



**BARRIERS AND OPPORTUNITIES IN WIND AND RENEWABLE ENERGY DEVELOPMENT:
XCEL ENERGY'S 2007 COLORADO RESOURCE PLAN**

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INTRODUCTION:

Integrating wind into the electrical system in Colorado has been a challenge for Xcel Energy, the holding parent company of Public Service Company of Colorado, the dominant regulated utility in the state. Xcel has embraced a mantle of leadership in the national wind market: it added 775 MW (megawatts) of wind to the Colorado system in 2007¹ and plans to gradually add more wind according to its most recent Colorado Resource Plan (2007 CRP).² Wind integration and transmission were issues addressed in the 2007 CRP proceedings before the Colorado Public Utilities Commission (PUC).

The PUC requires Xcel to file a resource plan every four years.³ According to PUC regulations, the purpose of the resource planning process is to create a “cost-effective resource portfolio” from resources acquired mostly through a “competitive acquisition process.”⁴ The filing includes: statements of the resource acquisition and planning periods; annual electric demand forecasts; evaluation of existing resources; assessment of planning reserve margins and

¹ Rebuttal Testimony and Exhibits of Karen T. Hyde at 21, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (June 9, 2008) (available online at: <http://www.xcelenergy.com/docs/CRPHydeRebuttal.pdf>).

² Xcel Energy, *Xcel Energy Files Long-Range Generation Resource Plan*, Nov. 15, 2007, http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_15531_46991-42162-0_0_0-0.00.html.

³ 4 COLO. CODE REGS. § 723-3-3603.

⁴ 4 COLO. CODE REGS. § 723-3-3601.

need for additional resources, as well as the plan for acquiring those resources; emissions projections; proposals adhering to the competitive acquisition requirement; discussions of rates; and three case studies examining compliance with the “Renewable Energy Standard, 4 CCR 723-3-3650 et seq.” and “demand-side management resource requirements under § 40-3.2-104, C.R.S.”⁵

This paper summarizes testimony by Xcel and Interwest Energy Alliance (Interwest) on wind integration and transmission in the 2007 CRP, as well as relevant discussions in hearings before the PUC in July 2008. Toward highlighting barriers and opportunities in wind integration in Colorado, this paper also describes the transmission-constrained Western Interconnection context of 2007 CRP.

XCEL’S 2007 CRP:

Xcel filed its resource plan on November 15, 2007, applying to the PUC for approval of the concepts and assumptions to guide the utility’s resource acquisitions through 2015. In the filing, Xcel voluntarily retired coal plants to meet carbon goals, increased its customer efficiency programs and budgets, added wind and solar on schedules limited by operational concerns and transmission timing, and proposed its approach to competitive bidding for all resources.⁶ A number of Xcel witnesses appeared in the PUC’s hearings, which concluded in July 2008.

Paul Bonavia, President of Utilities Group for Xcel summarized the 2007 CRP, in part, as an effort to “take care of the traditional business of resource planning,” so as to “make significant progress towards meeting the State’s carbon reduction goals in a manner that both benefits customers and promotes the long-term financial health of the company.”⁷ Mr. Bonavia also explained that energy development and transmission is not a “chicken and egg game,” emphasizing that more transmission is necessary in Colorado for Xcel to meet its loads and develop a regional energy market. Furthermore, Mr. Bonavia identified cost recovery mechanisms and cooperation amongst utilities in the state as necessities for transmission development that may require legislative solutions. Expecting future federal carbon regulation, Mr. Bonavia testified to Xcel’s interest in owning more renewable energy generation.⁸ He expressed Xcel’s desire to participate in “the new energy economy” envisioned by Colorado’s policy makers by moving quickly on carbon regulation.⁹

As further described below, limits on solar and wind acquisitions in the 2009-2015 resource acquisition period covered by the 2007 CRP were premised by Xcel on operational and

⁵ 4 COLO. CODE REGS. § 723-3-3604.

⁶ See Xcel Energy, *2007 Colorado Resource Plan*, http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_41994_45385-42116-0_0_0-0,00.html.

⁷ Rebuttal Testimony and Exhibits of Paul Bonavia at 4, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (June 9, 2008) (available online at: <http://www.xcelenergy.com/docs/CRPBonaviaRebuttal.pdf>).

⁸ *Id.* at 26-27.

⁹ See COLO. REV. STAT. § 40-2-124 (1)(c)(I) (2008) (imposing as the Colorado Renewable Energy Standard (RES), the requirement that public utilities subject to PUC jurisdiction achieve electric generation from renewable resources at the following rates: three percent for 2007, five percent for 2008-10, ten percent for 2011-2014, fifteen percent for 2015-2019, and twenty percent for 2020 and beyond.).

reliability concerns. Meeting wind variability and controlling wind integration costs depend on the ability to schedule generator or capacity resources and natural gas that can match wind variability in an effective way. Because of scheduling difficulties, Xcel mobilized work to gather information about capabilities for flexibility in its existing generation fleet.

INTEGRATING WIND AT A HIGH MARKET PENETRATION LEVEL:

Karen Hyde, Vice President of Resource Planning and Acquisition for Xcel, explained the company's desire to limit acquisition of all intermittent renewable resources under the 2007 CRP to 850 MW until the subject resource planning period ends in 2015.¹⁰ The bulk of this proposed addition comes from even, "staged" additions of wind generation: "100 MW in each of 2010, 2011, 2012, and 2013 and then 200 MW per year in 2014 and 2015 for a total of 800 MW," with continued additions through 2020.¹¹ Under this "reasoned approach," wind will be added slowly enough for integration to be studied, including the effect on carbon emissions.¹² Xcel's Plan showed a 20% gas burn reduction attributed to the company adding 775 MW of wind.¹³

According to Ms. Hyde, adding more than 800 MW in the 2007 CRP, or 60% of the minimum load, could jeopardize compliance with regional electric reliability standards.¹⁴ She also noted that the Colorado Renewable Energy Standard (RES) does not require any additional wind to meet minimum requirements.¹⁵ Ms. Hyde further explained that adding steady increments of wind will offer proof of its reliability and the opportunity to improve forecasting and operations that could lead to further wind additions under an interim resource planning filing with the PUC expected in 2009. In short, Xcel contends that limiting wind in the 2007 CRP will not harm future plans, but will allow for valuable and necessary study on wind integration.¹⁶

Ms. Hyde described Xcel's "leading edge" study by a "cross-functional team,"¹⁷ assembled to perform a "comprehensive" inquiry into expanding wind to a 20% penetration level, including, but not limited to, the topics of:

- experience;
- "bottoming" effects;
- operating reserves;
- the "value" of ramping, quick-start, and multiple daily start/stop capabilities;
- dump energy;
- geographic diversity;¹⁸ and
- forecasting methods.¹⁹

¹⁰ Rebuttal Testimony and Exhibits of Karen T. Hyde, *supra* note 1 at 30.

¹¹ *Id.* at 19.

¹² *Id.* at 27.

¹³ PUBLIC SERVICE COMPANY OF COLORADO, 2007 COLORADO RESOURCE PLAN, Vol. 1, Page 1-47, Figure 1.6-3 (2007) (available online at: <http://www.xcelenergy.com/docs/Volume1-Sections1-6through1-12.pdf>).

¹⁴ Rebuttal Testimony and Exhibits of Karen T. Hyde, *supra* note 1 at 27.

¹⁵ *Id.*

¹⁶ *Id.* at 28.

¹⁷ *Id.* at 22.

¹⁸ *Id.* at 24.

¹⁹ *Id.* at 23.

Ms. Hyde also stated that Xcel would seek to use the entire Public Service Company (PSCo) system to balance wind variability in Colorado. Thus, as described in her Exhibit No. KTH-2, the efforts of the cross-functional team are focusing on identifying:

- 1) “key engineering threats to the power plant fleet,”
- 2) “operational constraints for the power plant fleet,”
- 3) “engineering and operating costs related to the power plant fleet,” and
- 4) “strategies to optimize cycling operation within the power plant fleet.”²⁰

The study should be done in late 2008 to inform Requests for Proposals under the 2007 CRP this fall.²¹ Ms. Hyde called this internal study “exactly the right thing...at exactly the right time.”²²

Concerning an important area of the cross-functional team’s inquiry, Ms. Hyde testified that forecasting improvements can quickly lower integration costs and increase wind penetration, while saving fuel costs and lowering carbon emissions.²³

Thomas Imbler, Vice President of Commercial Operations, stated that Xcel currently uses “grid point” data from the National Weather Service to inform its wind forecasting, leading to error ratings as high as 20%. Mr. Imbler identified retrieval of better site data for use in a real-time, updated “hour ahead” model as an opportunity to improve the forecast error rating. Xcel is currently engaged in discussions with the National Center for Atmospheric Research in Boulder, CO regarding a professional wind forecast costing some \$3 million. Mr. Imbler further testified that better forecasting can enhance the available options to compensate for variable wind production, including shutting down thermal resources and making deals with neighboring utilities.²⁴

Cooperation with other utilities in the region was raised as a method to achieve benefits from geographic diversity of wind resources. Mr. Imbler stated that the Rocky Mountain Reserve Group provides a safety net in situations where wind generation must be curtailed, but Xcel’s policy is generally not to ask for help. The PSCo Wind Curtailment Operating Policy requires losses in wind production to be mitigated within 30 minutes, on a one-to-one basis, and PSCo has sufficient dispatchable resources to compensate for the current wind portfolio.²⁵

To accommodate more wind, Brendan Kirby, a veteran from the Oak Ridge National Laboratory and power systems engineering consultant for Interwest, testified that bilateral agreements between Xcel and its regional partners to change to a sub-hourly schedule, short of

²⁰ *Id.* at Exhibit No. KTH-2.

²¹ *Id.* at 24-25.

²² *Id.* at 26.

²³ *Id.* at 23.

²⁴ Rebuttal Testimony and Exhibits of Thomas A. Imbler 18, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (June 9, 2008) (available online at: <http://www.xcelenergy.com/docs/CRPImblerRebuttal.pdf>).

²⁵ Rebuttal Testimony and Exhibits of Robert Staton 10-11, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (June 9, 2008) (available online at: <http://www.xcelenergy.com/docs/CRPStatonRebuttal.pdf>).

amending the Western Electrical Coordinating Council's (WECC) hourly scheduling protocols, could "significantly reduce wind integration costs" within the timeframe of the 2007 CRP.²⁶

Transmission Control Center Manager Robert Staton identified Xcel's Cabin Creek pumped storage facility as another important tool to maintain compliance with Control Performance Standards imposed by the North American Electric Reliability Corporation (NERC) requiring retention of CPS 1 and CPS 2 data.²⁷ The Mount Elbert pumped storage facility, operated as a base load resource by the Western Area Power Administration (WAPA), was also discussed as a potential balancing resource. Ms. Hyde described the prospect of Xcel using this neighboring resource to accommodate its wind additions, however, as slim. Despite this barrier, Mr. Staton agreed that moving toward a larger balancing authority, beyond the PSCo system in Colorado, is a key to more wind penetration.

Quantifying these operational challenges into numerical values was discussed in the 2007 CRP proceedings. James Hill, Manager for Resource Planning and Acquisition, testified that "production-related cost," 15%-20% of which comes from gas storage and gas supply costs, makes up 75%-90% of wind integration cost estimates, with the remainder devoted to "regulation cost" that reflects the cost of reserves necessary to meet performance standards.²⁸ For purposes of the 2007 CRP, Xcel extrapolated an integration cost estimate of \$4.77/MWh (megawatt hour) at 15% market penetration, derived from its 2006 wind integration study,²⁹ up to \$11.00/MWh at 33% penetration.³⁰

Mr. Hill testified that this value was based on "learning" from the 10%, 15%, and 20% market penetration studies performed for Xcel/PSCo and expectations that mitigation measures would flatten integration costs.³¹ Mr. Hill testified that Xcel/PSCo studies show that at a 20% wind penetration level, a 500 MW combined cycle plant reduces wind integration costs by \$1.50-\$3.00/MWh amounting to over \$6 million in annual savings.³² Meanwhile, Mr. Hill also testified that "back casting" techniques, comparing actual system conditions to forecasted conditions, show integration costs are around \$3-4/MWh at 15% wind penetration.³³

²⁶ Rebuttal and Cross Answer Testimony of Brendan Kirby for Interwest Energy Alliance 6, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (available online at: <http://www.dora.state.co.us/puc/DocketsDecisions/DocketFilings/07A-447E/>).

²⁷ See Rebuttal Testimony and Exhibits of Robert Staton, *supra* note 25 at Exhibit No. RS-1 (displaying NERC standard BAL 001-0); see also NERC, RELIABILITY STANDARDS FOR THE BULK ELECTRIC SYSTEMS OF NORTH AMERICA (July 21, 2008) (available online at: http://www.nerc.com/files/Reliability_Standards_Complete_Set_21Jul08.pdf) (containing a full listing of standards).

²⁸ Rebuttal Testimony and Exhibits of James F. Hill 9-10, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (June 9, 2008) (available online at: <http://www.xcelenergy.com/docs/CRPHillRebuttal.pdf>).

²⁹ XCEL ENERGY, WIND INTEGRATION STUDY FOR PUBLIC SERVICE COMPANY OF COLORADO 22, (May 22, 2006) (available online at: http://www.nrel.gov/wind/systemsintegration/pdfs/colorado_public_service_windintegstudy.pdf).

³⁰ Direct Testimony and Exhibits of James F. Hill 12, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (November 15, 2007) (available online at: http://www.xcelenergy.com/docs/HillFinal_DirectTestimony.pdf).

³¹ Rebuttal Testimony and Exhibits of James F. Hill, *supra* note 28 at 9.

³² Direct Testimony and Exhibits of James F. Hill, *supra* note 30 at 19.

³³ Rebuttal Testimony and Exhibits of James F. Hill, *supra* note 28 at 8.

INTERWEST ENERGY ALLIANCE:

Interwest intervened the Xcel's resource docket to represent the interests of its developer and non-profit members, who are interested in advancing renewable energy. Interwest presented witnesses who addressed policy, consumer benefits, integration costs and operations, contract risk allocations, and transmission.

Craig Cox, Interwest Executive Director, testified that any wind integration cost estimates over \$4.77/MWh in the 2007 CRP were unreliable because Xcel had not finished and published its 20% wind penetration study, including opportunity for "rigorous peer review."³⁴ Brendan Kirby, who was also a member of the Technical Review Committee (TRC) for the 2006 wind integration study, testified that although such rigorous peer review provided by the TRC "greatly improved past PSCo studies at the 10% and 15%" levels, the TRC had not met since February 2007 when it expressed concerns about the methodology employed in Xcel's draft 20% study and the company resorted to its course of internal study.³⁵ Mr. Kirby testified that the TRC identified the following methodological problems in the draft:

inappropriate scaling of wind, the inappropriate use of a wind forecast error series taken from Minnesota data and applied to Colorado, concerns with production cost impacts, inconsistencies in the gas supply analysis, and a discrepancy in the regulation analysis.³⁶

In light of these concerns, Mr. Kirby testified that there is no technical justification for the 20% and 33% estimates related above,³⁷ and that the \$4.77/MWh figure derived from the peer-reviewed 2006 study should be relied upon until a thorough study can be completed at the higher wind penetration levels.³⁸

Karen Hyde, Vice President of Resource Planning and Acquisition for Xcel, stated that the 20% study would be completed by the end of the year and submitted for peer review, however, James Hill, the Manager for Resource Planning and Acquisition, stated he saw little or no value in the peer review. Mr. Cox testified to his hopes that this study will be completed in time for Xcel's expected interim filing in 2009.³⁹

BENEFITS ADDER, SHARING ACE, IPP SUBHOURLY SCHEDULES:

Mr. Cox suggested a "ten percent adder to reflect non-utility benefits for all renewable energy resources" be inserted into the Strategist model used by Xcel.⁴⁰ He argued that the same rationales that motivated the commission to add a ten percent value to efficiency measures in a

³⁴ Answer Testimony of Craig Cox 19, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (Apr. 28, 2008) (available online at: <http://www.dora.state.co.us/puc/DocketsDecisions/DocketFilings/07A-447E/>).

³⁵ Rebuttal and Cross Answer Testimony of Brendan Kirby for Interwest Energy Alliance, *supra* note 26 at 4-5.

³⁶ *Id.* at 5.

³⁷ *Id.* at 5-6.

³⁸ *Id.* at 7.

³⁹ Cross Answer and Reply Testimony of Craig Cox 8, *Application of Public Service Company of Colorado for Approval of its 2007 Colorado Resource Plan*, No. 07A-447E (available online at: <http://www.dora.state.co.us/puc/DocketsDecisions/DocketFilings/07A-447E/>).

⁴⁰ *Id.*

PUC case on that topic could be relied on by the commission in this resource planning case.⁴¹ Karen Hyde responded for Xcel that the suggested figure was arbitrary, and that assigning any value to “non-energy benefits” from renewable resource projects should be part of a later qualitative analysis by the PUC.

Mr. Kirby recommended sharing area control error (ACE) diversity through increased cooperation with other utilities. ACE sharing has been established in the Northern Tier Transmission Group’s ACE Diversity Interchange (ADI) program. He also encouraged “instituting sub-hourly schedules” with independent power producers (IPPs) to increase response capability on the PSCo system to relieve wind integration costs.⁴²

TRANSMISSION TO STRENGTHEN STATE AND REGIONAL RENEWABLE ENERGY MARKETS:

Alongside integration issues, improving transmission capacity is a key to expanding future development of wind and other variable renewable resources in Colorado. Generally, Colorado’s richest wind resource areas are not well served by transmission. Constraints on wind development due to lack of transmission have accompanied all the wind development in Colorado to date. In response, a Transmission Task Force (TTF) was created in 2006 by the Colorado General Assembly to analyze and report on the transmission infrastructure in Colorado.⁴³ The TTF concluded that the economic vitality of the state as a whole demands “sufficient transmission capability.”⁴⁴

Based on recommendations of the TTF, the General Assembly enacted two important pieces of legislation in 2007: Senate Bills 07-091 and 07-100 (SB 91 and SB 100, hereinafter, respectively). SB 91 was an effort to identify generation development areas (GDAs) in the state best suited for renewable energy projects. A subsequent SB 91 Task Force mapped out the best spots for wind, solar and other renewable energy projects in the state, many far away from urban centers where such energy is needed.⁴⁵

SB 100 took a significant next step toward developing the GDAs in Colorado by allowing the PUC to grant certificates of public convenience and necessity (CPCN) for new transmission facilities serving GDAs needed by utilities in order to comply with the RES.⁴⁶ SB 100 was also enacted in response to the existing Colorado Coordinated Planning Group’s (CCPG) Long Range Transmission Plan proposing “mutually exclusive ‘northern’ and ‘southern’ transmission scenarios,” put forward in 2006 as a coordinated statewide effort.⁴⁷

⁴¹ *Id.*

⁴² Rebuttal and Cross Answer Testimony of Brendan Kirby for Interwest Energy Alliance, *supra* note 26 at 6.

⁴³ COLORADO SENATE BILL 07-091 RENEWABLE RESOURCE GENERATION DEVELOPMENT AREAS TASK FORCE, CONNECTING COLORADO’S RENEWABLE RESOURCES TO THE MARKETS 35 (submitted to the Governor of Colorado and the General Assembly on Dec. 21, 2007) (available online at: http://www.colorado.gov/energy/in/uploaded_pdf/ConnectingColoradoResources.pdf).

⁴⁴ *Id.*

⁴⁵ *Id.* at 8-27.

⁴⁶ COLO. REV. STAT. ANN. § 40-2-126 (West 2008) (crediting SB 07-100 for its addition in Laws 2007, Ch. 61, § 2).

⁴⁷ Letter from Craig Cox, Executive Director, Interwest Alliance, to Shane Gutierrez (available online at: <http://www.interwest.org/documents/index.html>).

WestConnect is a forum for transmission planning within the Western Interconnection, comprised of utilities providing transmission services in the Southwest.⁴⁸ Within WestConnect, subregional planning activities are undertaken by the CCPG.⁴⁹ A ten year planning regime guides the planning efforts of the CCPG.⁵⁰ Following the CCPG's Colorado Long Range Transmission Planning Study 2005-2015, stakeholders expressed additional concerns with the study's lack of public participation and consideration of renewable resources for use in Colorado and in export.⁵¹

After the General Assembly passed SB 100, Xcel filed their SB 100 report. Xcel then filed an application for a CPCN for a Pawnee-Smoky Hill upgrade, and various short-term fixes to other transmission bottlenecks. Stakeholders then expressed concern that Xcel was not implementing SB07-100 properly, because only one GDA was being considered for development by the company.⁵² Interwest subsequently reached an agreement with Xcel regarding the timing of filing for subsequent CPCN applications and stakeholder participation in the development of transmission to all GDAs identified by the SB 91 Task Force in Xcel's service area.⁵³

During the 2007 CRP proceedings, Teresa Mogensen, Director of Transmission Asset Management and Business Relations, stated that Xcel promotes an open process in its aggressive transmission planning for renewable energy on a ten-year planning horizon for transmission.⁵⁴ In response to stakeholder queries regarding the more far-sighted CapX2020 transmission proposals in Xcel's Minnesota service area,⁵⁵ Ms. Mogensen said that the speculation involved in this long-term planning was undesirable. Ms. Mogensen also stated that Xcel will continue to participate in joint planning within the CCPG and it intends to work with the PUC staff to develop transmission to GDAs through the SB 100 process. In addition to Xcel's leadership, Interwest has suggested in comments on a current PUC transmission investigation that the PUC enhance its staff to better address stakeholder concerns by "emphasiz[ing] leadership, convening parties to work on issues, and mobilizing allies to get things done."⁵⁶

Moving forward on GDA development, the Colorado Governor's Energy Office (GEO) has announced a new initiative on Permitting and Financing Transmission.⁵⁷ The GEO's vision is a regional renewable energy market supported export of massive renewable energy resources in Colorado to other markets. The SB 91 Task Force identified 96 GW (gigawatts) of wind

⁴⁸ WestConnect, *About WestConnect* (2008) <http://www.westconnect.com/aboutwc.php>.

⁴⁹ WestConnect, *WestConnect Transmission Planning* (2008) <http://www.westconnect.com/planning.php>.

⁵⁰ WestConnect-SWAT-CCPG, Principles for Regional Transmission Expansion (available online at: http://www.westconnect.com/filestorage/swat_ccpg_principles_planning_081005.pdf).

⁵¹ Letter from Ronald L. Lehr, Counsel, American Wind Energy Association, to Chuck Sisk, Chairman, CCPG (Feb. 9, 2007) (available online at: <http://www.interwest.org/documents/index.html>).

⁵² Letter from Craig Cox, *supra* note 47.

⁵³ Interwest Energy Alliance, *Agreement with Xcel Energy on SB 100 Transmission Development and Stakeholder Participation Process*, http://interwest.org/documents/documents/SB100_agreement_26feb08.htm.

⁵⁴ Ms. Mogensen described this regime as a "just in time model."

⁵⁵ See CapX2020, *CapX2020 Frequently Asked Questions*, <http://www.capx2020.com/faq.html>.

⁵⁶ Interwest Energy Alliance Comments on Colorado PUC Policy Statement, *Investigation of Electric Transmission Issues and the Opening of and Investigatory Docket*, No. 08A-08I-227E (available online at: <http://www.interwest.org/documents/documents/2008-07-18%2008I-227E%20Interwest%20comments.pdf>).

⁵⁷ COLORADO GOVERNOR'S ENERGY OFFICE, STATEMENT OF PROJECT OBJECTIVES 1 (on file with Matt Futch, Utilities Program Senior Associate, matt.futch@state.co.us).

power and 26 GW of solar power, much of which could be exported if developed.⁵⁸ Through this effort, the GEO will facilitate permitting and siting of transmission facilities to GDAs.⁵⁹ In this process, the GEO will craft a report that other states in the Western Interconnection can use to participate in “substantially expanding and creating an aggregated, liquid, regional, renewable energy market.”⁶⁰

Other efforts in developing regional renewable energy markets around Colorado include the Rocky Mountain Area Transmission Study (RMATS),⁶¹ which led to \$4-6 billion in transmission announced by Rocky Mountain Power (RMP). RMP is a subsidiary of a utility holding company, MidAmerican, owned by Berkshire Hathaway. Tri-State Generation and Transmission Association, Inc., owner of over 5,200 miles of transmission in Colorado, Nebraska, New Mexico and Wyoming, is also investing in transmission to alleviate strain and accommodate renewable resources.⁶² Its Eastern Plains Transmission Project (EPTP) depends on coal plants that have been vetoed. Also, the Wyoming-Colorado Intertie Transmission Project (WCI) conducted a successful “Open Season” process to gauge transmission capacity.⁶³ Both Tri-State’s EPTP and the WCI could potentially be incorporated into the High Plains Express (HPX) project.⁶⁴

The HPX is an initiative to connect Wyoming, Colorado, New Mexico, and Arizona with a 500 kV AC transmission system.⁶⁵ A recent Feasibility Report focused on power transfers from the northeast to southwest, although HPX could transfer power in both directions,⁶⁶ to accommodate “substantial new renewable energy integration consistent with public policy.”⁶⁷ The potential benefits to member states are as follows:

- a) Arizona: Ability to increase its reliance on renewables as a cost-effective power supply source by blending and supplementing in-state renewables with renewables imported from the “upstream” HPX states, particularly New Mexico;
- b) Colorado and New Mexico: Ability to optimize renewable energy use for in-state and export purposes by taking advantage of geographical diversity afforded by HPX’s development, without limiting in-state renewable energy development prospects;
- c) Wyoming: Ability to export its high-quality, low-cost resources, particularly wind to the “downstream” HPX states to enhance the performance and reliability of the resources used within and exported by those states[.]⁶⁸

⁵⁸ Interwest Energy Alliance, *Agreement with Xcel Energy on SB 100 Transmission Development and Stakeholder Participation Process*, http://interwest.org/documents/documents/SB100_agreement_26feb08.htm.

⁵⁹ COLORADO GOVERNOR’S ENERGY OFFICE, *supra* note 57 at 1.

⁶⁰ *Id.*

⁶¹ See generally, ROGER HAMILTON ET AL., INTEGRATING WIND INTO TRANSMISSION PLANNING: THE ROCKY MOUNTAIN AREA TRANSMISSION STUDY (2004) (available online at: http://www.nrel.gov/wind/systemsintegration/pdfs/2004/milligan_wind_integration.pdf).

⁶² Tri-State, *Transmission*, <http://www.tristatetg.org/Transmission/>.

⁶³ Wyoming-Colorado Intertie Transmission Project, *Overview*, <http://wyia.org/wci>.

⁶⁴ HIGH PLAINS EXPRESS TRANSMISSION PROJECT, FEASIBILITY STUDY REPORT 3 (June 2008) (available online at: <http://www.rmao.com/wtpp/HPX/HighPlainsExpress%20First%20Stage%20Feasibility%20Report%2008.pdf>).

⁶⁵ *Id.*

⁶⁶ *Id.*

⁶⁷ *Id.* at 4.

⁶⁸ *Id.* at 7.

The future of HPX involves siting transmission lines, sequentially developing project segments, modeling operations, assessing applicable laws, quantifying costs, allocating costs and cost recovery mechanisms, continuing stakeholder involvement, and developing business and financial relationships.⁶⁹ During the 2007 CRP proceedings, Ms. Mogensen stated that HPX has the potential to make Xcel a merchant vendor, however, a regional tariff would need to be established. Ms. Mogensen also provided a “high level cost estimate” of \$5.1 billion for the project. To put this in context, the Texas Public Utility Commission recently granted preliminary approval to a \$4.9 billion transmission plan to connect wind resources in west Texas to Dallas area load centers: “what experts say is the biggest investment in clean and renewable energy in U.S. history.”⁷⁰

On a larger scale, the Western Governors’ Association recently adopted a “Work Plan to Identify Renewable Energy Zones and Associated Transmission in the Western Interconnection,” involving phases of: technical and stakeholder analysis to identify renewable energy zones (REZ), development of “conceptual transmission plans to the REZs,” procurement coordination “to support a regional renewable energy market,” and enhancing interstate cooperation on permitting and “multi-state cost allocation issues.”⁷¹ This Western Renewable Energy Zones (WREZ) project, spanning “[eleven] states, two Canadian provinces, and areas in Mexico,” seeks to develop “30,000 [MW] of clean and diversified energy by 2015.”⁷² Advancing toward this goal, the Department of Energy and the National Renewable Energy Laboratory (NREL) are conducting the Western Wind and Solar Integration Study, which is the “largest regional wind integration study undertaken to date” to examine the operational impacts and opportunities appurtenant to developing wind and solar power in the West.⁷³ Xcel’s participation in the SB100 process, therefore, should prepare it for leadership in the WREZ project.

TRANSMISSION AND MARKET STRUCTURE:

Colorado’s island status within the Western Interconnection, however, highlights that the existing transmission infrastructure and market structure are major barriers. Karen Hyde, Vice President of Resource Planning and Acquisition for Xcel, testified that studies of better-connected systems are informative for Xcel’s work when adapted to the factual situation in Colorado:

- 1) Xcel’s resource plan would lead to 15% peak and 30% off-peak wind penetration,
- 2) it has limited transmission import capability,
- 3) there is limited interconnection for balancing,
- 4) the utility is part of no regional transmission organization, and

⁶⁹ *Id.* at 7-8.

⁷⁰ Jim Vertuno, Associated Press, *Texas Sees its Future Blowing in the Wind*, ROCKY MTN. NEWS, Jul. 18, 2008, at NEWS 27 (available online at: <http://www.wtopnews.com/?nid=104&sid=1441940>).

⁷¹ WESTERN GOVERNORS’ ASSOCIATION, WORK PLAN TO IDENTIFY RENEWABLE ENERGY ZONES AND ASSOCIATED TRANSMISSION IN THE WESTERN INTERCONNECTION 2 (Apr. 21, 2008) (available online at: <http://www.westgov.org/wga/initiatives/wrez/wrez-workplan.pdf>).

⁷² Western Governor’s Association, *Western Renewable Energy Zones*, <http://www.westgov.org/wga/initiatives/wrez/index.htm>.

⁷³ WestConnect, *Western Wind and Solar Integration Study* (2008), http://www.westconnect.com/init_wwis.php; Western Wind and Solar Integration Study, http://www.nrel.gov/wind/systemsintegration/pdfs/2008/lew_western_integration_study.pdf.

5) it has no access to a regional balancing market.⁷⁴
Also, the timing of wind development and transmission do not match. Planning is underway. A better developed regional market requires adequate transmission connections for the long term.

NREL WIND INTEGRATION SUMMARY:

The National Renewable Energy Laboratory (NREL) recently published a summary of international case studies on integrating wind into power systems at high penetration levels, concluding that results across the studies are not easily compared.⁷⁵ While methodologies, data collections, and assumptions differ, unifying lessons emerged:

- 1) “[t]ransmission is the key to aggregation benefits, electricity markets, and larger balancing areas[.]”
- 2) regional and international coordination will reduce variability and forecast errors and costs,
- 3) “less than day-ahead” forecasting reduces error rates,
- 4) integration costs should be compared to alternative production forms, such as fossil fuels, including fuel cost savings and emissions benefits, and
- 5) high wind penetration requires “increased generation flexibility, transmission to neighboring areas, demand side management, or storage (e.g., pumped hydro, thermal, or batteries of electric cars).”⁷⁶

The 2007 CRP shows Xcel has acknowledged most of these lessons.

CONCLUSION:

This paper discussed integration and transmission issues raised by Xcel and Interwest relating to Xcel’s 2007 CRP. Xcel limited new renewable energy in the 2007 CRP due to operational and reliability concerns. They proposed further internal study to substantiate their proposed limits, but have not yet reported any conclusions or recommendations from that work. Transmission planning is underway but it is limited to ten years and does not match renewable energy development timetables; these plans address only limited regional market opportunities and could be better coordinated at statewide and regional levels. Finally, market issues are being developed in WestConnect and studied in other forums, but only at modest levels.

⁷⁴ Rebuttal Testimony and Exhibits of Karen T. Hyde, *supra* note 1 at 22.

⁷⁵ B. PARSONS ET AL., IMPACTS OF LARGE AMOUNTS OF WIND POWER ON DESIGN AND OPERATION OF POWER SYSTEMS 7 (June 2008) (available online at: http://www.nrel.gov/wind/systemsintegration/pdfs/2008/parsons_wind_impacts_large_amounts.pdf).

⁷⁶ *Id.*

ⁱ Article developed through the Pioneer Legal Internship Program. Please forward all comments and inquiries regarding this article to: **Joshua D. Prok: jprok@du.edu, (303) 917-2356.**