SWAT Background on the Origin of the SunZia Project and Constraints on the Project's Capacity to Carry Renewable Energy

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SWAT Background on the Origin of SunZia and Incorporation of the Southwestern Power Group's Bowie Power Plant into the Project

The transmission ideas that led to the SunZia Southwest Transmission Project were formulated by the Southwest Area Transmission Regional Planning Group (SWAT) in 2004 and were briefly summarized in a November 2005 SWAT report[1]. In 2004 Governor Richardson of New Mexico had created a task force for developing and exporting New Mexico wind energy, and the New Mexico subcommittee of SWAT proposed several 500-kV lines from central New Mexico to Arizona to accomplish this. One route went south along the White Sands Missile Range near Alamagordo to El Paso and then west along I-10 to Tucson and the Palo Verde hub west of Phoenix (Figure 1). This was the germ of the idea that eventually became SunZia. At this time the National Renewable Energy Laboratory had not yet developed its 80-meter wind-speed maps showing the actual wind potential of New Mexico, and the area of potential New Mexico wind energy development was defined very subjectively (Figure 1).

The hypothetical route that SWAT proposed passed through or very near the Southwestern Power Group's (SWPG's) permitted Bowie power plant (Figure 1), and seeing this, in the fall of 2006 SWPG proposed the SunZia Project with the Bowie plant as its hub to provide the transmission capacity needed to fully develop the plant. Such a transmission line would allow SWPG to sell Bowie power both westward to Phoenix and California and eastward to El Paso. The line also would provide a path for the transmission of wind-generated electricity from New Mexico, although, as stated above, at this time this area was poorly defined, and the eastern terminus of the SunZia Project lay ~150 miles south of the wind-generating area that is now the focus of development.

Throughout the remainder of 2006 and most of 2007, SWPG openly showed the project's relationship to the Bowie power plant in various meeting presentations to demonstrate that the project would have a major buyer for its transmission capacity. In a presentation to New Mexico's Renewable Energy Transmission Authority (RETA) by Mark Etherton in October of 2007, however, references to the Bowie plant were removed, and when the project was reformulated to extend to the primary wind-generating area of central New Mexico in June 2008, the Bowie plant was never mentioned again, although it still remained the center of SWPG's interest in SunZia.

Since this time, the Southwestern Power Group has carefully avoided any reference to the Bowie plant as a reason for constructing SunZia. The Willow substation, which is an integral component of SunZia, is actually a permitted part of the Bowie power plant, and integration of SunZia with it will facilitate uploading of power onto project lines. SWPG would simply add a needed 500-kV transformer at the substation to transfer power. SWPG has intentionally hidden its intended use of SunZia for the Bowie plant and appears to have misrepresented the project as delivering primarily renewable energy to gain the support of governmental, environmental and public interests to expedite the project's construction.

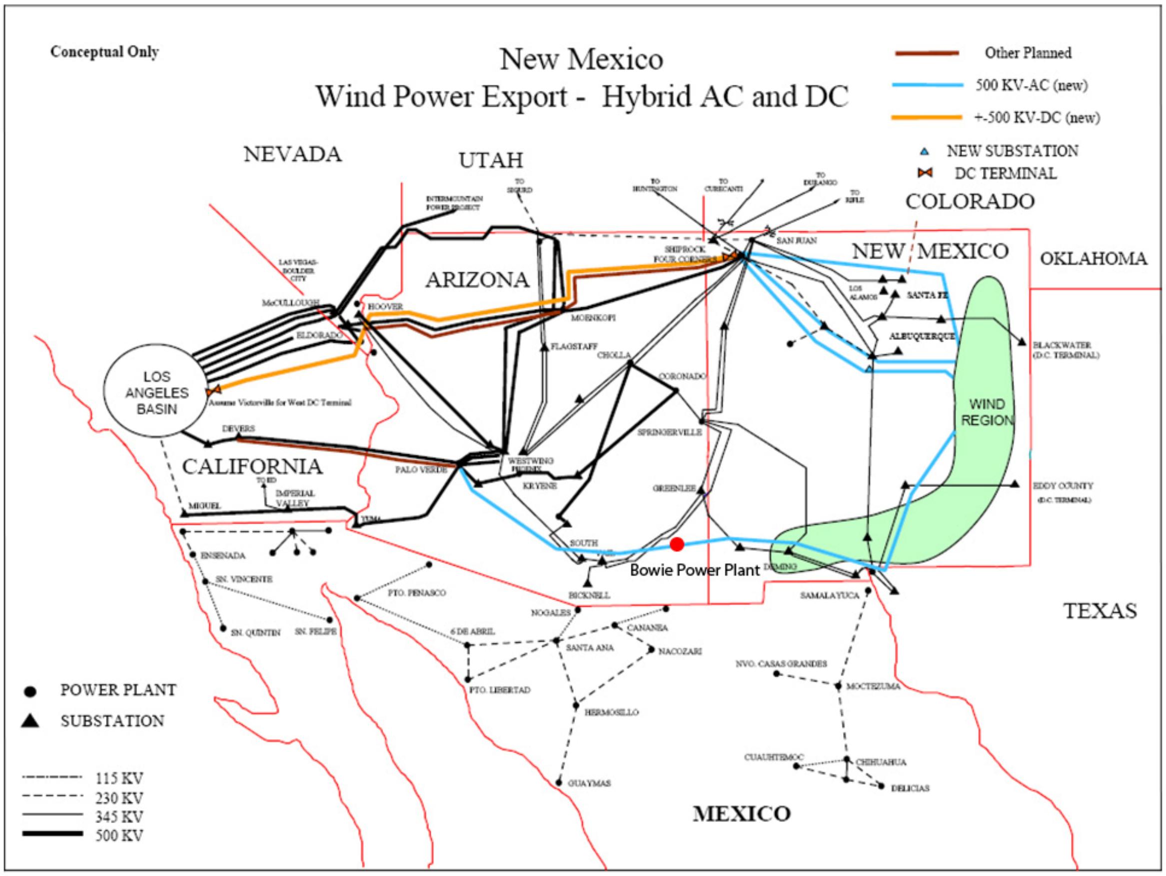

Figure 1. Blue lines are hypothetical 500-kV lines proposed by the Southwest Area Transmission Regional Planning Group (SWAT) in 2004 in response to New Mexico Governor Bill Richardson's initiatives to develop and export New Mexico wind energy[1]. The blue line running from the wind region south to El Paso and then west across southwestern New Mexico and southeastern Arizona became the underlying model for the Southwestern Power Group's (SWPG's) initial proposal to build the SunZia Southwest Transmission Project. The location of SWPG's Bowie power plant, permitted but yet to be built at this time, is marked by the red dot. The desire for transmission capacity for this plant was unquestionably SWPG's motivation for proposing the SunZia Project and offering to pay 50% of its cost[2].

Lack of the Use of New Mexico Wind Data in Formulating SunZia

In contrast to the High Plains Express Project, of which the current SunZia Project was originally the southern New Mexico–Arizona leg, the Southwestern Power Group did not avail itself of the extensive wind energy data for New Mexico available from the National Renewable Energy Laboratory. SWPG instead proposed the SunZia Project and pursued it without considering the great variability in New Mexico wind-generating capacity (Figure 2) and how much nonrenewable energy would be required to stabilize power delivery. The great daily and seasonal fluctuations in wind output create serious physical and economic limitations and constraints. Large amounts of nonrenewable energy are required to make such a project feasible in both respects, and SWPG did not consider this, neglecting it in its statement of purpose for the project.

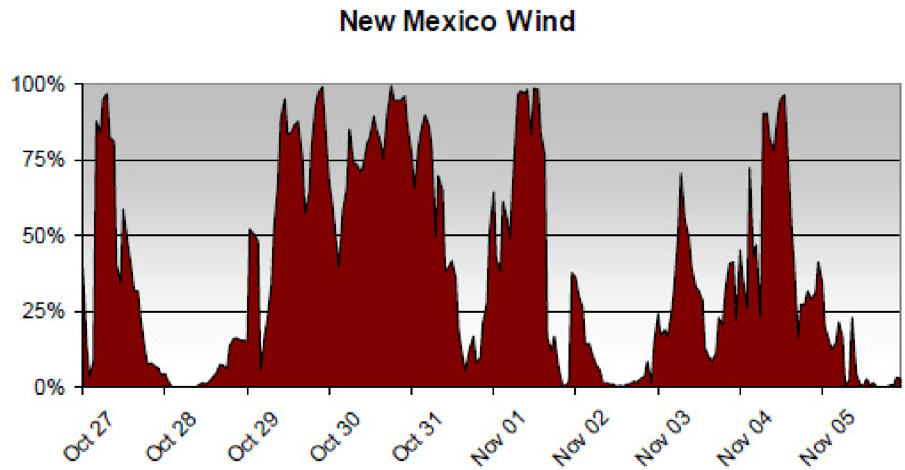

Figure 2. Hourly percentage of nameplate (wind turbine rated capacity) for New Mexico wind over a 10-day period (year unknown)[2]. Note that power output can decrease from 100% of capacity to 0% of capacity in less than 24 hours. This would mean that for 3,000 MW of installed wind-generating capacity, power output would drop from 3,000 MW to 0 MW in this time.

Perhaps the most important factor to consider in developing wind energy is its capacity factor, that is, how much power an installed component of a rated capacity will actually generate. For New Mexico wind, that factor is 36% for the summer, the peak load season, which means that for an installed capacity of 3,000 MW, on average the system will generate and deliver only 1,080 MW of power. This will leave almost two-thirds of the transmission system's capacity unused on average. The High Plains Express Project's *Feasibility Study Report*[3] indicates that this is not economically viable.

In addition, stabilizing wind power generation requires that as much nonrenewable generating capacity be available to the system somewhere to compensate for these fluctuations in wind capacity. It is assumed that the grid will absorb all available wind-generated electricity no matter the load on the system in order to displace as much nonrenewable power as possible. Wind-generating capacity can fall from 100% to 0% in less than 24 hours, however (Figure 2)[4]. All of this shortfall must be picked up by nonrenewable generation from either (1) existing excess or displaced capacity, (2) peak load facilities, or (3) new generation facilities. Figure 3, which is the inverse of Figure 2, shows the nonrenewable energy required to maintain an even level of power.

Even if wind-generated electricity is only displacing existing nonrenewable generation rather than increasing overall system capacity, all of that nonrenewable capacity must come back online to balance these extreme fluctuations. Thus devising a large-scale transmission system that will carry "primarily renewable energy" is not realistic. Any such system must be integrated with roughly the same amount of nonrenewable generating capacity somewhere. All of this capacity need not be connected directly to SunZia, but one must consider this requirement when projecting how the system is likely to be used and in formulating a statement of purpose for the project.

If half of the transmission capacity of SunZia is used to accommodate nonrenewable generation that will not be used to offset wind-power fluctuations – a reasonable assumption in light of the transmission needs for the 1,000-MW Bowie power plant and for the several natural gas plants along the SunZia route in southwestern New Mexico that may use SunZia – this further limits the actual amount of renewable energy that the system can carry. Although the output from New Mexico's wind generation area will on average equal only about one-third of the area's rated installed capacity, wind power companies must still purchase an amount of capacity equal to the maximum rated output of their systems. The average unused transmission capacity cannot be sold to other companies. Thus 1,500 MW of transmission capacity must be purchased to deliver, on average, ~500 MW of power. If the transmission system has 3,000 MW of capacity and only half is devoted to wind energy, the amount of wind-generated electricity in the system will be vastly less than what the public has been led to expect from SunZia.

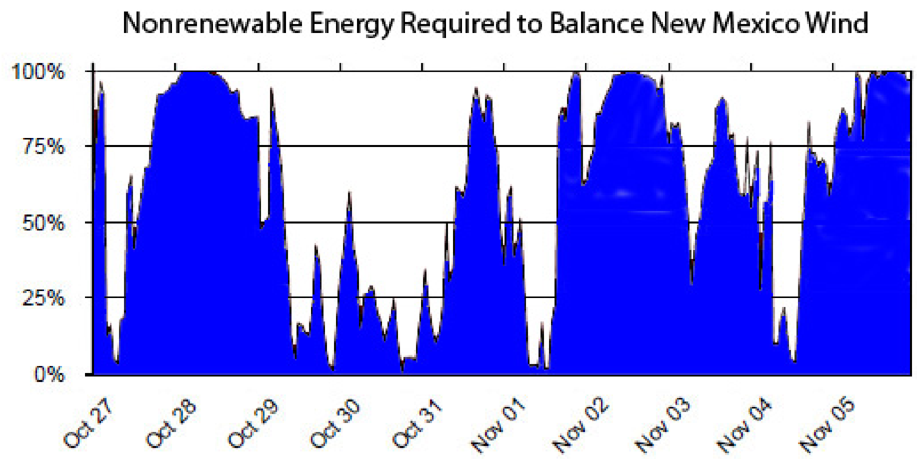

Figure 3. The inverse of Figure 2, showing how much nonrenewable energy would be required to maintain an even level of power in the system. Because the ideal is to use all wind-generated power to displace nonrenewable power somewhere, the reactivation of all of the nonrenewable power displaced will occur when wind power is lost.

A Revised Statement of Purpose for SunZia

In light of the above information, the following is a potential revised statement of purpose for SunZia

> The SunZia Southwest Transmission Project will provide transmission capacity for the development of wind-power resources in central New Mexico; needed transmission capacity for permitted but yet-to-be-built 1000-MW Bowie, Arizona, power plant; additional transmission and interconnection opportunities for several natural gas plants in southwestern New Mexico, most notably the 570-MW Luna Energy Facility; and transmission capacity for expansion of these natural gas plants.
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> Secondarily, the project will offer potential transmission capacity for high-quality solar resources in southwestern New Mexico near Lordsburg and Deming and for geothermal resources near the Rio Grande Rift (River). These secondary resources are less economic and more hypothetical and are not considered necessary to the success of this project.

Overall, this transmission system will increase regional power transfer capacity and reliability. Although the allocation of renewable and nonrenewable transmission capacity cannot be predicted or predetermined, a reasonable estimate is that half of the transmission capacity will be sold to wind-generating facilities and half to nonrenewable generating facilities (predominantly natural gas and possibly coal). Of the 3,000 MW of transmission capacity, approximately 1,500 MW will eventually serve each type of generation.

Concluding Notes

If one assumes that capacity factors of each type of generation are 36% for New Mexico wind (summer dependable capacity factor) and ~85% for natural gas, this means that, on average, 1,500 MW of wind-generating capacity will produce 540 MW of power in the summer (peak load season), and 1,500 MW of natural gas generating capacity will produce 1,275 MW of power, yielding a total average generation of 1,815 MW. This results in an average system utilization of 60.5%. At times each form of generation will reach 1,500 MW of output, however, and each must thus be supported with this much transmission capacity, or a total of 3,000 MW for both forms of generation. In this scenario, 29.8% of the power in the system would be from renewable sources.

These determinations assume that all wind-generated power will be fully used and that natural gas generation will operate at full capacity serving base load requirements rather than peak load requirements. The latter is unlikely to be the case, and the average total megawatts of power in the system is likely to be considerably less than 1,815 MW, with a correspondingly lower system utilization rate. This would increase the percentage of renewable energy in the system.

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[1] "Report of Southwest Area Transmission 2004 Study Activities (Draft) Prepared for the SWAT Oversight Committee," November 23, 2005. Available from http://www.westconnect.com/filestorage/swat_activity_rpt_112305.doc. Accessed July 4, 2011.

[2] SWAT Meeting Minutes, 10.18.06, Las Vegas, page 3. Available from http://www.westconnect.com/filestorage/swat_mtg_min_101806.pdf. Accessed June 24, 2011.

[3] *High Plains Express Transmission Project Feasibility Study Report*, June 2, 2008. Available from http://www.highplainsexpress.com/site/static/feasibilityStudyPDFs/HPX_First_Stage_Feasibility_Report.pdf. Accessed June 24, 2011.

[4] *Stage 2 Feasibility Report*, High Plains Express Project, March 2011. Available from http://highplainsexpress.com/stakeholder-meetings/. Accessed July 5, 2011.