WESTERN RESOURCE
ADVOCATES

Request for Support: The Western Resource Advocates Flexible Grid Project

I. Introduction

Western Resource Advocates is a regional nonprofit organization dedicated to protecting the West's land, air, and water. WRA's Energy Program works to reduce the environmental impacts of electricity production in the Interior West by fostering the transition of power production from environmentally harmful fossil-fuel technologies to renewable energy, energy efficiency and other clean resources, with a focus on reducing greenhouse gas emissions from the region's power sector.

Over the next year, WRA will work in state and regional forums to maintain, and where possible expand, clean energy development. At the state level, this work will include maintaining and improving renewable portfolio standards; maintaining funding for energy efficiency programs as well as removing disincentives and securing incentives for these programs; securing utility commitments and regulatory approvals for coal plant retirements; and securing future clean energy investments through utility resource planning processes.

One of our new initiatives is called the "Flexible Grid Project". Our goal is to work with utilities to improve electric grids to take advantage of local generation from a variety of sources, manage local storage devices including electric vehicles, and manage customer loads in an intelligent manner. The project will focus on making grids more reliable and cost effective, and helping the utility industry modernize for the 21st century. We invite your support of the Flexible Grid Project.

II. Energy Program

WRA works for a clean energy future, one based on efficient resource use and the West's world-class renewable energy resources, such as wind and solar. We are committed to preventing the damage to lands, air, water, communities, and wildlife caused by traditional energy production, and dedicated to making the West a leader in curtailing climate change.

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Renewable Energy and Efficiency 2013 Goals**:**

Arizona

- Participate in the Arizona Corporation Commission's 2012-2013 reviews of renewable energy and energy efficiency plans to ensure that the Commission refrains from diluting the energy efficiency or renewable energy standards and supports the commitment of Arizona Public Service Company (APS) to exceed the Renewable Energy Standard.
- Participate in Commission proceedings related to APS's resource plan to make the case for renewable energy, energy efficiency, energy storage, and early coal plant retirements.
- Increase the capabilities of community organizations to design and implement energy efficiency programs so that they can effectively improve the energy efficiency of their constituents even if utility programs are cut back by regulators.

Colorado

- Participate in Xcel Energy's Renewable Energy Standard compliance plan docket to ensure that Xcel continues to invest in renewable energy resources, even though the company has achieved compliance with the state's Renewable Energy Standard.
- Ensure that programs and rates encourage increasing levels of energy efficiency. Participate in Xcel's 2013 Demand-Side Management strategic issues docket.
- With Co-Counsel Earthjustice, defend Colorado's Renewable Energy Standard from constitutional challenge.
- Intervene and participate in Colorado state court cases to defend the Commission's decision to retire 900 MW of coal-fired generating capacity in the Denver-metro area against attempts to overturn it.

Nevada

- Participate in regulatory and legislative processes to revise Nevada's existing Renewable Portfolio Standard to expand renewable energy investments in the state.
- Secure a Nevada Public Utilities Commission decision requiring NV Energy to retire the company's Reid Gardner coal plant before 2020.

New Mexico

- Promote the implementation of a state-level policy to limit greenhouse gas emissions from the power sector at the New Mexico Public Regulation Commission and at the Legislature.
- Participate in Commission proceedings to strengthen utility and customer incentives to invest in energy efficiency.
- Work with Public Service Company of New Mexico and other stakeholders to secure firm retirement commitments for the San Juan Generating Station coal plant.
- Advocate for more energy efficiency and more renewable energy, with less reliance on fossil fuels.

Utah-Wyoming

- Participate in PacifiCorp's 2013 Integrated Resource Plan process to increase the company's commitments to renewable energy and energy efficiency and to move the company to retire some of its existing coal plants.

III. WRA Flexible Grid Project

Project Purpose: Our nation's distribution grids have not changed significantly since the days of Thomas Edison. These aging and outdated grids will limit our ability to reduce greenhouse gas emissions, provide reliable and secure energy, and sustain leadership in green jobs. We need to encourage utilities and regulators to invest in smarter, more flexible distribution grids that will allow us to move into the future.

Background: Electricity is currently delivered from large, central-station generation plants to customers in the same way it was one hundred years ago. Unlike the telecommunications network, which has undergone sweeping changes in the past 30 years, the electric grid remains a stiff, inflexible system that delivers electricity much like plumbing delivers water. There is little intelligence built into the power grid and little ability to help buffer sudden changes in generation and demand. This inhibits the use of distributed generation and new storage technologies, as well as many innovative demand reduction programs.
The electric grid has two components: transmission and distribution. Transmission lines carry energy at high voltage from large generation facilities such as coal plants, wind farms, and natural gas turbines, to distribution substations. The distribution substation transforms power to a lower voltage and sends it out over the distribution feeders to the service transformers at or near the customer location. The distribution grid is composed of all the wires, poles and transformers that we see across cities and rural areas that deliver energy to the customer. New transmission facilities are large, capital investments that are planned and constructed over long periods of time by utilities, the Federal Government, and private investors. Western Resource Advocates has an aggressive program in place to advocate for good decisions on new transmission routes in the West. The Flexible Grid Project will move WRA into the distribution grid arena as well.

In general, utilities have not made sufficient investments to modernize their distribution grids. Smart Grid is a term that is being applied to modernization of the distribution grid; however, the main focus of smart grid projects to date has mainly been the replacement of old meters at customer locations with smart meters. Traditional utility meters are devices that mechanically or electrically keep track of kilowatt hours used and must be physically read by a meter reader once per month. Smart Meters transmit usage data on a regular basis back to the utility using a variety of methods. Some smart meters allow two-way communications with the customer location, providing a variety of capabilities. There was a great deal of investment activity in smart meters under the American Recovery and Reinvestment Act of 2009 (ARRA) where the Department of Energy matched dollar-for-dollar utility investments in smart meters and a limited number of smart grid demonstration projects. Since these initial investments were made, however, there has not been much activity with smart grid investments. Utilities and regulators have been slow to make additional investments, failing to take action on the general need to modernize the distribution grid.

The "lessons learned" from initial smart grid projects need to be translated into projects that effectively modernize distribution grids. We have chosen to call the project we are proposing a "flexible grid" project instead of a smart grid project. Smart Grid investment has focused on smart meters, which have unfortunately received a stigma in some quarters due to concerns over electromagnetic interference and privacy, and do not currently have good business cases. Our concept for a flexible grid is broader in scope, but also focused on overall grid modernization and its ability to provide higher reliability and access to more clean energy resources, rather than simply investing in smart meters.

What is a Flexible Grid: The distribution grid that currently exists in most cities and rural areas delivers electricity over a very static set of wires and transformers with a limited set of active devices such as remotely controlled switches and capacitor banks. There is very little information available to the utility about the status of the grid at any given time, and there is no communication path to get data to and from the customer location on a real time basis. A smarter, more flexible grid would have the following characteristics:

- A rich set of data about grid status and operation, with feedback on current loads, overload possibilities, maintenance status, possible failure alerts, etc.
- More reliability through alternate routing, preventive maintenance based on real time data, more robust back up, etc.
- Quicker outage detection and more accurate dispatch through real time, automated fault location
- Improved safety through faster automated shutdown for short circuits and shutdown of active generation, such as rooftop solar panels.
- Improved integration of Distributed Generation, controlling overall variability
- Integration of Electric Vehicles through smart charging and eventual Vehicle to Grid operation
- Load control and customer DSM (Demand Side Management) integration to decrease overall load variability
- Automated management of grid resources such as energy storage, customer owned generation, and dynamic load control

Advantages of a Flexible Grid:

- Reduced greenhouse gas emissions by maximizing use of renewable generation
- Reduced peak loads with a commensurate reduction in expensive peaking facilities
- Reduced need for reserve generation
- More efficient energy use through Integrated Volt VAR control (IVVC) [also called Conservation Voltage Reduction (CVR)]
- Automated Demand Reduction (DR)
- Price signals that allow customers to take advantage of time of day pricing
- Improved safety achieved by shutting down renewable generation during an outage
- Improved reliability
- Less costly voltage and frequency regulation and less costly ancillary services in general
- Variable load control integrated with transmission and large generation facilities

Grid of the Future

The grid of the future will take advantage of local generation from a variety of sources, manage local storage devices including electric vehicles, and manage customer loads in an intelligent manner. It will be more reliable and cost effective, taking the utility industry into the 21st century by:

- Integrating generation from Customer owned Combined Heat and Power (CHP) and Bloom Box type facilities where they are economical.
- Integrating distributed generation from small wind turbines based on available wind
- Integrating distributed generation from solar energy based on available sun
- Incorporating energy storage technologies to shift the time when wind and solar energy provide electricity for consumers and to provide ancillary services such as frequency and voltage regulation as wind and solar output changes suddenly.
- Utilizing efficient loading from air conditioning units that freeze ice at night when power is cheap and evaporate it during the heat of the day (such as Ice Bear). Cooling load can be matched with renewable generation from wind power.
- Ensuring a secure supply by islanding parts of the grid to help prevent blackouts from going beyond a small area and developing the ability to use local supply exclusively during emergencies.
- Shaving peak loads through Demand Reduction and Demand Side Management
- Utilizing alternative generation during periods of peak load
- Assuring good regulation during peak variability by microsecond control of large loads and distributed generation
- Developing fully automated control of Distributed Energy Resources (DER – generation, storage and large load balancing)

Two Phase Project: It would be impossible to focus simultaneously on all the elements of a flexible, smart grid listed above. It will take time and significant investments for utilities to move from the current grid to the grid of the future. A flexible grid project needs to move in measured stages, focusing on logical steps in pragmatic ways. We propose a two phase project. The first phase will focus on a report to lay out a road map for the grid of the future. The second phase will take the knowledge gained in the first phase and collaborate with utilities and regulators to move distribution grids in the Western United States to grids of the future.

Phase One - Game Plan and Report: While we understand that the road to achieving a flexible power grid will be challenging, we believe it is achievable. The first phase of the Flexible Grid Project will focus on producing a report that identifies the critical elements of a more flexible distribution grid and the steps that will need to be taken to get there. This will be done through research on current industry thinking and through structured conversations with industry professionals. Over the past few years a great deal has been written about smart grids and the need to change the distribution grid. We will consolidate this information and make it specific for Western states where energy generation, transmission and distribution are still dominated by vertically integrated Investor Owned Utilities (IOUs) and many, relatively small Municipal Utilities and Rural Cooperatives. This is a very different landscape from the central and eastern US where generation, transmission and distribution

have been split apart. In Phase One we will also select and interview twelve to fifteen innovative and creative industry professionals who are knowledgeable about relevant facets of the energy field in the Western US. These will include regulators, utility executives, grid consultants, legal professionals, and technology leaders. We will pose questions to these professionals to determine their vision of the grid of the future, the barriers they see in getting there, and the avenues they see around those barriers. Information gained in our research and in the interviews will be refined and consolidated and then circulated to the experts for additional comments. We will then draft a report, send it to the experts for review, and publish a final report. The report will be designed to inform and guide Phase Two of the project. We anticipate Phase One will take six months to complete.

Questions that need to be asked and answered in Phase One:

- How can the electric grid move into the digital age?
- How should we focus an effort to improve distribution grids in the Western region?
- What benefits can we gain from moving to a flexible, intelligent power grid?
- What are the changes that need to be made in the monitoring, operation and infrastructure of the grid to make it a flexible network for reliably delivering electricity to homes, businesses and factories?
- What are the institutional barriers at utilities, regulatory agencies, and elsewhere that inhibit advancement toward a more flexible grid?
- What are the regulatory and legislative changes that would make a more flexible grid possible?
- What are the economic benefits of a flexible grid?
- How can we convince utilities and regulators to make the necessary investments?

Phase One Industry Experts: The key to a successful Phase One will be the proper selection of industry experts, the development of interview questions, and the interviews themselves. A tentative list of industry experts includes the following:

Utility Regulators:

- Current and former Colorado PUC Commissioners
- Current and former ACC Commissioners
- Current and former Federal Energy Regulatory Commissioners
- Current or former CA regulators
- Former or current board member of NERC

Utility Executives

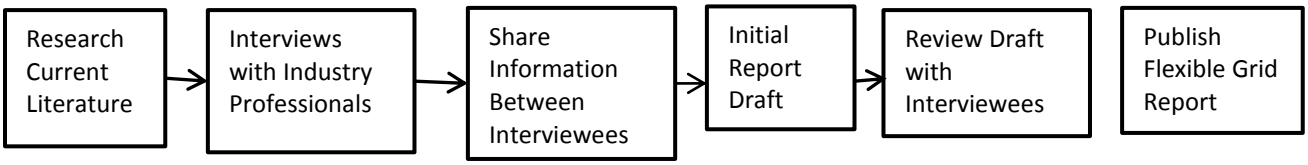
- Executive at Xcel Energy
- Executive at Southwestern Power Group
- Executive at APS
- Executive at Rocky Mountain Power

Grid Consultants

- Industry grid consultant familiar with islanding and microgrids
- Industry consultant familiar with grid monitoring and automation
- Consultant from NREL and/or Sandia National Lab

Legal and Academic

- Member of CU's Renewable and Sustainable Energy Institute
- Member of CSU's Policy Center for New Energy Economy
- Member of the CU Law Department
- Faculty Member from Colorado School of Mines
- Grid or energy storage expert from DOE



Phase One Work Flow

Phase Two - Education, Economics, Collaboration and Advocacy: Implementation of flexible grids in western states will be the focus of Phase II. It will require cooperation and collaboration from many entities. We envision Phase Two of the Flexible Grid Project lasting two years, with the possibility of extensions beyond that period.

Elements of Phase 2

- Presentations of Phase 1 findings with PUC Commissions, Utility executives and managers, Smart Grid Consultants, and state legislators
- Developing economic analysis and business cases for elements of the grid of the future
- Determining how to build flexible grid funding into long term utility acquisition plans
- Developing testimony that can be used in PUC proceedings that will fund flexible grids
- Submitting testimony and testifying in PUC proceedings for flexible grid funding

Conclusion: Western Resource Advocates has been active in the areas of renewable energy and transmission planning for many years. The distribution grid is a third link in the energy chain that needs attention. Changes will be needed in the distribution grid to facilitate Distributed Generation, energy conservation, and grid reliability. Regulators and utilities are starting to look at the investments that will be needed over the next twenty years to modernize the distribution grid. It is both timely and prudent for WRA to initiate a flexible grid project that will address the changes that need to be made in distribution grids across the Western region.

Key members of the project team:

Energy Program Director: John Nielsen
Mr. Nielsen has worked at WRA as an economist and policy advisor since 1995, becoming Energy Program Director in 2002. He is a leader in the western environmental community on the relationship between energy policy and air quality, and has served as an expert witness in regulatory proceedings around the region involving utility resource planning, electric industry restructuring, renewable energy, energy conservation and green marketing. Mr. Nielsen holds a B.A. in mathematics and economics from the University of Colorado at Boulder and M.A. and M.Phil. degrees in economics from Yale University.

Chief of Policy Analysis: David Berry
Dr. Berry is an economist and planner specializing in natural resources, including land use, energy, outdoor recreation, and water policy. Before joining WRA in 2001, he served as Chief of Economics and Research at the Arizona Corporation Commission for eleven years. In addition, he taught urban and regional planning at the University of Illinois and Boston University. He has a B.A. in geography from Syracuse University and a Ph.D. in regional science from the University of Pennsylvania.

Senior Policy Advisor: Gwen Farnsworth
Ms. Farnsworth joined WRA in March 2011. She was most recently an associate research director at E Source in Boulder, Colorado, where her research focused on energy efficiency program design, marketing, implementation, and evaluation. She previously worked at Russian Petroleum Investor in Los Angeles as an editorial director and research manager and was a research fellow at the RAND Corporation in California and a research intern at the International Institute for Applied Systems Analysis in Austria. Ms. Farnsworth is active as a volunteer and community organizer promoting energy conservation in Boulder and has served on the city's Climate Action Plan technical committees. She has a B.A. in Political Science and a B.A. in Russian Civilization from the University of California, Los Angeles; an Advanced Russian Language Program certificate from St. Petersburg State University in Russia; and a Masters of Philosophy from the RAND Graduate School in Santa Monica, California.

Project consultant: Ken Wilson
Ken Wilson is an engineering consultant, working on smart grid technology for innovative companies like Power Tagging and Spirae. He has also worked on Community Solar Gardens as a consultant for clients such as the City of Golden and Prairie Star. Ken had a long career in engineering management at Bell Labs and AT&T, starting in 1980 and taking early retirement in 1998. While there he worked on network architecture, network performance, asset management, cellular telephones and many other projects including an initiative that saved $2 billion in avoided capital and $200 million per year in expenses. From 1998 to 2007 Ken ran a telecommunications consulting business, primarily acting as an expert witness in court proceedings and cases before public utility commissions that involved disputes between telecom utilities. A 17 year resident of Boulder Colorado, Ken won special election to the Boulder City Council in July 2007 and a four year seat in November 2007. He was appointed for two years as Deputy Mayor in November 2009 and his current term expires in 2013. From 2002 to 2007, he held an appointment to Boulder's Water Resources Advisory Board. Ken has a MS in Electrical Engineering from the University of Illinois, a BS in Electrical Engineering from Oklahoma State, and more recently, as a non-traditional student, completed all the courses and research for an MA in Biology, specializing in microbiology, at the UC Boulder.