440
Energy savings in 2025 (million decatherms)	30.3	14.3	21.5	--	66.1
Transportation Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	--	--	--	$3,940	$3,940
Energy savings in 2025 (trillion Btu)	--	--	--	86.6	86.6

Note: In order to calculate energy savings for the Overall Energy Efficiency Scenario, electricity is considered as primary energy equivalent using a conversion factor of 11,500 Btu per kWh; i.e., accounting for energy losses in electricity generation, transmission and distribution from thermal power plants.

RESULTS

Table ES-2 shows the economic impacts of the Overall Energy Efficiency Scenario. By 2025, we estimate a net increase of 11,600 jobs in the state and a net increase in wage and salary compensation of $440 million (in 2007 dollars). Gross State Product (GSP) also rises slightly by 2025. The very small drop in GSP in 2015 and 2020 is the result of the transition from the capital-intensive nature of the electric and natural gas utility industries to more labor intensive energy efficiency investments.

Table ES-2. Overall Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	4,660	$134	($43)
2020	8,900	$303	($2)
2025	11,600	$440	$44

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total.

How significant is the estimated increase in jobs and income in Colorado? According to the Colorado Department of Labor and Employment, about 2.6 million workers were employed in Colorado and about 134,000 individuals in the state were unemployed as of 2008.[1] Thus, adding 4,660 jobs by 2015 will mean about a 0.2% increase in statewide employment. And adding 11,600 jobs by 2025 would mean about a 0.45% increase in statewide employment. The values are not enormous, but they are non-trivial for a state the size of Colorado.

The services, retail trade, and construction sectors all gain a sizable number of employees in the in the Overall Efficiency Scenario. The retail trade and the service sectors benefit from the actual investments in energy efficiency programs and technologies. They also benefit from the higher level of goods and services sold as ratepayers and businesses spend their energy bill savings elsewhere in the economy. The construction sector is the industry that benefits most directly as contractors and others are hired to install the new technologies and make the requisite efficiency upgrades.

In the Electricity Efficiency Scenario, electricity use in 2025 drops by nearly 26 percent relative to electricity use that same year in the baseline scenario. Table ES-3 shows the macroeconomic results for this scenario. Net jobs increase by 5,500 and net wage and salary compensation increases by more than $200 million in 2025. However, there is a very small reduction in GSP for each year reviewed.

[1] These figures were the annual averages. See http://www.coworkforce.com/lmi/ali/lfpage.asp for details.

Table ES-3. Electricity Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	3,220	$101	(31)
2020	4,920	$174	(53)
2025	5,500	$213	(73)

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume a 26 percent reduction in electricity use over the year 2025 forecasted values and a displacement of conventional electric-generating resources by the use of energy efficiency technologies.

In the Natural Gas Efficiency Scenario, natural gas use in 2025 drops by just over 18 percent relative to natural gas use that same year in the baseline scenario. Table ES-4 shows the macroeconomic results for the Natural Gas Efficiency Scenario. Net jobs increase by 1,520 and wage and salary compensation exceeds $33 million in 2025. Similar to the Electricity Efficiency Scenario, there is also a small drop in GSP for each year reviewed.

Table ES-4. Natural Gas Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	920	$20	(8)
2020	1,330	$30	(23)
2025	1,520	$33	(45)

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume an 18 percent reduction in natural gas use over the year 2025 forecasted values by the use of energy efficiency technologies.

In the Transportation Efficiency Scenario, gasoline use in 2025 drops by 22 percent relative to gasoline use that year in the baseline scenario. Table ES-5 shows the macroeconomic impacts for the Transportation Efficiency Scenario. Net jobs increase by 4,590 and wage and salary compensation by $194 million in 2025. GSP increases by $162 million in 2025, in contrast to the small reductions in GSP in the Electricity and Natural Gas Efficiency Scenarios. This is because the impact of businesses and consumers spending gasoline fuel savings is more than sufficient to offset the loss in GSP due to reduced investment in the petroleum-related sectors.

Table ES-5. Transportation Energy Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	520	$13	($4)
2020	2,650	$99	$74
2025	4,590	$194	$162

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume a reduction of 16.5 million barrels of motor gasoline over the year 2025 forecasted.

CONCLUSION

We estimate that implementing the energy efficiency initiatives in Governor Ritter's Colorado Climate Action Plan, thereby increasing the efficiency of electricity, natural gas, and gasoline use, will add 11,600 jobs in the state by 2025, roughly a 0.45 percent increase in the state's employment rate. Job growth would be widely distributed throughout the state's economy, with most of the growth occurring in the services, retail trade, and construction sectors. Electric utilities, gas utilities, mining, and the oil and gas production sectors lose jobs, although some of this loss can be mitigated if utilities provide comprehensive energy efficiency services to their customers.

As noted above, the energy efficiency policies analyzed in this study are consistent with proposals in the American Clean Energy and Security Act of 2009, the comprehensive federal energy and climate change legislation introduced by Representatives Waxman and Markey in early 2009. Thus we can conclude that at least the energy efficiency components of this legislation will have a positive impact on employment and income in Colorado.

A net increase in employment and income is just one of the benefits of widespread investment in energy efficiency measures. Other benefits include saving consumers and businesses money, reducing the need for costly and controversial new power plants and transmission lines, reducing carbon dioxide emissions and thus the state's contribution to global warming, reducing water consumption (less electricity generation means less water consumption), and reducing other harmful pollutants including nitrogen oxides, particulates, and mercury.

These positive results will occur by fully implementing the energy efficiency initiatives in Governor Ritter's Colorado Climate Action Plan. Some of the initiatives in the Plan are already underway due to either state or federal actions. In particular, investor-owned electric and gas utilities in Colorado are now implementing comprehensive energy efficiency programs for their customers. Federal lamp efficiency standards have been enacted, and the fuel economy standards for new cars and light

trucks are increasing as a result of federal legislation adopted in 2007. In addition, the Governor's Energy Office (GEO) is launching a statewide industrial energy efficiency program in 2009.

But some of the energy efficiency initiatives in the Governor's Plan have not yet been implemented or are only partially adopted. The missing or partially adopted elements include:

- strong energy efficiency programs on the part of municipal utilities and rural electric cooperatives in the state,
- state-of-the-art building energy codes in all cities and counties along with a process for routinely upgrading energy codes periodically, and
- adoption of the Clean Car Standards first promulgated in California.

We recommend fully implementing all of these initiatives in order to maximize the job gains as well as realize the other economic and environmental benefits of energy efficiency improvements.

A. INTRODUCTION

Many studies have shown that adoption of energy efficiency measures by households and businesses leads to increased employment and personal income. For example, a study completed in 1992 estimated that widespread energy efficiency improvements in all sectors of the U.S. economy would lead to a net addition of 1.1 million jobs after 18 years of effort.[2] More recently it was estimated that investing $100 billion in energy efficiency and renewable energy measures via the Federal stimulus effort would result in 2 million new jobs, more jobs than would be created by providing households with the same amount of money via income tax rebates or by spending the same amount on incentives for oil and gas production.[3] Likewise, researchers in California estimate that current energy efficiency initiatives will lead to a net increase of 181,000 jobs in the state by 2020, and that new energy efficiency, renewable energy, and other greenhouse gas-reducing initiatives could add 222,000 more jobs.[4]

Energy efficiency improvement leads to an increase in jobs in a number of ways. First, there are direct jobs from producing, selling and installing energy efficiency measures. Among others these include energy-efficient lamps or appliances, energy management and control systems, or retrofitting buildings to make them more energy-efficient. Second, there are indirect jobs associated with producing intermediate goods such as the materials that go into insulation or the electronic components that go into energy control systems. Third, there are so-called induced jobs when households and businesses lower their utility bills as a result of adopting energy efficiency measures, and then spend the money that is saved on other goods and services in the economy. All of these factors are analyzed in energy efficiency and jobs studies.

In 2002, SWEEP published a study titled *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*. The study analyzed the potential economic and environmental benefits from increasing the efficiency of electricity use in six southwest states during 2003-2020. It included analysis of the jobs and other macroeconomic impacts of a high efficiency scenario for each state in the region as well as for the region as a whole. The study found that reducing electricity use in Colorado by 31 percent after an 18-year effort would increase statewide employment by 6,900 jobs and personal income by $280 million per year.[5]

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[2] H. Geller, J. DeCicco, and S. Laitner. 1992. *Energy Efficiency and Job Creation: The Employment and Income Benefits from Investing in Energy Conserving Technologies.* Washington, DC: American Council for an Energy-Efficient Economy. Oct.

[3] R. Pollin, H. Garrett-Peltier, J. Heintz, and H. Scharber. 2008. *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy.* Washington, DC: Center for American Progress and the Political Economy Research Institute. Sept. http://www.peri.umass.edu/fileadmin/pdf/other_publication_types/peri_report.pdf

[4] D. Roland-Host. 2008. *Energy Efficiency, Innovation, and Job Creation in California.* Center for Energy, Resources, and Economic Sustainability. University of California, Berkeley. Oct. http://are.berkeley.edu/~dwrh/CERES_Web/Docs/UCB%20Energy%20Innovation%20and%20Job%20Creation%2010-20-08.pdf

[5] *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*. Boulder, CO: Southwest Energy Efficiency Project. Nov. 2002. http://www.swenergy.org/nml/index.html

This report updates and expands upon the Colorado analysis included in *The New Mother Lode* study. It examines the impacts that increasing the efficiency of electricity, natural gas, and gasoline use could have on jobs and personal income in Colorado by 2015, 2020 and 2025. The energy efficiency policies and key assumptions for those policies are based mainly on the energy efficiency initiatives included in the Colorado Climate Action Plan issued by Governor Bill Ritter in November 2007.[6]

B. Energy Efficiency Policy and Program Assumptions

The analysis of the macroeconomic impacts of energy efficiency improvements is based on a number of assumptions regarding energy efficiency policies and programs, and their associated costs and benefits. As noted above, we made use of the key energy efficiency initiatives included in the Colorado Climate Action Plan as the basis for our high efficiency scenario. The discussion below summarizes the policies and programs included in our analysis, and the key assumptions for each of them. For those policies and programs already underway, we start the analysis in 2007 since this is the first year of the Climate Action Plan.

The energy efficiency policies included in this study are consistent with those proposed in the American Clean Energy and Security Act of 2009, the comprehensive energy and climate change legislation introduced by Representatives Waxman and Markey in early 2009. Thus our analysis is indicative of the impacts that the energy efficiency components of this legislation, along with key components of the Energy Independence and Security Act of 2007, would have in Colorado.

1. Expand Electric Utility DSM Programs

The Colorado Climate Action Plan assumes that electric utilities will expand their demand-side management (DSM) programs and that these programs will result in 41 percent of the CO_2 emissions reduction from all energy efficiency initiatives included in the Plan for the utility sector. In 2008, the Colorado Public Utilities Commission (PUC) adopted energy efficiency goals for Xcel Energy that call for achieving energy savings equal to 1 percent of electricity sales by 2015 and 1.2 percent of sales by 2019. These savings are from programs implemented in one year alone. By 2020, the savings from cumulative programs implemented during 2009-2020 would equal to about 11.5 percent of Xcel's annual electricity sales.[7]

This policy assumes that the state adopts aggressive but achievable electricity savings standards or targets for utilities throughout the state, and that the standards or targets are met. In particular, it is assumed that utilities save the equivalent of 1 percent of their electricity sales from DSM programs each year starting in 2010. The standards or

[6] *Colorado Climate Action Plan: A Strategy to Address Global Warming*. Governor Bill Ritter, Jr. Nov. 2007. http://www.colorado.gov/energy/in/uploaded_pdf/ColoradoClimateActionPlan_001.pdf

[7] Decision No. C08-0560. Public Utilities Commission of the State of Colorado. Docket No. 07A-420E. Denver, CO, June 5, 2008.

targets would apply to Xcel Energy and other larger utilities in the state including municipal utilities and rural electric cooperatives, but would exclude the smallest utilities; i.e., those with less than 10,000 customers. Overall, the policy would cover utilities providing 92 percent of total electricity use in the state.

In 2025, savings from DSM programs implemented during 2007-2025 reach about 15 percent of statewide electricity sales that year. In order to meet these savings standards or targets, we estimate that electric utilities in aggregate would spend $90-100 million per year on energy efficiency programs during 2010-2025. For comparison, Xcel Energy is planning to spend $50 million on electric DSM programs in 2009 and $63 million in 2010.[8] The total investment in electric efficiency measures during 2007-2025, investments made by both utilities and consumers, would be about $3.2 billion.

2. Expand Gas Utility DSM Programs

Legislation adopted in 2007 (HB07-1037) directs natural gas utilities in Colorado to implement energy efficiency (DSM) programs for their customers. Xcel Energy began implementing a diverse set of gas DSM programs in January 2009, and other gas utilities in the state will launch programs later in 2009. The programs are paid for and offered to full service customers only; that is, they do not apply to larger customers that purchase natural gas in the wholesale market.

This policy assumes that gas DSM programs ramp up over the next few years and achieve savings equivalent to about 1 percent of gas sales each year by 2011. The savings only apply to full service gas customers which account for about 60 percent of gas consumption in the state (excluding gas use for electricity production). In 2025, savings from DSM programs implemented during 2007-2025 reach about 16.5 percent of sales that year to full service gas customers. In order to achieve this level of energy savings, gas utilities in aggregate would spend about $30 million per year on their energy efficiency programs. The total investment in gas efficiency measures during 2007-2025 would be about $943 million.

3. Update and Enforce Building Energy Codes

It is estimated that approximately 580,000 new single family homes will be built in Colorado during 2008-2025, or about 32,000 per year on average.[9] In addition, a substantial number of multi-family housing units will be constructed. Likewise, a considerable amount of commercial floor space will be built or renovated between now and 2025. Colorado is a home rule state, but legislation enacted in 2007 (HB07-1146) requires all local jurisdictions with building codes to adopt the 2003 International Energy

[8] 2009/2010 Demand-Side Management Biennial Plan. Public Service Company of Colorado. Revised Feb. 2009.
http://www.xcelenergy.com/Company/About_Energy_and_Rates/Energy%20Prices%20(Rates%20and%20Tariffs)/Pages/Demand-SideManagementBiennialPlan%E2%80%9320092010.aspx

[9] S. Dunn. 2007. *High Performance Homes in the Southwest: Savings Potential, Cost Effectiveness and Policy Options.* Boulder, CO: Southwest Energy Efficiency Project. Nov.
http://www.swenergy.org/hph/index.html

Conservation Code (IECC) or better. The legislation also allows the Governor's Energy Office (GEO) to establish a more stringent code as the floor for local energy codes in the future. A new version of the IECC was recently published. For new homes, the 2009 IECC provides about 12-15 percent energy savings compared to the 2006 version of the IECC.

This policy assumes that energy codes result in 5 percent electricity savings and 10 percent natural gas savings in all new buildings starting in 2007, and that 5 percent additional savings is realized every three years starting in 2010. However, due to diminishing returns, no further improvement in energy codes is assumed after 2020. These values are average energy savings across all new buildings; in reality some buildings will achieve more and others will achieve less savings. Also, it is assumed that GEO funds code-related training to help achieve high levels of energy code compliance, a requirement included in the American Recovery and Reinvestment Act of 2009. This policy was also included in the Colorado Climate Action Plan.

The analysis considers both electricity and natural gas savings in all new residential and commercial buildings. Most of the electricity savings comes from commercial buildings but most of the gas savings from residences. Total projected electricity savings in 2020 are 1,935 GWh and projected gas savings are 10.7 million decatherms. By 2025, the savings reach 3,185 GWh of electricity and 15.9 million decatherms of gas. We estimate that about $3.0 billion would need to be invested in efficiency measures during 2007-2025 in order to achieve these levels of energy savings.

4. Implement Lamp Efficiency Standards

The Energy Independence and Security Act of 2007 included minimum efficiency standards on so-called general service lamps. The standards take effect in two phases beginning in 2012. The standards will eliminate ordinary incandescent lamps, thereby stimulating widespread use of CFLs and other more efficient types of lights such as LED lights. This will result in large electricity savings at a very modest cost to consumers. Lamp efficiency standards were included in the Colorado Climate Action Plan.

It is assumed that the federal lamp standards begin to have an impact in 2012 with savings per home increasing until reaching maximum savings of 1,150 kWh/yr per home by 2023. The standards also have an impact in the commercial sector. We estimate a total investment of $370 million in more efficient lamps during 2011-2025, with electricity savings of 3,820 GWh/yr by 2020 and 4,765 GWh/yr by 2025.

5. Implement an Industrial Energy Efficiency Program

The Colorado Climate Action Plan also calls for an industrial energy efficiency program. GEO is planning to launch a program whereby industries are called upon to make voluntary commitments to reduce their energy intensity, including pledging to audit facilities and implement all cost-effective energy efficiency projects. Technical assistance

would be offered to companies that request it, and recognition and annual awards would be given to outstanding companies.

It is assumed that this policy is effective in engaging industries and stimulating increased investment in energy efficiency measures and practices. Energy savings across the industrial sector, both electricity and natural gas, are assumed to reach 6.5 percent by 2015, 11.5 percent by 2020, and 16.5 percent by 2025. Total projected electricity savings in 2025 is 2,190 GWh and projected gas savings is 21.5 million decatherms. It is estimated that about $925 million would need to be invested in efficiency measures and practices during 2007-2025 in order to achieve these levels of energy savings in the industrial sector.

6. Adopt the Clean Car Standards

California and thirteen other states, including Arizona and New Mexico, have adopted standards known as the Clean Car Standards, which regulate the CO2 emissions of new cars and light trucks. During the Bush administration, the U.S. EPA failed to grant California and the other states the waiver needed under the Clean Air Act to implement the Clean Car Standards. However, the Obama administration has indicated it will approve such a waiver.

The Colorado Climate Action Plan indicates that the state will join with other states that have adopted the Clean Car Standards. It directed the Department of Public Health and Environment to propose the Standards within 12 to 24 months. However, this has not occurred so far. This policy assumes that the Obama administration allows states to implement the Clean Car Standards and that Colorado does join other states in adopting and enforcing the Standards, or that the administration harmonizes the federal CAFE standards and the Clean Car Standards. In addition, we consider here the combined impact of the Clean Car Standards and the strengthened federal CAFE fuel efficiency standards included in the 2007 Energy Independence and Security Act.

The combination of the stronger CAFE and Clean Car Standards leads to a very significant improvement in new vehicle efficiency. We estimate that the standards would result in 10 million barrels of gasoline savings in Colorado by 2020 and 16.5 million barrels of savings by 2025. The latter is equivalent to about 22 percent of projected gasoline use in the state in the absence of the new standards. In order to achieve these savings, we estimate an incremental cost of $3.9 billion for cars and light trucks purchased in the state during 2009-2025. But this investment is very cost effective with an average payback period of less than three years. These investments apply entirely to improving the fuel efficiency of new cars and light trucks. Additional investments could be made in mass transit or other strategies for reducing vehicle use, but they are not considered in this study.

C. METHODOLOGY

To analyze the employment and other economic impacts of the energy efficiency policies, we used an input-output model which accounts for interactions between all sectors of the economy. Input-output (I-O) models were initially developed to trace supply linkages in the economy. For example, I-O models can show how states that produce fabricated metal products, for instance, will likely benefit from expanded sales of locally manufactured, high-efficiency light fixtures; states without such production will not benefit in the same way.

To capture the full economic impacts of the investments in energy efficiency, three separate effects (direct, indirect, and induced) must be examined for each change in expenditure.

- The *direct* effect refers to the on-site or immediate effects produced by expenditures. In the case of installing energy efficiency upgrades in a home or business, the direct effect is the on-site expenditures and jobs of the construction or trade contractors hired to carry out the work.

- The *indirect* effect refers to the increase in economic activity that occurs when a contractor or vendor receives payment for goods or services delivered and he or she is able to pay others who support their businesses. This includes the equipment manufacturer or wholesaler who provided the new technology. It also includes the bank that provides financing to the contractor, the vendor's accountant, and the building owner where the contractor maintains its local offices.

- The *induced* effect derives from the change in spending that energy efficiency investments enable. Businesses and households are able to meet their energy, heating, cooling, lighting, and transportation needs at a lower total cost, due to efficiency investments. This lower cost of doing business and operating households makes greater wealth available for businesses and families to spend or invest in other goods and services such as food, clothing, entertainment, or marketing (in the case of businesses).

The sum of these three effects yields the total effect resulting from a single expenditure.

1. Analyzing the Energy Efficiency Scenario

To analyze the energy efficiency scenario, the net changes in expenditures are matched with appropriate industry multipliers. In this study we have adapted industry multipliers from the 2007 IMPLAN model for the analysis.[10] The analysis considers all changes in business and consumer expenditures — both positive and negative. Different types of expenditures support different levels of total employment. Table 1 shows the

[10] See Minnesota IMPLAN Group, Stillwater, MN, www.implan.com.

total number of jobs in Colorado that are directly and indirectly supported for each one million dollars of expenditures in different areas of the economy.[11]

Table 1. Colorado Employment Multipliers for Selected Economic Sectors

Sector	Employment Multipliers
Oil Refining	2.1
Natural Gas Utilities	2.5
Electric Utilities	2.7
Motor Vehicles	2.8
Primary Metals	3.1
Oil and Gas Production	3.5
Coal Mining	4.1
Transportation, Communication & Utilities	5.1
Other Mining	5.3
Other Manufacturing	5.3
Food	5.9
Insurance/Real Estate	7.1
Finance	7.6
Wholesale Trade	7.6
Construction	9.6
Agriculture	10.5
Government	11.3
Services	12.4
Retail Trade	17.6

Source: Adapted from the 2007 IMPLAN database for Colorado. The employment multipliers represent the direct and indirect jobs supported by one million dollars of expenditure for the goods or services from a given sector.

The employment multipliers in Table 1 cover key sectors of the economy such as agriculture, construction, manufacturing, utility services, wholesale and retail trade, services, and government, among others. For this analysis, a job is defined as sufficient wages to employ one person full-time for one year. Of immediate interest in Table 1 is the relatively small number of jobs supported for each one million dollars spent on fuels production, electricity, and natural gas. As it turns out, much of the net job creation from energy efficiency programs is derived from the difference between the number of jobs lost within the utility and fuel supply sectors offset by the number of other jobs supported by the spending of energy bill savings throughout the economy.

[11] Table 1 presents what are referred to as Type 1 multipliers, incorporating only the direct and indirect effects of an expenditure. Adding the induced effect (i.e., the additional level of impact from the spending of wages in the Colorado economy) generates what are known as Type II multipliers (or Type III multipliers as referenced in the IMPLAN model). However, since household spending is part of the final demand changes in the analysis it was decided to limit the employment and other macroeconomic impacts to the Type I multipliers.

The analysis included several modifications to this technique of matching expenditures with their appropriate multipliers. First, it was assumed that only 90 percent of the efficiency investments are spent within the state of Colorado. Typically, most efficiency improvements are completed by local contractors and dealers. But some can be done by out-of-state firms.

Second, an adjustment was made in the employment impacts to account for sector-specific changes in labor productivity that are projected to occur. As indicated in the Bureau of Labor Statistics' *Employment and Output by Industry, 1996, 2006, and Projected 2016,* productivity rates are expected to vary widely among sectors, ranging from a 0.4 percent annual productivity gain in the finance sectors to just under 5.0 percent annual productivity gain in the construction sectors.[12]

Third, for purposes of estimating energy bill savings it was assumed that energy prices remain at 2007 levels in constant (inflation–adjusted) dollars. This simplifies the matching of energy prices with an input-output model based upon 2007 price relationships. If future energy prices rise faster than inflation, then the net increase in jobs and personal income would be even greater than that estimated here. So the assumption of level energy prices in constant dollars is conservative.

Fourth, it was assumed that approximately 80 percent of the investment upgrades will be financed by bank loans carrying an average interest rate of 10 percent over a five-year period. To limit the scope of the analysis, however, no parameters were established to account for any changes in interest rates as less capital-intensive technologies (i.e., efficiency investments) are substituted for conventional supply strategies, or in labor participation rates — all of which might affect overall spending patterns.

Finally, it should again be noted that the full effects of the efficiency investments are not accounted for since the energy bill savings beyond 2025 are not incorporated in the analysis. Nor does the analysis include other productivity benefits that are likely to come about from the efficiency investments. These can be substantial, especially in the commercial and industrial sectors. Energy efficiency investments by businesses often result in improved product quality, lower capital and operating costs, reduced waste generation, or increased employee productivity.[13] To the extent these benefits are realized in addition to the energy savings, the economic impacts will be greater than those reported here.

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[12]The productivity trends were calculated by MRG & Associates using data from the Bureau of Labor Statistics employment projections, downloaded from the BLS FTP site www.ftp.bls.gov/pub/special.requests/ep/ind.employment/empinddetail.txt, U.S. Department of Labor, Washington, DC, January 2009.

[13] See J.J. Romm. 1999. *Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions.* Washington, DC: Island Press. Also, N.P. Hall and J.A. Roth. 2003. "Non-Energy Benefits from Commercial and Industrial Energy Efficiency Programs: Energy Efficiency May Not Be the Best Story." *Proceedings of the 2003 International Energy Program Evaluation Conference.* Seattle, WA. pp. 689-702.

D. DATA AND RESULTS

Table 2 shows the cumulative energy efficiency investments and energy savings achieved as a result of these investments by sector for each of the Scenarios examined in this study. In the Overall Efficiency Scenario, we consider all six energy efficiency initiatives described above in combination. In addition, we separately consider initiatives that save electricity, natural gas, and gasoline. The investment values shown in Table 2 are for the 19 year period 2007-2025.[14] The energy savings are the annual savings in 2025. We note again that the energy efficiency investments will result in energy savings well beyond 2025; however these savings were not considered in the study.

Table 2. Energy Efficiency Investments and Energy Savings

	Residential	Commercial	Industrial	Transportation	Total
Overall Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$3,530	$3,201	$1,730	$3,940	$12,401
Energy savings in 2025 (trillion Btu)	120.2	95.4	73.3	86.6	375.5
Electricity Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$2,375	$2,361	$1,286	--	$6,021
Energy savings in 2025 (GWh)	89.9	81.1	51.8	--	222.8
Natural Gas Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	$1,155	$840	$444	--	$2,440
Energy savings in 2025 (million decatherms)	30.3	14.3	21.5	--	66.1
Transportation Efficiency Scenario					
Cumulative Investment (million 2007 dollars)	--	--	--	$3,940	$3,940
Energy savings in 2025 (trillion Btu)	--	--	--	86.6	86.6

Notes: In order to calculate energy savings for the Overall Energy Efficiency Scenario, electricity is considered as primary energy equivalent using a conversion factor of 11,500 Btu per kWh; i.e., accounting for energy losses in electricity generation, transmission and distribution from thermal power plants.

As shown in Table 2, we assume a total investment of about $12.4 billion (in 2007 dollars) in energy efficiency measures during 2007-2025 in the Overall Efficiency Scenario. About half the investment is in measures that save electricity, 31 percent in measures that reduce gasoline use, and 19 percent in measures that reduce natural gas consumption. We estimate that these investments result in about 375 trillion Btu of primary energy savings per year by 2025, with about 32 percent of the primary energy

[14] Efficiency investments and savings in the transportation analysis begin in 2009 and run through 2025.

savings coming from the residential sector, 25 percent from the commercial sector, 23 percent from the transportation sector, and about 20 percent from the industrial sector.

Using the imput-output model, the investment and savings estimates were used to estimate three sets of impacts. The first is the net contribution to Colorado's employment base as measured by full-time equivalent jobs. The second is the net gain to Colorado's wage and salary compensation, measured in millions of 2007 dollars. The final impact is the net contribution to Gross State Product (GSP) also measured in millions of 2007 dollars. In other words, once the gains and losses are sorted out in each scenario, the analysis provides the net impact of the scenario on the state's economy.

1. Overall Energy Efficiency Scenario

Table 3 shows the economic impacts of the Overall Energy Efficiency Scenario. It provides the estimated economic benefits of the accelerated use of energy efficiency technologies in all sectors.

Table 3. Overall Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	4,660	$134	($43)
2020	8,900	$303	($2)
2025	11,600	$440	$44

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total.

There are a number of different aspects of Table 3 worth noting. The first is that wage and salary earnings as well as employment rise throughout the period of analysis. The impacts increase over time as more investment in energy efficiency and more energy savings occur. By 2025, we estimate a net increase of 11,600 jobs in the state and a net increase in wage and salary compensation of $440 million (in 2007 dollars). Gross State Product (GSP) also rises slightly by 2025.

The very small drop in GSP in 2015 and 2020 shown in Table 3 is the result of the transition from the capital-intensive nature of the electric and natural gas utility industries. These industries require greater total assets for each dollar of revenues generated by the utility, relative to other industries. As the revenues of the utilities decrease under the efficiency scenario, the amount of capital investment also decreases (i.e., fewer new power plants and pipelines are built); this in-turn lowers the overall value-added and GSP for the state as a whole. This impact is tempered somewhat by the investments in efficiency and spending of energy bill savings. However, the full impact

of these investments and savings in more labor intensive, rather than capital intensive industries, is not realized until several years later; at that point, GSP turns positive. However, the estimated change in GSP in all years is very small.

How significant is the estimated increase in jobs and income in Colorado? According to the Colorado Department of Labor and Employment, about 2.6 million workers were employed in Colorado and about 134,000 individuals in the state were unemployed as of 2008.[15] Thus, adding 4,660 jobs by 2015 will mean about a 0.2% increase in statewide employment. And adding 11,600 jobs by 2025 will mean about a 0.45% increase in statewide employment. The values are not enormous, but they are non-trivial for a state the size of Colorado.

Table 4 provides additional insight into the projections. It shows how each of the major economic sectors is affected in the year 2025 in the Overall Efficiency Scenario. The sectors are listed according to the anticipated job impacts beginning with those sectors that have the largest employment gains.

Table 4 shows that the services, retail trade, and construction sectors all gain a sizable number of employees in the in the Overall Efficiency Scenario. The retail trade and the service sectors benefit from the actual investments in energy efficiency programs and technologies. They also benefit from the higher level of goods and services sold as ratepayers and businesses spend their energy bill savings elsewhere in the economy.

The construction sector is the industry that benefits most directly as contractors and others are hired to install the new technologies and make the requisite efficiency upgrades. The construction sector alone pulls in about 9 percent of the net job increases in the year 2025. Using the construction industry as a benchmark for evaluation, it might be noted that about 1 out of 11 new jobs in this sector in 2025 are from the efficiency investments made in that year. The remaining impacts are the result of spending of energy bill savings by households and businesses.

As might be expected, the energy industries incur overall losses in jobs, wage compensation, and GSP. But this result can be tempered somewhat as the industries themselves are undergoing internal restructuring. For example, as the electric utilities engage in more energy efficiency services and other alternative energy investment activities, they will undoubtedly employ more people from the business services and engineering sectors. Explained differently, while the electric utilities may lose an estimated 980 traditional jobs (due to selling less energy), they can gain many of those jobs back if they move aggressively into the energy efficiency business, thereby absorbing some of the job gains realized in other sectors, such as the construction and service sectors. In effect, if they expand their participation in the energy efficiency market, their job totals can increase relative to the estimates based on a more conventional definition of an electric utility as solely an energy supplier.

[15] These figures were the annual averages. See http://www.coworkforce.com/lmi/ali/lfpage.asp for details.

Table 4. Overall Efficiency Scenario Impacts by Sector in 2025

Sectors	Jobs (Actual)	Wage and Salary Compensation (million $)	GSP (million $)
Services	7,880	$458	$631
Retail Trade	2,560	$129	$206
Construction	1,050	$59	$71
Insurance/Real Estate	750	$30	$110
Other Manufacturing	430	$70	$99
Government	430	$38	$43
Wholesale Trade	250	$40	$67
Agriculture	200	$5	$15
Food	160	$14	$25
Finance	150	$25	$42
Transportation, Communication & Utilities	30	$7	$12
Motor Vehicles	20	$2	$2
Primary Metals	10	$3	$6
Oil Refining	(10)	($7)	($19)
Other Mining	(20)	($3)	($5)
Coal Mining	(100)	($19)	($33)
Natural Gas Utilities	(340)	($64)	($155)
Oil and Gas Production	(860)	($168)	($450)
Electric Utilities	(980)	($178)	($625)
TOTAL	**11,600**	**$440**	**$44**

Notes: The numbers in parentheses reflect losses that are projected to occur in that sector as a result of the energy efficiency scenario. Jobs refer to the net jobs created or lost in each sector. Compensation refers to the net gain in wage and salary income by sector. GSP refers to the net gain or loss in Colorado's Gross State Product by sector. All dollar values are in millions of 2007 dollars. Totals may not add up due to rounding.

As elsewhere it should be noted that the results in these tables are not intended to be precise forecasts but rather approximate estimates of overall impact. While the aggregate totals offer reasonable insights into the benefits of the energy efficiency investments and savings, some of the individual sectors show impacts that are very small, meaning that the results may swing one way or the other depending upon even modest changes in the assumptions.

2. ELECTRICITY EFFICIENCY SCENARIO

In the Electricity Efficiency Scenario, electricity use in 2025 drops by nearly 26 percent relative to electricity use that same year in the baseline scenario. Electricity

savings result from expanded utility DSM programs, lamp efficiency standards, improved building energy codes, and the industrial sector initiative. The cumulative investment in electricity efficiency measures during the 2007 through 2025 study period totals just over $6.0 billion, while annual electricity bill savings reach just under $1.7 billion in 2025. Table 5 shows the macroeconomic results for this scenario.

Table 5. Electricity Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	3,220	$101	(31)
2020	4,920	$174	(53)
2025	5,500	$213	(73)

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume a 26 percent reduction in electricity use over the year 2025 forecasted values and a displacement of conventional electric-generating resources by the use of energy efficiency technologies.

The results in Table 5 are generally positive. Net jobs increase by 5,500 and net wage and salary compensation increases by more than $200 million in 2025. An interesting result is the drop in GSP for each year reviewed. Similar to the Overall Efficiency Scenario discussed earlier, this reflects the lower electric utility industry revenues and the capital-intensive nature of the industry. The positive impacts from the investments in efficiency and spending of energy bill savings (again in more labor intensive industries, rather than capital intensive industries) are not sufficient to offset the utility, natural gas and petroleum industry-related GSP losses.

On the other hand, the wage and salary compensation share of GSP actually increases in all three periods evaluated here. This is for two reasons. First, new electric plants are displaced by more cost-effective efficiency investments that are more labor rather than capital intensive. Second, the spending of electricity bill savings, from consumer and business purchases, is also more labor intensive. The change in the economic mix results in a net increase in wages and employment.

Similar to the Overall Efficiency Scenario, Table 6 shows the same three big "winners" in the Electricity Efficiency Scenario. These are the service sectors, retail trade, and construction industry. Retail trade and the service sectors are winners because they benefit from the actual investments in energy efficiency programs and technologies. They also benefit from the higher level of goods and services sold as households and businesses spend their energy bill savings throughout the economy. The construction industry benefits as contractors are hired to make the energy efficiency upgrades.

Table 6. Electricity Efficiency Scenario Impacts by Sector in 2025

Sectors	Jobs (Actual)	Wage and Salary Compensation (million $)	GSP (million $)
Services	3,110	$181	$249
Retail Trade	1,510	$76	$122
Construction	720	$40	$48
Government	540	$48	$55
Insurance/Real Estate	250	$10	$37
Other Manufacturing	160	$27	$38
Finance	130	$21	$36
Agriculture	80	$2	$6
Wholesale Trade	80	$14	$23
Food	60	$5	$9
Primary Metals	10	$2	$4
Other Mining	10	$1	$2
Motor Vehicles	10	$1	$1
Natural Gas Utilities	0	$1	$2
Oil Refining	0	$0	$1
Transportation, Communication & Utilities	(30)	($7)	($12)
Oil and Gas Production	(50)	($9)	($24)
Coal Mining	(100)	($19)	($33)
Electric Utilities	(1,000)	($181)	($636)
TOTAL	**5,500**	**$213**	**($73)**

Notes: The numbers in parentheses reflect losses that are projected to occur in that sector as a result of the alternative energy scenario. Jobs refer to the net jobs created or lost in each sector. Compensation refers to the net gain in wage and salary income by sector. GSP refers to the net gain or loss in Colorado's Gross State Product by sector. All dollar values are in millions of 2007 dollars. Totals may not add up due to rounding.

Table 6 shows that the traditional electric utilities sector loses the most jobs, similar to the results for the Overall Efficiency Scenario. The loss of jobs assumes a traditional economic structure for electric utilities in 2025. Thus, as fewer conventional power plants are needed as a result of energy efficiency gains, fewer traditional utility jobs are sustained. Once again, this points to an important opportunity for utilities: if utilities become more proactive in the area of energy efficiency services, they can employ more employees to carry out these new responsibilities. One might assume, therefore, that utilities can incorporate at least part of the jobs gained in the construction and service sectors if they implement well-funded and comprehensive energy efficiency programs for their customers.

It should also be remembered that these estimates are not job losses in the strict sense of the word. Rather, they reflect differences between a business-as-usual (baseline) projection of future employment and jobs made available from an energy efficiency scenario. In the aggregate, there is a significant positive gain in employment and wage and salary compensation, a drop in the unemployment rate, and more than 17 jobs created for each million dollars of investment in 2025.[16]

3. NATURAL GAS EFFICIENCY SCENARIO

In the Natural Gas Efficiency Scenario, natural gas use in 2025 drops by just over 18 percent relative to natural gas use that same year in the baseline scenario. Natural gas savings result from expanded gas utility DSM programs, building energy codes, and the industrial energy efficiency initiative. The cumulative investment in natural gas efficiency measures during 2007-2025 totals just over $2.4 billion, while annual natural gas bill savings reach just over $525 million in 2025. Table 7 summarizes the main results for the Natural Gas Efficiency Scenario.

Table 7. Natural Gas Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	920	$20	(8)
2020	1,330	$30	(23)
2025	1,520	$33	(45)

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume an 18 percent reduction in natural gas use over the year 2025 forecasted values by the use of energy efficiency technologies.

The results in Table 7 are generally positive. Net jobs increase by 1,520 and wage and salary compensation exceeds $33 million in 2025. Similar to the Electricity Efficiency Scenario, there is also a small drop in GSP for each year reviewed. This reflects not only the capital-intensive nature of the gas and petroleum-related industries, but the significant share of natural gas derived from local resources. As the sales of natural gas decreases, the reduction in demand impacts investment by the oil and gas industries. This in turn lowers the overall value-added and GSP for the state as a whole. Similar to the Electricity Efficiency Scenario, the positive impacts from the investments in efficiency and spending of energy bill savings (again in more labor intensive, rather than capital intensive, industries) are not sufficient to offset the gas utility and oil and gas production-related GSP losses.

[16] This estimate is based on an electricity only investment of $317 million in 2025 (5,500 jobs / $317 million investment = 17.5).

Table 8. Natural Gas Efficiency Scenario Impacts by Sector in 2025

Sectors	Jobs (Actual)	Wage and Salary Compensation (million $)	GSP (million $)
Services	750	$44	$60
Construction	490	$27	$33
Retail Trade	420	$21	$34
Government	80	$7	$8
Insurance/Real Estate	80	$3	$11
Other Manufacturing	70	$12	$17
Agriculture	40	$1	$3
Finance	40	$7	$12
Wholesale Trade	30	$5	$8
Food	20	$2	$3
Coal Mining	0	$0	$0
Oil Refining	0	$0	$1
Primary Metals	0	$1	$2
Other Mining	0	$0	$0
Motor Vehicles	0	$0	$0
Electric Utilities	0	$1	$2
Transportation, Communication & Utilities	(30)	($6)	($10)
Oil and Gas Mining	(140)	($27)	($72)
Natural Gas Utilities	(350)	($66)	($157)
Total	**1,520**	**$33**	**($45)**

Notes: The numbers in parentheses reflect losses that are projected to occur in that sector as a result of the alternative energy scenario. Jobs refer to the net jobs created or lost in each sector. Compensation refers to the net gain in wage and salary income by sector. GSP refers to the net gain or loss in Colorado's Gross State Product by sector. All dollar values are in millions of 2007 dollars. Totals may not add up due to rounding.

On the other hand, the wage and salary compensation share of GSP increases in all three periods evaluated here. This is for two reasons. First, natural gas use is displaced by more cost-effective efficiency investments that are more labor intensive rather than capital intensive. Second, the spending of natural gas bill savings, from consumer and business purchases, is also more labor intensive. The change in the economic mix results in a net increase in employment and just under 12 jobs created for each million dollars of investment in 2025.[17]

[17] This estimate is based on a natural gas only investment of $128 million in 2025 (1,520 jobs / $128 million investment = 11.8).

As Table 8 shows, the services sector gains the most jobs, followed by the construction industry and retail trade industry. Similar to the other scenarios, they gain from the investments in natural gas efficiency programs and technologies. They also benefit from the spending of energy bill savings throughout the economy. The construction industry benefits as special trade contractors and others are hired to install the new efficient technologies and make the efficiency upgrades.

Table 8 also shows that the natural gas utilities sector loses the most jobs. Again, the loss of jobs assumes a traditional economic structure for natural gas utilities in 2025. Thus, as natural gas demand decreases as a result of efficiency gains, fewer traditional utility jobs are sustained. Once again, similar to electric utilities, this points to an important opportunity for natural gas utilities to become more proactive in the area of energy efficiency services and other similar programs.

4. TRANSPORTATION EFFICIENCY SCENARIO

The Transportation Efficiency Scenario considers improvements in the fuel efficiency of new cars and light trucks; it does not involve investments in mass transit or other strategies for reducing vehicle use. In the Transportation Efficiency Scenario, gasoline use in 2025 drops by 22 percent relative to gasoline use that year in the baseline scenario. The investment in transportation efficiency measures between 2009 and 2025 totals just over $3.9 billion while annual energy bill savings reach just under $1.7 billion in 2025. Table 9 summarizes the main impacts for the Transportation Efficiency Scenario.

Table 9. Transportation Energy Efficiency Scenario Impacts

Year	Net Jobs Gain	Change in Wage and Salary Compensation (million $)	Change in Gross State Product (million $)
2015	520	$13	($4)
2020	2,650	$99	$74
2025	4,590	$194	$162

Notes: Dollar figures are in millions of 2007 dollars while employment reflects the actual job total. The calculations assume a reduction 16.5 million barrels of motor gasoline over the year 2025 forecasted.

The results for the Transportation Efficiency Scenario are very positive. Net jobs increase by 4,590 and wage and salary compensation by $194 million in 2025. GSP increases by $162 million in 2025. Perhaps the most interesting result in this table is the increase in GSP for each year after 2015 compared with the reduction in GSP in the Electricity and Natural Gas Efficiency Scenarios. Although the petroleum industry is capital-intensive, similar to the electric and natural gas utility industries, the impacts from

spending gasoline fuel savings (consumer and business purchases) are more than sufficient to offset the loss in value added and GSP after 2015. Consistent with the impacts from spending of gasoline fuel savings, the wage and salary compensation share of GSP and jobs also increases in all three periods evaluated here.

Transportation efficiency investments account for almost 32 percent of the total efficiency investments (as shown in Table 2) by the year 2025 and result in just under 20 jobs per million dollars of investment in 2025.[18] At the same time, transportation efficiency improvements lead to nearly 40 percent of net employment benefits in 2025 in the Overall Efficiency Scenario.

Table 10 indicates that while many sectors show job gains under the Transportation Efficiency Scenario, the service sector is the big "winner". This is due primarily to consumers and businesses spending gasoline savings on services (and elsewhere in the economy). Similar to the results for the Electricity Efficiency Scenario, the retail sector also shows a large benefit, although significantly lower than might be expected when compared with the Electricity Efficiency Scenario. This difference is primarily the result of the variation in investment spending. In the electricity efficiency scenario a significant portion of the investments in efficiency measures is spent at retail establishments. This does not occur in the Transportation Efficiency Scenario.

Table 10 also shows that the traditional petroleum-based industries lose the most jobs, similar to the results for the Overall Efficiency Scenario. As demand for gasoline diminishes, fewer jobs are sustained in the petroleum industry.

At the same time, Table 10 indicates that the government and construction sectors and other petroleum-related industries sustain job losses as well. Government loses jobs mainly due to the loss in tax revenues associated with reduction in gasoline sales volumes. The construction industry loses jobs from associated reductions in demand related to oil and gas mining. By contrast, the construction sector gains jobs in the Electricity Efficiency Scenario because it is one of the key industries benefiting directly from the energy efficiency investments.

As noted earlier, it should also be remembered that these estimates are not job losses in the strict sense of the word. Rather, they reflect differences between a business-as-usual (baseline) projection of future employment and jobs and an enhanced energy efficiency scenario. In the aggregate, there is a significant positive gain in employment, wage and salary compensation, and GSP, and a drop in the overall unemployment rate, as a result of adopting the Clean Car Standards and strengthening the Federal CAFE standards.

[18] This estimate is based on a transportation investment of $232 million in 2025 (4,590 jobs / $232 million investment = 19.8).

Table 10. Transportation Energy Efficiency Impacts by Sector in 2025

Sectors	Jobs (Actual)	Wage and Salary Compensation (million $)	GSP (million $)
Services	4,010	$233	$321
Retail Trade	630	$32	$50
Insurance/Real Estate	420	$17	$62
Other Manufacturing	190	$31	$44
Wholesale Trade	130	$21	$36
Transportation, Communication & Utilities	100	$19	$34
Agriculture	80	$2	$6
Food	80	$7	$13
Electric Utilities	20	$3	$10
Motor Vehicles	10	$1	$1
Coal Mining	0	($0)	($0)
Natural Gas Utilities	0	$0	$1
Primary Metals	0	$0	$0
Oil Refining	(10)	($8)	($21)
Finance	(20)	($3)	($5)
Other Mining	(30)	($4)	($7)
Construction	(150)	($9)	($10)
Government	(190)	($17)	($19)
Oil and Gas Production	(680)	($132)	($354)
TOTAL	**4,590**	**$194**	**$162**

Notes: The numbers in parentheses reflect losses that are projected to occur in that sector as a result of the alternative energy scenario. Jobs refer to the net jobs created or lost in each sector. Compensation refers to the net gain in wage and salary income by sector. GSP refers to the net gain or loss in Colorado's Gross State Product created by sector. All dollar values are in millions of 2007 dollars. Totals may not add up due to rounding.

E. CONCLUSION

Consistent with the results of previous energy efficiency and jobs studies, increasing energy efficiency will have a positive impact on employment and salary and wage compensation in Colorado. We estimate that a total investment of about $12.4 billion in energy efficiency measures is feasible during 2007-2025 and is consistent with fully implementing the major energy efficiency initiatives in Governor Ritter's Colorado Climate Action Plan. If such an investment were made, we estimate that it would result in a net increase of about 4,700 jobs in the state by 2015, 8,900 jobs by 2020, and 11,600 jobs by 2025. Likewise, aggregate salaries and wages in the state would rise by about

$130 million per year as of 2015, $300 million per year as of 2020, and $440 million per year as of 2025. However, Gross State Product would not change significantly due to a variety of effects including reducing the need for capital investment in energy production.

Table 11 shows the increase in jobs by year and by scenario. It shows that the largest impacts come from the electricity and gasoline-saving initiatives. Furthermore, as expected, the jobs impacts grow over time as more energy efficiency investment is made and the energy savings increase.

Table 11. Job Gains by Scenario and Year

Year	Electricity Efficiency Scenario	Natural Gas Efficiency Scenario	Transportation Efficiency Scenario	Overall Efficiency Scenario
2015	3,220	920	520	4,660
2020	4,920	1,330	2,650	8,900
2025	5,500	1,520	4,590	11,600

The estimated increase in employment is modest but non-trivial. Adding 11,600 jobs in 2025 would mean roughly a 0.45 percent increase in the employment rate (i.e., a 0.45 percent reduction in the unemployment rate) in the state. The increase in jobs would be widely distributed throughout the state's economy with most of the job growth occurring in the services, retail trade and construction sectors. Electric utilities, gas utilities, mining, and the oil and gas production sectors lose jobs, although some of this loss can be mitigated if utilities provide comprehensive energy efficiency services to their customers.

As noted above, the energy efficiency policies analyzed in this study are consistent with proposals in the American Clean Energy and Security Act of 2009, the comprehensive federal energy and climate change legislation introduced by Representatives Waxman and Markey in early 2009. This legislation includes stringent energy efficiency requirements for electric and gas utilities, requirements for states to upgrade their building energy codes along with financial and technical assistance for states that adopt advanced building energy codes, new lighting and appliance efficiency standards, and a directive to harmonize the federal fuel economy standards and the Clean Car Standards adopted by California and other states. Although there are some differences in details, and in some cases our assumptions are more detailed than what is proposed in this legislation, we can conclude that at least the energy efficiency components of this legislation would have a positive impact on employment and income in Colorado.

A net increase in employment and income is just one of the benefits of widespread investment in energy efficiency measures. Other benefits include saving consumers and businesses money, reducing the need for costly and controversial new

power plants and transmission lines, reducing carbon dioxide emissions and thus the state's contribution to global warming, reducing water consumption (less electricity generation means less water consumption), and reducing other harmful pollutants including nitrogen oxides, particulates, and mercury.[19]

These positive results will occur by fully implementing the energy efficiency initiatives in Governor Ritter's Colorado Climate Action Plan. Some of the initiatives in the Plan are already underway due to either state or federal actions. In particular investor-owned electric and gas utilities in Colorado are now implementing comprehensive energy efficiency programs for their customers.[20] Federal lamp efficiency standards have been enacted, and the fuel economy standards for new cars and light trucks are increasing as a result of federal legislation.[21] In addition, GEO is launching a statewide industrial energy efficiency program in 2009.

But some of the energy efficiency initiatives in the Governor's Plan have not yet been implemented or are only partially adopted. The missing or partially adopted elements include:

- strong energy efficiency programs on the part of municipal utilities and rural electric cooperatives in the state,
- state-of-the-art building energy codes in all cities and counties along with a process for routinely upgrading energy codes periodically, and
- adoption of the Clean Car Standards first promulgated in California.

We recommend fully implementing all of these initiatives in order to maximize the jobs gains as well as realize the other economic and environmental benefits of energy efficiency improvements.

[19] See Footnote 4 for details on these other benefits of energy efficiency improvements. Also, see *Energy Efficiency Task Force Report.* Western Governors' Association Clean and Diversified Energy Initiative. Denver, CO. Jan. 2006. http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf

[20] Xcel Energy and all investor-owned gas utilities were implementing comprehensive energy efficiency programs for their customers as of early 2009. Black Hills Energy, the one other investor-owned electric utility in the state, was awaiting approval of its proposed energy efficiency programs as of April 2009. These programs are expected to be approved and launched during the summer of 2009.

[21] Both the lamp efficiency standards and the targets for higher CAFE standards were included in the Energy Independence and Security Act of 2007. The Department of Transportation was still developing the detailed rules for the higher vehicle efficiency standards as of April 2009.