Smart Power Alternative to Coal

By Mike Mendelsohn

For many utilities in the West, particularly public power entities, pulverized coal is still considered to be the primary low-cost resource option to meet load growth. In this article, Western Resource Advocates (WRA) will show how an alternative portfolio of demand-side management (DSM), renewable energy, and natural gas-fired resources, referred to as a Smart Power portfolio, can provide an equivalent level of dependable capacity and annual energy as a new pulverized coal plant.

For purposes of this exercise, we assess whether a Smart Power portfolio can replace the capacity and energy from a planned super-critical pulverized coal plant of 800 MW for 2015. The coal facility has an expected forced outage rating of 5% (or 95% availability), and an overall capacity factor of 90%. The capacity and energy of the coal plant and the Smart Power portfolio are shown in Table1.

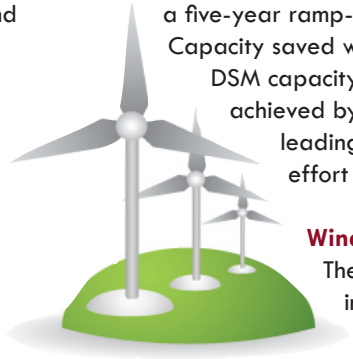
Energy Efficiency and Land Management

We start with energy efficiency and load management services. The lowest cost MWh in any portfolio is the MWh we don't have to generate. DSM can provide significant energy and capacity benefits and remains largely untapped by the public power entities of the U.S. West. Figure 1 represents a supply curve of economic DSM potential in the Xcel Energy service territory in Colorado, as determined in a study by KEMA Consulting.

The study showed that a large fraction (up to 20%) of future energy usage could be saved for a very low cost of roughly $0.04/kWh. In fact, 15% of system energy could be saved for less than $0.01/kWh. For purposes of assessing the Smart Power portfolio, we assumed a relatively conservative price of $0.03/kWh, or $30/MWh.

Interestingly, Xcel determined the KEMA study too conservative and set savings goals far higher than the "economic potential" levels determined by KEMA. The array of potential measures targeted by Xcel is wide and includes lighting, HVAC retrofit and retrocommissioning, new and retrofit building envelope improvements, high efficiency appliances and other cost-effective opportunities.

To show the savings capability, we assumed a public power entity was capable of saving 1% of energy usage after a five-year ramp-up period. Capacity saved was based on DSM capacity factors achieved by utilities leading the DSM effort in the West.[1]



Wind Power

The next resource in our Smart Power portfolio is wind. The West is blessed with extensive wind resources. A recent independent taskforce report determined there are 96 GWs of wind capacity in Colorado alone. Most western states have good to superior wind resources. In our alternative portfolio, we assumed 900 MW of wind energy with a 35% capacity factor and a 12.5% capacity credit (i.e., only 12.5% of the wind capacity can be relied on during system peak periods). The cost of wind was based on the following assumptions: $1,645/kW installed cost and $11/MWh integration costs (representing the cost of incremental spinning reserve) for a total running cost of $87/MWh.[2]

Solar Power

Next in our Smart Power portfolio is concentrating solar power (CSP) with storage. We believe CSP with storage is coming of age quickly and that a plant planned in the near future could easily be commercially operational in time to meet the assumed 2015 load. Storage – primarily with molten salt – provides an excellent opportunity to maximize utilization of the steam generator and extend the production profile to match peak air conditioning load very well. Solar resources are extraordinary in the Southwest U.S. Over 3,000 MWs of CSP resources are currently in some form of advanced contract negotiation or development in the West, particularly in California. Xcel just announced plans to procure 200-600 MWs of CSP with storage in the 2013-2015 time frame. CSP prices range from $160/MWh to as low as $140/MWh with storage assuming $2,958/kW installed, $20/MWh operating cost and a 35% capacity factor. Our alternative portfolio incorporated 150 MWs of CSP with storage.

Geothermal

The next resource in the Smart Power portfolio is geothermal. Again, various pockets of the U.S. west are blessed with commercially significant quantities of untapped geothermal energy, including regions of Nevada, Oregon, Idaho, Utah,

	Nameplate Capacity (MW)	Capacity Credit (%)	Capacity Credit (MW)	Capacity Factor (%)	Annual Energy (GWh)
Coal	800	95%	760	90%	6,307
Smart Power Portfolio					
DSM	247	43%	106	43%	931
Wind	900	13%	113	35%	2,759
CSP w/ Storage	150	68%	102	35%	460
Geothermal	150	90%	135	90%	1,183
Gas-Fired CC	320	95%	304	40%	1,121
Total			760		6,454

Table 1. Capacity & Energy of Coal Plant & Smart Power Alternative

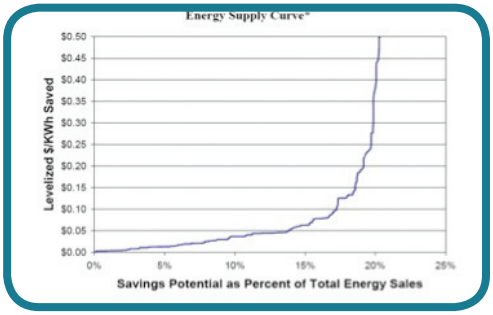


Figure 1. Energy Supply Curve

Arizona, California, and New Mexico. Although every site is unique, geothermal resources are well-proven after years of experience with them. We assumed our alternative portfolio included 150 MWs of geothermal with a running cost of $84/MWh based on $3,640/kW installed, $23/MWh operating cost, and a 90% capacity factor. The Smart Power portfolio includes 150 MWs of geothermal capacity.

Gas-Fired Combined Cycle Plant

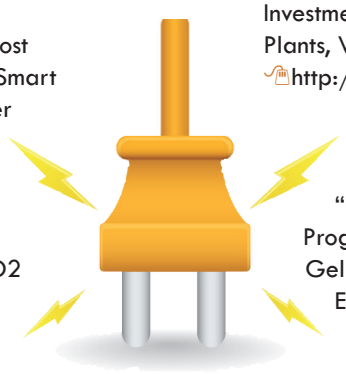
The final item in our alternative portfolio is a gas-fired, combined cycle plant. We assumed 320 MWs of CC allocated to the portfolio with a 40% capacity factor. Total cost, before consideration of CO2 allowance costs, is $131/MWh based on an installed cost of $1,140/kW, gas at $8.50 – escalating at 2.5%, a conservative heat rate of 7,350 Btu/kWh, fixed O&M of $7 MM/yr and variable O&M of $3/MWh.

New Coal-Fired Energy

To project the cost of new coal-fired energy, we assumed an installed cost of $3,000/kW, fixed operating cost of $13.5 MM/yr, a 90% capacity factor, and coal at $1.20/MMBtu, escalating at 2.5%. One important assumption in the coal forecast is the price of CO2 emission allowances. We applied the Xcel Energy forecast recently approved in their 2008 IRP filing. The forecast starts at $20/ton in 2010 and escalates at 7% per year. The forecast was based on various academic studies of the impact of the proposed Lieberman-Warner bill in Congress. That bill did not make it out to the floor for a full vote, but we believe it represents the most likely federal government response to the climate change issue.

Conclusion

Considering all of the above, how does our alternative portfolio compare to the price of a new pulverized coal plant? As seen in Table 2, the price of our alternative portfolio is significantly below that of the total running cost of the new pulverized coal facility, saving $143 million per year.



We also tested the cost effectiveness of the Smart Power portfolio under alternative input assumptions including CO2 allowance price curves. When the CO2 allowance prices were escalated at 2.5%, not 7%, the benefits of the alternative portfolio dropped to roughly $32 million – but were still in favor of the Smart Power portfolio. Of course, the devil is in the details, but we believe the results allow us to test the conventional wisdom that coal is always the cheapest option available. Western Resource Advocates look forward to working with any western utility that has questions about the Smart Power portfolio, or wants to assess alternative portfolio options to reduce the cost and risk to their constituents of the resource selection process.

	Nameplate Capacity (MW)	Annual Energy (GWh)	Pre-CO2 Unit Cost ($/MWh)	CO2 Cost ($/MWh)	Total Unit Cost ($/MWh)	Total Cost ($MM/yr)	Net Cost ($/MM/yr)
Coal	800	6,307	$ 75	$ 43	$ 118	$ 744.3	$ 143.3
Smart Power Portfolio							
DSM	247	931	$ 30	$ -	$ 30	$ 27.9	
Wind	900	2,759	$ 87	$ -	$ 87	$ 240.6	
CSP w/ Storage	150	460	$ 140	$ -	$ 140	$ 64.5	
Geothermal	150	1,183	$ 84	$ -	$ 84	$ 99.2	
Gas-Fired CC **	320	1,121	$ 131	$ 20	$ 151	$ 168.8	
Total		5,523				$ 601.1	$ (143.3)

Table 2. Costs of Smart Power Alternative and Coal Facility

Author's Picks for Further Reading

Renewable Energy Atlas of the West: A Guide to the Region's Resource Potential, Land and Water Fund of the Rockies, available at www.energyatlas.org

A Balanced Energy Plan for the Interior West, Western Resource Advocates, available at http://www.westernresourceadvocates.org/energy/clenergy.php

Investment Risk of New Coal-Fired Power Plants, Western Resource Advocates, http://www.westernresourceadvocates.org/energy/pdf/Investment%20Risk.pdf

"Update on Utility Energy Efficiency Programs in the Southwest," Howard Geller and Jeff Schlegel, Southwest Energy Efficiency Project, published in the ACEEE 2008 Summer Study.

Endnotes

[1]Including Arizona Public Service, PacifiCorp, Nevada Power, Sierra Pacific Power, and Xcel Energy. See Update on Utility Energy Efficiency Programs in the Southwest, Howard Geller and Jeff Schlegel, Southwest Energy Efficiency Project.

[2]The cost of all resources (except DSM) was calculated at a 6.0% discount rate and a 30-year book life.

About the Author

Michael Mendelsohn is the Senior Policy Advisor for Western Resource Advocates. He may be reached via email to mmendelsohn@westernresources.org or by calling 303.444.1188 x 226.