by: Markus I. Bryant
General Manager

PART 8 – WIND POWER - "DECIDING WHAT IS FEASIBLE"

If you have been following my columns, you might be tempted to think that I'm anti-wind power. I assure you that I'm not! However, your board has entrusted me with your cooperative's mission, which is to supply you with highly reliable electric service at an affordable cost. I also serve as a trustee on the board of Buckeye Power, whose mission is to supply your cooperative with stably and competitively priced, economical and highly reliable wholesale power.

In these two roles, I am responsible for making recommendations to your board and for approving recommendations made to the Buckeye Power board by its management. In both cases, I must consider the four tests laid out in my first column: Is it affordable, reliable, fair and achievable? Wind power, like any other source of generation, has real operational and economic issues which must be evaluated. I have tried to share some of these issues with you. It is my job to look beyond wishful thinking which is often disguised as "public policy."

I am very positive about the capabilities of the American people. After all, we sent men to the moon, and invented much of the world's modern technology. We can accomplish anything, IF, 1) we can agree on the goal and 2) are willing to spend the money (It seems we can print that too). For electric industry decision makers, it really boils down to two questions: 1) What can be done? and, 2) How much will it cost? This month's column tries to address these two questions.

All power sources need grid access

I voted enthusiastically for Buckeye's 30 MW participation in the Story County, Iowa, wind farm project. This project looked feasible because central Iowa is in a "red" area for wind intensity (see Part 6 – Figure 1). The projected cost after the federal wind tax credit was 5 cents per kWh for energy and .6 cents per kWh for transmission service. The 5.6 cents per kWh compares favorably with Buckeye's current 6.2 cents cost, projected to rise to about 7.2 cents when the last coal plant scrubbers are completed in 2013. I believe (still do) this project was important because the cost was reasonable and the Ohio cooperatives needed experience with wind energy. What we learned is we have to pay an additional 3 cents per kWh for transmission "congestion" charges. The real cost per kWh for this wind project turned out to be 8.6 cents per kWh.

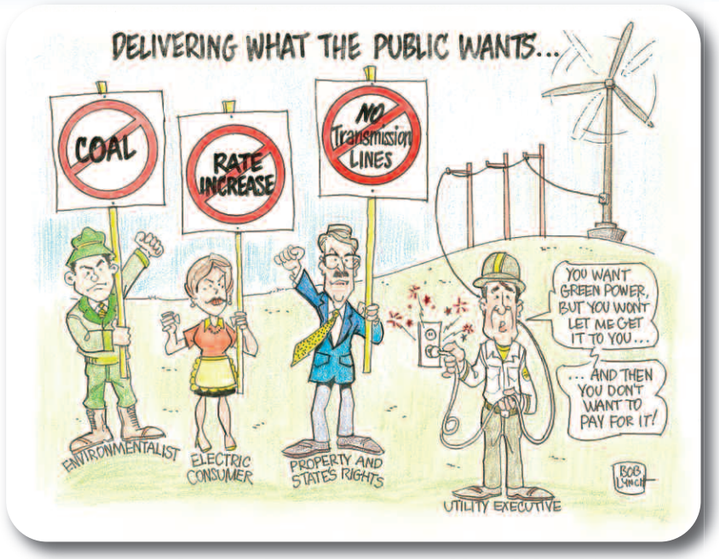


Figure 1 is a simple illustration of transmission grid operation. The amount of energy demanded must be matched by the amount of energy produced, provided the transmission line between them is adequately sized. Transmission "congestion" occurs whenever there is a mismatch between power production and demand and/or an inadequately sized transmission line. For example, assume the power generated is equal to the power demanded, but the transmission line capacity is too small. The transmission grid assesses a "congestion" charge. Another example is there is plenty of power generated (such as wind power at night), but there is not enough power demand to use all of the energy. In this case the transmission grid must choose between paying another generator (usually gas or coal fired) to reduce their amount generated or tell the wind generators to go off-line. Either decision results in higher transmission "congestion" costs. This "congestion" issue is what occurs at the Story County wind project.

The better solution to transmission "congestion" is to build more transmission lines, either where line capacity is limited, or where lines are needed to move the power further distances to where there is more energy demand. Remember, the EPRI study looked at "utility-scale" sites within a reasonable distance from transmission lines. This is because for every area considered for wind generation, there is a physical limit to the amount of wind generation (or any other kind of generation) that can be added before the transmission "congestion" problem develops. This is a hard business reality in the electric industry regardless of any "public policy" goal of 20 to 30 percent plus renewables by any chosen target date.

Figure 1 — Balancing the Transmission Grid

Figure 2 illustrates the biggest challenge to integrating renewables into the nation's electric grid. Note that wind resources are concentrated in the Northwest Central region of the country which the EPRI study clearly identified as the best areas for wind development. Figure 2 identifies the desert Southwestern U.S. as the best area for solar energy development and the Western states as the best area for geothermal power production. The inescapable fact is all three best areas of the country for renewable energy development are in the least populated areas (and outside of Ohio except for Lake Erie) AND there is both insufficient power demand in those areas to use all the renewable energy that could be developed AND insufficient transmission line capacity available to move the excess power to where it could be used, primarily the industrial heartland states and coastal cities. This lack of transmission capacity is in addition to the back-up generation issues covered in last month's column. Therefore, evaluating wind power feasibility also necessitates evaluating the availability and cost of transmission capacity.

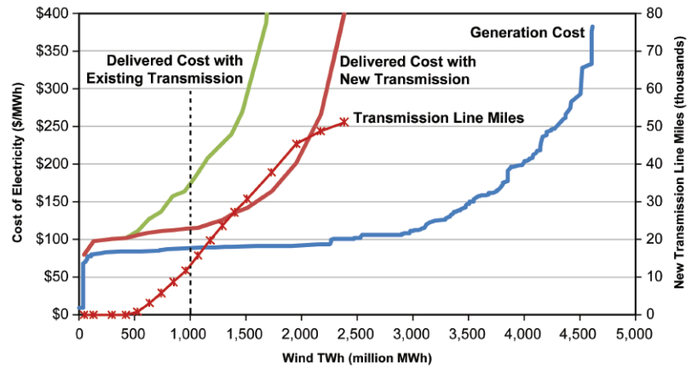
What will it cost?

Figure 3 is taken from the EPRI study analyzing the wind energy potential supply curve for the whole U.S. Please note that 50 percent of this total U.S. potential wind energy is in the NW central states discussed in last month's column. Potential wind energy is measured in tWh (terawatt hours). 2008 U.S. energy production was 3.97 trillion kWh or 3,870 tWh. Therefore, 20 percent of U.S. energy production is roughly 1,000 tWh represented by the vertical black dashed line. Twenty-five percent was chosen since it is a goal often used for a future percentage of renewable energy to total electricity supply. Notice the blue line for only wind generation costs stays fairly steady at 8-9 cents per kWh up to 1,000 tWh, rises to 10 cents per kWh at 2,500 tWh, and then rises dramatically. This is because the better and more economical wind resources are used first.

Figure 2 — Renewable Energy Location Versus Areas Needed

Source: Green Superhighway: Overhauling the Grid to Accommodate Renewables http://www.renewableenergyworld.com/

Figure 3 — National Wind Energy Potential Supply Curve (Including transmission costs)



Source: Electric Power Research Institute
Preliminary Insites from EPRI's Regional Model, Bryan Hannegan, Ph.D.

Therefore, we could develop 12.5 percent, or 500 tWh, of our country's electricity supply with wind without a major investment in new transmission. This might be a realistic goal, IF we also take the steps to manage the intermittent supply impact on the grid discussed in last month's column. One estimate of back up generation cost to stabilize the grid to manage wind power is an additional 2-3 cents per kWh to the costs shown in the EPRI study.

The green line represents the cost of wind generation plus transmission costs for the existing grid system. Note that total cost stays stable at 10 cents per kWh until 500 tWh or about 12.5 percent of U.S. electricity production. After 500 tWh, the green line rises dramatically due to "congestion" issues discussed previously. The only way to reduce these costs is to build additional transmission line capacity. The miles of transmission line needed is shown by the red "asterisked" line, while the total wind generation cost with new transmission line investment is shown by the red line. In this scenario, costs are relatively stable at about 11-12 cents per kWh until you reach 1,000 tWh. Thereafter, costs begin to escalate dramatically because increasing transmission investment is required.

Will it happen?

If our wind power goal is 25 percent, or 1,000 tWh, of our country's electricity supply, then per the EPRI study, we will need to commit to the following: 1) construction of 175,000 1.5 MW wind turbines costing $650 billion, AND 2) construction of 19 new extra high voltage transmission lines, 13,000 miles in length, costing $50 billion.

Wind power development of this magnitude simply will not happen without a concerted national effort coupled with changes in transmission siting authority and eminent domain laws at the federal level. Today, most transmission siting occurs at the state or local level. If you think getting regulatory approval for a new power plant is difficult, (wind farms included), just try building a major transmission line across one or more state lines. Do you really think this will happen just to develop intermittent wind power at 10-13 cents per kWh versus 9.5 cents from a new combined cycle natural gas-fired plant or 10.2 cents from a new coal-fired plant? Probably not. However there are additional reasons for a national effort to upgrade and expand the transmission grid, which we will explore in another column.