The Colorado Renewable Energy Standard Ballot Initiative: Impacts on Jobs and the Economy

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Executive Summary

A growing number of states have enacted policies to increase the use of renewable electricity sources. Seventeen states have enacted renewable energy standards that require electric companies to increase their use of renewable energy sources. Fifteen states have enacted renewable energy funds, which provide financial resources for renewable energy development.

Colorado's Amendment 37 will be the first opportunity for citizens in any state to vote on these policies directly. Amendment 37 would establish a renewable energy standard requiring the state's largest electric companies to increase their use of renewable sources from less than two percent today to 10 percent of electricity sales by 2015. The Amendment would also establish a funding mechanism for solar, using a rebate to building owners who install solar systems, similar to funding mechanisms established in many of the state renewable energy funds.

Colorado's proposed renewable energy standard is in the middle of what the other 17 states have already adopted. The proposed minimum rebate for solar systems is among the lowest of rebates currently available in 16 other states.

The Union of Concerned Scientists (UCS) analyzed the costs and benefits of the renewable energy standard as written in Amendment 37, using a modified version of the Energy Information Administration's (EIA) National Energy Modeling System (NEMS). Under the most likely scenario that primarily utilizes renewable energy technology cost projections from the Department of Energy's national labs, we found that by 2025 Amendment 37 would result in the following economic benefits for Colorado:

- $236 million in savings on consumer electricity and natural gas bills
- 2,000 new jobs in manufacturing, construction, operation, maintenance, and other industries.
- $70 million in additional income and $50 million increase in gross state product
- $709 million in new capital investment
- $15 million in income to rural landowners from wind power land leases
- $107 million in new property tax revenues for local communities[1]

The Impact on Electricity Generation

Under the renewable energy ballot initiative, Colorado would increase its total homegrown renewable power by nearly 1,300 megawatts (MW) by 2025. Colorado's strong wind resources would power the vast majority of this development, with the remaining power coming from solar resources. This level of development would produce enough electricity to meet the needs of 620,000 typical homes. Early on in the forecast, renewable energy helps to displace natural gas generation. In the later years, renewable energy tends to displace more coal generation. Coal powered electric generation would still increase by nearly two-thirds compared to today's levels under the proposed renewable energy standard.

[1] Results are in cumulative net present value 2002$ using a 7% real discount rate. Job results are for the year 2020.

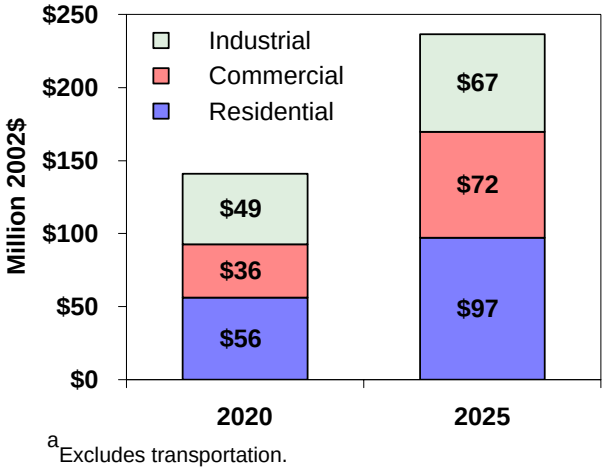
The Impact on Energy Consumers

Average consumer electricity prices would be virtually unchanged under the renewable energy standard proposal compared to business as usual. The impact on average monthly residential electricity bills between 2005 and 2025 would range from a savings of 4 cents for customers of municipal utilities and rural electric cooperatives that opt out of the solar energy requirement to an additional cost of about 10 cents for Xcel Energy customers. Commercial and industrial customers of all utilities would see savings on their electric bills, even with the costs of the solar requirement included. The total impact on all consumers for electricity would be an additional cost of just $4.5 million, or one-hundredth of one percent increase, over two decades. This result is very consistent with the $12.6 million dollar impact on electricity bills for the most likely scenario presented in a recent analysis of Amendment 37.

Our analysis also found that the increased use of renewable energy under the standard would create competition with natural gas power plants, leading to reduced gas demand and lower prices. As a result, residential consumers who use natural gas to heat their homes would see gradually increasing savings on their natural gas bills under the standard. Savings on a typical winter gas bill for customers of Xcel Energy and other utilities would reach an average of $2.00 per month, or about 1.5 percent, from 2015 to 2025. Savings on an average monthly gas bill over the course of a year would reach $1.00 per month.

By 2025, consumers would save a total of $236 million as a result of the renewable energy standard. All sectors of the economy would benefit, with residential, commercial, and industrial customers' total savings reaching $97 million, $72 million, and $67 million, respectively (Figure ES1).

Figure ES1. Cumulative Impact on Consumers, by Sector (10 percent by 2015 RES)[a]



[a] Excludes transportation.

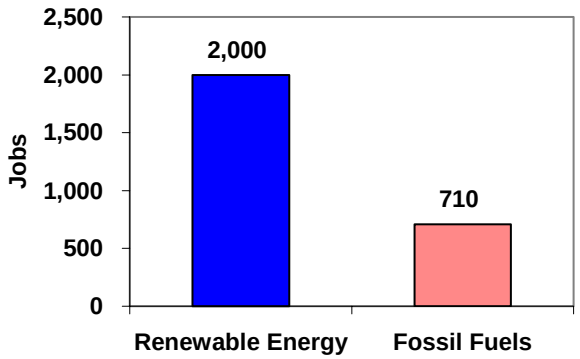
Natural gas costs continue to rise in Colorado. Xcel Energy recently informed its residential customers to expect to pay up to 26 percent more to heat their homes with natural gas this December compared to a year ago. Compared to December 2002, typical residential gas bills will be more than twice as high. Reducing dependence on natural gas for electricity by increasing renewable energy supplies can also provide a hedge against these volatile natural gas prices in the near term. For example, the Lamar wind facility is saving its consumers $4.6 million on their power bills, primarily as a result of hedging against higher natural gas prices, according to Xcel Energy's testimony before the Federal Energy Regulatory Commission in June 2003.

If natural gas prices exhibit either short-term price spikes or long-term sustained increases beyond those currently projected by the EIA, or if the federal production tax credit for wind and other renewable resources is extended beyond 2005, consumer savings would be greater than reported here.

The Impact on Jobs and Economic Development

By 2020, the 10 percent standard would create 2,000 new jobs in manufacturing, construction, operation, maintenance, and other industries. In fact, the amount of renewable energy need to meet the requirement would create 2.8 times more jobs than fossil fuels—a net increase of nearly 1,300 jobs by 2020 (Figure ES2). It would also generate an additional $70 million in income and $50 million in gross state product in Colorado's economy.

Figure ES2. Renewable Energy vs. Fossil Fuel Jobs, 2020 (10 percent by 2015 RES)



Rural economies across Colorado would also receive a tremendous boost from the renewable energy standard. Many of the jobs identified above would be created in rural areas where the most of the facilities would be located. By 2025, the 10 percent standard would provide:

- $709 million in new capital investment
- $107 million in new property tax revenues for local communities
- $15 million in income to rural landowners from wind power land leases

Renewable energy development has already demonstrated that it can create new high-paying jobs and other economic benefits in Colorado. During its construction phase, the Lamar wind facility employed nearly 400 people, and provided an economic boost to Prowers County. Today, the project provides 15-20 permanent jobs and nearly $2 million each year in funding for the county, local school district, and medical center. The farmers and ranchers leasing the land where the 108 turbines are located earn between $3,000 and $6,000 per turbine per year.

The Impact on the Environment

Increasing renewable energy use will reduce the amount of air pollution from power plants that threaten the people of Colorado's health by burning coal, oil, and natural gas. Carbon dioxide (CO_2) emissions, which trap heat in the atmosphere and cause global warming, would also be reduced. The 10 percent renewable energy standard will reduce about 3 million metric tons (MMT) of power plant CO_2 emissions per year by 2025—a reduction of 4.5 percent below business-as-usual levels. The renewable energy standard will also reduce harmful water and land impacts from extracting, transporting, and using fossil fuels and conserve resources for future generations.

Results From the Less Likely Scenario

Even with more pessimistic assumptions for renewable energy technology costs, the renewable energy standard would provide important benefits for Colorado's citizens and environment. This scenario would result in a similar amount of renewable energy development and economic development benefits, 1,550 new jobs, and greater reductions in CO_2 emissions. Consumers would experience a small increase in costs. The impact on average monthly residential electricity bills over the 2005-2025 period would range from an additional cost of about 30 cents (or six-tenths of a percent) for customers of municipal utilities and rural electric cooperative to 50 cents

(or about one percent) for Xcel Energy customers. However, residential consumers would also save an average of 63 cents (0.6 percent) per month on their typical winter natural gas bills from 2015 to 2025. Savings on an average monthly gas bill over the course of a year would reach 31 cents per month. The total impact of the standard on all energy consumers would be an additional cost of $139 million, or one quarter of one percent increase, over two decades.

Introduction

A growing number of states have enacted policies to increase the use of renewable electricity sources. Seventeen states have enacted renewable energy standards that require electric companies to increase their use of renewable energy sources. Fifteen states have enacted renewable energy funds, which provide financial resources for renewable energy development.

Colorado's Amendment 37 will be the first opportunity for citizens in any state to vote on these policies directly. Amendment 37 would establish a renewable energy standard requiring the state's largest electric companies to increase their use of renewable sources from less than two percent today to 10 percent of electricity sales by 2015. Four percent of the renewable energy (or 0.4 percent of covered electricity sales) would be required to come from solar energy. The Amendment would also establish a funding mechanism for solar, using a rebate to building owners who install solar systems, similar to funding mechanisms established in many of the state renewable energy funds.

The Union of Concerned Scientists (UCS) analyzed the costs and benefits of the renewable energy standard as written in Amendment 37. A previous analysis has found that the standard would have virtually no effect on consumer electricity prices, and would provide other significant benefits to consumers and the environment.[2] That analysis, however, did not examine the impact of increasing renewable energy on natural gas prices, or examine the impact on other aspects of Colorado's economy.

A number of prior analyses have found that increasing renewable energy reduces the price of natural gas, by reducing the demand for gas relative to the supply. The U.S. Department of Energy's Energy Information Administration (EIA) has repeatedly found that national renewable energy standards will reduce natural gas prices.[3] An analysis by the Energy and Analysis Group for the American Council for an Energy Efficient Economy found an even stronger impact of renewable standards on reducing gas prices than EIA, including an impact on gas prices from individual state standards as well as from a national standard.[4]

This report uses the EIA's National Energy Modeling System (NEMS) to examine the impact of the proposed Colorado renewable energy standard on natural gas prices as well as electricity rates and consumer electricity bills. Additionally, we report the findings from the EIA NEMS model on the electric generation mix, renewable energy development, investment, and emissions of carbon-dioxide, the heat-trapping gas that contributes to global warming. We also run the output of the EIA NEMS model through the IMPLAN input-output model to determine the impact of the standard on employment and income.

We analyze the range of costs and benefits under two scenarios for renewable energy technology cost assumptions. The more likely scenario primarily utilizes projections from the Department of Energy's national labs that study renewable energy technologies. The other scenario utilizes

[2] Binz, Ronald J. *The Impact of the Renewable Energy Standard in Amendment 37 on Electric Rates in Colorado. Public Policy Consulting.* Denver, Colo. September 2004.
[3] Union of Concerned Scientists. *Renewable Energy Can Help Alleviate Natural Gas Crisis*. June 2003.
[4] Elliot, R.N., A. Shipley, S. Nadel, and E. Brown. *Natural Gas Price Effects of Energy Efficiency and Renewable EnergyPractices and Policies.* American Council for an Energy-Efficient Economy. December 2003.

much more pessimistic projections on renewable energy costs and performance from the EIA.[5] UCS has reviewed these assumptions extensively with federal and state government analysts, independent consultants and renewable energy developers and businesses. A number of EIA assumptions appear highly unrealistic, with current technology performance already exceeding EIA's projections in a few cases. We believe that renewable energy costs and performance are likely to be much closer to the first scenario, but present the results of the more pessimistic scenario as well, in order to simulate a "worst case."

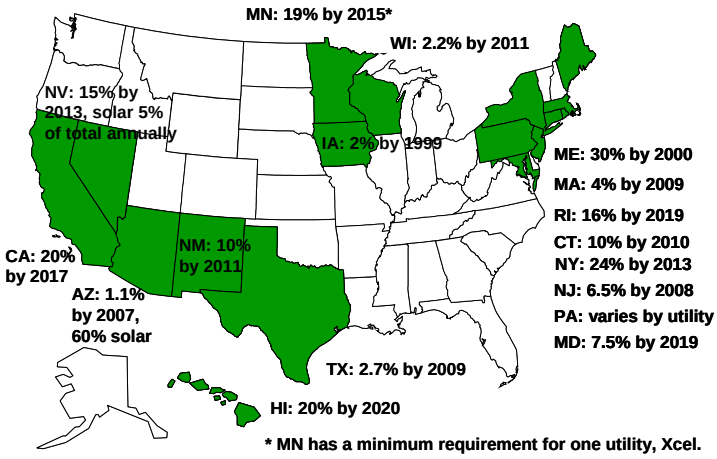
This report first provides an overview of the renewable energy standard as a policy tool, and the experience that other states have had with it to date. We then provide a detailed description of the renewable energy standard as written in Amendment 37, and how it compares to other state programs. We also present our modeling methods and major assumptions for the analysis followed by detailed results that highlight the impacts on consumers, jobs, and rural economic development. Finally, we sum up our results and the implications of the ballot initiative on the energy future of Colorado and other states.

Renewable Energy Standards

A renewable energy standard is a market-based policy mechanism that requires electric utilities to gradually increase the amount of renewable energy resources—such as wind, solar, and bioenergy—in their electricity supplies. Though they can vary in design, a renewable energy standard generally establishes annual requirements for each utility covered by the program to meet a certain percentage of their electricity sales using renewable power.

One relatively common compliance mechanism is a renewable energy credit (REC) trading program. Under a REC program, a renewable energy facility earns one credit for kilowatt-hour (kWh) of electricity that is generated in a given year. These RECs can then be bought and sold by utilities with annual target requirements—much like the Clean Air Act credit-trading system, which permits lower-cost, market-based compliance with air pollution regulations. This market-based approach instills competition among renewable energy generators and creates an ongoing incentive to drive down costs. A REC trading market provides compliance flexibility while ensuring the greatest amount of renewable power is delivered for the lowest price.

Figure 1. Renewable Energy Standards

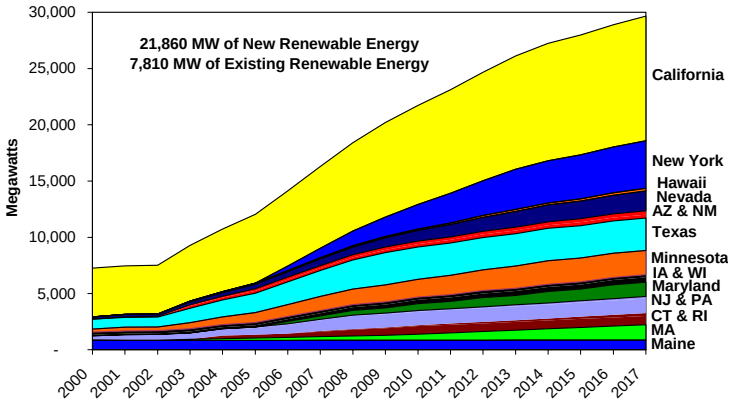


A growing number of states are choosing renewable energy standards as their primary tool for promoting renewable energy. To date, 17 states have implemented minimum renewable

[5] For one technology, distributed solar photovoltaics, EIA projects slightly lower costs. To bracket the likely range of results, we have combined the more optimistic assumptions in one scenario and the more pessimistic assumptions in the other scenario.

energy standards (Figure 1).[6] In September 2004, New York created the second-largest new renewable energy market in the country (behind only California) when the state Public Service Commission adopted a 24 percent by 2013 renewable energy standard. Hawaii, Maryland, and Rhode Island also enacted renewable energy standards this year. The majority of these 17 states enacted their standard legislatively, with about half included as part of legislation deregulating electricity generation. Several states—including Minnesota, Nevada, New Mexico, and New Jersey—have revised and significantly increased or accelerated their standards.

Figure 2. Renewable Energy Expected From State Standards*



* Projected development assuming states achieve annual targets.

UCS projects that existing state renewable energy standards will result in nearly 22,000 MW of new renewable energy development by 2017 (Figure 2). This represents enough clean power to meet the electricity needs of 13.9 million typical homes.

While most standards have been enacted too recently to fully evaluate their effectiveness, a number of studies have found that renewable energy standards are and will continue to be the primary driver of new renewable energy generation in the United States.[7] In fact, two-thirds of the wind facilities installed between 1998 and 2003 (3,300 MW) occurred in states with a renewable energy standard. In Minnesota, Xcel Energy (also the largest utility in Colorado) has acquired about 600 MW of wind and bioenergy power as a direct result of its requirement. Wisconsin utilities have secured enough renewable resources to meet their targets through 2011, and Iowa has met and exceeded its relatively low renewable energy requirement.

The most successful renewable energy standard so far may belong to Texas. In 1999, the Texas legislature adopted a standard that requires 2,000 MW of new renewable electricity generating capacity to be installed by 2009. More than 1,100 MW of renewable energy have already been installed in Texas, which puts the state well ahead of its 2005 target of 850 MW. The Texas renewable energy standard has been successful, in part, due to the availability of good renewable energy resources in the state and the inclusion of the following key provisions in the legislation:

- New renewable energy requirements high enough to trigger market growth in the state
- Requirements can be met using tradable renewable energy credits
- Requirements apply across the board to all electricity providers

[6] For detailed information on state renewable energy standard programs and other state policies to promote renewable energy, see UCS website, http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=114.
[7] See UCS website, http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1517.

- Significant financial penalties for retail providers that do not comply with the targets[8]

Technological advances and increasing market share have led to significant decreases in the cost of renewable energy technologies over the past two decades. In areas with the best resources, wind energy can compete on a lowest-cost resource basis with fossil fuels on a long-term basis. However, there continues to be numerous market barriers, such as access to transmission lines and low-cost financing, which drive up the cost and hamper the development of renewable energy, as well as company decision-making based only on short-term rather than long-term costs. The renewable energy standard is designed to overcome these barriers and reduce costs for new renewable energy technologies so they can eventually compete with fossil fuel generators on a level playing field.

Amendment 37: The Colorado Renewable Energy Standard

Colorado has some of the strongest and most diverse clean energy resources in the country. The state has the technical potential to generate nearly 10 times its current electricity needs from renewable energy resources. Colorado's strongest resources are wind and solar, but unfortunately they remain largely untapped. Instead, Colorado's electric utilities remain heavily reliant on coal and natural gas, with more than 97 percent of the state's electricity coming from fossil fuels. Non-hydro renewable energy currently accounts for less than one percent of the state's electric supply.

Wind power has experienced some growth recently in Colorado, thanks to a 2001 decision by the Colorado Public Utilities Commission (PUC) ordering Xcel Energy to build a 162 MW wind facility in Lamar. Legislative efforts to create a larger, long-term renewable energy market through a renewable energy standard have fallen short each of the past three years. Some of the key features of the renewable energy standard proposal, and when pertinent, how they compare to other state standard programs, are discussed below.[9]

Table 1. Renewable Energy Standards Comparison

State	Renewable Requirement (% sales)
Maine	30% by 2000
New York	24% by 2013
California	20% by 2017
Hawaii	20% by 2020
Minnesota	19% by 2015*
Rhode Island	16% by 2019
Nevada	15% by 2013
Connecticut	10% by 2010
New Mexico	10% by 2011
Colorado	***10% by 2015***
Maryland	7.5% by 2019
New Jersey	6.5% by 2008
Massachusetts	4% by 2009
Texas	2.7% by 2009**
Wisconsin	2.2% by 2011
Iowa	2% by 2000
Arizona	1.1% by 2007
Pennsylvania	Varies

* Minnesota's standard is for Xcel Energy only, and it includes the utility's 1994 and 2003 requirements.
** The Texas standard is capacity-based, requiring 2,880 MW of renewable energy by 2009.

The Colorado renewable energy standard requires utilities with more than 40,000 customers to generate

[8] Wiser, R., K. Porter and R. Grace. *Evaluating Experience with Renewables Portfolio Standards in the United States*. March 2004. Wiser, R. and O. Langniss. *The Renewables Portfolio Standard in Texas: An Early Assessment*. November 2001.

[9] The full text of the renewable energy standard ballot initiative can be viewed at http://www.renewableenergyyes.com/learnmore/Initiativetextfull.html.

or acquire renewable energy equal to at least three percent of retail sales by 2007, increasing to six percent in 2011, 10 percent in 2015, and remaining at 10 percent each year thereafter. This requirement is large enough to trigger new renewable energy growth, and would place Colorado in the middle of the pack compared to the 17 states that currently have renewable energy standards (Table 1).

Seven utilities would initially have to meet the requirements under Amendment 37—accounting for nearly 80 percent of the state's electricity sales. Over the course of the next two decades, an additional eight utilities are projected to grow large enough to be subject to the standard, raising the total covered sales to about 90 percent. Most states with a renewable energy standard employ varying methods to exempt small and/or publicly held utilities, or the sales to certain customers, from meeting the requirements. Municipal-owned utilities and rural electric cooperatives are given the option to remove themselves from Colorado PUC oversight by "self-certifying" a similar renewable energy standard. They also have the option under the proposal to exempt themselves from the standard by securing a majority vote from their customers.

Amendment 37 defines eligible renewable energy resources as: solar, wind, geothermal, bioenergy (energy crops, forest and agricultural residues, animal wastes), landfill gas, small-scale (less than 10 MW) hydro, and fuel cells using renewable fuel sources. Because of its unique benefits and higher costs compared with other renewable energy technologies, solar energy receives additional support under the ballot measure. The standard requires that at least four percent of the total annual renewable energy supply (or 0.4 percent of the requirement) come from solar energy, half of which must be customer-sited. Several other states have included similar provisions in their standards to support solar energy and/or customer-sited renewable generation. Like Amendment 37, Arizona, Nevada, New Jersey, and New York all have separate requirements for solar energy technologies. The standards in Arizona, Nevada, and New Mexico give multiple credits for solar and other types of renewable energy generated.

To provide support for homes and businesses that want to install solar photovoltaic (PV) systems, Amendment 37 requires the utilities subject to the standard to establish a solar rebate program of at least $2 per watt (up to 100 kW per installation). Rebate programs make solar PV systems more affordable to customers and stimulate their development. Solar PV rebate programs are available in 16 states, all of which offer rebates equal to or greater than the $2 per watt rebate in the ballot initiative, at incentives up to $6.25 per watt.

Table 2. State-level Solar PV Rebate Programs Comparison

State	Rebate
Texas*	$5 to $6.25 per watt
Illinois	$6 per watt
California	$3 to $6 per watt
New Jersey	$5.50 per watt
Connecticut	$5 per watt
Nevada	$5 per watt
Rhode Island	$5 per watt
Delaware	50% of system cost, up to $22,500
New York	$4 to $4.50 per watt
Pennsylvania*	$4 per watt
Montana*	$4 per watt
Arizona*	$2 to $4 per watt
Oregon	$3 per watt (residential) $2.50 per watt (commercial)
Vermont	$2.50 per watt
Wisconsin	25% of system cost, up to $35,000
Minnesota	$2 per watt
Colorado	***$2 per watt***

* Solar PV rebate in these states are only available to the customers of certain utilities.

Source: Database of State Incentives for Renewable Energy (http://www.dsireusa.org).

The ballot proposal requires the Colorado PUC to establish a REC trading system to track compliance and provide greater flexibility in meeting the annual requirements. Ten states—including neighboring Arizona, Nevada, New Mexico, and Texas—use REC trading programs to help achieve renewable energy standard compliance.

A cost cap is included in the renewable energy standard, which protects all customer classes against the potential of higher than expected compliance costs. The maximum retail rate impact from meeting the renewable energy standard is set at 50 cents per month for the average residential customer of a qualifying utility. Many other states renewable energy standard programs control the cost of compliance, primarily by placing a cap on REC prices or establishing an alternative compliance payment mechanism.

Amendment 37 encourages renewable energy development in Colorado by providing extra credit (1.25 RECs) for each kilowatt-hour of renewable energy generated inside the state. To the extent that renewable energy facilities are constructed in Colorado, this will reduce the overall amount renewable energy required to meet the standard. However, by creating an incentive to develop renewable energy in Colorado, this provision will increase the local economic and air quality benefits.

Utilities are required to enter into 20-year contracts for the acquisition of renewable energy under the ballot proposal. This will help further reduce renewable energy development costs by providing access to low-cost financing. Utilities would be allowed to fully recover the costs incurred by meeting the renewable energy standard, including the potential for regulated utilities to earn a bonus on investments in renewable energy that yield a net economic benefit to consumers. The Colorado PUC is also authorized under the renewable energy standard proposal to establish penalties for non-compliance.

Methods and Assumptions

We used nationally recognized models and adopted conservative assumptions to estimate the cost and benefits of the Colorado renewable energy standard ballot initiative. The following describes the models and key assumptions we used to project the energy and macroeconomic impacts.

Modeling Energy Impacts

We used a modified version of the EIA NEMS model to quantify the direct costs and benefits of the Colorado renewable energy standard. EIA uses the NEMS model to conduct the official long-term forecasts of U.S. energy supply, demand, prices, and expenditures and to estimate the impacts of energy policy proposals.[10] We recently used this modified version of the NEMS model to estimate the impacts of a national renewable energy standard on the U.S. and several states.[11] The Tellus Institute, a Boston-based consulting group with extensive experience running the NEMS model, completed the NEMS runs for the Colorado renewable energy standard for UCS.

[10] For complete documentation of the NEMS model, see http://www.eia.doe.gov/bookshelf/docs.html

[11] Union of Concerned Scientists. *Renewing America's Economy*. September 2004. Available online at: http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1505.

We started with the version of the model that EIA used to produce *Annual Energy Outlook 2004* (AEO 2004)—the EIA's most recent long-term energy forecast. The business as usual (BAU) forecast used in our analysis is identical to EIA's business as usual forecast for AEO 2004, except for the following changes. First, we modified NEMS to incorporate more conservative estimates of the market potential for wind, geothermal, and biomass resources to account for siting, transmission, penetration, and other potential constraints in some regions of the country. These changes resulted in a reduction of up to 50 percent of the wind potential and up to 60 percent of the conventional geothermal potential in the West. We also reduced the available biomass supply by reducing forest residues by 50 percent to provide an extra margin against relying on unsustainable sources, even though EIA's estimate already excluded road less areas, steep slopes, and more than half the remaining residues.

Second, we modified several EIA assumptions that artificially constrain the growth and raise the projected cost of renewable energy technologies. As a starting point, we incorporated changes made to NEMS by the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) to examine the impact of their renewable energy research and development (R&D) programs for the FY05 Government Performance Review Act (GPRA) and by EIA for the "DOE Goals" case in AEO 2004.[12] In addition, we supplemented this information with input from renewable energy experts and developers, utilities, and recent studies.

Based on this information, the two key changes to the model that have an impact on this analysis include:

- We changed EIA's designation of wind as a commercial technology to "evolutionary" status to allow for a greater reduction in capital costs as installed capacity increases based on the GPRA projections.

- We increased capital costs for wind power by up to 50 percent as the penetration of wind increases to 30 percent of a region's electricity generation. This includes a cost increase of up to 20 percent for integrating wind into the broader electricity system based on a recent analysis for PacifiCorp's Integrated Resource Plan and a cost increase of up to 30 percent for additional siting and transmission costs. (EIA assumes, without substantiation, cost increases up to 200 percent).[13]

Modeling Macroeconomic Impacts

We used the Impact Analysis for Planning (IMPLAN) model and specific data on Colorado's economy to estimate the macroeconomic impacts (employment, income, and gross state product) of the Colorado renewable energy standard. IMPLAN is an input-output (I-O) model that identifies interactions between all sectors of the economy. I-O models can show how expenditures for installing, manufacturing, operating and maintaining renewable energy

[12] GPRA assumptions are online at *www.eere.energy.gov/office_eere/gpra_estimates_fy05.html*. EIA assumptions for the DOE Goals case can be found in Assumptions to Annual Energy Outlook 2004, pp 135-137. These assumptions are an update to assumptions originally made in NEMS by the Interlaboratory Working Group of the five national energy laboratories in *Scenarios for a Clean Energy Future*.

[13] For a description of the other changes we made to the model that impacts other states and regions see: http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1504.

technologies and related equipment not only directly benefit the industries engaged in these activities, but also indirectly benefit businesses that provide inputs (i.e., goods and services) to these industries. I-O models can also show the benefits of workers re-spending the income earned from these direct and indirect activities and the impact of changes in consumer energy bills.

The macroeconomic analysis was completed by MRG & Associates using a well-established analytical approach and the inputs and results of the energy modeling described above.[14] There were four main steps in completing the macroeconomic analysis. First, we estimated total expenditures for installing, manufacturing, operating and maintaining renewable energy technologies that are projected to be developed to meet the Colorado renewable energy standard and for coal and natural gas power plants that would have otherwise been developed without the standard. Second, the expenditures are broken down and allocated to the industries that would directly supply the equipment, labor, and services for these technologies. Third, these detailed expenditures are multiplied by the estimated local share of equipment, labor, and services that can be supplied by Colorado businesses and matched to the appropriate sectors in the IMPLAN model to calculate the direct and indirect macroeconomic impacts in Colorado. Finally, we calculated the macroeconomic impacts of changes in consumer energy bills in Colorado.

The key assumptions and data sources for the macroeconomic analysis include:

- The expenditure breakdown for the construction and operation and maintenance of renewable and conventional power plants was based on data from actual projects collected from a variety of sources, including state and federal agencies, renewable energy developers and utilities. The expenditure breakdown and local share data on wind projects—the technology that benefits most under the renewable standard—was based on inputs used in NREL's Jobs and Economic Development Impacts (JEDI) Model.[15]

- We used data from the IMPLAN model to estimate the local share of expenditures for specific industries, with a few exceptions. We conservatively assumed that 33 percent of the manufacturing for the wind and solar technologies installed in Colorado would be produced by businesses located in the state. We also do not include any jobs or economic development from Colorado manufacturers exporting equipment to other states or countries. If Colorado is able to attract renewable energy manufacturers to produce equipment for facilities in the state and for export, the jobs and income from the standard would increase significantly. In addition, we assume that 25 percent of the fuel expenditures for coal and 50 percent of the fuel expenditures for natural gas stay in Colorado based on data from EIA and a recent study by NREL.[16]

[14] The analytical approach used in this analysis is similar to that used by Geller, DeCicco, and Laitner, *Energy Efficiency and Job Creation*, American Council for an Energy Efficient Economy, 1992.
[15] For more information about the JEDI model, see http://www.eere.energy.gov/windpoweringamerica/jedi.html.
[16] Energy Information Administration. *Natural Gas Production & Use by Colorado*, available online at http://www.eia.doe.gov/emeu/states/ngsales/ngsales_co.html. Tengen, Suzanne. *Statewide Economic Impacts of Wind Energy Compared with Coal and Natural Gas*. National Renewable Energy Laboratory. March 2004.

Major Features of Amendment 37

The following describes our main assumptions in modeling the implementation details of the proposed renewable energy standard.

Covered Utilities. The proposed standard would apply to utilities that serve at least 40,000 customers in Colorado. Based on this threshold, the standard would initially apply to seven utilities, covering nearly 80 percent of total electricity sales in the state. Using data on specific utilities from EIA and NEMS projections for the growth in regional electricity use, we project that eight more utilities will exceed the 40,000 customer threshold over the next 20 years, which will increase the share of total electricity sales in the state covered under the standard to 90 percent.

Renewable Energy Targets. We assume that the utilities covered under the standard will generate or purchase the minimum amount of renewable energy needed to meet the proposed targets of 3 percent of retail sales by 2007, 6 percent by 2011, and 10 percent by 2015. We also assume that the targets will increase linearly between these years and stayed fixed at 10 percent after 2015.

Solar requirement. We assume that 4 percent of the total renewable energy produced will come from solar energy, with half of this coming from distributed solar photovoltaics installed on homes and businesses and the other half coming from large scale solar thermal and PV facilities, as proposed in the Amendment. We assume that only Xcel Energy and Aquilla will meet the solar requirement. We assume that rural electric cooperatives and municipal will "self-certify" that they have adopted a renewable energy standard that is substantially similar to the statutory requirement, as allowed in the Amendment, to remove themselves from PUC oversight and so they will not have to meet the solar requirement.

We used the NEMS model to determine the incentives that would be needed to meet the targets for large scale solar. The costs of meeting the targets for distributed solar PV were estimated in an offline analysis. Amendment 37 requires utilities to offer a rebate to consumers of at least $2/watt for a PV system of up to 100 kilowatts. We assume that utilities will offer rebates that are sufficient to stimulate enough consumer investment to meet the solar requirement. We assume that this will initially require rebates of approximately $4-5 per watt for residential systems and $2.5-3.5 per watt for commercial systems, declining to $2 per watt over the next 10 years as the cost of PV is projected fall. In addition, we assume that utilities will treat the rebate programs as capital investments that are recovered from all retail customers and allowed to earn the utility's authorized rate of return.

In-state multiplier. Amendment 37 would allow each kilowatt-hour of eligible renewable electricity generated in Colorado to count as 1.25 kilowatt-hours for the purposes of compliance with the standard. We assume that this extra credit would provide enough of an incentive to install 100 percent of the renewable energy used to meet the standard in Colorado, based on an offline analysis of the relative cost of and potential for developing renewable energy in Colorado and neighboring states. Based on this assumption, we project that the extra credit would effectively reduce the renewable energy standard from 10 percent to 7.9 percent of covered electricity sales in 2015.

Green Power Program Eligibility. The proposal requires the Colorado PUC to determine through an evidentiary hearing whether renewable generation that is purchased at a premium from customers under a voluntary utility green pricing program may be used to comply with the renewable standard. For this analysis, we assume that utilities would not be able to count this generation toward the standard. Customers that are willing to voluntarily pay more for renewable energy want their money to lead to incremental environmental improvement. The Minnesota PUC recently agreed with this in ruling that Xcel Energy could not count renewable generation from its Minnesota green pricing program towards its Minnesota renewable energy standard. If the PUC decided otherwise, however, it could reduce the cost of the standard below what we project, at the expense of additional renewable energy development.

Scenarios

We modeled two main scenarios in this analysis to estimate the potential range of costs and benefits that could result from implementing the Colorado renewable energy standard. The scenario that examines the most likely impacts of the standard uses cost and performance assumptions for renewable energy technologies developed by the National Renewable Energy Laboratory and the DOE for use in the GPRA analysis and by EIA for the "DOE Goals Case" in AEO 2004.[17] In addition, we used EIA's projections in the NEMS model for distributed solar photovoltaics. We believe these assumptions better reflect improvements in renewable energy technologies that are likely to occur through continued R&D, industry expansion, and increases in installed capacity. We also modeled a less likely scenario that uses EIA's more pessimistic cost and performance assumptions for large-scale wind, biomass, geothermal, and solar technologies and slightly higher cost projections for distributed solar from the GPRA analysis.

For both scenarios, we assume that the federal production tax credit for wind and closed loop biomass is extended only through 2005 and is expanded to include solar, geothermal, and other biomass resources, as included in a bill recently adopted by Congress. We assume that only the amount of renewable generation that is needed to meet the fairly low renewable energy targets in the early years of the proposal will be installed. Therefore, only a small amount of new wind capacity is assumed to be eligible for the federal PTC in this analysis. Xcel Energy recently received approval from the Colorado Public Utilities Commission to acquire up to 500 MW of new wind capacity by 2007 to allow the company to take advantage of the PTC. This amount of wind capacity represents about half of the total capacity that the model projects will be needed to meet the entire renewable energy standard by 2016. To the extent that some or all of this renewable capacity is installed by the end of 2005 or the PTC is extended beyond 2005, which we think is likely, the cost of meeting the proposed Colorado renewable energy standard would be significantly lower than estimated in this report.

[17] See footnote 9. The renewable energy cost and performance assumptions were originally developed by the Electric Power Research Institute (EPRI) and recently updated by the National Renewable Energy Laboratory (NREL) in the *Power Technologies Databook* 2003 and in the GPRA analysis.

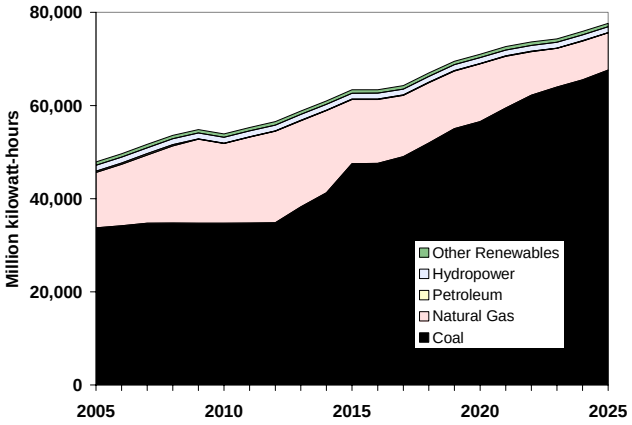
Results

Below we present the results from our analysis for two renewable energy technology cost scenarios. We begin with our "most likely" scenario, using the renewable energy technology cost projections from NREL as described in our methods and assumptions section. For this scenario, we identify the impact of the Colorado 10 percent by 2015 renewable energy standard ballot initiative on Colorado's electricity mix, energy consumers, jobs and economic development, and the environment. We then present the results from our "less likely" scenario, focusing on these same impacts.

The Impact on Electricity Generation

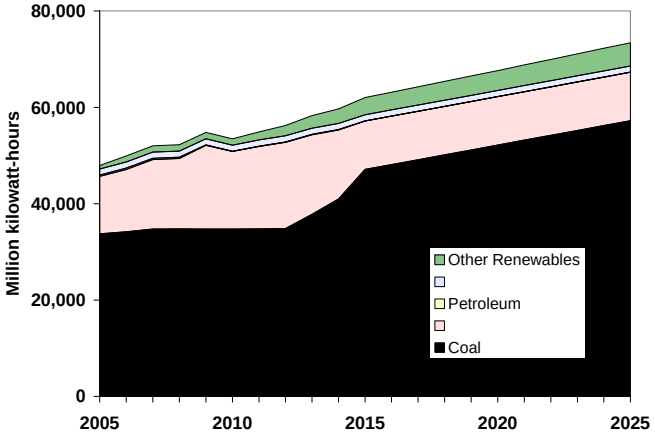
Under the renewable energy ballot initiative, Colorado would increase its total homegrown renewable power by nearly 1,300 megawatts (MW) by 2025. Colorado's strong wind resources would power the vast majority of this development, with the remaining power coming from solar resources. This level of development would produce enough electricity to meet the needs of 620,000 typical homes.

Figure 3. Colorado's Electric Generation Mix under Business as Usual, 2005-2025



Under a business as usual scenario, Colorado increases its dependence on fossil fuels to meet strong growth in electricity use through 2025 (Figure 3). Coal use would double its 2005 levels in just 20 years, primarily because natural gas prices are projected to increase to levels that would make new coal-powered electric generation cost competitive. Non-hydro renewable energy resources would see very little growth under this business as usual forecast.

Figure 4. Colorado's Electric Generation Mix Under a 10 Percent RES, 2005-2025



Under the 10 percent renewable energy standard, wind and solar resources meet a much larger share of Colorado's electricity needs (Figure 4). Early on in the forecast, renewable energy helps to displace natural gas generation. In the later years, renewable energy tends to displace more coal generation. Coal powered electric generation would still increase by nearly two-thirds compared to today's levels under the proposed renewable energy standard.

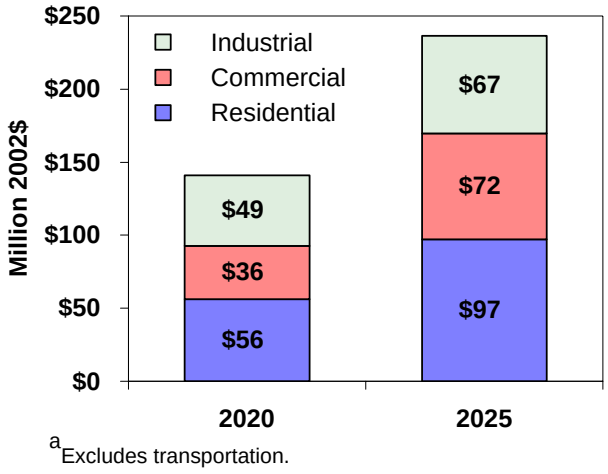
The Impact on Energy Consumers

Average consumer electricity prices would be virtually unchanged under the renewable energy standard proposal compared to business as usual. The impact on average monthly residential electricity bills between 2005 and 2025 would range from a savings of 4 cents for customers of municipal utilities and rural electric cooperatives that opt out of the solar energy requirement to an additional cost of about 10 cents for Xcel Energy customers. Commercial and industrial customers of all utilities would see savings on their electric bills, even with the costs of the solar requirement included. The total impact on all consumers for electricity would be an additional cost of just $4.5 million, or one-hundredth of one percent increase, over two decades. This result is very consistent with the $12.6 million dollar impact on electricity bills for the most likely scenario presented in the analysis of the Colorado renewable energy standard ballot initiative conducted by Binz.[18]

The Binz study, however, does not examine the impact that the renewable energy standard has on consumer natural gas bills. Our analysis found that the increased use of renewable energy under the standard would create competition with natural gas power plants, leading to reduced gas demand and lower prices. As a result, residential consumers who use natural gas to heat their homes would see gradually increasing savings on their monthly natural gas bills under the renewable energy standard compared to business as usual. Savings on a typical winter gas bill would reach an average of $2.00 per month, or about 1.5 percent, from 2015 to 2025. Savings on an average monthly gas bill over the course of a year would reach $1.00 per month.

By 2025, consumers would save a total of $236 million as a result of the renewable energy standard. All sectors of the economy would benefit, with residential, commercial, and industrial customers' total savings reaching $97 million, $72 million, and $67 million, respectively (Figure 5).

Figure 5. Cumulative Impact on Consumers, by Sector (10 percent by 2015 RES)[a]



[a] Excludes transportation.

Natural gas costs continue to rise in Colorado. Xcel Energy recently informed its residential customers to expect to pay up to 26 percent more to heat their homes with natural gas this December compared to a year ago.[19] Compared to December 2002, typical residential gas bills will be more than twice as high. Reducing dependence on natural gas for electricity by increasing renewable energy supplies can also provide a hedge against these volatile natural gas prices in the near term. For example, the Lamar wind facility is saving its consumers $4.6 million on their power bills, primarily as a result of hedging against higher natural gas prices, according to Xcel Energy's testimony before the Federal Energy Regulatory Commission in June 2003.

[18] Binz, Ronald J. *The Impact of the Renewable Energy Standard in Amendment 37 on Electric Rates in Colorado. Public Policy Consulting*. Denver, Colo. September 2004.

[19] Chakrabarty, Gargi. "Heating bills heading up: Winter looks costly as natural gas prices soar." Rocky Mountain News. October 16, 2004.

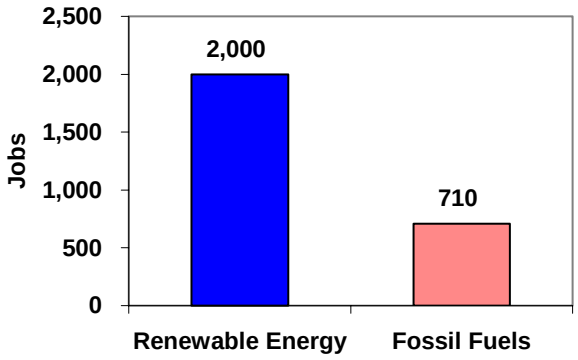
If natural gas prices exhibit either short-term price spikes or long-term sustained increases beyond those currently projected by the EIA, consumer savings would be greater than reported here. Studies have found that the natural gas futures market does anticipate higher gas prices than EIA projects for at least the next 10 years.[20] And EIA has had to raise its long-term gas price forecast in each of the last seven years.[21]

The Impact on Jobs and Economic Development

The renewable energy standard would increase jobs and economic development benefits in Colorado. By 2020, the 10 percent standard would create 2,000 new jobs in manufacturing, construction, operation, maintenance, and other industries. In fact, the amount of renewable energy need to meet the requirement would create 2.8 times more jobs than fossil fuels—a net increase of nearly 1,300 jobs by 2020 (Figure 6). It would also generate an additional $70 million in income and $50 million in gross state product in Colorado's economy.

These job results reflect the conservative assumption that 33 percent of the manufacturing for the wind and solar technologies installed in Colorado is produced by businesses located in the state. They also do not reflect any jobs or economic benefits from Colorado manufacturers exporting equipment to other states or countries. If Colorado communities were able to attract additional renewable energy manufacturers to produce equipment for facilities in the state and for export, the jobs and income from the renewable energy standard would increase significantly.

Figure 6. Renewable Energy vs. Fossil Fuel Jobs, 2020 (10 percent by 2015 RES)



Rural economies across Colorado would also receive a tremendous boost from the renewable energy standard. Many of the jobs identified above would be created in rural areas where the most of the facilities would be located. By 2025, the 10 percent standard would provide:

- $709 million in new capital investment
- $107 million in new property tax revenues for local communities
- $15 million in income to rural landowners from wind power land leases[22]

Renewable energy development has already demonstrated that it can create new high-paying jobs and other economic benefits in Colorado. During its construction phase, the Lamar wind facility employed nearly 400 people, and provided an economic boost to Prowers County. Today, the project provides 15-20 permanent jobs and nearly $2 million each year in funding for the county,

[20] Bolinger, M., R.H. Wiser, and W. Golove. *Accounting for Fuel Price Risk: Using Forward Natural Gas Prices Instead of Gas Price Forecasts to Compare Renewable to Natural Gas-Fired Generation*. August 2003.
[21] See UCS, *Renewable Energy Can Help Ease the Natural Gas Crunch* at http://www.ucsusa.org/clean_energy/renewable_energy/page.cfm?pageID=1370
[22] Results are in cumulative net present value 2002$ using a 7% real discount rate. Job results are for the year 2020.

local school district, and medical center. The farmers and ranchers leasing the land where the 108 turbines are located earn between $3,000 and $6,000 per turbine per year.[23]

The Impact on the Environment

Increasing renewable energy use will reduce the amount of air pollution from power plants that threaten the people of Colorado's health by burning coal, oil, and natural gas. Carbon dioxide (CO_2) emissions, which trap heat in the atmosphere and cause global warming, would also be reduced. The 10 percent renewable energy standard will reduce about 3 million metric tons (MMT) of power plant CO_2 emissions per year by 2025—a reduction of 4.5 percent below business-as-usual levels. The renewable energy standard will also reduce harmful water and land impacts from extracting, transporting, and using fossil fuels and conserve resources for future generations.

The decrease in emissions of CO_2 and other pollutants also reduces the financial exposure of Colorado utilities and customers to future costs of regulating those emissions. Recently, Xcel Energy CEO Wayne Brunetti said that the US will likely impose carbon dioxide emission regulations "in one form or another" on the power industry in the near future.[24] Such regulation will result in higher costs for fossil fuel in the form of added controls, emission allowance permits, or emission taxes. Some utilities, like Pacificorp in the northwest and Pacific Gas & Electric in California, are already assuming CO_2 costs of $8 per ton, or approximately 0.3 cents per kWh in higher natural gas generation costs and 0.7 cents per kWh in higher coal plant costs in their long-range planning. These avoided costs in the renewable standard scenario are not explicitly considered in this analysis.

Results From the Less Likely Scenario

Even with more pessimistic assumptions for renewable energy technology costs, the renewable energy standard would provide important benefits for Colorado's citizens and environment. Colorado would still increase its total homegrown renewable power by 1,300 megawatts (MW) by 2025. Colorado's strong wind resources would also continue to power the vast majority of this development. However, the higher cost assumptions for wind power results in the use of some bioenergy resources for co-firing in existing coal power plants. Solar resources also continue to make a smaller, but important contribution to meeting the renewable energy requirements.

Under this less likely scenario, the renewable energy standard's impact on consumers would be a small increase in costs. The impact on average monthly residential electricity bills over the 2005-2025 period would range from an additional cost of about 30 cents (or six-tenths of a percent) for customers of municipal utilities and rural electric cooperative to 50 cents (or about one percent) for Xcel Energy customers. The increased use of renewable energy would still stimulate competition with natural gas facilities, resulting in reduced natural gas demand and prices. The residential consumer would see an average of 63 cents (0.6 percent) per month in savings on a typical winter natural gas bills from 2015 to 2025 under the renewable energy standard compared to business as usual. Savings on an average monthly gas bill over the course of a year would

[23] Cox, Craig. From Snack Bars to Rebar: How Project Development Boosted Local Businesses Up and Down the Wind Energy 'Supply Chain' in Lamar, Colorado. Prepared for the U.S. Department of Energy under Grant Number SF22339. March 2004. Available online at http://www.state.co.us/oemc/events/cwade/2004/presentations/cox.pdf.
[24] Dow Jones, February 4, 2004.

reach 31 cents per month. The total impact of the standard on all energy consumers would be an additional cost of $139 million, or one quarter of one percent increase, over two decades.

The level of economic development benefits—such as new capital investment, property tax revenues, and land lease payments for wind power—are largely the same as those found in our more likely scenario because the amount of renewable energy development is similar. However, somewhat fewer jobs would be created under this scenario. By 2020, the 10 percent standard would create 1,550 new jobs in manufacturing, construction, operation, maintenance, and other industries. The amount of renewable energy need to meet the requirement would still create 1.4 times more jobs than fossil fuels—a net increase of 420 jobs. The growth of new jobs is lower primarily as a result of the additional costs to energy consumers in this scenario compared to the consumer savings in our more likely scenario.

The impact on CO_2 emission from power plants would actually be greater under the higher costs scenario. The increased use of bioenergy for co-firing directly displaces coal power generation, which is the greatest source of global warming emissions in the country. As a result, the 10 percent renewable energy standard would reduce about 4.5 MMT of power plant CO_2 emissions per year by 2025—a reduction of nearly 7 percent below business-as-usual levels.

Conclusions

A growing number of states are choosing renewable energy standards as their primary tool for promoting renewable energy. If passed, the 10 percent by 2015 renewable energy standard in Amendment 37 would place Colorado in the middle of the 17 standards already enacted in other states. The proposed minimum rebate for solar systems is among the lowest of rebates currently available in 16 other states.

Our analysis shows that adopting the renewable energy standard in Amendment 37 would generate significant economic and environmental benefits for Colorado. By diversifying Colorado's electricity mix, the renewable energy standard would help stabilize electricity and natural gas prices, while saving consumers money on their natural gas bills. It would create jobs and provide important economic development benefits for rural communities. It would provide environmental and public health benefits by reducing air pollution, carbon dioxide emissions, and harmful water and land impacts from extracting and burning fossil fuels, while conserving resources for future generations. Finally, it would provide insurance against rising energy prices and future regulations on carbon emissions.