

# Projected Impacts of Proposed Federal Renewable Portfolio Standards on the Colorado Economy

**Final Report to  
Bipartisan Policy Center**

*by*

**Burton C. English, Kim Jensen, Jamey Menard, and Daniel De La Torre Ugarte \***

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**\*Professors, Research Associate, and Professor, respectively, Department of Agricultural Economics, The University of Tennessee.**

**BIOBASED ENERGY ANALYSIS GROUP**

**DEPARTMENT OF AGRICULTURAL ECONOMICS, 302  
MORGAN HALL, THE UNIVERSITY OF TENNESSEE,  
KNOXVILLE, TN 37996, 865-974-7231.**



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## Executive Summary

The purpose of this study is to project how meeting proposed Federal Renewable Energy Portfolio Standards might impact the Colorado economy. The impacts from two Federal proposals, the 25% RES and the 20% RES, are compared with the impacts from the current Colorado Renewable Energy Standard (CO RES).

Projections of future electricity demands and renewable energy requirements under each of the three policy scenarios were used to project the amounts of renewable energy that would need to be generated. Once projections of renewable energy requirements for the state were made, the type and number of facilities required to meet these energy needs was projected. Renewable energy technologies were assessed to determine their ability to contribute to meeting the additional renewable energy requirements given the resource base of Kansas. Incorporated in the analysis is an assessment of potential renewable energy resources in Kansas. The expenditures on construction of additional renewable energy facilities and recurring operating expenditures on inputs to renewable energy generation were then used to project the economic impacts of meeting the additional renewable energy requirements. These impacts include measurements of increased activity as a result of investments in renewable energy facilities and the operation of these facilities. The impacts are estimated and broken down at state adjusted Bureau of Economic Analysis (BEA) region level as well as by renewable energy source. Estimates of economic activity added and jobs created are provided. These estimates are provided by tracing economic transactions using a regional input/output model, IMPLAN. Individual IMPLAN models are used to project the economic impacts from expenditures by the renewable electricity industry at both state and BEA regions. Economic impacts from the renewable electricity generation, renewable electricity feedstock production, such as dedicated energy crop production or collecting livestock wastes, from leasing of land for wind energy projects, and from electricity rate per kWh changes are projected. Renewable energy sources evaluated included wind, co-fire of dedicated energy crops, and co-fire of livestock manure.

An estimated 4.7 to 5.0 billion kWh will be generated from renewable resources by 2015 under the various RES scenarios. By 2025 this increases to 7.2 to 11.3 billion kWh depending on the scenario (Table ES.1).

Statewide, the projected 2025 Total Industry Output (TIO) from operating additional renewable facilities is \$1.9 billion under the CO RES, \$3.0 billion under the 25% RES, and just under \$2.6 billion under the 20% RES (Table ES.2).

Under the CO RES, in 2025, the largest economic impacts are projected to be derived from wind, followed by direct fire of wood residues and co-fire of wood residues with coal. Under the 25% RES and 20% RES's, the largest impacts are projected to accrue from direct fire of wood residues, followed by wind and co-fire of wood residues with coal. Reflecting the changes in the relative importance between the technologies in meeting the renewable energy needs under the three policy scenarios, under the CO RES for 2025, the Denver BEA Region is projected to experience the largest economic impacts, while under the 25% RES and 20% RES's, the Grand Junction BEA Region is projected to receive the largest economic impacts.

Operations from the additional renewable electricity industry is projected to add 7,076 jobs in 2025 under the CO RES, 11,362 under the 25% RES, and 9,927 under the 20% RES. The largest share of these jobs would occur in the Grand Junction BEA Region.

Rural communities are projected to benefit from expansion of renewable energy through several means. First, farmers and rural landowners may receive wind lease payments for locating wind turbines on their lands. Second, in this study, cattle manure is used as a

feedstock to be co-fired with coal. Third, wood residues to be used in co-firing and direct firing are projected to be derived from rural areas, particularly in the western half of the state. For 2025, economic impacts from collection of agro-forestry feedstocks and wind leases on farmlands are projected at \$240 million under the CO RES, \$462 million under the 25% RES, and \$388 million under the 20% RES. Direct economic activity from either the Colorado RES or either of the Federal RES' has the potential impact in significant income gains annually for Colorado's agricultural and forest sector. Impacts per farm are estimated to average between \$9,000 and \$11,300 for the CORES and 25% RES scenarios by 2025.

Although there are negative household income impacts from increased electricity prices, the overall economic impacts from the additional renewable electricity industry are still positive. There is a net estimated impact of about \$1.7 billion in 2025 under the CO RES, about \$2.6 billion under the 25% RES, and about \$2.3 billion under the 20% RES.

Table ES.1. Summary Electricity Production by Projected Energy Source for Colorado, 2015 and 2025

Variable	2015			2025		
	Co Res	20% RES Federal	25% RES Federal	Co Res	20% RES Federal	25% RES Federal
	Billion kWh					
Total Generation <sup>a</sup>	56.4	56.4	55.1	66.4	66.4	63.7
Total Generation from Renewables	4.7	5.0	4.7	7.3	9.9	11.3
Municipal Waste:						
Landfill	0.1	0.1	0.1	0.1	0.1	0.1
MSW	-	-	-	-	-	-
Co-fire:						
Wood	1.6	1.6	1.6	1.6	1.6	1.6
Manure	0.2	0.2	0.2	0.6	0.6	0.6
Direct Fire:						
Wood	-	0.3	0.0	1.9	4.6	5.9
Solar:						
Non Industrial	0.2	0.2	0.2	0.2	0.2	0.2
Industrial	-	-	-	0.1	0.1	0.1
Wind:	2.6	2.6	2.6	2.7	2.7	2.7

In 2008, Colorado consumed 51.4 billion kWh of electricity. This is projected to be 56.4 in 2015 and 66.4 billion kWh in 2025. Total sales are based on EIA projections.

<sup>a</sup>The projected net generation is adjusted for the ability to use energy savings to meet the RES.

Table ES.2. Summary of the projected economic impacts for Colorado, 2015 and 2025<sup>a</sup>

Variable	2015			2025		
	Co Res	20% RES Federal	25% RES Federal	Co Res	20% RES Federal	25% RES Federal
Economic Impacts Million dollars						
Total Industry Output:						
Operating	1,225.6	1,301.4	1,225.6	1,962.9	2,636.2	2,975.1
Household	(137.4)	(145.1)	(137.4)	(217.9)	(287.4)	(322.2)
Agriculture and Forestry:						
Direct	65.2	74.3	65.2	127.9	208.4	248.9
Total	120.6	137.3	120.6	237.5	385.1	459.3
Investment Impacts <sup>b</sup>	6,739.2	7,008.5	6,739.2	1,264.6	3,160.6	4,919.0
Employment Impacts Number of jobs						
Operating	4,367	4,688.0	4,367.0	7,076	9,927.0	11,362.0
Investment	37,227	38,790.0	37,227	7,598	18,267.0	28,476.0
cents/kWh						
Projected change in energy price	0.0039	0.0041	0.0039	0.0052	0.0069	0.0077

<sup>a</sup> Does not include cost impact on price of energy saving technologies

<sup>b</sup> Investment impacts are one time impacts estimated to occur during the 2010-2015 period for 2015, and 2021 to 2025 for the 2025 column.



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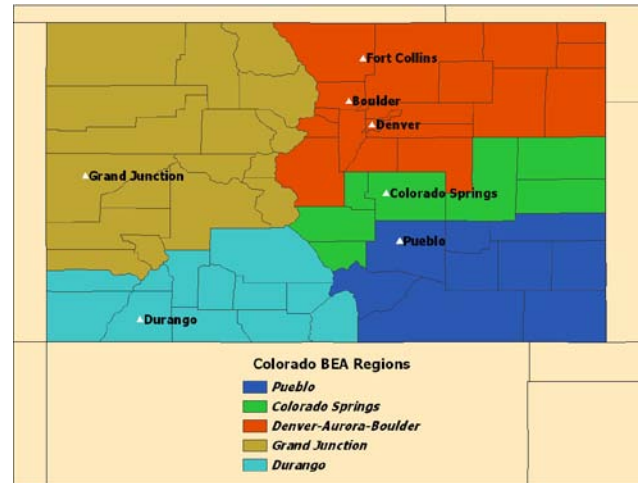
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# Projected Impacts of Proposed Federal Renewable Energy Portfolio Standards on the Colorado Economy

## Study Purpose

The purpose of this study is to project how meeting proposed Federal Renewable Energy Portfolio Standards might impact the Colorado economy. The two proposals analyzed, which will be discussed later in this document, are the 25% RES and the 20% RES. To conduct the analysis, these two proposed Federal Renewable Energy Portfolio Standards are compared with Colorado's current renewable energy portfolio standard and existing and planned renewable energy generation. Changes from projected renewable energy generation to amounts required to meet the proposed Federal standards are estimated. Renewable energy technologies are assessed to determine their ability to contribute to meeting the additional renewable energy requirements given the resource base of Colorado. The expenditures on construction of additional renewable energy facilities and recurring operating expenditures on inputs to renewable energy generation are then used to project the economic impacts of meeting the additional renewable energy requirements. These impacts are projected for the state and for "modified" Bureau of Economic Analysis (BEA) regions within the state (Figure 1).



**Figure 1. Colorado Modified Bureau of Economic Analysis Regions**

## Methods of Analysis

In this analysis, projections of renewable energy requirements for the state of Colorado will be made for three policy scenarios: 1) the current state law, 2) the 20% RES, and 3) the 25% RES. Once projections of renewable energy requirements for the state are made, the type and number of facilities required to meet these energy needs must be determined. The number and type of facilities are determined not only at the state level, but also at the BEA region level.

The number and type of facilities in each BEA region are determined based upon plans for facility construction or the potential for facilities based on resources in the region. For example, co-fire and direct fire of wood conversion facilities are placed in BEA regions according to location of current crop production. Because in many cases, the sizes and technologies of facilities that might be placed in a region are unknown, representative technologies and sizes for facilities that might go into a region are assumed. These sizes and technologies are selected based upon previous literature and availability of engineering cost data.

Costs, facility sizes, and input requirements for representative renewable energy technologies are then used to project required facility expenditures. Descriptions of the

representative technologies are in the Appendix B of this document. The costs and prices presented in the tables in Appendix B are all in \$2006. A regional input/output model, IMPLAN, (Olson and Lindall, 1999) is used to project the economic impacts from expenditures by the energy conversion facilities both statewide and by BEA regions. Impacts from the various technologies differ depending on the pre-specified demand for that technology, the capital costs involved, and the operating costs. The dollar value projections presented in the document from the IMPLAN model are all in \$2009.

The IMPLAN model results presented include estimates of Total Industry Output (TIO), Employment, and Value-Added. Total industry output, a measure of economic activity, is defined as the value of production by industry per year. Employment represents total wage and salary employees, as well as self-employed jobs in a region, for both full-time and part-time workers. Total value added is defined as all income to worker paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses. The IMPLAN results presented include both direct and total impacts. Direct effects measure the response for a given industry given a change in final demand for that same industry. Indirect effects represent the response by all local industries from a change in final demand for a specific industry. Induced effects represent the response by all local industries caused by increased (decreased) expenditures of new household income and inter-institutional transfers generated (lost) from the direct and indirect effects of the change in final demand for a specific industry. Total effects are the sum of direct, indirect, and induced effects. For purposes of brevity, only direct and total effects are presented.

The operating costs for the various technologies shown in Appendix B were used to generate "breakeven" prices for each technology. The breakeven price for each technology was then weighted by projected electricity sales from that technology to arrive at an overall weighted renewable electricity price. The difference between the electricity prices with the additional renewable energy under the two federal proposals and without the additional renewable energy are assumed to be passed on to consumers either directly through changes in electricity rates or indirectly through rate increases to commercial users that then pass on these costs to consumers through increases in prices of goods and services. The household incomes of consumers in the IMPLAN model were then impacted by this overall amount.

The analysis in this document will be as follows. First, the requirements under the proposed federal renewable portfolio and energy efficiency savings (Bingaman and 25% RES's) will be presented. Second, an energy profile of Colorado will be presented. Third, the state's energy situation by potential source of renewable energy will be analyzed, including assessment of potential for feedstocks to supply sufficient energy. Fourth, projections of Colorado's renewable energy demand under the 20% RES and the 25% RES will be presented. Fifth, the economic impacts of meeting the renewable energy requirements under the various policy scenarios will be projected and compared.

## **Colorado's Renewable Portfolio Standard and The Proposed Federal Renewable Portfolio Standards and Federal Energy Savings Requirements**

Colorado has past a state level renewable portfolio standard. In addition, two proposals have been put forward regarding federal energy standards. The first is for a federal renewable energy portfolio standard. The second proposes energy savings requirements for utilities and a

renewable energy portfolio standard. The current law and the two federal proposals are discussed in this section.

*Colorado's Renewable Energy Standard (CO RES)*

Requirements of the Colorado law are summarized in Table 1. Eligible renewable-energy resources include solar-electric energy, wind energy, geothermal-electric energy, biomass facilities that burn nontoxic plants, landfill gas, animal waste, hydropower, recycled energy, and fuel cells using hydrogen derived from eligible renewables. Recycled energy is defined as energy produced by a generation unit with a nameplate capacity of not more than 15 megawatts (MW) that converts the otherwise lost energy from the heat from exhaust stacks or pipes to electricity and that does not combust additional fossil fuel. As can be seen from Table 1, the law has differing requirements for investor owned versus municipals or cooperatives. In addition, the law contains solar energy requirements and gives special credit to renewable energy generated within the state. The full law is presented in Appendix A.

**Table 1. Colorado's Renewable Energy Standard (CO RES)**

Timeframe	Investor Owned Utilities	Municipal or Cooperatives Serving Greater than 40,000 Customers
<i>Renewable Energy Requirement as Overall Percentage of Retail Electricity Sales in Colorado</i>		
2008-2010	5%	1%
2011-2014	10%	3%
2015-2019	15%	6%
2020 and beyond	20%	10%
<i>Solar Requirements</i>		
	4% of RES, ½ generated on-site at customers' facilities	No requirement, if before July 1, 2015 receive 300% credit for RES, if after 100% credit
<i>In-state Generation</i>		
	Receives 125% credit for RES	Community based projects < 30MW receives 150% credit for RES, Otherwise 125% credit
<i>Tradeable Renewable Energy Credits</i>		
	May be used	May be used

*The 20% RES*

The proposed new PURPA Section 610-Federal Renewable Portfolio Standard made by Bingaman, or The 20% RES, would require that electric utilities obtain certain percentages of their sales of electricity to consumers from new renewable energy, existing renewable energy, or energy efficiency (Summary of Bingaman Discussion Draft, 2009). These percentages are as shown in Table 2.

Eligible sources include solar, wind, ocean or geothermal energy, biomass, landfill gas, or incremental hydropower. The proposed means of compliance are that the electric utility will submit renewable energy credits, federal energy efficiency credits, or alternative compliance payments. Federal energy efficiency credits cannot be used to meet more than 25% of the

requirement. The required percentages shown in Table 2 are adjusted by 25% energy efficiency credits, with these adjusted values shown in the far right column. The alternative compliance payments are at a rate of 3 cents per kWh.

**Table 2. Proposed Federal RPS Annual Renewable Energy Percentage Requirement Under the New PURPA Section 610 by Bingaman (The 20% RES)**

Year	Required Annual Percentage of Sales	Required Annual Percentage Adjusted for Energy Efficiency Credits
2011-2012	4.0	3.0
2013-2015	8.0	6.0
2016-2018	12.0	9.0
2019-2020	16.0	12.0
2021-2039	20.0	15.0

*The 25% RES*

The second proposal is an energy savings act coupled with a renewable energy portfolio standard, termed the “Save American Energy Act” (Save American Energy Act, 2009) and the “American Renewable Energy Act” (American Renewable Energy Act, 2009) respectively. This set of proposals was made by Markey (The 25% RES) to amend PURPA. The “Save American Energy Act” would require nationwide minimal levels of electricity and natural gas savings to be obtained through utility efficiency programs, building energy codes, appliance standards, and related efficiency measures (Save American Energy Act, 2009). The performance standards as they relate to retail electricity distributors are shown in Table 3.

The “American Renewable Energy Act” requires the following annual percentages of renewable energy displayed in Table 4. The percentage may be met by submitting the Federal renewable energy credit or an alternative compliance payment. The payment is equal to the smallest of 200% of the Federal renewable electricity credit for the previous compliance year or 5 cents adjusted by the Gross Domestic Product Implicit Price Deflator. The proposed Act treats wind, solar, geothermal, biomass or landfill gas, qualified hydropower, and marine or hydrokinetic renewable energy as qualified renewables.

**Table 3. Proposed Electricity Savings Requirements for Retail Electricity Distributors Under the “Save American Energy Act” (The 25% RES)**

Year	Cumulative Electricity Savings Percentage
2012	1.00
2013	2.00
2014	3.25
2015	4.50
2016	6.00
2017	7.50
2018	10.00
2019	12.50
2020	15.00

**Table 4. Proposed Annual Renewable Energy Percentage Requirement Under the “American Renewable Energy Act” (The 25% RES)**

Year	Required Annual Percentage
2012	6.00
2013	6.00
2014	8.50
2015	8.50
2016	11.00
2017	11.00
2018	14.00
2019	14.00
2020	17.50
2021	17.50
2022	21.00
2023	21.00
2024	23.00
2025	25.00

The Department of Energy, Energy Information Administration (EIA) conducted an analysis of the 25% RES for a federal renewable energy portfolio (EIA, 2009). The percentages projected by EIA, given exclusion of small power retailers, hydro sales, municipal solid waste (MSW) sales, and energy efficiency credits, are shown in Table 5.

**Table 5. The 25% RES for Federal Renewable Energy Portfolio Standard: Analysis by the Energy Information Administration**

Calendar Year	Required in Proposed Law	Annual Percentage Excluding:		
		Small Power Retailers	Small Power Retailers, Hydro Sales, and MSW Sales	Sm. Power Retailers, Hydro and MSW Sales, and Allowable Energy Effic. Credits
Percent				
2012	6.0	5.3	5.0	3.4
2013	6.0	5.3	5.0	3.4
2014	8.5	7.5	7.1	4.9
2015	8.5	7.5	7.1	4.9
2016	11.0	9.7	9.2	6.3
2017	11.0	9.7	9.2	6.3
2018	14.0	12.3	11.8	8.0
2019	14.0	12.3	11.8	8.0
2020	17.5	15.4	14.7	10.0
2021	17.5	15.4	14.7	10.0
2022	21.0	18.5	17.6	12.0
2023	21.0	18.5	17.6	12.0
2024	23.0	20.2	19.3	13.1
2025	25.0	22.0	21.0	17.0

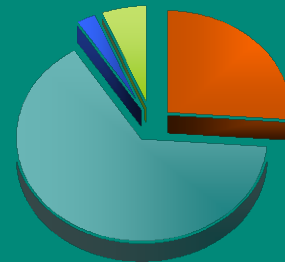
(Source: EIA, 2009).

## Current Energy Profile

Colorado's net electricity generation for 2008 was 53.7 million MWh (Table 6). Colorado's energy portfolio is currently heavily reliant upon coal-fired electricity. Based upon 2008 data, about 65.2 percent comes from coal-fired and about 26.0 percent comes natural gas-fired (Figure 2). Non-hydroelectric renewables account for about six percent.

**Table 6. Colorado Net Electricity Generation, 2008**

	Million MWh
Total Net Electricity Generation	53.7
<i>By Source:</i>	
Petroleum-Fired	0.0
Natural Gas-Fired	14.0
Coal-Fired	35.0
Nuclear	0.0
Hydroelectric	1.5
Other Renewables	3.2
Other	0.0



Source: Department of Energy, Energy Information Administration, Electric Power Monthly.

## Renewable Electricity Generators

Facilities existing or planned as of 2007 that use at least some renewable sources to produce energy had a total of 1,142.32 MW of nameplate capacity. This can be compared with 10,060.0 MW of nameplate capacity for all facilities in the state. Currently, Colorado's renewable electricity generation is derived primarily from wind. The names, locations, energy sources, and nameplate capacities of facilities using renewable energy sources are displayed in Table 7. Planned facilities as of 2007 are listed in Table 8. As can be seen from these tables, the renewable energy is derived from a mixture of wind, biomass, solar, and landfill gas. A map of the locations of existing facilities is shown in Figure 3.

**Table 7. Colorado Electricity Generation Facilities Using Renewable Energy Sources**

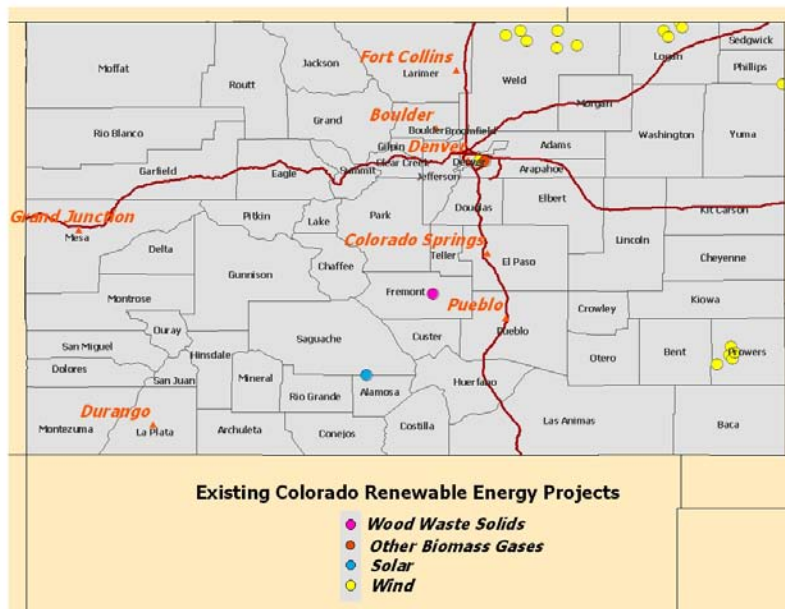
Utility Name	Plant Name	County	Name-plate Capacity	Energy Source*
Aquila, Inc.	W N Clark	Fremont	43.07	WDS, BIT
Colorado Golden Energy Corp.	Metro Wastewater Reclamation District	Denver	15	OBG, NB
SunE Alamosa LLC	SunE Alamosa	Alamosa	8.2	SUN
Aurora Wal Mart	Aurora Wal Mart	Arapahoe	0.05	WND
Babcock & Brown/BP America	Cedar Creek	Weld	79.5	WND
Babcock & Brown/BP America	Cedar Creek	Weld	221	WND
PPM Energy/Shell Renewables	Colorado Green	Prowers	162	WND
Arkansas River Power Authority	Lamar Wind Energy Project	Prowers	1.5	WND
Arkansas River Power Authority	Lamar Wind Energy Project	Baca	1.5	WND
Lamar Light & Power	Lamar Wind Energy Project	Prowers	4.5	WND
FPL Energy	Peetz Table Wind Energy Center (3Q)	Logan	264	WND
FPL Energy	Peetz Table Wind Energy Center (4Q)	Logan	136.5	WND
Caithness	Peetz Table Wind Farm	Peetz	29.7	WND
Xcel Energy	Ponnequin, phase I & II	Weld	16.5	WND
Xcel Energy	Ponnequin, phase III	Weld	0.6	WND
Xcel Energy	Ponnequin, phase III	Weld	4.5	WND
Xcel Energy	Ponnequin, phase III	Weld	9.9	WND
Invenergy	Spring Canyon	Logan	60	WND
	Twin Buttes	Bent	75	WND
Wray School District	Wray School District	Wray	0.9	WND

(Sources: Non-wind energy-Department of Energy Information Administration, Form EIA-860 Database. Wind energy-American Wind Energy Association)

\* See the Appendix for an abbreviation listing of energy sources.

**Table 8. Proposed Colorado Electricity Generation Facilities Using Renewable Energy Sources, Colorado, 2007**

Utility Name	Plant Name	City	State	Zip	Total Nameplate Capacity	Energy Source	Target Year
MMA Belmar Power LLC	Belmar	Lakewood	CO	80226	1.6	SUN	2008
MMA DAS Power	DIA		CO		1.9	SUN	2008
SunE SR1 Rifle EIC LLC	WWRF Solar Plant	Rifle	CO	81650	1.7	SUN	2008
WM Renewable Energy LLC	DADS Gas Recovery	Aurora	CO	80018	3.2	LFG	2008



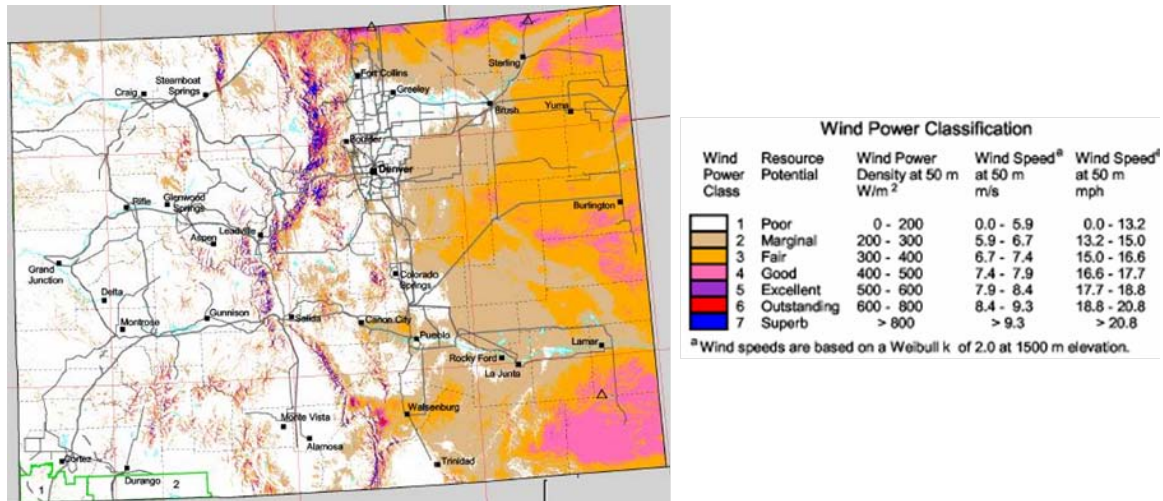
**Figure 3. Renewable Energy Facilities, Colorado**

## Potential for Energy Generation to Meet Renewable Energy Requirements

### Wind

Colorado already has a significant amount of wind energy production (6<sup>th</sup> in the United States). Currently installed wind capacity is 1067.65 MW, or assuming a capacity factor of about .375, enough to supply about 3,507.2 million kWh of electricity per year. The state's overall wind potential, factoring in environmental and land use exclusions for wind class of 3 and higher, has been estimated at 54,900 MW or enough to produce 481 billion kWh or 481,000 million kWh per year (Pacific Northwest Laboratory, 1991). Hence, the state has only

developed about 2 percent of its possible capacity. The majority of this wind potential exists in the eastern third of the state or along ridgelines in other parts of the state. See the map of wind power potential in Figure 4. Capacity and expenditures for an example facility are provided in Table B.1 of Appendix B.



**Figure 4. Wind Power Potential, Colorado**  
(Source: Department of Energy, EERE)

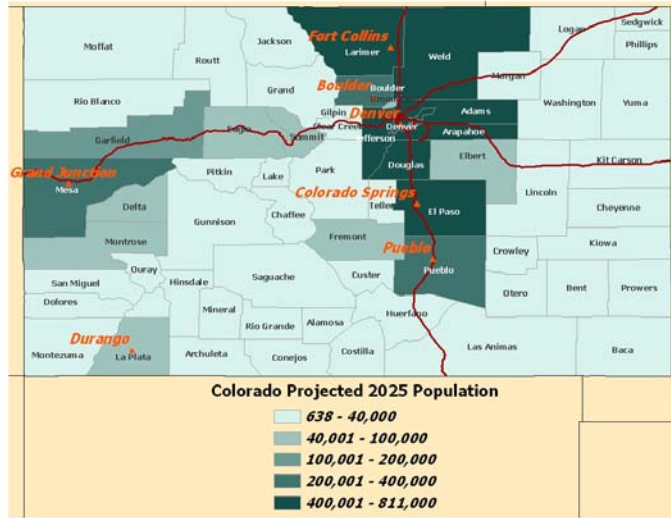
### Solar

The Colorado RES contains a solar requirement for investor-owned utilities. As shown in Tables 7 and 8, a few solar projects are in place. The Colorado RES requires that at least half of the solar come from on-site customer locations. Population is used to project where solar rooftop sized facilities for residential and small businesses might be located by region (Table 9 and Figure 5). Capacities and expenditures for both rooftop scale and utility scale solar example facilities are provided in Tables B.2 and B.3 of Appendix B.

**Table 9. Projected Population by BEA Region, Colorado**

BEA Region/State	2015	2020	2025
Colorado Springs	801,320	869,111	935,380
Denver-Aurora-Boulder	3,907,378	4,262,587	4,615,292
Durango	161,725	181,481	199,380
Grand Junction	606,341	692,370	771,371
Pueblo	260,541	281,472	302,123
Colorado	5,737,305	6,287,021	6,823,546

(Source: Colorado Department of Local Affairs, State Demography Office)



**Figure 5. Projected Colorado Population, 2025**

*Landfill Gas*

Currently Colorado has one operational landfill gas project that produces electricity. However, several other landfills are listed as candidate landfills. According to the EPA Landfill Methane Outreach Program, nine landfills are listed as candidate landfills. Of these landfills, seven have at least 2 million tons of waste in place. These 7 landfills have the potential to produce about 120.3 million kWh of electricity in a year.<sup>1</sup> With the existing facility in Aurora, this is a total of 144.2 million kWh per year. Scale and expenditures for an example landfill gas facility are shown in Table B.4 of Appendix B. A listing of landfills and their status is provided in Table 10 and map in Figure 6.



**Figure 6. Colorado Landfills**

<sup>1</sup> The EPA Landfill Methane Outreach Program Database of operational facilities in the U.S. has a total of 3766.8 million tons of waste in place for the U.S. with a total of 1531.7 MW capacity. This is an average of .4066 MW of electricity generation capacity per million tons of waste. Using this average, the Colorado tons of waste in place in candidate landfills with at least 2 million tons of waste in place is 39.4 million tons or enough for 16.0 MW. With a capacity factor of .856 (See Appendix B, Table B.4), this is a potential generation of about 120.3 million kWh in a year.

**Table 10. Colorado Landfills**

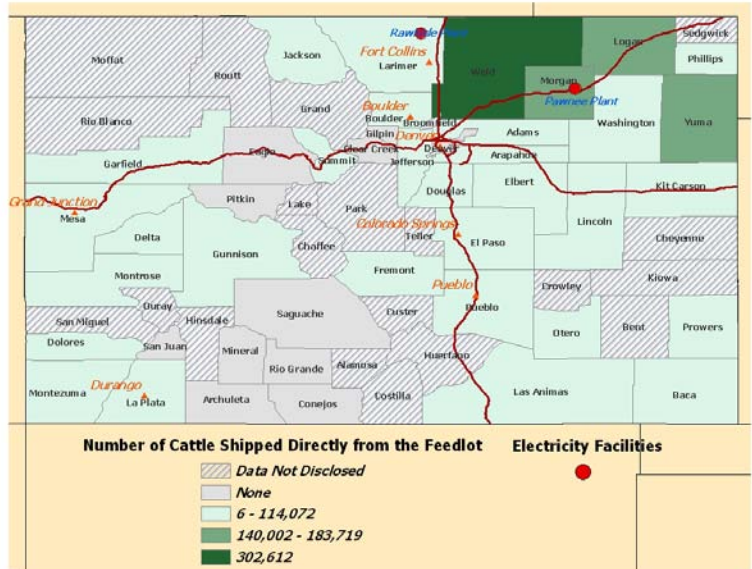
Landfill Name	Landfill City	Landfill County	Waste In Place (tons)	Project Status	MW Capacity
Denver Arapahoe Disposal Site-DADs	Aurora	Arapahoe	11,499,652	Operational 7/15/2008	3.2
Larimer County Landfill	Fort Collins	Larimer	12,558,321	Candidate	
Orchard Mesa SWDS	Grand Junction	Mesa	8,688,255	Candidate	
Denver Regional Landfill (South)	Erie	Weld	7,600,000	Candidate	
Foothills Landfill	Golden	Jefferson	3,394,539	Candidate	
Summit County Solid Waste Disposal Site	Dillon	Summit	2,680,410	Candidate	
Pitkin County Resource Recovery LF	Snowmass Village	Pitkin	2,465,911	Candidate	
Montrose East End SWDS	Montrose	Montrose	2,054,466	Candidate	
Milner Landfill	Milner	Routt	1,125,701	Candidate	
Midway Landfill	Fountain	El Paso	1,059,137	Candidate	
Lowry Landfill	Aurora	Arapahoe	25,725,664	Potential	
WMI/Colorado Springs SWDS	Colorado Springs	El Paso	15,562,598	Potential	
Central Weld County Landfill	Greeley	Weld	6,246,093	Potential	
Fountain Landfill	Fountain	El Paso	5,218,297	Potential	
Boulder Landfill	Boulder	Boulder	4,689,328	Potential	
Longmont SLF	Longmont	Weld	2,711,778	Potential	
Templeton Gap Landfill, Inc.		El Paso	2,058,908	Potential	
South Canyon Landfill	Glenwood Springs	Garfield	1,798,154	Potential	
Morgan County SWDLF	Fort Morgan	Morgan	915,183	Potential	
York & SH 224	Denver	Adams	867,423	Potential	
North Weld LF	Ault	Weld	831,063	Potential	
Broadacre Landfill Inc.	Pueblo	Pueblo	393,114	Potential	
Phantom Landfill	Penrose	Fremont	180,000	Potential	
Archuleta County Landfill	Pagosa Springs	Archuleta		Potential	
Buffalo Ridge Landfill	Keenesburg	Weld		Potential	
Consolidated Waste Services LF				Potential	
Front Range Landfill	Erie	Weld		Potential	
Jeffco #1	Golden	Jefferson		Potential	
Rooney Road LF	Golden	Jefferson		Potential	

(Source: EPA, Landfill Methane Outreach Program Database)

### *Co-Fire of Cattle Manure*

Colorado has a significant fed cattle industry, and cattle manure can be used to generate electricity through co-fire with coal. According to the 2007 Census of Agriculture, Colorado has 2.7 million cattle and 1.1 million cattle on feed. Counties with the largest numbers of cattle on feed are Logan (140,002 head), Morgan (140,670 head), Weld (302,612 head), and Yuma (183,719 head). These counties lie in the Northeast quarter of the state. Sweeten, Annamalai, Heflin, and Freeman (2002) provided costs of conversion for cattle feedlot manure co-firing with coal. Sweeten, Annamalai, Auvermann, Heflin, and Parker estimated that cattle on feed produce about a ton of manure over a 5 month period. Annualized, this is about 2.4 tons per year. Sweeten, Annamalai, Heflin, and Freeman (2002) also provided estimates of the BTU in manure as taken at about 3,445 Btu per pound. Hence, over a year, an animal unit

would provide manure to be converted to about 16.5 million BTU. Two coal-fired plants are in relatively close proximity to feeding center counties. These plants are the Rawhide Plant in Wellington, with 293.6 MW capacity (29.4 MW at 10% co-fire). While located in Larimer County, it is close to Weld County. The second is the Pawnee Plant in Brush (Morgan County) with a capacity of 552.3 MW (55.2 at 10% co-fire). Using the Rawhide and Pawnee Plants as examples, the Rawhide Plant can produce about 205.8 million kWh/year or 701,064.5 million BTU/year, and the Pawnee Plant can produce about 387.1 million kWh/year or about 1,320,675.1 million BTU/year. Given that each animal is estimated to produce manure for 16.5 million BTU, these sizes of facilities would be able to take manure from about 42,549 head and 80,041 head respectively. This is enough for a total of three large scale feedlots (See Table B.5 in Appendix B for an example conversion facility of manure to energy). A map of cattle on feed with the two coal-fired facilities is shown in Figure 7.



**Figure 7. Number of Cattle Shipped from Feedlots, Colorado, 2007**

*Co-Fire of Wood Residues*

Wood residues can be co-fired with coal to produce electricity. However, the ability to economically co-fire wood residues requires coal plants located nearby areas of wood residue production. Projections of availability of wood residues across the regions of Colorado are that nearly 47% of wood residues would come from the Grand Junction region. The locations of Colorado’s coal plants are shown in Figure 8. A listing of the coal-fired plants in the Grand Junction region is shown in Table 11. In total, the capacity of the plants in the Grand Junction region is 1,515 MW, or at a 15% co-fire rate, about 227.3 MW of co-firing capacity. Assuming a capacity factor of .80, this is enough to produce about 1,592.6 million kWh of electricity in a year. This rate of co-firing would require approximately 754,746



**Figure 8. Colorado’s Coal-Fire Electricity Plants, 2007**

tons of wood residues.<sup>2</sup> An example facility's scale and expenditures are given in Table B.6 of Appendix B

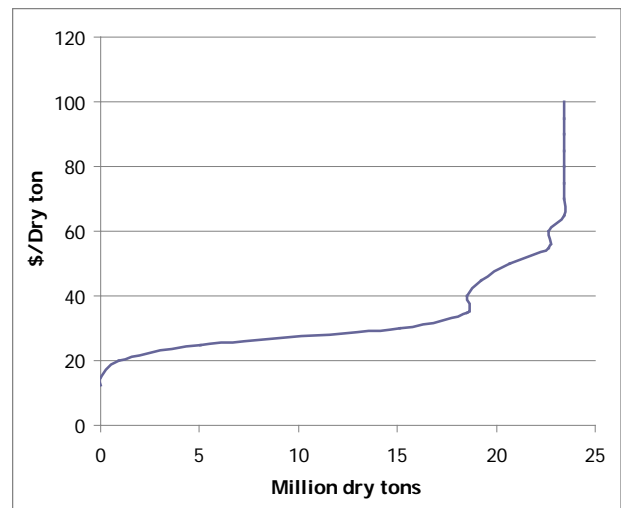
**Table 11. Coal-Fire Plants, Grand Junction Region, 2007**

Utility Name	Plant Name	City	Zip	Nameplate Capacity
Public Service Co of Colorado	Cameo	Palisade	81526	22.0
Public Service Co of Colorado	Cameo	Palisade	81526	44.0
Public Service Co of Colorado	Hayden	Hayden	81639	190.0
Public Service Co of Colorado	Hayden	Hayden	81639	275.4
Tri-State G & T Assn, Inc	Craig	Craig	81626	446.4
Tri-State G & T Assn, Inc	Craig	Craig	81626	446.4
Tri-State G & T Assn, Inc	Nucla	Nucla	81424	79.3
Tri-State G & T Assn, Inc	Nucla	Nucla	81424	11.5
Region				1,515.0

(Source: Energy Information Administration, Electricity Generators Database)

*Direct Fire of Wood Residues*

Using supply functions from a prior study (English et al., 2006), the projected supplies of wood residues available at various prices from the Grand Junction region were calculated. These are shown in Figure 9, with residues being supplied beginning at around \$20 per ton. The price \$45 per ton was used for all three periods in this analysis. At \$45 per ton, in 2025, 19.2 million dry tons are projected to be available. Hence, the supplies of wood residues would far exceed the amounts required by the co-firing facilities (754,746 tons). Wood residues beyond those that are projected to be used in co-firing (18,445,254 tons) are sufficient to supply about 38,921.6 million kWh (assumes a tons per kWh of .00047). Scale and expenditure for an example facility are provided in Table B.7 of Appendix B.

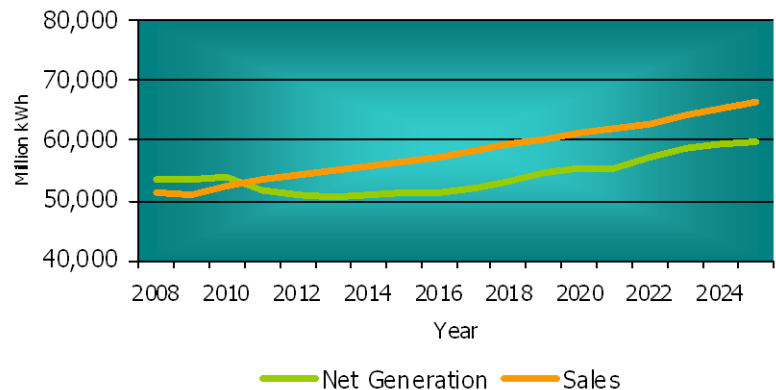


**Figure 9. Estimated Wood Residue Supply Curve, Grand Junction Region, 2025**

<sup>2</sup> The BTU of dry western softwoods is assumed to be 9,000 BTU per pound or 18,000,000 BTU per ton. The BTU per kWh is 3,412.1, so the estimated kWh per ton is 5,275.3. However, assuming a moisture of 60%, the kWh per ton assumed is 2,110.1. If 1,592.6 million kWh are to be generated, this would require 1,592.6 million kWh/2,110.1 kWh/ton or 0.7547 million tons.

## Projections to Meet the CO RES and the Federal Proposals

Because the CO RES and the two federal proposals are percentages of overall electricity sales that must come from renewables, it is necessary to obtain projections of electricity demand for the state through 2025. In order to calculate projected electricity demand, the actual demand for 2008 from EIA's Electric Power Monthly was used. The annual projected growth rate for the Southwest Power Pool from EIA's Annual Energy Outlook was then used with the 2008 electricity sales to project electricity sales into the future through 2025. The same method and data sources were used to project net generation by the year 2025. The electricity sales for 2008 were 51,372 million kWh. By 2025, the projection is 66,356 million kWh. The projected values are displayed in Figure 10.



**Figure 10. Projected Net Generation and Sales of Electricity for Colorado**

### *The Colorado RES*

The percentage requirements under the Colorado RES were used, along with projected electricity demand, to project the million kWh requirements for renewable energy (Table 12). Since the requirements under RES differ depending on whether the utility is investor owned or a municipal or cooperative utility, the share of customers served by these types of utilities had to be taken in to account when making the projections. According to the Colorado Public Utilities Commission, investor-owned utilities serve about 59% of the customers in Colorado. Municipal and cooperative utilities with more than 40,000 customers serve about 23% of the customers in Colorado. For example, the percent requirement for investor-owned utilities was multiplied by the projected electricity demand and then this value was multiplied by 59% to obtain a projected million kWh requirement for investor-owned utilities. In addition, investor-owned utilities receive a 1.25 renewable energy credit (REC) if the electricity is generated in-state. This was also taken into account in Table 12. The total required million kWh (including investor-owned and municipals and cooperatives serving greater than 40,000 customers) by the year 2025 under the CO RES is projected to be 7,821 million kWh. Of this amount, the solar requirement is projected to be 425 million kWh.

**Table 12. Projected Requirements Under the CO RES**

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
<b>Projected Electricity Demand (Million kWh)</b>															
52,271	53,420	54,309	54,800	55,609	56,367	57,305	58,317	59,274	60,254	61,172	61,936	62,824	63,999	65,244	66,356
<b>Investor Owned Utilities (About 59% of customers)</b>															
Overall Percent Required of Investor Owned Utilities															
5.00%	10.00%	10.00%	10.00%	10.00%	15.00%	15.00%	15.00%	15.00%	15.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%
Projected kWh Requirement of Investor Owned Utilities Without Credit for In-State Generation															
1,542	3,152	3,204	3,233	3,281	4,989	5,072	5,161	5,246	5,333	7,218	7,309	7,413	7,552	7,699	7,830
Projected kWh Requirement of Investor Owned Utilities With Credit for In-State Generation (1.25 REC for in-state)															
1,234	2,521	2,563	2,587	2,625	3,991	4,057	4,129	4,197	4,266	5,775	5,847	5,931	6,041	6,159	6,264
Solar Percent Required of Investor Owned Utilities (4% of RES)															
0.20%	0.40%	0.40%	0.40%	0.40%	0.60%	0.60%	0.60%	0.60%	0.60%	0.80%	0.80%	0.80%	0.80%	0.80%	0.80%
Projected Solar kWh Requirement of Investor Owned Utilities Without Credit for In-State Generation															
62	126	128	129	131	200	203	206	210	213	289	292	297	302	308	313
Projected Solar kWh Requirement of Investor Owned Utilities With Credit for In-State Generation (1.25 REC for in-state)															
49	101	103	103	105	160	162	165	168	171	231	234	237	242	246	251
<b>Municipals and Cooperatives With Greater than 40,000 Customers (About 23% of customers)</b>															
Overall Percent Required of Municipals and Cooperatives Serving Greater than 40,000 Customers															
1.00%	3.00%	3.00%	3.00%	3.00%	6.00%	6.00%	6.00%	6.00%	6.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Projected kWh Requirement of Municipals and Cooperatives Without Credit for In-State Generation															
120	369	375	378	384	778	791	805	818	832	1,407	1,425	1,445	1,472	1,501	1,526
Projected kWh Requirement of Investor Owned Utilities With Credit for In-State Generation (1.5 REC for in-state)*															
80	246	250	252	256	519	527	537	545	554	938	950	963	981	1,000	1,017
<b>Overall kWh Required With Credit for In-State Generation</b>															
<b>1,314</b>	<b>2,767</b>	<b>2,813</b>	<b>2,839</b>	<b>2,881</b>	<b>4,509</b>	<b>4,584</b>	<b>4,665</b>	<b>4,742</b>	<b>4,820</b>	<b>6,713</b>	<b>6,796</b>	<b>6,894</b>	<b>7,023</b>	<b>7,159</b>	<b>7,281</b>

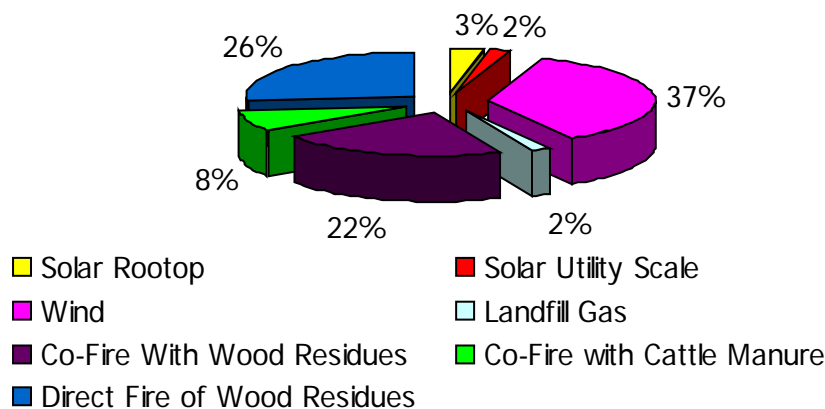
\*If less the project is community based and less than 30MW capacity, the REC is 1.5 for in-state generation.

(Sources: Electricity Sales and Projected Growth,-Department of Energy, Energy Information Administration, Percent Investor Owned-Colorado Department of Regulatory Agencies. Public Utilities Commission, <http://www.dora.state.co.us/puc/energy/ColoradoElectricPowerUtilities.pdf>)

The projected kWh's generated from each type of renewable energy under the Colorado law are presented in Table 13. Figure 11 represents the shares of kWh by type of renewable energy in 2025.

**Table 13. Projected Renewable Electricity Generation Under the CO RES, Colorado, 2015, 2020, and 2025**

Technology	2015	2020	2025
	Million kWh		
Solar Rooftop	159.6	231.0	246.4
Solar Utility Scale	0.0	0.0	133.0
Wind	2,595.3	2,631.3	2,667.3
Landfill Gas	144.3	144.3	144.3
Co-Fire With Wood Residues	1,592.6	1,592.6	1,592.6
Co-Fire with Cattle Manure	205.8	592.9	592.9
Direct Fire of Wood Residues	0.0	1,520.6	1,923.2
<b>TOTAL</b>	<b>4,697.6</b>	<b>6,712.6</b>	<b>7,299.6</b>



**Figure 11. Projected Share of Additional Renewable Electricity Generation by Technology Under the CO RES, 2025**

*The 25% RES*

The percentages of renewable energy required under the 25% RES (using the Energy Information Administration's projected percentages) are displayed in Table 14 (Adjusted Markey Percentage). Based upon the projected electricity demand shown and these percentages, the projected million kWh requirements under the 25% RES are calculated. Notably, by 2025, an additional 11,281 million kWh would need to be from renewable sources. By comparing Table 14 and Table 12, it can be seen that the projected requirements under the 25% RES surpass the projected requirements under the CO RES by the year 2022.

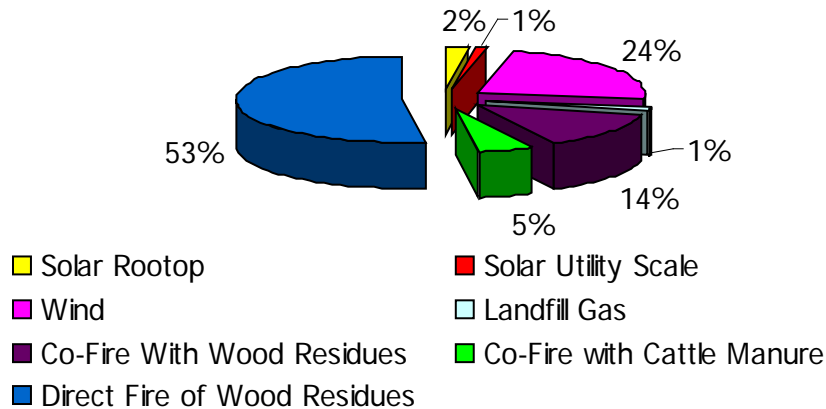
**Table 14. Projected Requirements Under the 25% RES**

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Projected Electricity Demand (Million kWh)															
52,271	53,420	54,309	54,800	55,609	56,367	57,305	58,317	59,274	60,254	61,172	61,936	62,824	63,999	65,244	66,356
Adjusted Markey Percentage															
0	0	3.4%	3.4%	4.9%	4.9%	6.3%	6.3%	8.0%	8.0%	10.0%	10.0%	12.0%	12.0%	13.1%	17.0%
Adjusted Markey Requirement (Million kWh)															
0	0	1,861	1,878	2,700	2,737	3,601	3,664	4,740	4,818	6,115	6,191	7,536	7,677	8,571	11,281

The projected kWh's generated from each type of renewable energy under the under the 25% RES are presented in Table 15. Figure 12 represents the shares of kWh by type of renewable energy in 2025. As can be seen in Figure 12, compared with Figure 11, the state is projected to be reliant on direct fire of wood residues to meet the additional energy needs.

**Table 15. Projected Renewable Electricity Generation Under the 25% RES, Colorado, 2015, 2020, and 2025**

Technology	2015	2020	2025
	Million kWh		
Solar Rooftop	159.6	231.0	246.4
Solar Utility Scale	0.0	0.0	133.0
Wind	2,595.3	2,631.3	2,667.3
Landfill Gas	144.3	144.3	144.3
Co-Fire With Wood Residues	1,592.6	1,592.6	1,592.6
Co-Fire with Cattle Manure	205.8	592.9	592.9
Direct Fire of Wood Residues	0.0	1,520.6	5,904.2
<b>TOTAL</b>	<b>4,697.6</b>	<b>6,712.6</b>	<b>11,280.6</b>



**Figure 12. Projected Share of Additional Renewable Electricity Generation by Technology Under the 25% RES, 2025**

*The 20% RES*

Requirements under the 20% RES for a federal renewable energy portfolio standard are shown in Table 19. The 20% RES percentages are listed in the table. The percentages are taken of the prior year's electricity sales. Under the 20% RES, 25% or less can be met with energy efficiency credits. Therefore, in the table, the percentages adjusted for the 25% energy efficiency credits are calculated. These adjusted percentages are used to calculate the million kWh required under the 20% RES. Shown in Table 16, by 2025, the 20% RES would require an additional 9,953 million kWh. Comparing the projected requirements in Tables 16 and Table 12, it can be seen that the projected requirements under 20% RES exceed those under the CO RES by the year 2016.

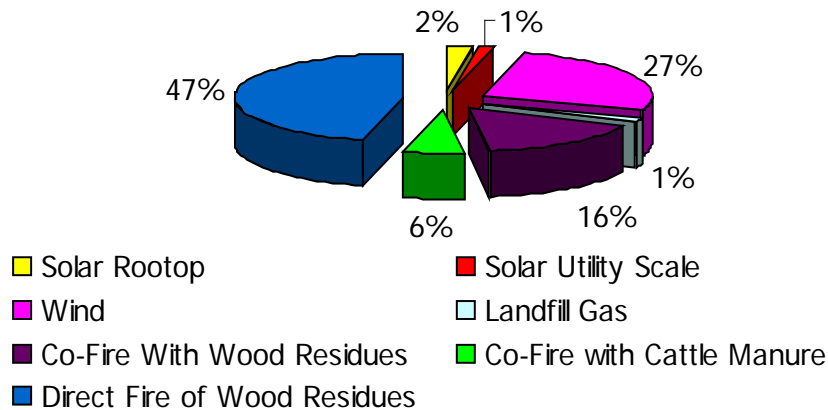
**Table 16. Projected Requirements Under the 20% RES**

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Projected Electricity Demand (Million kWh)															
52,271	53,420	54,309	54,800	55,609	56,367	57,305	58,317	59,274	60,254	61,172	61,936	62,824	63,999	65,244	66,356
Bingaman Percentage															
0	4	4	8	8	8	12	12	12	16	16	20	20	20	20	20
Bingaman Percentage With 25% Energy Efficiency Credit															
0	3	3	6	6	6	9	9	9	12	12	15	15	15	15	15
Bingaman Requirement (Million kWh)															
0	1,603	1,629	3,288	3,337	3,382	5,157	5,249	5,335	7,231	7,341	9,290	9,424	9,600	9,787	9,953

The projected kWh's generated from each type of renewable energy under the 25% RES are presented in Table 17. Figure 13 represents the shares of kWh by type of renewable energy in 2025.

**Table 17. Projected Renewable Electricity Generation Under the 20% RES, Colorado, 2015, 2020, and 2025**

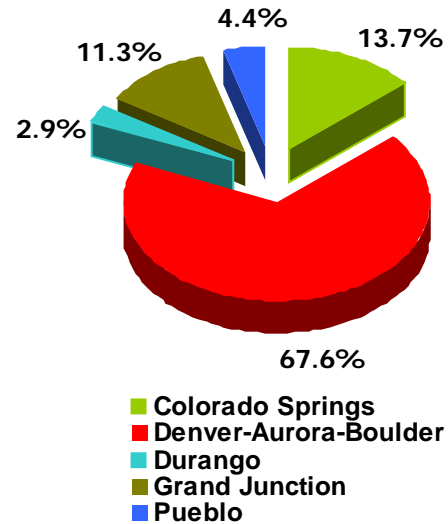
Technology	2015	2020	2025
Million kWh			
Solar Rooftop	159.6	231.0	246.4
Solar Utility Scale	0.0	0.0	133.0
Wind	2,595.3	2,631.3	2,667.3
Landfill Gas	144.3	144.3	144.3
Co-Fire With Wood Residues	1,592.6	1,592.6	1,592.6
Co-Fire with Cattle Manure	205.8	592.9	592.9
Direct Fire of Wood Residues	293.4	2,148.6	4,577.1
<b>TOTAL</b>	<b>4,990.9</b>	<b>7,340.6</b>	<b>9,953.4</b>



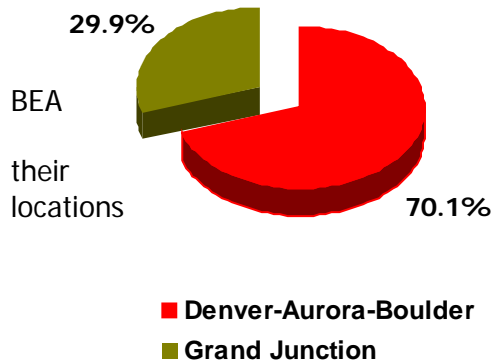
**Figure 13. Projected Share of Additional Renewable Electricity Generation by Technology Under the 20% RES, 2025**

## Placement of Additional Renewable Energy Facilities Across the State

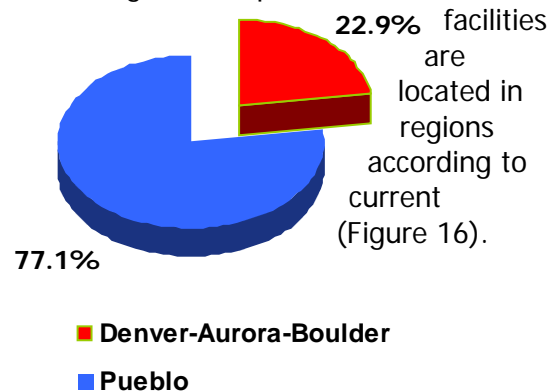
Once the number of plants at the state level was determined, the location (BEA region) of the plants and value of the feedstock was decided. This was achieved through the use of various types of weights along with information from POLYSYS generated output<sup>3</sup>. Since the locations of the several wind facilities were already established, these were allocated to the BEA's in which they have been proposed. The locations of facilities using cattle manure were sited according to where cattle on feed were located. The solar rooftop facilities are placed into BEA regions in proportion to population (Figure 14). The landfill gas facilities are located at the candidate landfills with at least 2 million tons of waste in place (Figure 15). The livestock manure facilities were located where the two coal plants were in close proximity to the livestock feeding center counties (Denver-Aurora-Boulder BEA region). The plants co-firing wood residues were all located in the Grand Junction region due to the abundance of wood residues and eligible coal plants. The wind



**Figure 14. Projected Population Shares, by BEA, Colorado, 2025**



**Figure 15. Proportion of Landfill Gas Facilities, by BEA, Colorado, 2009**



**Figure 16. Proportion of Wind Facilities, by BEA, Colorado, 2009**

<sup>3</sup> The output used in this analysis from POLYSYS, an agricultural simulation model, was initially generated for an analysis used by the 25 X 25 group (English, et al., 2006).

Table 18 displays the projected electricity generation by BEA region for 2025 under the three scenarios. Notably, under the CO RES, the Grand Junction and Denver BEA Regions would add the most kWh of renewable electricity. This is also true for the Markey and 20% RES's. However, the additions in the Grand Junction region are projected to increase relative to the other regions under the two federal proposals as additional renewable energy needs are met through direct fire of wood residues.

**Table 18. Projected Additional Renewable Energy Generation Under the CO RES, Markey, and Bingaman Scenarios, by Technology and BEA Region, Colorado, 2025**

Technology	Region					
	Colorado Springs	Denver-Aurora-Boulder	Durango	Grand Junction	Pueblo	All Regions
Million kWh						
<u>CO RES</u>						
Solar Rooftop	33.8	166.6	7.2	27.8	10.9	246.4
Solar Utility Scale	133.0	0.0	0.0	0.0	0.0	133.0
Wind	0.0	2,056.5	0.0	0.0	610.8	2,667.3
Landfill Gas	0.0	101.1	0.0	43.2	0.0	144.3
Co Fire with Wood Residues	0.0	0.0	0.0	1,592.6	0.0	1,592.6
Co-Fire with Cattle Manure	0.0	592.9	0.0	0.0	0.0	592.9
Direct Fire of Wood Residues	0.0	0.0	624.2	1,299.0	0.0	1,923.2
All Renewables	166.8	2,917.1	631.4	2,962.6	621.7	7,299.6
<u>The 25% RES</u>						
Solar Rooftop	33.8	166.6	7.2	27.8	10.9	246.4
Solar Utility Scale	133.0	0.0	0.0	0.0	0.0	133.0
Wind	0.0	2,056.5	0.0	0.0	610.8	2,667.3
Landfill Gas	0.0	101.1	0.0	43.2	0.0	144.3
Co Fire with Wood Residues	0.0	0.0	0.0	1,592.6	0.0	1,592.6
Co-Fire with Cattle Manure	0.0	592.9	0.0	0.0	0.0	592.9
Direct Fire of Wood Residues	0.0	0.0	1,916.3	3,987.9	0.0	5,904.2
All Renewables	166.8	2,917.1	1,923.5	5,651.5	621.7	11,280.6
<u>The 20% RES</u>						
Solar Rooftop	33.8	166.6	7.2	27.8	10.9	246.4
Solar Utility Scale	133.0	0.0	0.0	0.0	0.0	133.0
Wind	0.0	2,056.5	0.0	0.0	610.8	2,667.3
Landfill Gas	0.0	101.1	0.0	43.2	0.0	144.3

**Table 18. Projected Additional Renewable Energy Generation Under the CO RES, Markey, and Bingaman Scenarios, by Technology and BEA Region, Colorado, 2025**

Technology	Region					
	Colorado Springs	Denver-Aurora-Boulder	Durango	Grand Junction	Pueblo	All Regions
Million kWh						
Co Fire with Wood Residues	0.0	0.0	0.0	1,592.6	0.0	1,592.6
Co-Fire with Cattle Manure	0.0	592.9	0.0	0.0	0.0	592.9
Direct Fire of Wood Residues	0.0	0.0	1,485.5	3,091.5	0.0	4,577.1
All Renewables	166.8	2,917.1	1,492.7	4,755.1	621.7	9,953.4

Using the representative facilities sizes for each of the technologies, as displayed in the tables in Appendix B, the number of additional renewable energy facilities invested in and the number of additional facilities operating in each BEA region is projected. The projected numbers of facilities invested in for each BEA region under the CO RES is shown as an example in Table 19. These numbers of facilities along with the expenditures on investment for each type of facility shown in Appendix B are used to project the economic impacts from investment. As can be noted in Table 19, the projected numbers of facilities sometimes contained decimals or “parts of facilities”. This is because sometimes planned facilities were a different size than the representative or example facilities in Appendix B, therefore the planned facilities were expressed as proportions of the example facilities for the purposes of projecting the economic impacts.

**Table 19. Assumed Additional Renewable Electricity Generating Facilities Investment to Meet the CO RES, 2010-2015, 2016-2020, and 2021-2025, Colorado**

BEA Region/State	2010-2015	2016-2020	2021-2025	2010-2015	2016-2020	2021-2025
	<u>Solar Rooftop</u>			<u>Solar Industrial</u>		
Colorado Springs	1,674.5	723.6	138.2	0.0	0.0	1.0
Denver-Aurora-Boulder	8,165.0	3,596.6	752.7	0.0	0.0	0.0
Durango	337.9	162.8	39.9	0.0	0.0	0.0
Grand Junction	1,267.0	643.4	181.1	0.0	0.0	0.0
Pueblo	544.4	232.2	42.5	0.0	0.0	0.0
	<u>Wind</u>			<u>Landfill Gas</u>		
Colorado Springs	0.0	0.0	0.0	0.0	0.0	0.0
Denver-Aurora-Boulder	38.1	0.5	0.5	2.9	0.0	0.0
Durango	0.0	0.0	0.0	0.0	0.0	0.0
Grand Junction	0.0	0.0	0.0	1.3	0.0	0.0
Pueblo	11.3	0.2	0.2	0.0	0.0	0.0

**Table 19. Assumed Additional Renewable Electricity Generating Facilities Investment to Meet the CO RES, 2010-2015, 2016-2020, and 2021-2025, Colorado**

BEA Region/State	2010-2015	2016-2020	2021-2025	2010-2015	2016-2020	2021-2025
	<u>Co-Fire With Wood Residues</u>			<u>Co-Fire With Cattle Manure</u>		
Colorado Springs	0.0	0.0	0.0	0.0	0.0	0.0
Denver-Aurora-Boulder	0.0	0.0	0.0	2.8	5.3	0.0
Durango	0.0	0.0	0.0	0.0	0.0	0.0
Grand Junction	14.5	0.0	0.0	0.0	0.0	0.0
Pueblo	0.0	0.0	0.0	0.0	0.0	0.0
	<u>Direct Fire With Wood Residues</u>					
Colorado Springs	0.0	0.0	0.0			
Denver-Aurora-Boulder	0.0	0.0	0.0			
Durango	0.0	2.8	0.7			
Grand Junction	0.0	5.9	1.6			
Pueblo	0.0	0.0	0.0			

The numbers of representative or example facilities projected to be operating in the selected years 2015, 2020, and 2025 are displayed in Table 20. These numbers of facilities operating in each of the selected years project the cumulative investment over the intervals of years shown in Table 19.

**Table 20. Assumed Additional Renewable Electricity Generating Facilities Operating Meet the CO RES, 2015, 2020, and 2025, Colorado**

BEA Region/State	2015	2020	2025	2015	2020	2025
	<u>Solar Rooftop</u>			<u>Solar Industrial</u>		
Colorado Springs	1,674.5	2,398.1	2,536.3	0	0	1
Denver-Aurora-Boulder	8,165.0	11,761.7	12,514.3	0	0	0
Durango	337.9	500.8	540.6	0	0	0
Grand Junction	1,267.0	1,910.4	2,091.6	0	0	0
Pueblo	544.4	776.7	819.2	0	0	0
	<u>Wind</u>			<u>Landfill Gas</u>		
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	38.1	38.6	39.1	2.9	2.9	2.9
Durango	0	0	0	0	0	0
Grand Junction	0	0	0	1.3	1.3	1.3
Pueblo	11.3	11.5	11.6	0	0	0
	<u>Co-Fire With Wood Residues</u>			<u>Co-Fire With Cattle Manure</u>		
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	0	0	0	2.8	8.1	8.1

**Table 20. Assumed Additional Renewable Electricity Generating Facilities Operating Meet the CO RES, 2015, 2020, and 2025, Colorado**

BEA Region/State	2015	2020	2025	2015	2020	2025
Durango	0	0	0	0	0	0
Grand Junction	14.5	14.5	14.5	0	0	0
Pueblo	0	0	0	0	0	0
	<u>Direct Fire With Wood Residues</u>					
Colorado Springs	0	0	0			
Denver-Aurora-Boulder	0	0	0			
Durango	0	2.8	3.6			
Grand Junction	0	5.9	7.4			
Pueblo	0	0	0			

## Economic Impacts for 2015, 2020, and 2025: Investment and Operating

Multiple annual impacts accrue as a result of investing in renewable energy. The impacts reported in this section include the impacts of investing in and operating a renewable electricity industry. The impacts from the renewable electricity industry will come not only from electricity generation, but also from production of feedstocks for renewable electricity. Therefore, impacts are also reported forest residues, collecting animal waste, and the impacts of a change in electricity prices (assuming the increased cost of producing the renewable electricity is passed on to consumers). This section provides impacts for the years 2015, 2020, and 2025. Impacts presented include total industry output, employment, and value-added to the state's and BEA Regions' economies.

### *Economic Impacts: Investment in Renewable Electricity Industry*

Based upon the facilities numbers, facilities locations by BEA Region, and expenditures by representative facilities shown in Appendix B, economic impacts were projected using IMPLAN. Economic impacts by BEA Region from the investment in additional renewable energy facilities under each of the three policy scenarios are shown in Appendix C Tables C.1-C.3. Table C.1 displays the TIO from the investment in the additional renewable energy facilities, while Table C.2 displays the employment, and Table C.3 displays the value-added. It should be noted that investment impacts are one-time impacts that occur in the year when the facilities are constructed.

### *Economic Activity (Total Industry Output) from Investment*

Figure 17 displays the TIO that would occur from investment in additional renewable electricity facilities under the three policy scenarios (CO RES, The 25% RES, and the 20% RES) for 2015 and 2025. The figure provides the overall TIO and what shares the BEA Regions would accrue. These TIO values represent total impacts (direct + indirect + induced impacts). In 2015, under each policy scenario, the Denver Region is projected to experience the greatest

TIO, with the Pueblo Region second, and the Colorado Springs Region third. Statewide, the 2015 TIO from investment in additional renewable facilities is \$6.7 billion under the CO RES, \$6.7 billion under the 25% RES, and \$7.0 billion under the 20% RES. By 2025, the TIO from investment is \$1.3 billion under the CO RES, \$4.9 billion under the 25% RES, and \$3.2 under the 20% RES. By 2025, under the 25% RES, the Grand Junction Region receives the highest economic impacts from investment, followed by the Durango and Colorado Springs Regions. Under the 20% RES, the Grand Junction, Colorado Springs, and Durango Regions accrue the greatest economic impacts from investment. For the CO RES Scenario, in 2025, Colorado Springs, Denver, and Grand Junction Regions receive the greatest investment economic impacts.

### *Employment from Investment*

The total number of jobs created through investment in the renewable energy industry increases from nearly 11,534 to 37,227 jobs in 2015 under all three policy scenarios (Table 21). For 2025, jobs created through investment in the renewable energy industry would increase to 28,476 under the 25% RES and 18,267 under the 20% RES. The share of jobs projected to result from investment in the renewable energy industry by BEA Region in 2025 are shown in Figure 18. Under the CO RES, the Colorado Springs BEA experiences the greatest additions to jobs, while under the Markey and 20% RES's, the Grand Junction Region is projected to add the largest share of jobs.

### *Economic Impacts: Year-to-Year Operations of Renewable Electricity Facilities*

Some economic impacts occur each year as a result of the year-to-year business activities of the renewable energy industry. This section presents a summary of those projections. Detailed economic impacts by BEA Region from the year-to-year operations of the additional renewable energy facilities for the three policy scenarios are shown in Tables C.4-C.6. Table C.4 shows the total industry output from the annual operations of the additional renewable energy facilities, while Table C.5 displays the employment, and Table C.6 shows the value-added.

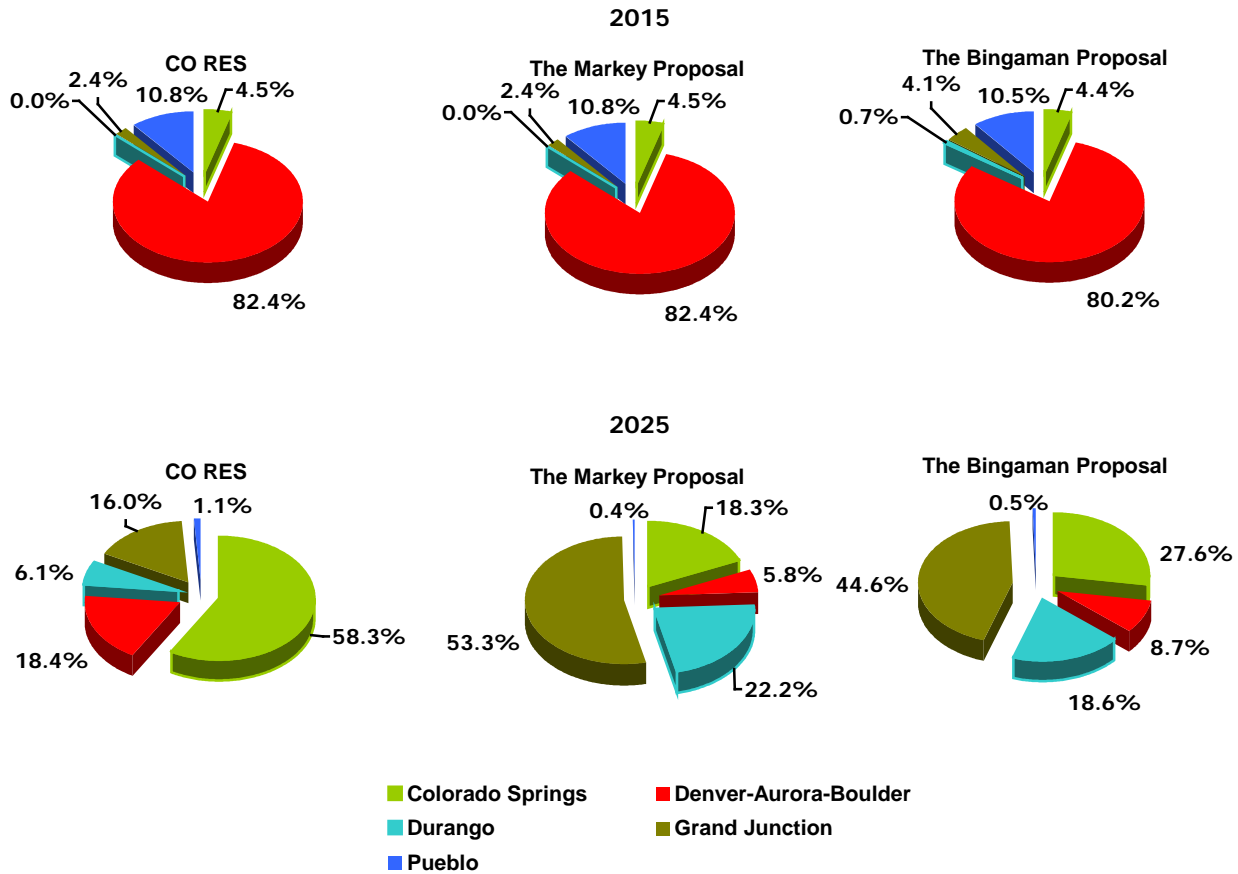
### *Economic Activity (Total Industry Output) from Operating*

In addition to economic activity resulting from investment in renewable facilities, operation of the renewable energy facilities is projected to add ongoing economic activity to Colorado's economy annually. In 2015, the annual impact is measured at \$1.2 billion under the CO RES, \$1.2 billion under the 25% RES, and \$1.3 billion if the 20% RES is adopted. Statewide, by 2025, the annual TIO from operating is \$2.0 billion under the CO RES, \$3.0 billion under the 25% RES, and \$2.6 billion under the 20% RES.

Figure 19 displays the Total Industry Output that would occur from operations in the additional renewable energy facilities under the three policy scenarios (CO RES, The 25% RES, and the 20% RES) for 2015 and 2025. The figure provides the overall TIO and what shares the BEA Regions would accrue. These TIO values represent total impacts (direct + indirect + induced impacts). By 2025, with the Markey and Bingaman policy scenarios, the Grand Junction is projected to experience the greatest TIO from operations of a renewable electricity industry, with the Denver Region second, and the Durango Region third. Under the CO RES,

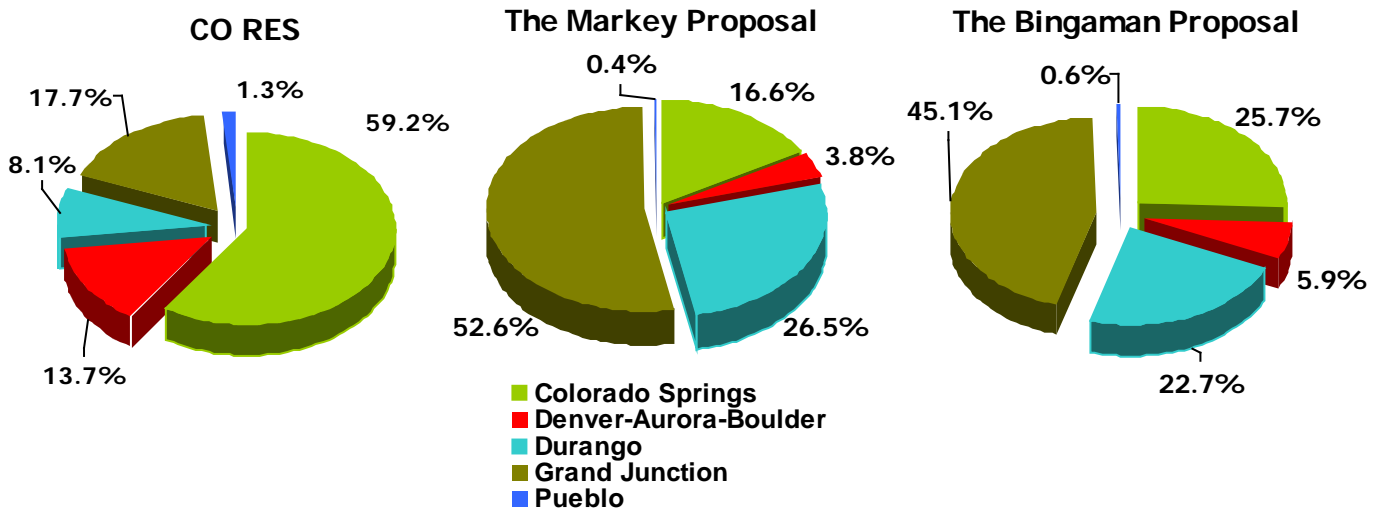
the Denver Region experiences the greatest TIO from operating, followed by the Grand Junction Region.

In Table C.7, the total industry output (including direct, indirect, and induced impacts) from year-to-year operations by BEA Region and by renewable technology are shown for each of the three policy scenarios. Figure 20 contains the economic impacts as measured by increased total industry output for 2015 and 2025 as a result of the individual projected technologies. As can be seen these figures, the largest annual operating economic impacts are projected to be derived from wind in 2015, wind in 2025 for the CO RES, and direct fire of wood residues in 2025 for the Markey and 20% RES's.



Year	Statewide Total Industry Output		
	CO RES	The 25% RES	The 20% RES
2015	\$6,739,232,830	\$6,739,232,830	\$7,008,534,641
2025	\$1,264,643,295	\$4,918,974,770	\$3,160,592,357

**Figure 17. Total Industry Output from Investment in Additional Renewable Energy Under the CO RES, the 25% RES, and the 20% RES, 2015 and 2025**



**Figure 18. Jobs from Investment in Additional Renewable Electricity Industry Facilities, Share by BEA Region, Colorado, 2025**

**Table 21. Employment Projections From Renewable Energy Investment Under the Three Policy Scenarios for 2015 and 2025, Colorado**

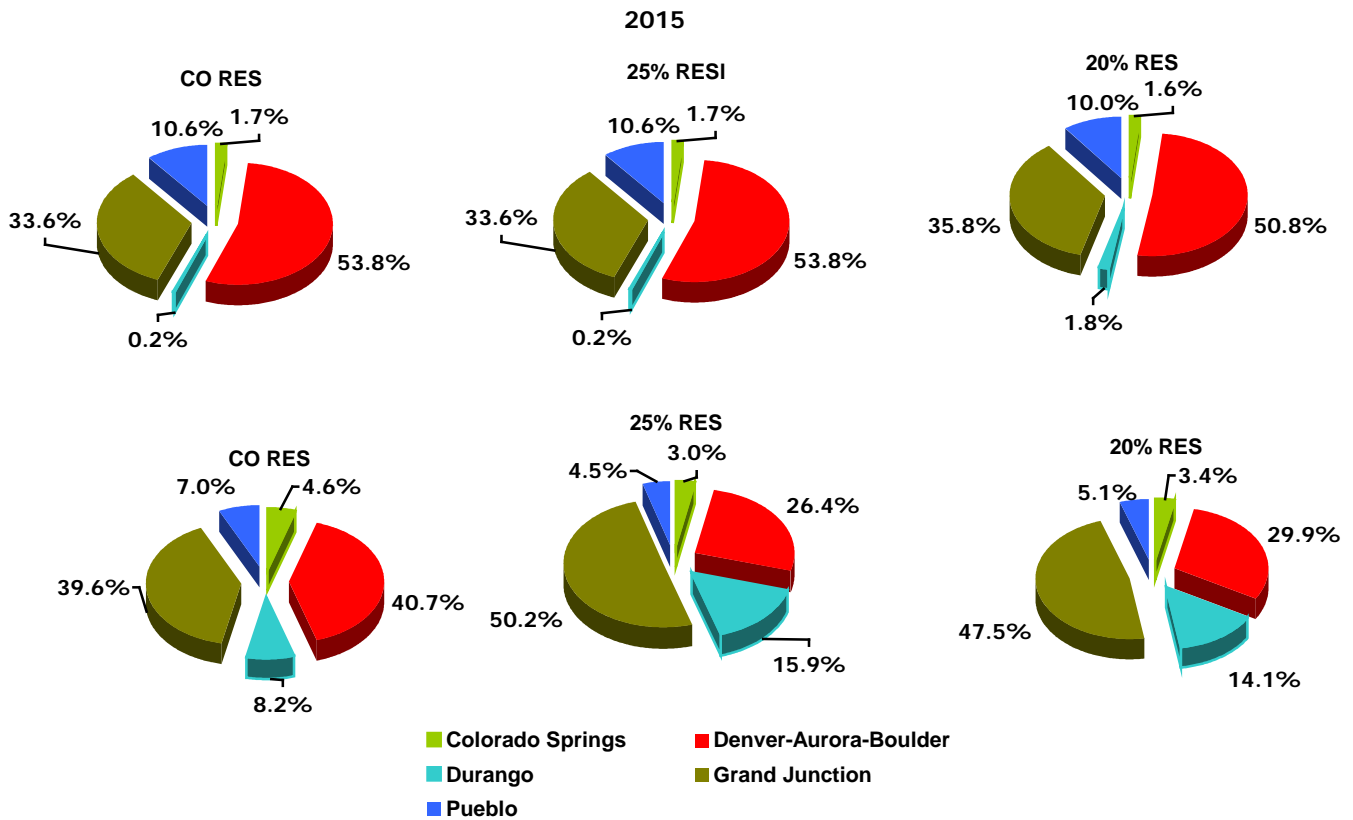
Year	CO RES		The 25% RES		The 20% RES	
	Direct	Total	Direct	Total	Direct	Total
2015	11,534	37,227	11,534	37,227	12,114	38,790
2025	2,308	7,598	10,054	28,476	6,266	18,267

*Employment from Operating*

For 2015, annual jobs for all three policy scenarios ranges from 4,367 to 4,688 (Table 22). Annual jobs in the renewable energy industry for 2025 would increase to 11,362 under the 25% RES and 9,927 under the 20% RES. The shares of the additional jobs that would result in each region are shown in Figure 21. Under all three policy scenarios, the Grand Junction Region is projected to experience the greatest additions to jobs from the additional operations of the renewable electricity industry.

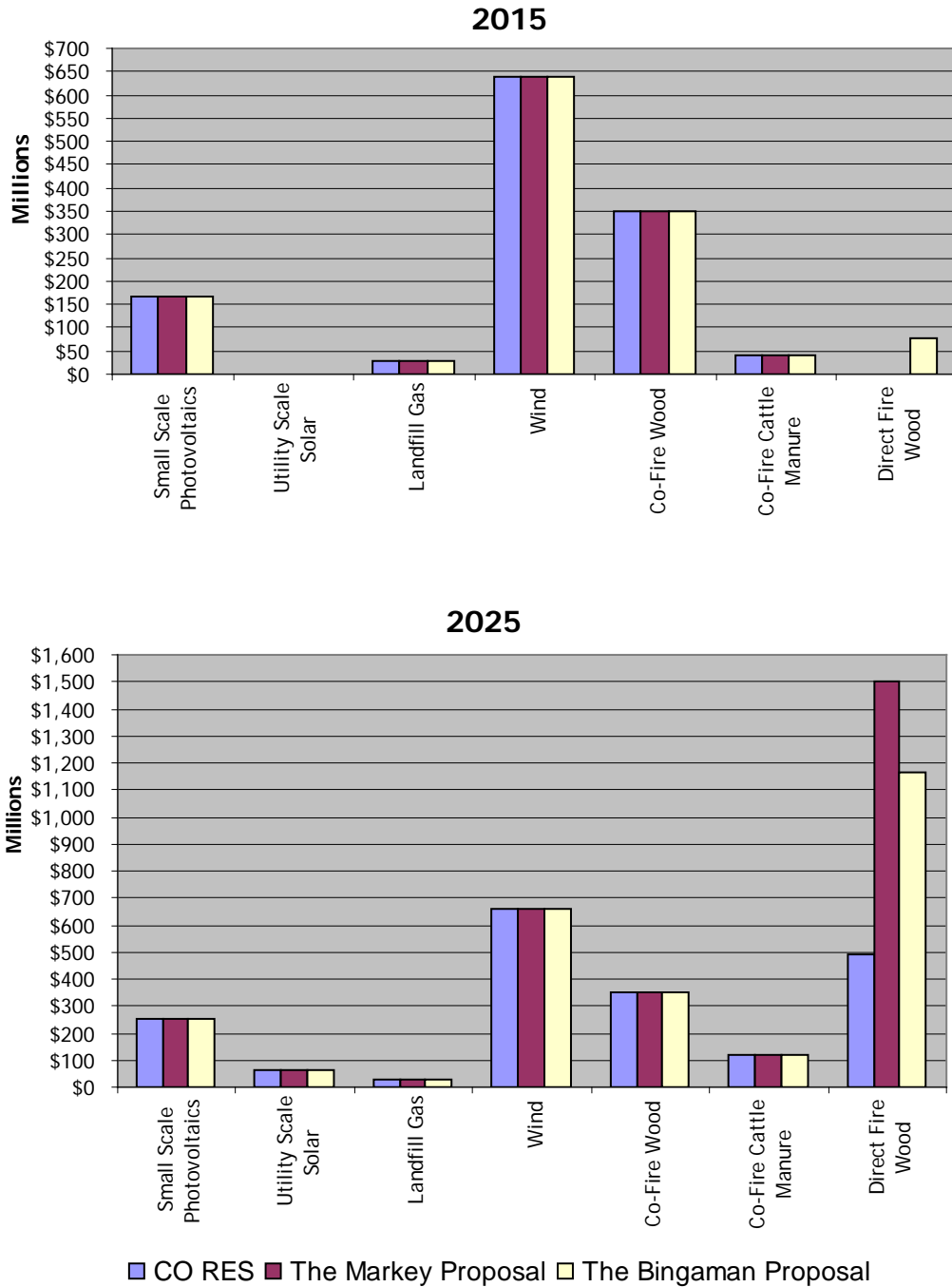
**Table 22. Employment Projections From Renewable Energy Operations Under the Three Policy Scenarios for 2015 and 2025, Colorado**

Year	CO RES		The 25% RES		The 20% RES	
	Direct	Total	Direct	Total	Direct	Total
2015	593	4,367	593	4,367	637	4,688
2025	930	7,076	1,520	11,362	1,323	9,927

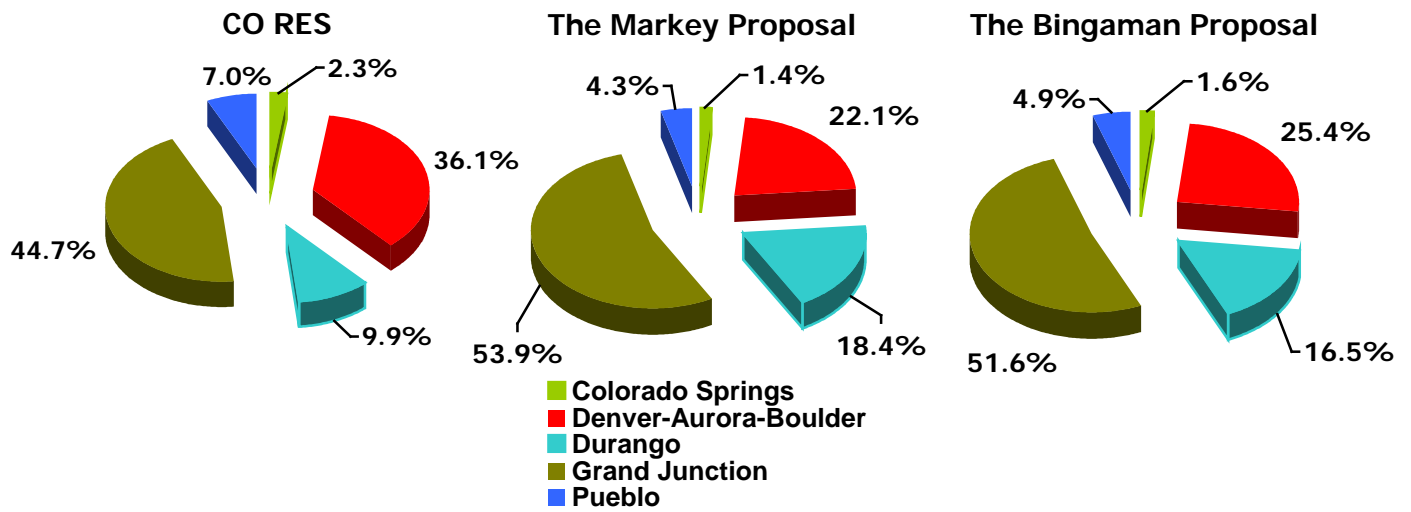


Year	Statewide Total Industry Output		
	CO RES	The 25% RES	The 20% RES
2015	\$1,225,557,215	\$1,225,557,215	\$1,301,361,011
2025	\$1,962,908,350	\$2,975,111,974	\$2,636,224,417

**Figure 19. Total Industry Output Operating Additional Renewable Energy Under the CO RES, the 25% RES, and the 20% RES, 2015 and 2025**



**Figure 20. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, By Renewable Energy Technology, Colorado, 2015 and 2025**



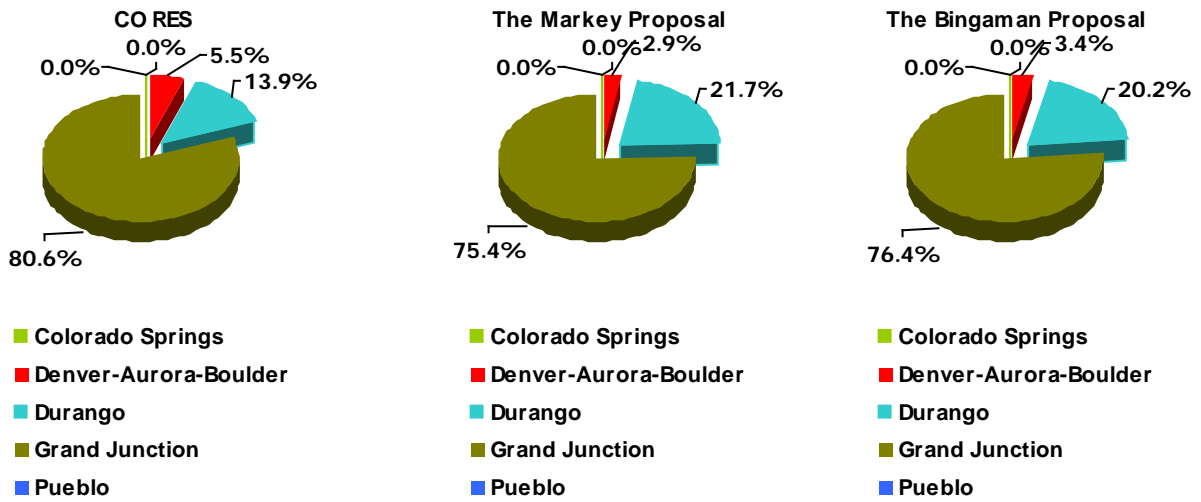
**Figure 21. Jobs from Operating Additional Renewable Electricity Industry, Share by BEA Region, Colorado, 2025**

*Economic Impacts: Agricultural and Forestry Feedstock Production*

Two types of impacts associated with agricultural and forestry feedstock production are measured in this analysis – the impacts of harvesting/collecting either forest residues or cattle manure. In 2015, the direct economic activity under CO RES is estimated to exceed \$65 million each year in economic activity. When multiplied through the economy, this increases to \$120.6 million (Table 23). By 2025, the total impact under CO RES increases to \$237.5 million. Under the Markey and 20% RES's, in 2025, the direct total industry output increases to \$248.9 and \$208.4 million with a total annual economic impact of \$459.4 and \$385.1 million, respectively. In all three scenarios, over 75% of the agro-forestry economic activity from renewable energy will take place in the Grand Junction Region (Figure 22). See Appendix C, Tables C8 through C10 for detailed estimates of changes in economic activity, jobs, and value-added, respectively.

**Table 23. Total Industry Output Projections From Renewable Energy Agro-Forestry Operations Under the Three Policy Scenarios for 2015 and 2025, Colorado**

Year	CO RES		The 25% RES		The 20% RES	
	Direct	Total	Direct	Total	Direct	Total
Million Dollars						
2015	\$65.2	\$120.6	\$65.2	\$120.6	\$74.3	\$137.2
2025	\$127.9	\$237.5	\$248.9	\$459.4	\$208.4	\$385.1



**Figure 22. Total Industry Output from Renewable Energy Agro-Forestry Operations Under the Three Policy Scenarios, by BEA Region, Colorado, 2025**

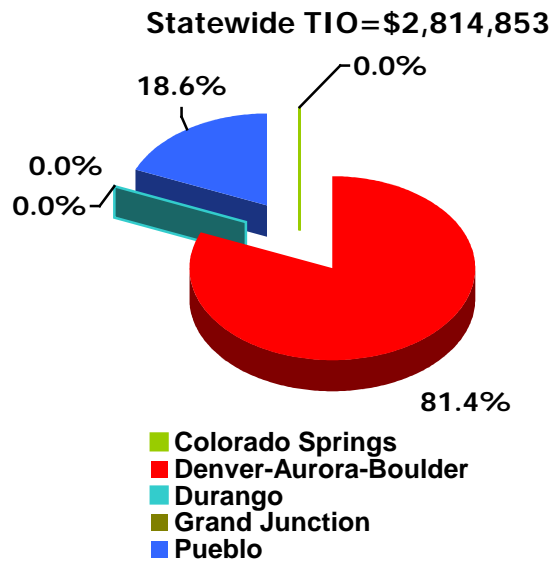
*Economic Impacts: Wind Energy on Farmland*

Farmers receive a direct payment from allowing the installation and generation of electricity from wind turbines. These payments can be based on revenues generated, an annual lease, or some combination of the two with such things as escalating clauses imbedded in the lease. Jim Ploger, Kansas State Energy office, stated that a typical landowner lease payment per megawatt might range between \$2,000 and \$4,000 per year (Bipartisan Policy Institute, 2009). In this study, the lower end of the range, \$2,000 per MW installed nameplate capacity, is assumed. For 2025, direct additional annual payments to the landowners in Colorado are estimated to be \$1.6 million with the Denver BEA receiving nearly \$1.3 million and the Pueblo BEA receiving \$.4 million annually (Table 24).

**Table 24. Annual Estimated Income Received from Wind Lease Payments, Colorado, 2015, 2020, and 2025**

BEA	Income from Wind Leases		
	2015	2020	2025
Colorado Springs			
Denver-Aurora-Boulder	\$1,218,242	\$1,235,128	\$1,252,033
Durango			
Grand Junction			
Pueblo	\$361,854	\$366,873	\$371,891
State	\$1,580,097	\$1,602,010	\$1,623,924

To determine how this income would flow through the states' economy, the 2007 Agricultural Census's county level data on the number of farms by sales bracket was aggregated to BEA and state. These data are then used to weight the lease payments to IMPLAN household income brackets and IMPLAN is run at the BEA and state levels. The estimated statewide TIO for 2025 including multiplier effects is \$2.8 million. The shares of resulting economic impacts (TIO) by BEA can be seen in Figure 23. The values for all three policy scenarios are projected to be the same. The Denver and Pueblo Regions are projected to experience the largest shares of TIO from wind lease payments. Detailed presentation of the TIO, employment, and value-added from the lease payments can be found in Appendix C, Tables C.11-C.13.



**Figure 23. Projected Shares of TIO from Wind Lease Payments to Farmers, By BEA, Colorado, 2025**

### *Economic Impacts of Potential Rate Increases*

With the additional renewable electricity, electric rates per kWh are projected to increase. As outlined in the methods, the rate increase projections are based upon "breakeven" prices for the various technologies and projections of electricity sales by type of technology. Shown in Table 25, the projected electricity rate change per kWh is between .00387 and .00771 cents over the years of analysis.

**Table 25. Projected Electricity Rate Changes Under the Federal Policy Scenarios, Colorado, 2015, 2020, and 2025**

Year	Electricity Rate Change for:		
	CO RES	The 25% RES	The 20% RES
		\$/kWh	
2015	.00387	.00387	.00409
2020	.00506	.00506	.00548
2025	.00521	.00771	.00687

The projected economic impacts occurring each year from the rate changes (shown in Table 24) are displayed in Table 26. Including multiplier effects, the negative impact on household incomes from the rate changes decreases total industry output by \$217.8 million and jobs by 1,428 with the CO RES in the year 2025. Under the Markey scenario, in 2025, the TIO decreases by \$322.2 million and jobs decrease by 2,112 as a result of the rate changes. With

the Bingaman scenario, the TIO decreases by \$287.4 million and jobs decrease by 1,884 in 2025.

**Table 26. Projected Annual Economic Impacts from Electricity Rate Changes Under the Three Policy Scenarios, Colorado**

	2015		2020		2025	
	Direct	Total	Direct	Total	Direct	Total
CO RES						
TIO	-\$77,387,800	-\$137,401,980	-\$109,743,019	-\$194,848,646	-\$122,703,668	-\$217,860,270
Jobs	-447	-901	-634	-1,277	-709	-1,428
TVA	-\$32,246,585	-\$67,128,862	-\$47,146,716	-\$96,612,994	-\$52,714,743	-\$108,022,989
The 25% RES						
TIO	-\$77,387,800	-\$137,401,980	-\$109,743,019	-\$194,848,646	-\$181,473,165	-\$322,205,465
Jobs	-447	-901	-634	-1,277	-1,049	-2,112
TVA	-\$33,246,585	-\$68,128,862	-\$47,146,716	-\$96,612,994	-\$77,962,717	-\$159,761,106
The 20% RES						
TIO	-\$81,718,991	-\$145,092,005	-\$119,014,354	-\$211,309,894	-\$161,881,323	-\$287,420,166
Jobs	-472	-951	-688	-1,385	-936	-1,884
TVA	-\$35,107,308	-\$71,941,854	-\$51,129,776	-\$104,775,075	-\$69,545,862	-\$142,513,297

## Conclusions

This study projected potential economic impacts for Colorado under three energy policy scenarios. The first policy evaluated is the current Colorado Renewable Energy Standard. The other two are potential federal legislative actions: The 25% RES (Save American Energy and American Renewable Energy Acts) and the 20% RES. To conduct the analysis, renewable electricity requirements under the federal proposals are compared with Colorado's existing law, taking into account already planned new renewable energy generation in the state. The changes in economic activity resulting from the changes in renewable electricity requirements were then projected using IMPLAN, an economic input-output model. Projected economic impacts were reported for the years 2015, 2020, and 2025.

The Colorado law requires investor owned utilities supply a certain percentage of solar energy. In addition, the law has differing overall requirements for investor owned utilities compared with municipally owned or cooperative utilities. These requirements were taken into account in the analysis. The projected requirements under the CO RES by 2025 are 7,281 million kWh. In addition to solar energy, the CO RES is projected to be met through wind energy, landfill gas, co-firing wood residues with coal, co-firing cattle manure with coal, and direct fire of wood residues. Additional renewable electricity is required above and beyond that required under the CO RES. The requirements in 2025 are projected at 11,281 million kWh under the 25% RES and 9,953 under the 20% RES. Therefore, the projections of electricity required for the Markey and 20% RES's were made and then differences between the

requirements under these proposals and generation under the CO RES were taken. Additional requirements are projected to be met through direct fire of wood residues.

**Table 27. Summary of Annual Economic Impacts by Scenario, Colorado, 2025**

Impact	CO RES	The 25% RES	The 20% RES
		Million \$	
<b>Operating</b>	\$1,962.91	\$2,975.11	\$2,636.22
Contribution from agriculture and forestry	\$237.50	\$459.40	\$385.10
Contribution from wind leases	\$2.81	\$2.81	\$2.81
Households Rate Increase	-\$217.86	-\$322.21	-\$287.42
Net Operating	\$1,745.05	\$2,652.91	\$2,348.80
<b>Investment</b>	\$1,264.64	\$4,918.97	\$3,160.59

The Colorado agricultural sector averaged over \$6 billion in receipts during 2001 to 2006. With \$5 billion in expenses, the agricultural sectors realized net farm income has average slightly more than \$1 billion over the same period (Figure 24). The CO RES will add \$475 million by 2025 with the 20% and 25% adding a projected \$566 and \$597 million, respectively, to the agricultural sector and rural land owners. The potential impacts to the agricultural and forest sectors are multiple, occurring from the collection of livestock wastes, lease payments to farmers for wind projects, and forest residues. All of these sources would be derived from rural areas with multiple areas of the state benefiting, with manure co-fired with coal along with wind located in the eastern part of the state, and forest residues located in the western part of the state. Direct economic activity from either the Colorado RES or either of the Federal RES' has the potential impact in significant income gains annually for Colorado's agricultural and forest sector. Impacts per farm are estimated to average between \$9,000 and \$11,300 for the CO RES and 25% RES scenarios by 2025.

As shown in Table 27, while there would be negative impacts from the rate increases associated with greater energy generation costs, the overall impacts from the renewable electricity generation industry are still projected to be positive. Under the CO RES, in 2025, the net additions to TIO are projected to be \$1,745.05 million, while under the 25% RES, they are \$2,652.91 million, and under the 20% RES, they are \$2,348.80 million.

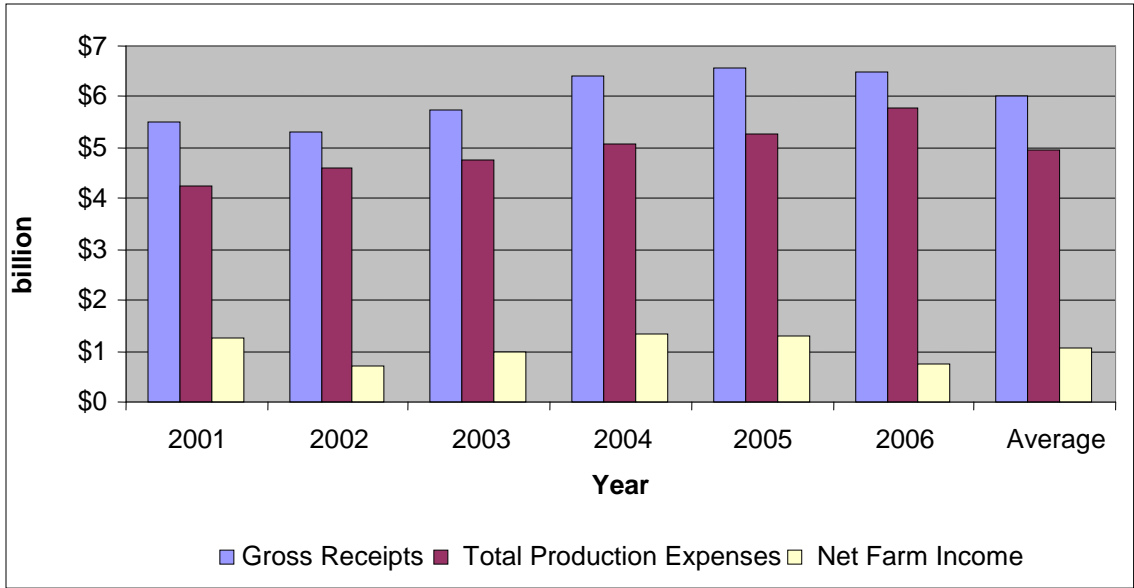


Figure 24. Colorado Agricultural Receipts, Expenses, and Realized Net Farm Income, 2000 - 2008.

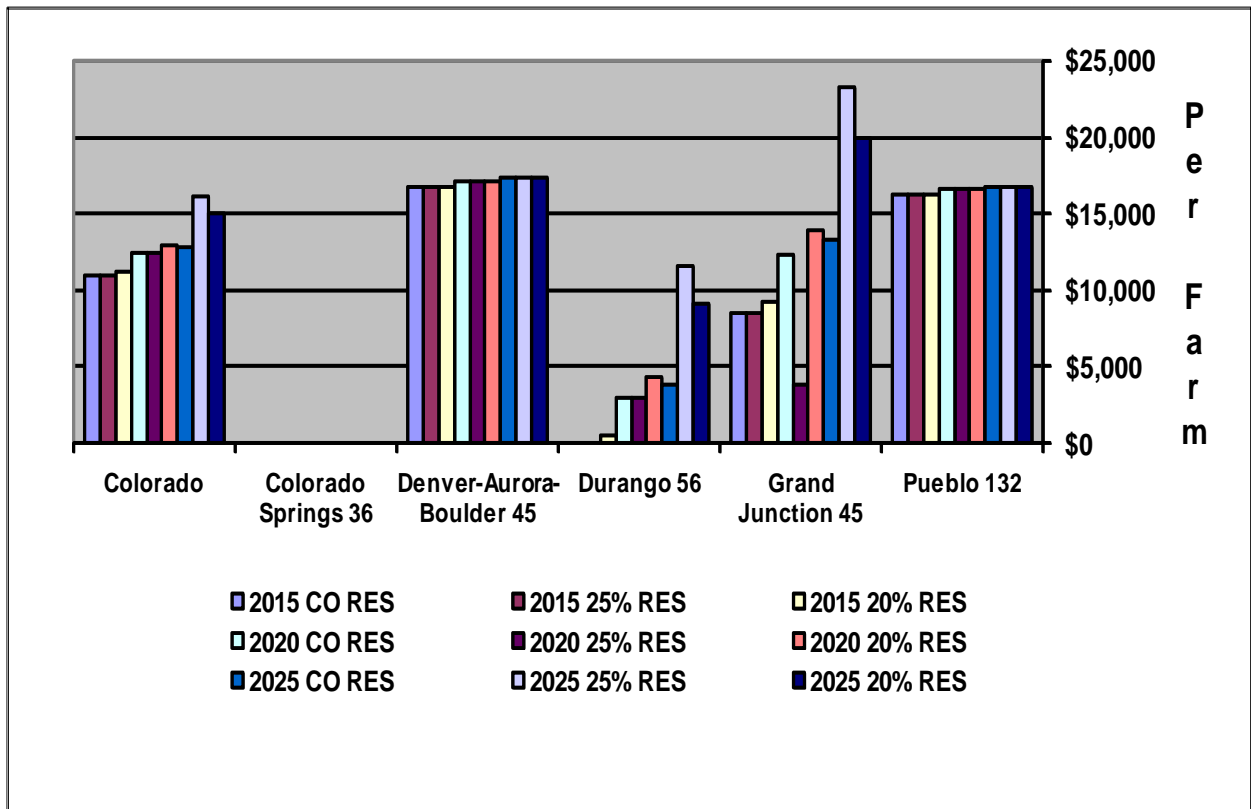


Figure 25. Potential Gains in Per Farm Economic Activity by BEA, 2015, 2020, and 2025

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**APPENDIX A**

**ENERGY SOURCE ABBREVIATIONS AND THE COLORADO  
RENEWABLE ENERGY STANDARD**

Table A.1. Energy Source Abbreviations

Abbreviation	Description	Abbreviation	Description
BIT	(Anthracite Coal, Bituminous Coal)	BLQ*	Black Liquor
LIG	Lignite Coal	GEO*	Geothermal
SUB	Subbituminous Coal	LFG*	Landfill Gas
WC	Waste/Other Coal (Anthracite Culm, Bituminous Gob, Fine Coal, Lignite Waste, Waste Coal)	MSW*	Municipal Solid Waste
SC	Coal Synfuel. Coal-based solid fuel that has been processed by a coal synfuel plant, and coal-based fuels such as briquettes, pellets, or extrusions, which are formed from fresh or recycled coal and binding materials.	OBS*	Other Biomass Solid (Animal Manure and Waste, Solid Byproducts, and other solid biomass not specified)
DFO	Distillate Fuel Oil (includes all Diesel and No. 1, No. 2, and No. 4 Fuel Oils)	OBL*	Other Biomass Liquid (Ethanol, Fish Oil, Liquid Acetonitrile Waste, Medical Waste, Tall Oil, Waste Alcohol, and other Biomass not specified)
JF	Jet Fuel	OBG*	Other Biomass Gases (Digester Gas, Methane, and other biomass gases)
KER	Kerosene	OTH	Other (Batteries, Chemicals, Coke Breeze, Hydrogen, Pitch, Sulfur, Tar Coal, and miscellaneous technologies)
RFO	Residual Fuel Oil (includes No. 5 and No. 6 Fuel Oils and Bunker C Fuel Oil)	PUR	Purchased Steam
WO	Oil-Other and Waste Oil (Butane (Liquid), Crude Oil, Liquid Byproducts, Oil Waste, Propane (Liquid), Re-refined)	SLW	Sludge Waste
PC	Petroleum Coke	SUN*	Solar (Photovoltaic, Thermal)
NG	Natural Gas	TDF	Tires
BFG	Blast Furnace Gas	WAT	Water (Conventional, Pumped Storage)
OG	Other Gas (Butane, Coal Processes, Coke-Oven, Refinery, and other processes)	WDS*	Wood/Wood Waste Solids (Paper Pellets, Railroad Ties, Utility Poles, Wood Chips, and other wood solids)
PG	Propane	WDL*	Wood Waste Liquids (Red Liquor, Sludge Wood, Spent Sulfite Liquor, and other wood related liquids not)
SG	Synthetic Gas, other than coal-derived	WND*	Wind
SGC	Synthetic gas, derived from coal		
NUC	Nuclear (Uranium, Plutonium, Thorium)		
AB*	Agriculture Crop Byproducts/Straw/Energy Crops		

\*Classified as "renewable" energy sources in this study.

## **Table A.2. Colorado 40-2-124. Renewable Portfolio Standard (REPS)**

### **CRS 40-2-124. Renewable energy standard - definitions - net metering. Enacted 11/2/2004**

(1) Each provider of retail electric service in the state of Colorado, other than municipally owned utilities that serve forty thousand customers or less, shall be considered a qualifying retail utility. Each qualifying retail utility, with the exception of cooperative electric associations that have voted to exempt themselves from commission jurisdiction pursuant to section 40-9.5-104 and municipally owned utilities, shall be subject to the rules established under this article by the commission. No additional regulatory authority of the commission other than that specifically contained in this section is provided or implied. In accordance with article 4 of title 24, C.R.S., on or before October 1, 2007, the commission shall revise or clarify existing rules to establish the following:

(a) Definitions of eligible energy resources that can be used to meet the standards. "Eligible energy resources" means recycled energy and renewable energy resources. "Renewable energy resources" means solar, wind, geothermal, biomass, new hydroelectricity with a nameplate rating of ten megawatts or less, and hydroelectricity in existence on January 1, 2005, with a nameplate rating of thirty megawatts or less. The commission shall determine, following an evidentiary hearing, the extent to which such electric generation technologies utilized in an optional pricing program may be used to comply with this standard. A fuel cell using hydrogen derived from an eligible energy resource is also an eligible electric generation technology. Fossil and nuclear fuels and their derivatives are not eligible energy resources. For purposes of this section:

(I) "Biomass" means:

- (A) Nontoxic plant matter consisting of agricultural crops or their byproducts, urban wood waste, mill residue, slash, or brush;
- (B) Animal wastes and products of animal wastes; or
- (C) Methane produced at landfills or as a by-product of the treatment of wastewater residuals.

(II) "Recycled energy" means energy produced by a generation unit with a nameplate capacity of not more than fifteen megawatts that converts the otherwise lost energy from the heat from exhaust stacks or pipes to electricity and that does not combust additional fossil fuel. "Recycled energy" does not include energy produced by any system that uses energy, lost or otherwise, from a process whose primary purpose is the generation of electricity, including, without limitation, any process involving engine-driven generation or pumped hydroelectricity generation.

(b) Standards for the design, placement, and management of electric generation technologies that use eligible energy resources to ensure that the environmental impacts of such facilities are minimized.

(c) Electric resource standards:

(I) Except as provided in subparagraph (V) of this paragraph (c), the electric resource standards shall require each qualifying retail utility to generate, or cause to be generated, electricity from eligible energy resources in the following minimum amounts:

- (A) Three percent of its retail electricity sales in Colorado for the year 2007;
- (B) Five percent of its retail electricity sales in Colorado for the years 2008 through 2010;
- (C) Ten percent of its retail electricity sales in Colorado for the years 2011 through 2014;
- (D) Fifteen percent of its retail electricity sales in Colorado for the years 2015 through 2019; and
- (E) Twenty percent of its retail electricity sales in Colorado for the years 2020 and thereafter.

(II) Of the amounts in subparagraph (I) of paragraph (c) of this subsection (1), at least four percent shall be derived from solar electric generation technologies. At least one-half of this four percent shall be derived from solar electric technologies located on-site at customers' facilities.

(III) Each kilowatt-hour of electricity generated from eligible energy resources in Colorado shall be counted as one and one-quarter kilowatt-hours for the purposes of compliance with this standard.

(IV) To the extent that the ability of a qualifying retail utility to acquire eligible energy resources is limited by a requirements contract with a wholesale electric supplier, the qualifying retail utility shall acquire the maximum amount allowed by the contract. For any shortfalls to the amounts established by the commission pursuant to subparagraph (I) of this paragraph (c), the qualifying retail utility shall acquire an equivalent amount of either renewable energy credits; documented and verified energy savings through energy efficiency and conservation programs; or a combination of both. Any contract entered into by a qualifying retail utility after December 1, 2004, shall not conflict with this article.

(V) Notwithstanding any other provision of law but subject to subsection (4) of this section, the electric resource standards shall require each cooperative electric association and municipally owned utility that is a qualifying retail utility to generate, or cause to be generated, electricity from eligible energy resources in the following minimum amounts:

- (A) One percent of its retail electricity sales in Colorado for the years 2008 through 2010;
- (B) Three percent of retail electricity sales in Colorado for the years 2011 through 2014;
- (C) Six percent of retail electricity sales in Colorado for the years 2015 through 2019; and
- (D) Ten percent of retail electricity sales in Colorado for the years 2020 and thereafter.

(VI) Each kilowatt-hour of electricity generated from eligible energy resources at a community-based project shall be counted as one and one-half kilowatt-hours. For purposes of this subparagraph (VI), "community-based project" means a project located in Colorado:

- (A) That is owned by individual residents of a community, nonprofit organization, cooperative, local government entity, or tribal council;
- (B) The generating capacity of which does not exceed thirty megawatts; and
- (C) For which there is a resolution of support adopted by the local governing body of each local jurisdiction in which the project is to be located.

(VII) (A) For purposes of compliance with the standards set forth in subparagraph (V) of this paragraph (c), each kilowatt-hour of renewable electricity generated from solar electric generation technologies shall be counted as three kilowatt-hours.

(B) Sub-subparagraph (A) of this subparagraph (VII) applies only to solar electric technologies that begin producing electricity prior to July 1, 2015. For solar electric technologies that begin producing electricity on or after July 1, 2015, each kilowatt-hour of renewable electricity shall be counted as one kilowatt-hour for purposes of compliance with the renewable energy standard.

(VIII) Each kilowatt-hour of electricity from eligible energy resources may take advantage of only one of the methods for counting kilowatt-hours set forth in subparagraphs (III), (VI), and (VII) of this paragraph (c).

(d) A system of tradable renewable energy credits that may be used by a qualifying retail utility to comply with this standard. The commission shall also analyze the effectiveness of utilizing any regional system of renewable energy credits in existence at the time of its rule-making process and determine whether the system is governed by rules that are consistent with the rules established for this article. The

commission shall not restrict the qualifying retail utility's ownership of renewable energy credits if the qualifying retail utility complies with the electric resource standard of paragraph (c) of this subsection (1) and does not exceed the retail rate impact established by paragraph (g) of this subsection (1).

(e) A standard rebate offer program. Each qualifying retail utility, except for cooperative electric associations and municipally owned utilities, shall make available to its retail electricity customers a standard rebate offer of a minimum of two dollars per watt for the installation of eligible solar electric generation on customers' premises up to a maximum of one hundred kilowatts per installation. Such offer shall allow the customer's retail electricity consumption to be offset by the solar electricity generated. To the extent that solar electricity generation exceeds the customer's consumption during a billing month, such excess electricity shall be carried forward as a credit to the following month's consumption. To the extent that solar electricity generation exceeds the customer's consumption during a calendar year, the customer shall be reimbursed by the qualifying retail utility at its average hourly incremental cost of electricity supply over the prior twelve-month period. The qualifying retail utility shall not apply unreasonably burdensome interconnection requirements in connection with this standard rebate offer. Electricity generated under this program shall be eligible for the qualifying retail utility's compliance with this article.

(f) Policies for the recovery of costs incurred with respect to these standards for qualifying retail utilities that are subject to rate regulation by the commission. These policies shall provide incentives to qualifying retail utilities to invest in eligible energy resources in the state of Colorado. Such policies shall include:

(I) Allowing a qualifying retail utility to develop and own as utility rate-based property up to twenty-five percent of the total new eligible energy resources the utility acquires from entering into power purchase agreements and from developing and owning resources after March 27, 2007, if the new eligible energy resources proposed to be developed and owned by the utility can be constructed at reasonable cost compared to the cost of similar eligible energy resources available in the market. The qualifying retail utility shall be allowed to develop and own as utility rate-based property more than twenty-five percent but not more than fifty percent of total new eligible energy resources acquired after March 27, 2007, if the qualifying retail utility shows that its proposal would provide significant economic development, employment, energy security, or other benefits to the state of Colorado. The qualifying retail utility may develop and own these resources either by itself or jointly with other owners, and, if owned jointly, the entire jointly owned resource shall count toward the percentage limitations in this subparagraph (I). For the resources addressed in this subparagraph (I), the qualifying retail utility shall not be required to comply with the competitive bidding requirements of the commission's rules; except that nothing in this subparagraph (I) shall preclude the qualifying retail utility from bidding to own a greater percentage of new eligible energy resources than permitted by this subparagraph (I). In addition, nothing in this subparagraph (I) shall prevent the commission from waiving, repealing, or revising any commission rule in a manner otherwise consistent with applicable law.

(II) Allowing qualifying retail utilities to earn an extra profit on their investment in eligible energy resource technologies if these investments provide net economic benefits to customers as determined by the commission. The allowable extra profit in any year shall be the qualifying retail utility's most recent commission authorized rate of return plus a bonus limited to fifty percent of the net economic benefit.

(III) Allowing qualifying retail utilities to earn their most recent commission authorized rate of return, but no bonus, on investments in eligible energy resource technologies if these investments do not provide a net economic benefit to customers.

(IV) Considering, when the qualifying retail utility applies for a certificate of public convenience and necessity under section 40-5-101, rate recovery mechanisms that provide for earlier and timely recovery of costs prudently and reasonably incurred by the qualifying retail utility in developing, constructing, and operating the eligible energy resource, including:

(A) Rate adjustment clauses until the costs of the eligible energy resource can be included in the utility's base rates; and

(B) A current return on the utility's capital expenditures during construction at the utility's weighted average cost of capital, including its most recently authorized rate of return on equity, during the construction, startup, and operation phases of the eligible energy resource.

(V) If the commission approves the terms and conditions of an eligible energy resource contract between the qualifying retail utility and another party, the contract and its terms and conditions shall be deemed to be a prudent investment, and the commission shall approve retail rates sufficient to recover all just and reasonable costs associated with the contract. All contracts for acquisition of eligible energy resources shall have a minimum term of twenty years; except that the contract term may be shortened at the sole discretion of the seller. All contracts for the acquisition of renewable energy credits from solar electric technologies located on site at customer facilities shall also have a minimum term of twenty years.

(VI) A requirement that qualifying retail utilities consider proposals offered by third parties for the sale of renewable energy or renewable energy credits. The commission may develop standard terms for the submission of such proposals.

(g) Retail rate impact rule:

(I) Except as otherwise provided in subparagraph (IV) of this paragraph (g), for each qualifying utility, the commission shall establish a maximum retail rate impact for this section of two percent of the total electric bill annually for each customer. The retail rate impact shall be determined net of new alternative sources of electricity supply from noneligible energy resources that are reasonably available at the time of the determination. If the retail rate impact does not exceed the maximum impact permitted by this paragraph (g), the qualifying utility may acquire more than the minimum amount of eligible energy resources and renewable energy credits required by this section.

(II) Each wholesale energy provider shall offer to its wholesale customers that are cooperative electric associations the opportunity to purchase their load ratio share of the wholesale energy provider's electricity from eligible energy resources. If a wholesale customer agrees to pay the full costs associated with the acquisition of eligible energy resources and associated renewable energy credits by its wholesale provider by providing notice of its intent to pay the full costs within sixty days after the wholesale provider extends the offer, the wholesale customer shall be entitled to receive the appropriate credit toward the renewable energy standard as well as any associated renewable energy credits. To the extent that the full costs are not recovered from wholesale customers, a qualifying retail utility shall be entitled to recover those costs from retail customers.

(III) Subject to the maximum retail rate impact permitted by this paragraph (g), the qualifying retail utility shall have the discretion to determine, in a nondiscriminatory manner, the price it will pay for renewable energy credits from on-site customer facilities that are no larger than one hundred kilowatts.

(IV) For cooperative electric associations, the maximum retail rate impact for this section is one percent of the total electric bill annually for each customer.

(h) **Annual reports.** Each qualifying retail utility shall submit to the commission an annual report that provides information relating to the actions taken to comply with this article including the costs and benefits of expenditures for renewable energy. The report shall be within the time prescribed and in a format approved by the commission.

(i) Rules necessary for the administration of this article including enforcement mechanisms necessary to ensure that each qualifying retail utility complies with this standard, and provisions governing the imposition of administrative penalties assessed after a hearing held by the commission pursuant to section 40-6-109. The commission shall exempt a qualifying retail utility from administrative penalties for an individual compliance year if the utility demonstrates that the retail rate impact cap described in paragraph (g) of this subsection (1) has been reached and the utility has not achieved full compliance with paragraph (c) of this subsection (1). Under no circumstances shall the costs of administrative penalties be recovered from Colorado retail customers.

(2) (Deleted by amendment, L. 2007, p. 257, § 1, effective March 27, 2007.)

(3) Each municipally owned electric utility that is a qualifying retail utility shall implement a renewable energy standard substantially similar to this section. The municipally owned utility shall submit a statement to the commission that demonstrates such municipal utility has a substantially similar renewable energy standard. The statement submitted by the municipally owned utility is for informational purposes and is not subject to approval by the commission. Upon filing of the certification statement, the municipally owned utility shall have no further obligations under subsection (1) of this section. The renewable energy standard of a municipally owned utility shall, at a minimum, meet the following criteria:

(a) The eligible energy resources shall be limited to those identified in paragraph (a) of subsection (1) of this section;

(b) The percentage requirements shall be equal to or greater in the same years than those identified in subparagraph (V) of paragraph (c) of subsection (1) of this section, counted in the manner allowed by said paragraph (c); and

(c) The utility must have an optional pricing program in effect that allows retail customers the option to support through utility rates emerging renewable energy technologies.

(4) For municipal utilities that become qualifying retail utilities after December 31, 2006, the percentage requirements identified in subparagraph (V) of paragraph (c) of subsection (1) of this section shall begin in the first calendar year following qualification as follows:

(a) Years one through three: One percent of retail electricity sales;

(b) Years four through seven: Three percent of retail electricity sales;

(c) Years eight through twelve: Six percent of retail electricity sales; and

(d) Years thirteen and thereafter: Ten percent of retail electricity sales.

**(5) Procedure for exemption and inclusion - election.**

(a) (Deleted by amendment, L. 2007, p. 257, § 1, effective March 27, 2007.)

(b) The board of directors of each municipally owned electric utility not subject to this section may, at its option, submit the question of its inclusion in this section to its consumers on a one meter equals one vote basis. Approval by a majority of those voting in the election shall be required for such inclusion, providing that a minimum of twenty-five percent of eligible consumers participates in the election.

(5.5) Each cooperative electric association that is a qualifying retail utility shall submit an annual compliance report to the commission no later than June 1 of each year in which the cooperative electric association is subject to the renewable energy standard requirements established in this section. The

annual compliance report shall describe the steps taken by the cooperative electric association to comply with the renewable energy standards and shall include the same information set forth in the rules of the commission for jurisdictional utilities. Cooperative electric associations shall not be subject to any part of the compliance report review process as provided in the rules for jurisdictional utilities. Cooperative electric associations shall not be required to obtain commission approval of annual compliance reports, and no additional regulatory authority of the commission other than that specifically contained in this subsection (5.5) is created or implied by this subsection (5.5).

(6) (Deleted by amendment, L. 2007, p. 257, § 1, effective March 27, 2007.)

(7) (a) **Definitions.** For purposes of this subsection (7), unless the context otherwise requires:

(I) "Customer-generator" means an end-use electricity customer that generates electricity on the customer's side of the meter using eligible energy resources.

(II) "Municipally owned utility" means a municipally owned utility that serves five thousand customers or more.

(b) Each municipally owned utility shall allow a customer-generator's retail electricity consumption to be offset by the electricity generated from eligible energy resources on the customer-generator's side of the meter that are interconnected with the facilities of the municipally owned utility, subject to the following:

- (I) **Monthly excess generation.** If a customer-generator generates electricity in excess of the customer-generator's monthly consumption, all such excess energy, expressed in kilowatt-hours, shall be carried forward from month to month and credited at a ratio of one to one against the customer-generator's energy consumption, expressed in kilowatt-hours, in subsequent months.
- (II) **Annual excess generation.** Within sixty days after the end of each annual period, or within sixty days after the customer-generator terminates its retail service, the municipally owned utility shall account for any excess energy generation, expressed in kilowatt-hours, accrued by the customer-generator and shall credit such excess generation to the customer-generator in a manner deemed appropriate by the municipally owned utility.
- (III) **Nondiscriminatory rates.** A municipally owned utility shall provide net metering service at nondiscriminatory rates.
- (IV) **Interconnection standards.** Each municipally owned utility shall adopt and post small generation interconnection standards and insurance requirements that are functionally similar to those established in the rules promulgated by the public utilities commission pursuant to this section; except that the municipally owned utility may reduce or waive any of the insurance requirements. If any customer-generator subject to the size specifications specified in subparagraph (V) of this paragraph (b) is denied interconnection by the municipally owned utility, the utility shall provide a written technical or economic explanation of such denial to the customer.
- (V) **Size specifications.** Each municipally owned utility may allow customer-generators to generate electricity subject to net metering in amounts in excess of those specified in this subparagraph (V), and shall allow:
  - (A) Residential customer-generators to generate electricity subject to net metering up to ten kilowatts; and
  - (B) Commercial or industrial customer-generators to generate electricity subject to net metering up to twenty-five kilowatts.

**Source: Initiated 2004:** Entire section added, see L. 2005, p. 2337, effective December 1, 2004, proclamation of the Governor issued December 1, 2004. **L. 2005:** Entire section amended, p. 234, § 1,

effective August 8; (6) added by revision, see L. 2005, p. 2340, § 3. **L. 2007:** Entire section amended, p. 257, § 1, effective March 27. **L. 2008:** (7) added, p. 190, § 3, effective August 5.

**Editor's note:** (1) A declaration of intent was contained in the initiated measure, Amendment 37, and is reproduced below:

**SECTION 1. Legislative declaration of intent:**

Energy is critically important to Colorado's welfare and development, and its use has a profound impact on the economy and environment. Growth of the state's population and economic base will continue to create a need for new energy resources, and Colorado's renewable energy resources are currently underutilized.

Therefore, in order to save consumers and businesses money, attract new businesses and jobs, promote development of rural economies, minimize water use for electricity generation, diversify Colorado's energy resources, reduce the impact of volatile fuel prices, and improve the natural environment of the state, it is in the best interests of the citizens of Colorado to develop and utilize renewable energy resources to the maximum practicable extent.

(2) This initiated measure was approved by a vote of the registered electors of the state of Colorado on November 2, 2004. The vote count for the measure was as follows:

FOR: 1,066,023

AGAINST: 922,577

(3) Subsection (7) was contained in a 2008 act that was passed without a safety clause. For further explanation concerning the effective date, see page ix of this volume.

## 4 CCR 723-3-3650 et seq. Enacted 7/2/2006

### **3650. Applicability.**

- (a) Rules 3650 to 3665 shall apply to all investor owned jurisdictional electric utilities in the state of Colorado that are subject to the Commission's regulatory authority.
- (b) Rules 3651, 3652, 3654(b), (e) through (j), and (m), 3659(a)(I) through (a)(V), (b) through (k), 3660(i), 3661(b), (c), (g), and (j), 3662(a)(I) through (a)(X), (a)(XII), (b), (d) and (e) shall apply to cooperative electric associations in the state of Colorado.
- (c) Rules 3651, 3652, 3653, 3654(b), (c), (e) through (j) and (m), 3659(a)(I) through (a)(V), (b) through (k) shall apply to municipally owned electric utilities in the state of Colorado, which are QRUs.
- (d) The board of directors of each municipally owned electric utility not subject to these rules may, at its option, submit the question of whether to be subject to these rules to its consumers on a one meter equals one vote basis. Approval by a majority of those voting in the election shall be required for such inclusion, providing that a minimum of 25 percent of eligible consumers participates in the election.
- (l) Within 45 days of the conclusion of any vote to be subject to these rules, the municipally owned electric utility shall provide written notification of the outcome of the vote to the Director of the Commission.
- (e) Nothing in these rules is intended to expand the Commission's regulatory oversight and powers over municipally owned electric utilities or cooperative electric associations.

### **3651. Overview and Purpose.**

The purpose of these rules is to establish a process to implement the renewable energy standard for qualifying retail utilities in Colorado, pursuant to § 40-2-124, C.R.S.

Section 40-2-124, C.R.S., was enacted by the voters of the State of Colorado as 2004 Ballot Amendment 37 and was amended by the 2005 Colorado General Assembly by Senate Bill 05-143. Section 40-2-124 was further amended by the 2007 Colorado General Assembly by House Bill 07-1281. Energy is critically important to Colorado's welfare and development, and its use has a profound impact on the economy and environment. Growth of the state's population and economic base will continue to create a need for new energy resources, and Colorado's renewable energy resources are currently underutilized. Therefore, in order to save consumers and businesses money, attract new businesses and jobs, promote development of rural economies, minimize water use for electricity generation, diversify Colorado's energy resources, reduce the impact of volatile fuel prices, and improve the natural environment of the state, it is in the best interests of the citizens of Colorado to develop and utilize renewable energy resources to the maximum practicable extent. It is the policy of this State to encourage local ownership of renewable energy generation facilities to improve the financial stability of rural communities.

### **3652. Definitions.**

The following definitions apply only to rules 3650 – 3665. In the event of a conflict between these definitions and a statutory definition, the statutory definition shall apply.

- (a) "Annual compliance report" means the report a QRU is required to file annually with the Commission pursuant to rule 3662 to demonstrate compliance with the Renewable Energy Standard.
- (b) "Biomass" means nontoxic plant matter consisting of agricultural crops or their byproducts, urban wood waste, mill residue, slash, or brush; animal wastes and products of animal wastes; or methane produced at landfills or as a by-product of the treatment of wastewater residuals.
- (c) "Community-based project" means a project located in Colorado and: (a) that is owned by individual residents of a community, a local nonprofit organization, a cooperative, a local government entity, or a tribal council; (b) whose generating capacity does not exceed thirty megawatts; and (c) for which there is a resolution of support adopted by the local governing body of each local jurisdiction in which the project is to be located.
- (d) "Compliance plan" means the annual plan a QRU is required to file with the Commission pursuant to rule 3657.
- (e) "Compliance year" means a calendar year for which the renewable energy standard is applicable.

- (f) "Eligible energy" means renewable energy, recycled energy or RECs.
- (g) "Eligible energy resources" are recycled energy or facilities that generate electricity by means of the following energy sources: solar radiation, wind, geothermal, biomass, hydropower, and fuel cells using hydrogen derived from eligible energy resources. Fossil and nuclear fuels and their derivatives are not eligible energy resources. Hydropower resources in existence on January 1, 2005 must have a nameplate rating of thirty megawatts or less. Hydropower resources not in existence on January 1, 2005 must have a nameplate rating of ten megawatts or less.
- (h) "Off-grid on-site solar system" means an on-site solar system located on the premises of an end-use electric consumer located within the service territory of a QRU or an electric utility that is eligible to become a QRU pursuant to § 40-2-124(5)(b), C.R.S., that is not connected to, and operates completely independently from, the distribution system or transmission system facilities of any electric utility.
- (i) "On-site solar system" means a solar renewable energy system located on the premises of an end-use electric consumer located within the service territory of a QRU or an electric utility that is eligible to become a QRU pursuant to § 40-2-124(5)(b), C.R.S. For the purposes of this definition, the non-residential end-use electric customer, prior to the installation of the solar renewable energy system, shall not have its primary business being the generation of electricity for retail or wholesale sale from the same facility. In addition, at the time of the installation of the solar renewable energy system, the non-residential end-use electric customer must use its existing facility for a legitimate commercial, industrial, governmental, or educational purpose other than the generation of electricity. An On-site solar system is limited to a maximum size of two MW.
- (j) "Person" means Commission staff or any individual, firm, partnership, corporation, company, association, cooperative association, joint stock association, joint venture, governmental entity, or other legal entity.
- (k) "Qualifying retail utility" or "QRU" means any provider of retail electric service in the state of Colorado other than municipally owned electric utilities that serve 40,000 customers or fewer.
- (l) "Recycled energy" means energy produced by a generation unit with a nameplate capacity of not more than fifteen megawatts that converts the otherwise lost energy from the heat from exhaust stacks or pipes to electricity and that does not combust additional fossil fuel. Recycled energy does not include energy produced by any system that uses energy, lost or otherwise, from a process whose primary purpose is the generation of electricity, including, without limitation, any process involving engine-driven generation or pumped hydroelectricity generation.
- (m) "Renewable energy" means energy generated from eligible energy resources.
- (n) "Renewable energy credit" or "REC" means a contractual right to the full set of non-energy attributes, including any and all credits, benefits, emissions reductions, offsets, and allowances, howsoever entitled, directly attributable to a specific amount of electric energy generated from an eligible energy resource. One REC results from one megawatt-hour of electric energy generated from an eligible energy resource. For the purposes of these rules, RECs include, but are not limited to, S-RECs and SO-RECs.
- (o) "Renewable energy credit contract" means a contract for the sale of renewable energy credits without the associated energy.
- (p) "Renewable energy standard" means the electric resource standard for eligible renewable energy resources specified in § 40-2-124, C.R.S.
- (q) "Renewable energy supply contract" means a contract for the sale of renewable energy and the RECs associated with such renewable energy. If the contract is silent as to renewable energy credits, the renewable energy credits will be deemed to be combined with the energy transferred under the contract.
- (r) "Solar electric generation technologies" means any technology that uses solar radiation energy to generate electricity.
- (s) "Solar on-site renewable energy credit" or "SO-REC" means a REC created by an on-site solar system.
- (t) "Solar renewable energy credit" or "S-REC" means a REC created by a solar renewable energy system. For the purposes of these rules, S-RECs include, but are not limited to, SO-RECs.
- (u) "Solar renewable energy system" means a system that uses a solar electric generation technology to generate electricity.
- (v) "Standard rebate offer" or "SRO" means a standardized incentive program offered by a QRU to its

retail electric service customers for on-site solar systems that do not exceed 100 kW per installation.(w) "Watt" means a unit of measure of alternating current electric power at a point in time, as capacity or demand. For the purposes of measurement of output from solar renewable energy systems used in the solar program, the watts referenced herein mean those determined by a nationally accepted testing organization.

### **3653. Municipal Utilities.**

(a) Each municipally owned QRU implementing a renewable energy standard substantially similar to the provisions of § 40-2-124, C.R.S., shall submit a statement to the Commission that demonstrates its renewable energy standard program, at a minimum, meets the following criteria: (I) The eligible energy resources shall be limited to those identified in subsection § 40-2-124(1)(a);

(II) The percentage requirements shall be equal to or greater in the same years than those identified in subsection § 40-2-124(1)(c)(V) and counted in the manner allowed by rule 3654; and

(III) The utility must have an optional pricing program in effect that allows retail customers the option to support through utility rates emerging renewable energy technologies.

(b) The statement to be submitted by a municipally owned QRU is for information purposes only and is not subject to approval by the Commission. Upon filing of the certification statement, the municipally owned QRU shall have no further obligations under these rules.

(c) Nothing in this section prohibits a municipally owned electric utility from buying and selling RECs.

### **3654. Renewable Energy Standard.**

(a) Each investor owned QRU shall generate or cause to be generated (through purchase or by providing rebates or other form of incentive) eligible energy in the following minimum amounts:

(I) Three percent of its retail electricity sales in Colorado for the compliance year 2007;

(II) Five percent of its retail electricity sales in Colorado for each of the compliance years 2008 through 2010;

(III) Ten percent of its retail electricity sales in Colorado for each of the compliance years 2011 through 2014;

(IV) Fifteen percent of its retail electricity sales in Colorado for each of the compliance years 2015 through 2019; and

(V) Twenty percent of its retail electricity sales in Colorado for each of the compliance years beginning in 2020 and continuing thereafter.

(b) Each cooperative electric association QRU and municipally owned QRU shall generate or cause to be generated eligible energy in the following minimum amounts:

(I) One percent of its retail electricity sales in Colorado for each of the compliance years 2008 through 2010;

(II) Three percent of its retail electricity sales in Colorado for each of the compliance years 2011 through 2014;

(III) Six percent of its retail electricity sales in Colorado for each of the compliance years 2015 through 2019; and

(IV) Ten percent of its retail electricity sales in Colorado for each of the compliance years beginning in 2020 and continuing thereafter.

(c) For municipal utilities that become a municipally owned QRUs after December 31, 2006, the minimum percentage requirements of eligible energy shall begin in the first calendar year following qualification as follows:

(I) Years one through three: One percent of retail electricity sales;

(II) Years four through seven: Three percent of retail electricity sales;

(III) Years eight through twelve: Six percent of retail electricity sales; and

(IV) Years thirteen and thereafter: Ten percent of retail electricity sales.

(d) Of the eligible renewable energy amounts specified in rule 3654(a), each investor owned QRU shall derive at least four percent from solar electric generation technologies. At least one-half of this four percent shall be derived from on-site solar systems located at customers' facilities (e) For purposes of compliance with the renewable energy standard specified in rules 3654(b) and (c), for cooperative electric association QRUs and municipal QRUs, each kilowatt-hour of eligible

energy generated from solar electric generation technology shall be counted as 3.0 kilowatt-hours of eligible energy, provided that the solar electric generation technology commenced producing electricity prior to July 1, 2015. For solar electric generation technology that commenced producing electricity on or after July 1, 2015, each kilowatt-hour of eligible energy generated from solar electric generation technology shall be counted as 1.0 kilowatt-hours of eligible energy for compliance purposes.

(f) For purposes of compliance with the renewable energy standard, each kilowatt-hour of eligible energy generated in Colorado shall be counted as 1.25 kilowatt-hours of eligible energy.

(g) For purposes of compliance with the renewable energy standard, each kilowatt-hour of eligible energy generated from a community-based project shall be counted as 1.5 kilowatt-hours of eligible energy.

(h) For purposes of compliance with the renewable energy standard, each kilowatt-hour of eligible energy may take advantage of only one of the compliance multipliers in rules 3654(e), (f) or (g).

(i) For purposes of compliance with the renewable energy standard, a QRU may generate, or cause to be generated, and count eligible energy for compliance:

(I) For the compliance year immediately preceding the compliance year during which it was generated, provided that such eligible renewable energy is generated no later than July 1 of the calendar year immediately following the end of the compliance year for which it is being counted;

(II) For the compliance year during which it was generated; or

(III) For the five compliance years immediately following the compliance year during which it was generated.

(IV) Eligible energy generated on or after January 1, 2004 may be counted for compliance with this renewable energy standard. Eligible energy or RECs generated on or before December 31, 2003 shall not be eligible for, and shall not be counted for, compliance with this renewable energy standard. The eligibility for compliance of all eligible energy shall expire at the end of the fifth calendar year following the calendar year during which it was generated.

(j) For purposes of compliance with this renewable energy standard, a QRU may substitute the equivalent RECs, S-RECs, or SO-RECs for eligible energy.

(k) For the first four compliance years the QRU may borrow forward eligible energy generated during the following two compliance years. Any borrowed eligible energy generated during a compliance year must be made up by actual eligible energy generated during that compliance year or borrowed from subsequent compliance years, provided that the fourth compliance year is the last compliance year that borrowing forward may occur pursuant to this rule. For purposes of this rule, the term "borrow forward" means that a QRU may count eligible energy that it has not yet generated or caused to be generated to satisfy its current year obligations toward compliance with the renewable energy standard and the term "made up" means that any counting of eligible energy resources by a QRU in a compliance year that it had not actually generated nor caused to be generated shall be actually generated or caused to be generated in a subsequent year.

(l) For the first four compliance years, 2007 through 2010, no administrative penalties shall be assessed against an investor owned QRU if the failure to meet the renewable energy standard results from events beyond the reasonable control of the QRU which could not have reasonably been mitigated by the QRU.

(m) For purposes of compliance with this renewable energy standard, there shall be no "double counting" of renewable energy or RECs. Notwithstanding the foregoing, eligible renewable energy generated or acquired by a QRU and counted toward compliance with a federal renewable energy standard may also be counted by the QRU toward compliance with the renewable energy standard.

(n) A QRU may apply to the Commission for a determination as to whether eligible energy sold by the QRU under an optional renewable energy pricing program may be counted by the QRU toward compliance with the renewable energy standard. Such eligible energy shall not be counted toward compliance with the renewable energy standard until the Commission grants approval of the utility's application following an evidentiary hearing.

(o) For purposes of compliance with this renewable energy standard, if a generation system uses a combination of fossil fuel and eligible renewable energy resources to generate electricity, a QRU may count only as eligible renewable energy the proportion of the total electric output of the generation system that results from the use of eligible renewable energy resources. The QRU shall include in its annual compliance plan the method of calculation used to determine the

proportion of eligible renewable energy.

(p) The QRU may generate, or cause to be generated, eligible renewable energy without regard to economic dispatch procedures.

**3658. Standard Rebate Offer.**

(a) Each investor owned QRU shall make available to its retail electricity customers a standard rebate offer of \$2.00 per watt for on-site solar systems, up to a maximum of 100 kW per system, that become operational on or after December 1, 2004. At the QRU's option, the standard rebate offer may be paid based upon the direct current (DC) watts produced by the on-site solar systems. Any SO-RECs acquired by the QRU pursuant to such SRO program, regardless of whether the associated renewable energy is specifically metered or contractually specified without specific metering, may be counted by the QRU for purposes of compliance with the renewable energy standard.

(b) On or before June 1, 2006, each QRU shall make a one-time offer to purchase, under a renewable energy credit contract, the SO-RECs associated with on-site solar systems, up to a maximum of ten kW per system existing prior to December 1, 2004, and off-grid on-site solar systems, up to a maximum of ten kW per system. The purchase price offered by the QRU for such SO-RECs shall be no less than the QRU's then current standard offer payment rate for SORECs, exclusive of the standard rebate payment, associated with the QRU's standard rebate offer and established pursuant to rule 3658. Subsequent offers shall be made at the discretion of the QRU. SO-RECs purchased by a QRU pursuant to this rule may be counted for purposes of compliance with the renewable energy standard.

(c) The standard rebate offer of the investor owned QRUs shall be set forth at least annually and shall meet the following requirements:

(I) The QRU need not offer a rebate for an on-site solar system smaller than 500 watts.

(II) The rebate must be made available to all retail utility customers of the QRU on a nondiscriminatory, first-come, first-served basis, based upon the date of contract execution.

(III) Applicants who are accepted for SRO rebates shall have one year from the date of contract execution to demonstrate substantial completion of their proposed on-site solar system. Substantial completion means the purchase and installation on the customer's premises of all major system components of the on-site solar system. Customers who do not achieve substantial completion within one year will not receive a rebate, unless the substantial completion date is extended. When substantial completion of an on-site solar system has been achieved by an applicant pursuant to this rule the SO-RECs may be counted for purposes of compliance with the renewable energy standard. Within 30 days of substantial completion, the SRO rebate, pursuant to rule 3658(a), and SO-REC payment, pursuant to rule 3658(c)(VIII), shall be paid to the applicant.

(IV) With the exception of batteries, all on-site solar systems eligible for SRO rebates shall be covered by a minimum five-year warranty. Contracts will require customers to maintain the on-site solar system so that it remains operational for the term of the contract.

(V) On-site solar systems must consist of equipment that is commercially available and factory new when installed on the original customer's premises to be eligible for the SRO rebate. Rebuilt, used, or refurbished equipment is not eligible to receive the rebate.

(VI) Customers may contract to expand their on-site solar systems and obtain a rebate for the expanded capacity.

(VII) In order to receive the SRO rebate payment, the customer must enter into an agreement with the QRU, with a minimum term of 20 years, that transfers the SO-RECs generated by the on-site solar system during the term of the agreement from the customer to the QRU.

(VIII) For on-site solar systems, up to and including ten kW, that become operational on or after December 1, 2004, the QRU shall offer to make a one-time payment, in addition to the standard rebate payment, for the SO-RECs contracted to be transferred from the customer to the QRU. Any customer that receives the rebate payment and one-time SOREC payment under this program shall not be entitled to any other compensation for the SO-RECs contracted to be transferred to the QRU. To facilitate installation of these small systems, all procedures, forms, and requirements shall be clear, simple, and straightforward to minimize the time and effort of homeowners and small businesses.

(IX) For on-site solar systems greater than ten kW that become operational on or after December 1, 2004, the QRU, in addition to the standard rebate payment, shall offer to pay for the SO-RECs contracted

to be transferred from the customer to the QRU. Such SO-RECs and the associated payments shall be determined by the specifically metered renewable energy output from the on-site solar system.

(X) The customer or its representative shall provide a calculation of the annual expected kilowatt-hour production from the customer's on-site solar system. The customer or its representative shall provide the following documentation to back up the customer's calculation:

(A) Tilt of the system in degrees (horizontal = 0 degrees);

(B) Orientation of the system in degrees (south = 180 degrees);

(C) A representation that the orientation of the system is free of trees, buildings and or other obstructions that might shade the system measured from the center point of the solar array through a horizontal angle plus or minus 60 degrees and a through vertical angle between 15 degrees and 90 degrees above the horizontal plane.

(D) A calculation of the annual expected kWh of electricity produced by the system. For PV systems, the calculation of annual expected kWh of electricity will be based on the public domain solar calculator PVWatts Version 1 (or equivalent upgrade).

(i) The weather station that is either nearest to or most similar in weather to the installation site;

(ii) The system output rating which equals the module rating times the inverter efficiency times the number of modules;

(iii) Array type: fixed tilt, single axis tracking, or 2 axis tracking; For variable tilt systems, the PVWatts calculations can be run multiple times corresponding to the number of times per year that the system tilt is expected to be changed using those months corresponding to the specific tilt angle used;

(iv) Array tilt (degrees); and

(v) Array azimuth (degrees).

(E) In the event PVWatts is no longer available, an equivalent tool shall be established.

(F) For on-site solar systems up to and including ten kW, the REC payment may be adjusted, either up or down, based on the calculation of expected kWh of electric output derived from rule 3658(X)(D) as compared with an optimally oriented fixed, i.e. non-tracking, system at the customer's location, but only if the calculated system output differs from the optimally oriented system output by more than ten percent.

(XI) The level of SO-REC payments for systems of ten kW and smaller offered in connection with a QRU's SRO program may be adjusted from time to time as needed to achieve compliance with the renewable energy standard.

(XII) The on-site solar system installed must remain in place on the customer's premises for the duration of its useful life. The customer's equipment must have electrical connections in accordance with industry practice for permanently installed equipment, and it must be secured to a permanent surface (e.g., foundation, roof, etc.). Any indication of portability, including, but not limited to, wheels, carrying handles, dolly, trailer or platform, will render the system ineligible for participation and payments under the SRO program.

### **3659. Renewable Energy Credits.**

- (a) Renewable energy credits will be used to comply with the renewable energy standard. Eligible RECs acquired by contracts or through a system of tradable renewable energy credits, exchanges, or brokers may also be used by QRUs to comply with this standard. In calculating compliance, the total RECs acquired from eligible energy resources during a compliance year may include:
- (I) RECs generated by eligible energy resources owned by the QRU or by a QRU affiliate;
  - (II) RECs acquired by the QRU pursuant to renewable energy supply contracts;
  - (III) RECs acquired by the QRU pursuant to renewable energy credit contracts;
  - (IV) RECs acquired by the QRU pursuant to a standard offer program;
  - (V) RECs acquired through a system of tradable renewable energy credits, from exchanges or from brokers
  - (VI) RECs carried forward from previous compliance years, pursuant to rule 3654(i);
  - (VII) RECs borrowed forward from future compliance years, pursuant to rule 3654(k).
- (b) RECs representing electricity generated at eligible energy resources shall be counted for compliance purposes consistent with the compliance multipliers in rule 3654(e), (f), and (g).
- (c) The Commission shall not restrict the QRU's ownership of RECs if the QRU complies with the renewable energy standard established in rule 3654 and does not exceed the retail rate impact established in rule 3661.
- (d) Subject to the maximum retail rate impact in rule 3661, the QRU shall have the discretion to determine, in a nondiscriminatory manner, the price it will pay for RECs from on-site customer facilities that are no larger than one hundred kilowatts.
- (e) All contracts between QRUs and the owners of eligible energy resources entered into after the effective day of these rules shall clearly specify the entity who shall own the RECs associated with the energy generated by the facility.
- (f) A renewable energy credit shall expire at the end of the fifth calendar year following the calendar year during which it was generated.
- (g) Renewable energy credits that are generated on or after January 1, 2004 may be counted for compliance with this renewable energy standard.
- (h) RECs shall be used for a single purpose only, and shall expire or be retired upon use for that purpose. All RECs utilized by the QRU to comply with the renewable energy standard:
- (I) May not be sold or otherwise exchanged with any other party, or in any other state or jurisdiction;
  - (II) May not be included within a blended energy product certified to include a fixed percentage of renewable energy in any other state or jurisdiction;
  - (III) May be counted simultaneously toward compliance with a federal renewable portfolio standard and with the renewable energy standard.
- (i) RECs that are generated with fuel cell energy using hydrogen derived from an eligible energy resource are eligible for compliance purposes only to the extent that the energy used to generate the hydrogen did not create renewable energy credits.
- (j) If a renewable energy system uses an eligible energy resource in combination with a nonrenewable energy source to generate electricity, only the RECs associated with the proportion of the total electric output of the renewable energy system that results from the use of eligible energy resources shall be eligible to count toward compliance with the renewable energy standard.
- (k) If an on-site solar systems of ten kW or below has received a one-time REC payment from a QRU under rule 3658, the QRU shall be entitled to count the anticipated SO-RECs purchased by the one-time REC payment for compliance with the renewable energy standard even if the on-site solar systems is removed or becomes inoperable.
- (l) An investor owned QRU:
- (I) Shall develop an auditable process to account for RECs using a central database. In the absence of a central third-party database, the QRU shall maintain its own REC internal database and shall make an extract of the REC information available on the utility's website.
  - (II) Shall designate within its database any REC sold to a wholesaler if the REC has been assigned to that wholesaler.

(III) Shall apply for the inclusion of any losses or gains from the purchase or sale of RECs through an appropriate adjustment clause mechanism.

(IV) Shall hire an independent auditor to verify the accuracy of the QRU internal database which tracks REC. The independent verification shall occur after two years then every three years thereafter.

(m) The investor owned QRU shall record REC information from eligible energy resources in a central database. The database shall include, but not be limited to, a list of all eligible energy resources the QRU intends to use for compliance with the renewable energy standard, including their type, location, owner, operator, start of operation, actual REC generation, ownership, transfer and retirement. A summary database shall be provided to the Commission Staff and be publicly viewable via the Commission's website. Owners of eligible energy resources with nameplate ratings of 100kW or below and larger eligible energy resources, at their option, shall have their name and address encoded for privacy. Systems that are encoded for privacy shall have a unique identifying number assigned, and will continue to have the zip code reported.

(n) In conjunction with the QRU compliance plans specified in rule 3657, a QRU may make a request that the Commission allow the use of a central third-party database to account for RECs. If a QRU proposes to use a central third-party database for the accounting of RECs, the QRU must show that the central third-party database can be readily audited by the Commission Staff to verify that the renewable energy standard is met and that the alternative system is cost effective.

### **3660. Cost Recovery and Incentives.**

(a) The investor owned QRU shall be entitled to timely cost recovery through retail rate mechanisms for all funds prudently expended to comply with these rules, including the costs the QRU incurs to administer the standard rebate offer and the acquisitions of eligible energy resources. The QRU shall be entitled to recover its investment and expenses associated with these rules through appropriate adjustment clauses that allow recovery of expenditures without the full resetting of electric rates.

(b) In advance of the approval of the first compliance plan, an investor owned QRU may propose, by application, to implement a forward-looking cost recovery mechanism to provide funding for implementing the renewable energy standard. In its application, the QRU must demonstrate that the funding mechanism proposed will not exceed the retail rate impact test. If approved, the forward-looking funding mechanism may be implemented prior to the first compliance year. Each QRU with a forward-looking cost recovery mechanism shall separately identify the forwardlooking cost recovery mechanism on its customers' bills.

(1) Interest shall accrue on the unexpended balance of funds collected from a forwardlooking rider. The interest rate shall be at the Commission's customer deposit interest rate at the time of the rider. A QRU may request interest on any funds it expends in excess of those collected through the forward-looking rider. The request for interest on excess expenditures shall include the reason(s) for the excess expenditures. The request for interest shall be included as part of the annual compliance report, pursuant to rule 3662.

(c) If the investor owned QRU incurs costs in acquiring eligible energy to meet the renewable energy standard that exceed the maximum retail rate impact, the QRU shall be entitled to carry forward these costs to a future year for cost recovery. These carried forward amounts shall not increase the amounts that a QRU may charge customers under the retail rate impact rule.

(d) The investor owned QRU shall be entitled to earn an extra profit on the QRU's ownership investment in a specific eligible energy resource if that eligible energy resource provides net economic benefits to customers. For these investments, the QRU shall be entitled to a return equal to the QRU's most recent authorized rate of return on rate base plus a bonus limited to 50 percent of the of the net economic benefit as long as the QRU is in compliance with these rules implementing the renewable energy standard. If the QRU's investment in a specific eligible renewable energy resource does not provide a net economic benefit to customers, the QRU shall be entitled to a return equal to the QRU's most recent authorized rate of return on rate base.

(1) For the purposes of this rule 3660, net economic benefit shall mean that the specific eligible energy resource in which the QRU has made an ownership investment results in an average retail rate impact less than the rate impact that would have resulted from the acquisition of the alternative eligible energy resource meeting the same component of the renewable energy standard that would have been selected

absent the QRU's investment. The QRU shall set forth its calculation of the proposed net economic benefit either at the time of a compliance plan filing, an annual compliance report filing, a QRU rate filing or by application. The Commission shall determine the level of the net economic benefit and the level of the bonus after review of the utility's filing. The Commission may set the matter for hearing if appropriate under the Commission's Rules of Practice and Procedure.

(II) To the extent that a QRU uses computer modeling in its analysis of net economic benefit, the QRU shall use the same methodologies and assumptions it used in its most recently approved least-cost planning case, except as otherwise approved by the Commission. Confidential information may be protected in accordance with rules 1100 through 1102 of the Commission's Rules of Practice and Procedure.

(III) Any net economic benefit for which the QRU qualifies to receive a bonus shall be included in the calculation of the retail rate impact rule pursuant to rule 3661.

(e) An investor-owned QRU may propose to develop and own, in whole or in part, a new eligible energy resource by filing an application with the Commission. The Commission may set the matter for hearing, if appropriate, under the Commission's Rules of Practice and Procedure. For the purpose of this rule 3660(e):

(I) A QRU shall be allowed to develop and own as utility rate-based property, without being required to comply with the competitive bidding requirements in rule 3655, up to twentyfive percent of the total new eligible energy resources that the QRU acquires from entering into power purchase agreements and from developing and owning resources after March 27, 2007 if the Commission determines that the QRU-owned new eligible energy resource can be constructed at a reasonable cost compared to the cost of similar eligible energy resources available in the market.

(II) A QRU shall be allowed to develop and own as utility rate-based property, without being required to comply with the competitive bidding requirements in rule 3655, up to fifty percent of the total new eligible energy resources that the QRU acquires from entering into power purchase agreements and from developing and owning resources after March 27, 2007 if the Commission determines that the QRU-owned new eligible energy resource can be constructed at a reasonable cost compared to the cost of similar eligible energy resources available in the market and that the proposed new eligible energy resource would provide significant economic development, employment, energy security, or other benefits to the state of Colorado.

(III) The QRU shall be allowed to develop and own as utility rate-based property more than the percentages of total new eligible energy resources set forth in rules 3660(e)(I) and (e)(II), if the QRU bids to own the new eligible energy resources in a competitive solicitation and is selected as a winning bidder in that competitive solicitation.

(IV) The QRU may develop and own new eligible energy resources either solely or jointly with other owners. If the QRU owns the new eligible energy resource jointly, the entire jointly owned resource shall count toward the percentage limitations set forth in rule 3660(e). For purposes of this rule, participation by any parent, affiliate or subsidiary of a QRU in a QRU's owned new eligible energy resource shall count towards the percentage limitations. The QRU's rate base portion of any new eligible energy resource is limited to only the QRU's ownership percentage in the new eligible energy resource.

(V) If the QRU intends to develop and own new eligible energy resources as provided for under rule 3660(e)(I) or (e)(II), it shall propose for Commission approval, in advance of filing its application under this rule, the name of the independent evaluator whom the utility intends to hire to conduct an assessment of whether the proposed new eligible energy resources can be constructed at a reasonable cost compared to the cost of similar eligible energy resources available in the market. The independent evaluator will develop a report to the Commission on its assessment of whether the proposed new eligible energy resources can be constructed at a reasonable cost compared to the cost of similar eligible energy resources available in the market. The independent evaluator shall have at least five years' experience conducting and/or reviewing the conduct of competitive electric utility resource acquisition, including computerized portfolio costing analysis. The independent evaluator shall be unaffiliated with the utility; and shall not, directly or indirectly, have benefited from employment or contracts with the utility in the preceding five years, except as an independent evaluator under these rules. The independent evaluator shall not participate in, or advise the utility with respect to, any decisions relating to the proposed new

eligible energy resource. The utility shall conduct any additional modeling requested by the independent evaluator to test the assumptions and results of the cost analyses. The independent evaluator's report shall be filed with the utility's application for approval of the proposed new eligible energy resource. The evaluator's report shall contain the evaluator's views on whether the proposed new eligible energy project can be constructed at a reasonable cost compared to the cost of similar eligible energy resources available in the market.

(VI) Nothing in rule 3660(e) shall prevent the Commission from waiving, repealing, or revising any Commission rule in a manner otherwise consistent with applicable law.

(f) When an investor owned QRU applies for a certificate of public convenience and necessity, the Commission shall consider rate recovery mechanisms that provide for earlier and timely recovery of costs prudently and reasonably incurred by the QRU in developing, constructing, and operating the eligible energy resource, including: (a) rate adjustment clauses until the costs of the eligible energy resource can be included in the utility's base rates; and (b) a current return on the utility's capital expenditures during construction at the utility's weighted average cost of capital, including its cost of debt and its most recently authorized rate of return on equity, during the construction, startup, and operation phases of the eligible energy resource.

(g) The utility is entitled to recover through rates, its prudently incurred expenditures. While not the exclusive method for establishing prudence, if the Commission approves a renewable energy supply contract or a renewable energy credit contract, the expenditures of the investor owned QRU under the contract shall be deemed to be prudent expenditures.

(h) If the investor owned QRU recovers fuel and purchased energy expense through an incentive adjustment clause, the QRU shall not receive a benefit from the incentive adjustment clause for the energy generated from QRU-owned eligible renewable energy resources, but the QRU shall be entitled to recover all the fuel and purchased energy costs associated with the eligible energy resource.

(i) Each wholesale energy provider shall offer to its wholesale customers that are cooperative electric associations the opportunity to purchase their load ratio share of the wholesale energy provider's electricity from eligible energy resources. If a wholesale customer agrees to pay the full costs associated with the acquisition of eligible energy resources and associated renewable energy credits by its wholesale provider by providing notice of its intent to pay the full costs within sixty days after the wholesale provider extends the offer, the wholesale customer shall be entitled to receive the appropriate credit toward the renewable energy standard as well as any associated renewable energy credits. To the extent that the full costs are not recovered from wholesale customers, a qualifying retail utility shall be entitled to recover those costs from retail customers.

### **3661. Retail Rate Impact.**

(a) The net rate impact of actions taken by an investor owned QRU to comply with the renewable energy standard shall not exceed two percent of the total electric bill annually for each customer of that QRU.

(b) The net rate impact of actions taken by a cooperative electric association QRU to comply with the renewable energy standard shall not exceed one percent of the total electric bill annually for each customer of that QRU.

(c) The net rate impact shall include the prudently incurred direct and indirect costs of all actions by a QRU to meet the renewable energy standard, including, but not limited to, program administration, rebates and performance-based incentives, payments under renewable energy supply contracts, payments under renewable energy credit contracts, payments made for RECs purchased through brokers or exchanges, computer modeling and analysis time, and QRU investment in and return on investment for eligible energy resources.

(d) The administrative costs of a QRU to implement these rules is capped at ten percent per year of the total annual collection. A QRU may include in its compliance plan a waiver request of this rule during the initial ramp-up stage of the QRU's program.

(e) For purposes of calculating the retail rate impact, the investor owned QRU shall use the same methodologies and assumptions it used in its most recently approved least-cost planning case, unless otherwise approved by the Commission. Confidential information may be protected in accordance with rules 1100 through 1102 of the Commission's Rules of Practice and Procedure.

(f) In its compliance plan filed under rule 3657, the investor owned QRU shall estimate the retail rate impact of its plan to comply with the renewable energy standard over the upcoming compliance year and shall submit a report detailing the development of the retail rate impact estimate. The compliance plan shall identify the funds that need to be made available to the QRU to comply with the renewable energy standard and the retail rate impact rule. By approving the compliance plan of an investor owned QRU, the Commission will be approving the investor owned QRU's budget for acquiring eligible energy over the compliance year. Once approved by the Commission, the investor owned QRU shall implement its compliance plan. Actions taken by an investor owned QRU in compliance with the filed and approved compliance plan shall be deemed prudent.

(g) The retail rate impact shall be determined net of new alternative sources of electricity supply from non-eligible energy resources that are reasonably available at the time of the determination.

(h) The basic method for investor owned QRUs for performing the estimate of the retail rate impact limit is as follows:

(I) The QRU shall determine all commercially available resources to the QRU, either through ownership or by contract, at the time of the beginning of the compliance year and for a minimum of the ten years thereafter (the "RES planning period"). The projected costs of these available resources shall be reflected in both of the scenarios analyzed by the QRU's computer planning models under this paragraph. The QRU shall determine the QRU's capacity and energy requirements over the RES planning period. The QRU shall develop two scenarios to estimate the resource composition of the QRU's future electric system and the cost of that system over the RES Planning Period. The first scenario, a renewable energy standard plan or "RES plan" should reflect the QRU's plans and actions to acquire new eligible energy necessary to meet the renewable energy standard reflecting a gradual ramp-up to the twenty percent level. The second scenario, a "No RES plan" should reflect the QRU's resource plan that meets the QRU's capacity and energy requirements over the RES planning period by replacing the new eligible energy resources in the RES plan with new nonrenewable resources reasonably available. For purposes of this rule, new eligible renewable energy means eligible energy from resources which are not commercially operational at the time these two modeling scenarios are performed.

(II) The QRU shall use the comparison of the two model runs of the RES planning period along with any additional analysis needed to calculate the estimated annual net retail rate impact for the first compliance year of the RES planning period. The maximum retail rate impact shall not exceed two percent of the total retail bill annually for each customer. To the extent the RES plan exceeds this maximum retail rate impact, the QRU shall modify the RES plan to limit the acquisition of eligible energy so that the QRU compliance plan does not exceed the maximum retail rate impact for the first compliance year of the RES planning period. In calculating the annual net retail rate impact in each compliance plan for the first compliance year of the RES planning period, the QRU shall take into account the on-going annual costs of all eligible energy that the QRU has contracted to acquire under the standard rebate offer under rule 3658 and all eligible energy from resources that were constructed by the QRU or contracted for by the QRU after the effective date of these rules.

(i) Any investor owned QRU with annual retail sales of less than five million megawatt-hours can use an alternate method to determine the estimate of the retail rate impact. The alternative method can be used for those RES planning period years when the only remaining portion of the renewable energy standard with which the QRU needs to comply is the eligible energy that must be acquired from solar electric generating technologies.

(I) The retail rate impact will be determined by using the estimated costs of the proposed solar electric generating technologies less the estimated annual average costs of energy of existing resources that would be replaced with energy generated by the proposed solar electric generating technologies. The QRU shall also incorporate into this retail rate impact analysis other cost savings created by the deployment of the solar electric generating technologies and any other cost savings from the deployment of other nonsolar eligible energy resources used to meet the standard. These cost savings include, but are not limited to, the avoided or deferred costs of generation, transmission and distribution facilities.

(II) The QRU will then convert this net cost figure into a percent of total electric bill annually for each customer. In no event shall the percent of total electric bill annually exceed one percent for each customer. To the extent that the net cost figure results in the QRU

exceeding the two percent for each customer threshold, the QRU shall modify its acquisition of solar electric generating technologies in order to not exceed the maximum retail rate impact.

(j) If the retail rate impact does not exceed the maximum percent level, a QRU may acquire more than the minimum amount of eligible energy resources and RECs required under the renewable energy standard.

(Sources: Colorado Department of Regulatory Agencies, Public Utilities Commission, 2004 and 2006)



**APPENDIX B**

**EXPENDITURES BY REPRESENTATIVE RENEWABLE ENERGY  
FACILITIES**

**Conversion Technology:** Horizontal Axis Wind Turbine Power Plant  
**Facility Size (Nameplate):** 16 MW  
**Capacity Factor:** 0.375  
**Generation/Year:** 52,560,000 kWh/year  
**Total Industry Output:** \$3,999,816 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$6,621,693 (\$0.1260/kWh)  
**Employees:** 7  
**Source:** Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.1. IMPLAN Expenditures for Horizontal Axis Wind Turbine Power Plant.**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures
Investment	41	Other New Construction (Foundations, Civil Engineering, Installation & Commissioning, etc.)	\$7,344,000
Investment	285	Turbine & Turbine Generator Set Units Manufacturing (Tower, Wind Turbine/Generator, Power Collection System)	\$11,296,000
Investment	316	Industrial Process Variable Instruments (Electrical/Controls/Instrumentation)	\$5,232,000
Investment	334	Motor & Generator Manufacturing (Rotor Assembly)	\$6,672,000
Investment	394	Truck Transportation (Transportation & Freight)	\$1,280,000
Investment	425	Banking (Project & Process Contingency)	\$288,000
Investment	437	Legal Services (Due Diligence, Permitting, Legal)	\$6,000,000
Investment	439	Architectural & Engineering Services (Engineering)	\$192,000
Investment	442	Computer Systems Design Services (SCADA & Communications)	\$320,000
Operating	485	Commercial Machinery Repair & Maintenance (includes Turbines, BOP, insurance, admin.)	\$880,000
Depreciation	41	Other New Construction (Foundations, Civil engineering, Substation, Metering, Interconnection, Sensors, etc.)	\$367,000
Depreciation	285	Turbine & Turbine Generator Set Units Manufacturing (Tower, Wind Turbine/Generator, Power Collection System)	\$1,129,600
Depreciation	316	Industrial Process Variable Instruments (Electrical/Controls/Instrumentation)	\$523,200
Depreciation	334	Motor & Generator Manufacturing (Rotor Assembly)	\$667,200

\*2006 dollars

**Expenditure Summary for Horizontal Axis Wind Turbine Power Plant**

Expenditure Type	Total \$	\$/kWh
Investment	\$38,624,000	\$0.73
Operating	\$880,000	\$0.02
Depreciation	\$2,687,200	\$0.05

\*2006 dollars

**Conversion Technology:** Large Residential or Small Commercial Solar Photovoltaic  
**Facility Size (Nameplate):** 0.01 MW (dc)  
**Capacity Factor:** 0.152  
**Generation/Year:** 13,315 kWh (dc)/year  
**Total Industry Output:** \$1,013 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$4,885 (\$0.3669/kWh)  
**Employees:** 0  
**Source:** Borenstein, Severin. 2008. "The Market Value and Cost of Solar Photovoltaic Electricity Production". Center for the Study of Energy Markets, University of California Energy Institute; Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.2. IMPLAN Expenditures for Solar Photovoltaic Technology**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Investment	311	Semiconductors & Related Device Manufacturing (Solar Panels)	\$82,863
Operating	485	Commercial Machinery Repair & Maintenance	\$275
Depreciation	311	Semiconductors & Related Device Manufacturing	\$3,836

\*2006 dollars

**Expenditure Summary for Solar Photovoltaic Technology**

Expenditure Type	Total \$*	\$/kWh
Investment	\$82,863	\$6.22
Operating	\$275	\$0.02
Depreciation	\$3,836	\$0.29

\*2006 dollars

**Conversion Technology:** Utility Scale Solar Photovoltaic Power Plant (One-Axis Tracking)  
**Facility Size (Nameplate):** 50 MW  
**Capacity Factor:** 0.305  
**Generation/Year:** 133,590,000 kWh/year  
**Total Industry Output:** \$10,166,199 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$23,700,504 (\$0.1774/kWh)  
**Employees:** 5  
**Source:** Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.3. IMPLAN Expenditures for Utility Scale Solar Photovoltaic Power Plant (One-Axis Tracking)**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Investment	311	Semiconductors & Related Device Manufacturing (Heliostats, Collectors, & Concentrators)	\$154,950,457
Investment	425	Banking (Project & Process Contingency)	\$29,105,109
Investment	439	Architectural & Engineering Services (General Facilities & Engineering Fees)	\$25,751,548
Investment	442	Computer System Design Services (Balance of Plant)	\$61,123,024
Investment	451	Management of Companies & Enterprises (Owner costs)	\$11,268,875
Operating	485	Commercial Machinery Repair & Maintenance	\$441,955
Depreciation	311	Semiconductors & Related Device Manufacturing	\$15,495,046

\*2006 dollars

**Expenditure Summary for Utility Scale Solar Photovoltaic Power Plant (One-Axis Tracking)**

Expenditure Type	Total \$*	\$/kWh
Investment	\$282,199,014	\$2.11
Operating	\$441,955	\$0.003
Depreciation	\$15,495,046	\$0.12

\*2006 dollars

**Conversion Technology:** Landfill Gas  
**Facility Size (Nameplate):** 4.6 MW  
**Capacity Factor:** 0.856  
**Generation/Year:** 34,457,555 kWh/year  
**Total Industry Output:** \$2,622,220 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$3,009,451 (\$0.0873/kWh)  
**Employees:** 30  
**Source:** Environmental Protection Agency, Landfill Methane Outreach Program. 2005. Documents, Tools, and Resources. Energy Project Landfill Gas Utilization Software (E-Plus).

**Table B.4.. IMPLAN Expenditures for Landfill Gas**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Investment	41	Other New Construction (Electricity Generation Installation & Other Costs, Gas Treatment Installation & Other Costs, Inter Connect Installation & Other Costs)	\$2,041,998
Investment	205	Iron, Steel Pipe & Tube from Purchased Steel (Pipe)	\$1,687,370
Investment	239	Metal Tank, Heavy Gauge, Manufacturing (Condensate Knockout)	\$112,638
Investment	261	Oil & Gas Field Machinery & Equipment (Well & Well Heads)	\$775,457
Investment	275	Air Purification Equipment Manufacturing (Filters)	\$16,577
Investment	276	Industrial & Commercial Fan and Blower Manufacturing (Blowers)	\$51,696
Investment	277	Heating Equipment, except Warm Air Furnaces (Radiator Costs)	\$238,008
Investment	289	Air & Gas Compressor Manufacturing (Compressor)	\$92,700
Investment	298	Industrial Process Furnace & Oven Manufacturing (Flares)	\$76,340
Investment	316	Industrial Process Variable Instruments (Monitor)	\$1,021
Investment	333	Electric Power & Specialty Transformer Manufacturing (Substation Costs & Intertie Wiring Costs)	\$320,985
Investment	336	Relay & Industrial Control Manufacturing (Protective Relays Costs)	\$47,099
Investment	341	Wiring Device Manufacturing (System Disconnect Costs)	\$99,182
Investment	350	Motor Vehicle Parts Manufacturing (IC Low Engine & Engineer Wiring Costs)	\$2,087,201
Investment	442	Computer Systems Design Services (Substation Telemetry Costs)	\$10,025
Operating	485	Commercial Machinery Repair & Maintenance (Collection System Variable O&M, Compression System Variable O&M,)	\$989,521

**Table B.4.. IMPLAN Expenditures for Landfill Gas**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Depreciation	41	Other New Construction (Electricity Generation Installation & Other Costs, Gas Treatment Installation & Other Costs, Inter Connect Installation & Other Costs)	\$204,200
Depreciation	205	Iron, Steel Pipe & Tube from Purchased Steel (Pipe)	\$168,737
Depreciation	239	Metal Tank, Heavy Gauge, Manufacturing (Condensate Knockout)	\$11,264
Depreciation	261	Oil & Gas Field Machinery & Equipment (Well & Well Heads)	\$77,546
Depreciation	275	Air Purification Equipment Manufacturing (Filters)	\$1,658
Depreciation	276	Industrial & Commercial Fan and Blower Manufacturing (Blowers)	\$5,170
Depreciation	277	Heating Equipment, except Warm Air Furnaces (Radiator Costs)	\$23,801
Depreciation	289	Air & Gas Compressor Manufacturing (Compressor)	\$9,270
Depreciation	298	Industrial Process Furnace & Oven Manufacturing (Flares)	\$7,634
Depreciation	316	Industrial Process Variable Instruments (Monitor)	\$102
Depreciation	333	Electric Power & Specialty Transformer Manufacturing (Substation Costs & Intertie Wiring Costs)	\$32,098
Depreciation	336	Relay & Industrial Control Manufacturing (Protective Relays Costs)	\$4,710
Depreciation	341	Wiring Device Manufacturing (System Disconnect Costs)	\$9,918
Depreciation	350	Motor Vehicle Parts Manufacturing (IC Low Engine & Engineer Wiring Costs)	\$208,720

\*2006 dollars

**Expenditure Summary for Landfill Gas**

Expenditure Type	Total \$*	\$/kWh
Investment	\$7,658,297	\$0.22
Operating	\$989,521	\$0.03
Depreciation	\$764,827	\$0.02

\*2006 dollars

**Conversion Technology:** Co-fire (10%) of Cattle Feedlot Biomass with Coal (Feedlot Size 15,111 head)

**Facility Size (Nameplate):** 10.5 MW

**Capacity Factor:** 0.800

**Generation/Year:** 73,233,600 kWh/year

**Feedstock kWh/ton:** 2,019.3

**Total Industry Output:** \$5,573,077 (\$0.0761/kWh)

**Breakeven Total Industry Output:** \$6,580,339 (\$0.0899/kWh)

**Employees:** 7

**Source:** Sweeten J., K. Annamalai, K. Heflin, and M. Freeman. 2002. "Cattle Feedlot Manure Quality for Combustion in Coal/Manure Blends". Presented at the 2002 ASAE Annual International Meeting, Chicago. Paper No. 024092; English, B., J. Menard, M. Walsh, and K. Jensen. 2004. "Economic Impacts of Using Alternative Feedstocks in Coal-Fired Plants in the Southeastern United States".

**Table B.5. IMPLAN Expenditures for Co-fire (10%) of Cattle Feedlot Biomass with Coal (Feedlot Size 15,111 head).**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures
Investment	41	Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical)	\$2,346,421
Investment	232	Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom)	\$75,243
Investment	292	Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.)	\$522,830
Investment	298	Industrial Process Furnace & Oven Manufacturing (Modification at Burners)	\$34,209
Investment	316	Industrial Process Variable Instruments (Controls)	\$165,213
Investment	346	Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder)	\$123,326
Investment	425	Banking (Contingency (30%))	\$907,930
Investment	439	Architectural & Engineering Services (Engineering @ 10%)	\$389,953
Operating	11	Cattle Ranching/Farming (Feedstock)	\$725,351
Operating	18	Agriculture & Forestry Support Activities	\$179,715
Operating	407	Gasoline Stations (Fuel/Lube)	\$71,608
Operating	425	Banking (Depreciation & Capital)	\$338,257
Operating	485	Commercial Machinery Repair & Maintenance (Repair)	\$688,519
Depreciation	41	Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical)	\$234,642
Depreciation	232	Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom)	\$3,762
Depreciation	292	Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.)	\$52,283
Depreciation	298	Industrial Process Furnace & Oven Manufacturing (Modification at Burners)	\$3,421
Depreciation	316	Industrial Process Variable Instruments (Controls)	\$16,521
Depreciation	346	Motor Vehicle Body Manufacturing (Truck)	\$12,333

**Table B.5. IMPLAN Expenditures for Co-fire (10%) of Cattle Feedlot Biomass with Coal (Feedlot Size 15,111 head).**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures
		Tipper with Hopper and Feeder)	

\*2006 dollars

**Expenditure Summary for Co-fire (10%) of Cattle Feedlot Biomass with Coal (Feedlot Size 15,111 head)**

Expenditure Type	Total \$	\$/kWh
Investment	\$4,565,125	\$0.06
Operating	\$2,003,450	\$0.03
Operating w/out Feedstock Expenditures	\$282,178	\$0.004
Depreciation	\$322,962	\$0.004

\*2006 dollars

**Conversion Technology:** Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal  
**Facility Size (Co-fire Nameplate):** 15.6 MW  
**Capacity Factor:** 0.800  
**Generation/Year:** 109,850,400 kWh/year  
**Feedstock kWh/ton:** 1,585.0  
**Total Industry Output:** \$8,359,615 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$10,800,915 (\$0.0983/kWh)  
**Employees:** 7  
**Source:** English, B., J. Menard, M. Walsh, and K. Jensen. 2004. "Economic Impacts of Using Alternative Feedstocks in Coal-Fired Plants in the Southeastern United States".

**Table B.6. IMPLAN Expenditures for: Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Investment	41	Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical)	\$2,346,421
Investment	232	Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom)	\$75,243
Investment	292	Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.)	\$522,830
Investment	298	Industrial Process Furnace & Oven Manufacturing (Modification at Burners)	\$34,209
Investment	316	Industrial Process Variable Instruments (Controls)	\$165,213
Investment	346	Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder)	\$123,326
Investment	425	Banking (Contingency (30%))	\$907,930
Investment	439	Architectural & Engineering Services (Engineering @ 10%)	\$389,953
Operating	14	Logging (Feedstock)	\$3,811,885
Operating	485	Commercial Machinery Repair & Maintenance	\$282,178
Depreciation	41	Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical)	\$234,642
Depreciation	232	Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom)	\$3,762
Depreciation	292	Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.)	\$52,283
Depreciation	298	Industrial Process Furnace & Oven Manufacturing (Modification at Burners)	\$3,421
Depreciation	316	Industrial Process Variable Instruments (Controls)	\$16,521
Depreciation	346	Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder)	\$12,333

\*2006 dollars

**Expenditure Summary for Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal**

Expenditure Type	Total \$*	\$/kWh
Investment	\$4,565,125	\$0.04
Operating	\$4,094,063	\$0.04
Operating w/out Feedstock Expenditure	\$282,178	\$0.003
Depreciation	\$322,962	\$0.003

\*2006 dollars

**Conversion Technology:** Wood Fired Power Plant  
**Facility Size (Nameplate):** 25 MW  
**Capacity Factor:** 0.800  
**Generation/Year:** 175,200,000 kWh/year  
**Feedstock kWh/ton:** 1,688.1  
**Total Industry Output:** \$13,332,720 (\$0.0761/kWh)  
**Breakeven Total Industry Output:** \$20,627,246 (\$0.1177/kWh)  
**Employees:** 26  
**Source:** Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.7. IMPLAN Expenditures for Wood Fired Power Plant**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
Investment	37	Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack)	\$11,863,878
Investment	161	Paint & Coating Manufacturing (Paint)	\$148,500
Investment	203	Iron & Steel Mills (Structural Steel)	\$4,198,787
Investment	240	Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin)	\$22,892
Investment	259	Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2)	\$1,164,724
Investment	273	Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant)	\$163,847
Investment	277	Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X))	\$617,701
Investment	278	AC, Refrigeration, & Forced Air Heating (Cooling Tower)	\$2,649,048
Investment	285	Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set)	\$17,510,303
Investment	292	Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor)	\$246,019
Investment	315	Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS)	\$1,472,982
Investment	316	Industrial Process Variable Instruments (Instrumentation)	\$2,121,239
Investment	346	Motor Vehicle Body Manufacturing (Truck Scale/Unloader)	\$115,288
Investment	425	Banking (Contingency Fee)	\$12,347,492
Investment	451	Management of Companies & Enterprises (Home Office Expense (w/Overhead), Field Expenses (w/Overhead), Contractor Fees)	\$18,719,831
Operating	14	Logging (Feedstock)	\$4,670,370
Operating	485	Commercial Machinery Repair & Maintenance	\$2,348,845

**Table B.7. IMPLAN Expenditures for Wood Fired Power Plant**

Type	IMPLAN Sector	IMPLAN Sector Description	Expenditures*
		(Maintenance)	
Depreciation	37	Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack)	\$593,194
Depreciation	161	Paint & Coating Manufacturing (Paint)	\$14,850
Depreciation	203	Iron & Steel Mills (Structural Steel)	\$209,939
Depreciation	240	Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin)	\$2,289
Depreciation	259	Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2)	\$116,472
Depreciation	273	Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant)	\$16,385
Depreciation	277	Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X))	\$61,770
Depreciation	278	AC, Refrigeration, & Forced Air Heating (Cooling Tower)	\$264,905
Depreciation	285	Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set)	\$1,751,030
Depreciation	292	Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor)	\$24,602
Depreciation	315	Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS)	\$147,298
Depreciation	316	Industrial Process Variable Instruments (Instrumentation)	\$212,124
Depreciation	346	Motor Vehicle Body Manufacturing (Truck Scale/Unloader)	\$11,529

**Expenditure Summary for Wood Fired Power Plant**

Expenditure Type	Total \$*	\$/kWh
Investment	\$73,362,531	\$0.42
Operating	\$7,019,215	\$0.04
Operating w/out Feedstock Expenditure	\$2,348,845	\$0.01
Depreciation	\$3,426,388	\$0.02

\*2006 dollars

**APPENDIX C**  
**ECONOMIC IMPACTS FROM ADDITIONAL RENEWABLE ENERGY FACILITIES**

**Table C.1. Total Industry Output from Investment in Additional Renewable Energy Under the CO RES, 25% RES, and The Bingaman Proposal\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$124,862,442	\$253,328,407	\$124,862,442	\$253,328,407	\$124,862,442	\$253,328,407
Denver-Aurora-Boulder	\$2,229,901,963	\$4,617,121,518	\$2,229,901,963	\$4,617,121,518	\$2,229,901,963	\$4,617,121,518
Durango	\$0	\$0	\$0	\$0	\$23,389,099	\$41,846,075
Grand Junction	\$68,689,048	\$132,828,298	\$68,689,048	\$132,828,298	\$123,689,010	\$238,567,620
Pueblo	\$388,550,500	\$603,347,917	\$388,550,500	\$603,347,917	\$388,550,500	\$603,347,917
Colorado	\$3,065,361,506	\$6,739,232,830	\$3,065,361,506	\$6,739,232,830	\$3,200,747,261	\$7,008,534,641
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$53,956,681	\$109,470,550	\$53,956,681	\$109,470,550	\$53,956,681	\$109,470,550
Denver-Aurora-Boulder	\$314,533,003	\$744,944,076	\$314,533,003	\$744,944,076	\$314,533,003	\$744,944,076
Durango	\$130,978,952	\$234,338,020	\$130,978,952	\$234,338,020	\$159,045,870	\$284,553,310
Grand Junction	\$294,999,794	\$567,147,276	\$294,999,794	\$567,147,276	\$359,999,748	\$692,111,930
Pueblo	\$6,877,000	\$10,678,724	\$6,877,000	\$10,678,724	\$6,877,000	\$10,678,724
Colorado	\$1,147,097,745	\$2,554,149,169	\$1,147,097,745	\$2,554,149,169	\$1,298,411,235	\$2,855,133,546
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$285,810,966	\$559,032,973	\$285,810,966	\$559,032,973	\$285,810,966	\$559,032,973
Denver-Aurora-Boulder	\$76,910,891	\$176,707,437	\$76,910,891	\$176,707,437	\$76,910,891	\$176,707,437
Durango	\$32,744,738	\$58,584,505	\$378,903,396	\$677,906,415	\$210,501,887	\$376,614,675
Grand Junction	\$79,999,944	\$153,802,651	\$844,999,409	\$1,624,540,503	\$469,999,671	\$903,590,576
Pueblo	\$6,877,000	\$10,678,724	\$6,877,000	\$10,678,724	\$6,877,000	\$10,678,724
Colorado	\$544,747,457	\$1,264,643,295	\$2,381,643,505	\$4,918,974,770	\$1,497,654,168	\$3,160,592,357

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.2. Employment From Investment in Additional Renewable Energy Under the CO RES, 25% RES, and 20% RES\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	167	1,172	167	1,172	167	1,172
Denver-Aurora-Boulder	8,285	24,998	8,285	24,998	8,285	24,998
Durango	0	0	0	0	187	357
Grand Junction	534	1,057	534	1,057	875	1,804
Pueblo	2,355	4,544	2,355	4,544	2,355	4,544
Colorado	11,534	37,227	11,534	37,227	12,114	38,790
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	72	507	72	507	72	507
Denver-Aurora-Boulder	632	3,494	632	3,494	632	3,494
Durango	1,046	2,001	1,046	2,001	1,271	2,430
Grand Junction	1,830	4,008	1,830	4,008	2,233	4,891
Pueblo	42	80	42	80	42	80
Colorado	3,821	13,575	3,821	13,575	4,469	15,322
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	1,405	3,632	1,405	3,632	1,405	3,632
Denver-Aurora-Boulder	171	839	171	839	171	839
Durango	262	500	3,027	5,789	1,682	3,216
Grand Junction	496	1,087	5,241	11,480	2,915	6,385
Pueblo	42	80	42	80	42	80
Colorado	2,308	7,598	10,054	28,476	6,266	18,267

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.3. Value-Added From Investment in Additional Renewable Energy Under the CO RES, 25% RES, and 20% RES\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$13,987,099	\$82,522,709	\$13,987,099	\$82,522,709	\$13,987,099	\$82,522,709
Denver-Aurora-Boulder	\$877,570,305	\$2,260,506,038	\$877,570,305	\$2,260,506,038	\$877,570,305	\$2,260,506,038
Durango	\$0	\$0	\$0	\$0	\$12,243,923	\$22,985,489
Grand Junction	\$35,819,932	\$72,430,420	\$35,819,932	\$72,430,420	\$67,526,842	\$133,420,351
Pueblo	\$167,293,664	\$293,625,144	\$167,293,664	\$293,625,144	\$167,293,664	\$293,625,144
Colorado	\$1,109,576,617	\$3,181,830,419	\$1,109,576,617	\$3,181,830,419	\$1,176,090,869	\$3,326,099,495
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$6,044,231	\$35,660,455	\$6,044,231	\$35,660,455	\$6,044,231	\$35,660,455
Denver-Aurora-Boulder	\$59,256,820	\$306,894,403	\$59,256,820	\$306,894,403	\$59,256,820	\$306,894,403
Durango	\$68,565,966	\$128,718,738	\$68,565,966	\$128,718,738	\$83,258,673	\$156,301,325
Grand Junction	\$170,064,332	\$327,127,813	\$170,064,332	\$327,127,813	\$207,536,134	\$399,206,822
Pueblo	\$2,960,950	\$5,196,905	\$2,960,950	\$5,196,905	\$2,960,950	\$5,196,905
Colorado	\$414,222,403	\$1,210,474,684	\$414,222,403	\$1,210,474,684	\$488,561,862	\$1,371,716,592
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$114,631,201	\$269,101,225	\$114,631,201	\$269,101,225	\$114,631,201	\$269,101,225
Denver-Aurora-Boulder	\$17,640,922	\$75,107,416	\$17,640,922	\$75,107,416	\$17,640,922	\$75,107,416
Durango	\$17,141,492	\$32,179,685	\$198,351,545	\$372,364,922	\$110,195,303	\$206,869,401
Grand Junction	\$46,119,141	\$88,712,627	\$487,133,425	\$937,027,125	\$270,949,952	\$521,186,685
Pueblo	\$2,960,950	\$5,196,905	\$2,960,950	\$5,196,905	\$2,960,950	\$5,196,905
Colorado	\$215,686,584	\$624,373,388	\$1,117,272,069	\$2,580,995,960	\$682,973,124	\$1,639,003,762

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.4. Total Industry Output From Year-to-Year Operations of Additional Renewable Energy Under the CO RES, 25% RES, and 20% RES\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$8,481,343	\$19,805,986	\$8,481,343	\$19,805,986	\$8,481,343	\$19,805,986
Denver-Aurora-Boulder	\$331,097,487	\$614,212,894	\$331,097,487	\$614,212,894	\$331,097,487	\$614,212,894
Durango	\$1,711,464	\$1,981,784	\$1,711,464	\$1,981,784	\$12,405,135	\$22,143,743
Grand Junction	\$172,858,132	\$383,792,321	\$172,858,132	\$383,792,321	\$196,384,208	\$432,554,527
Pueblo	\$80,339,762	\$121,180,757	\$80,339,762	\$121,180,757	\$80,339,762	\$121,180,757
Colorado	\$594,488,694	\$1,225,557,215	\$594,488,694	\$1,225,557,215	\$630,847,175	\$1,301,361,011
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$12,146,377	\$28,364,727	\$12,146,377	\$28,364,727	\$12,146,377	\$28,364,727
Denver-Aurora-Boulder	\$388,919,554	\$723,637,862	\$388,919,554	\$723,637,862	\$388,919,554	\$723,637,862
Durango	\$62,421,110	\$115,844,165	\$62,421,110	\$115,844,165	\$88,085,920	\$164,232,868
Grand Junction	\$302,302,270	\$649,300,335	\$302,302,270	\$649,300,335	\$353,631,891	\$755,690,603
Pueblo	\$82,889,501	\$124,618,562	\$82,889,501	\$124,618,562	\$82,889,501	\$124,618,562
Colorado	\$848,678,812	\$1,773,959,840	\$848,678,812	\$1,773,959,840	\$925,673,243	\$1,934,485,525
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$37,420,208	\$83,560,801	\$37,420,208	\$83,560,801	\$37,420,208	\$83,560,801
Denver-Aurora-Boulder	\$396,164,322	\$736,491,333	\$396,164,322	\$736,491,333	\$396,164,322	\$736,491,333
Durango	\$79,732,570	\$148,336,727	\$235,860,167	\$442,701,336	\$184,530,546	\$345,923,931
Grand Junction	\$335,301,061	\$716,910,988	\$664,666,128	\$1,399,581,869	\$553,451,950	\$1,169,069,624
Pueblo	\$83,791,333	\$125,909,780	\$83,791,333	\$125,909,780	\$83,791,333	\$125,909,780
Colorado	\$932,409,494	\$1,962,908,350	\$1,417,902,158	\$2,975,111,974	\$1,255,358,358	\$2,636,224,417

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.5. Employment From Year-to-Year Operations of Additional Renewable Energy Under the CO RES, 25% RES, and 20% RES\***

BEA Region/State	CO RES		25% RES		20% RES	
	Direct	Total	Direct	Total	Direct	Total
	<i>2015</i>					
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	373	2,127	373	2,127	373	2,127
Durango	0	0	0	0	13	95
Grand Junction	141	1,644	141	1,644	169	1,857
Pueblo	79	469	79	469	79	469
Colorado	593	4,367	593	4,367	637	4,688
	<i>2020</i>					
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	414	2,456	414	2,456	414	2,456
Durango	73	530	73	530	104	757
Grand Junction	294	2,785	294	2,785	356	3,249
Pueblo	81	477	81	477	81	477
Colorado	861	6,408	861	6,408	955	7,087
	<i>2025</i>					
Colorado Springs	5	158	5	158	5	158
Denver-Aurora-Boulder	417	2,480	417	2,480	417	2,480
Durango	94	681	283	2,062	221	1,608
Grand Junction	333	3,075	733	6,054	598	5,048
Pueblo	81	481	81	481	81	481
Colorado	930	7,076	1,520	11,362	1,323	9,927

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.6. Value-Added From Year-to-Year Operations of Additional Renewable Energy Under the CO RES, 25% RES, and 20% RES\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$1,344,624	\$5,386,867	\$1,344,624	\$5,386,867	\$1,344,624	\$5,386,867
Denver-Aurora-Boulder	\$143,350,700	\$294,195,496	\$143,350,700	\$294,195,496	\$143,350,700	\$294,195,496
Durango	\$271,334	\$420,348	\$271,334	\$420,348	\$5,549,748	\$9,718,490
Grand Junction	\$98,686,588	\$185,905,802	\$98,686,588	\$185,905,802	\$110,299,099	\$208,733,451
Pueblo	\$36,224,807	\$59,115,109	\$36,224,807	\$59,115,109	\$36,224,807	\$59,115,109
Colorado	\$279,878,132	\$586,597,477	\$279,878,132	\$586,597,477	\$297,824,740	\$622,573,511
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$1,925,674	\$7,714,688	\$1,925,674	\$7,714,688	\$1,925,674	\$7,714,688
Denver-Aurora-Boulder	\$171,209,976	\$348,463,193	\$171,209,976	\$348,463,193	\$171,209,976	\$348,463,193
Durango	\$29,961,261	\$52,692,593	\$29,961,261	\$52,692,593	\$42,629,454	\$75,008,135
Grand Junction	\$161,488,524	\$309,252,852	\$161,488,524	\$309,252,852	\$186,824,911	\$359,058,634
Pueblo	\$37,044,754	\$60,436,385	\$37,044,754	\$60,436,385	\$37,044,754	\$60,436,385
Colorado	\$401,630,188	\$844,005,303	\$401,630,188	\$844,005,303	\$439,634,769	\$920,189,846
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$10,086,230	\$27,070,520	\$10,086,230	\$27,070,520	\$10,086,230	\$27,070,520
Denver-Aurora-Boulder	\$173,397,838	\$353,434,897	\$173,397,838	\$353,434,897	\$173,397,838	\$353,434,897
Durango	\$38,438,683	\$67,619,132	\$115,503,527	\$203,372,013	\$90,167,140	\$158,740,929
Grand Junction	\$177,469,269	\$340,637,139	\$340,044,421	\$660,224,237	\$285,148,915	\$552,311,711
Pueblo	\$37,395,586	\$61,006,065	\$37,395,586	\$61,006,065	\$37,395,586	\$61,006,065
Colorado	\$436,787,606	\$925,888,141	\$676,427,602	\$1,406,274,008	\$596,195,709	\$1,245,439,973

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.



**Table C.7. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, 2015, 2020, 2025, Continued**

Region Name	CO RES			25% RES			20% RES		
	2015	2020	2025	2015	2020	2025	2015	2020	2025
<i>Wind</i>									
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$488,305,145	\$494,713,349	\$501,121,553	\$488,305,145	\$494,713,349	\$501,121,553	\$488,305,145	\$494,713,349	\$501,121,553
Durango	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$118,019,426	\$120,108,266	\$121,152,685	\$118,019,426	\$120,108,266	\$121,152,685	\$118,019,426	\$120,108,266	\$121,152,685
Colorado	\$640,404,359	\$649,478,915	\$657,257,106	\$640,404,359	\$649,478,915	\$657,257,106	\$640,404,359	\$649,478,915	\$657,257,106
<i>Co-Fire Wood</i>									
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Durango	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087	\$367,981,087
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456	\$351,667,456
<i>Co-Fire Manure</i>									
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$38,151,123	\$110,365,748	\$110,365,748	\$38,151,123	\$110,365,748	\$110,365,748	\$38,151,123	\$110,365,748	\$110,365,748
Durango	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$40,840,688	\$118,146,276	\$118,146,276	\$40,840,688	\$118,146,276	\$118,146,276	\$40,840,688	\$118,146,276	\$118,146,276

**Table C.7. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, 2015, 2020, 2025, Continued**

Region Name	CO RES			25% RES			20% RES		
	2015	2020	2025	2015	2020	2025	2015	2020	2025
<i>Direct Fire Wood</i>									
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Durango	\$0	\$112,906,973	\$145,166,108	\$0	\$112,906,973	\$439,530,717	\$20,161,960	\$161,295,676	\$342,753,312
Grand Junction	\$0	\$261,542,740	\$328,036,657	\$0	\$261,542,740	\$1,010,707,538	\$48,762,206	\$367,933,007	\$780,195,293
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$0	\$387,937,072	\$490,495,148	\$0	\$387,937,072	\$1,502,698,772	\$75,803,796	\$548,462,756	\$1,163,811,215
Region Name	<i>Total</i>								
Colorado Springs	\$19,805,986	\$28,364,727	\$83,560,801	\$19,805,986	\$28,364,727	\$83,560,801	\$19,805,986	\$28,364,727	\$83,560,801
Denver-Aurora-Boulder	\$614,212,894	\$723,637,862	\$736,491,333	\$614,212,894	\$723,637,862	\$736,491,333	\$614,212,894	\$723,637,862	\$736,491,333
Durango	\$1,981,784	\$115,844,165	\$148,336,727	\$1,981,784	\$115,844,165	\$442,701,336	\$22,143,743	\$164,232,868	\$345,923,931
Grand Junction	\$383,792,321	\$649,300,335	\$716,910,988	\$383,792,321	\$649,300,335	\$1,399,581,869	\$432,554,527	\$755,690,603	\$1,169,069,624
Pueblo	\$121,180,757	\$124,618,562	\$125,909,780	\$121,180,757	\$124,618,562	\$125,909,780	\$121,180,757	\$124,618,562	\$125,909,780
Colorado	\$1,225,557,215	\$1,773,959,840	\$1,962,908,350	\$1,225,557,215	\$1,773,959,840	\$2,975,111,974	\$1,301,361,011	\$1,934,485,525	\$2,636,224,417

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.8. Total Industry Output from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$2,105,824	\$4,532,413	\$2,105,824	\$4,532,413	\$2,105,824	\$4,532,413
Durango	\$0	\$0	\$0	\$0	\$2,421,235	\$4,565,021
Grand Junction	\$63,107,654	\$116,771,009	\$63,107,654	\$116,771,009	\$68,434,370	\$127,811,626
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$65,213,478	\$120,630,350	\$65,213,478	\$120,630,350	\$74,278,618	\$137,244,373
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$6,091,848	\$13,111,624	\$6,091,848	\$13,111,624	\$6,091,848	\$13,111,624
Durango	\$13,558,913	\$25,564,118	\$13,558,913	\$25,564,118	\$19,369,876	\$36,520,168
Grand Junction	\$91,678,221	\$175,988,866	\$28,570,567	\$59,217,858	\$103,300,147	\$200,077,486
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$115,591,687	\$215,062,060	\$115,591,687	\$215,062,060	\$134,788,453	\$250,244,698
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$6,091,848	\$13,111,624	\$6,091,848	\$13,111,624	\$6,091,848	\$13,111,624
Durango	\$17,432,888	\$32,868,151	\$52,782,912	\$99,517,458	\$41,160,987	\$77,605,357
Grand Junction	\$98,941,925	\$191,044,254	\$173,515,947	\$345,612,899	\$148,335,108	\$293,420,889
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$127,856,287	\$237,539,857	\$248,902,562	\$459,385,935	\$208,376,056	\$385,111,477

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.9. Employment from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	9	24	9	24	9	24
Durango	0	0	0	0	3	21
Grand Junction	274	750	274	750	281	798
Pueblo	0	0	0	0	0	0
Colorado	297	735	297	735	338	835
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	27	70	27	70	27	70
Durango	17	120	17	120	24	172
Grand Junction	309	1,008	309	1,008	323	1,113
Pueblo	0	0	0	0	0	0
Colorado	530	1,312	530	1,312	617	1,525
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	27	70	27	70	27	70
Durango	21	154	64	468	50	365
Grand Junction	318	1,074	409	1,748	378	1,521
Pueblo	0	0	0	0	0	0
Colorado	585	1,448	1,130	2,792	948	2,342

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.10. Value-Added from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora- Boulder	\$211,408	\$1,384,264	\$211,408	\$1,384,264	\$211,408	\$1,384,264
Durango	\$0	\$0	\$0	\$0	\$1,195,126	\$2,105,263
Grand Junction	\$9,314,699	\$32,250,726	\$9,314,699	\$32,250,726	\$11,943,975	\$37,419,306
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$7,606,797	\$32,318,344	\$7,606,797	\$32,318,344	\$8,669,112	\$36,729,452
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora- Boulder	\$611,574	\$4,004,478	\$611,574	\$4,004,478	\$611,574	\$4,004,478
Durango	\$6,692,703	\$11,789,470	\$6,692,703	\$11,789,470	\$9,561,004	\$16,842,100
Grand Junction	\$23,417,179	\$59,973,109	\$23,417,179	\$59,973,109	\$29,153,782	\$71,250,011
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$13,443,509	\$57,938,602	\$13,443,509	\$57,938,602	\$15,693,117	\$67,279,770
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora- Boulder	\$611,574	\$4,004,478	\$611,574	\$4,004,478	\$611,574	\$4,004,478
Durango	\$8,604,904	\$15,157,890	\$26,053,736	\$45,894,723	\$20,317,134	\$35,789,463
Grand Junction	\$27,002,556	\$67,021,173	\$63,812,421	\$139,381,291	\$51,383,116	\$114,948,004
Pueblo	\$0	\$0	\$0	\$0	\$0	\$0
Colorado	\$14,880,759	\$63,906,570	\$29,065,784	\$122,807,827	\$24,316,613	\$103,087,582

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.11. Total Industry Output from Wind Lease Payments on Farmland Under the Three Policy Scenarios, 2015, 2020, and 2025\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$1,193,708	\$2,058,096	\$1,193,708	\$2,058,096	\$1,193,708	\$2,058,096
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$351,693	\$471,459	\$351,693	\$471,459	\$351,693	\$471,459
Colorado	\$1,548,034	\$2,378,885	\$1,548,034	\$2,378,885	\$1,548,034	\$2,378,885
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$1,210,264	\$2,086,640	\$1,210,264	\$2,086,640	\$1,210,264	\$2,086,640
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$356,573	\$478,001	\$356,573	\$478,001	\$356,573	\$478,001
Colorado	\$1,569,503	\$2,776,870	\$1,569,503	\$2,776,870	\$1,569,503	\$2,776,870
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$1,226,820	\$2,115,185	\$1,226,820	\$2,115,185	\$1,226,820	\$2,115,185
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$361,449	\$484,537	\$361,449	\$484,537	\$361,449	\$484,537
Colorado	\$1,590,971	\$2,814,853	\$1,590,971	\$2,814,853	\$1,590,971	\$2,814,853

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**Table C.12. Employment from Wind Lease Payments on Farmland Under the Three Policy Scenarios, 2015, 2020, and 2025 \***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	7	13	7	13	7	13
Durango	0	0	0	0	0	0
Grand Junction	0	0	0	0	0	0
Pueblo	2	3	2	3	2	3
Colorado	9	18	9	18	9	18
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	7	13	7	13	7	13
Durango	0	0	0	0	0	0
Grand Junction	0	0	0	0	0	0
Pueblo	2	3	2	3	2	3
Colorado	9	18	9	18	9	18
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	0	0	0	0	0	0
Denver-Aurora-Boulder	7	13	7	13	7	13
Durango	0	0	0	0	0	0
Grand Junction	0	0	0	0	0	0
Pueblo	2	3	2	3	2	3
Colorado	9	18	9	18	9	18

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.13. Value-Added from Wind Lease Payments on Farmland Under the Three Policy Scenarios, 2015, 2020, and 2025\***

BEA Region/State	CO RES		25% RES		20% RES	
	<i>2015</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$502,286	\$1,008,695	\$502,286	\$1,008,695	\$502,286	\$1,008,695
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$122,826	\$196,424	\$122,826	\$196,424	\$122,826	\$196,424
Colorado	\$646,537	\$1,338,601	\$646,537	\$1,338,601	\$646,537	\$1,338,601
	<i>2020</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$509,252	\$1,022,685	\$509,252	\$1,022,685	\$509,252	\$1,022,685
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$124,531	\$199,149	\$124,531	\$199,149	\$124,531	\$199,149
Colorado	\$655,503	\$1,357,166	\$655,503	\$1,357,166	\$655,503	\$1,357,166
	<i>2025</i>					
	Direct	Total	Direct	Total	Direct	Total
Colorado Springs	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder	\$516,219	\$1,036,675	\$516,219	\$1,036,675	\$516,219	\$1,036,675
Durango	\$0	\$0	\$0	\$0	\$0	\$0
Grand Junction	\$0	\$0	\$0	\$0	\$0	\$0
Pueblo	\$126,233	\$201,873	\$126,233	\$201,873	\$126,233	\$201,873
Colorado	\$664,470	\$1,375,730	\$664,470	\$1,375,730	\$664,470	\$1,375,730

\* Some Colorado numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in \$2009.

**APPENDIX D:  
COLORADO AGRICULTURAL ECONOMIC ACTIVITY FOR SELECTED  
RES SCENARIOS BY BEA**

**Table D.1. Economic activity for Colorado's Agricultural and State Economy, 2006**

State/Adjusted BEA Region	Direct Economic Activity <sup>a</sup>						Proportion of Agriculture to Total Economy	Number of Farms <sup>b</sup> Number
	Total State	Agricultural	Logging	Fishing	Hunting/ Trapping	Total Ag/For		
	Million 2006 \$						Proportion	
Colorado	\$442,995.7	\$5,903.8	\$185.0	\$4.0	\$12.5	\$6,105.4	0.014	37,054
Colorado Springs 36	\$47,429.8	\$467.2	\$7.8	\$0.0	\$0.3	\$475.3	0.010	4,513
Denver-Aurora-Boulder 45	\$340,183.3	\$3,412.6	\$92.1	\$4.0	\$2.6	\$3,511.4	0.010	15,788
Durango 56	\$7,805.8	\$550.3	\$35.4	\$0.0	\$1.9	\$587.5	0.075	4,544
Grand Junction 45	\$36,810.9	\$740.4	\$48.1	\$0.0	\$2.8	\$791.3	0.021	7,448
Pueblo 132	\$10,770.0	\$733.3	\$1.7	\$0.0	\$4.9	\$739.9	0.069	4,761

Sources: <sup>a</sup> Data developed from IMPLAN data bases; <sup>b</sup> 2007 Census of Agriculture

**Table D.2. Projected Economic impacts as a Result of Selected renewable Electricity Standards, Colorado, by BEA region, 2015, 2020, and 2025**

State/Adjusted BEA Region	Study Scenarios (Direct Ag/For Feedstocks Plus Wind (\$2009))								
	2015			2020			2025		
	CO RES	25% RES	20% RES	CO RES	25% RES	20% RES	CO RES	25% RES	20% RES
Colorado	\$404,378,910	\$404,378,910	\$413,444,050	\$459,563,107	\$459,563,107	\$478,459,873	\$475,947,125	\$596,993,400	\$556,466,894
Colorado Springs 36	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Denver-Aurora-Boulder 45	\$263,688,880	\$263,688,880	\$263,688,880	\$271,107,752	\$271,107,752	\$271,107,752	\$274,540,601	\$274,540,601	\$274,540,601
Durango 56	\$0	\$0	\$2,421,235	\$13,558,913	\$13,558,913	\$19,369,876	\$17,432,888	\$52,782,912	\$41,160,987
Grand Junction 45	\$63,107,654	\$63,107,654	\$68,434,370	\$91,678,221	\$28,570,567	\$103,300,147	\$98,941,925	\$173,515,947	\$148,335,108
Pueblo 132	\$77,582,376	\$77,582,376	\$77,582,376	\$78,955,516	\$78,955,516	\$78,955,516	\$79,642,085	\$79,642,085	\$79,642,085

**Table D.3. Estimated 2007 Gross Receipts per Farm and Estimated Potential per Farm Economic Impacts of Selected RES scenarios for Colorado by BEA, 2015, 2020, and 2025**

	2007 Agricultural Gross Receipts	2015			2020			2025		
		<i>CO RES</i>	<i>25% RES</i>	<i>20% RES</i>	<i>Co RES</i>	<i>25% RES</i>	<i>20% RES</i>	<i>Co RES</i>	<i>25% RES</i>	<i>20% RES</i>
Dollars per farm										
Colorado	186,680	7,642	7,642	7,814	8,685	8,685	9,042	8,995	11,283	10,517
Colorado Springs 36	58,799	-	-	-	-	-	-	-	-	-
Denver-Aurora- Boulder 45	279,288	4,983	4,983	4,983	5,124	5,124	5,124	5,189	5,189	5,189
Durango 56	415,798	-	-	46	256	256	366	329	998	778
Grand Junction 45	143,679	1,193	1,193	1,293	1,733	540	1,952	1,870	3,279	2,803
Pueblo 132	103,745	1,466	1,466	1,466	1,492	1,492	1,492	1,505	1,505	1,505



**APPENDIX E – Adjusted Bureau of Economic Analysis Regions  
Defined by County**

**Table E.1. Adjusted Bureau of Economic Analysis Region Assignment by County**

County	Bureau of Economic Analysis Region
Adams	Denver-Aurora-Boulder
Alamosa	Durango
Arapahoe	Denver-Aurora-Boulder
Archuleta	Durango
Baca	Pueblo
Bent	Pueblo
Boulder	Denver-Aurora-Boulder
Broomfield	Denver-Aurora-Boulder
Chaffee	Grand Junction
Cheyenne	Colorado Springs
Clear Creek	Denver-Aurora-Boulder
Conejos	Durango
Costilla	Durango
Crowley	Pueblo
Custer	Colorado Springs
Delta	Grand Junction
Denver	Denver-Aurora-Boulder
Dolores	Durango
Douglas	Denver-Aurora-Boulder
Eagle	Grand Junction
El Paso	Colorado Springs
Elbert	Denver-Aurora-Boulder
Fremont	Colorado Springs
Garfield	Grand Junction
Gilpin	Denver-Aurora-Boulder
Grand	Grand Junction
Gunnison	Grand Junction
Hinsdale	Durango
Huerfano	Pueblo
Jackson	Grand Junction
Jefferson	Denver-Aurora-Boulder
Kiowa	Pueblo
Kit Carson	Colorado Springs
La Plata	Durango
Lake	Grand Junction
Larimer	Denver-Aurora-Boulder
Las Animas	Pueblo
Lincoln	Colorado Springs
Logan	Denver-Aurora-Boulder
Mesa	Grand Junction
Mineral	Durango

**Table E.1. Adjusted Bureau of Economic Analysis Region Assignment by County**

County	Bureau of Economic Analysis Region
Moffat	Grand Junction
Montezuma	Durango
Montrose	Grand Junction
Morgan	Denver-Aurora-Boulder
Otero	Pueblo
Ouray	Grand Junction
Park	Denver-Aurora-Boulder
Phillips	Denver-Aurora-Boulder
Pitkin	Grand Junction
Prowers	Pueblo
Pueblo	Pueblo
Rio Blanco	Grand Junction
Rio Grande	Durango
Routt	Grand Junction
Saguache	Durango
San Juan	Durango
San Miguel	Grand Junction
Sedgwick	Denver-Aurora-Boulder
Summit	Grand Junction
Teller	Colorado Springs
Washington	Denver-Aurora-Boulder
Weld	Denver-Aurora-Boulder
Yuma	Denver-Aurora-Boulder