Platte River Power Authority

Climate Action Plan

June 2009

Prepared by KEMA, Inc. Oakland, California

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Executive Summary

Platte River Power Authority (Platte River) generates and delivers reliable, affordable, and environmentally responsible electricity to the communities of Estes Park, Fort Collins, Longmont, and Loveland, Colorado, where this electricity is distributed by each local municipal utility to community residents and businesses.

In 2007, the Governor of the State of Colorado issued the Colorado Climate Action Plan, which included a goal of reducing statewide greenhouse gas emissions to 20 percent below 2005 levels by 2020 and 80 percent below 2005 levels by 2050. To meet the 2020 goal, Platte River would need to reduce carbon dioxide emissions by approximately 700,000 metric tons. The Governor's Energy Office asked the state's electric utilities to voluntarily develop plans to meet these non-binding targets using approaches specific to each utility's unique circumstances. This plan is not prescriptive, but rather lays out a set of options that Platte River can adopt to meet the 2020 target and prepare for emerging federal or regional regulations. Platte River's Board of Directors will make policy and budget decisions associated with any future implementation of options.

Climate change is one of the profound challenges of our time. Scientific evidence suggests that rising greenhouse gas concentrations in the atmosphere could have severe consequences for our state, our nation, and our world. Platte River as a provider of electric energy, a vital public good, must balance competing interests of affordability, reliability, and environmental stewardship in a fair, open, and judicious manner. Platte River welcomes the opportunity to take part in this important discussion to establish a rational roadmap forward to a sustainable energy future.

About Platte River

Platte River has been providing power to its owner municipalities for over 35 years. Platte River's generating resources include a mix of coal, natural gas, wind, and hydropower. This diversity of generation resources provides operational flexibility and enhanced reliability.

Platte River takes pride in its approach to operation and management of its electricity generation plants, and has been recognized by electric industry experts for those efforts. In October 2008, *POWER Magazine* recognized the Platte River Rawhide Energy Station for the advanced technologies and operations improvements implemented over the last decade. Rawhide Unit 1 has an outstanding record of operating well below environmental permit requirements, and has one of the lowest sulfur dioxide emission rates of coal plants in the

United States. Platte River also operates five gas-fired combustion turbines units at the Rawhide site and has an 18 percent ownership in two coal units located near the town of Craig, Colorado.

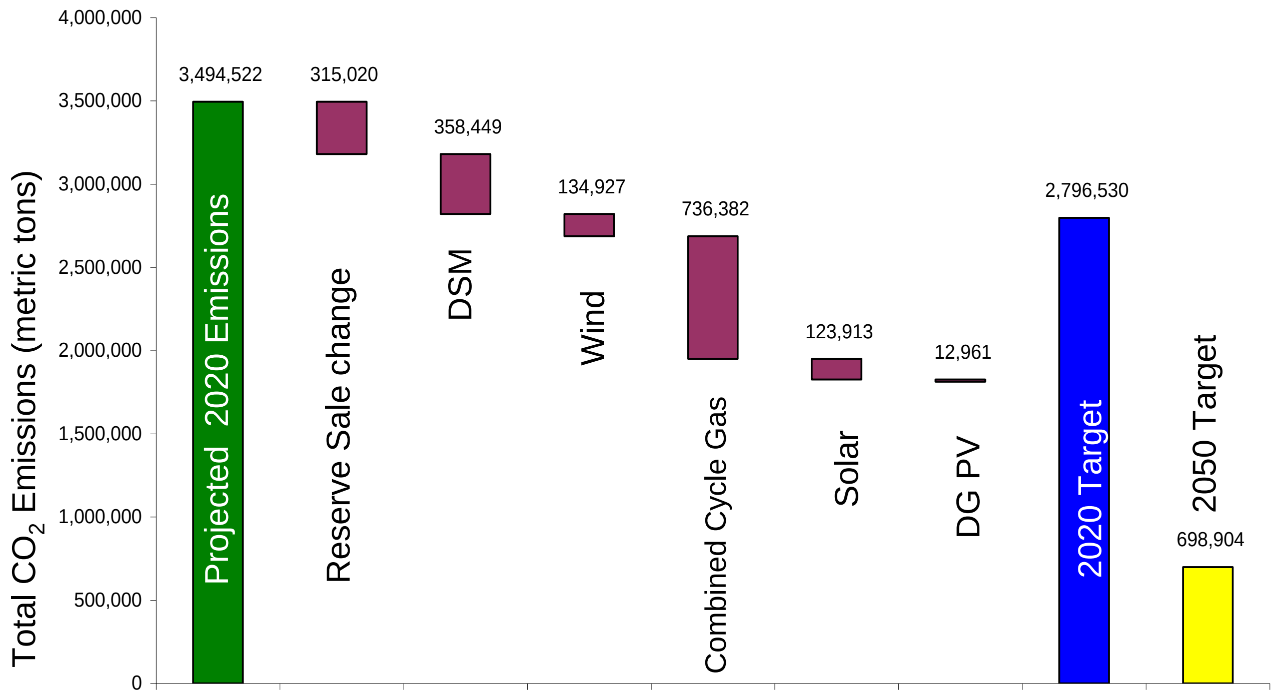
Platte River's renewable energy policy established a portfolio goal of over 300,000 megawatt hours per year from renewable sources by 2020. This level is above the current Colorado Renewable Energy Standard, driven by policies in the owner municipalities. In 1998, Platte River was the first utility in the region to provide wind power to its customers. Current wind supplies include the Medicine Bow Wind Project, purchases from Clipper Windpower, Inc., and purchases of renewable energy certificates. Later this year, a new wind project will be added at the Silver Sage Wind Project site near Cheyenne, Wyoming. To address continuing growth in the demand for energy and to provide enhanced services to customers of the owner municipalities, Platte River has provided energy efficiency services and demand side management (DSM) programs since the early 1990's. Investment in DSM since 2002 has exceeded $5 million and over $2 million is budgeted for DSM in 2009. This amount supplements the DSM expenditures of the owner municipalities.

Meeting the Governor's Goals

Using a portfolio of strategies Platte River can achieve the goal of reducing carbon dioxide emissions to 20 percent below the 2005 rate of emissions by 2020. Platte River engaged KEMA, Inc., an independent global energy consultant, to assist with the development of this plan. Platte River and KEMA brainstormed potential measures to achieve necessary emissions targets. The Table below provides some of the potential options Platte River considered to meet the governor's goals.

Potential Measures to meet the 2020 Target (Quantitative Study)	Additional Measures to meet the 2050 Target (Qualitative Study)
• Reduce Reserve Sales of Electricity • Aggressive Demand Side Management (DSM) Programs • Distributed Photovoltaics (PV) • Combined-Cycle Natural Gas Base Load Generation • Concentrated Solar Power • Increased Wind Generation	• Plant optimization measures such as coal drying • Smart grid, demand response, and other advanced DSM programs • Utility Scale PV Arrays • Developing and New Technologies for Coal Generation • Biomass Co-firing • Greenhouse Gas Offsets

To meet the 2020 target, an analysis was performed to determine the amount of carbon dioxide emissions that could be saved by each of the measures identified. The following chart shows the emissions reduction potential for each analyzed measure:

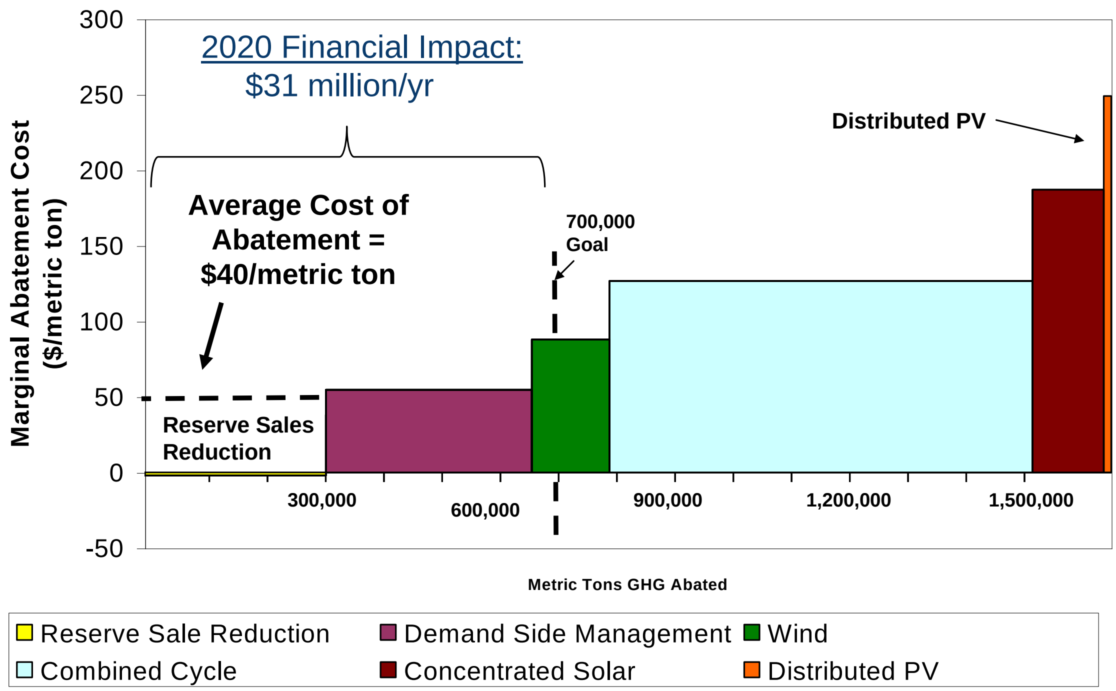


The chart demonstrates that Platte River can achieve the 2020 emissions target with a combination of the evaluated measures. Achieving the 2050 target will involve additional measures.

Carbon dioxide mitigation potential and costs for each measure were estimated compared to a business-as-usual scenario to determine the relative cost-effectiveness for each measure. Costs reflect Platte River's costs (for example, new technology capital costs, operations and maintenance costs, program costs, lost revenues) and benefits (reduced fuel costs). There may be costs or benefits that fall outside our analysis. For example, participants in energy efficiency and distributed photovoltaic programs will have both costs and savings related to the measures installed.

The most cost-effective measures include reduction of surplus reserve energy sales, aggressive demand side management (accounting for up to a one percent reduction of energy demand per year), and increasing wind generation.

The emissions reduction supply curve in the following figure graphically demonstrates which measures are least costly to meet the 2020 target. The vertical dotted line represents the desired emissions reduction by 2020. Implementing these measures will result in estimated additional expenditures of approximately $31 million per year between now and 2020. Platte River financial staff estimates this will result in a wholesale rate increase of approximately 16 percent above base case rate projections.



Additional carbon dioxide reduction strategies could be pursued, but at much higher costs. Such strategies could include transition to more natural gas generation and expanded renewable generation, including concentrated central station solar generation or distributed solar photovoltaic generation.

It is unclear at this time how Platte River could meet the 2050 target of an 80 percent reduction below 2005 levels. New technologies would likely be needed, along with expansion of the more expensive existing technologies evaluated in this study.

The evaluation conducted for this Climate Action Plan shows that Platte River can achieve the 2020 target, but it will be costly. This plan is a living document that will be updated periodically as technology and regulations evolve. In the meantime, Platte River will continue to provide leadership in serving its customers with reliable, affordable, and environmentally responsible energy.

1. Introduction

Platte River Power Authority's Mission Statement

Deliver energy services that provide superior value to its customers through:

- Competitively priced products and services
- Reliable generation and transmission
- Sensitivity to environmental concerns
- Meeting customers' changing needs
- Improving operational efficiency
- Increasing community awareness through open dialogue
- Developing a highly qualified and dedicated staff.

Platte River Power Authority (Platte River) generates and delivers reliable, affordable, and environmentally responsible electricity to the municipalities of Estes Park, Fort Collins, Longmont, and Loveland, Colorado, where this electricity is distributed by each local utility to community residents and businesses. Platte River's Board of Directors consists of the mayors and representatives of the local utilities for each of the municipalities served.

Platte River's headquarters is located in Fort Collins with generation and transmission facilities located along Colorado's Front Range, in northwestern Colorado and near Medicine Bow, Wyoming.

In 2007, the Governor of the State of Colorado issued the Colorado Climate Action Plan,[1] which included a goal of reducing statewide greenhouse gas (GHG) emissions to 20 percent below 2005 levels by 2020 and 80 percent below 2005 levels by 2050. The Governor's office asked the state's investor-owned, cooperatively owned and municipally owned utilities to develop plans to meet these targets, using approaches specific to each utility's unique circumstances. This plan lays out a set of options that Platte River can adopt in response to emerging federal or regional regulations. This plan is not prescriptive or binding, but rather is an exploration of various considerations, costs and benefits of some greenhouse gas mitigation strategies. Platte River's Board of Directors will make policy and budget decisions associated with any future implementation of options.

In early 2009, Platte River engaged KEMA, Inc. for energy consulting services to assist with development of this plan to meet the governor's emissions reduction target. With over 30 years

[1] http://www.colorado.gov/energy/in/uploaded_pdf/ColoradoClimateActionPlan_001.pdf

of experience providing emissions mitigation strategies, cost modeling, and policy analysis expertise, KEMA provides independent, un-biased solutions to the global energy and utility industry's most challenging problems.

2. Summary of Key Findings

- Meeting the 2020 emissions reduction target will require Platte River to reduce approximately 700,000 metric tons of CO_2 versus a business-as-usual emissions level.

- Platte River can technically achieve these targets using a portfolio of strategies, including reducing sales of surplus energy, implementing a regionally coordinated and aggressive demand side management program and installing additional wind energy.

Key Measures to Meet the Governor's 2020 Goals

- Reduce sales of surplus energy
- Implement aggressive residential, commercial, and industrial energy efficiency programs
- Add more wind power

- Implementing the above stated measures will result in an estimated additional expenditure of approximately $31 million per year by 2020. This cost would be passed on to the owner municipalities and their customers. The wholesale rate impact associated with the measures is estimated as 16 percent.

- The average cost of abatement for the three key measures listed above is approximately $40 per metric ton of GHG reduced.

- Additional strategies could be pursued at higher costs. Such strategies could include distributed solar and the transition to more natural gas generation and expanded renewable generation including concentrated solar generation with storage.

- Meeting the 2050 targets of 80 percent below 2005 levels may not be viable economically or technically without advances in clean technologies.

- The current regulatory environment is highly uncertain due to potential federal greenhouse gas regulations. Sensible climate policy design is critical for energy consumers.

- Estimates of costs and rate impacts are preliminary, based on currently available data. These are likely to change over time as more information becomes available.
- This plan is a living and non-binding document that will be updated as conditions change.

3. The Challenge of Climate Change

Climate change presents one of the most profound challenges of our time. Leading climate scientists agree the earth's climate system is changing in response to elevated levels of greenhouse gas in the atmosphere from the combustion of fossil fuels and other sources.

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report[2] concluded that:

- The climate system's recent warming trend is unequivocal
- Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in human-caused GHG emissions
- Man-made warming could lead to some effects that are abrupt or irreversible, depending upon the rate and magnitude of the climate change.

According to the International Climate Change Taskforce[3], the European Union, and the 2007 Bali Declaration by Scientists[4], current scientific understanding is that a 2°C increase in average global temperature over the next century is a safe level of global warming. Beyond this level, the risks to human societies and ecosystems grow significantly. To minimize average global temperature increase to 2°C, greenhouse gas concentrations need to be stabilized at a level well below 450 parts per million. Achieving this level requires global greenhouse gas emissions to be reduced by at least 50 percent below their 1990 levels by the year 2050.

[2] IPCC 2007. Fourth Assessment Report (AR4): Climate Change 2007 Summary for Policy Makers.

[3] International Climate Change Task force. "Meeting the Challenge of Climate Change." 2005. http://www.americanprogress.org/kf/climatechallenge.pdf

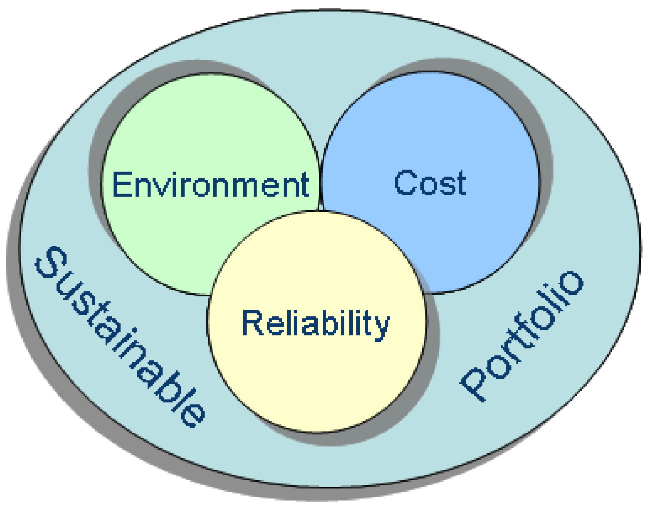
[4] http://www.ccrc.unsw.edu.au/news/2007/Bali.html

If average temperatures increase more than 2°C, substantial agricultural losses, loss of snow pack, increased water shortages, and widespread harmful health impacts could occur. The risks of abrupt, accelerated, or runaway climate change would also increase, potentially leading to the loss of the West Antarctic and Greenland ice sheets, which could raise sea levels more than ten meters over a few centuries.

Currently, the U.S. is the second largest emitter of greenhouse gases next to China. Approximately one-third of U.S. emissions stem from electricity generation through the combustion of fossil fuels, such as coal and natural gas. That electricity is used to light our buildings, run our air conditioners, and power our computers and networks critical for a healthy economy in the 21st century.

3.1 The Challenge for Platte River

Dealing with climate change involves balancing competing interests in a fair manner. Platte River's business is providing electric power to its owner municipalities. In providing this power, Platte River must balance three principles:



- Reliability – Platte River must provide electric power on demand to its customers at any time of the day or night, 365 days a year.
- Cost – As a non-profit community owned utility, Platte River maintains competitive rates to support the economies of the owner municipalities and protect consumers.
- Environmental Protection – Platte River attempts to minimize the negative impacts on resources and the environment.

Platte River can achieve the 2020 emission reduction goals suggested by Governor Ritter, but it will not be easy and will not be free. Reducing carbon dioxide emissions requires investments that will ultimately be paid for in the energy bills received each month by citizens and businesses in the communities Platte River serves.

3.2 Regulatory Drivers

The Colorado Climate Action Plan coincides with a pivotal time in the evolution of climate policy activity at the regional and federal level. Given this, it is imperative to consider this CAP document within the context of a broader national view of climate regulation.

Federal Legislation

At the federal level, developments on Capitol Hill proceed at a rapid pace. On March 31, 2009, Congressmen Henry Waxman (Democrat-CA) and Edward Markey (Democrat-MA) introduced the American Clean Energy and Security Act of 2009 (ACES) to the House Energy and Environment Subcommittee. The discussion draft would set a cap on greenhouse gas emissions equal to 20 percent below 2005 levels in 2020, 44 percent below 2005 levels in 2030, and 80 percent below 2005 levels by 2050. As initially proposed, emission cap enforcement would begin in 2012.

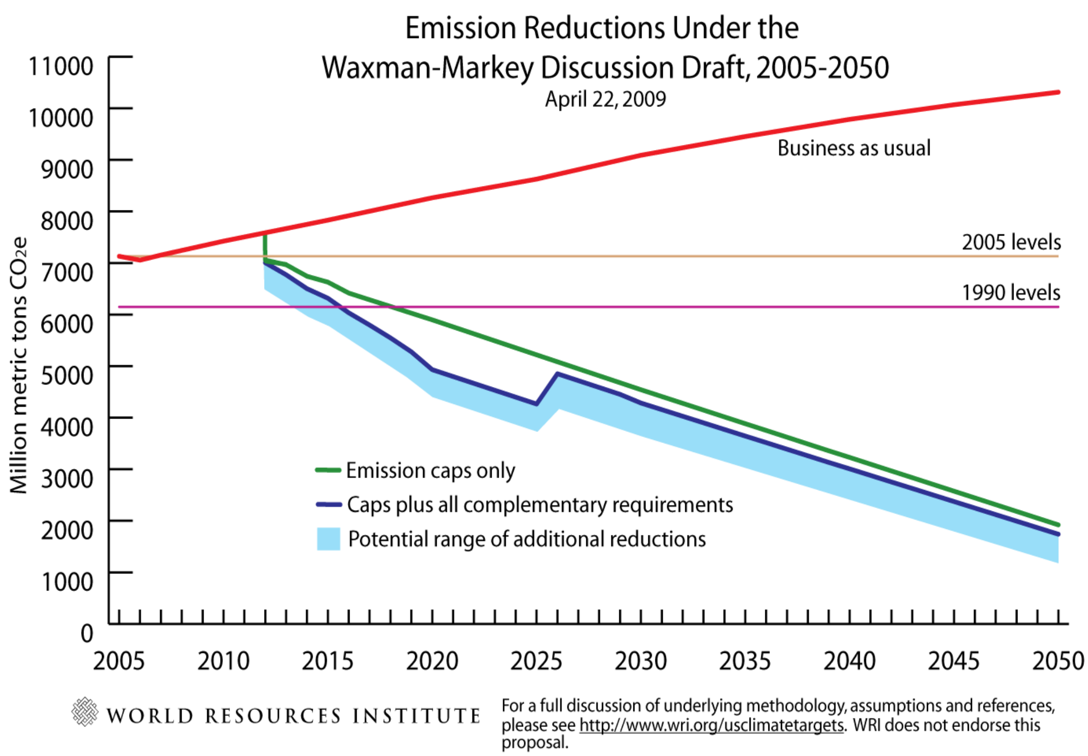


Figure 2: Emissions Reductions under Waxman-Markey Proposal
Source: World Resources Institute

This cap-and-trade program would cover 88 percent of U.S. greenhouse gas emissions including all electricity generators that emit greenhouse gases. The Environmental Protection Agency (EPA) would be authorized to regulate greenhouse gas emissions from smaller sources using performance standards.

Covered entities would need to acquire permits, known as emissions allowances, equal to the number of tons of greenhouse gas emitted during a given compliance period. Allowances could be given away free to capped sources, sold in an auction, or a combination of both. Generally, giving away allowances for free reduces the financial burden passed on to consumers. On the other hand, auctioning allowances sends a stronger price signal to consumers to become more efficient and could raise money for clean technology programs. Politically, it is unlikely that a cap-and-trade program will pass without a significant transition period from free allocation to 100 percent auctioning.

As the economy-wide emissions cap becomes more stringent over time until 2050, regulated entities may be permitted to meet a gradually escalating proportion of their compliance obligation with offsets. Carbon offsets are projects outside of the capped sectors that remove greenhouse gasses from the atmosphere; these can include re-forestation, methane capture from landfills for the production of electricity, or changing soil tilling practices.

Many analysts believe that a climate bill has a good chance to be signed by President Obama in 2010.[5]

Federal Regulation

In 2009, the U.S. Environmental Protection Agency declared greenhouse gases to pose an endangerment to public health and welfare under the Clean Air Act (CAA), and thus the EPA can regulate greenhouse gases under the existing Clean Air Act. A multi-year rulemaking process will need to be undertaken to define how this Act will manage a greenhouse gas regulation component. Many people, including the EPA, prefer that Congress pass climate legislation because the CAA would be an unwieldy regulatory instrument to regulate greenhouse gas emissions. Nevertheless, the Obama Administration may take steps through the CAA to motivate legislators to pass a comprehensive climate bill.

[5] New Carbon Finance. North America Research Note January 2009

Western Climate Initiative

Colorado is an observing member of the Western Climate Initiative (WCI). The WCI is a collaboration of seven U.S. states and four Canadian provinces that are collaboratively developing a comprehensive climate change program, including an economy-wide cap-and-trade program. In September 2008, the WCI Partner jurisdictions released a cap-and-trade program design, which when fully implemented would cover approximately 90 percent of the economy-wide emissions in applicable states and provinces. As such, the WCI program is the most comprehensive cap-and-trade program developed to date. The program is scheduled to start in 2012 with mandatory emissions reporting to begin with 2010 emissions. The WCI Partner jurisdictions include: Washington, Oregon, California, Montana, Utah, Arizona, New Mexico, British Columbia, Manitoba, Ontario, and Quebec. Together these states and provinces account for about 20 percent of the United States economy and 70 percent of the Canadian economy. As an observing member, Colorado is not subject to the mandatory requirements of WCI.

4. Platte River's Commitment to Sustainability

At Platte River Power Authority, sustainability means maintaining a reliable power supply and providing affordable electric energy for citizens and businesses in the owner municipalities, while ensuring environmental protection for current and future generations.

CLIMATE ACTION LEADER™
www.climateregistry.org

Platte River Power Authority has been a leader in environmental stewardship since its inception in 1973. Throughout the years, Platte River has provided affordable energy while operating some of the cleanest, most fuel-efficient fossil fuel plants in the nation. Platte River has been measuring and reporting greenhouse emissions through the California Climate Action Registry since 2006 and is a founding member of The Climate Registry.

4.1 Platte River's Generation Resources

Platte River's generating resources include a mix of coal-fired, gas-fired peaking, and wind generation technologies, and an allocation of Federal hydropower from the Western Area Power Administration.

Pulverized Coal

Platte River's coal-fired generation includes Rawhide Unit 1 and Craig Units 1 and 2. Rawhide Unit 1 is capable of producing 280 MW, and has been recognized by industry experts as one of the best, most efficient coal-fired plants in the nation. Platte River also has an 18 percent ownership (154 MW) in Craig Units 1 and 2. The Craig Station is part of the Yampa Project located on the western slope, outside the town of Craig, Colorado.

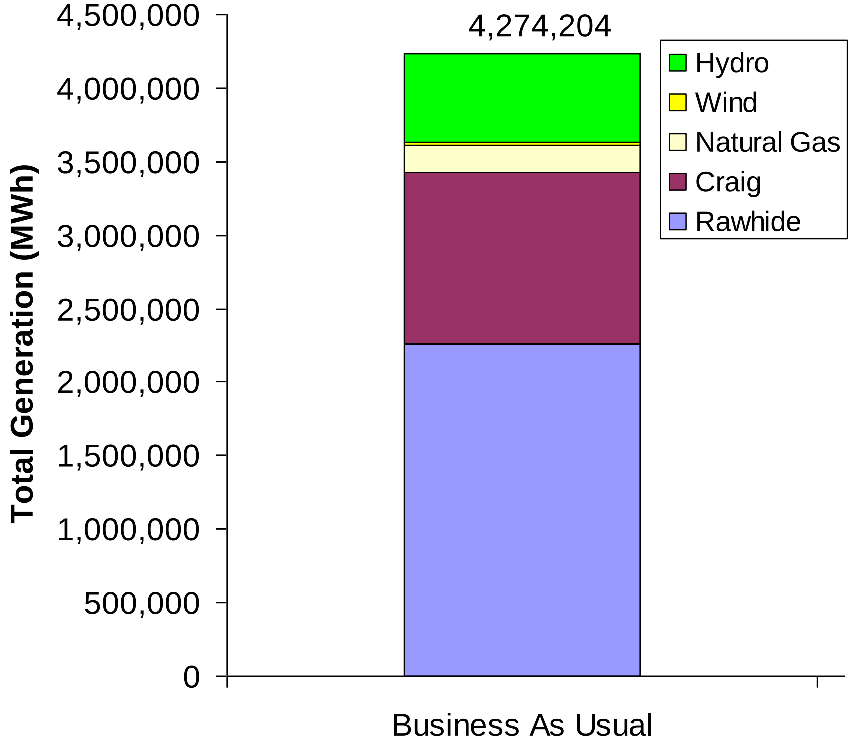
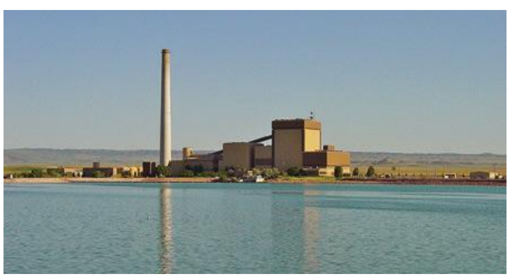


Figure 3. Generation Profile



Rawhide Energy Station
Wellington, CO

Natural Gas

Rawhide Peaking Units A, B, C, and D are each 65 MW natural gas-fired, simple-cycle turbines. In 2008, Unit F was installed, adding an additional 128 MW of capacity. The peaking units are utilized to meet the local municipalities' peak demands during the summer and to enhance system reliability in the event of a forced outage of one of Platte River's coal-fired units.

Hydroelectric power

Platte River has two contracts with the Western Area Power Administration for hydroelectric resources. Hydropower is provided from the Colorado River Storage Project (CRSP) and the Loveland Area Projects (LAP). The Colorado River Storage Project is Platte River's largest allocation of Federal hydroelectric power and comes from the hydroelectric generation units located along the Colorado River and its tributaries in Colorado, New Mexico, Wyoming, Utah, and Arizona. Loveland Area Projects are located in the Missouri River watershed. The CRSP and LAP contracts provide energy during the peak summer months of 61 MW and 30 MW respectively.

Medicine Bow Wind Site

Wind Power

The Medicine Bow Wind Project is located in Wyoming and provides a maximum wind generation output of 8.3 MW. The site currently has nine Vestas wind turbines, owned and operated by Platte River, as well as the prototype Clipper Liberty turbine. All energy output from the Liberty turbine is purchased by Platte River, but the turbine is owned and operated by Clipper. Platte River's renewable energy policy established a goal of over 300,000 megawatt hours per year by 2020 from renewable sources. Current wind supplies include the Medicine Bow Wind Project, purchases from Clipper Windpower, Inc., and purchases of renewable energy credits from several sites in the region (Western Electricity Coordinating Council (WECC) and states contiguous to Colorado). Later this year, Platte River will purchase 12 MW from a new 42 MW wind project to be added at the Silver Sage Wind Project site near Cheyenne Wyoming.

Demand Side Management

Continuing load growth, ongoing evaluations of new generation resources (supply side) to meet growth, and heightening environmental concerns related to fossil-fueled generation, have led many municipalities to initiate utility-sponsored demand side management programs. Platte River began significant investments in demand side management programs in 2002.

Demand side management programs provide rebates, incentives, and education for customers to reduce overall energy use, reduce energy use at peak times, or provide distributed energy generation. Energy efficiency involves using technology to reduce the energy consumed for a given task, such as compact fluorescent lighting or ENERGY STAR appliances. Reducing peak demand, called demand response, may involve programs to reduce energy consumed by air conditioners in the summer and electric heat in the winter. Distributed energy is energy produced directly by individual homeowners or businesses. Solar or wind units for homes and businesses are considered distributed energy generation. Combined heat and power (CHP) is another form of distributed generation in which the efficiency of fuel-driven generation is increased by making use of the waste heat. CHP is typically used by larger commercial or industrial businesses that have a significant, year-round use for the waste heat.

Platte River funds and administers the *Electric Efficiency Program*, *LIGHTENUP*, and *Lighting With a Twist*. *The Electric Efficiency Program* provides commercial and industrial customers with rebates for prescriptive and custom energy efficiency projects, such as efficient appliances, air conditioning units, and motors. *LIGHTENUP* provides commercial and industrial customers with rebates for energy-efficient lighting retrofits. *Lighting with a Twist* promotes energy-efficient compact fluorescent lighting for residential customers, through customer education and funding to participating retailers of reducing customer costs of selected compact fluorescent products. Figure 4 shows the achievements in energy savings since 2002.

The programs that are funded and administrated by Platte River are offered in all four owner municipalities. In addition, the municipalities fund and operate their own individual programs. These municipal programs have also grown in recent years.

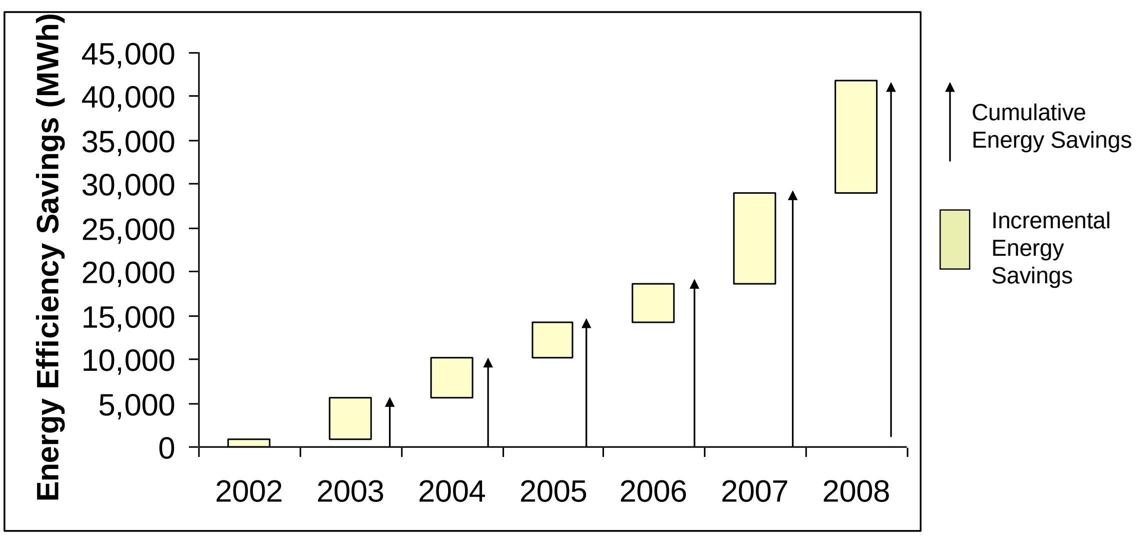


Figure 4: Platte River Energy Savings Achievements

For 2009, two new pilot programs are being developed to diversify Platte River's efficiency program portfolio and take advantage of regional efficiency efforts already underway. First, a retro-commissioning pilot program is being developed for commercial customers. Retro-commissioning refers to a standardized, documented process for identifying and implementing low-cost operational and maintenance improvements in existing buildings. This pilot program will provide funding to assist with retro-commissioning projects to determine the potential savings and cost effectiveness of the program before it is offered on a wider basis. Platte River is also working with a group of regional utilities and other stakeholders to develop an *Energy Star® New Homes Program* for Northern Colorado. This program will provide technical assistance, marketing, and rebates to homebuilders that build to Energy Star® standards. These new programs (as well as existing programs) will be examined and modified as necessary to ensure they are providing cost-effective energy savings.

4.2 Excellence in Plant Operations and Emissions Performance

Platte River takes pride in operating its electricity generation plants. The culture is one of continuous improvement so that customers can reap the benefits of low cost electricity and clean air. For over a decade, Platte River has made investments to improve efficiencies, reduce emissions and improve operations at the flagship Rawhide Energy Station, making it one of the most efficient coal-fired power plants in the United States.

Some examples of these investments in state of the art technology include the installation of a "neural network control system" which uses artificial intelligence in its computer systems to learn and improve plant combustion efficiency over time. In 2008, Platte River upgraded the steam-driven turbine generators using the latest technology to improve efficiency.

These improvements have produced direct benefits in terms of greenhouse gas reductions. Improving efficiency means Platte River burns less coal. This reduces energy costs for citizens and businesses while also reducing greenhouse gas emissions.

The electric power industry has taken note of Platte River's hard work and results. In October 2008, *POWER Magazine*, a leading electric industry publication, recognized the Rawhide Energy Station as one of the top five coal-fired generating units.

The commitment to clean technology has allowed Platte River's Rawhide Energy Station to operate well below all state and federal air pollution requirements. Figures 5, 6 and 7 illustrate how Platte River's plants' air emissions ranks against permitted levels and other plants in the nation. Figure 5 shows Platte River's performance compared to environmental operating permitted levels. Actual performance is kept to a fraction of the allowed emissions.

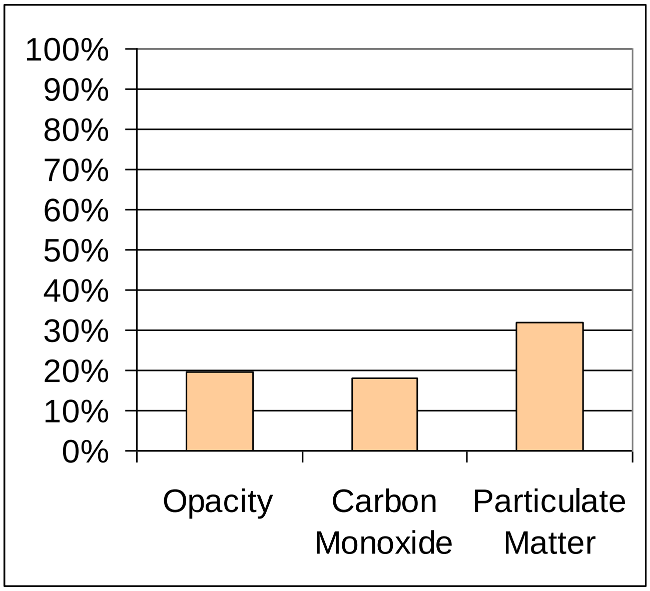


Figure 5: Platte River Emissions Compared to Permit Requirements

Compared with approximately 480 coal plants nationwide in 2007, the Rawhide and Craig coal plants sulfur dioxide emissions are among the lowest in the nation (Figures 6 and 7). Nitrous oxide emissions are also well below most other plants.

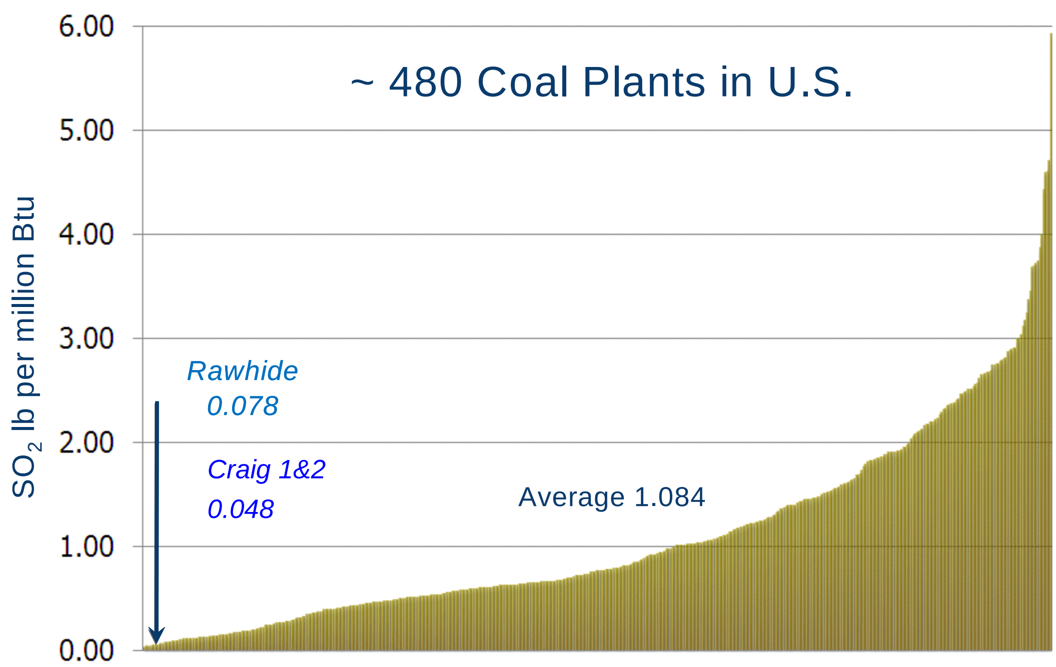
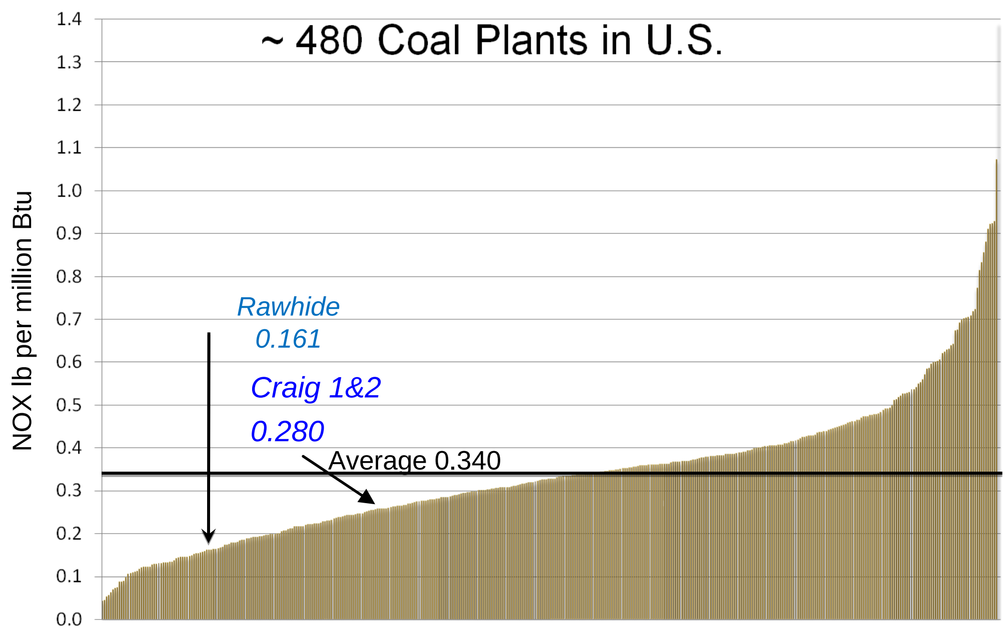


Figure 6 and 7: Platte River SO_2 and NO_X Emissions Compared with 480 U.S. Coal Plants



5. Climate Action Plan

The Governor's Climate Action Plan asks Colorado utilities to reduce their emissions to 20 percent below 2005 levels by 2020. In 2005, Platte River emitted approximately 3.5 million metric tons of carbon dioxide (CO_2). A twenty percent reduction below the 2005 level would be about 2.8 million metric tons of emissions. Taking into account plant improvements since 2005, upgrades in CO_2 monitoring systems, surplus sales market forecasts and expected load growth within the owner municipalities, Platte River would need to reduce its emissions by approximately 700,000 metric tons of CO_2 from a business-as-usual practice in the year 2020. Figure 8 shows Platte River's emissions history and 2020 emissions reduction target.

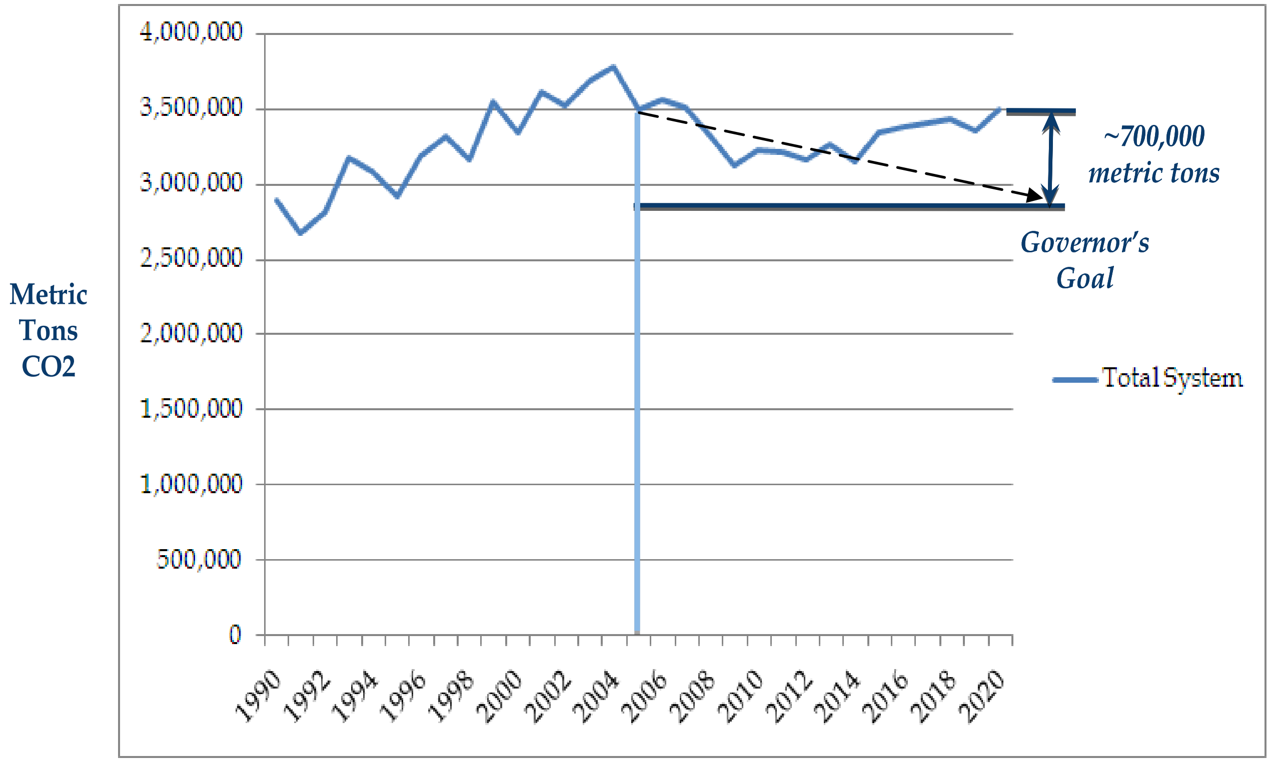


Figure 8. Platte River Emissions Profile and Reduction Target

Platte River and KEMA identified potential measures to achieve necessary emissions targets and divided them into short-term strategies to meet the 2020 goal and longer-term strategies to meet the 2050 goal. The list of 2020 strategies was chosen based on each measure's technological maturity, Platte River's available resources, maintaining reliability, and potential for significant emissions reductions. Longer-term options were also identified. Table 1 presents the list of these measures considered quantitatively and qualitatively for the Platte River Climate Action Plan.

Table 1: List of Measures to Meet Emissions Reduction Targets

Potential Measures to meet 2020 Targets (Quantitative Study)	Additional Measures to meet 2050 Targets (Qualitative Study)
• Reduce Reserve Sales of Electricity	• Plant optimization measures such as coal drying
• Demand Side Management (DSM) Programs	• Smart grid, demand response, and other advanced DSM programs
• Distributed Photovoltaics (PV)	• Utility Scale PV Arrays
• Combined-Cycle Natural Gas Base Load Generation	• Developing and New Technologies for Coal Generation
• Concentrated Solar Power	• Biomass Co-firing
• Increased Wind Generation	• Greenhouse Gas Offsets

KEMA performed cost analyses for each of the 2020 strategies. Due to the difficulty in predicting costs beyond 2020, the longer-term strategies are presented only in qualitative terms. Each of these strategies is briefly described in the following sections.

5.1 Key Strategies Evaluated to Meet 2020 Goals

The following strategies can be implemented either now or in the near term.

5.1.1 Reducing Reserve Sales

Currently, Platte River generates more energy than is needed by the owner municipalities and sells the surplus energy in the wholesale market. To reduce emissions by 2020, the portion of surplus sales associated with reserve energy could be reduced. Rather than selling this energy (as is currently the case), Platte River could hold required reserve capacity on its coal and gas units, reduce energy generation from these units and reduce reserve energy sales. This would reduce emissions from the Craig and/or Rawhide coal plants, and possibly a small amount of gas plant emissions.

5.1.2 Demand Side Management Programs

Platte River's owner municipalities' loads are currently projected to grow at an average annual rate of 1.7 percent between 2009 and 2020, such that use in 2020 will be about 20 percent higher than in 2009. Platte River's existing DSM programs are currently estimated to save 0.4 percent of load annually, so without DSM, loads would grow about 2.1 percent annually. Demand side management programs could be expanded to achieve as much as 1 percent savings annually. If the program expansion were initiated in 2010, the total energy growth by 2020 could be cut from 20 percent to about 11 percent.

A preliminary evaluation of technical and economic potential for demand side management programs, focusing on energy efficiency, found that a 1 percent reduction in annual load was an achievable goal, though aggressive, especially for small municipal utilities. A report recently published by the American Council for an Energy Efficient Economy[6], shows that states which have pursued aggressive demand side management programs have achieved 0.8 percent of 2007 kilowatt hour sales on average. The savings range from 0.1 percent in Texas to 1.8 percent in Vermont. Trends from 2006 to 2007 show an increase of goals and achievements over the two years. Many utilities are now setting goals at or above 1 percent, though it is unclear if the 1 percent level is sustainable over the long term.

An expanded demand side management program would include programs across industrial, commercial, residential, and government sectors with dedicated funding and incentives to push superior and sustained performance. Measuring and verifying performance of energy efficiency measures over time, and using established monitoring and verification protocols to do so is critical for program success.

Platte River is committed to long-term demand side management programs, and could explore broad strategies to grow program savings including:

- Regional coordination of programs, with the goal of developing a consistent set of core programs to ease implementation and customer understanding

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[6] American Council for an Energy Efficient Economy. "Meeting Aggressive New State Goals for Utility-Sector Energy Efficiency: Examining Key Factors Associated with High Savings."

- Identification of Platte River and all of the municipal utilities to customers as the source of these programs, to achieve economies of scale and market transformation across the areas Platte River serves

- Coordination and marketing with trade allies, such as large retailers, wholesalers, local energy engineers, and contractors

- Leveraging and expanding programs that have been successful elsewhere

Customers receive many benefits from demand side management programs beyond reducing greenhouse gas emissions. Many of these benefits are not quantifiable, but are valuable to the community, including:

- Reduced electricity bills for program participants

- Reducing vulnerability to energy price increases and volatility

- Improving the local economy and providing local jobs by establishing a market for third-party energy efficiency providers

- Reducing peak energy demand and improving utilization of the electricity system

- Diversifying the available energy supply

- Providing additional services to customers

- Non-energy benefits, such as aesthetics, comfort, and improved productivity

5.1.3 Increased Wind Generation

Wind energy is a mature technology with which Platte River has many years of experience, beginning with the Medicine Bow project in 1998. Wind power has the benefit of incremental installation and it helps Platte River achieve local, state (and potentially federal) renewable energy policies and standards for the owner municipalities. Wind generation is intermittent, meaning electricity is only generated when the wind blows at usable levels. While significant wind resources exist in northern Colorado and southern Wyoming, wind does not blow consistently or when the needs are greatest. For example, at the time of Platte River's system peak, there have been many years when wind generation levels were near zero. Therefore, unless cost effective storage technologies can be developed, wind generation does not reduce the need for firm generation capacity. Accordingly, increasing quantities of wind generation could require additional expenditures for generation capacity to firm the intermittent output from wind.

It is estimated that Platte River operations can incorporate as much as 50 MW of wind energy at a reasonable cost, balancing the intermittency of wind with the current generation resources. Beyond this level, storage or associated backup generation is likely needed, increasing the costs significantly. Recent price data (from wind installations in Colorado) support a projected cost of wind generation at approximately $95 per megawatt hour in 2013 including capital costs, transmission, and ancillary services (load following and regulation).

5.1.4 Concentrated Solar Power

Concentrated solar power (CSP) is a technology that focuses solar energy using convex mirrors, which look like troughs. The solar energy is concentrated to a steam boiler, which can power a generator. Concentrated solar is a viable technology that has been used in southern California since the 1980s, however it remains expensive and poses unique challenges. One challenge is that a plant can only generate when the sun shines during the day under little cloud cover. For much of the winter months, the solar troughs do not generate much power. That means power would be available for only approximately 27 percent of the year on average.

Photo credit: National Renewal Energy Laboratory

One potential solution is to include energy storage mechanisms in the solar array. These could include molten salts that maintain heat for generation after dark. For now, emerging storage technologies, including battery storage, make base load solar prohibitively expensive. Therefore CSP has been identified as a long-term strategy.

5.1.5 Distributed Generation Photovoltaics

A distributed generation photovoltaics (distributed PV) program could be initiated to provide rebates or other incentives to customers who install grid-connected PV systems. Rebates reduce the upfront cost of installation and shorten the time it takes to pay back the customer's initial investment through energy cost savings. Another approach provides a periodic incentive over the life of the system based on its actual electricity generation. PV solar provides customers an option for reducing their individual environmental impact and can provide work for local solar businesses. The current cost of solar PV is very high relative to other emission reduction options.

5.1.6 Increased Natural Gas Generation

Photo credit: Siemens Inc

Currently, Platte River generates its base load power with coal units because they operate at the lowest cost. Roughly speaking, the cost of coal-fired generation is about one-sixth the cost of natural gas fired generation, primarily because of the difference in fuel prices. This is why the natural gas units are run only on the hottest days in the summer when there is a *peak* demand for electricity to run air conditioners. These units also enhance reliability as they provide backup for coal units.

Because natural gas units emit about one-third to one-half of the carbon dioxide per kilowatt-hour generated by traditional coal units, generating more electricity using natural gas results in lower greenhouse gas emissions, though at a much higher cost. Therefore, the effects of running a combined-cycle natural gas plant continuously through the year to offset coal generation were analyzed.

To do this, Platte River could convert the newest and most efficient natural gas unit (the GE7FA unit) to a combined-cycle unit. Currently, the GE7FA unit is run as a *simple cycle*, meaning natural gas is combusted in a turbine, which spins an electric generator. Adding a Heat Recovery Steam Generator (HRSG) increases the efficiency of the unit (from 38 percent to nearly 60 percent) by capturing waste heat to spin an additional electric generator. Adding the Heat Recovery Steam Generator, (making it a “1 on 1” configuration) raises the capacity of the unit to about 219 MW. Later, if additional capacity were needed, an additional turbine could be added to the system (making it a “2 on 1” configuration), allowing the plant to run at a maximum capacity of about 500 MW. Large gas units such as this may experience fuel supply constraints, particularly if this strategy is widely deployed. Costs for the large unit would also be much higher.

5.2 Possible Longer Term Strategies

As part of the planning process for the Climate Action Plan, wide varieties of strategies were identified. This section addresses strategies that were considered but not included in the cost-benefit analysis for 2020. Appendix A provides a summary of these strategies.

5.2.1 Optimizing Rawhide Power Generation Facilities

The coal-fired power generation facilities at Rawhide consist of a 280 MW coal-fired generating facility, with cooling reservoir, coal-handling facilities, emissions control equipment and related transmission facilities. Rawhide has been operating since 1984, and numerous upgrades and improvements have been made. As shown in Figure 9, a series of projects over the last 14 years have resulted in 7 percent improvement in heat rate, a key determinant of efficiency and greenhouse gas emissions.

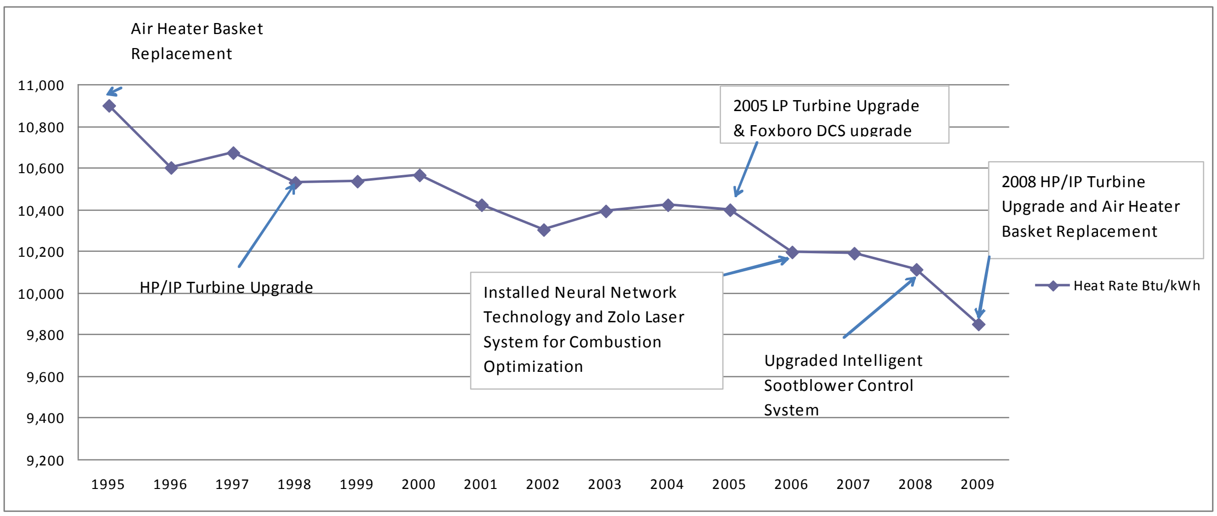
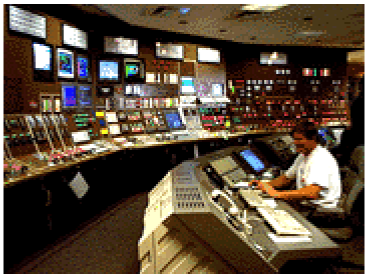


Figure 9: Rawhide Heat Rate History

Platte River installed neural-network control system to optimize thermal efficiency and emissions reductions. The network identifies minute changes in key parameters, and the controls make adjustments to respond to changes in the combustion process. This highly efficient system is crucial to getting the most electricity out of every pound of coal burned.

Further improvements in heat rate may be possible. Platte River is evaluating a list of measures that may improve heat rate and reduce emissions. Periodic blasting of the super-heater and economizer to clean the tubes is one measure identified as part of periodic maintenance. Platte



River is also evaluating replacement of electric motors at Rawhide to reduce onsite energy consumption.

The measure with the most long-term potential involves using waste heat from the natural gas turbines to reduce the moisture content in the coal feed to Rawhide Unit 1. This option requires consistent rather than intermittent use of the gas units, because consistent feed characteristics are required to maximize efficiency and minimize emissions. Currently the natural gas units are employed only when peak power is required, generally for a small fraction of the operating hours of the coal unit. Coal drying will be considered as a medium- or long-term option, appropriate when combined with a consistent source of waste heat, such as base load natural gas units.

5.2.2 Biomass

Biomass involves taking waste or dead woody materials and burning it for electricity generation. Biomass sources currently available have a wide range of physical and chemical characteristics (density, moisture content, heat properties). Co-firing raw biomass with coal in a plant boiler would reduce operational control and likely increase emissions. A new technology for preparing biomass for co-firing is currently under development. Using a process similar to coffee roasting, the biomass is heated to 200 to 300^{o}C. The roasted biomass is formed into pellets that are designed to be fed along with coal into the combustion units. The pelletized biomass can be prepared and transported over several weeks, whereas raw biomass must be transported before it decays. Co-firing with pelletized biomass may be appropriate in the mid-term, as this technology is developed.

Woody Biomass

Pelletized

Photo Credit: California Energy Commission

5.2.3 Smart Grid

The existing electric grid delivers power from points of generation to consumers through a transmission and distribution system. Platte River transmits electricity from power plants and purchase sources to distribution systems in the cities of Fort Collins, Longmont, Loveland, and Estes Park. The cities distribute power to retail consumers.

The smart grid concept is for a widely distributed energy delivery network that is automated and allows a two-way flow of energy and information. Smart energy technologies will enable the local utility to monitor the health of the power delivery systems, better managing voltage levels, and restore power more quickly in the event of outages. In the home, energy management systems will control lighting and high efficiency appliances, such as dishwashers, water heaters, air conditioners. Demand side automation, such as advanced metering, in-home networks and energy management systems, provides information and choices for customers to manage their energy use.

Platte River supports smart grid concepts, although most will require implementation by the municipal distribution utilities. Platte River will support and coordinate with the city utilities to implement smart grid measures.

5.2.4 Other Demand Side Management Programs

In addition to the programs described above, Platte River could develop complementary programs for distributed generation, peak reduction, and education.

Distributed generation involves small-scale power generation outside of traditional utility operations. Typical projects include:

- Combined heat and power consisting of onsite systems that generate usable heat and electricity at commercial, industrial and institutional facilities
- Biogas from wastewater treatment plants utilizing biogas from anaerobic digestion, which is collected and combusted, generating heat and possibly electricity for use at the facility
- Small-scale wind turbines at buildings, housing developments, or other facilities

5.2.5 Carbon Offset Projects

Greenhouse gas offset projects have emerged in recent years as a part of the solution to rising greenhouse gas emissions. Greenhouse gas emissions in one location could be reduced to *offset* greenhouse gases emitted elsewhere. For example, Platte River could work

Photo Credit: California Energy Commission with a local landfill to capture the release of methane (CH_4) into the atmosphere and use it to generate electricity. Combusting CH_4 converts it to CO_2. Since CH_4 is 21 times as powerful as a greenhouse gas relative to CO2, this conversion results in a considerable reduction of greenhouse gas emissions that also provides renewable electricity. Other opportunities exist in forestry, biogas from dairy farms, agricultural soils, and wastewater treatment. Many of these opportunities could be developed locally, perhaps in partnership with the Colorado Carbon Fund.[7]

Standard protocols and verification requirements through organizations, such as the Climate Action Reserve and the Voluntary Carbon Standard, provide credibility that emissions projects legitimately reduce emissions. The EPA is also exploring options for operating its own greenhouse project offset registry. After the primary opportunities for emissions reductions are exhausted, particularly those that are most cost effective, emissions offsets could become a viable way to reduce carbon.

5.2.6 Utility Scale Photovoltaic Generation

Photovoltaic (PV) technology converts the sun’s radiant energy directly into electricity; when sunlight hits a PV cell, a semiconductor, electrons are dislodged creating an electrical current which can be captured and harnessed. Solar technologies can generate electricity without producing any emission. When a 30 percent solar investment tax credit was provided to investor owned utilities, many utilities used the opportunity to own solar. Recently Pacific Gas & Electric Company entered into an agreement with BrightSource to purchase 1310 megawatts of solar PV power, the largest contract to purchase solar power to date. Previously, Southern California Edison bought 1300 megawatts of solar capacity.[8]

However, utility-scale solar is not without challenges. One of the major implementation barriers is cost. The levelized cost of utility solar generation is generally estimated to be above $150/MWh, while many competing renewable technologies, such as wind, biomass and geothermal, are well below the cost of generating solar. Although the cost of solar generation is falling, it is not expected to catch up with other renewable technologies in the immediate future. Solar projects are capital intensive; with financing conditions deteriorating in the past year, it

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[7] The Colorado Carbon Fund is a voluntary carbon offset program, developed by the Governor’s Energy Office to support high quality climate change mitigation projects in Colorado.
[8] http://www.environmentalleader.com/2009/05/15/new-solar-deal-breaks-previous-record-barely/

might be more difficult to obtain financing for solar projects. Generally, land availability, land use permitting and transmission availability are major implementation barriers for utility-scale solar. However, if Platte River sites the solar project at the Rawhide site, these traditional barriers may be mitigated. Others barriers to developing utility-scale solar projects had been the procurement of solar panels and the shortage of experienced solar installers. These are expected to be short-term issues.

5.2.7 Developing and New Technologies for Coal Generation

Technologies that are currently in the development stage have the potential to be viable in the long term. Additional technologies may be developed in the future that allow coal generation, likely with a mechanism to capture carbon dioxide and store (sequester) it long term, to better protect the atmosphere. Experts believe that the use of carbon capture and sequestration are critical to the long-term use of coal in a carbon-constrained world.[9]

Photo Credit:
National Energy Technology Laboratory

Integrated Gasification Combined Cycle, or IGCC, is a technology that turns coal or coke into a synthesis gas. Synthesis gas is a mixture of hydrogen and carbon monoxide. After gasification and cooling, impurities are removed from the coal gas. The coal gas is then combusted to power a combustion turbine that generates electricity. The U.S. Department of Energy has been sponsoring demonstration projects with IGCC for over 15 years, and currently four IGCC demonstration utility scale plants exist in the U.S and Europe.

The process is expensive, and reliable performance using coal has not been consistently demonstrated. This process has been considered potentially easier to adapt to carbon capture and sequestration than pulverized coal combustion plants.

Carbon capture technologies are designed to remove carbon dioxide from exhaust gas streams. Chemical absorption using solvents is one option considered to be commercially available. The

[9] The Future of Coal, Options for a Carbon Constrained World, An interdisciplinary study by the Massachusetts Institute of Technology. Dr. James Katzer, Executive Director. ISBN 978-0-615-14092-6. 2007.

process requires significant energy, primarily to regenerate the amine solution. Other carbon capture technologies use membranes, physical absorption or cryogenics. All are expensive, and many are in early stages of development.

Carbon sequestration involves injecting captured carbon into a geological formation or the ocean. The goal of sequestration is to remove carbon dioxide from the atmosphere permanently, using subsurface reservoirs, aging oil fields, saline aquifers, ocean water or other carbon sinks. This technology may be required to minimize carbon in the atmosphere in the future; however, there are significant concerns about the potential for sudden releases of large amounts of carbon, should the technology fail, with unknown impacts to the Earth's climate systems.

5.2.8 Long Term Planning Summary

Meeting the long-term goal of reducing greenhouse gas emissions 80% by mid-century will require dramatic changes in the way energy is produced, delivered and used. To be effective, all nations and all sources must share in reducing CO_2 emissions. Increased use of zero-emission technologies will be required, including renewable energy technologies and potentially the addition of nuclear generation. Energy efficiency technologies and conservation behaviors must be expanded to all sectors. For national security, energy independence and economic reasons, coal-fired generation should remain in the U.S. resource mix. Energy storage and Smart Grid control technologies will be required to improve the efficiency of the electric grid and to allow integration of large amounts of intermittent renewable energy. Finally, integration of plug-in hybrid vehicles and other transportation technologies must be addressed.

All of these issues will require significant expansion of research and development, and eventual application of new or enhanced technologies. These issues will also fundamentally impact long-term resource planning, financial planning and risk management for Platte River.

5.3 Modeling Results

Platte River and KEMA modeled each of the six measures designed to meet the 2020 target: reserve sales reduction, DSM, wind, distributed PV, natural gas combined-cycle, and concentrated solar. A description of the model is provided in Appendix B.

An analysis was performed to determine the CO_2 emissions that could be saved by each of these measures. The results of this analysis are presented in Figure 10, displayed as a waterfall chart.

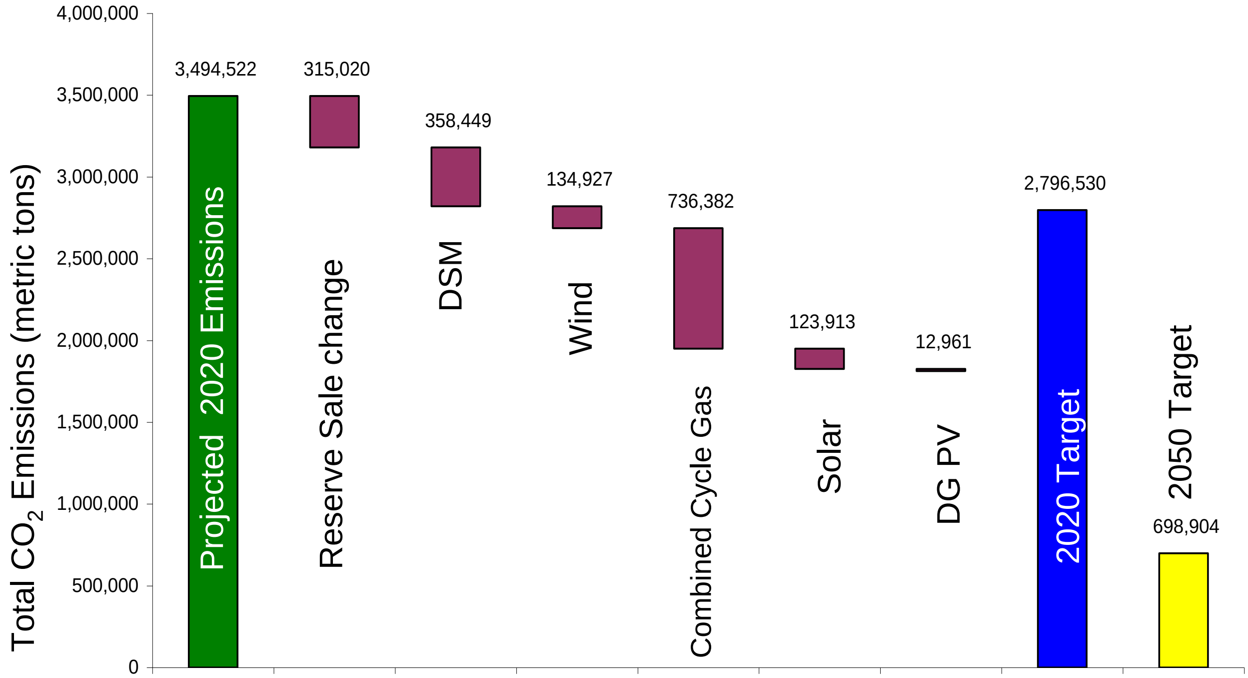


Figure 10. Waterfall Chart of Emissions Reductions

The green bar in the chart shows the projected emissions for Platte River in the year 2020. Each of the evaluated measures shown in the purple bars represents a potential decrease in emissions. The blue and yellow bars show the 2020 and 2050 emissions targets. The chart demonstrates that the evaluated measures can achieve the desired emissions target in 2020.

KEMA estimated how much each measure would cost in relation to a business-as-usual scenario. The resulting data provides an understanding of the "cost-effectiveness" or how the measures stack up in terms of cost per ton of CO_2 mitigated. The results of this calculation are presented in Table 2.

Table 2: Summary of Modeling Results

Measure Name	Measure Cost (Million $)	Reference Cost (Million $)	Net Cost (Million $)	CO_2 Abatement (1000s of Metric Tons)	Cost per Ton ($/Metric Ton)	Cumulative CO_2 Abated (1000s of Metric Tons)
Reserve Sale Reduction	$70	$71	-$1	315	-$2	315
Demand Side Management	$91	$71	$20	358	$55	673
Wind	$83	$71	$12	135	$88	808
Combined Cycle	$164	$71	$93	736	$127	1,545
Concentrated Solar	$94	$71	$23	124	$187	1,669
Distributed PV	$74	$71	$3	13	$249	1,682

Table 2 demonstrates the calculated cost of the lower carbon option against the reference or "business-as-usual" cost. The net cost is the measure case subtracted from the reference case. This number is then divided by the total amount of CO_2 reduced for each measure to calculate a dollar per metric ton of CO_2 abated. The final column shows the cumulative CO_2 abatement of all the measures. The graphical presentation of this data is shown in figure 11. Note that all estimates are preliminary and will likely change over time.

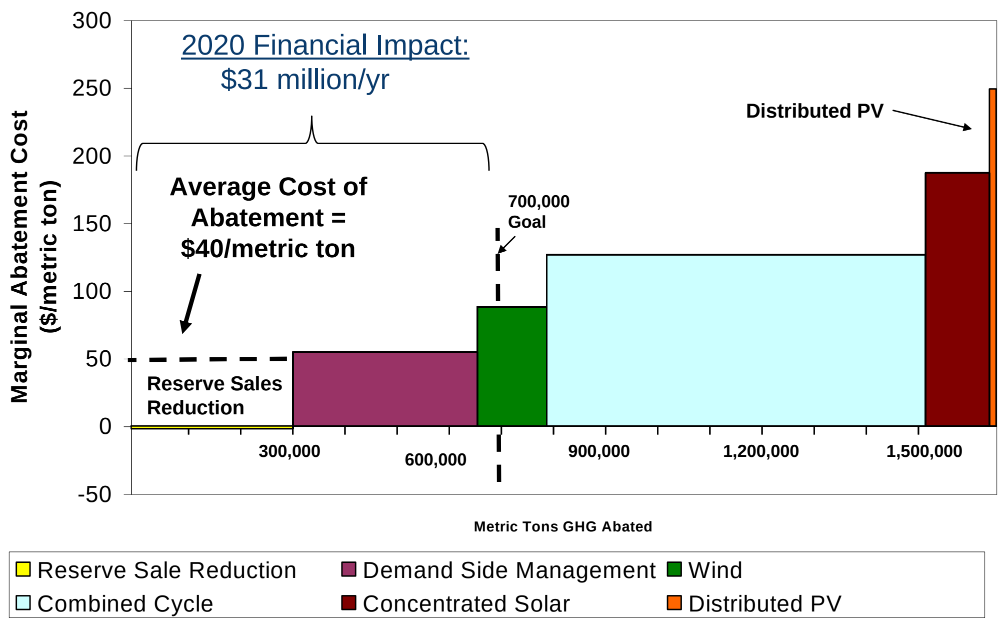


Figure 11. Marginal Abatement Curve

This is known as a marginal abatement curve or an emissions reduction supply curve. The curve demonstrates graphically which measures make the most economic sense to meet the 2020 target. On the left side of the chart are the measures that are the most cost effective while on the right side of the chart are the least cost effective measures.

Also, it should be noted that the curve is measured from Platte River's financial perspective and does not take into account costs and benefits from the consumers' perspective. For example, an energy efficiency program would mean that Platte River spends money to encourage consumers to retrofit their homes and businesses with energy efficient appliances. By 2020, the participating consumers require less energy than they would have normally and receive lower energy bills that would ultimately pay back the initial investment. Subsequently energy savings provide them with net benefit. But in 2020, the model assumes that Platte River not only spends the money on the energy efficiency program but it also loses revenue from not selling as much energy. Therefore, the marginal abatement curve in Figure 11 shows DSM as a net cost, whereas for customers this would be a negative cost (revenue). A marginal abatement curve from the customers' perspective is not treated in this study, but it is likely that only DSM provides a net revenue source for consumers.

The vertical dotted line in Figure 11 represents the desired emissions reduction in the year 2020. Adding up the costs of each of the measures needed to meet the target and dividing by the reduction of emissions produces an average cost of abatement, represented by the horizontal dotted line, of approximately $40 per metric ton of CO_2 reduced.

5.4 Discussion of Modeling Results

The modeling demonstrates that meeting the 2020 target appears technically feasible with the identified options. Platte River could meet the 700,000 metric ton reduction through a combination of reserve sales reduction, demand side management programs, and increasing wind generation at an average abatement cost of approximately $40 per metric ton. This would result in a net cost of roughly $31 million per year in 2020. Platte River estimates this to be approximately a 16 percent increase in wholesale electricity rates, in addition to the base case rate forecast.

KEMA modeled the following portfolio of solutions to meet the 2020 target:

- Reduce generation at Craig station and end reserve energy sales

- Implement an aggressive demand side management program to achieve a 1 percent reduction in load every year (with a four year ramp up)
- Install 30 MW additional wind generation (for a total of 50 MW)

Platte River's generation and emissions profile under this scenario is shown in Figures 12 and 13.

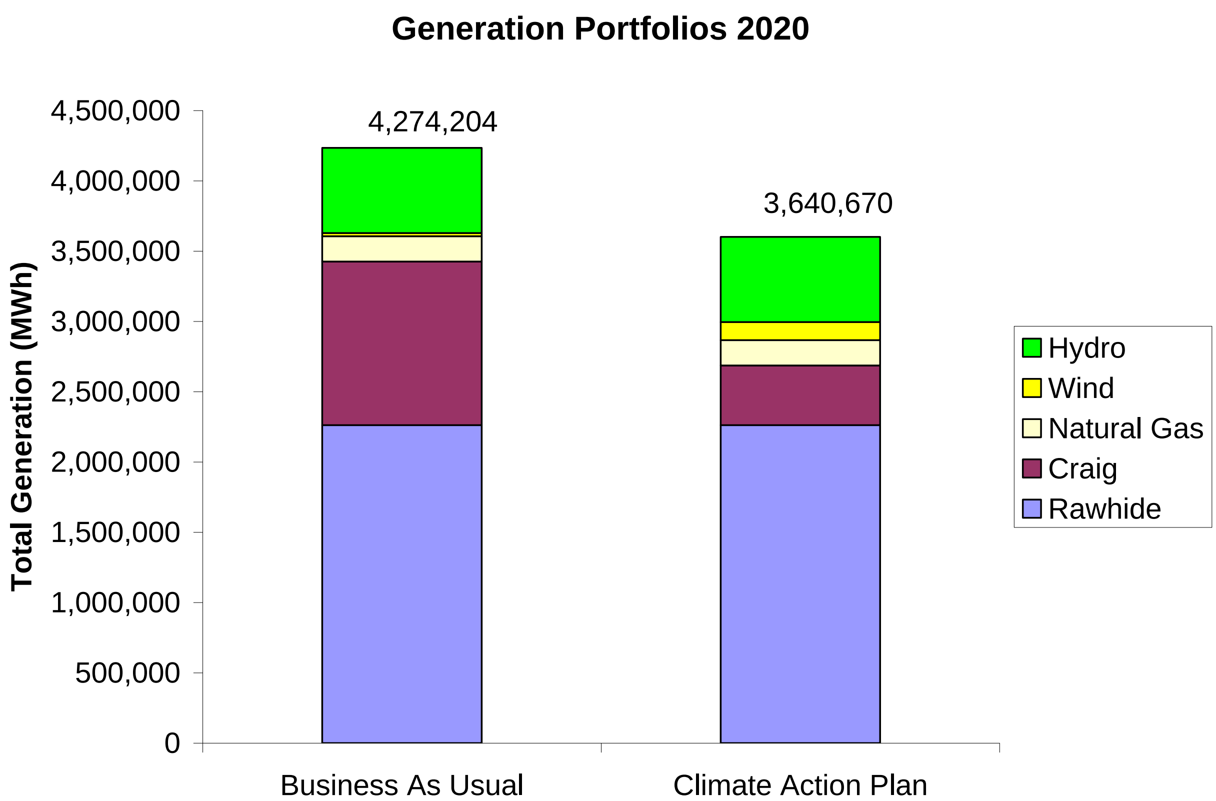


Figure 12. Platte River Generation Portfolio in 2020 under Business-as-Usual and Climate Action Plan Scenarios

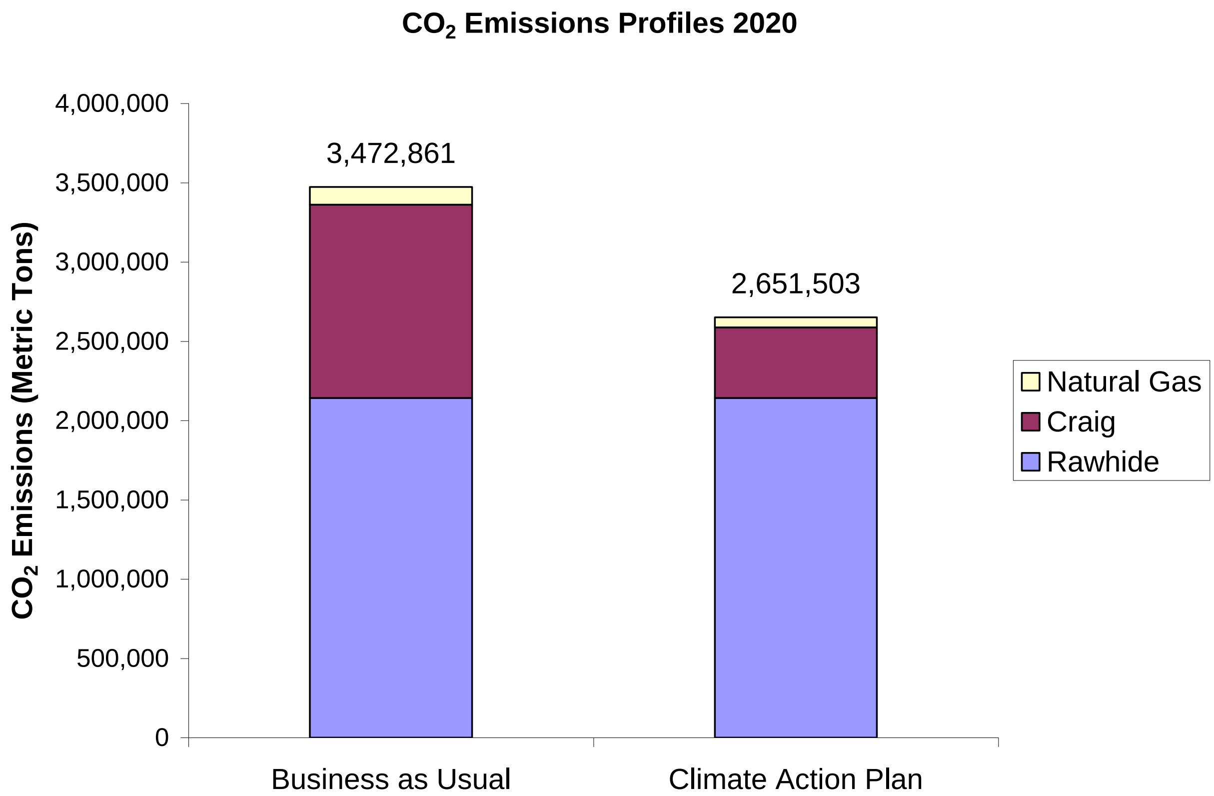


Figure 13. Platte River Greenhouse Gas Emissions in 2020 under Business-as-Usual and Climate Action Plan Scenarios

The reserve sale reduction has potential to provide a significant offset of emissions at approximately net zero cost. Depending on the unit used to carry reserves, savings in fuel costs and reserve charges could effectively offset lost revenue. For this measure, note that emission reductions for Platte River may be somewhat offset by emission increases elsewhere in the region.

Demand side management programs also provided a significant lever in meeting the reduction goal. The KEMA evaluation shows that in Platte River's territory, a 1 percent annual reduction in load may be achievable and sustainable after a four-year program ramp up. Significant opportunities exist for efficiency gains in the residential, commercial, and industrial sectors. Platte River provides power to the municipalities but not the customer directly; programs established at Platte River are implemented with the municipalities. Regional coordination of DSM programs in all four cities and with neighboring utilities is critical for capturing economies of scale through uniform implementation, branding, marketing and coordination with trade allies. The model estimates for DSM costs are based on the cost to Platte River. When benefits to the customers are included, the costs are reduced.

Wind energy could also provide a significant amount of carbon free energy. Platte River could install another 30 MW of wind by 2020 on its current system (for 50 MW total), however any more than that would require significantly higher costs to integrate that generation into the system as a firm resource. Until storage or other integration technologies advance, wind power remains a challenge.

No changes were modeled to Rawhide generation compared to the business as usual case between now and 2020. Rawhide is a highly efficient plant with lower operating costs and lower emissions than Craig. Assuming incremental reductions in Craig generation, reduction of Rawhide generation was not necessary to meet the 2020 reduction target.

6. The Climate Action Plan as a Living Document

This climate action plan is a forward-looking document. As such, many questions remain regarding the future of technology and climate policy. Like any other business, Platte River makes investment decisions based on perceived risks and opportunities. Significant regulatory uncertainty makes it difficult to make informed decisions on investments that must ultimately balance the three key principles of reliability, affordability, and environmental stewardship.

Some key questions for the future:

- Will comprehensive energy and climate legislation be passed and signed in this session of Congress? What will the form of that legislation be? How many emissions allowances will Platte River be required to purchase? What will the cost of carbon emissions be?

- Will there be a Federal renewable energy standard?

- Will EPA regulate greenhouse gas emissions through the Clean Air Act?

How the cap-and-trade program is designed has important ramifications for Platte River and its owner municipalities. The carbon price and the number of allowances Platte River would need to purchase will determine how much carbon liability must be passed on to consumers. The following chart shows how much Platte River would have to pay under varying scenarios of auctioning and carbon price in the year 2020.

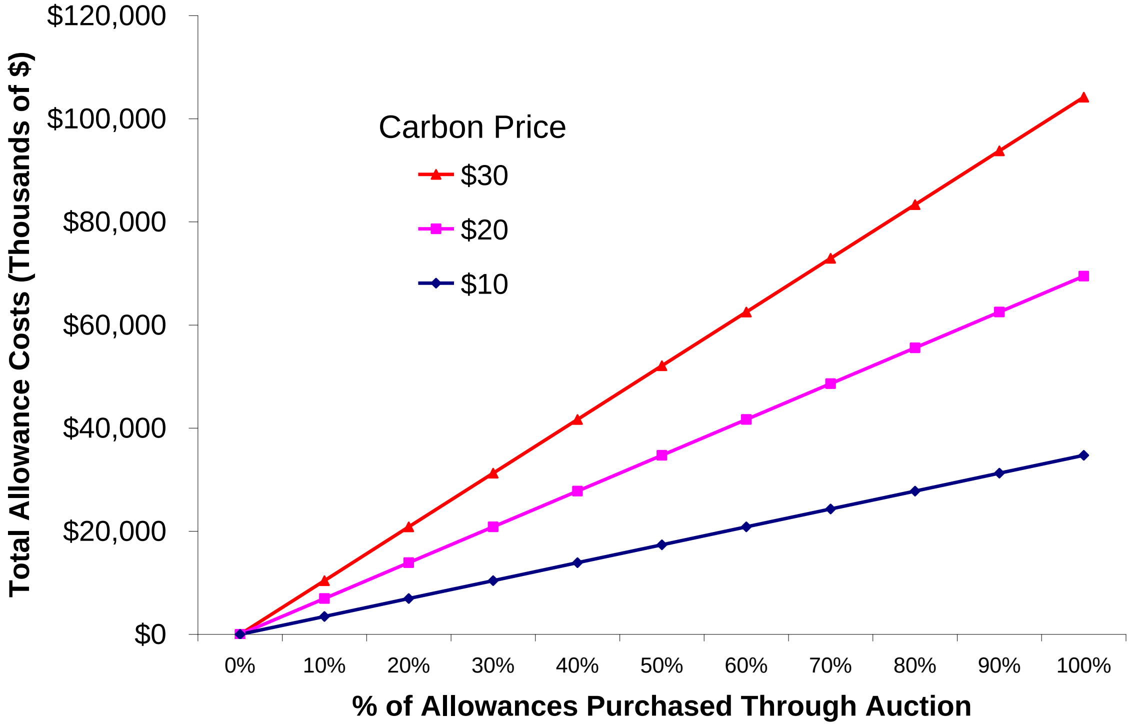


Figure 14: Potential Carbon Liabilities in 2020

In addition to the political uncertainty, there is also technological uncertainty. While the 2020 target appears achievable with current technology, the 2050 target provides a much more difficult challenge. Meeting an 80 percent reduction target would require significant advances in new technologies.

While there are many uncertainties, what is clear is that there is no single solution. Our energy future will likely be one of diversification of multiple sources of energy provided to increasingly efficient homes, industries, businesses, and vehicles. Renewables, efficiency, natural gas, biomass, technologies for reducing emissions from existing coal plants, carbon capture and sequestration, Smart Grid and new energy storage technologies must all be considered.

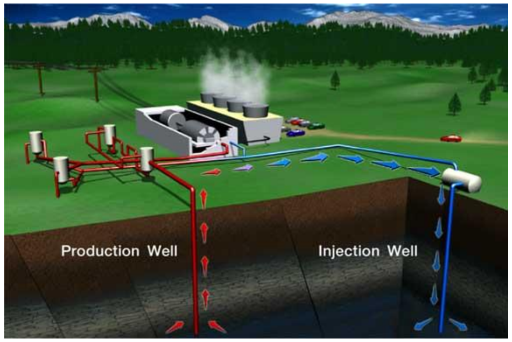
As technology continues to progress and as our political leaders grapple with this monumentally difficult task, Platte River will continue to provide leadership in supplying the lifeblood of the local economy while always striving to protect our environment now and into the future.

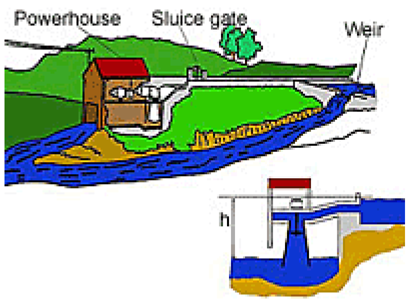
Appendix A: Measures Considered in the Climate Action Plan

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Demand Side Management	Energy Efficiency Programs 	Provide incentives, education, and marketing to foster energy efficiency in the residential, commercial and industrial sectors. Energy efficiency programs reduce the need to generate energy and emissions.	Ongoing	Yes	Yes
Demand Side Management	Distributed generation photovoltaic solar power  Photo credit: Archicentral architecture news daily	Provide incentives, education, and marketing for customers to install and operate solar photovoltaic systems. These systems will replace energy generated from coal or gas with usable energy from the sun.	Short-term	Yes	Yes
Demand Side Management	Combined Heat and Power  Photo credit: Siemens, Inc.	Encourage use of onsite systems to generate usable heat and electricity at commercial, industrial and institutional facilities. Facilities that require heat or cooling throughout the day and night can use fuel more efficiently than a central power plant.	Short-term	Yes	No

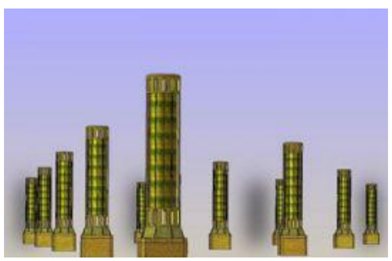
Type	Strategy	Description	Time Frame	Included In Review	Quantified
Demand Side Management	Biogas at Waste Water Treatment Works  Photo credit: AEI Engineering	Encourage municipal waste water treatment plants to capture the digester gas (methane) and generate electricity or heat with the gas for onsite operations. Fuel cells and engines are available technologies. Generating power or heat from waste water gas reduces emissions.	Short-term	Yes	No
Demand Side Management	Smart Grid 	Support member cities in deploying advanced metering and smart grid technology. Smart grid is an automated, widely distributed energy delivery network characterized by a two-way flow of energy and information. Advanced metering can assist customers in understanding how they use energy, allowing consumer choice.	Short-term	Yes	No
Renewable Generation	Wind Power 	Turbines convert kinetic energy into electricity. By the end of 2009, Platte River will have approximately 20 MW of wind power. An additional 30 MW of energy could be harnessed near the Rawhide site or from other sites. More wind energy would require either storage or other integration resources. Additional wind may be added over the mid- and long-term depending on integration resource or storage availability.	Ongoing	Yes	Yes

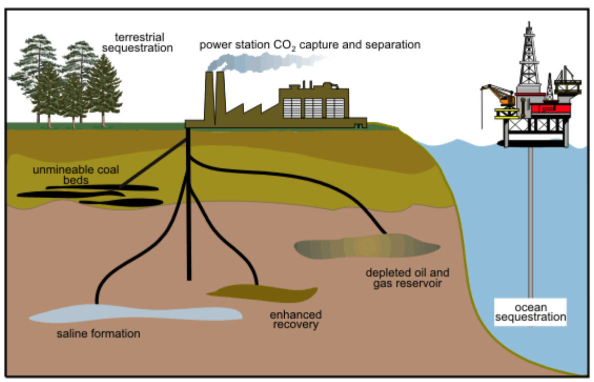
Type	Strategy	Description	Time Frame	Included In Review	Quantified
Renewable Generation	Co-firing with biomass  Woody Biomass  Pelletized Photo credit: California Energy Commission	Feed coal and biomass fuel together to unit #1 at Rawhide. Biomass sources currently available have a wide range of physical and chemical characteristics (density, moisture content, heat properties). Co-firing with raw biomass would reduce operational control and likely increase emissions. Developing technology of roasting and pelletizing biomass yields more consistent characteristics, as well as decreasing transport limitations. Co-firing with pelletized biomass may be appropriate in the mid-term.	Mid-term; appropriate if technology matures	Yes.	No. Mid-term strategies (post 2020) not quantified.
Renewable Generation	Solar Thermal Generation 	Solar cells, arranged to focus the solar energy on a fluid-filled pipe, convert solar energy to hot water or steam for generating electricity. This technology was evaluated for short-term deployment, but was found to be more expensive than other technologies. As costs come down, this technology will be re-evaluated.	Mid-term. Appropriate as costs are reduced.	Yes	Yes

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Renewable Generation	Solar Photovoltaic Generation – Utility Scale 	Photovoltaic cells convert solar energy directly into electricity. Large scale arrays of solar cells can be installed at the Rawhide site to generate power. Power is generated only during daytimes when solar radiation to the cells occurs. Because this is a non-continuous source of energy, storage or backup with another energy source (such as natural gas) is needed. Currently, the costs for these systems exceed the costs for other low carbon options. As this technology becomes more mature, the costs may come down.	Mid-term Appropriate as costs are reduced. Will require associated storage	Yes	No
Renewable Generation	Geothermal  Photo credit: University of Wisconsin-Eau Claire	Geothermal sources, where available, can be utilized to generate power. Underground sources of hot water or natural steam can be extracted from production wells and used to power the turbine generator. Geothermal sources have not been identified in Platte River's territory. Geothermal resources are available in western and southern Colorado.	Not Available	No	No

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Renewable Generation	Small-Scale Hydroelectric Power  Photo credit: Re-Energy.Ca	Hydroelectric power is generated from running water, typically through a turbine. Large scale hydropower requires dams. Small scale hydroelectric power systems direct the flow of a fast-moving stream or river to a turbine via a weir and a long pipe. The water is directed to the blades of the turbine in nozzles, and the turbine spins, running an electric generator. PRPA has evaluated several options for small scale or run-of-stream hydroelectric power. All of these were very small but may be considered in the future.	Mid -Term PRPA will evaluate options as available	Yes	No
Generation	Efficiency Improvements at Rawhide  Photo credit: Pratt and Whitney	Platte River is committed to continually seeking appropriate upgrades in efficiency at Rawhide. For example, periodic media blasting to clean boiler tubes from coal ash may be considered to improve heat rates.	Ongoing	Yes. Facility will foster current practice of continuous improvement	No. Many small measures

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Generation	Emissions optimization at Rawhide	PRPA intends to continually identify relevant controls and equipment to minimize emissions.	Ongoing	Yes. Facility will foster current practice of continuous improvement	No.
Generation	Preconditioning fuel (coal drying)  Photo Credit: Alibaba.com	Coal has embedded moisture when purchased. The moisture does not contribute to the combustion of the coal. Reducing the moisture of the coal with waste heat onsite would improve the heat rate. This option requires an available waste heat source to be cost-effective and may be appropriate if a natural gas unit is refitted for combined cycle base load operation.	Mid-term; if a gas unit is retrofitted for baseload operations.	Yes. Improvement in heat rate of approximately 1percent may be possible	No. Mid-term strategies (post 2020) not quantified.
Generation	Combined Cycle Natural Gas Units 	Existing or new gas-fired power generation units at Rawhide could be converted from operations designed primarily to meet short-term peaks in demand to baseload operating units. The current units are single cycle (one gas turbine); they could be converted to run one or two steam turbines (combined cycle). Natural gas is considerably more expensive than coal, but produces about half as much GHG emissions.	Mid-term: possible after 2020 depending on cost.	Yes	Yes

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Generation (New Technologies)	Integrated gasification combined cycle (IGCC)  Photo credit: National Energy Technology Laboratory	Integrated gasification combined cycle is a process that turns coal into a synthetic gas, which is then combusted in a gas turbine to generate electricity. The process is expensive and the technology is not yet consistently reliable.	Long-term: may be appropriate if technology matures	Not at this time. May be re-evaluated if technology matures	No.
Generation (New Technologies)	CO_2 capture  Prototype technology for extracting carbon dioxide from air Photo credit: Global Research Technologies, LLC	Technologies for capturing carbon dioxide are currently the subject of ongoing research. Capture technologies include absorption by solvents, capture by membranes or solid sorbents, and cryogenic processes. Captured carbon dioxide could be removed from the atmosphere by sequestering below ground.	Long-term: may be appropriate if technology matures	Not at this time. May be re-evaluated if technology matures	No.

Type	Strategy	Description	Time Frame	Included In Review	Quantified
Generation (New Technologies)	Oxyfuel combustion  Photo credit: National Energy Technology Laboratory	Fuel (coal) is burned in oxygen rather than air, yielding a pure carbon dioxide exhaust that could potentially be captured and subsequently sequestered from the atmosphere. Currently at the research stage, and very expensive.	Long-term: may be appropriate if technology matures	Not at this time. May be re-evaluated if technology matures	No.
Generation (New Technologies)	CO_2 sequestration  Source: Energy Information Administration, Department of Energy	Carbon dioxide captured from the emissions is stored away from the atmosphere in soils, oceans, or plants.	Long-term: may be appropriate if technology matures	Not at this time. May be re-evaluated if technology matures	No.

Appendix B: Model Description

KEMA Inc. designed the Platte River Power Authority Climate Action Plan model (PRPA-CAPM) for Platte River's Climate Action Plan (CAP). The CAP was envisioned as a high-level strategy document that evaluates a myriad of unique strategies for achieving desired emissions reductions goals. To assist in this effort, the model generates a marginal abatement cost curve (MAC) as its principle output. A MAC curve is a representation of the various total feasible amounts of reductions versus the costs of the measures needed to accomplish that level of total reductions, with costs ordered from the lowest to the highest individual costs. The value for cost expressed as $/metric ton is depicted on the vertical axis and a total metric tons mitigated is depicted on the horizontal axis. This graphically demonstrates the relative "cost effectiveness" of each measure such that planners can gain a clear understanding of which measures achieve the highest number of emissions reductions per dollar. The figure below presents a generic depiction of a MAC curve.

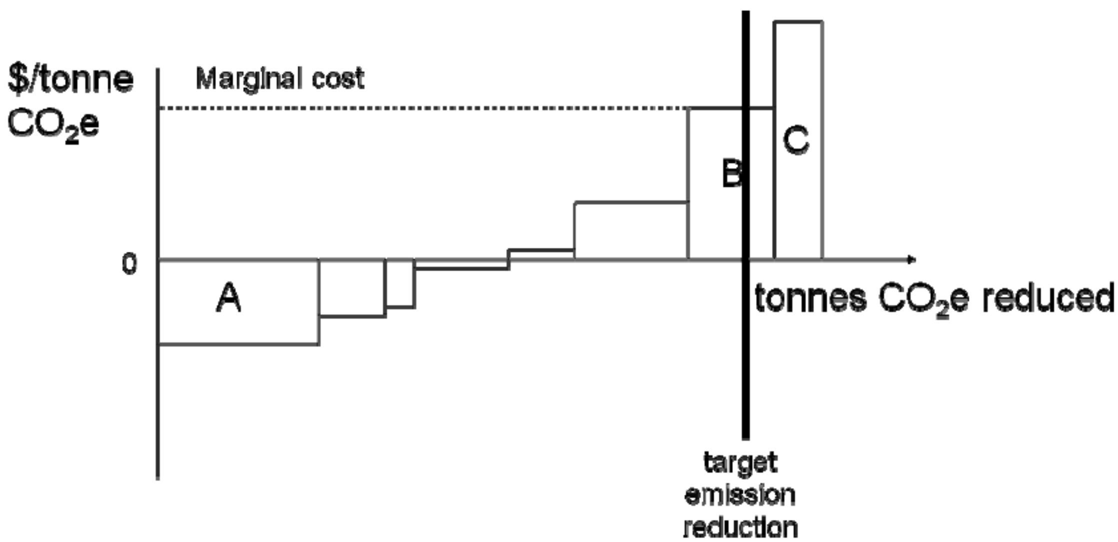


Figure 1: A simple depiction of a MAC curve[10]

[10] Precourt Institute for Energy Efficiency 2007. "Analysis of Measures to Meet the Requirements of California's Assembly Bill 32" January.

To develop a cost per metric ton, the model compares a proposed measure case versus a business as usual (BAU) scenario. The BAU case generates outputs for energy, greenhouse gas emissions, fuel costs, reserve sales revenue, and an optional cap-and-trade cost section. The measure case runs on the same excel engine with an additional line item for "measure costs." These measure costs can include capital costs for new equipment, debt service, additional transmission and distribution costs, program costs, and lost revenue resulting from DSM programs.

The following equation determines the $/metric ton abated:

$$\frac{\text{Total }\$_{\text{Measure Case}} - \text{Total }\$_{\text{Business as Usual}}}{\text{GHG (metric tons)}_{\text{measure case}} - \text{GHG (metric tons)}_{\text{Business-as-Usual}}}$$

The model generates emissions and fuel costs based on the projected generation of Platte River's generation assets. Key inputs include load and generation projections from Platte River's financial model, fuel costs in terms of $/kWh for the coal and natural gas plants, and CO_2 emissions factors. The model has the ability to evaluate carbon liabilities with cap-and-trade costs. Assuming a cap-and-trade program is enacted, this is only applicable if Platte River is the point of regulation, meaning the entity that would be required to surrender carbon allowances at the end of a compliance period. Three components are critical for this calculation. First, one must determine the size of the cap during the first year of compliance and the size of the cap at the target year. The second key parameter is how many allowances would Platte River need to purchase in an auction versus how many would be given away for free. The third key parameter is the carbon price.