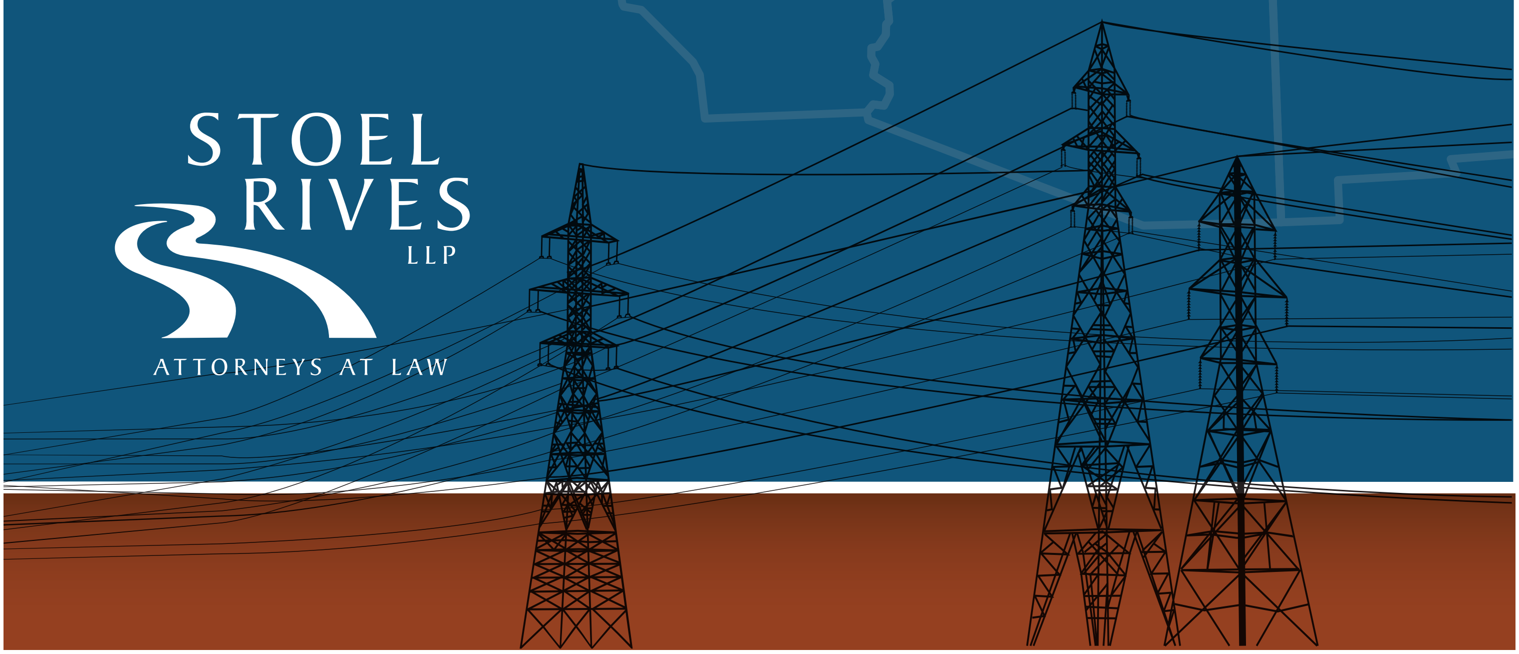
Uncork that Transmission Bottleneck

A Legislative and Technological Roadmap for Tapping the West's Vast Renewable Energy Resources



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Uncork That Transmission Bottleneck: A Legislative and Technological Roadmap for Tapping the West's Vast Renewable Energy Resources

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The West possesses remarkably abundant but geographically remote renewable energy resources—resources that cannot feasibly be delivered to load centers utilizing existing transmission capacity and generation balancing approaches. This white paper examines the root causes of the constrained Western grid and presents potential solutions. Specifically, the white paper first examines the type and location of available renewable resources, and then examines the limitations of the existing grid and the underlying reasons for these constraints. The white paper also assesses the specific challenges—beyond simply that of remote locations—that intermittent resources present to our existing electricity delivery system. The paper then addresses the political challenges to developing interstate transmission capacity. Within this context, the white paper concludes by presenting a series of promising opportunities in federal policy and new technology to overcome these bottlenecks and to enable rapidly expanded delivery of renewable energy from resource-rich locations to heavily populated urban centers. This paper proposes a set of policy goals that may serve as a logical starting point for Western transmission expansion and drive policy change at the national level.

SUMMARY OF RECOMMENDATIONS

- The Federal Energy Regulatory Commission ("FERC") should have the authority to prioritize high-voltage, interstate transmission lines that serve broader regional and national interests, and FERC or another federal agency should have primary siting and condemnation authority with respect to such prioritized projects. A proven model for such authority is the comparable provisions of the Natural Gas Act. The states should retain primary siting authority over all non-prioritized interstate projects and all transmission lines that have terminal points within a single state's boundaries.

- The federal government should provide financial risk mitigation for the initially unallocated share of certain transmission projects in order to avoid the inefficient development of transmission capacity and use of transmission corridors.

- The federal government should require that a task force from the Eastern and Western grids investigate, on an expedited basis, the feasibility and best alternatives for constructing robust direct current ("DC") tie lines between the interconnections to facilitate energy services that cross interconnection boundaries.

- The states should evaluate the impacts of their renewable energy legislation proposals on the efficient interstate transmission of renewable energy and should resist measures that would restrict such interstate commerce.

- Federal and state regulators must investigate the widespread adoption of optimization strategies that can be quickly and efficiently deployed, such as:
  - the consolidation of balancing authority areas or spreading balancing responsibilities across wider regions;
  - intra-hour scheduling using 10-minute persistence schedules that will reduce the costs of generation following services; and
  - load shifting to reduce peak demand on the transmission system and generation fleet.

  In addition, regulators should create pilot projects to investigate the feasibility and benefits of

  - controlling and monitoring the transmission grid in real time using smart grid devices, as well as balancing renewables to load and allowing for dynamic transmission line ratings;
  - creating a Western market for generation following services; and
  - using storage to reduce the dollars-per-MWh cost of delivered energy attributable to transmission.

INTRODUCTION: UNTAPPED POTENTIAL

Renewable energy is increasingly being called upon to address critical but diverse national energy-related issues, including climate change, energy security, and reinvigorating the American economy. The President has said, "Everybody in America should have a stake in legislation that can transform our energy system into one that's far more efficient, far cleaner, and provide energy independence for America—making the best use of resources we have in abundance . . . ."[1] Increasing national concern about climate change has prompted many states to give greater consideration to the development of non-polluting energy resources. As a result, 29 states in the nation, plus the District of Columbia, currently have Renewable Portfolio Standards ("RPS") that require their regulated utilities to serve their electricity demand using, in part, renewable energy.[2] Of the states represented by the Western Governors' Association ("WGA"), eight have adopted an RPS, or some variation thereof.[3] California's RPS is the most ambitious thus far: Its utilities must serve one-third of their electricity demand with renewable

[1] President Barack Obama, Address at the Massachusetts Institute of Technology on Renewable Energy Policy (Oct. 23, 2009) (transcript available at http://www.nytimes.com/2009/10/24/us/politics/24obama.text.html).

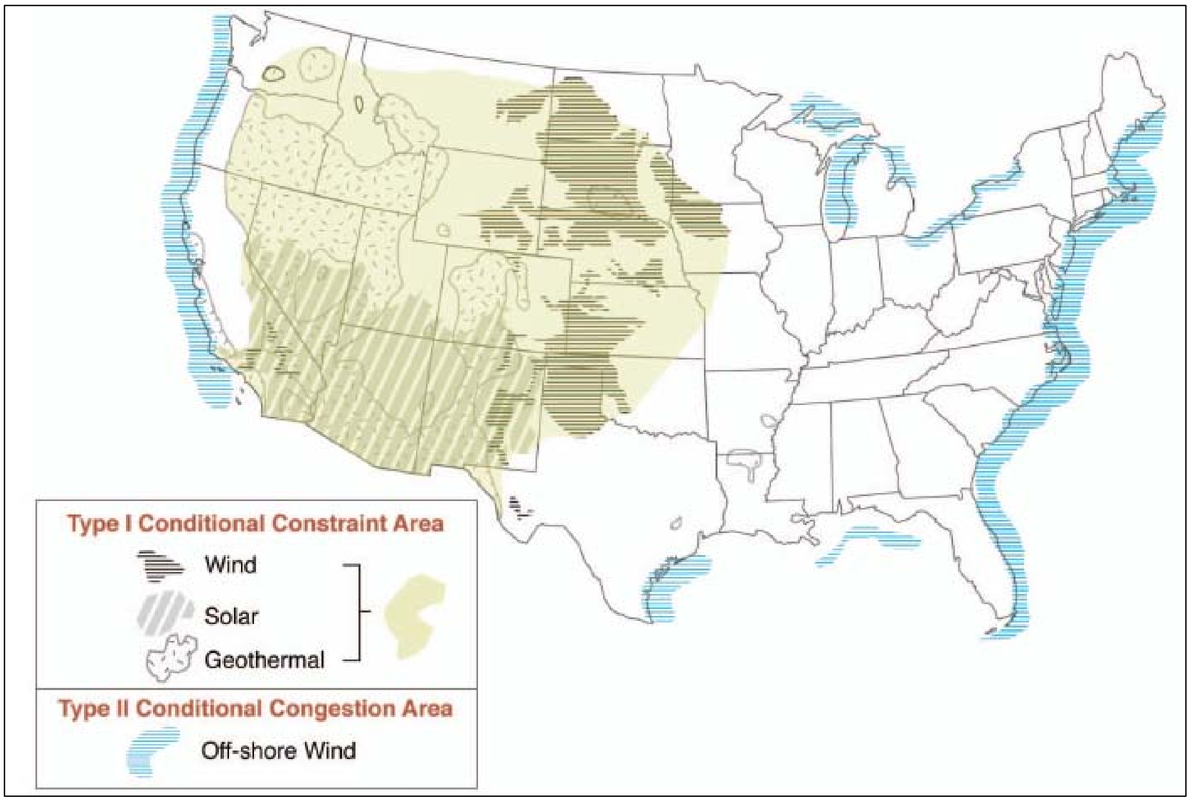
[2] DSIRE: Database of State Incentives for Renewables & Efficiency, Renewable Portfolio Standards (July 2010), *available at* http://www.dsireusa.org/documents/summarymaps/RPS_map.pptx. In addition to the RPS programs adopted nationwide, seven additional states have adopted renewable energy "goals." *Id.*

[3] *Id.*

energy by 2020.[4] In order to meet RPS goals, however, the Western states must be able to develop their best renewable resources and deliver those resources to areas of high load.

The states located in the Western Interconnection possess the greatest proven potential to develop renewable resources in the nation. However, many of the very best of those resources cannot be fully developed because they are located in areas with inadequate transmission capacity. Figure 1 shows the renewable resources that could be developed economically, if only transmission capacity were available.[5] Renewable energy development in the West is suffering from transmission constraints because of a lack of transmission capacity to deliver energy to load centers. Because of this lack of transmission, delivery of power must be constrained by denial of service, and existing service must be controlled by equipment (known as "phase shifters") designed to limit energy flows and operational limits imposed to maintain reliability.[6]

Figure 1: Areas of Potential Renewable Energy Development



Source: 2009 Congestion Study, *infra* note 5, Fig. ES-1.

The Western Governors are keenly aware of the energy potential in the West and the challenge presented by the underdeveloped transmission system. In 2009, the WGA, in

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[4] *Id.*

[5] U.S. Dep't of Energy, *National Electric Transmission Congestion Study*, at viii-ix (Dec. 2009) ("2009 Congestion Study"), *available at* http://www.congestion09.anl.gov/documents/docs/Congestion_Study_2009.pdf.

[6] *Id.* at 6.

partnership with the U.S. Department of Energy ("DOE"), announced the identification of Western Renewable Energy Zones ("WREZs"). The WREZs were identified as "areas . . . that feature the potential for large scale development of renewable resources in areas with low environmental impacts."[7] The WREZs have an estimated capacity of 163,000 GW that have the potential to produce 450,000 GWh per year—roughly 11% of the total U.S. generation in 2008.[8]

Transmission Bottlenecks

Prior to announcing the WREZs, the WGA sent a letter to congressional leaders, identifying transmission as an impediment to Western renewable energy development and requesting a financing partnership with the federal government to build extra transmission capacity.[9] Such a partnership could have helped address the major transmission constraints that impair development of the WREZs that were announced later in 2009. Figure 2 shows the WREZs with overlaid Western transmission constraints that will substantially limit development.

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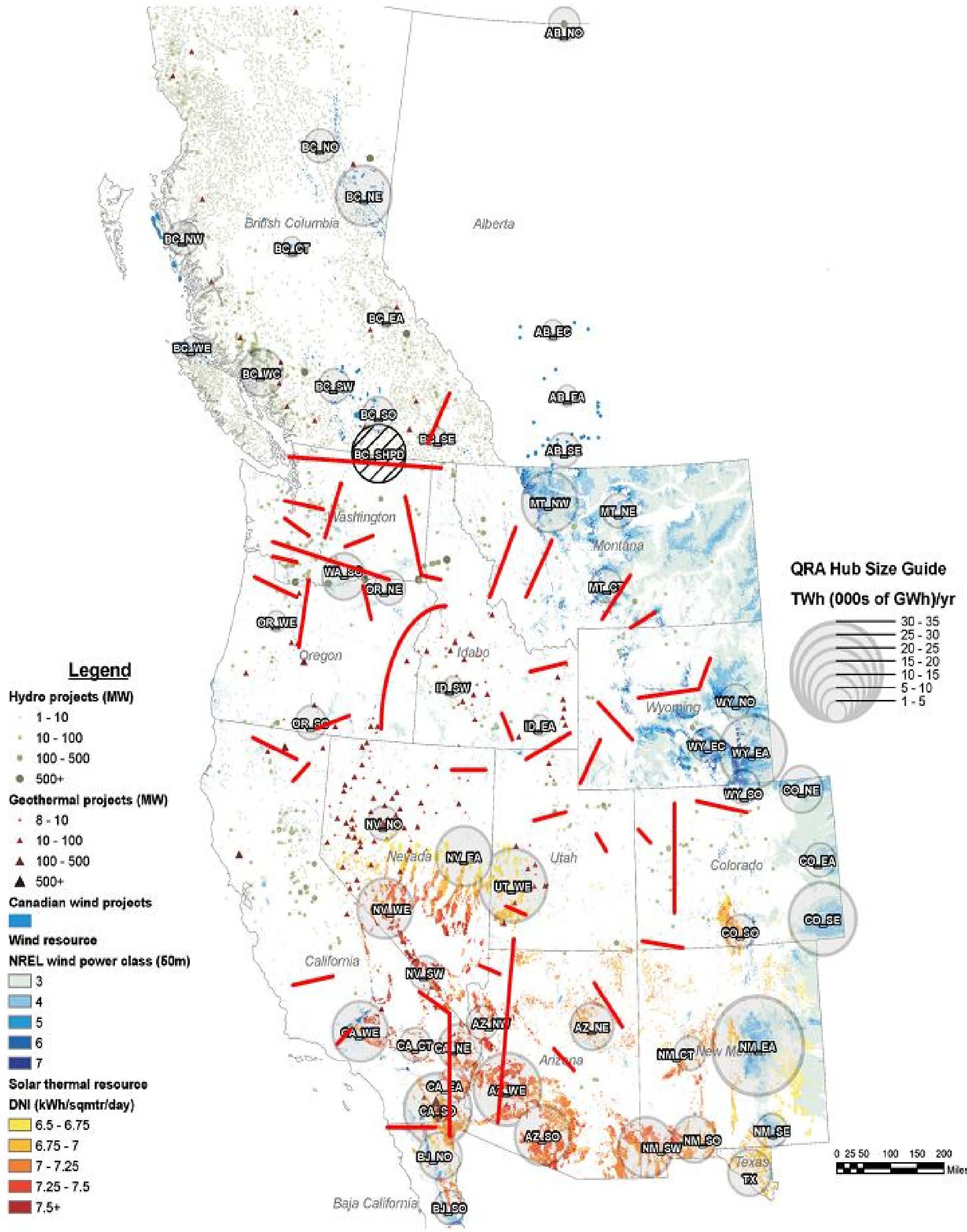
[7] W. Governors' Ass'n & U.S. Dep't of Energy, *Western Renewable Energy Zones – Phase 1 Report*, at 2 (June 2009), *available at* http://www.westgov.org/wga/publicat/WREZ09.pdf.

[8] 2009 Congestion Study, *supra* note 5, at 16.

[9] Letter from W. Governors' Ass'n to U.S. Reps. Pelosi, Boehner & Sens. Reid, McConnell (Jan. 27, 2009), *available at* http://www.westgov.org/index.php?option=com_joomdoc&task=doc_download&gid=371&Itemid= (discussing need for transmission to serve location-constrained renewable resources).

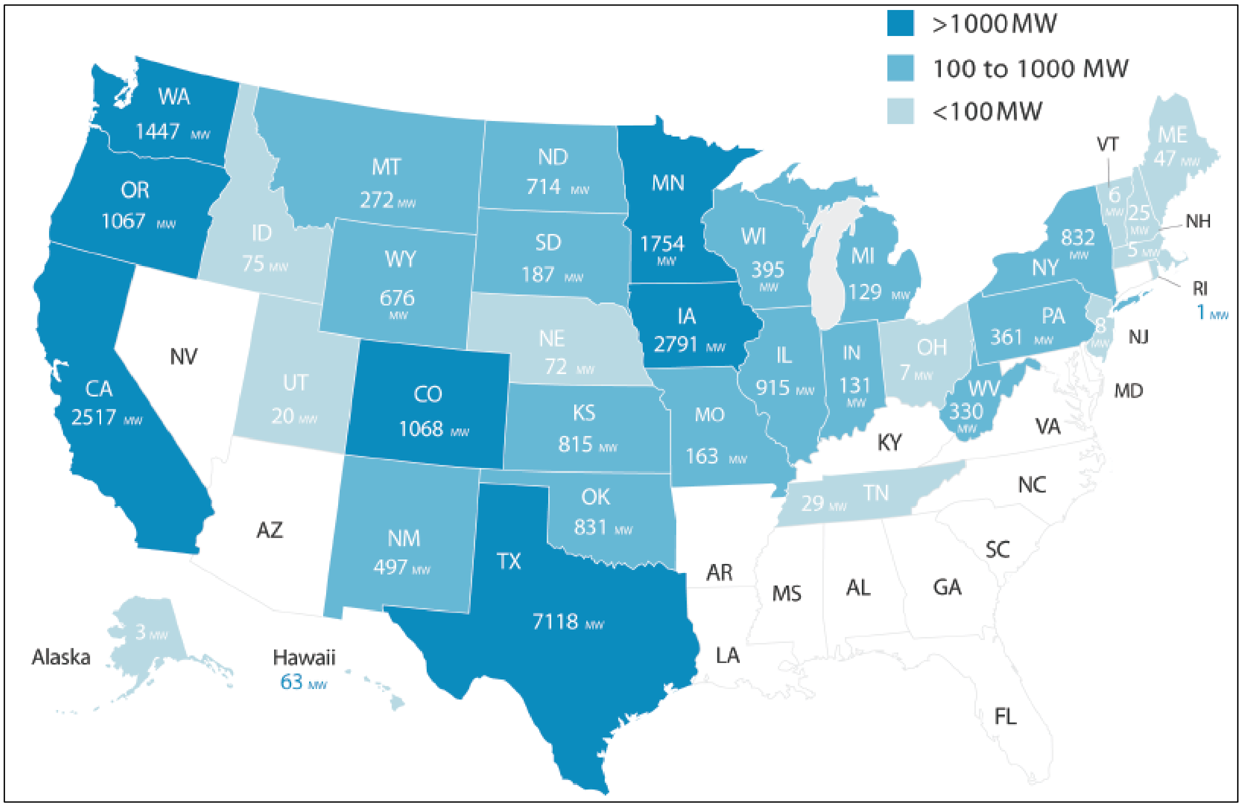
Figure 2: Western Renewable Energy Zones in Relation to Transmission Congestion in the West



Sources: *Western Renewable Energy Zones – Phase 1 Report*, *supra* note 7, at 12; Nw. Power & Conservation Council, *Sixth Northwest Conservation and Electric Power Plan*, at 7-4 (Feb. 2010), *available at* http://www.nwcouncil.org/energy/powerplan/6/final/SixthPowerPlan.pdf. The transmission constraints are from a presentation given by the Western Electricity Coordinating Council in 2006.

Access to transmission often dictates the success of a renewable energy project or area. The DOE has stated that "[i]n many cases transmission access makes the difference between an economic and uneconomic project or development area."[10] In addition, DOE studies have shown a direct correlation between (a) areas with access to transmission capacity to interconnect and deliver resources to load and (b) the extent of renewable resource development.[11] Figure 3 shows limited development of wind energy in the states of the Intermountain West and Northern Plains, with the exception of Colorado. What Figure 3 does not show, however, is how wind development is slowing in states where substantial transmission infrastructure already exists but capacity is becoming increasingly scarce.

Figure 3: Wind Power Development in the United States, 2008 (Megawatts Installed by State)



Source: 2009 Congestion Study, *supra* note 5, at 18.

The lack of transmission capacity is not just affecting developers; utilities, too, are beginning to understand that without additional transmission capacity, they will fail to meet their RPS requirements. On June 4, 2010, the Public Service Company of Colorado ("PSCo") asked its state utilities commission to cut the utility's 2008-2015 RPS solar energy requirement by nearly one-half[12] in order to "match the capability of the existing transmission system."[13] PSCo

[10] 2009 Congestion Study, *supra* note 5, at ix.

[11] *Id.* at 18.

[12] Verified Application of Public Service Co. of Colorado for Approval of an Amendment to Its 2007 Colorado Resource Plan, at 5-6, *In re Pub. Serv. Co. of Colo.*, No. 10A-377E (filed with Colo. Pub. Utils. Comm'n, June 4, 2010).

[13] Public Service Co. of Colorado's Notice of Witness Testimony Pursuant to Decision Nos. R10-329-I and

(continued . . .)

cited uncertainty with regard to necessary transmission development delayed at the state regulatory level as the reason for the request to decrease its RPS requirement.[14] The delayed transmission line was intended to reach "the best solar Energy Resource Zone . . . in the state"[15]—the only solar resource, in fact, identified as a WREZ in Colorado.[16] Until transmission capacity is in place, Colorado's best solar resource will remain underdeveloped, and the state and local communities will miss out on new jobs and additional tax revenues. In addition, the nation will fail to capture the carbon reduction benefits that the development of this resource would provide.

The solution to the problems described above seems simple enough: just build transmission. Unfortunately, what seems straightforward is deceptively difficult and unwieldy, resulting in no major interstate transmission project completions in the West (outside of California) for over a decade. The problems with developing transmission in the West are simple enough to identify—siting, condemnation, financing and cost allocation, and political impediments—but the solutions are difficult ones. However, if the Western states are to contribute to achieving what should be viewed as regional, as well as national, goals, then difficult decisions must be made in the interests of the public good. To maintain the status quo will result in continued delay and impasse. But before we discuss specific impediments and the difficult choices ahead, perhaps it is best to briefly cover why we even want to address the difficult questions in the first place.

BENEFITS OF NEW RENEWABLE ENERGY RESOURCES

Provide Energy for a Growing Population and Economy. The development of renewable resources is proceeding at a feverish pace, and these sources of energy are serving more Americans than ever before. From 1996 to 2009, the installed capacity of renewable resources across the nation increased from 75,796 MW to 141,115 MW,[17] an 86% increase. The states comprising the Western Electricity Coordinating Council ("WECC") already play a central role in renewable energy development, generating nearly 30% of the nation's renewable energy as of February 2010.[18]

(. . . continued)
R10-486-I, at 5, *In re Pub. Serv. Co. of Colo.*, No. 09A-325E (filed with Colo. Pub. Utils. Comm'n, June 4, 2010).

[14] *Id.* at 4.

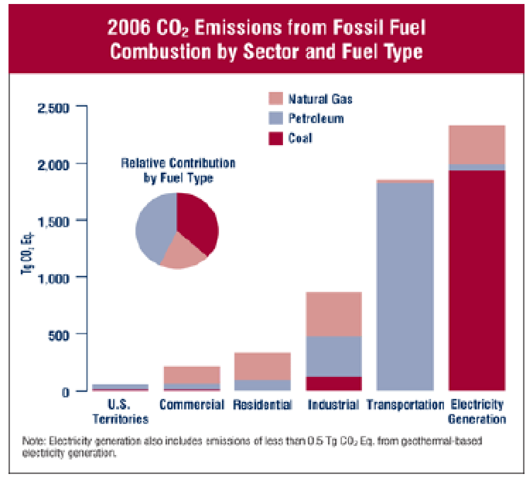
[15] *Id*.

[16] *See* Fig. 2.

[17] U.S. Energy Info. Admin. ("EIA"), *Electric Power Monthly* tbl. 1.1 (July 2010), *available at* http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html.

[18] Rough calculation using state percentage contributions to renewable energy (non-hydro) generated nationwide, available from the EIA.

Reduce GHG Emissions. Electricity production—specifically the burning of fossil fuels—is a significant contributor to the nation's greenhouse gas ("GHG") emissions.[19] From 1997 to 2008, emissions of nitrous oxides (NO_x) and sulphur dioxide (SO_2) created as the result of electricity production were cut nearly in half, and carbon emissions have remained flat since 2000.[20] These reductions, of course, were not caused just by renewable energy replacing fossil fuel-fired resources; rather, these reductions are the product of effective and comprehensive public policies that caused change in emissions requirements. Public policy can similarly enable renewable resources, as well as other tools that are available, to continue cutting into the nation's dependence on fossil fuels.



Source: EPA, CO_2 Sources, *infra* note 19.

Protect the Economy from Fuel Price Volatility. Because the cost of the fuel is "free," such renewable energy sources as wind, solar, and geothermal energy offer valuable price hedges against volatile costs in natural gas and coal. Between 1996 and 2010, the price per ton of coal has bounced around between a low of \$24.28 and a high of \$45.93,[21] while residential natural gas prices doubled between 2002 and 2008[22] and prices at the wellhead fluctuated between a low of \$1.85 and a high of \$8.01 per MCF.[23] Over the period, overall prices trended upward. In addition, it is likely that the costs associated with fossil fuels will continue to rise with the recovery of the economy from the current recession, with the introduction of carbon or GHG regulation., and as fossil fuel supplies become increasingly difficult and expensive to develop.[24]

Reduce Our Reliance on Foreign Oil. The Pentagon has declared the nation's dependence on fossil fuels a security threat.[25] Domestic electric energy production, combined with development of additional renewable resources, can reduce reliance on imported fuels, especially if electric cars and vehicle-to-grid (V2G) technologies reach a tipping point of market acceptance. For instance, in areas where wind generation peaks at night, the batteries in electric vehicles represent a nighttime load that will absorb the wind in real time. "Wind generation and

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[19] U.S. Envtl. Prot. Agency, *Human-Related Sources and Sinks of Carbon Dioxide* (updated July 14, 2010), http://www.epa.gov/climatechange/emissions/co2_human.html ("EPA, CO_2 Sources"). Transportation is listed as the second-largest source of carbon dioxide emissions.

[20] EIA, *Electric Power Annual* tbl. 3.9 (Jan. 2010), *available at* http://www.eia.doe.gov/cneaf/electricity/epa/epat3p9.html.

[21] EIA, *supra* note 17, tbl. 4.1, *available at* http://www.eia.doe.gov/cneaf/electricity/epm/table4_1.html.

[22] EIA, *Natural Gas Navigator*, U.S. Price of Natural Gas Delivered to Residential Consumers (updated July 29, 2010), *available at* http://www.eia.doe.gov/dnav/ng/hist/n3010us3m.htm.

[23] *Id.*, U.S. Natural Gas Wellhead Price (updated July 29, 2010), *available at* http://www.eia.doe.gov/dnav/ng/hist/n9190us3m.htm.

[24] Although the recent economic contraction has caused natural gas prices to fall, the reduction in prices is expected to be only temporary.

[25] President Barack Obama, *supra* note 1.

plug-in hybrid electric vehicles are synergistic. Adding [electric vehicles] to a system makes it more attractive to wind generation and adding high penetrations of wind reduces the cost of charging [electric vehicles]."[26]

Create Jobs for the Future. Equipment manufacturing and the construction and operation of renewable energy projects have become a source of new, family-wage jobs, and the tax revenue provides support to communities. Moreover, the jobs and tax revenues created either directly or indirectly as the result of renewable energy development tend to benefit rural areas the most, and renewable energy projects in those areas also complement other rural industries, like agricultural and forestry businesses. Furthermore, recent legislation from Congress, such as the American Recovery and Reinvestment Act of 2009,[27] increasingly relies on renewable energy to be a catalyst for economic recovery and strength.

INHERENT CHALLENGES OF INTEGRATING RENEWABLE ENERGY

Upgrading our energy delivery system to accommodate more renewable energy from remote locations will require care to ensure we maintain high standards of transmission system reliability and strike a balance among several policy considerations.

Reliability

The transmission grid must be modernized in order to ensure that high penetrations of renewable resources may be integrated without sacrificing reliable electricity service to retail consumers. In the most general sense, electricity reliability refers to operational limitations and operating protocols that are designed to keep the lights on. Before intermittent renewable resources became a dominant force on the transmission grid, transmission operators relied on large central station fossil fuel and hydroelectric generators to deliver power consistently and as needed. With intermittent renewable resources, however, such energy is delivered as the weather permits. As small amounts of intermittent renewable resources energy started to come online, transmission operators hardly noticed any effect on reliability, because the fluctuations exhibited by intermittent generation were lost in, and often offset by, the much larger fluctuations exhibited by loads. But as intermittent renewable resources have approached higher penetration levels, transmission operators have had to take increasingly costly generation following measures.

A number of technologies and operational processes can help to reliably integrate large amounts of intermittent renewable resources. Smart grid technology, for example, has the potential to provide transmission operators with the ability to observe and react to conditions on the grid in real time, and additionally allow for greater intermittent renewables-to-demand control balancing, thereby reducing overall generation following requirements by balancing areas. Other solutions for maintaining reliability include state-of-the-art forecasting, storage, and increased coordination among balancing authorities; each is discussed further below.

[26] Nat'l Renewable Energy Lab. ("NREL"), *Western Wind and Solar Integration Study*, at 290 (May 2010) ("NREL Integration Study"), *available at* http://www.nrel.gov/wind/systemsintegration/pdfs/2010/wwsis_final_report.pdf.

[27] Pub. L. No. 111-5, 123 Stat. 115.

Environmental Considerations

Building transmission lines will leave an environmental footprint that may extend for hundreds, or even thousands, of miles. These rights-of-way and the tower structures constructed within them are unsightly and may transect otherwise untouched wilderness areas. Therefore, in order to minimize the size of these rights-of-way and prevent reentry into wilderness areas to upgrade lines and tower structures, it is essential to use transmission voltages that will be most efficient in terms of the number of transmission corridors required. A single high-voltage line requires a smaller right-of-way than multiple lower-voltage lines needed to carry the same amount of capacity.[28] For example, a 765 kV transmission line requires a 200-foot right-of-way, whereas three double-circuit 345 kV lines require 450 feet. Moreover, when compared to 345 kV lines, 765 kV lines allow for greater distances between towers, thus requiring less construction within the right-of-way and fewer towers per mile. A 765 kV line also has the power carrying capacity of approximately five otherwise comparable 345 kV lines.[29] Because the highest-voltage lines in the Western grid are 500 kV, the example of the reduced environmental impacts of a 765 kV line is used primarily to illustrate the advantages of using higher voltages. But further inquiry into the technical and administrative issues that relate to use of 765 kV lines in the West is warranted to determine whether the obstacles to the use of 765 kV lines could and should be overcome.

Transmission of Non-Renewable Resources

Transmission lines do not discriminate against any particular type of generation resource. "A transmission project developed to open up new renewable resource areas could also be used to transmit non-renewable generation. A transmission line developed primarily to serve power from one source or area will probably carry electricity generated by various sources."[30] Such multiple potential uses are not a legitimate reason for opposing robust transmission development, because rather than harming wind development by underbuilding transmission (or building nothing at all) to avoid creating additional markets for fossil fuel generation, the desire to restrict certain uses of the transmission line should be accomplished through other regulatory or legislative means, such as carbon or GHG caps, taxes or other regulation.. We believe that significant new coal generation development is unlikely even in the absence of carbon or GHG regulation. Others are not as certain and there will be continuing concern about, or opposition to transmission that might open new markets for high-carbon resource portfolios. Consequently, it is appropriate to require carbon capture and sequestration technologies for any new coal resources using transmission facilities built with federal financial support.

Other good policy considerations argue against the initially attractive idea of limiting new transmission to serving renewable resources. First, access to non-renewable resources is needed to shape and store renewable energy to match output to load demands. Second, use of new transmission lines for exchange of power can permit less-efficient fossil-fueled resources to be

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[28] Am. Elec. Power, *Looking Towards the Future: Right-of-Way Stewardship*, http://www.aep.com/about/i765project/docs/LookingTowardstheFuture.pdf (last visited Aug. 8, 2010).

[29] Am. Elec. Power, *Transmission Facts*, at 3, *available at* http://www.aep.com/about/transmission/docs/transmission-facts.pdf (last visited Aug. 8, 2010).

[30] 2009 Congestion Study, *supra* note 5, at 24.

displaced by more-efficient fossil-fueled resources, thus reducing overall energy costs, as well as reducing carbon emissions.[31] Third, transmission lines used only by intermittent resources are likely to convey only about one-third of their total transfer capability, and to provide service in only one direction (from renewable resources to load centers). By encouraging more intensive use of new transmission by a broad range of resources, the cost per megawatt-hour of delivered power from renewable resources located long distances from major load centers can be dramatically reduced.

Energy Efficiency

Just as transmission capacity should not be underbuilt to avoid use by non-renewable resources, new transmission capacity should not be withheld from the market in order to incent the adoption of greater energy efficiency measures. Energy efficiency aims to provide the public the same level of services using less electricity. It is an important tool for using our generation and transmission resources more efficiently and is complementary to, not an alternative to, expanding transmission capacity. Rather than imposing arbitrary caps on transmission capacity to incent efficiency, the latter can be successfully achieved alongside transmission development, by using regulatory and cost allocation tools. In the Northwest, transmission planning assumes that energy efficiency should be considered prior to determining the amount of transmission capacity that may be needed. In addition, energy efficiency should be viewed as a demand resource, which should become increasingly easy to aggregate and track as the smart grid develops. Further work is needed to link energy efficiency and other demand resources such as load shifting into the smart grid development and transmission planning. The DOE, however, has determined that significant transmission expansion is needed under any scenario of our energy future.[32]

IMPEDIMENTS TO DEVELOPING TRANSMISSION IN THE WEST

Siting and Land Condemnation – *"We have met the enemy and he is us."*[33]

In the West, the lack of a coordinated and comprehensive regulatory process to approve the siting of long-haul, interstate transmission lines prevents projects from being completed on a timely basis, or from being completed at all. These delays in timing, as well as the costs that mount as transmission developers are forced to reroute and modify their projects to satisfy competing state and local needs, may ultimately kill a project, as renewable energy developers will delay committing to a transmission project (and developing their own renewable resource nearby) until the successful completion of the state siting processes becomes reasonably certain.

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[31] Some may argue that if new transmission line capacity is used by other than renewable generation, the result may be increased generation from high-carbon-emitting coal generation facilities. This concern is substantially misplaced. Existing coal facilities are difficult to cycle and thus already usually operate around the clock as baseload resources. And absent successful deployment of effective carbon capture technologies, new coal plants simply are not being built.

[32] U.S. Dep't of Energy, *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*, at 93 (July 2008) ("DOE 20% Wind Energy"), *available at* http://www.nrel.gov/docs/fy08osti/41869.pdf.

[33] Walt Kelly, *Pogo* Earth Day poster (1970).

Unfortunately, transmission developers often cannot justify endlessly pouring money into a project with only hesitant support from generation developers, and transmission projects may undergo multiple changes in ownership as developers tire of risking more and more development costs. The history of the transmission grid in the West indicates why state processes are not designed to consider interstate lines that serve regional or national interests.

The transmission system originally developed in order to serve local loads using nearby generation resources. In the Northwest, the transmission system was a hydro/thermal system designed to deliver hydroelectric power from nearby dams, and longer-distance transmission was added to deliver coal-fired generation from a distance. In addition, the transmission system developed in fragments—by previously islanded utilities with little desire to integrate with neighboring systems, other than occasionally in order to access new resources. Thus, transmission development primarily occurred at the local level and, naturally, the state regulatory processes for overseeing transmission siting focused locally, too.

Many state siting authorities object to limiting state siting control, even to facilitate consideration of overriding regional or even national interests when reviewing a transmission line proposal. Yet, allowing states to apply existing state standards creates barriers to implementing regional transmission plans or national policy. For example, imagine a transmission line with terminal points in Montana and Nevada, crossing Wyoming and Idaho. In Montana, the Department of Environmental Quality is not required to consider regional or national interests in deciding the public's interest in the line, but the department must consider state benefits.[34] In Wyoming, the Public Service Commission cannot consider regional benefits unless a transmission line also serves citizens of the state.[35] The Idaho Public Utilities Commission, on the other hand, is allowed to consider both state and regional interests.[36] Even Idaho's newer fast-track process directs the utilities commission to consider whether transmission facilities will benefit Idaho customers and the state economy, as well as improvements to regional transmission capacity.[37] In Nevada, the Public Service Commission may consider interstate benefits.[38]

The requirement that certain siting authorities be limited to considering state benefits may cause transmission developers to make uneconomic alterations to their projects simply to justify state "need." For instance, a developer of a DC line may be forced to install an expensive conversion station that provides no operational benefit to the project in order to satisfy any one state—without the conversion station, the line may have no on- or off-ramp in the state. The addition of a conversion station may upset the economics of the project, but, without it, the project may fail to meet a particular state's interpretation of "need." In addition, the current over

[34] Mont. Code. Ann. § 75-20-301(2)(b); Mont. Admin. R. 17.20.1604.

[35] 023-020-002 Wyo. Code R. § 205. The Public Service Commission's jurisdiction extends to "public utilities," which term excludes companies that do not serve the citizens or consumers of Wyoming. Wyo. Stat. Ann.. § 37-1-101(a)(C).

[36] *See In re Application of Rocky Mountain Power for a Certificate of Public Convenience & Necessity Authorizing Construction of the Populus to Terminal 345 kV Transmission Line Project*, No. PAC-E-08-03, 2008 WL 4606421 (Idaho Pub. Utils. Comm'n Oct. 10, 2008).

[37] Idaho Code Ann. § 61-516(4).

[38] Nev. Admin. Code. §§ 703.423(8)(b)(3), (12)(d).

DC lines has no frequency and therefore does not synchronize with or provide reliability benefits to the larger alternating current transmission grid. DC lines simply appear as a source (where power is withdrawn from the DC line) and a sink (where power is injected onto the DC line) on the alternating current grid. Thus, although DC lines may be the cheapest and most efficient way to transmit power over long distances, they may provide little in terms of direct physical benefits to their through-and-out states, leaving them prone to rejection by regulatory agencies charged with considering only in-state benefits.

The state siting process subjects developers to uncertainties that reduce the likelihood that a transmission project will succeed, as well as multiple forums for opponents to delay proceedings and file appeals. To meaningfully develop transmission in the West, there should be a new approach to siting. Specifically, siting interstate transmission lines should be viewed from a regional or national perspective. Because climate change and GHG emissions are not localized problems, we all benefit by displacing non-renewable resources and eliminating sources of harmful emissions. Admittedly, the positive externalities associated with renewable energy can be amorphous, but it cannot be denied that the states have a common purpose in reducing carbon and GHG emissions.

A similar problem can confront transmission developers with respect to land condemnation that may be required to develop transmission facilities. State law usually requires a showing that the condemnation provides a public benefit within the state. Interstate benefits are not a sufficient showing. While most property for transmission lines is acquired in consensual arrangements, without the condemnation option, an interstate transmission line developer can be blocked by a single landowner.[39]

A more centralized means for siting and condemning land for interstate transmission lines that serve regional or national interests is needed. A program that allows FERC to prioritize certain high-voltage transmission facilities, which are important for achieving carbon reduction goals, and designating a federal agency to exercise primary siting authority to ensure that participating projects are considered on the basis of their benefit to the region or nation. As noted below, the least intrusive way to do this may be to tie such federal siting authority to interstate transmission lines receiving federal support.

The drafters of this white paper recognize that any proposal to reduce state control over siting and condemnation decisions will be highly controversial politically. We note, however, that federal siting of and condemnation for natural gas pipelines has been the norm for generations, without irreparable damage being done to state interest. Moreover, the federal interstate highway system hardly would have been possible without federal control of final decision-making, and six- and eight-lane expressways generally have much greater overall environmental impact than do new transmission lines. In the absence of effective interstate decision-making, developers are looking increasingly to federal entities, such as the Bonneville Power Administration (“BPA”) and Western Area Power Administration, to build new transmission lines, which effectively bypasses state jurisdiction. Whether siting and

[39] We recognize as axiomatic that condemnation cannot be a way to circumvent environmental considerations that are inherent in and central to any siting decision. There are places in this nation where renewable energy and transmission development simply do not belong.

condemnation are accomplished directly or indirectly, changes are needed for the West to succeed in building meaningful interstate transmission to support the development of remote renewable resources.[40]

Financing and Cost Allocation **–** *"If you build it, [they] will come."*[41]

One of the biggest, and perhaps the most controversial, issues facing transmission development is financing, and the related cost allocation challenge. The "[a]llocation of costs is not a matter for the slide-rule. It involves judgment on a myriad of facts. It has no claim to an exact science."[42] Thus, often the best approach is one that both supports stated public policy goals and is easily administered. To build a robust transmission grid that will provide capacity well into the future, it becomes obvious that one developer in the nation is best able to backstop billion-dollar projects and provide bridge financing for unsubscribed transmission capacity that would otherwise remain undeveloped. That developer is the federal government. It is important to note, however, that we are not advocating the federalization of the transmission system. Rather, we are suggesting that the most effective approach to building high-priority interstate transmission lines to access remote renewable resources is to allow the federal government to take a financial risk-mitigating role in the transmission market. We believe that such a role, if properly implemented, will convey great interstate benefits at relatively little cost to the federal government.

Historically, transmission lines that captured economies of scale and provided capacity in excess to the load of the utilities building the line were developed as ancillary facilities to large generation projects. The generation projects were oversized for near-term load growth but were nevertheless approved by regulators because excess power could be sold into regional markets and credited to ratepayers. If a utility could gain regulatory approval for such oversized generation projects, then approval for large interstate transmission lines that would be fully and immediately utilized (which would cost only a small fraction of the generation project) would follow. After all, any failure to approve an adequate transmission line would island a portion of the generation project. Currently, however, the tail is wagging the dog, *i.e.*, transmission capacity (which still costs only a small fraction of the costs to develop the collective generation projects that will subscribe a line) is acting as a barrier to generation development. We are thus left attempting to first build transmission projects that may not be fully and immediately utilized so that renewable resource development will follow. With available transmission capacity dictating generation development, many interstate transmission projects that are currently being proposed face one of two problems. Either they are suffering from what has widely been referred to as the "chicken or egg" situation, or they have not received sufficient immediate market interest to justify building to capture the economies of scale.

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[40] The authors' focus is on a federal process for siting high-priority interstate transmission projects—not on which agency is the lead federal agency in any siting process. FERC may or may not be the appropriate agency to control such decisions.

[41] Taken (and modified) from *Field of Dreams*, Universal Pictures (1989)—a film based on the 1982 novel *Shoeless Joe* by W.P. Kinsella in which Ray Kinsella builds a baseball field in his Iowa cornfield.

[42] *Colo. Interstate Gas Co. v. FPC*, 324 U.S. 581, 589 (1945).

The "chicken or egg" situation is one where a transmission developer cannot secure financing without commitments from generation resources that will use the line, and generation developers cannot receive financing until they are assured that transmission will be available for their project.[43] Both the transmission developer and the generation developer are dependent upon the other party taking action before they may advance their own project. The reality is that both projects will stall.

FERC addressed the "chicken or egg" situation in its February 2009 ruling in *Chinook Power Transmission*.[44] There, FERC drew from a concept used for years in the natural gas industry—an "anchor shipper"—to allow merchant transmission developers to pre-subscribe transmission capacity with a generation developer (the "anchor tenant") prior to opening the capacity to public bidding. The anchor tenant arrangement was intended to break the "chicken or egg" deadlock by giving the transmission developer a partner with which to finance the project and share risk, and by giving the generation developer certain preferential transmission rights. The ruling was farsighted, but despite its intended effect, anchor tenant relationships have struggled to succeed. The issue that even the anchor tenant concept could not resolve was cost-recovery risk. Even for large renewable energy companies considering to become an anchor tenant, long-haul high-voltage transmission lines can be a bet-the-company type of risk, and given the uncertainties introduced by state siting authorities, as well as the risk that the anchor tenant may be underbid for power sales by a competitor, that is not a risk many companies will take. In our view, the federal government should act to alleviate the risk associated with long-haul transmission development by providing initial financing that will get high-priority interstate transmission projects off the ground.

Transmission developers that have not subscribed their project's full capacity will also benefit from early federal financing. These projects may have gone into the market and attracted generation customers, but not enough of them to continue with the project as planned.[45] Instead, the transmission developer's options are to abandon the project, wait for additional market support, or revise the project's capacity downward to reflect market interest. Transmission downsizing may result in an inefficient use of transmission rights-of-way, and potentially the need to incrementally expand the line as more capacity is needed in the future. With early financing from the federal government, the transmission developer could capture the economies of scale and sustain a proposal that includes unused capacity, thus making efficient use of rights-of-way and hopefully delaying any need for capacity upgrades well into the future.

The California Independent System Operator ("ISO") administers a similar financing mechanism that offers a helpful conceptual framework. The California ISO created a category of transmission facilities known as Location Constrained Resource Interconnection Facilities (or "trunklines").[46] Basically, the California ISO builds trunklines to remote areas that are

[43] *Chinook Power Transmission, LLC*, 126 FERC ¶ 61,134, P 44 (2009).

[44] *Id.*

[45] For example, the Wyoming-Colorado Intertie, a beneficial transmission line that will deliver Wyoming wind to load in Colorado, is currently without any customers who have reserved capacity.

[46] *Cal. Indep. Sys. Operator Corp.*, 119 FERC ¶ 61,061 (2007); Cal. Indep. Sys. Operator Corp., *Proposal to Remove Barriers to Efficient Transmission Investment* (Sept. 21, 2006), *available at* http://www.caiso.com/1879/18799b184b440.pdf.

renewable energy rich and transmission poor. The California ISO then socializes the entire cost of any unused portion of the line, initially allocating such costs to load.[47] As new generators come online and make use of any unused trunkline capacity, those generators then pay a pro rata share for the capacity they use going forward.[48]

This financing risk-mitigation mechanism provides a number of benefits. First, rather than building transmission capacity in increments (which would require outages as more upgrades are necessary), developers can create a robust, existing grid where renewable energy developers can be confident that they will get their product to market. Second, by providing an alternative allocation for initially unused capacity, the methodology avoids charging generation developers for more transmission than their projects require. Although the trunkline methodology works well on an intrastate basis, such a program cannot easily be expanded interconnection-wide because the regulatory structures currently in place do not allow FERC to allocate costs to load interregionally across the West.[49]

Development of high-priority transmission projects could be accelerated by creating a financing risk-mitigation program modeled on the California ISO's trunkline program, whereby a federal agency could support financing of the unsubscribed portions of interstate transmission lines that serve a regional or national interest. Such financing support would allow transmission projects to achieve economies of scale and make the most efficient use of limited transmission corridors. In addition, the federal government would be relieved of its financial support obligations as additional generation developers made use of transmission capacity over time.

This federal support, properly managed, would be a relatively low-cost proposition. We know where the most robust renewable resources are. If federal and state policies mandate aggressive development of such resources, and the needed lines to the best resource areas are built, the lines will be fully used relatively soon, even if not immediately upon completion. Thus, governmental support, if any, can be expected to be relatively modest and short-lived.

[47] 119 FERC ¶ 61,061, P 5.

[48] *Id.*

[49] FERC issued a Notice of Proposed Rulemaking in June 2010 as this white paper was being written. In the notice, FERC seeks comments on a proposed rule that would establish local and regional transmission planning driven by state and federal public policy requirements, improve coordination between neighboring transmission planning regions, and eliminate certain incentives for incumbent transmission providers. *Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities*, 131 FERC ¶ 61,253 (2010) ("June 17 NOPR"). Although the June 17 NOPR is a step forward, it is unlikely to have a positive effect for a number of years while transmission planners wade through one compliance filing after another. In addition, regions may disagree on the coordination planning efforts, thus leading to potential rehearing of a FERC order in the docket and/or litigation. Even with planning principles in place, however, the states may slow the process further by challenging how interregional transmission costs filter down to state-regulated utilities. These delays, combined with the delays already occurring in state siting proceedings, could well stall development of high-quality renewable resources for years and contribute significantly to a failure to meet renewable energy standards and carbon reduction standards in the West.

State-Level Market Protection

To justify the cost of building a robust transmission system, there must be policies that allow distant, out-of-state renewable energy to serve large load centers, and particularly those of the largest load in the West: California. However, in recent years there have been several state-level attempts to restrict interstate commerce in energy sales. Such restrictions negatively impact the use of renewable energy to achieve maximum carbon reduction.

The 2010 Washington legislature considered a law that would have used the state tax code to discriminate against renewable energy projects developed in Washington but selling to out-of-state utilities. Senate Bill 6143 proposed to limit the exemption from state taxes imposed on machinery and equipment used for generating renewable energy so it would apply only to wind projects sold to, or selling energy to, a Washington utility.[50] Conversely, renewable energy projects sold, or selling, to out-of-state buyers would no longer have received such exemption. After much protest, the discriminatory tax treatment was cut from the bill and the uniform eligibility of wind projects for the exemption was retained.

In 2009, the California legislature proposed requiring that renewable power generated outside California be delivered to California at the same time and from the same source as the energy associated with renewable energy credits ("RECs") to count toward California's RPS.[51] If the delivery requirements were not met, then the RECs associated with that power could still be counted to meet up to 25% of a utility's RPS requirements as long as the generation with which the RECs were associated was located within WECC. The delivery requirement would have significantly restricted out-of-state renewable energy that would qualify for the California RPS.[52]

Under California law, the California Energy Commission ("CEC"),[53] not the California Public Utilities Commission ("CPUC"), is tasked with certifying whether generation is an eligible renewable resource that can be used to meet the California RPS. Under California's RPS statute, power not only must be generated using certain defined renewable resources (wind, solar, biomass, small hydro, geothermal), it also must be delivered to California.[54] At the time of the proposal to require simultaneous generation and delivery of renewable energy and associated RECs, the CEC allowed power delivered to California to be generated at a different time and in a different location than the power associated with the RECs.[55] This allowed sellers and

[50] S.S.B. 6143, 61st Leg., Reg. Sess. § 1701 (Wash. 2010) (first substitute bill).

[51] S.B. 14, Reg. Sess. § 1 (Cal. 2009-10) (as amended July 14, 2009) ("[E]lectricity shall be deemed delivered if it is either generated at a location within the state, or generated at a location outside the state and scheduled for simultaneous consumption by California end-use retail customers.").

[52] During the period the California legislature was attempting to restrain interstate commerce to ensure that <u>more</u> wind generation was built in its state, as noted above, the Washington legislature was being asked to take action that would ensure that <u>less</u> wind generation was built in its state. Yet both states are among the leaders in advocating for meaningful and prompt carbon reduction policies.

[53] S.B. 1036, Reg. Sess. (Cal. 2007-08).

[54] Cal. Pub. Util. Code. §§ 383.5, 399.12(a).

[55] Cal. Energy Comm'n, *Renewables Portfolio Standard Eligibility*, at 23 (3d ed. Jan. 2008) (*citing* Cal. Pub. Res. Code § 25741), *available at* http://www.energy.ca.gov/2007publications/CEC-300-2007-006/CEC-300-2007-006-ED3-CMF.PDF.

purchasers of intermittent generation from outside California to firm and shape the power delivered to California—a common service associated with intermittent renewable resources. However, in a number of transactions, utilities bought both the RECs and the power from a renewable generator, and then sold the power either back to the generator or to another party, retaining the RECs.[56] The utility then delivered power to California from a different source rebundled with the RECs, allowing it to count the RECs toward its RPS requirement even if the power delivered into California was not produced by a renewable resource.

The bills to curb these practices passed the California legislature in 2009 but were later vetoed by the Governor, in large part due to the limitations imposed on out-of-state renewable generators. After the Governor's veto, the CPUC also got into the act. On December 23, 2009, the CPUC issued a proposed decision that would have simply categorized *all* out-of-state transactions as unbundled transactions, and limited those unbundled transactions to 40% of a utility's RPS requirement.[57]

The CPUC made its final decision on March 11, 2010, allowing state utilities to use tradable renewable energy credits ("TRECs") to meet their RPS obligations, subject to a 25% cap.[58] To address the issue of utilities attaching RECs to brown power, the CPUC sought to define certain transactions as unbundled transactions—transactions that, in the view of the CPUC, did not result in importing additional renewable generation into California. The CPUC struggled, however, to distinguish between transactions it viewed as "unbundled" and those that would not be subject to the cap. Under the CPUC's decision, a utility can simply purchase TRECs from a renewable generator, without having to purchase the associated power. Furthermore, although the CPUC proposed to permit the purchase of TRECs from out-of-state facilities, the delivery requirement in the RPS legislation would still have to be met, so a comparable amount of power would have to be imported into the state, along with the RECs. Regardless of the CPUC's distinctions regarding bundled versus unbundled RECs, the potential cap could put significant restrictions on using out-of-state renewable energy for RPS purposes. This decision subsequently was suspended for further consideration.

Currently, the California legislature is proposing to divide RPS-eligible renewable energy resource electricity products into three categories, depending on whether those products are generated in-state or out-of-state, and, if out-of-state, whether and how those products are delivered to California.[59] The legislation directs utilities to acquire not less than 75% of their RPS requirements from eligible resources that are scheduled into the California ISO balancing authority on an hourly or within-hour basis, thus leaving out-of-state renewable resources that are shaped and firmed eligible to meet only up to 25% of the utilities' obligations. That 25% may be reduced to as low as 15% if a utility uses products from the third category (unbundled RECs) for RPS compliance.

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[56] D.10-03-021, *Order Instituting Rulemaking to Develop Additional Methods to Implement the California Renewables Portfolio Standard Program*, Docket No. R06-02-012, at 29 (Calif. Pub. Utils. Comm'n Mar. 11, 2010) ("March 11 Decision").

[57] *Revised Proposed Decision of ALJ Simon*, Cal. Pub. Utils. Comm'n, at 3 (Dec. 23, 2009).

[58] March 11 Decision, *supra* note 56.

[59] S.B. 722, Reg. Sess. (Cal. 2009-10).

Consider the following, for example: A non-California wind-generation facility uses a pumped storage hydroelectric facility to store nighttime energy and deliver that energy in the daytime. The resulting on-peak energy is much more valuable to California than the stored nighttime energy. Moreover, the on-peak renewable energy can be delivered on a firm, predictable basis, to displace resources with high carbon emissions. This great increase in the economic and environmental value of the wind project will be stymied by a requirement for delivery to California that is simultaneous with generation at the wind project. And, of course, devaluing renewable energy by limiting its options for delivery into California only serves to slow the development of those resources. Thus, state restrictions on interstate commerce in electric energy can have both direct consequences, such as potentially blocking development and sale of lower cost out-of-state renewable resources,, and indirect consequences, such as preventing the conversion of interruptible off-peak renewable energy into an on-peak firm power supply that is more valuable to the purchasing utilities.

Overcoming the Impediments Through Federal Policy

As shown above, the impediments to developing a robust transmission system in the West include siting (and condemnation) barriers, financing risk mitigation and cost allocation, and in some cases state action that threatens to impair the interstate renewable energy market that is necessary for supporting transmission projects. Removing these impediments will require bold, and sometimes politically difficult, decisions that focus on regional and national needs.

OPTIMIZING RENEWABLE ENERGY DELIVERY SYSTEMS

To meet the West's growing and changing energy needs, it is evident that additional transmission capacity is required to access the West's valuable untapped renewable energy resources. An additional, and until recently overlooked, challenge is the shaping of intermittent generation to meet load requirements. The best intermittent renewable resources generally are located in areas without adequate means of providing shaping, but shaping is essential so that intermittent generation can be matched with second-to-second load requirements.

In addition to construction of new transmission resources, we suggest the following as technological breakthroughs and operational changes that will help the West use its generation and transmission resources as effectively as possible. The technologies and operational changes discussed will not eliminate the need for discrete transmission facilities. They are independently necessary, however.

Storage

Storage technologies, such as batteries, pumped storage, and compressed air, can make renewable energy more valuable and transmission more efficient. The most obvious use for storage is time shifting of energy deliveries. In certain areas of the West, prevailing wind patterns occur at night when loads and wholesale energy prices are low, and thermal and hydro generators are operating near minimum generation. With storage devices installed and acting like loads on the grid,[60] nighttime wind energy can be stored as it is generated and saved until

[60] Fleets of electric vehicles can act as a collective battery on the grid by drawing energy when wind and (continued . . .)

daytime hours when demand and market prices are up.[61] Storing nighttime wind has the added benefit of saving thermal generators from reducing output to uneconomical levels (resulting in operation and maintenance costs) or causing hydroelectric plants to spill water past turbines (a lost opportunity cost).

On-site storage also allows transmission lines to carry more intermittent resources. As is well known, the output from wind and solar facilities may substantially vary during any given hour. Utilities receiving that power, however, often desire that power be delivered as a firm, non-variable product, which requires intermittent resources to enter an intermediate transaction wherein an intermittent resource sends its variable output to another generator—a shaping party—that will shape the wind or solar output and deliver a firm product to the ultimate buyer. When the shaping party is located at a distance from the intermittent resource, there is an inefficient use of transmission capacity.

If, for example, a 100 MW wind generator is obligated to deliver 40 MWh of firm product to its offtaker, the wind generator must reserve 100 MW of transmission capacity in between its point of interconnection and the shaping party's point of receipt. The wind generator's actual output over the hour, however, may vary anywhere between 0 and 100 MWh, resulting in the wind generator's having to reserve 100 MW of transmission capacity to deliver fewer than 100 MWh of energy to its shaping party. The unused portion of the reserved capacity would also remain off-limits as firm capacity available to other generators.

With storage on-site, the wind generator could shape its output into 40 MWh of firm product and will then require only 40 MW of transmission capacity to deliver the product to its buyer.[62] As a result, the wind generator would require 60% less transmission capacity to deliver

(. . . continued)

solar plants are generating, and returning some energy to the grid when intermittent resources are not generating. The PJM Interconnection already pays researchers at the University of Delaware to use electric cars as batteries, using the cars to feed energy onto the transmission grid in order to maintain stable frequency. Joel Achenbach, *The 21st Century Grid*, National Geographic 138 (July 2010).

[61] NREL recently called the value of using storage in an arbitrage manner into question. "The best way to integrate wind and solar generation into the system is to make full use of the capabilities of all of the generating units in the system. Although the flexible operation of storage is attractive, when gas fired generation [is] on the margin both on peak and off peak there is little economic room for using the storage in an 'energy arbitrage' manner due to the 25% losses associated with pumped storage hydro or batteries. As long as balancing area issues don't interfere, utilizing the ramping capabilities of [a] system's dispatchable generation is generally more efficient. With perfect forecasts of the renewable generation, the spot prices drop throughout the day and generally reduce the price ranges needed throughout the day to make storage attractive. Broader price ranges may exist with state-of-the-art forecasts and high levels of renewables but even then, the value appears to fall significantly short of what is needed to make new storage economically attractive." NREL Integration Study, *supra* note 26, at 290. It should be noted, however, that NREL did not consider all of the other benefits of storage discussed in this white paper, such as using storage to deliver consistent power. Nor did NREL consider the cost of additional carbon emissions when determining whether continued use of fossil fuel generation was more efficient than storage.

[62] Grasslands, LLC's Wind Spirit Project is an example of a potentially transformative project that proposes to combine wind energy and storage. Grasslands will be designed to collect up to 3,000 MW of wind energy that is aggregated from geographically diverse wind farms in Montana, North Dakota, Alberta, and Saskatchewan; store the collected energy with pumped storage applications; and then deliver 1,000 MW of consistent power. Grasslands is a client of Stoel Rives LLP. Grasslands Wind Spirit Project Overview, *available at* http://www.gre-llc.com/wp-content/uploads/2010/01/Presentation3.pdf.

its firm product—which 60% remains available to other transmission customers. The resulting cost of transmission ultimately paid by ratepayers is significantly lower on a dollars per megawatt-hour basis for delivered energy, because less transmission capacity was needed to deliver an equivalent amount of energy.[63]

Resource Location Diversity

There is substantial diversity at any given time between wind strengths in widely separated areas, and geographical dispersion can help to counteract the overall variability of intermittent resources within a balancing authority. In other words, "[t]he greater the number of wind turbines operating in a given area, the less their aggregation production variability," causing the wind generation fleet to become more predictable.[64] A robust transmission system could take advantage of this diversity to achieve higher overall use of new transmission and result in more efficient use of regulation and load following reserves. "Consolidating or aggregating resources over larger balancing areas and feeding diverse resources into the transmission system reduces variability on the system and levelizes peak load."[65] In addition, aggregating intermittent resources behind the meter, either physically or virtually, smoothes the power fluctuations that intermittent resources would otherwise exhibit when not combined.[66] This allows multiple wind farms, for example, to act as one large wind farm with steady wind speeds on the transmission grid, as the differences in variability across the multiple sites would act to reduce overall variability.[67] In turn, balancing authorities observe reductions in the total reserve requirements needed to follow wind generation.[68] Thus, balancing authorities should be directed to study how virtual renewable resource clustering can be used to reduce the amount and cost of reserve requirements.

Diversity Between Wind and Solar Generation

In many areas, wind resources may generate disproportionately at night during load valleys, and may provide relatively little generation on the hottest summer peak days. Solar generation has the opposite patterns. Solar generation closely follows the diurnal cycle, thus allowing solar resources to closely complement changes in load. As wind generation is ramping down during late morning, solar generation ramps to peak at noon and then tails off with load in the late afternoon.[69] Wind output then resumes higher levels of output during evening and early morning hours.[70] Therefore, wind and solar resources together can provide a somewhat constant

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[63] That is, of course, if the storage cost is lower than the cost of excess transmission capacity (60 MW in the example). If the cost of storage is too high, the economical choice is to use a distant shaping party to transform an intermittent resource into a consistent product.

[64] DOE 20% Wind Energy, *supra* note 32, at 89-90.

[65] WIRES, *Integrating Locationally-Constrained Resources into Transmission Systems: A Survey of U.S. Practices* (Oct. 2008). Wind farms already function to physically cluster wind turbines that, by themselves, exhibit greater variability than wind farms spread over geographically large sites.

[66] *Id.* at 49.

[67] *Id.* at 50.

[68] *Id.*

[69] NREL Integration Study, *supra* note 26, at 57.

[70] *Id.*

power source to serve load.[71] In addition, the variations in both solar and wind resources can serve to reduce overall transmission system volatility, much like aggregating wind resources over wider geographic areas.[72] Consequently, transmission lines that access both robust solar and robust wind areas can tap this diversity to benefit from relatively constant output from intermittent resources and reduced variability across the system.

Load Shifting

Load shifting allows for a more efficient use of the transmission system by causing loads that would otherwise contribute to peak daytime demand (in some cases causing the transmission system to reach its ratings limits) to shift to low-demand hours when the transmission system is no longer congested. In 2006, 15% of the total generation capacity in the PJM Interconnection operated less than 1.1% of the time (96 hours or less), and 20% of the capacity ran less than 2.3% of the time (202 hours or less).[73] Maintaining approximately one-fifth of the total generation capacity simply to meet peak load costs ratepayers billions of dollars, and thus there is much to gain in terms of system and economic efficiencies by shifting as much energy demand as possible to non-peak hours.[74] Leveling out the demand curve will additionally improve reliability and spread needed generation and transmission capacity more evenly across all hours.

Dynamic pricing is a method that provides energy consumers an incentive to shift demand to off-peak hours. Generally speaking, retail consumers' electricity rates (which are flat) do not reflect the wholesale market rates (which vary by time of day). With dynamic rates in place, consumers are encouraged to shift their consumption patterns to avoid paying for the expensive peaking power that serves peak demand. Consumers who are able to shift their energy usage to off-peak hours may benefit from lower utility bills and contribute to a more efficient use of generation and transmission resources.

However, dynamic rates are not without controversy.[75] Certain segments of the population, specifically lower-income individuals, may not have the ability to shift their energy usage to hours in which rates are low. Thus, in considering whether to implement dynamic retail electricity rates, state utility commissions must consider whether such rates would unduly burden any group of ratepayers, and whether dynamic pricing should be imposed on only a limited subset of retail customers, such as large industrial customers. In addition, state utility

[71] WIRES, *supra* note 65, at 51.

[72] The authors note that wind and solar resources do not have coincident peaks, and therefore the two resources may not offset variability as substantially as when aggregating just wind resources across a wider geographic region.

[73] Kathleen Spees & Lester Lave, *Impacts of Responsive Load in PJM: Load Shifting and Real Time Pricing*, Energy J., Apr. 2008, *available at* http://www.entrepreneur.com/tradejournals/article/177590473.html.

[74] *Id.*

[75] Pacific Gas & Electric has received substantial criticism for its smart meter program in California. Many customers have complained to the utility and state regulators that the smart meters have failed to accurately measure utility services, resulting in charges that are not related to actual usage. *See* Laura Anthony, *PG&E Under Fire from Angry SmartMeter Customers*, E. Bay News, Mar. 12, 2010, *available at* http://abclocal.go.com/kgo/story?section=news/local/east_bay&id=7328144.

commissions must consider whether certain technologies, such as smart meters, will actually encourage retail consumers to change their energy usage behaviors.

Smart Grid

A dynamic grid is essential for efficiently integrating dynamic resources. Generally speaking, "smart grid" refers to software applications and small-scale technologies that operate both on the transmission system and from within consumers' homes. On the transmission system, smart grid technology may allow grid operators to monitor, and quickly react to, real-time conditions, and quickly adjust the balance between load and generation resources. Doing the latter may allow grid operators to reduce the variability impacts of intermittent generation, thus reducing the balancing reserves needed for, and the costs of, integrating such resources. In addition, smart grid technologies may allow transmission operators to utilize dynamic transmission system ratings, *i.e.*, capacity ratings that vary with ambient conditions, to increase transmission capacity when the circumstances allow. Dynamic transmission ratings may be particularly helpful for wind generation deliveries, because a transmission line's capacity drops as the temperature increases and, absent smart grid technology, the line must be rated based on what it will carry on a hot day, in still weather. In the vicinity of wind generation, in times of high winds and maximum wind generation, the weather conditions normally should allow transmission lines to carry more than their nominally rated, hot-day capacity. Thus, dynamic ratings could allow for increased energy production from intermittent renewable resources.

In homes, smart grid technology will help to implement load-shifting techniques and align nighttime-peaking wind resources with new fleets of electric vehicles. As stated above, there are tremendous potential benefits to leveling out demand curves, such as reducing inefficient uses of generation and transmission capacity, thereby causing billions in savings for electricity consumers.

Smart grid technologies cross jurisdictional boundaries. Therefore, state and federal agencies must cooperate to determine which smart grid technologies provide demonstrable benefit to the grid and help to integrate renewable resources, without placing an undue cost burden on retail ratepayers. Thankfully, these collaborative efforts have already begun.

It is important to not only modernize the physical elements installed on the transmission system, but modernize operational processes as well. Forecasting, scheduling procedures, and increased coordination among (or perhaps consolidation of) balancing authorities can all contribute to optimizing clean energy resources.

Wind and Solar Forecasting Advances

Forecasting refers to the expected production of a clean energy resource for a point of time in the future, *e.g.*, hour-ahead or day-ahead. The greater the accuracy of the forecast, the less uncertainty there is with respect to a variable resource's output. When a forecast is overestimated, there may not be sufficient resources online to serve load when a variable resource fails to deliver according to its forecast. Conversely, when a forecast is underestimated, grid operators may be forced to push thermal generators to minimum generation limits or spill water from hydroelectric plants. Severe forecasting errors may result in variable generation being curtailed. A recent study found that state-of-the-art wind and solar forecasts would reduce

WECC operating costs by 14%, or $5 billion per year.[76] "Advancements in wind forecasting in recent years have vastly improved the reliability of day-ahead and hour-ahead estimates of wind generation. What system operators once considered a wholly unreliable resource, they increasingly view as a predictable and manageable source of emissions-free energy. . . . Real-time forecasting is the key."[77]

In addition, using aggregated forecasts over a wide geographic area can be more accurate than using project-specific forecasts. State-of-the-art forecasting for a specific plant may result in 12-20% error. In comparison, "aggregating forecasts across a whole region can cut those error rates in half or better, to around 5 percent."[78] Thus, in order to prevent curtailment of wind and solar resources, minimize transmission system disturbances, and avoid drastic operational changes to baseload generators, resource planners must apply enhanced forecasting techniques to intermittent renewable resources to set day-ahead unit commitments.

Intra-Hour Scheduling

Shorter energy scheduling periods will help to reduce the uncertainty of whether intermittent renewable resources will produce their scheduled output, thereby reducing how often generation imbalance reserves must be dispatched, as well as the costs of integrating intermittent renewable resources. Scheduling is the process by which transmission operators commit energy to flow from generation resources to meet projected demand. Energy schedules are submitted hourly by generation resources, meaning that a generator will commit to providing the scheduled amount of energy over the next hour. For baseload resources that maintain consistent output, it is not particularly difficult to adhere to an hour-ahead schedule. For intermittent renewable resources, however, whose output can vary significantly over the course of an hour, transmission providers are forced to carry substantial balancing reserves that can be used to meet any shortfall in the schedule. In addition, the amount of balancing reserves that a balancing authority must hold for each scheduling period affects the balancing authority's abilities to react to moment-to-moment variations in intermittent renewable resources (a/k/a regulation and load following service).

The amount of reserves that a transmission operator must carry is, in part, a product of its scheduling practices. The National Renewable Energy Laboratory recently determined that hourly scheduling can yield balancing reserve requirements that leave balancing authorities with fewer, or perhaps no, reserves to provide regulation and load following services.[79] "[T]he current practice of hourly scheduling has a greater impact on the regulation requirements than does the wind and solar variability."[80] In addition, intra-hour scheduling increases efficiency and reduces wear on the generation resources that provide balancing services. "[T]he maneuvering of combined-cycle plants [that provide load following and regulation service] with sub-hourly

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[76] NREL Integration Study, *supra* note 26, at 312.

[77] Michael T. Barr, *Forecasting Brings Wind Energy Under Control*, NERC News, at 11 (May 2010) (*citing* Public Utilities Fortnightly, May 2010).

[78] *Id.*

[79] NREL Integration Study, *supra* note 26, at 311.

[80] *Id.*

scheduling is about half of that with hourly scheduling, . . . [resulting in] [i]mprovements in plant efficiency and reductions in [operations and maintenance] costs . . . ."[81] The benefits to balancing reserves requirements could be even greater if balancing authorities adopted even shorter scheduling periods (*e.g.*, 10-minute scheduling).[82]

In 2009, wind developers asked BPA to adopt intra-hour scheduling to reduce a proposed wind integration charge for regulation and load following services. The charge was initially proposed at approximately $12/MWh based on hourly scheduling practices.[83] In response, BPA expressed (and continues to express) concerns that it is not capable of implementing intra-hour scheduling. BPA instead adopted new wind-only curtailment procedures to arrive at a more manageable rate of $5.70/MWh.[84] Given that either intra-hour scheduling or curtailment procedures may have resulted in BPA's final wind integration rate, BPA chose the route that causes wind generation to be cut from its system and causes a loss of carbon reduction benefits. Although curtailment may occasionally be required as an interim measure, DOE policy should require federal power marketing agencies such as BPA to promptly implement operational changes—such as shorter scheduling increments—needed to maximize electricity production from interconnected wind generators. In addition, FERC should investigate instances where curtailment procedures are implemented instead of cost-effective operational changes that will prevent loss of wind generation.[85]

Balancing Authority Coordination

The overall variability of intermittent resources is reduced when such resources are aggregated over a wider geographic area.[86] In other words, the smaller the balancing authority area, the more difficult (and costly) it may be to integrate increasing amounts of intermittent resources. In WECC alone, there are 37 balancing authorities—five of which are generators only—[87]that are each responsible for balancing load and generation within their electrical boundaries.[88] In addition, balancing authorities schedule interchange transactions on hourly

[81] *Id.*

[82] It should be noted, however, that the impact of intra-hour scheduling is not to reduce the amount of generation following required within an hour, but instead to shift the burden of such following from the balancing authority in which the resource is located to the balancing authority at the load. Such a shift in following responsibilities can be advantageous when the resource is located in a balancing authority with very limited generation following capability, as is frequently the case with remote renewable resources.

[83] Bonneville Power Administration, *Administrator's Final Record of Decision: 2010 Wholesale Power and Transmission Rate Adjustment Proceeding (BPA-10)*, at P-4 (July 2009) (stating the rate initially proposed of $2.72/kW/month).

[84] Bonneville Power Administration, 2010 Transmission and Ancillary Service Rates (Oct. 1, 2009).

[85] *Id.* App. C, at 65.

[86] *Id.*

[87] Some generators in the West have established themselves as balancing authorities because the costs of ancillary services from the local utility balancing authority were beyond economical levels. For instance, the Glacier Wind Energy balancing authority in Montana is the first wind-only balancing authority in WECC. Michelle Mizumori & Bradley Nickell, *Balancing Authority Proliferation*, WECC (Nov. 13, 2008). It was created, in part, because Northwestern Energy (the utility balancing authority) was forced to acquire balancing services at a premium from the market.

[88] *See* http://www.wecc.biz/library/WECC%20Documents/Publications/Balancing%20Authorities.pdf.

periods, which scheduling procedure itself has a significant effect on balancing reserve capabilities.[89]

Operationally speaking, balancing authorities can enhance their ability to provide intermittent resources with balancing service by consolidating balancing operations and pooling their reserve resources. "[O]verall variability is reduced when balancing is performed over a larger area."[90] Even with significantly higher penetrations of renewable resources, variability only slightly increases when balancing services are aggregated.[91] In addition, the cost of providing balancing services is reduced when reserves are pooled because balancing authorities have greater access to more and flexible resources.[92] At only 10% renewables penetration, WECC operating costs could be reduced by $2 billion by sharing resources over larger regions.[93]

Create a Market in Generation Following Services

Markets for regulation and following services can help lower the cost to intermittent resources for such necessary services, especially in areas where balancing authorities have difficulty providing the services with their own generation. "A deep, liquid real-time market is the most economical approach to providing the balancing energy required by wind plants with variable outputs . . . ."[94] In the West, however, balancing authorities are largely without generation markets and are thus often left to use their own merchant generation to provide transmission ancillary services. In certain circumstances, balancing authorities draw from neighboring balancing authorities during contingencies, but those situations do not encompass the day-to-day services needed to follow intermittent resources.[95] As a result, intermittent resources (wind, in particular) are left to acquire necessary, but costly, ancillary services at a premium, forcing some resources to form their own balancing authorities. Rather than forcing the creation of multiple generation-only balancing authority areas that will only serve to undermine the goals of balancing authority consolidation, the better alternative for providing generation following services cheaply and efficiently is to create a competitive market for such services. Thus, FERC should investigate the creation of an ancillary services market in the West to allow independent power producers to compete with merchant generation as an ancillary services provider.

Strengthen Ties Between the Eastern and Western Interconnections

The transmission system in the United States operates as three asynchronous grids, and many of the best renewable resources are located near the boundary between the Eastern Interconnection and Western Interconnection (the "Interconnections"). Thus, these resources are located on the boundaries of their respective transmission grids, with only six small DC tie lines

[89] NREL Integration Study, *supra* note 26, at 311.

[90] *Id.*

[91] *Id.*

[92] *Id.*

[93] *Id.*

[94] DOE 20% Wind Energy, *supra* note 32, at 92.

[95] *See, e.g.*, the Northwest Power Pool Reserve Sharing Group.

allowing energy transfers between the Interconnections. But we should ask ourselves this: Is it better to have our best, proven renewable resources located on the *outskirts* of the Western grid, or would there be more benefit to increasing power transfer capabilities between the Interconnections, thereby placing these resources in the *middle* of an almost-national grid? Could efficiencies be gained by increasing cross-Interconnection exchanges? Currently, the great wind potential of such states as Montana and Wyoming is located on the northeast edges of the WECC grid. A broader marketplace for resources from these regions, as enabled by increased cross-Interconnection exchanges, could spur the more rapid and complete development of the West's renewable energy potential to meet the nation's climate challenges. In addition, the ability to perform meaningful energy transfers between the Interconnections may allow generation following and shaping resources to be tapped from large generation/load areas both to the east and to the west of the most robust wind resource areas, thus allowing for the less burdensome integration of additional intermittent resources.

Robust DC tie lines between the Interconnections could provide many of the economic benefits of synchronizing the grids, while maintaining the reliability benefits that come from keeping the Interconnections electrically separated. Further, increasing exchanges using DC lines avoids many of the significant technical and political barriers to fully synchronizing the Interconnections (which, after all, are international organizations). However, there must be coordinated transmission planning across the Interconnections to ensure that energy crossing robust DC tie lines will not be constrained from reaching major load centers. Thus, in planning within-Interconnection grid expansion, transmission planners should remain mindful of whether expansion plans include, or alternatively rule out, the possibility for increased cross-Interconnection exchanges. Such connections are unlikely to arise, however, under the current planning processes as overseen by FERC. There is no planning process for studying cross-Interconnection facilities, and FERC recently indicated that such a process is unlikely to occur.[96] We would urge the FERC to mandate the prompt creation of such a process.

CONCLUSION

Renewable energy is a main ingredient for achieving carbon reductions and energy security, but the West's ability to develop its vast renewable energy resources is limited by a lack of transmission infrastructure to reach those resources located far from load centers. As described herein, there remain significant impediments to developing the transmission needed to meet regional and national public policy goals. These impediments are difficult to overcome—there are no painless answers—but the Western states and the federal government must make some bold decisions on siting and cost allocation for our goals to be achieved. Our recommendations are set forth at the beginning of this white paper, and we encourage FERC to address the issues raised herein in its related proceedings.[97]

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[96] June 17 NOPR, *supra* note 49, P 114 n.121 ("This [proposed interregional planning reform] does not require a public utility transmission provider to enter into an interregional transmission planning agreement with a neighboring transmission planning region in *another interconnection*." (emphasis added)).

[97] *See, e.g.*, June 17 NOPR, *supra* note 49; *Integration of Variable Energy Resources*, 130 FERC ¶ 61,053 (2010); *Smart Grid Policy*, 128 FERC ¶ 61,060 (2009).

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