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Descending from the Pollution Plateau

Why Carbon Dioxide Emissions are Declining in the Mountain West and How to Keep it that Way

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Western Resource Advocates
August 2012

Abstract

After increasing for many years, carbon dioxide (CO_2) emissions from power plants in the Mountain West region have begun to level off and decline. There are several reasons for this change in trajectory, beginning with the retirement of a large coal-fired power plant. Another major factor has been the recession, which greatly reduced demand for electricity. In addition, state regulatory policies increased the role of renewable energy and energy efficiency, which displace fossil-fuel generation and reduce carbon dioxide emissions. And municipal, community-based, and business sustainability goals are contributing to greater adoption of renewable energy and energy efficiency, thereby reducing emissions.

Concerted public and private sector efforts to deploy renewable energy, increase energy efficiency, and retire coal-fired power plants are needed to continue a downward trend in CO_2 emissions from the electric power sector.

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Acknowledgements

The research reported in this paper was supported by the Energy Foundation, the William and Flora Hewlett Foundation, and the Argosy Foundation. John Nielsen, Gwen Farnsworth, Phil Williamson, and Anita Schwartz provided insightful comments and suggestions; Nicole Theerasatiankul coordinated the production of the report.

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Introduction

Concern over emission of greenhouse gases and climate change has motivated an abundance of policy analyses and proposals for reducing the rate of carbon dioxide (CO_2) emissions.[1]

The purpose of this report is to provide public and private sector decision makers, students, and interested businesses and individuals with a preliminary assessment of the impacts of policy and other factors affecting CO_2 emissions from the electric power sector in the Mountain West region of the United States (Arizona, New Mexico, Nevada, Utah, Colorado, and Wyoming). These emissions have recently leveled off and even declined slightly. Is this change in direction a harbinger of the future or simply a temporary diversion in a long-running pattern of increasing emissions?

Figure 1 shows the trajectory of CO_2 emissions from 1990-2010 using data from the Energy Information Administration (2011a). To see the pattern more clearly, the graph also includes a trend line.[2]

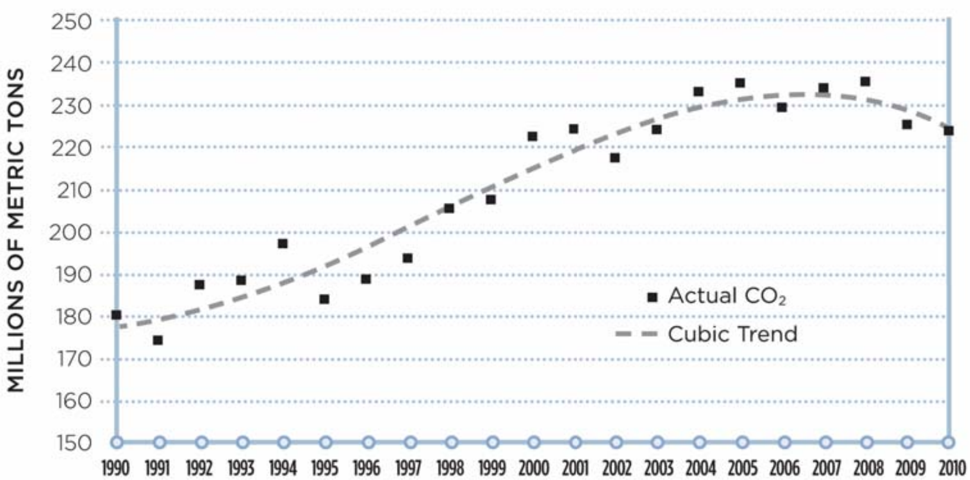

Figure 1. *CO_2 Emissions from the Electric Power Sector in the Mountain West*

Is the decline in CO_2 emissions from the electric power sector in the Mountain West a harbinger of the future or merely a temporary diversion?

1 See, for example, Stern (2008), van den Bergh (2010), Turner et al. (2010), U.S. Government Accountability Office (2008), and U.S. Department of State (2010).

2 The equation for the trend line is: $C = 177{,}265{,}210 + 540{,}378T^2 – 20{,}539T^3$, where T is time in years (1990 = 1) and C is carbon dioxide emissions from the electric power industry, measured in metric tons. The coefficients are significant at the 1% level and the adjusted $R^2 = 0.93$. The trend line is not intended to explain the year-to-year changes in emission levels; it only provides a convenient summary.

The remainder of this report examines factors affecting the path of CO_2 emissions: the amount of fossil-fuel power generation, policies that encourage retirement of coal-fired power plants, shifts in the demand for electricity in the region, and public and private sector policies and programs that promote renewable energy and energy efficiency as substitutes for fossil-fuel power generation. Unless otherwise specified, data on generation, generation capacity, retail electricity sales, number of customers, and CO_2 emissions are from EIA (Energy Information Administration, 2011a and 2012).

The Role of Fossil Fuels in Power Generation

In the Mountain West, burning coal to produce electricity is a major source of CO_2 emissions. In 2010, the region's coal-fired power plants emitted 189.4 million metric tons of CO_2 while generating 187.9 million megawatt-hours (MWh) of electricity, resulting in an average emission rate of 1.01 metric tons of CO_2 per MWh. In comparison, natural gas-fired power plants in the region emitted 34.1 million metric tons of CO_2 in 2010 while generating 79.9 million MWh, resulting in an average emission rate of about 0.43 metric tons of CO_2 per MWh. Figure 2 shows the amount of CO_2 emissions from coal versus natural gas plants in 2010. In 2010, coal and natural gas generation accounted for approximately 83% of total MWh of electricity generated in the region.

Figure 3 shows that most of the increase in power generation over the study period is due to an increase in gas generation and, to a lesser extent, solar, wind, and geothermal generation (labeled as "SWG"). Consequently, the average CO_2 emissions rate for the power sector, as measured by metric tons of CO_2 per MWh generated, has decreased over time, especially after 2000. This rate dropped from 0.83 metric tons per MWh generated in 1990 to 0.78 metric tons per MWh generated in 2000, and to 0.69 metric tons per MWh generated in 2010.

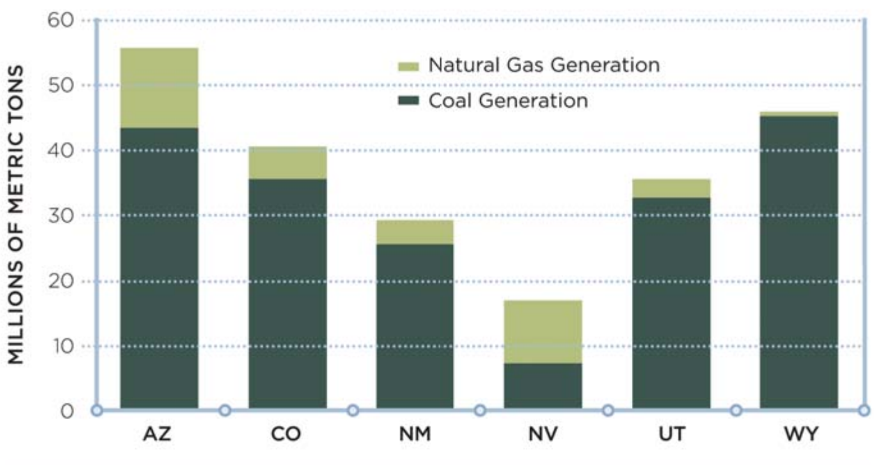

Figure 2. *Carbon Dioxide Emissions from the Mountain West Electric Power Industry, 2010*

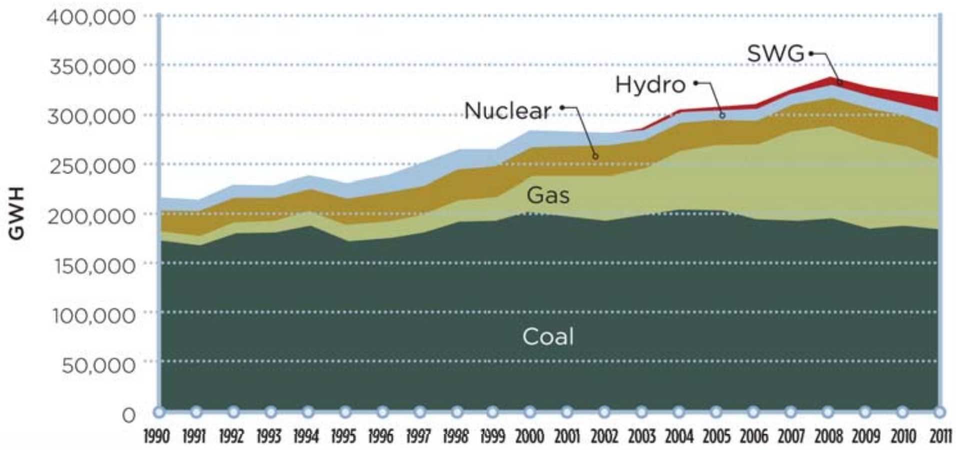

Figure 3. *Mountain West Power Generation by Fuel Type (Excludes Other Generation Such as Pumped Storage; swg = Central Station Solar, Wind and Geothermal Generation)*

Seven coal-fired power plants (accounting for about 2,200 MW of generating capacity) were added in the Mountain West after 2005, including Springerville Units 3 and 4 in Arizona and Comanche Unit 3 in Colorado. Nonetheless, total coal-fired generation (measured in MWh) declined after 2005.

As of July 2011, the only coal plants in the study region that were near or under construction are in Wyoming (National Energy Technology Laboratory, 2011). Other new coal-fired power plants were proposed to be constructed in the Mountain West region but were put on hold because of the reduced growth in demand for electricity, the increasing costs of new coal plants, the potential for incurring compliance costs for possible future regulation of greenhouse gas emissions and other pollutants, and the availability of natural gas-fired generation or renewable energy.

Coal Plant Retirements

Coal plant retirements are critical to reducing CO_2 emissions. At the end of 2005, the 1,580 MW coal-fired Mohave power plant in Nevada was retired. If the entire Mohave 2005 output was replaced by gas generation, CO_2 emissions would have declined by 5.3 million metric tons per year, on net.[3] The net effect of this retirement on Nevada emissions is shown in Figure 4. Emissions fell from

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3 The U.S. Environmental Protection Agency (EPA) reported that the Mohave power plant generated 10.5 million MWh in 2005 and emitted 9.8 million metric tons of CO_2 in 2005 (Source: EPA, eGRID2007, Version 1.0, Plant File, Year 2005 Data). It is unlikely that any significant amount of coal generation replaced the Mohave plant as coal generation in the region dropped by about 10 million MWh from 2005 to 2006 and declined even further from 2006 to 2011. From 2005 to 2006, gas generation in the region increased by about 10 million MWh and continued to increase until the recession hit.

about 26 million metric tons in 2005 to 17 to 18 million metric tons in the period 2006 to 2010. The changes in generation and emissions extend beyond Nevada as power plants in other states were also used to replace the power that would have been generated by the Mohave plant. The figure pertains only to Nevada generation and emissions.

Coal plant retirements from 2005-2017 will add up to about 3,300 MW. If this generation is replaced by gas generation, the net impact is a reduction of about 11 million metric tons of CO_2 emissions per year.

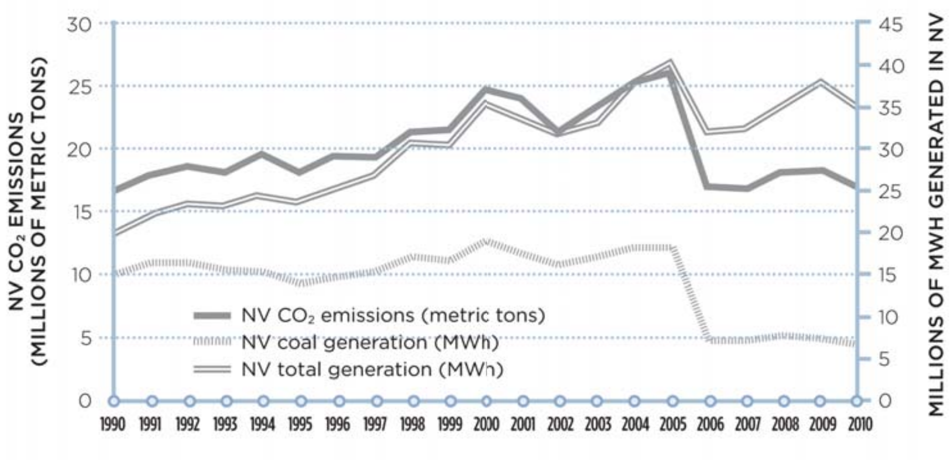

Figure 4. *Net Effect in Nevada of Retirement of the Mohave Coal Plant at the End of 2005*

Colorado's 2010 Clean Air-Clean Jobs Act (Colorado House of Representatives, 2010) required regulated utilities with coal-fired generation to file an emission reduction plan with the Public Utilities Commission and required the Commission to review the plans by the end of 2010. The plans had to focus on replacing or repowering coal-fired power plants with natural gas generation and energy efficiency and must be implemented by December 31, 2017. Through 2017, 1178 MW of Colorado coal generation capacity has been planned for retirement. Note that the Clean Air-Clean Jobs Act had no effect on the historical trend of CO_2 emissions through 2010. Its impact occurs after that.

California's Emission Performance Standard (California Senate, 2006; California Energy Commission, 2012) requires that baseload generation owned by or under long-term contract to publicly owned utilities cannot emit more than 1,100 pounds of CO_2 per MWh (about 0.5 metric tons per MWh). The standard applies to the construction or purchase of new baseload power plants, the purchase of existing baseload power plants, and life extending investments in coal plants. The emission performance standard has led to Southern California Edison's (SCE's) pending withdrawal from its share of the Four Corners coal-fired power plant in New Mexico. SCE plans to sell its share of Units 4 and 5 to Arizona Public Service Company (APS), and APS will in turn retire 560 MW of generation capacity at Four Corners Units 1, 2, and 3 (Arizona Public Service Company, 2010). SCE will replace its share of Four Corners with a mix of renewable energy and natural gas-fired generation.

As a result of these policies and actions, completed and planned coal plant retirements over the period 2005 through 2017 add up to about 3,300 MW (including the Mohave plant). If this generation is replaced by gas generation, the net impact is a reduction of about 11 million metric tons of CO_2 emissions per year. As noted above, some additional coal plants were completed after 2005, but the total MWh of coal-fired generation in the Mountain West decreased after 2005. Additionally, older, less efficient coal-fired power plants are becoming less competitive. Natural gas prices have fallen, making gas-fired generation cheaper as compared to coal-fired generation, and some coal plants are faced with the need to install new pollution controls to comply with federal Clean Air Act requirements. Thus, the economics of power markets may also cause some coal plants to be retired (Tierney, 2012; Moody's Investors Service, 2012).

The Demand for Electricity

While some of the electricity produced in the Mountain West is exported,[4] much of it serves customers in the region. The demand for electricity in the region affects the amount generated in the region, and changes in demand will cause changes in the amount of CO_2 emitted from fossil-fuel power plants. This section discusses two drivers of demand – the economy and weather.

Impact of the Economy on Electricity Demand

Figure 5 shows how closely retail electric sales in the region follow personal income.[5] From 1990 through part of 2008, the region experienced a long period of economic growth and increasing electricity consumption. But then the economy began to contract rather severely and recovery has been slow (National Bureau of Economic Research, 2012). As business activity slowed and residential consumers became more cautious about spending money, electricity consumption decreased. From 2008 to 2009, the period when aggregate personal income decreased, CO_2 emissions in the Mountain West declined by about 10.3 million metric tons. Of that decline, some was due to an increase in renewable energy and energy efficiency displacing fossil-fuel generation. An estimate of the proportion of the decline in emissions due to the recession is provided in the "Decomposition of Factors" section below, where several factors are considered simultaneously.

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4 Exports are not known precisely. In 2006, California imported roughly 23,195 GWh of coal-fired generation, 13,207 GWh of natural gas-fired generation, 5,635 GWh of nuclear generation, 2,343 GWh of large hydro generation, and 579 GWh of renewable energy from Arizona, Colorado, New Mexico, Nevada, Utah, and Texas (California Energy Commission, 2007).

5 Personal income data and the gross domestic product implicit price deflator to calculate values in constant dollars are from the Bureau of Economic Analysis (2012a and 2012b).

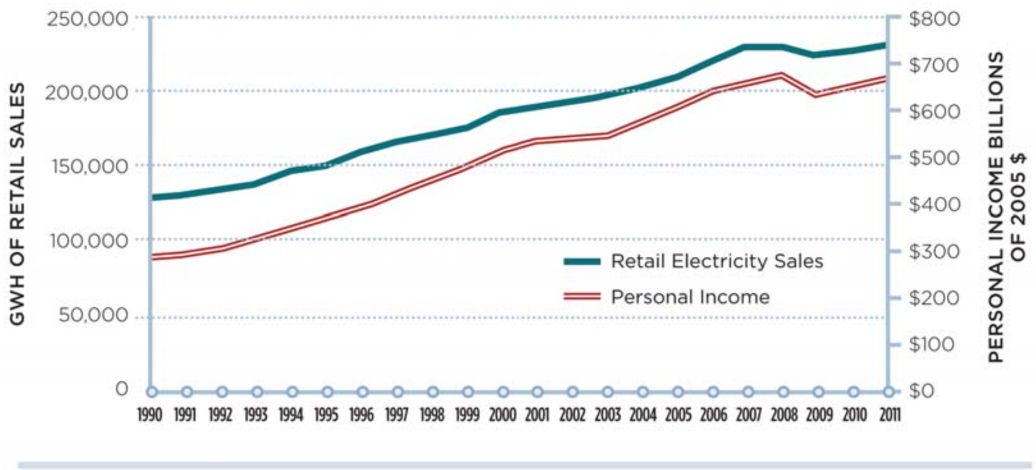

Figure 5. *Retail Electricity Sales and Personal Income in the Mountain West*

Impact of Warmer Temperatures on Electricity Demand

Another factor affecting the demand for electricity is the trend toward hotter weather. Air conditioning contributes to summer demand in the region and, as air conditioning load increases, CO_2 emissions from power plants will increase. Figure 6 shows the upward trend of population-weighted cooling degree days (labeled cdd in the graph) in the Mountain Census Division (the Mountain West region plus Idaho and Montana).[6]

Because of the high summer temperatures in much of the state, Arizona is an extreme case of cooling demand. Figure 7 shows the high correlation between Arizona residential retail electricity sales per customer over the period 1992 to 2010 and population-weighted cooling degree days in the state.[7]

Renewable Energy and Energy Efficiency

Most renewable energy and energy efficiency resources emit little or no CO_2. They typically displace the marginal or most expensive conventional resources that would otherwise operate. Much of the time these are natural gas-fired combustion turbines or combined cycle units, although coal-fired generation may be

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6 Data are from the Energy Information Administration (2011b) and use a 65° F (18.3 C) base. The cooling degree days for each sub-region are weighted by the sub-region's population so that cooling degree days for more populous areas are given more weight – cooling degree days in Phoenix would be given more weight than cooling degree days for Show Low, Arizona, for example.

7 Arizona cooling degree data are from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service (various dates).

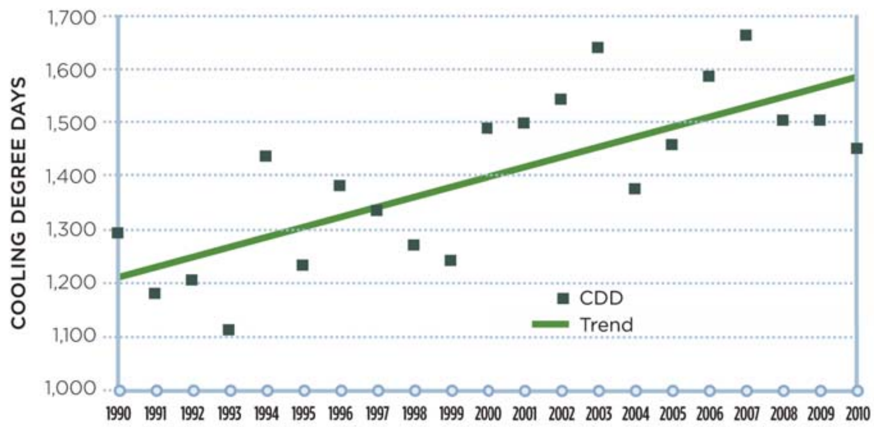

Figure 6. *Population-Weighted Annual Cooling Degree Days in the Mountain Census Division*

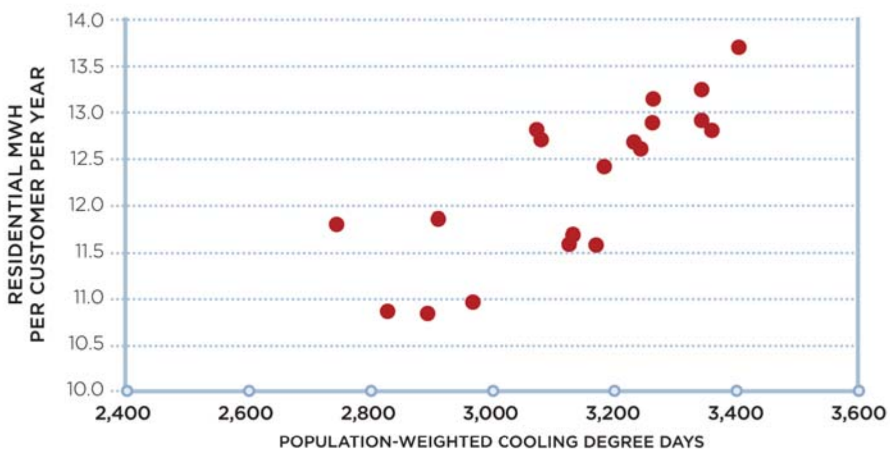

Figure 7. *Correlation of Residential Electricity Use Per Customer and Cooling Degree Days, Arizona, 1992-2010.*

displaced some of the time. The amount of CO_2 emission reduction that actually takes place as a result of clean energy resources depends on utility-specific characteristics and the time of day and season of the year that the clean energy resource is available.

In the Mountain West, renewable energy resources are primarily geothermal, wind, and various solar energy technologies for producing electricity. Biomass projects are less significant, in large part due to the dry climate. Conventional hydropower is important in the region, especially in Arizona, but the prospects for additional hydropower generation capacity are very limited due to environmental conflicts, absence of potential sites, and risk of persistent drought.

Energy efficiency refers to reduced waste in electricity consumption. Energy efficiency is improved through better devices for lighting, space cooling and heating, motor drives, refrigeration, and so forth; through better building design and landscaping (such as shade trees); and through changes in behavior. In addition, efficiency can be improved through intelligent systems that optimize many functions within a house, business, city, or other location and reduce energy usage as a result (Elliott *et al*., 2012). These systems may employ real-time feedback or automated controls, for example.

Policies and Programs Promoting Energy Efficiency and Renewable Energy

Much of the impetus for renewable energy and energy efficiency in the Mountain West has come from state and local policies, community organizations, and individual consumers. The major policy arenas have been:

- **Regulatory policies that prescribe a mix of generation resources, such as a minimum amount of renewable energy, or that set energy efficiency standards**. Tables 1 and 2 highlight features of renewable energy standards and energy efficiency standards in the Mountain West as they pertain to utilities. In addition, California's renewable energy standard (33% by 2020) is inducing investments in renewable energy projects in the Mountain West states that export electricity to California. In some states, however, emerging political opposition to these policies may limit their future impact. Moreover, future growth in renewable energy may slow down as utilities reach the ultimate target levels incorporated in the standards.[8]

- **Municipal policies in which local governments adopt sustainability plans or similar mechanisms and implement them**. Many local governments have prepared climate change or sustainability plans, some of which include action items for obtaining more electricity from renewable resources or reducing energy consumption through efficiency measures. For reviews of these types of programs, see Basset and Shandas (2010) and Wheeler (2008). One example is Pima County, Arizona's plan to power the county's facilities with at least 15% renewable energy by 2025 (Pima County, 2008). As a result of local efforts, numerous photovoltaic projects have been incorporated into municipal infrastructure (Western Resource Advocates, 2011). Some communities have adopted energy efficiency building codes, such as Boulder, Colorado, which has baseline energy efficiency requirements for existing rental housing (City of Boulder, 2011). Scottsdale, Arizona requires all new, occupied city buildings

8 State policies are also likely to be affected by impending discontinuation of federal incentives and by possible tariffs on imports of solar and wind equipment from China.

to obtain Gold level certification in the Leadership in Energy and Environmental Design (LEED™) program (City of Scottsdale, 2005).

- **Programs of community-based organizations to promote energy efficiency**. Some community-based organizations implement energy efficiency programs in which they educate consumers about energy efficiency and, in many cases, install or make available energy efficiency measures for residential or business consumers. These organizations are typically focused on community improvement and foster civic engagement processes. For a review of these programs, see Berry (2010).

Table 1. *State Energy Efficiency Standards**

STATE	POLICY
AZ	By 2020, cumulative annual efficiency savings = 22% of 2019 retail electricity sales.
CO	Annual sales reductions for Public Service Company of Colorado increase from 1.14% in 2012 to 1.68% in 2020.
NM	Savings target = 5% of 2005 total retail kWh sales by 2014 and 10% of 2005 total retail kWh sales by 2020.
NV	25% of retail electricity sales from renewable energy by 2025, of which up to 25% can be provided by energy efficiency.
UT	Individual utility programs.
WY	Individual utility programs.

** Sources: North Carolina Solar Center and Interstate Renewable Energy Council (2012); Colorado Public Utilities Commission (2011).*

Table 2. *State Renewable Energy Standards**

STATE	STANDARD	COMMENTS
AZ	15% by 2025, with distributed generation carve-out.	Salt River Project has its own goals.
CO	30% by 2020 (investor owned utilities or IOUs); 10% by 2020 (large municipal utilities and coops). IOUs must comply with distributed generation carve-out.	
NM	20% by 2020 (IOUs); 10% by 2020 (coops); distributed generation carve-out.	Various technology minimums.
NV	25% of retail electricity sales from renewable energy by 2025, of which up to 25% can be provided by energy efficiency.	Solar minimum.
UT	Goal (not a standard): 20% of adjusted retail electricity sales by 2025; renewable energy must be cost-effective.	No interim year goals.
WY	None adopted.	

**Source: North Carolina Solar Center and Interstate Renewable Energy Council (2012).*

- **Individual policies**. Businesses or other organizations may establish their own sustainability objectives and implement them through energy efficiency and renewable energy projects or purchases of renewable energy credits. For instance, Frito-Lay's plant in Casa Grande, Arizona uses solar energy and a biomass boiler (Randazzo, 2011). Another example is the Army Energy Security Implementation Strategy, which includes a target of reducing military installations' energy use by 30% by 2015 relative to a 2003 baseline, and a target of meeting 25% of electricity demand with renewable resources by 2025 (Army Senior Energy Council and Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, 2009, Table 1). There are several large photovoltaic projects on military bases in the region, such as the 14-MW facility at Nellis Air Force Base in Nevada.

Effect of Renewable Energy

Figure 8 shows the growth of renewable energy generation in the Mountain West from central station facilities, excluding distributed resources located on customers' premises. Wind energy has provided the majority of renewable energy generation in recent years. In 2010, central station geothermal, solar, and wind generation was 11,744 gigawatt-hours (GWh). If this electricity production from renewable resources displaced natural gas generation, avoided CO_2 emissions in 2010 would have been about five million metric tons. This estimate of avoided emissions is low because some coal generation, which produces more

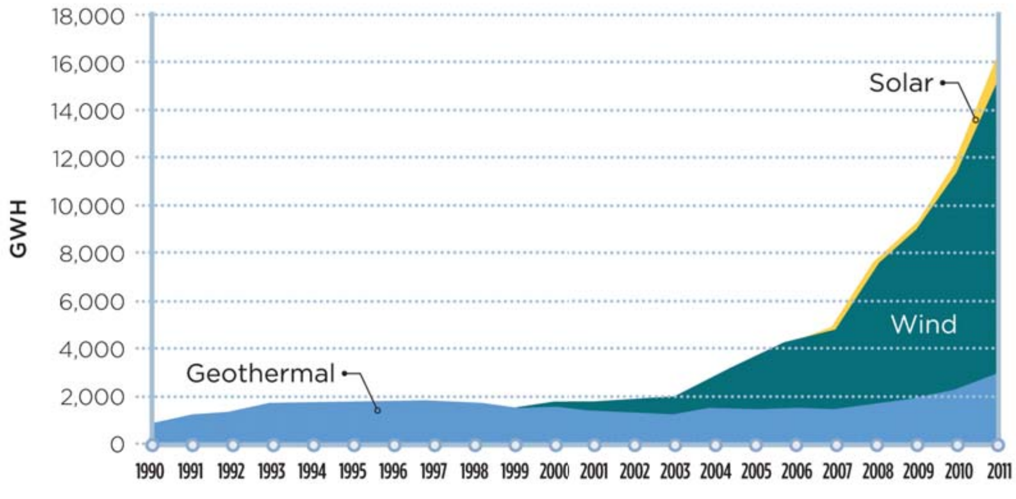

Figure 8. *Central Station Renewable Energy Generation in the Mountain West*

CO_2 per MWh than gas-fired generation, may have been displaced, and because it does not account for distributed photovoltaic generation located on consumers' premises, which also displaces fossil-fuel generation. Distributed photovoltaic generating capacity additions have been concentrated in Arizona and Colorado (Solar Energy Industries Association, 2010, 2011), but comprehensive energy production data are not available for distributed installations.

Effect of Energy Efficiency Savings

The American Council for an Energy-Efficient Economy (2011 and previous editions) has estimated incremental electricity savings from efficiency programs administered by utilities and third parties. Incremental savings are defined by ACEEE as new savings achieved from measures implemented in a given year and are contrasted with cumulative savings, which account for savings from measures installed in previous years plus the incremental savings in the given year.

Figure 9 shows the annualized incremental savings for the states in the Mountain West region.[9] Wyoming had minimal energy savings and is not included in the figure.

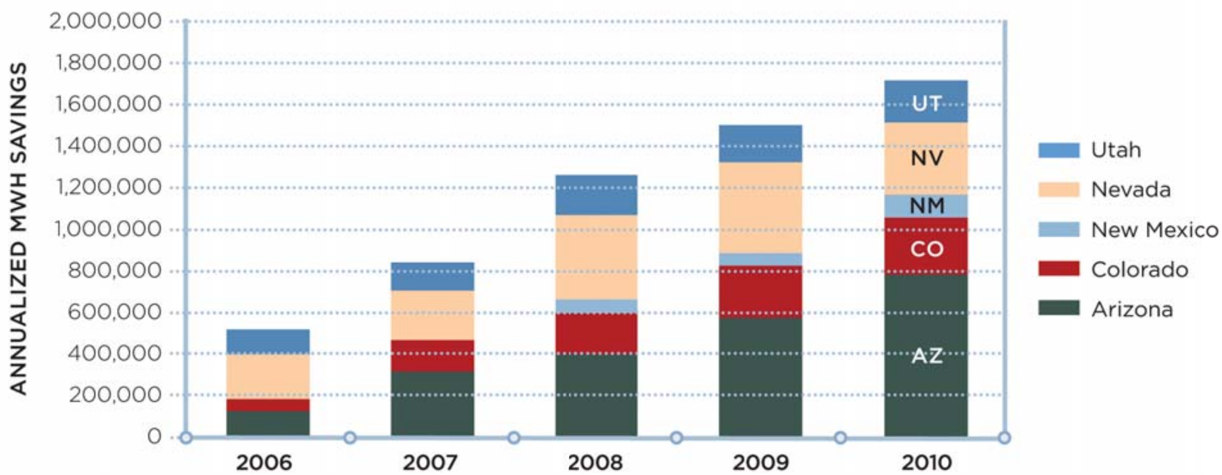

Figure 9. *Annualized Incremental Savings from Efficiency Programs in the Mountain West*

9 Annualized values assume that the energy efficiency measures added during a given year were installed on January 1 of that year. In reality, measures were installed gradually over the course of the year. Data for 2006 through 2009 are from ACEEE as described above. Data for 2010 were obtained from EIA Form 861 (Energy Information Administration, 2011c). The efficiency data do not account for attrition in the effects of efficiency measures installed in previous years nor do they account for savings due to actions taken outside utility and third-party-administered programs.

Decomposition of Factors Leading to Emission Reductions

This section ties together the factors described above to characterize the decline in CO_2 emissions after 2005. Table 3 summarizes the impacts of factors leading to the changes in emissions observed over the period 2005 to 2010. Note that entries in the table pertain to year-to-year changes or incremental changes.

Table 3. *Decomposition of CO_2 Emission Changes in the Mountain West, 2005-2010*

SOURCE OF CHANGE	Change in CO_2 emissions from previous year *(millions of metric tons)*				
	2006	**2007**	**2008**	**2009**	**2010**
1. Total emissions	-5.79	4.67	1.53	-10.30	-1.71
2. Impact of retirement of Mohave plant*	-5.27	0	0	0	0
3. Impact of renewable energy**	-0.29	-0.21	-1.18	-0.67	-1.06
4. Impact of energy efficiency savings†	-0.11	-0.29	-0.45	-0.59	-0.69
5. Subtotal *(line 2 + line 3 + line 4)*	-5.67	-0.50	-1.63	-1.26	-1.76
6. Residual *(line 1 – line 5)*	-0.12	5.16	3.16	-9.04	0.05
	Other explanatory factors				
7. Change in personal income from previous year (billions of 2005 $) *[2005 personal income = $607 billion]*	32.58	19.77	16.14	-40.68	13.54
8. Change in cooling degree days from previous year *[2005 cooling degree days = 1,457]*	129	77	-159	0	-54

* *Assumes entire output of Mohave plant was replaced by gas generation.*

** *Assumes renewable energy displaced gas generation; if some coal generation were also displaced, emission reductions would be greater.*

† *Emission reductions attributed to energy efficiency are based on the change in annual energy efficiency savings from the previous year. In any year, total efficiency savings are the sum of incremental savings from measures installed in previous years plus one half the annualized incremental savings for the current year to reflect gradual installation of measures in that year; assumes energy efficiency displaced gas generation; if some coal generation were also displaced, emission reductions would be greater.*

The table is constructed as follows:

Line 1. This line shows the changes in CO_2 emissions from the previous year.

Line 2. This line shows the year-to-year change in emissions attributable to the retirement of the Mohave plant, assuming that the entire output of the Mohave plant was replaced by natural gas generation.

Line 3. This line shows the year-to-year change in emissions attributable to changes in central station solar, wind, and geothermal generation, assuming that the renewable energy displaced gas generation.

Line 4. This line presents the estimated reduction in emissions attributable to changes in efficiency savings, assuming efficiency savings displaced gas generation.[10]

Line 5. This line combines the year-to-year changes in emissions due to the retirement of the Mohave plant, increases in renewable energy, and incremental efficiency savings. Figure 10 shows the combined year-to-year reductions in emissions due to these three factors. The largest impact occurred in 2006 as a result of the retirement of the Mohave plant at the end of 2005. (The reduction in emissions due to renewable energy and energy efficiency may be understated if some of the generation these resources displaced was from coal-fired power plants).

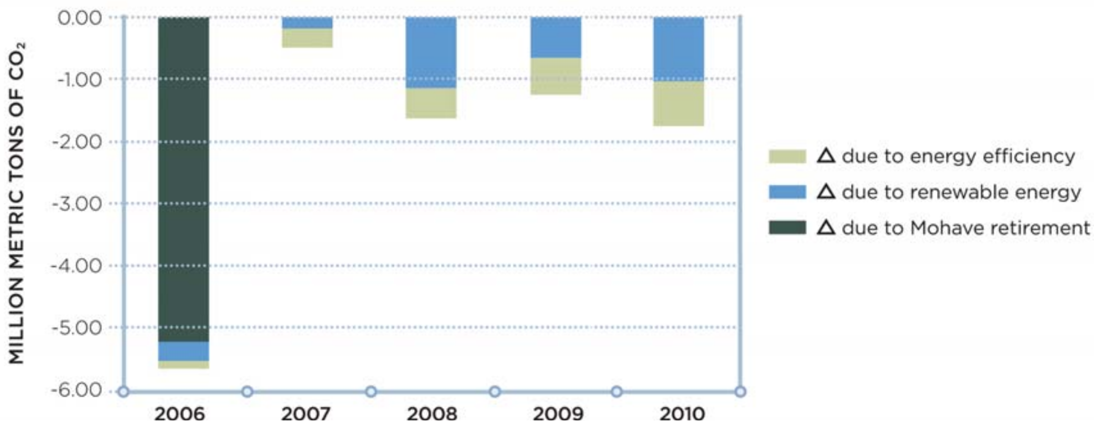

Figure 10. *Changes in CO_2 Emissions from Previous Year Due to Energy Efficiency, Renewable Energy and Coal Plant Retirements in the Mountain West.*

Other factors also affect the change in emissions from year to year, as indicated by the residual on line 6. The largest residual, in absolute value, occurred in 2009 (-9.04 million metric tons of CO_2), and most of this residual was likely a result of the recession. The depth of the recession is indicated by the large decline in personal income from 2008 to 2009 (line 7). Cooler summer weather (on a regional basis) was not a factor in the emissions decline in 2009; the level of cooling degree days did not change from 2008 (line 8).

10 The emission reductions attributed to energy efficiency are based on the change in annual energy efficiency savings from the previous year. In any year, total efficiency savings are the sum of incremental savings from measures installed in previous years plus one-half the annualized incremental savings for the current year to reflect gradual installation of measures in the current year. Line 4 disregards efficiency savings from years prior to 2006 due to lack of data; the impact of this assumption is small, as savings from earlier years are likely to be much smaller than the amount that occurred in 2006.

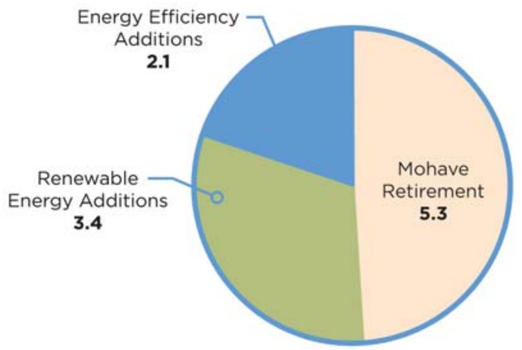

Figure 11. *CO_2 Emissions Avoided in 2010 in the Mountain West as a Result of Clean Energy Events Starting December 31, 2005 (million metric tons)*

Additional factors, including distributed renewable energy projects, outages of coal-fired power plants, substitutions between coal and gas generation due to relative fuel price changes, or additions of new fossil-fuel resources would also contribute to the residual. Specific effects of these additional factors were not analyzed for this report.

Figure 11 shows the CO_2 emissions avoided in 2010 as a result of the retirement of the Mohave plant, additions of renewable energy after 2005, and additions of energy efficiency savings after 2005. The cumulative effect in 2010 of these clean energy events is a reduction in emissions of about 11 million metric tons. The Mohave plant retirement was the largest contributor to avoided emissions.

Conclusions

In the Mountain West, there are forces working to both increase and decrease CO_2 emissions from power plants:

- Coal plant retirements have been and will be major contributors to the decline in CO_2 emissions as natural gas-fired generation and other low-emission resources are substituted for coal generation. Retirements are occurring, in part, because of state policies, most notably the Colorado Clean Air-Clean Jobs Act and the California Emission Performance Standard. Retirements may also result from the need to add expensive pollution control or other equipment to some coal-fired power plants to meet Clean Air Act and other environmental standards or from a continuation of low natural gas prices.

- Few new coal plants are currently planned or under construction in the region, thereby avoiding large increases in CO_2 emissions.

- The recession starting at the end of 2007 reduced demand for electricity and was a major cause of the decline in CO_2 emissions during the economic downturn. (One should not infer that a recession is proposed as a means for reducing emissions; it is not.) With the end of the recession, absent continued strong efforts to move toward less carbon-intensive resources, CO_2 emissions are likely to increase as electricity use increases.

- The trend toward hotter weather will increase the demand for air conditioning in at least part of the Mountain West where summers are very hot. To the extent that these increased demands are met by fossil-fuel resources, CO_2 emissions would increase.

- State regulatory policies have increased the role of renewable energy and energy efficiency, and these clean energy resources have displaced fossil-fuel generation and reduced CO_2 emissions. Maintaining and expanding these policies will further reduce CO_2 emissions over time.

- Municipal, community-based, and business and organizational sustainability or clean energy goals are contributing to greater adoption of distributed renewable energy and energy efficiency and may decrease emissions significantly in the future.

At the present time, it is not clear whether the pace of coal plant retirements and deployment of renewable energy and energy efficiency will more than offset increased emissions due to economic growth and warmer weather. Concerted public and private sector efforts to increase the adoption of renewable energy and energy efficiency and to retire coal-fired power plants are needed to continue a downward trend in CO_2 emissions from the electric power sector.

References

American Council for an Energy-Efficient Economy. 2011. *The 2011 State Energy Efficiency Scorecard*. Report E115. Washington, D.C.

Arizona Public Service Company. 2010. In the matter of the application of Arizona Public Service Company for the authorization for the purchase of generating assets from Southern California Edison and for an accounting order. Arizona Corporation Commission Docket No. E-01345A-10-0474, filed November 22.

Army Senior Energy Council and Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships. 2009. *Army Energy Security Implementation Strategy*. Washington, D.C. http://www.asaie.army.mil/Public/Partnerships/doc/AESIS_13JAN09_Approved%204-03-09.pdf.

Bassett, E. and V. Shandas. 2010. "Innovation and Climate Action Planning." *Journal of the American Planning Association* 76: 435-450.

Berry, D. 2010. "Delivering Energy Savings through Community-Based Organizations." *The Electricity Journal* 23 (9): 65-74.

Bureau of Economic Analysis. 2012a. Annual State Personal Income and Employment. http://www.bea.gov/iTable/iTable.cfm?ReqID=70&step=1&isuri=1&acrdn=4.

Bureau of Economic Analysis. 2012b. National Income and Product Accounts, Table 1.1.9, Implicit Price Deflators for Gross Domestic Product. http://www.bea.gov/iTable/iTable.cfm?ReqID=9&step=1.

California Energy Commission. 2007. *2006 Net System Power Report*, CEC-300-2007-007.

California Energy Commission. 2012. "SB 1368 Emission Performance Standards." http://www.energy.ca.gov/emission_standards/index.html.

California Senate. 2006. Senate Bill No. 1368. *Greenhouse Gases Emission Performance Standard for Baseload Electrical Generating Resources*. http://www.energy.ca.gov/emission_standards/documents/sb_1368_bill_20060929_chaptered.pdf.

City of Boulder. 2011. "Smart Regs Fact Sheet," http://www.bouldercolorado.gov/files/PDS/rentalhousing/Energy_Efficiency_Project/SR_factsheet.pdf.

City of Scottsdale. 2005. "Scottsdale Becomes First City in the Nation to Adopt Gold Standard for Energy and Environmental Design." News release. http://www.scottsdaleaz.gov/greenbuilding/LEED.

Colorado House of Representatives. 2010. Bill 10-1365, *Colorado Clean Air-Clean Jobs Act*. http://www.leg.state.co.us/clics/clics2010a/csl.nsf/fsbillcont/0CA296732C8CEF4D872576E400641B74?Open&file=1365_ren.pdf.

Colorado Public Utilities Commission. 2011. In the matter of the application of Public Service Company of Colorado for approval of a number of strategic issues relating to its DSM plan, including long-term electric energy savings goals, and incentives. Decision No. C11-0442.

Elliott, N., M. Molina, and D. Trombley. 2012. *A Defining Framework for Intelligent Efficiency*. Report E125. Washington, D.C.: American Council for an Energy-Efficient Economy.

Energy Information Administration. 2011a. *Electric Power Annual 2010*. State historical tables for 2010. Excel spreadsheets: http://www.eia.gov/cneaf/electricity/epa/epa_sprdshts.html.

Energy Information Administration. 2011b. *Annual Energy Review 2010*. http://www.eia.gov/totalenergy/data/annual/index.cfm#summary.

Energy Information Administration. 2011c. Form 861 Data Files for 2010, File 3. http://www.eia.gov/cneaf/electricity/page/eia861.html.

Energy Information Administration. 2012. *Electric Power Monthly*, February 2012. http://www.eia.gov/electricity/monthly/current_year/february2012.pdf.

Moody's Investors Service. 2012. *Shift in Electric Generation Mix Favors Natural Gas, Renewables at Expense of Coal*. Report Number 141980. New York, NY.

National Bureau of Economic Research. 2012. "US Business Cycle Expansions and Contractions." http://www.nber.org/cycles.html.

National Energy Technology Laboratory. 2011. *Tracking New Coal-Fired Power Plants*. U.S. Department of Energy, Washington, D.C.

North Carolina Solar Center and Interstate Renewable Energy Council. 2012. Database of State Incentives for Renewables and Efficiency. www.dsireusa.org. Last accessed June 1, 2012.

Pima County. 2008. *Sustainable Action Plan for County Operations*. Tucson, AZ.

Randazzo, R. 2011. "Frito's Casa Grande Facility Uses Technology to Harness Resources, Slash Costs." *Arizona Republic*, October 14. http://www.azcentral.com/arizonarepublic/business/articles/2011/10/14/20111014casa-grande-frito-lay-power1016.html.

Solar Energy Industries Association. 2010. *U.S. Solar Market Insight: 2010 Year in Review, Executive Summary.* Washington, D.C.

Solar Energy Industries Association. 2011. *U.S. Solar Market Insight: Report Q3 2011, Executive Summary.* Washington, D.C.

Stern, N. 2008. "The Economics of Climate Change." *American Economic Review* 98(2):1-37.

Tierney, S. 2012. *Why Coal Plants Retire: Power Market Fundamentals as of 2012*. Boston, MA: Analysis Group, Inc.

Turner, W., B, Bradley, L. Estes, D. Hole, M. Oppenheimer, and D. Wilcove. 2010. "Climate Change: Helping Nature Survive the Human Response." *Conservation Letters* 3(5): 304-312.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service. Various dates. *Monthly State, Regional, and National Cooling Degree Days Weighted by Population.* Historical Climatology Series 5-2. Asheville, NC. http://www.ncdc.noaa.gov/oa/documentlibrary/hcs/hcs.html#52updates.

U.S. Department of State. 2010. *U.S. Climate Action Report 2010*. Washington, D.C.

U.S. Government Accountability Office. 2008. *Climate Change: Expert Opinion on the Economics of Policy Options to Address Climate Change*. Report GAO-08-0605, Washington, D.C.

van den Bergh, J.C.J.M. 2010. "Safe Climate Policy Is Affordable – 12 Reasons." *Climatic Change* 101: 339-385.

Western Resource Advocates. 2011. *Solar Solutions: Incorporating Photovoltaics into Public Infrastructure*. Boulder, CO.

Wheeler, S. 2008. "State and Municipal Climate Change Plans." *Journal of the American Planning Association* 74(4): 481-496.

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