Foreword

Since 1991, Western Resource Advocates (WRA), formerly the Land and Water Fund of the Rockies, has promoted a vision of the western electric system that lowers electricity costs, reduces economic risk and protects the environment of the Interior West. This report updates that vision, focusing on the cost savings and reduced risks resulting from a more diversified mix of electric resources.

This report was made possible by a generous grant from the William and Flora Hewlett Foundation, whose support in many ways is essential to WRA's work. We are especially grateful to Rhea Suh for her encouragement and support throughout this project. Additional funding was provided by the Department of Energy's Denver Regional Office. We thank Cathy Iverson for her support.

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WRA is also grateful for the guidance, advice, and feedback provided by the Balanced Energy Plan Advisory Committee. The committee members are listed here with their professional affiliation. Participation on the Advisory Committee does not imply an endorsement or support for this report or its findings by either the individuals or their organizations.

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All views and opinions expressed in this report are those of Western Resource Advocates and do not necessarily reflect the views of the Advisory Committee, reviewers or funders. Any errors are the responsibility of WRA.

A Balanced Energy Plan for the Interior West

Produced by Western Resource Advocates
In collaboration with Synapse Energy Economics, Inc. and the Tellus Institute

A Report in the Hewlett Foundation Energy Series

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This report is dedicated to the memory of Steve Bernow, a founder and Vice President of the Tellus Institute. Throughout his career Steve made substantial contributions to a wide range of energy and environmental topics, with an emphasis on strategies for controlling global warming, encouraging energy efficiency and renewable resources, and making the world safer and more equitable for future generations. Steve brought a remarkable amount of passion, warmth and humor to his work, and all those who worked with him will miss him.

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Source: Tom Hall/DOE

Foote Creek Rim wind farm, Wyoming

Introduction

This report describes a Balanced Energy Plan for the Interior West region of Arizona, New Mexico, Nevada, Utah, Colorado, Wyoming and Montana. The plan shows how energy efficiency, renewable energy and combined heat and power resources can be integrated into the region's existing power system to meet growing electric demands in a way that is cost-effective, reduces risk, is reliable, and improves environmental quality.

A computer model of the western electricity grid was used to compare the costs, transmission requirements, reliability and environmental implications of the Balanced Energy Plan with a "Business as Usual" (BAU) approach that assumes the region continues to rely almost exclusively on coal and natural gas power plants to meet its growing electricity needs. Both cases are evaluated under a range of future scenarios designed to test how each affects future costs and risks facing electric utilities and their customers.

The seven-state Interior West region that is the focus of this study is characterized by an electric system based on fossil fuels (primarily coal), a rich endowment of renewable wind, solar, geothermal and biomass resources, and a significant but largely untapped potential to use electricity more efficiently.

Compared to the BAU scenario, the analysis shows that by 2020 the Balanced Energy Plan will:

- Lower the costs of electricity production in the region by $2.0 billion per year
- Save the region up to $5.3 billion per year in the event of higher natural gas prices, stricter future environmental regulations or prolonged drought
- Provide equivalent levels of electric system reliability
- Reduce carbon dioxide emissions associated with global warming by over 40 percent
- Reduce smog- and haze-forming pollutants by over 30 percent
- Decrease power sector water consumption

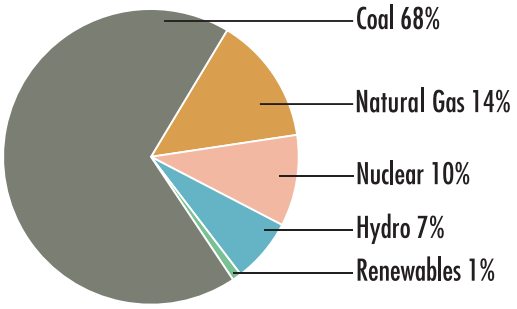
The report is divided into four chapters. Chapter 1 describes the economic and environmental risks and costs inherent in an electric system that relies mainly on fossil fuels. Chapter 2 assesses the region's energy efficiency, renewable energy and combined heat and power resource potential. Chapter 3 provides the economic and technical basis of the Balanced Energy Plan. It first describes how a portion of the resource potential identified in Chapter 2 can be added to the existing electric system in a cost-effective and reliable way and then discusses the benefits of the Balanced Energy Plan relative to BAU. Chapter 4 outlines barriers to the Balanced Energy Plan and provides examples of innovative private and public sector actions currently being taken to overcome these barriers and move the region toward a more balanced energy future. Drawing from these examples, the chapter offers several guidelines for implementing the plan in the years ahead.

The Problem: Meeting Growing Power Needs in an Uncertain and Risky World

By 2020, the Interior West is expected to need roughly 28,000 megawatts (MW) of new electric generating capacity to satisfy customer demand in the region and to continue electricity exports to California and the Pacific Northwest. This is enough power for five new cities the size of the Denver metro area.

Today, the region relies mainly on fossil fuels to generate its electricity (Figure ES-1). Coal is the largest source of power, accounting for 68 percent of the electricity produced in the region, while natural gas has been the fastest growing. Between 1990 and 2002 natural gas-fired generation in the region more than tripled. Natural gas now provides 14 percent of the region's electricity generation, up from only 4 percent ten years ago. Most of the rest of electricity production comes from nuclear and hydroelectric plants. Renewable wind, solar, geothermal and biomass resources today account for only 1 percent of the region's electricity generation.

Fig. ES-1. 2002 Electricity Generation Mix in the Interior West



Source: Energy Information Administration. 2003. *Electric Power Annual 2002.* DOE/EIA-0348(2002).

Historically, the electric system has provided low-cost, reliable power. Increasingly, however, the current system exposes customers to the risk of increased electricity costs, due to:

- Volatile and rising natural gas prices
- More stringent environmental regulations, including limits on carbon dioxide emissions
- Reduced hydroelectric output due to prolonged drought
- An increasingly overloaded transmission system that threatens reliable power delivery

These economic risks are not the only problems associated with the current system. A non-diversified fuel mix is also at the center of many of the region's most serious public health and environmental problems, including:

- Air pollution
- Damage to western landscapes from fossil fuel extraction
- Consumption and pollution of scarce water resources
- Climate change

Clear vistas, unspoiled landscapes, and clean air and water are important in their own right. But because they are central to the quality of life that draws people to the region, they are also critical to the region's economy.

Continued investment in fossil fuel generation to meet growing power needs increases our exposure to these economic risks and environmental impacts. Yet continued fossil fuel reliance is the current trend. Between 2002 and 2005 over 10,000 MW of new

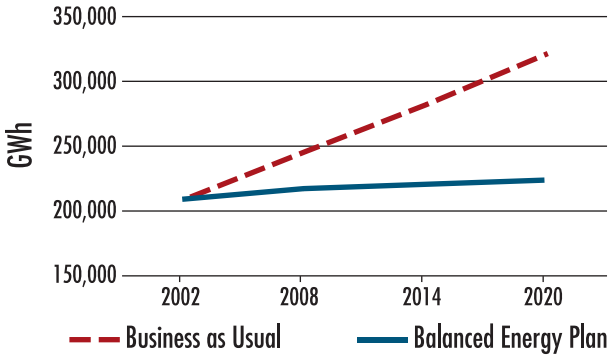
natural gas generating capacity are expected to come on-line in the seven-state Interior West region. In addition, roughly 30 new coal plants, representing 25,000 MW of new generating capacity, have been proposed in the Interior West. While many of these plants are speculative, 8000 to 10,000 MW have been proposed by viable developers who are currently seeking permits and other regulatory approvals.

The Solution: A Balanced Energy Plan for the Interior West

The Balanced Energy Plan developed in this report shows how these risks can be addressed by diversifying the region's electric resources with new investments in renewable energy, energy efficiency and combined heat and power resources over a 2002-2020 study period.

Energy efficiency is at the core of the Balanced Energy Plan. Implementation of commercially available energy efficiency technologies for uses such as lighting, heating, air conditioning and industrial motors remains the region's least-cost electric resource. These new efficiency technologies can reduce energy consumption without impairing the level or quality of the electric services we need. Figure ES-2 shows the electricity consumed in the region under the BAU case and under the Balanced Energy Plan. By 2020, the Balanced Energy Plan meets the region's needs with 30 percent less electricity than Business as Usual.

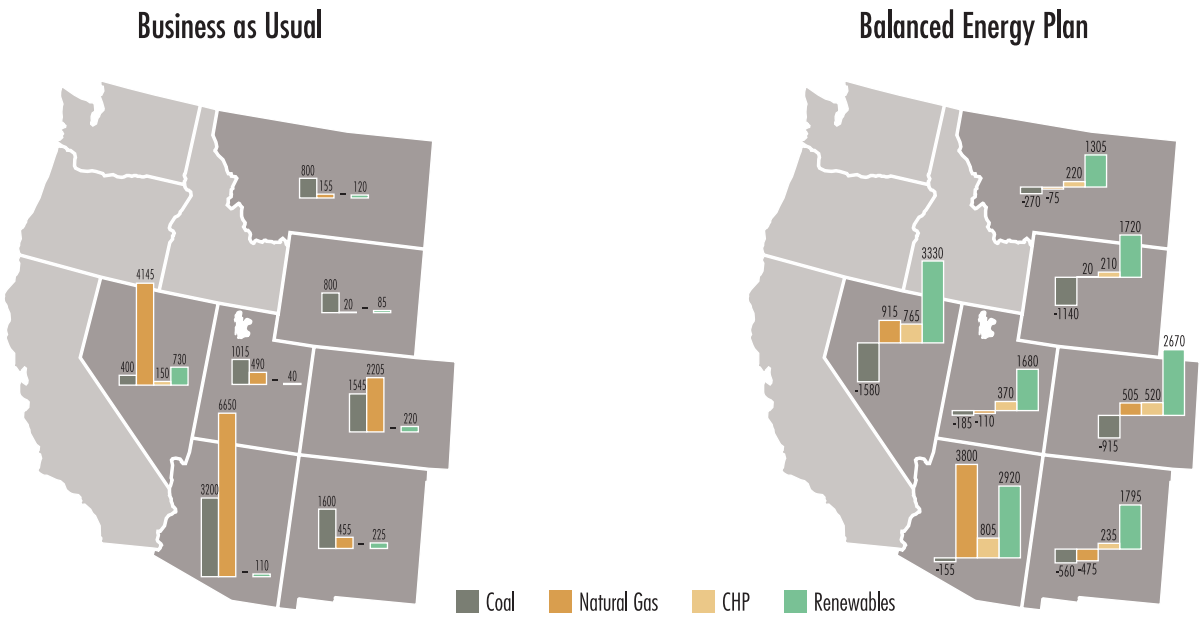
Fig. ES-2. Electric Load Growth in the Interior West: Business as Usual & Balanced Energy Plan



Renewable energy and combined heat and power generation are the other key components of the Balanced Energy Plan. Combined heat and power projects are facilities that produce both electricity and useful thermal energy in a single integrated system. By 2020, the Balanced Energy Plan adds 15,410 MW of renewable capacity and 3135 MW of combined heat and power to the region's electric system.

The Balanced Energy Plan also adds 7815 MW of gas-fired generation that were already under construction in 2002 and scheduled to be on-line by 2004. In addition, the plan retires 8050 MW of existing coal and natural gas-fired power plants. Of this amount, 2595 MW are plants retired at the end of their expected useful lives. The remaining 5455 MW are early retirements of less efficient, more polluting power plants.

Fig. ES-3. Net Capacity Additions by 2020: Business as Usual and Balanced Energy Plan



Note: Figures rounded to nearest 5 MW.

By contrast, the Business as Usual case adds 26,075 MW of coal and natural gas-fired power plants to the region's existing power base. Of this capacity, 16,075 MW are expected to be natural gas plants and 10,000 MW are expected to be conventional coal power plants. The BAU case also includes 1530 MW of renewable energy. Like the Balanced Energy Plan, the BAU case retires 2595 MW of natural gas and coal plants that reach the end of their expected lives during the study period. However, the BAU case does not retire any plants early.

Fig. ES-4. Regional Electric Generation Mix in 2020

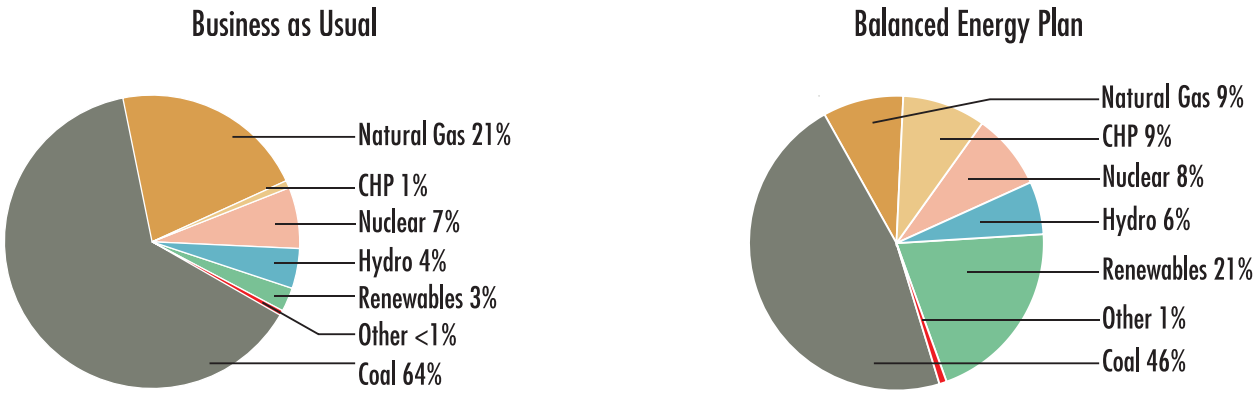


Figure ES-3 shows the resource additions by 2020 under both the BAU case and the Balanced Energy Plan. Figure ES-4 compares the regional generation mix that results in 2020 under each scenario.

By 2020, under the Balanced Energy Plan, renewable resources provide about 20 percent of electricity generation in the Interior West and combined heat and power provides about 9 percent. This compares to 3 percent renewable energy generation and 1 percent combined heat and power generation under BAU.

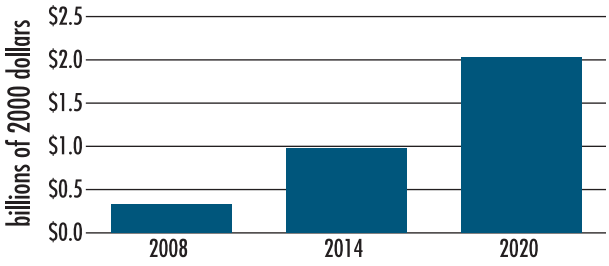
Evaluating the Balanced Energy Plan

The PROSYM computer model of the western electricity grid – often used by electric utilities to evaluate their own resource acquisition plans – was used to compare the Balanced Energy Plan to Business as Usual in terms of cost, risk mitigation, environmental impacts, and generation and transmission reliability.

Cost Under base case conditions, the analysis assumed that over the 2002-2020 study period natural gas prices would be in the range of $3 to $5 per million BTUs in year 2000 dollars. These prices are lower than the $5 to $6 per million BTUs the region is currently experiencing, and much lower than the $9 to $10 price spikes that have occurred within the last three years. In addition, the base case analysis assumes that no carbon dioxide regulations will be imposed and that hydroelectric conditions will be normal.

Under these conditions, the Balanced Energy Plan saves customers $0.3 billion in 2008 and $2.0 billion in 2020. Figure ES-5 shows the annual savings of the Balanced Energy Plan relative to BAU under our base case assumptions.

Fig. ES-5. Balanced Energy Plan Savings Relative to Business as Usual



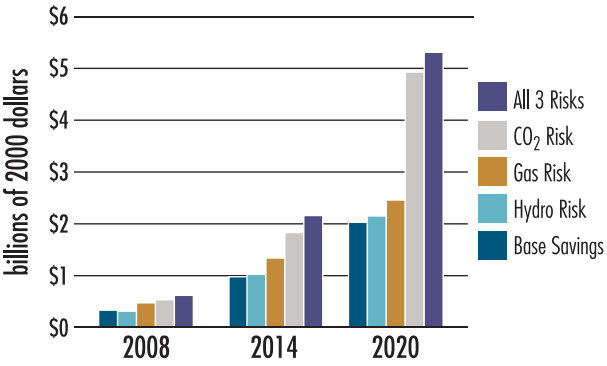
Risk Mitigation To compare how the Balanced Energy Plan and the BAU case respond to uncertainty and risk, we evaluated each plan under higher natural gas prices, future carbon dioxide regulations, and lower hydroelectric production due to prolonged drought. Two of these risks – higher natural gas prices and lower hydro output – were important factors contributing to the electricity crisis that originated in California and spread across the West during 2000 and 2001.

Natural gas price risk was analyzed by assuming a 25 percent increase above the base case gas price forecast. Carbon dioxide regulatory risks were analyzed assuming an emissions cap-and-trade program would impose a cost of $5 per ton of CO_2 in 2008, increasing to $20 per ton by 2020. These costs fall in the middle range of recent studies estimating the cost of complying with future carbon dioxide regulations. Risk of reduced hydro output due to drought was analyzed by assuming a 20 percent reduction in water conditions relative to a normal water year. Historically, 10 percent

of years experience this level of drought or worse. We also analyzed a combined scenario in which all three of these risky events were assumed to occur simultaneously.

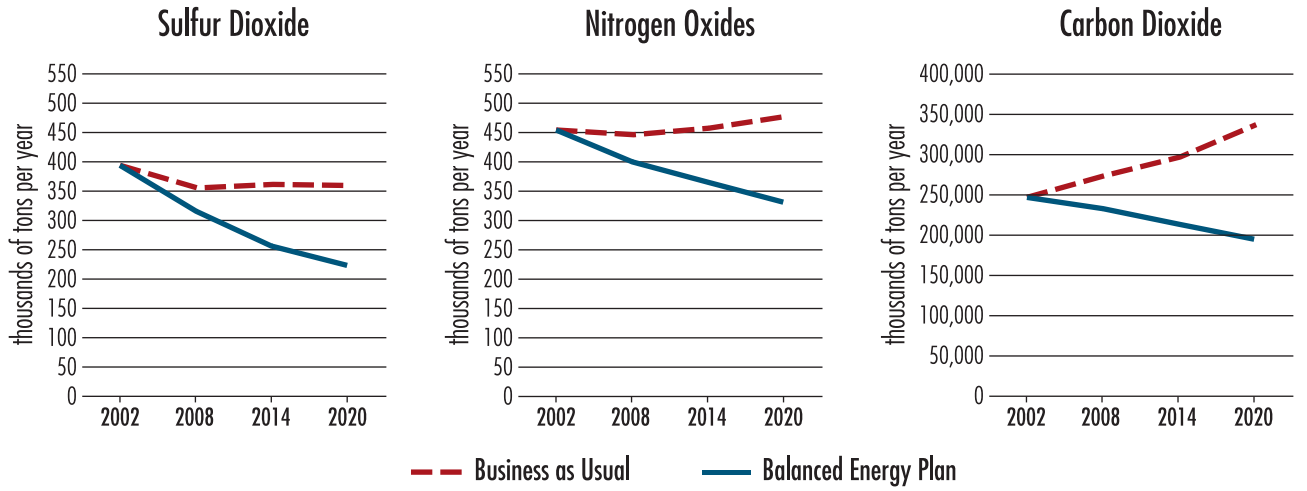
Under each of the risk scenarios, the Balanced Energy Plan performs better than BAU. In 2014, compared to BAU, the plan saves the region at least $1 billion per year in lower electricity production costs if any of the risks occur. In 2020, in the combined-risk scenario, the Balanced Energy Plan saves the region $5.3 billion per year. Figure ES-6 shows the savings resulting from the Balanced Energy Plan under the various risk scenarios.

Fig. ES-6. Risk Scenarios: Balanced Energy Plan Savings Relative to Business as Usual



Environmental Impacts The Balanced Energy Plan's efficiency and renewable energy investments, along with early retirements of older and more-polluting power plants, dramatically reduce power sector air emissions. Figure ES-7 summarizes the differences between power sector emissions of sulfur dioxide, nitrogen oxides and carbon dioxide under the Balanced Energy Plan and BAU. Sulfur dioxide and nitrogen oxides contribute to a range of public health and environmental problems. Carbon dioxide is the principal greenhouse gas contributing to climate change. By 2020, the Balanced Energy Plan outperforms BAU for all three emission types. In addition to protecting public health and the environment, these reductions will help decrease the need for costly pollution controls on industrial and manufacturing facilities to comply with federal, state and local air quality requirements.

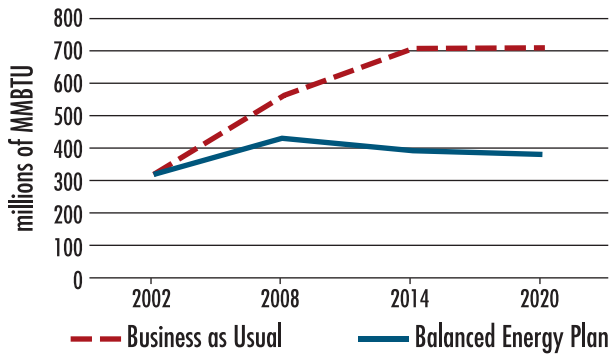
Fig. ES-7. Air Pollutant Emissions



The Balanced Energy Plan's lower level of fossil fuel generation also reduces the use of increasingly scarce and valuable water to cool power plants. We estimate that by 2020 the lower amount of coal and natural gas generation in the Balanced Energy Plan will reduce water consumption in the region by about 82 billion gallons per year, enough to serve the annual water needs of over one million urban residents.

Reduced reliance on fossil fuels can also help lessen the impacts of natural gas and coal extraction on western lands. For example, under the BAU scenario, between 2002 and 2020 annual natural gas consumption by power plants in the Interior West more than doubles. In contrast, under the Balanced Energy Plan, power plant natural gas consumption increases by only 18 percent (Figure ES-8). Similarly, by 2020, coal consumption under the Balanced Energy Plan is 42 percent lower than under BAU. This fuel savings should translate into less damage to western landscapes due to a reduced need to extract fossil fuels.

Fig. ES-8. Natural Gas Consumption by the Electric Power Sector in the Interior West



High voltage transmission lines

Reliability Absent new transmission investments or efforts to reduce power flows over the western grid, there is a mounting risk of transmission system failures and delivery interruptions to electricity consumers. Because many renewable resources, particularly wind, are in remote locations, the Balanced Energy Plan requires greater investment in major interstate transmission lines than BAU. However, because of its lower overall electricity demands due to investments in energy efficiency, the Balanced Energy Plan requires fewer local line upgrades. In the end, the lower localized transmission costs more than offset the higher interstate investments.

With regard to generation reliability, both the BAU scenario and the Balanced Energy Plan were developed to ensure that electricity demanded by consumers was available in all parts of the region during all times of the year. In the Balanced Energy Plan we paid special attention to ensuring that the intermittent wind resources did not compromise system reliability.

Toward a More Balanced Energy Future

The Balanced Energy Plan lowers energy costs, manages risk, stabilizes electric system reliability, and protects public health and the environment. As such, large industrial energy users, utilities, rural local governments, cities and, especially, future generations have an enormous stake in its implementation. However, the Balanced Energy Plan represents a departure from the conventional wisdom on how to meet electricity demands. If the plan is to be implemented it will require innovative actions from both the private and public sectors.

Businesses will need to lead the way. Businesses have a compelling need for a stable operating environment and, like all of us, for low-cost, reliable power. As importantly, businesses control the flow of most of the capital that could be invested in the technologies that are at the center of the Balanced Energy Plan. They see the opportunities, risks and benefits that these technologies can provide in their operations and markets better than anyone else.

Source: Bill Timmerman/NREL

Arizona Public Service Company's Dish Stirling Solar facility in Tempe, Arizona

Because it shapes the context in which businesses and consumers make energy investment decisions, public policy will also be important in moving the region toward a more balanced energy future. A wide variety of policies can be used to provide incentives and encourage investments in the resources comprising the Balanced Energy Plan. Some of the most important of these policies are identified in Chapter 4.

Ultimately, whether the Interior West achieves a balanced energy future depends on thousands of decisions made by utilities, independent power producers, businesses, utility customers, state regulators and many others. Our hope is that this report will help inform those decisions by making clear their associated risks, costs and environmental impacts and will start a regional dialogue on the stakes involved in the choices we make regarding our energy future.