Renewable Energy and Emissions Reductions

Patrick J. Kelly
U.S. Environmental Protection Agency

ABSTRACT

The influence of environmental legislation in many states has become common partners in creating a unique environment for renewable energy to step up to the plate. This environment offers opportunities that lead down many environmental paths and opens up economic conditions for marketplace advancement of renewable energy sources. Since 2000, more than 1100 MW of wind farm (WF) electrical power has been added or announced to be added to the Texas electrical grid. New Mexico is now experiencing the benefits of renewable energy, with more than 200 MW being installed by the end of 2003. New Mexico has even entered the marketplace with wind power crossing the borders of ERCOT in a daring bid to power the U.S. Environmental Protection Agency's (EPA) own laboratory in Houston with Green-e tagged blocks of renewable energy from Clovis, NM. Oklahoma will install more than 175 MW, finally opening its door to what could be a most notable crossroads in wind power development.

Now, overlay major environmental issues of another kind in water pollution and air pollution issues in rural and metropolitan areas coupled with changes in the national emissions inventory. The effect is that three new target areas come in the picture. These are concentrated animal feeding operations (CAFO) with new rules as of March 2003, publicly owned treatment works (POTW) who must now report emissions in more detail, and municipal solid waste landfills (MSW-LF) with the 2004 changes in landfill design of "bioreactors." These older facilities create more than 500 million tons of manure, more than 110 million tons of municipal solid waste and more than 50 million tons of human waste for treatment. With more than 650 million tons of waste, energy projects on small and large scales are possible. The logistics are

straight forward, and management in the industry does not always understand needs and methodology that must be followed to be a successful. The opportunities in developing resources lay in a shift in which regulations and recent shifts in environmental credits for renewable energy and energy efficiency for environmental progress.

INTRODUCTION

As part of an ongoing effort to open the dialogue for more renewable energy sources, all facilities need to re-look at what infrastructure is in place to produce energy as well as how much energy potential is being wasted. When the waste production or acceptance of waste at the facility can create significant energy, an outline for development should be performed to road map the project. This road mapping is part of the discussion in each section below on the specific targeted energy areas. The development outline of the project will include, 1) energy production is from what waste stream, 2) improvements in rural and local distribution grids to facilitate local marketing, 3) long distance transmission and distribution possibilities, 4) distributed generation and hardware considerations, and 5) emissions reductions benefits for air and water quality. The above task will require concerted efforts by both facility operators and owners along with the electrical service authority or selected electrical service provider.

WIND FARMS

The development of almost 1,500 MW of wind farms in Texas, Oklahoma and New Mexico has fueled several debates and set the stage for what could be one of the best showdowns. How far can one sell Green-e tag power? To what extremes will wind power go to build a framework of truly balanced wind power in the name of wind ranching? How will companies develop long-range forecasting and interest between themselves as protective instinct demands for short-term planning? What will wind farms do when fall, winter, and spring time means the time of over plenty begins? Will wind farms turn aggressive to sell more to add to profit margins, and what overbuilding coupled with price planning will take hold of the power market?

These questions are not that answerable, except to say that all is happening and companies are marketing and gearing up for what may well be one of the biggest battles in the electric industry in a long time. The battle of the generation source that means lower costs with every new long-term power purchase contract.

The crossroads is the price barrier to lower costs than that experienced in Texas in round 1 of the wind farm race, the installation of 680 MW of power output on 400 MW transmission lines. On the verge of all of this activity, wind power is preparing for round 2 and round 3 in Texas with announcement of transmission line extensions to the 1,200 MW range. Of the 2,000 MW that will be added across West Texas in different areas centered at McCamey, these power lines will only carry around 200 MW to 300 MW of wind power when the doldrums hit at summer peak demand. What mindset exists for wind power to be viable in the marketplace with such poor performance? As anyone who has lived in West Texas knows, if the wind isn't blowing at McCamey, it's still blowing North or further West on that other mesa or ridge top. What will be interesting is how quickly round 2 and round 3 will add to the electrical grid and what over capacity will be built to take advantage of summer time doldrums. Wind ranching in Texas is now a science and the planned excursions out of McCamey will look first at bulk generation and second begin to stabilizing the summer time doldrums and enhanced wind power generation. The balancing act between summer time and the rest of the year will become a wintertime battle ground for selling bulk power from these wind farms. What will happen in the bulk generating capability and summer doldrums stay tuned for round 2? What will happen to spreading out the wind power wealth and creating even more overbuilt wind farms for ERCOT? Stay tuned for round 3 if overbuilding is normal for wind farms in Texas. Texas can then expect somewhere between 2,800 MW and 3,400 MW by 2010 hugging the grid to play the summer and winter time generation seasons, if the same scenario unfolds as round 1.

CONCENTRATED ANIMAL FEEDING OPERATIONS

Concentrated animal feeding operation permitting rules changed in March 2003; new reporting and permitting requirements for many

not reported facilities is now occurring. The emission generated by the current manure management systems is of great concern, because in many cases, water discharges, applications to land, and alternative products development such as composted manure leads to environmental issues in both water and air quality. Facilities exist that could develop pilot projects with the correct expertise. Reports of flaring to reduce emissions are reported. In facilities with specific types of manure management systems know for producing methane naturally, energy production is a very good option for such CAFO's to reduce overhead costs.

Working with the states' emission inventory data, many states are now working to report biogenic sources. Oklahoma for example, completed an emission inventory for 1999, and reports that more than 30 billion cubic feet (bcf) of methane is produced from animal husbandry operations in the state. In looking at specific datasets in very early 2003, almost 17 billion cubic feet of gas could have been produced if "digester" technology had been phased in as a viable manure management system. In determining whether methane production was viable in these manure management systems, transportation of the animal waste away from the facility was always occurring, along with extended storage on site in required civil engineered and EPA permitted structures.

Looking at early 2003 animal population estimates in Region 6 states; Texas could produce more than 40 bcf, New Mexico could produce more than 8 bcf, Louisiana could produce more than 1 bcf and Arkansas could produce more than 74 bcf from animal waste to energy projects. As emissions impacts of NO (and N_2O, NO_2), P_2O_5 and K_2O become issues, many localities and states have become distressed over the environment around them and who or what is exactly responsible for these issue(s). The manure management systems in Arkansas, Louisiana, New Mexico, Oklahoma and Texas have followed specific paths over the years; in these states, dominant methane producers are well known. The general type of manure management system fall into three distinct types: 1) anaerobic lagoon, 2) pit storage, and 3) liquid slurry. Emphasis has long been placed on digesters and many engineering and management problems have caused many failures.

PUBLICLY OWNED TREATMENT WORKS

The most common practice in publicly owned treatment works (POTW) today is aerobic digestion of sewage materials. Historically, up to early 1970s, emphasis was placed through special incentives and grants to create anaerobic systems adjacent to the aerobic systems for making energy to drive pumps and heat the aerobic systems. This offset energy usage and allowed the plants to operate basic sewage treatment plants in a minor capacity and continue to operate the aeration basins. In the late 1960s, a shift occurred and decisions were made to look away from anaerobic digestion of wastes in favor of more expedient processes and other means of heating and aerating the processing basins. As with many situations, time once again is shifting the balance, and natural gas prices are a prime mover. The cost of fueling the aerobic processing and not capturing the methane produced by natural decay is altering approaches from city to city across the U.S. Bigger facilities produce large amounts of gas just in the sewage pipelines alone. The leakage rates can be lowered and captured to burn for heat. Older facilities that installed anaerobic digestion as part of the processing loops offer lower operating cost to cities, because they capture hundreds of thousands to millions of cubic foot of methane gas. They can burn the methane thus reducing smell issues from hydrogen sulfide (H_2S) and other products of decay, including particulate matter. Because of natural gas prices, the payback for an anaerobic digester upgrade on existing larger POTWs is now means. The POTW industry is now poised for a faster changeover in large facilities to anaerobic digester upgrades. Payback in simple terms for some cities, is less than five years at current bond rates. Will natural gas prices go appreciably lower in the next five years? This is a question answered by infrastructure supply and demand, the usual hazards of catastrophe and weather issues. On top of all of these overlay market conditions, transportation, foreign companies who now supply whole regions of the country, and the intentions of government. Of course in steps the government with permitting of these infrastructure improvements to bring more natural gas from outside resources, thus hoping to lower the price of gas or stabilize the pricing structures of our current marketing and distribution systems.

In all of this, POTWs are seeing "revitalization" of old approaches and even seeing profits by taking modern technology, better

and highly controlled anaerobic digesters and processing many of the issues of aerobic processing to create methane and usable fats and residues. The fats and residues collected from both anaerobic and aerobic digestions have great bio-fuels. As a commodity, fuels and alternatives have greater value in reducing operating costs and may be able take existing fleet and fuel credits as well as offer alternatives to oil and fat disposal for commercial and even residential recovery programs. Cities are investing resources into planning and physically doing POTW upgrades. Paybacks even at just under $0.05 per kWh are in less than five years and behoove very close scrutiny at current electricity cost for city governments. Failure not to take advantage mean more emissions and pollution with less renewable energy.

MUNICIPAL SOLID WASTE—LANDFILLS

In Texas, approximately 4 billion cubic feet of landfill methane is flared. The methane gas does not 1) generate electricity and 2) get sent to a boiler for fuel. For reasons that include costs, lack of a desire to go through the permit process one more time, and a failure to seriously take note of the resources year after year, landfill permit holders and operators routinely miss opportunities to develop landfills. With this missed opportunity, a new shift in thinking is required in regulatory language for landfills. This is happening soon very. This will allow new faster processing of municipal solid wastes that create methane on much faster levels and offer some control over gas production. These designs called bioreactors, offer higher energy production rates. The billions of cubic feet of methane that is being overlooked in old landfills will continue to create methane and the terms "economically viable energy projects" and "missed opportunity energy project" are being added to the maps. In labeling each landfill that warrants merit, emphasis is placed on the needed steps of putting out a "request for proposals," making waste stream changes going into landfill cells, deciding to close older landfills in favor of consolidating, picking up more waste stream to produce a viable energy project.

Municipal solid waste has the potential of adding more than 250 MW of yearly production capability around the major cities in Region 6 once "bioreactors" are constructed and operational in every major city. The added benefits of bioreactor sites are that POTWs and CAFOs

could deliver solid waste to these outlying "bioreactors" and digesters to produce the same methane gas that bioreactors are producing; minimizing overall transportation needs by locating all movement near older railroads, pipelines, highways and rural sources of fuel. In an ideal sense, once bioreactors become operational in many localities, they become ideal sites for long term energy production, and centers of resource movement. Remember, all engineering and usual issues with sound, smell and sight still hold true.

CONCLUSION

What is a reality is that emissions reductions from the destruction go methane wisely, redoing infrastructure and looking forward to tie in renewable energy resource from all over the electrical grid offers stable electrical power from a myriad of sources producing distributed energy and grid energizing power. With planned and wind farms exceeding 2,500 MW and likely growth to 4,000 MW of wind farms based on past examples and transmission potential. The cost of wind power could see another 2 cents per kWh fall in price to join the realm of the cheapest source of energy with 6 dollars per ton. CAFOs, long since viewed as just animals being raised for butchering; already offer a huge nameplate methane gas producing source in excess of 100 bcf and requires only a shift in manure management strategy. POTWs can become stand alone energy producers while not upsetting the processes in any serious way. POTWs can add 100 MW to the city generation by adding digesters—a few or one at a time. Benefits include elimination of some of the complaints about these facilities, and reduction in city expenditures for operations. Bioreactor's offer what is the greatest potential of all, producing quality power from landfills and being able to adjust seasonal production while meeting peak power delivery schedules during the day. The emissions reduction offsets from generation in Region 6 would be more than 63.7 MT CO_2, 194 KT SO_2, and 177 KT NO_x.

Note: As each year progresses and new technology is applied, facilities that have permitted (new source review) will be changing their emission rates. The higher price of natural gas has nearly idled and reduced power production of many combined cycle facilities. Wind

farms in West Texas have had success against combined cycle plants, even though they have limited production for several hours of the day in the summer time.

ABOUT THE AUTHOR

Patrick J. Kelly is an Energy Star and Renewable Energy coordinator for the U.S. Environmental Protection Agency located in Region 6, Dallas, Texas. He can be contacted at kelly.patrick@epa.gov.