Hello, My Name is David Korinek and I am a county board supervisor in Manitowoc County.

I served on the committee that created our Industrial Wind Turbine ordinance. We spent 1 ½ years creating our rules. Our committee had balanced membership, including the current president of Renew WI.'s board of directors. The PSC's wind siting council membership did not achieve that balance, with 70% of members owing their livelihood to the wind industry. That is not a recipe for good rule making.

I would like to express my concerns with the rules the PSC has created. Manitowoc County decided to use the worldwide standard of 5 DBA over ambient for our noise restriction. It adjusts with background noise, rather than picking an arbitrary number for the standard, as the PSC has done, which is higher than what the World Health Organization recommends. Manitowoc County's Board of Health has passed a resolution through our county board supporting the 5dba over ambient standard and I will submit it with my testimony.

Manitowoc County believes in property rights!! Siting a 500 ft. industrial turbine 550 ft. from my property line and 1250 from my home could take 700 ft of my property for a corporation's turbine safety setback. Worse yet the PSC has determined in their own research, that to meet their 45 dba. night time noise restriction, that same turbine should be 2200 ft from my home! That puts my home 950 feet on the wrong side of the PSC's noise setback. That is a Taking of Property by a Govt. Agency without compensation, using contradictory rules not designed to protect citizens but to promote industry.

The bottom line is that siting Turbines in WI. is tougher than in states with large open areas and few homes. If a turbine company needs to buy some property or sign neighbors to easements to place turbines, so be it. To sacrifice citizen's safety, health, and property values for a wind companies profit margin is just wrong. 2640 ft. should be the minimum setback; 1800 ft is already a compromise!!

Thanks for your time

David Korinek
1316 Rockledge rd.
Mishicot WI. 54228
920-755-4644

Lori Morehouse

4432 Mill Road

Denmark Wisconsin 54208

I have been a special education teacher in the Freedom Area School District for over 20 years. Part of my job there is to be an advocate for my high school students with learning disabilities and to instill in them self -advocacy skills. I'm here today in Madison, as I was last October, to do just that, to advocate for myself, my family, and my neighbors as to why the current rules proposed by the very biased Wind Siting Council and approved by the PSC are inadequate and need to be suspended. These proposed rules do not address the health and safety concerns of those living in a wind turbine project.

For the past 21 years I've lived in Morrison Township in the southeastern part of Brown County where my husband and I own 140 acres. I am not against renewable energy, nor is my husband. We had the first totally geothermally heated and cooled home in the state of Wisconsin.

We live in the area of the proposed Ledge Wind Project of Invenergy. There is the possibility of 54, 400 foot industrial wind turbines being built in our rural township. I have been called a NIMBY. They are correct in saying I do not want a 400 foot mechanical monster in my backyard, but, I also don't want it in anyone else's backyard either. They don't belong there. The current proposed wind siting rules would have these turbines in my backyard, as well as in the backyards of my neighbors and friends. The setbacks need to be changed to 1/2 mile, 2640 feet, from a property line, not 3.1 times a height of the turbine.

These turbines do not belong in anyone's backyard until the state health department conducts an epidemiological study of existing residents who live in wind project areas. I'm not willing to live in the largest proposed wind turbine project in the state until there is unbiased, reliable, valid health studies done to prove that myself, husband, my children, or our seven young grandchildren will not be harmed. There presently is no objective health studies done that prove living with turbines in your backyard is safe.

How precious is your drinking water? The Ledge wind energy project in our township creates a risk for groundwater contamination from the manure spreading on fields where turbines are being hosted. Due to the karst features in the project, the impact of the excavations and 81 miles of trenches, puts our groundwater supply at substantial risk. The proposed turbine locations are adjacent to shallow bedrock karst fractures, spring heads, and sinkholes. Over 100 wells in Morrison Township were contaminated in 2006. 23 wells were replaced at a total cost of over $300,000. Why would we continue to risk damaging our water supply by developing a wind turbine project when the geological features of the Niagara Escarpment puts us at significant risk for contamination of our groundwater?

Would you be willing to risk your property values being lowered by 40% or more because of turbines being sited too close to your home? If the wind developers say there is no loss of property value, then a

property protection plan for these impacted areas should be provided by the wind turbine project developers. This should be included in the siting rules.

Should town officials be able to sign contracts with wind developers while at the same time working on local ordinances that affect the town, its residents, and the wind developers? This scenario has happened across the state. New statewide siting rules should address the need for wind developers to disclose their intentions of developing a project publicly before any town officials sign contracts with them. There is a continued climate of deception, greed, mistrust, and personal self-interest surrounding this entire wind development process. This biased atmosphere has also lent itself to the Wind Siting Council, where nine of the fifteen members were directly conflicted.

Last fall my husband and I attended the First International Symposium on The Global Wind Industry and Adverse Health Effects held in Ontario, Canada. Like all of the presenters, including doctors, specialists, lawyers, authors, and professors, who came from all over the world including Canada, the United Kingdom, Australia, and various states in the US, we paid for all our own expenses. These experts presented three days worth of information, studies, and research on the negative effects of living close to wind turbines. These adverse health effects include noise concerns, especially low frequency noise concerns, sleep deprivation, and mental health issues. I will be presenting further written documentation from this conference to this Joint Administrative Committee.

The current rules proposed by the PSC are inadequate, seriously lacking, and need to be suspended. Please take more time to study the concerns presented today and error on the side of safety. Remember your constituents who are living or will be living in a wind turbine ghetto for years and years. The wind developers don't live in the wind turbine ghettos. I thank you for the opportunity to speak today. What a real life civics lesson that we get to experience today at the Capital. It is one I can share with my high school students tomorrow at school. Thank you for listening to my concerns.

Lori Morehouse

4432 Mill Rd.

Denmark, WI 54208

920-864-2223 Home

INTERNATIONAL SYMPOSIUM

THE GLOBAL [illegible] AND ADVERSE HEALTH EFFECTS

Loss of Social Justice?

SPEAKERS

October 29 to 31, 2010 in Picton, The Waring House, Prince Edward County, Ontario, Canada

THE SOCIETY FOR WIND VIGILANCE

WWW.WINDVIGILANCE.COM

MESSAGES OF SUPPORT

Many from around the world wanted to attend the FIRST INTERNATIONAL SYMPOSIUM: THE GLOBAL WIND INDUSTRY AND ADVERSE HEALTH EFFECTS: Loss of Social Justice? but were unable to do so. Support has been received from individuals and organized groups.

In an effort to acknowledge these, a snapshot of these messages is provided to Symposium attendees. A comprehensive list will be posted on The Society website after the Symposium. www.windvigilance.com

The comments and messages received represent the opinions and concerns expressed by the individual and groups submitting them. Any errors or omissions are unintended.

TO THE CHAIR - NEW ZEALAND

Daniel Shepherd
Department of Psychology
Auckland University of Technology
Auckland
New Zealand
daniel.shepherd@aut.ac.nz

Robert Y. McMurtry, M. D., F.R.C.S.(C), F.A.C.S.
Chair
The Society for Wind Vigilance
23.08.2010

Dear Dr McMurtry,

Ténã koutou.

I regretfully write to inform you that I am unable to attend the Society's conference planned for the end of October. In lieu of attendance I send words of support for both the conference and the Society at large. The line up of presenters hints at a stimulating and dynamic conference, and the success of the event seems assured. I sincerely hope this meeting will not be isolated, and I will keep a keen eye open for future conferences.

The output of the society has been of great utility to many communities in New Zealand faced with the decision of supporting or opposing wind turbine installations. The Society has consistently provided critiques of research and review documents that are laudable for both their balance and impartiality, and the level of insight afforded by the expertise of their creators. The ability of these works to inform communities of the risks and benefits of wind power cannot be overstated, and I suspect their impact goes far beyond any metrics you might currently use to track their use.

Of those speaking at the conference I note a number who have given up time to assist community groups in New Zealand. On behalf of these groups I would like to extend an expression of immense gratitude to these individuals, who include Richard R. James, Nina Pierpont, Christopher Hanning, and Michael A. Nissenbaum. To all members of the Society a message, keep up the good work, your efforts are appreciated by many.

Kia ora
(be well, be healthy)

Daniel Shepherd
Auckland, New Zealand

ONTARIO

Congratulations on the First International Symposium on the Adverse Health Effects of Industrial Wind Turbines. This is a great opportunity for members of our organization to hear from a wide range of international experts on topics of importance to our fight.

Those participating will no doubt leave armed with even more information that will assist in convincing neighbours and hopefully communities that they have a stake in this. It should also help us as we work with local councils and health organizations.

International medical experts will join with renowned academics from North America and other public figures to share much needed information in a format that is credible and valuable to us and the broader public.
Wind Concerns Ontario is proud to support this symposium.

John Laforet, President,
Wind Concerns Ontario

AUSTRALIA

From all over the world we will be watching the discussions and the information presented at your symposium about the health effects of wind turbines. We are so grateful that you are all doing this. Only two days ago I was at a protest rally against two turbines going up at Leonards Hill, near Daylesford in Victoria, Australia. The nearest home to these turbines will be only 500 metres away. People there are desperate. Our governments just keep signing the rights of the rural residents away to wind developers.

Governmental Planning Panels ignore legitimate claims and worries from country residents, worries about health effects from turbines...We are so grateful for the time you are putting in at the symposium about health effects from turbines.
...Good luck with your investigations.
We are all behind you.

Renate Metzger,
Smeaton, Victoria, Australia

EPAW (European Platform Against Windfarms)

EPAW supports the first International Symposium...427 federations and associations from 21 European countries (representing hundreds of thousands of citizens) have united into a European platform (EPAW) to transmit the following demands to the European authorities:
- a moratorium suspending all wind farm projects
- a complete assessment of the economic, social, and environmental impacts of wind farms
in Europe.
EPAW objects to industrial wind farms that...are degrading the quality of life of those living in their vicinity, affecting the health of many...
We applaud and support the first International Symposium gathering so famous expert speakers. Wind power endangers the health of people who live near wind turbines and some affected residents can only try to sell their homes and move away! We thank you for your commitment to this important cause.

Jean-Louis Butré,
Chairman of EPAW

GERMANY

Dear Carmen, dear members of the Society for Wind Vigilance, dear organizers, scientists, experts and visitors of this important symposium in Canada!

The members of EPAW - European Platform against Windfarms - in Germany support your International Symposium and your struggle to protect the health of human beings, social structures and nature against industrial wind energy by exposing the dangers caused by wind power plants for health and social justice.

Today there are some 22.000 wind turbines in Germany and the number is increasing all the time... We represent thousands of German victims...including those in the northernmost region in Germany, where once was the cradle of the German wind power, who are suffering since more than two decades from the impact of wind turbines. The symptoms, which Nina Pierpont calls WTS...many of us already know very well... Many people are too frightened to speak openly for their civil rights...I speak from painful, personal experience!...Living beside wind turbines between 300 to 1000 m away is like a trip to hell!

We, the German members of EPAW, want to thank you for this important international Symposium and your dedication to uncover the danger of the emissions by wind turbines for health and social life!"

Jutta Reichardt from
"Windwahnmarsch",
Schleswig-Holstein, Germany
Spokeswoman of EPAW
(European Platform against Windfarms)
for Germany

JAPAN

We are Japanese concerning about wind farm developments. Big wind is destroying nature and local communities in Japan too. People near wind farms are suffering from low-frequency noise from the turbines.

Although the Japanese government has just started a survey on the low-frequency noise, we suspect they will not solve the problem seriously.

We support the First International Symposium. We are really sorry not to be able to join you. But we believe it will be successful. And we believe it will be a great step for us all.

Yuki Tsuruta Oike

NOVA SCOTIA, Canada

To Carmen Krogh , Members of Windvigilance, Dr Nina Pierpont, Participating Scientists and Everybody at the Symposium !

We want to express our full support for this Symposium...Our social peace is gone by recklessly acting wind companies, who "successfully" were splitting communities and even friends and families. Local politicians were turning their backs on us and united with the wind lobby.

Whom shall we trust in difficult times to come?

We wish you all the best in achieving the necessary breakthrough for the inconvenient truth regarding wind power.

Anna Fabigan, Member of Concerned Residents against Industrial Wind Power - Digby Neck, & Member of EAS - Eco Awareness Society , Pictou County - Digby County NS

SPAIN Co-founder, European Platform Against Windfarms

I am writing to you from Spain. I wish to say how concerned we are, my European colleagues and I, about the ill-effects wind turbines are having on the health of nearby residents. In Europe as in North America, there is no effective legislation imposing minimum setbacks between these noisy, vibrating structures and human habitations. The collusion between the windfarm industry and the political class is such that the health issue is simply being negated. Yet, more and more victims of the Wind Turbine Syndrome are making their voices heard, and many of their poignant letters can be read on the Internet. Sadly, the mainstream media has largely ignored the problem, for it's not politically correct to tell the truth about windfarms.

But truth is remarkable in that it can't be covered up forever. Sooner or later it comes to the surface, and class action suits inevitably follow. May this First International Symposium go a long way in raising public awareness on the adverse health effects of windfarms. May the media bring it to their attention, and may governments finally legislate to impose a minimum distance between wind turbines and people's homes.

God bless you all.

Mark Duchamp, Co-founder,
European Platform Against Windfarms

SWEDEN

Being Editor-in-chief of the Danish nurses journal for 30 years (1974-2004) I understand deeply the concerns about adverse health effect caused by wind turbines close to humans.
Therefore, it is an extremely important conference, you have arranged.
We need much more initiatives like this in order to make the impact on humans visible for
the political decision makers, who seems to be totally controled by the wind power industry. Wind turbines near to humans and in sensitive landscapes is a peace time crime against humanity. On behalf of all Nordic and Baltic campaigners and victims I express my strongest support. Make the conference a eye opener. Good luck. Contre nous de la tyrannie.

Peter Skeel Hjorth, Journalist,
Spokesman for EPAW in the Nordic and Baltic Countries.

UNITED KINGDOM

I have been following the work of the organisers of the Symposium closely and I urge everyone to take cognisance of the important work which has been done to expose the dangers of industrial wind turbines. There is now ample evidence from the most eminent scientists to show the link between wind turbines and ill health.

It is important that all Authorities and Medical Services recognise that industrial wind turbines do cause ill health to those people unfortunate enough to have them in their neighbourhoods...
I know, from people I have spoken to, of the serious problems wind turbines have caused for people here in England; some of whom have had to abandon their homes.

Kind regards,
Michael Addison

UNITED STATES OF AMERICA: Vinalhaven, Maine

I fully support further research and study into the impact of wind turbine noise on individuals as well as on communities. The Maine's noise regulations that were developed in the 1970's for urban industrial areas, do not pretend to protect individuals. Current regulations in Maine are not adjusted according to rural, suburban, or urban areas. There is no doubt that the impact of a 55/45 dBA noise limit in a rural island community is vastly different than it would be in a busy urban environment. Low frequency sound is not measured or regulated. Gigantic wind turbines are built within a short distance of homes. People should not and can not be asked to live under these kinds of conditions. I support the International Symposium and hope very much that their efforts will help to correct an unethical wrong.

Sally Wylie,
Fox Island Wind Neighbors,
Vinalhaven, Maine.

COUNTRIES

Belgium
Canada
Crete
Denmark
EPAW
Estonia
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Netherlands
New Zeland
Poland
Scotland
Spain
Sweden
United Kingdom
United States of America

THE SOCIETY FOR WIND VIGILANCE

REAL PROPERTY TAKINGS

I was listening to a discussion on "takings" in relationship to noise, shadow flicker and property values during a recent wind siting council meeting. There was some disagreement as there is on many of the topics and it was decided to refer the question on takings to legal counsel. The following meeting it was stated that "staff" had determined that unless 100% of the property or the value of the property was taken, that it would not be considered a "takings". What I found interesting was why legal counsel did not give his opinion on the matter (he seemed to be in the room for some of the meeting as he commented on something later), but yet staff gave their "opinion" and the matter was dropped.

AWEA siting handbook refers to "an assessment of potential impacts to neighbors and other sensitive receptors is often prudent" and refers to property boundaries for noise limits, not homes.

Developers should be forced to sign a property value protection agreement. If they are adamant that the turbines do not affect property values, they should not have a problem signing an agreement. There can be no takings without compensation. NO ONE should be allowed to diminish another's quality of life and property value for their own financial gain. This includes all property, improved or vacant land. I did some research myself and came up with the following on takings. A zoning regulation that deprives the land owner of the economic value of the property might be challenged as a constructive taking.

PARTIAL TAKINGS
It is often the case that a landowner is not completely deprived of his property, but instead suffers a restriction or impairment of his or her right to use it. For example (and as is frequently the case), a government may need to run a utility through private property, or need to alter a shoreline such that the property is no longer on the waterfront. The property may need to be flooded to create a dam, or a building on the property may need to be relocated to make access to another point. In such cases, a partial taking may be effected, and the landowner is entitled to proportional compensation. (Source: What Constitutes a "Taking", Find Law)

"CONSTRUCTIVE" TAKING OR REVERSE CONDEMNATION
Still another form of taking may occur when there is no actual property being taken from a person. Instead, governmental activity on one property may so severely deplete the value of adjacent or neighboring property so as to constitute a "constructive taking," often referred to as inverse or reverse condemnation. Fumes, noises, vibrations, changes in flow of ground water, or toxic pollutants are some of the more common interferences that may constitute constructive takings. Examples include properties affected by airport noise and fumes, waterfront properties affected by rerouted water, or livestock farms affected by nearby noise or ground vibration. In each of these circumstances, property owners may be entitled to compensation from the governmental entity. (Source: What Constitutes a "Taking", Find Law)

TEMPORARY TAKINGS
Finally, a taking need not be permanent; it may be effected and justified only under limiting circumstances. For example, in time of war or insurrection, a government may need to exercise control and dominion over lands otherwise not needed for public welfare or safety. Again, a landowner may be compensated for the temporary impairment or deprivation in his or her use of private property. (Source: What Constitutes a "Taking", Find Law)

"NOR SHALL PRIVATE PROPERTY BE TAKEN FOR PUBLIC USE, WITHOUT JUST COMPENSTION"

THE FIFTH AMENDMENT TO THE UNITED STATES CONSTITUTION

"THE PROPERTY OF NO PERSON SHALL BE TAKEN FOR PUBLIC USE WITHOUT JUST COMPENSATION THEREFORE"
THE WISCONSIN CONSTITUTION

In regards to some in the wind energy industry referring that those that are being negatively affected by noise, shadow flicker, infrasound, and loss of property values as being collateral damage and should make a sacrifice for the greater good:

The United States Supreme Court has also stated that the Fifth Amendment to the United States Constitution is "designed to bar government from forcing some people alone to bear burdens which, in all fairness and justice, should be borne by the public as a whole". If the damage to an individual property owner is so great "that he ought not to bear it under contemporary standards, then the courts are inclined to treat it as a "taking" of the property". (Armstrong v. United States 1960)

Private property is held in subordination to the rights of society. Although one owns property, they may not do with it as they please, any more than they may act according to their personal desires. As the interest of society justifies restraints upon individual conduct, so also does it justify restraints upon the use to which property be devoted. It was not intended by these constitutional provisions to so far protect the individual in the use of his property as to enable him to use it to the detriment of society. (State v. Harper 1923)

I think we should all do our part and practice good conservation, something we all can do, without any negative effect on our neighbors. Let's put Wisconsin on the map for being a leader in responsible energy usage and conservation, but more importantly that we place more value on the health and safety of our residents than profits and politics.

While most takings involve the actual physical occupation of private land, it has long been recognized that private property may also be taken as a result of the enactment of statutes and regulations. In the seminal case of *Pennsylvania Coal Co.* v. *Mahon*, Justice Oliver Wendell Holmes, Jr., speaking for the Court, specified that "while property may be regulated to a certain extent, if regulation *goes too far* it will be recognized as a 'taking'.

We are in danger of forgetting that a strong public desire to improve the public condition is not enough to warrant achieving the desire by a shorter cut than the constitutional way of paying for the change." (*Pennsylvania Coal Co. v. Mahon)*

"When . . . [the] power [of eminent domain] is exercised it can only be done by giving the party whose property is taken or whose use and enjoyment of such property is interfered with, full and adequate compensation, not excessive or exorbitant, but just compensation." The Fifth Amendment's guarantee "that private property shall not be taken for a public use without just compensation was designed to bar Government from forcing some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole." Just compensation in partial taking condemnation cases must include compensation for the part of a property that is actually taken, as well as compensation for any damage that the taking causes to the part of the property that is not taken. (Find Law, Just Compensation)

Under the constitutional definition of "just compensation," all factors that make up market value must be taken into account in determining just compensation in direct condemnation cases.

Under the Michigan and United States constitutions, a condemning agency must pay a property owner "just compensation" when the agency takes the owner's property for a public purpose. Generally, just compensation is measured by determining the market value of the property that is taken. But when only part of a property is taken, the part that is not taken, sometimes called the "remainder," can experience a decrease in value attributable to the taking. The condemning agency must compensate the owner for any such decreases, because just compensation must leave the property owner in as good a position as the owner would have been had the taking never occurred. Numerous Michigan decisions have discussed the decreases in value attributable to partial takings that must be part of just compensation, and on occasion have discussed using the "cost to cure" some or all of the negative effects of a partial taking as an appropriate measure of compensation. Regardless of the approach that is taken to the problem, the property owner must always receive "just compensation" for losing its property.

This rule requires that the property's market value before the taking be compared with its market value afterward, and the difference serves as the amount of just compensation.

In cases like the present one, where there is a partial taking, just compensation is measured by the amount that the value of the remainder of the parcel has been diminished. This loss is usually expressed in terms of the diminution of the fair market value of the remainder of the property. And, fair market value is found by considering and evaluating all the factors and possibilities that would have affected the price that a willing buyer would have offered to a willing seller for the land under the circumstance. (Source: Calculating Just Compensation in Partial Taking Condemnation Cases by Jerome P. Pesick)

COST OF NOISE ANNOYANCE

The socio-economic impact of noise: A method for assessing noise annoyance.

Numerous attempts have been made to calculate a "cost" or to set a "price" on community noise annoyance. Factors that influence this "price" include the following:

- psycho-physiological effects, stress, etc.
- sleep disturbances (and resulting productivity loss)
- communication problems
- (possible) hearing damage

The price is likely to be reflected in a depreciation of property values. Studies have revealed that there is a linear relationship between noise level and change in property value (in Norway, roughly 0.5% per dBA). In other words, the change in value per decibel is independent of the absolute level.

A similar relationship has been found for the annoyance score. A given change in noise exposure is related to a certain change in annoyance score regardless of absolute noise level or degree of annoyance. By using noise exposure data as a common parameter, it is possible to relate annoyance directly to a sum of money, and any given change in annoyance can be expressed in monetary terms. (Source: Noise and Health, A quarterly inter-disciplinary International Journal)

Lynn Korinek
1316 Rockledge Rd
Mishicot, WI 54228

The wind siting rules were created to take away the "Patchwork" effect of local control despite the fact a state appeals court told Calumet County **they** could not use "blanket" standards. We now have a one size fits all set of rules that will have negative health effects and financial impacts on landowners, because it was written by a council stacked with those having a financial interest in the industry.

Claims are made about loss of jobs if setbacks are increased to protect our health, safety and property rights. At what personal and financial cost to the landowner, ratepayer and taxpayer should we "provide subsidized jobs"?

An important point needs to be made clear. Act 40 does not direct rules to be written to create or save jobs or to make sure wind turbines are sited regardless of negative effects, it distinctly states to set rules that provide reasonable protection from any health effects.

The PSC is responsible to protect us from rate increases and Clean Wisconsin and the Citizens Utility Board promote themselves as advocating on behalf of ratepayers for affordable rates. Knowing we have a glut of electrical capacity, they actively promote industrial wind energy aware that it increases utility rates. In a recession, we the taxpayers and consumers are being forced to subsidize energy we do not need. Wind is not free.

Wisconsin already has higher electric costs that all but 5 states, yet a utility rate increase requested by the PSC to subsidize the cost of renewable energy, was passed by the Joint Finance Committee during the lame duck session, resulting in a rate increase of $740 million dollars to rate payers over the next 4 years. Asking for responsible siting rules to protect us is not a jobs killer. Increasing utility rates, that's a jobs killer.

Wind is not the only renewable. Act 40 fails by not addressing whether wind is the best solution to the energy needs of the area being served. Utilities are forced to create power we do not need to meet the RPS, resulting in industrial wind turbines being forced into areas they do not belong. Wisconsin should be promoting safe, reliable, low cost, energy efficient renewable solutions to residential and commercial customers that will not have negative health effects and lower property values. How many jobs would be created if ACT 40 were repealed, and the state would promote nuclear, geo-thermal, solar, and most of all energy efficiency? Instead Clean WI and Cub are fighting the expansion of Point Beach, because they say, we do not need the power. If they want to make it about jobs, that expansion would create many high paying sustainable jobs.

Clean, RENEW, CUB and the PSC know that WE Energies has excess capacity until 2024 even without the Glacier Hills turbines, and that the project would literally have no impact on reducing emissions, but the project was permitted regardless. WE Energies ratepayers will now be paying over $525 million for energy that is not needed to satisfy demand, and those forced to live within the boundaries will be new victims of the PSC allowing turbines too close to homes.

Commissioner Azar commented that staff informed her based on research and computer modeling it would take a 2200 ft setback to meet the 45dba nighttime noise limit sited in the wind siting rules. I would like to submit the response I received from the records request I submitted regarding that statement. I also received a map of the Glacier Hills project, showing the noise setbacks if anyone is interested in viewing it.

I would like to ask that you suspend the rules as they fail to do so. I ask for a 2640 ft setback, a 5dba over ambient noise limit, a property value protection agreement and a moratorium on any new construction due to excess capacity in the state. Thank you for allowing me to speak here today.

Lynn Korinek
1316 Rockledge
Mishicot, WI 54228
920-755-4644

ACT 40 FLAWS AND REASONS TO SUSPEND THE WIND SITING RULES

1) Commissioner Callisto choose the members of the wind turbine committee by himself and only after complaints, the list of members was taken to the other two commissioners for their vote.
2) The committee was stacked with wind energy proponents that will benefit financially from development of wind turbines.
3) One of the "public" members is the President of RENEW, which resulted in two members of RENEW being on the council.
4) The rules do not include a property value agreement. If the developer is so determined that the turbines do not lower property values, they have no excuse to refuse an agreement.
5) No engineering studies were submitted to prove that a 1.1 setback is adequate for turbine collapse, blade throw or ice fling.
6) Leases are not regulated.
7) The language related to the noise restriction does not exclude ambient. The 45dba limit is to high and well below the 5dba over ambient recommended by the WHO.
8) Developers are allowed to self test.
9) All setbacks must be from property lines.
10) Conflict of Interest with local officials has been a problem and is not addressed.
11) PSC staff stated it would take 2200 foot setback to meet the 45dba noise limit, the 1250 feet setback is meaningless.
12) ACT 40 does not address the fact that Wisconsin has an excess electrical capacity.
13) Renewable energy cost is too high and impedes job growth in industry. Using data from the U.S. Energy Information Administration, the average family of four would have household electric bills in 2016 of $188.66 if the power was supplied by coal. If wind were used to supply 100% of the electricity used by this family, the cost would be $339.58, an increase of 55%. These numbers would devastate the industries in Wisconsin that rely on large amounts of electricity in their manufacturing process.
14) Wind Turbine projects requires huge taxpayer subsidies to be profitable to the developer
15) Wind projects will inhibit new development in the area. This will eliminate hundreds of jobs for new home and business construction and erode the tax base by decreasing the appraised value of the existing homes.
16) Wind turbines do not decrease emissions from other electricity generating sources. In studies in California and Colorado, the wind turbine projects actually increased emissions because of the cycling of coal and natural gas power plants to ensure a steady flow of electricity during periods of little wind. World-wide, not a single coal plant has been shut down because of wind turbines.
17) Eliminate the Renewable Portfolio Standard. Wisconsin business cannot afford the addition cost of subsidized renewable energy. Force the marketplace to innovate and engineer new solutions to the problem. We should not be throwing money at the wrong solution simply because it is here. Force the wind industry to prove scientifically that they are the long term solution.
18) Wisconsin currently has about 300 wind turbines in operation or under construction. To meet the 2025 RPS mandate an additional 12,000 turbines will be required. Where will the state put them? The marginal wind available is in the Eastern quarter of the state, which is also the most densely populated area of Wisconsin. The experiences of residents in Fond du Lac County have proven that wind turbines do not mix well in populated areas.

Public Service Commission of Wisconsin

Eric Callisto, Chairperson
Mark Meyer, Commissioner
Lauren Azar, Commissioner

610 North Whitney Way
P.O. Box 7854
Madison, WI 53707-7854

September 30, 2010

Lynn Korinek
1316 Rockledge Road
Mishicot, WI 54228

Re: Public Records Request ORR 2010-026

Dear Ms. Korinek:

I am writing again in response to one of your letters that the Public Service Commission received September 13, 2010, addressed to Deborah Erwin. In this letter you make a Public Records Request for:

> [A]ny and all specific calculations, studies and data including but not limited to sound study research and data, computer modeling research and data and testimony related research and date pertaining to the comments made by Commissioner Azar during the August 19th 2010 PSC meeting, stating that staff informed her based on research and computer modeling, it would take a 2200 ft setback to meet the 45dba nighttime noise limit sited in the wind siting rules.

The Commission's initial response to your letter was dated September 15, 2010. Enclosed with that response was a map that Commission staff had prepared for Commissioner Azar. This map used the Glacier Hills Wind Project as an example and showed how a 45 dBA maximum noise limit would have affected turbine siting for that project.

After receiving the map and reviewing other research materials that the Commission had earlier sent to Ms. Anita Roberts of Mishicot, you called me to explain your Public Records Request further. You stated that you wanted any further records of the Commission, demonstrating how the noise contour lines were drawn on the Glacier Hills map that show the 45 dBA noise threshold and its distance from each turbine.

Commission staff creates these maps by using the ArcGIS computer program, which is commercially available software from:

esri
380 New York St.
Redlands, CA 92373-8100

ArcGIS produces the map based on data stored in electronic files known as "shapefiles." To produce a wind farm map, different shapefiles contain information about a host of relevant subjects, such as turbine locations, roads, municipal boundaries, railroad lines, electric collector

circuits, church locations, home locations, and noise contours at different dBA levels. The information from each shapefile can be inserted into the map.

A computer model creates the shapefile that contains noise contour data. For its Glacier Hills Wind Project, Wisconsin Electric Power Company contracted with Hessler Associates to develop noise contour data. Hessler Associates produced a report, which is Appendix R to the Glacier Hills project application. That report explains the computer model that Hessler Associates used, the input data, and the results. You can find the report from Hessler Associates on the Commission's Electronic Regulatory Filing system, at PSC REF#: 103302.

Hessler Associates then produced the shapefile with noise contour data and delivered it to the Commission. Because this shapefile consists of electronic data, a user needs the ArcGIS software to make it meaningful.

In summary, the Commission records that are the basis for the noise threshold lines on Commissioner Azar's map are the Commission's copy of the ArcGIS program, the Hessler Associates report and the noise contour shapefile. For the purposes of the Public Records Law, "record" is defined in Wis. Stat. 19.32(2). That statute excludes "materials to which access is limited by copyright, patent or bequest; and published materials in the possession of an authority other than a public library which are available for sale." Because the ArcGIS program is copyrighted material and commercially available for sale, it is not a "record" under the Public Records Law. The Hessler Report is on the Commission's website, so you can download a copy of it at your leisure.

I can e-mail a copy of the noise contour shapefile to you on request. Please recognize that it is meaningless without the necessary ArcGIS program, but if you are interested in viewing this record feel free to contact me and provide me with your e-mail address. If I don't hear from you to request a copy of the shapefile, this letter concludes the Commission's response to your Public Records Requests.

Please do not hesitate to contact me at (608)266-5621 if you have any further questions or concerns.

This determination is subject to review by mandamus under Wis. Stat. § 19.37(1) or upon written application to the Dane County District Attorney or the Wisconsin Attorney General.

Sincerely,

David A. Ludwig
Acting Deputy General Counsel

DAL:ash:o:\open records request general counsel\2010\korinek third response 2010-026

CROPP COOPERATIVE

INDEPENDENT *and* FARMER-OWNED

RE: Public Comments for PSC 128 Wind Siting Rules
Before the Joint Committee for Review of Administrative Rules.
Wednesday, February 9 at 10:00 a.m.
Capitol, 412 East

I am submitting these comments on behalf of CROPP Cooperative ("CROPP"), a farmer-owned cooperative. With 1,625 farmers nationwide, CROPP Cooperative encourages a farming future emphasizing ecological and economic stability. CROPP's Organic Valley® brand is the nation's largest farmer-owned certified organic brand, used to market organic dairy, juice, soy, and produce products.

Not only is CROPP one of the largest employers in Southwest Wisconsin, over 500 of our farmer-owners are located in Wisconsin. Despite a down economy, CROPP's revenue reached $622 million in 2010 and we expect a 19% growth in 2011. Our farmers and our consumers are committed to our renewable energy efforts including our Cashton Community Wind project for which we have been working on for the past 2 years. We have partnered with Gunderson Lutheran and Wisconsin Western Technical College to create a community wind project that supports the local economy while providing a job training site and electricity to 1,000 homes in the area.

We also have 64 farmers in the state of Wisconsin that are committed to using renewable energy sources on their farms. Wind turbines provide our farmers with a reliable, homegrown source of energy as well as a consistent source of income. Suspending or reworking PSC 128 will significantly impact our ability to move forward on our Cashton Wind Project as well as our famer's abilities to move forward with many of their wind turbine projects in a timely manner.

We have participated in the public hearing process for the past year and a half and we strongly urge you to support the PSC rules as it was passed in December. As passed, the wind siting rule will support economic development in the state by providing manufacturing, construction, operation, maintenance, and development while providing

sources of revenue and energy for our rural communities and our farmers. Not only have our farmers shown strong interest in the installation of renewable energy systems; our customers demand sustainably-grown products. Suspending the rule now, before it has an opportunity to work, would send a mixed signal to our farmers and partners considering investing in the wined industry in Wisconsin. We need to create regulatory certainty now to restore confidence and create jobs in rural Wisconsin.

We thank you for the opportunity to consider CROPP Cooperative's comments on this very important issue.

2-9-11

My name is Dean Anhalt. I am a Supervisor with the Town of Mishicot in Manitowoc County. I have been dealing with wind turbine issues for more than 6 years.

In May of 2010 the Town's of Mishicot, Two Rivers, and Two Creeks in Manitowoc County and the Towns of Carlton and West Kewaunee in Kewaunee County drafted a joint letter expressing our concerns with proposed wind siting rules. which was submitted to the PSC for consideration.
The concerns are:

Setbacks should be taken from the property lines of the adjoining non-participants.

Setbacks should be large enough so as not to create shadow flicker or excessive ambient noise on adjacent property.

Setbacks should be large enough not to create a loss of wind or property rights for the adjoining property.

Decommissioning expenses should be backed by a bond fund from the developer.

Town road damage needs to be addressed during decommissioning as well as during construction.

Emergency Communication Interference caused by wind turbines will be corrected by the developer in conjunction with the political sub-divisions.

We also concur and endorse the concerns set forth by the Towns of Morrison, Wrightstown, and Glenmore in Brown County in their submission to the PSC, document # 133746, requesting World Health Organization standards for turbine noise.

We are not people whose daily employment is to promote wind energy. We are not wind farm developers. We are not individuals who seek to promote their ideals on people living elsewhere.

We are elected officials responding to citizen concerns looking to protect our constituent's health and safety and personal and property rights. We are educated on this subject and have seen the results of wind farms elsewhere.

According to the January 28, 2011, edition of the Wisconsin State Farmer, " Walker's wind siting proposal strips local control." "This unreasonable proposal is a steamroller driven by anti-wind special interests bent on denying local governments the ability to decide what's in their best interests" says Michael Vickerman of RENEW Wisconsin.

What kind of statement is this? Wind promoters have been working to take local control away for years. It began with state statute 66.0401 which was a legislative restriction on the ability of municipalities to regulate wind and solar except for issues that dealt with health and safety. So my county, Manitowoc County like others, wrote an ordinance which protected health and safety. Wind supporters lobbied that ordinances like these were to restrictive and got local control taken away and put in the hands of the PSC.

Through all this, property and wind rights have been lost. Wind developers have always pushed for minimal lot line setbacks so turbines can be legally placed on small parcels. With this they only have to come to terms with one landowner while using wind over the neighboring parcels free of charge. When using wind over adjacent lands, the developer, through State statutes, can control what is done on that land in order to protect wind access to their turbine. These lands may become unviable to host turbines of their own as the wind is already being used by someone else. Unsafe zones are also cast over these properties.

We need setbacks large enough to protect wind and property rights. Each landowner should be able to decide if their rights are for sale and then negotiate compensation. The State should not be deciding this for them.

Where I live we have two nuclear plants providing base load power to our state day in and day out. The plants provide good jobs to our area. These people spend money locally and have built homes adding to our tax base. We need to open up our state to new nuclear expansion.

We need economical power, especially in this day and age.
The promotion of conservation and efficiency is very important.
Do we actually need more power production in the State?
Are we siting wind turbines solely to meet State renewable guidelines?
According to the developer in our area this is what allows them to build their project.
According to the recent Strategic Energy Assessment prepared by the PSC, Wisconsin has a very significant and potentially expensive excess capacity.
Are we going to stop using facilities we currently have in exchange for wind power?

I want our leaders to make fiscally responsible decisions and use common sense when addressing our energy needs. We need to revamp and rethink our renewable goals.

We need to make changes to the wind siting rules.

Dean Anhalt
Supervisor, Town of Mishicot
Manitowoc County

Submitted to: PUBLIC SERVICE COMMISSION OF WISCONSIN
Docket no. 1-AC-231 Draft Chapter 128 - Wind Energy Systems

Comments by the Towns of Mishicot, Two Creeks, Two Rivers, Manitowoc County, Wisconsin, and the Towns of Carlton and West Kewaunee, Kewaunee County Wisconsin

The towns of Mishicot, Two Creeks, Two Rivers, Manitowoc County and the towns of Carlton and West Kewaunee, Kewaunee County respectfully submit our comments and concerns in regard to the May 14, 2010, draft of the Chapter 128 rules for wind energy systems.

The towns concur and endorse the concerns set forth by the Towns of Morrison, Wrightstown and Glenmore, Brown County, Wisconsin - Ref. PSC REF# 133746.

We submit the following for consideration by the PSCW when developing rules for Wind Energy Systems so that public safety and health are preserved.

Setbacks should be taken from the property line of the adjoining non-participants.

Setbacks should be large enough so as not to create shadow flicker or excessive ambient noise on adjacent property.

Setbacks should be large enough not to create a loss of wind or property rights for the adjoining property.

Decommissioning expenses should be backed by a Bond Fund from the developer.

Transportation should also include damage caused to roads from the decommissioning of the wind turbines.

EMS - Emergency Communication Interference caused by Wind Turbines should be corrected by the developer in conjunction with the political sub-divisions within a year.

Town of Mishicot

Town of Two Creeks

Town of Two Rivers

Town of Carlton

Town of West Kewaunee

To: <undisclosed-recipients:>
Sent: Wednesday, October 06, 2010 8:57 AM
Subject: Wi electricity supply [W.eb.bd]

Study says state has more electricity supply than it needs

By JUDY NEWMAN | jdnewman@madison.com | 608-252-6156 | Posted: Tuesday, October 5, 2010 5:35 pm | (2) Comments

Wisconsin has more electricity supplies than it needs, thanks to a buildup of generation and the effects of the recession, but getting power to customers is "an ongoing challenge," a new report says.

The recession has dramatically cut projections for future energy needs, according to a draft version of the Strategic Energy Assessment, a review conducted every two years by the Wisconsin Public Service Commission.

Peak energy demand is now expected to grow 1 percent a year statewide between 2011 and 2016, a sharp drop from projected annual increases of 2.1 percent in the 2008 report.

In individual comments, commissioner Lauren Azar said the recent phase of adding power generation has been "prudent" but coupled with the recession, Wisconsin has "very significant (and potentially expensive) excess capacity." Azar repeated her call for the Legislature to give the PSC more authority for long-term, comprehensive energy planning, rather than the current utility-by-utility assessment.

The draft report, which will be open for public comment until Jan. 7, also said Wisconsin is "well on its way" toward getting 10 percent of its electricity needs from renewable sources by 2015.

Posted in Govt-and-politics, Govt_and_politics on Tuesday, October 5, 2010 5:35 pm Energy Assessment, Electricity Supply, Psc, Public Service Commission, Lauren Azar

Public Service Commission of Wisconsin (PSC)

Submitted: 6/24/2010 11:08:34 PM

COMMENTS FILED ELECTRONICALLY IN

Wind Siting Rules

1-AC-231

Commentor Information:

Name: Glen R. Schwalbach, P.E. for towns of Morrison, Wrightstown, and Glenmore
Address: 1090 Moonriver Dr
City: De Pere State:WI Zip:54115
E-mail: glenschwalbach@netzero.com
Phone: 920-680-2436

Comment:

Submitted to: Public Service Commission of Wisconsin
Docket No. 1-AC-231 Draft Chapter 128--Wind Energy Systems

Request by the Towns of Morrison, Wrightstown and Glenmore
Brown County, Wisconsin
June 23, 2010

Issue: Request to delay issuing the PSCW wind siting standards until epidemiological studies of health complaints from Wisconsin`s current wind farms are thoroughly completed.

The towns of Morrison, Wrightstown, and Glenmore in Brown County are very concerned about the mounting evidence that there are serious negative impacts on human and animal health caused by wind turbines. It appears it is not only reasonable to delay the issuance of wind siting standards but it would be irresponsible to not do so in light of new studies and ongoing complaints of residents in and near Wisconsin`s existing wind farms.

In general, scientifically and statistically relevant studies have been limited. But, a very important report was published March 2010 by the World Health Organization (WHO) entitled "Night Noise Guidelines for Europe" (available at euro.who.int/en/what-we-publish/abstracts/night-noise-guidelines-for-europe).

The report is based on a six-year evaluation of scientific evidence by thirty-five scientists from medical and acoustical disciplines. WHO indicated that now governments have justifications to regulate noise exposure at night. WHO sets the limit for annual average exposure to not exceed 40 decibels (dB) outside of a residence.

WHO stated, "Recent research clearly links exposure to night noise with harm to health. Sleep disturbance and annoyance are the first effects of night noise and can lead to mental disorders. Just like air pollution and toxic chemicals, noise is an environmental hazard to health". WHO stated that they hope their new report will prompt governments to invest effort and money in protecting health from this growing hazard.

Our towns ask the PSCW to acquire the WHO report and evaluate its application to setting appropriate sound levels for wind turbines.

The PSCW`s draft rules do not address low frequency noise levels. It is not known whether the WHO report addresses this issue but other studies have described the likely effects. This is another area where epidemiological studies are needed before wind turbine setbacks can be reasonably proposed.

Besides sleep disturbance, there are complaints of other physiological problems. It is not acceptable to ignore or minimize the significance of these impacts as just quirks of human imagination.

Also, there is evidence that existing wind farms in Wisconsin are negatively affecting farm animals. Whether it is noise or some other physical phenomena, studies and testing should be done before setting siting standards.

At a public meeting of the Brown County Health Department and the Brown County Human Services Committee, reputable medical and health experts stressed the importance of epidemiological studies to determine the true nature of health impacts of wind turbines.

The State Board of Health pointed out that the lack of funding is a hurdle. But a conviction to do the right thing should prompt the PSCW to make a case to pursue the money issue with state legislators as well as our U.S. senators and representatives. Certainly, our towns would help in this endeavor. That said, it is even more appropriate for the wind developers and their associations to offer funding for independent studies since such studies should reduce future litigation. Electric utilities should have a stake in this effort as well. This is an opportunity to involve the University of Wisconsin research capabilities in both human health and animal health.

It appears that Act 40 does not set a deadline for completing the siting rules. This week a state senator who was one of the leaders in passing the wind siting law agreed that studies should be done to be sure the rules are adequate. If one or two years were used to study the existing wind farms while delaying any new installations, the developers would still have time to help utilities meet their 15% RPS by 2015. Again, if needed, our towns would help in getting the support of legislators.

Our towns implore the PSCW and the Wind Siting Council to not ignore the evidence of potentially serious health impacts and to not set standards until they have done the obvious and reasonable step of studying the health impacts of existing wind turbine installations in Wisconsin. Professional ethics demands no less. We believe our request aligns with the PSCW`s responsibility to protect the citizens of Wisconsin.

Submitted for the towns by Glen R. Schwalbach, P.E.

I affirm that these comments are true and correct to the best of my knowledge and belief.
Glen R. Schwalbach, P.E. for towns of Morrison, Wrightstown, and Glenmore

4) NON-SEVERABILITY OF WIND RIGHTS FROM SURFACE RIGHTS

Recommendation: Wind rights should not be severed from the land.

Explanation: The intent of this policy recommendation is to ensure that the economic benefits of wind energy development stay connected to the land, and thus the local community as much as possible. The impact of this policy would be that wind rights cannot be sold or leased in perpetuity separately from the land.

Note that a similar provision is included in South Dakota statute (§ 43-13-17 to 43-13-19; Source: SL 1996, ch 260, § 4).

5) DECOMMISSIONING AND SITE CLEAN UP FUND

Recommendation: Wind project owners should be required to maintain a fund with adequate resources to cover the costs of decommissioning and site clean up.

Explanation: Many wind agreements are vague and include minimal incentives to ensure that the project owners follow through with site clean up after decommissioning. Provisions in many contracts leave too much chance that landowners will be left with the responsibility of removing equipment.

6) INSURANCE AND INDEMNITY PRACTICES

Recommendation: Wind developers must maintain liability insurance at a minimum level specified in the land agreement. The developer must indemnify the landowner against liabilities for injuries or claims caused by the developer's exercise of rights granted in the lease or easement.

Explanation: Landowners should not be held liable for issues related to the wind project.

7) GUIDELINES FOR SETBACKS

Recommendation: Turbines should be sited no less than five times their rotor diameter from property lines, unless written permission is given by the neighbor. An easement or lease on the neighbor's land would be considered written permission.

Explanation: This recommendation is designed to protect wind rights of all landowners and minimize the impact of wind turbines on neighbors. Wind turbines produce wake effects 8-11 rotor diameters downwind. Requiring a setback of 5 rotor diameters from property lines provides a buffer that will protect the wind rights of all landowners in the vicinity of a wind project. We believe clear standards for property line setbacks are critical to preventing disputes over wind rights now and in the future. Without standards, conflicts among neighbors and among wind developers can arise. A prolonged or heated conflict over wind rights could delay or limit wind project development opportunities for a community.

This recommendation is based on the Minnesota Environmental Quality Board's wind access buffer rule that requires turbines to be placed 5 rotor diameters or more away from a project site's perimeter as a condition for granting permits on wind projects greater than 5 MW.

Alternative Recommendation: Establish a ***Resource Based Compensation Model*** for wind energy development where compensation is provided based on both real estate and wind resource usage.

Explanation: Wind energy development engages two primary natural resources: land and the wind blowing across it. Current models for compensating landowner hosts of wind projects are based on the use of the land for the placement of turbines, associated equipment and access roads. The wind resource consumed by a wind turbine extends approximately 8-11 rotor diameters downwind and approximately half as far laterally. A resource based compensation model for wind energy development would compensate all landowners in this "wind pool" or "wind print" in addition to the landowner providing real estate for the turbine. The need for mandated setbacks could be eliminated if all landowners providing wind resource are compensated. This model has the advantages of encouraging more collaboration within a community, preventing taking of anybody's wind resource without compensation, and providing the developer with maximum flexibility in siting turbines in the best wind locations. Disadvantages of this model include the possibility of complicating the land agreement process by the need for developers to negotiate with more landowners.

A fuller explanation of the Resource Based Compensation Model for Wind Energy Development will be available on the Windustry website later in the fall of 2005.

MICHELS CORPORATION

817 W. Main Street • P.O. Box 128 • Brownsville, WI 53006-0128
920/583-3132 • Fax 920/583-3429
www.michels.us

February 9, 2011

Senator Leah Vukmir
Representative Jim Ott
Joint Committee for Review of Administrative Rules
State Capitol
Madison, WI 53708

RE: PSC 128 (CR 10-057)

Dear Sen. Vukmir and Rep. Ott:

Michels Corporation supports the development and construction of wind energy projects in the state of Wisconsin. As background, Michels Corporation recently constructed the Forward Energy Center in Brownsville, WI. This 129 MW project had over 200 people employed as laborers, operators, ironworkers, and electrical workers, in addition to many support personnel who all worked together to get this project built safely and on time. Michels is proud of our environmental record on this project situated near the Horicon Marsh. We performed electrical construction for the Blue Sky Green Field, Butler Ridge and Glacier Hills projects, in addition to complete construction of the Shirley Wind project. While Michels is a diversified utility contractor, wind farm construction is an important part of our business.

We support the process the PSC used to identify the wind tower siting setback of 1,250 ft. The process was fair, balanced, and including various key stakeholders. Restricting the setback further would negatively impact the ability of wind developers to build wind generation projects in Wisconsin, and drive jobs and income to surrounding states. If given the opportunity, Michels, and our work force, would much rather work close to home and see the direct economic benefits of these projects enjoyed by Wisconsin businesses and Wisconsin workers – not those in a neighboring state.

The economic benefit of these projects goes all the way down to the local gas station. The BP station near the Forward Energy project daily sold hundreds of extra sodas and coffees during construction and Cunningham's Feed Mill restaurant and bar in Knowles had full lunch tables virtually every day during the 6-month peak construction period.

For each 100 MW wind project we employ on average 125 people over the duration of project, with 6-8 employed long term for maintenance. There are four 100 MW projects that likely would not be built if the 1,250 ft. setback is increased. This directly affects Michels and our employees.

Thank you for allowing us to offer our comments supporting wind farm development right here in America's Dairyland!

Sincerely,

Christopher J. Deschane
Business Development Manager

February 9, 2011

Joint Committee for Review of Administrative Rules
Room 412 East
State Capital, Madison WI

My name is Larry Lamont and I regrettably live in an industrial wind turbine area.

I have three minutes to describe some of the situations I will live with the rest of my life.

I was a supporter of wind generation until after they were put up in my back yard. I learned so much. The impact has been a lot bigger and more intrusive than they had been portrayed.

Where do I begin?

Constant noise – even when not turning we hear the energy wasting transformer hum, continuous distracting motion, shadow flicker, environmental impacts, loss of "flight for life", real and potential health problems, very obnoxious red flashing FAA warning lights, interference of radio reception, and according to the Wisconsin Realtors Association, up to a 40% reduction in property value.

Living inside the perimeter of a wind farm I can address all these problems. I bought 78 serene acres 40 years ago thinking I would be safe from intrusion by others. Not so .We have many omnipresent intruders. Three near the 1250-foot limit recommended by the PSC, one only 1101 feet from my house. Way to close.

I will first address the most persistent problem – noise, specifically the post-construction noise study. It seams that once the test is passed they will never be checked again and they are free to roar. I would like to make comment to three troubling statements in this study. First – The lead engineer is hard of hearing. After spending the better part of a week on site he said he did not witness the often described "whoosh-whoosh" of the turbines. Say what? Second – The report is very hard to understand. They even had trouble because they reported the cut in speed at 3m/sec when it should be 3.6m/sec. The significant of this is that the turbines where not producing electricity 71% of the time that day, just spinning slowly in the breeze. Thirdly – what is really meant by the engineer hired by the utility requiring all parties to meet before the test "to ensure a successful test"?

I borrowed a noise meter; on this meter I have had turbine noise readings as high as 63dbA. This is 20 TIMES the recommended 50dbA level. Remember these are on a logarithmic scale. Nobody is monitoring these abuses. Does anybody care – other than the people that have to live with under these conditions?

Monitoring should be continuous, unannounced and with no per-agreements. Noise is noise.

I passed my drivers test because I stayed under the posted speed. Does this exempt me from further monitoring – Hell no. Nobody is monitoring turbine noise. Why have guidelines if nobody gives a rip if they are ignored.

Our township has a nuisance ordinance. There are five definitions of causing or being a nuisance. The turbines are blatant violators of four of these categories. Here again the wind farms are beyond the law. They are not being monitored or held accountable. And they think they are good neighbors.

Another issue that bothers me is Vickermans band of 15 members that were selected to advise the PSC on wind tower placement. What a folly. Judging from their job descriptions who would ever have predicted this select group would support wind energy almost without reservation. What a waste of time and money. This is like asking a select group of tavern owners if they favor prohibition or not.

And I'm not totally buying into the green energy thing. Proponents say that the energy is carbon free. Nobody has talked about the large trail of energy and carbon that it takes to build, deliver and maintain these behemoths. It is the most expensive and least dependable way to generate electricity. 10 cents per kwh as opposed to 3-4 for coal and 2-3 for nuclear. And we still have to maintain all our other forms of generation because of there undependability.

If this information doesn't slow down the green theme a little check out some towers. Many are covered with dark splotches from a lubricant or something. Many blades are streaked with the same stuff. How much of this stuff are they splattering around the countryside?

These are a financial boon to those few that 'host' these things. $175,000 per tower over the life span is nothing to sneeze at. The rest of us put up with all these conditions for nothing. Many of the "hosts" are unhappy also but they cannot be too vocal.

And finally, I get so frustrated when the press and media buys into how great these things are as told to them by the well funded industry that build them or distributes there product. When affected residents try to explain their problems with living near the towers we get the "some people just do not like these things" explaination. I challenge them to come live with us for a while and then try to think of anything you do like about them.

I would welcome any response to my comments. Did you hear them, do you understand? Any questions?

Larry Lamont
W 2362 Ash Rd
Malone, WI 53049

American Superconductor®

REVOLUTIONIZING THE WAY THE WORLD USES ELECTRICITY®

9 February 2011

PSC128 Hearing

My name is Matt Pugh, Customer Service Operations Manager from American Superconductor Corporation. We are a global electrical power technologies company with approximately 200 employees here in Middleton and New Berlin, Wisconsin.

Over the course of the past five years – through the economic downturn – we have grown our local employee base by more than 156%. We have plans to continue growing here in the years ahead. But if the state's policy on wind power changes, we might very well have to focus our hiring efforts elsewhere.

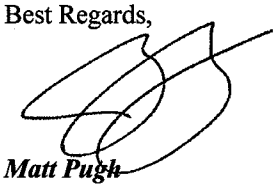
A vast majority of AMSC's revenues today come directly from the wind power market, and Wisconsin serves as our center of excellence for wind turbine power electronics and controls. We also manufacture grid interconnection solutions for wind farms and solar plants at our facilities here in the state.

Our company currently is planning to erect a wind turbine in Wisconsin. This will serve as a qualification bench for our next-generation power electronics, blade technology, generators and turbine controls, enabling AMSC to remain at the forefront of the wind industry. This is critical to our company's success and will help us continue to grow our headcount in the state.

AMSC also is uniquely positioned to bring a new wind turbine manufacturer into this state. We currently are working with a dozen wind turbine manufacturers worldwide, including two of the world's top ten producers. Some of these companies are looking to establish operations here in the U.S. A manufacturer like this would create hundreds of new green collar jobs and also would require a host of partners who could supply towers, blades and other critical components. A strong local market will foster new manufacturers and their suppliers. Wisconsin is one logical locale for this new manufacturer and supply chain, but only if support for the industry remains strong.

We urge this Committee to uphold PSC 128 for the sake of our company, our employees and our state.

Best Regards,



Matt Pugh
Customer Service Operations Manager
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mpugh@amsc.com
www.amsc.com

Why are we promoting Wind Energy in Wisconsin?

(negative impacts to Property owners)

Tim Harmann
4544 Mill Road
Denmark, WI 54208
Running for Town Supervisor in the Town of Morrison, Brown County, Wisconsin

What is the Return on Investment (ROI) on Subsidizing Wisconsin Wind Energy with Tax Dollars?

Property Owners

- Carbon Emissions
  - Bentek Energy Study
  - http://www.bentekenergy.com/files/userfiles/file/BENTEK%20-%20Executive%20Summary%20-%20How%20Less%20Became%20More_100416.pdf
  - 3 Page Executive Summary
  - RPS (renewable portfolio standards) "must take" mandate on wind energy causes cycling of coal plants to accommodate inconsistent wind power and therefore has had minimal or no impact on reducing carbon emissions. In some cases emissions are actually increased due to introduction of wind energy.
    - ROI: Basically little, no, or negative benefit on emissions
- Wisconsin Wind Class
  - Department of Energy
  - http://www.windpoweringamerica.gov/maps_template.asp?stateab=wi
  - Wisconsin is a Class 1 (Poor) and Class 2 (Marginal) wind state
  - Large subsidies of tax dollars to support wind projects that can never break even
    - 35% overcapacity of power in Wisconsin (why create more expensive power?)
    - Wind Averages 20% of installed name-plate capacity in Wisconsin
    - Do the math...It doesn't make any sense
      - ROI: Huge unnecessary spending, Negative payback
- Targeting Niagara Escarpment (class 2 - marginal)
  - Bedrock and Aquifers are only a few feet from the surface on the Niagara Escarpment causing runoff pollution and well issues. This is already a fragile area.
  - http://www.co.brown.wi.us/departments/page_1efd5d9c60d3/?department=097c0e79486a&subdepartment=7c17181709a3
    - Wells in the Town of Morrison have a history of issues
    - In 2006, over 34% of the wells tested exceeded the state drinking water standard for nitrate/nitrite (ppm N) of 10 ppm and 19% tested positive for bacteria.
      - ROI: Negative benefit to our health and water supply

- Health issues are one of the negative returns on this investment
    - Need a ½ mile setback from a property line and 5 dba over ambient to protect Wisconsin citizens who pay these taxes to subsidize wind that has no positive ROI
    - I've personally interviewed 10 people in the Blue Sky Green Fields WE Energies project near Fond Du Lac and they are experiencing sleep and noise issues
        - 4 of 10 allowed me to video our interviews
            - http://www.youtube.com/watch?v=34oOPKNJv-E
            - http://www.youtube.com/watch?v=9PvPXU0io_A
            - http://www.youtube.com/watch?v=pzh106w1lRA
            - http://www.youtube.com/watch?v=GlbzYXSM0zs
        - Overall ROI: Negative impacts and not enough citizen protection
- Our new Governor Scott Walker
    - Realizes that expensive wind energy and the resulting costly expansion of our over-taxed transmission lines will increase the cost of energy to manufacturers who are considering Wisconsin
    - We're restricting job creation in Wisconsin by promoting negative ROI, expensive, and inefficient wind energy.
        - Isn't responsible spending needed by ALL IN THIS ECONOMY(or any economy)?
    - We need to get on a single course/mission, working together to get out of this recession and emerging strong and moving forward
        - We cannot allow minimal setbacks which will allow more wind turbines and more wasteful tax spending with no ROI
            - ROI: Wisconsin Unattractive for Manufacturing/Business creation
- What about the Property Value Loss for homes near wind turbines
    - http://www.wind-watch.org/documents/wind-turbine-impact-study/
    - Appraisal Group One Study of Wind Turbines on Property Values
        - 24% - 47% loss in property value depending on size of parcel, improvements, and proximity to wind turbine
    - Why "Wind Farm Ghetto"?
        - Each turbine has a circle of Property Value "Taking" around it.
        - Shorter Setbacks = greater number of homes in the "Taking" circle
        - I personally quit making improvements to my beautiful home because my property improvement ROI has become negative due to the proposed wind turbines around my home.
        - Area Contractors suffer because large projects aren't started
        - Area retailers suffer because improvements ~~are~~ aren't made
        - Apprehensiveness to invest due to uncertainty about the wind projects (very much like the recession and struggling stock market)
            - Hard enough to attract talent to cold weather states now we're making it difficult for them to buy or build homes in Wisconsin rural areas
                - ROI: Huge loss to Property owners in the "Taking" circle.

Where is the positive return on our Tax investment? It doesn't exist!

What do we need to stop doing?

- Quit forcing more expensive power on our struggling businesses.
- Quit splitting up communities over wind. We need to work together.
- Quit killing the property values and property rights of citizens near wind turbines.
- Quit trying to reduce setbacks to force wind turbines too close to people
- Quit impacting health and sleep
- Quit killing the retailer's and contractor's businesses near wind ghettos.

What are some solutions?

- Reject subsidies on projects that don't have an ROI and do little of nothing to reduce emissions
- Put subsidies into research grants to find an innovative renewable energy replacement for coal that doesn't have all the side effects of wind power.
    - Wind companies could use their experience in renewable energy to find a viable solution that has an ROI and reduces emissions.
    - Solution could even create less expensive power than coal
    - Create jobs in Wisconsin and put us on the map
- Give subsidies/incentives to coal plants to install cleaner emission systems.
    - Wouldn't that solve everyone's problems?
- If we must subsidize wind turbines (and I would like a logical explanation of why we would invest tax dollars here) we must provide protection to Wisconsin citizens and businesses:
    - ½ mile setbacks from property lines and 5 dba over ambient to reduce the negative impacts of wind turbines

Sources are below that were referenced above:

http://www.windpoweringamerica.gov/maps_template.asp?stateab=wi

Department of Energy:

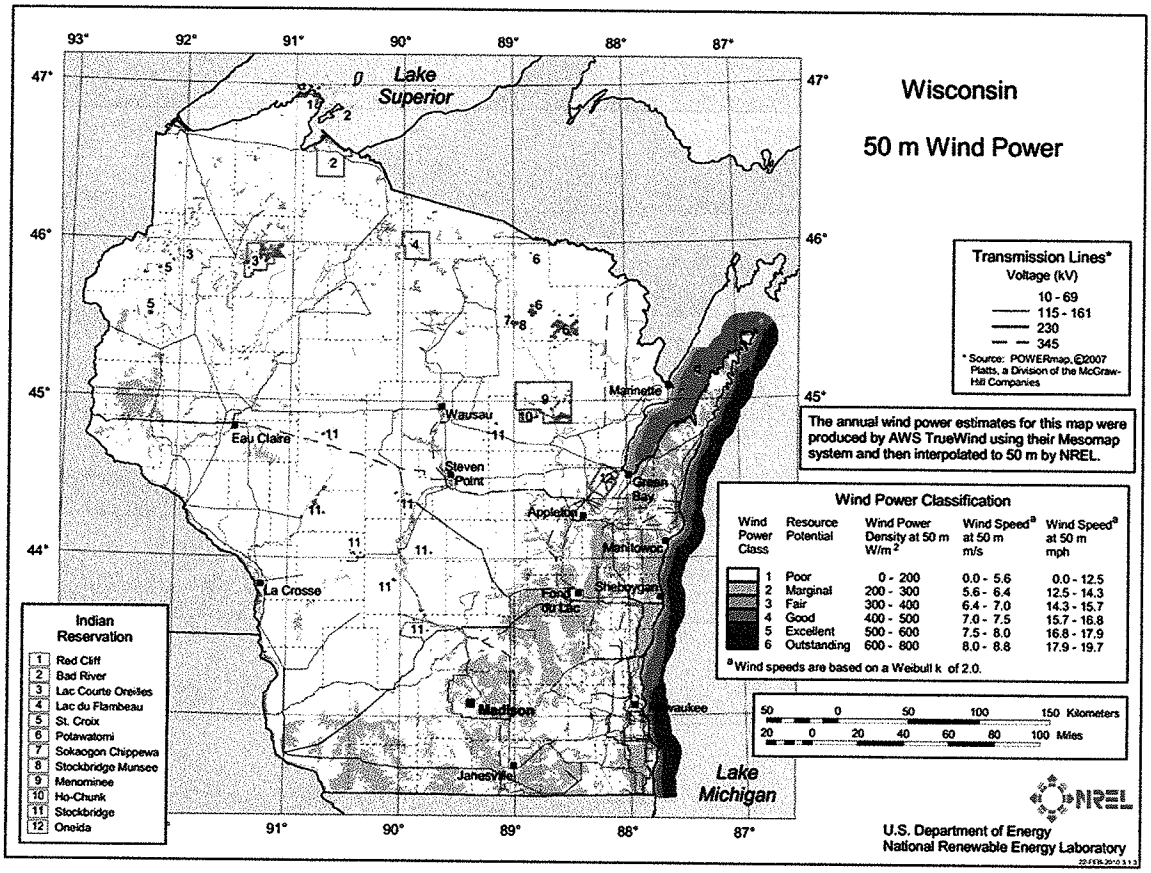
The Department of Energy's Wind Program and the National Renewable Energy Laboratory (NREL) published a wind resource map for the state of Wisconsin. This resource map shows wind speed estimates at 50 meters above the ground and depicts the resource that could be used for utility-scale wind development. Future plans are to provide wind speed estimates at 30 meters, which are useful for identifying small wind turbine opportunities.

As a renewable resource, wind is classified according to wind power classes, which are based on typical wind speeds. These classes range from Class 1 (the lowest) to Class 7 (the highest). In general, at 50 meters, wind power Class 4 or higher can be useful for generating wind power with large turbines. Class 4 and above are considered good resources. Particular locations in the

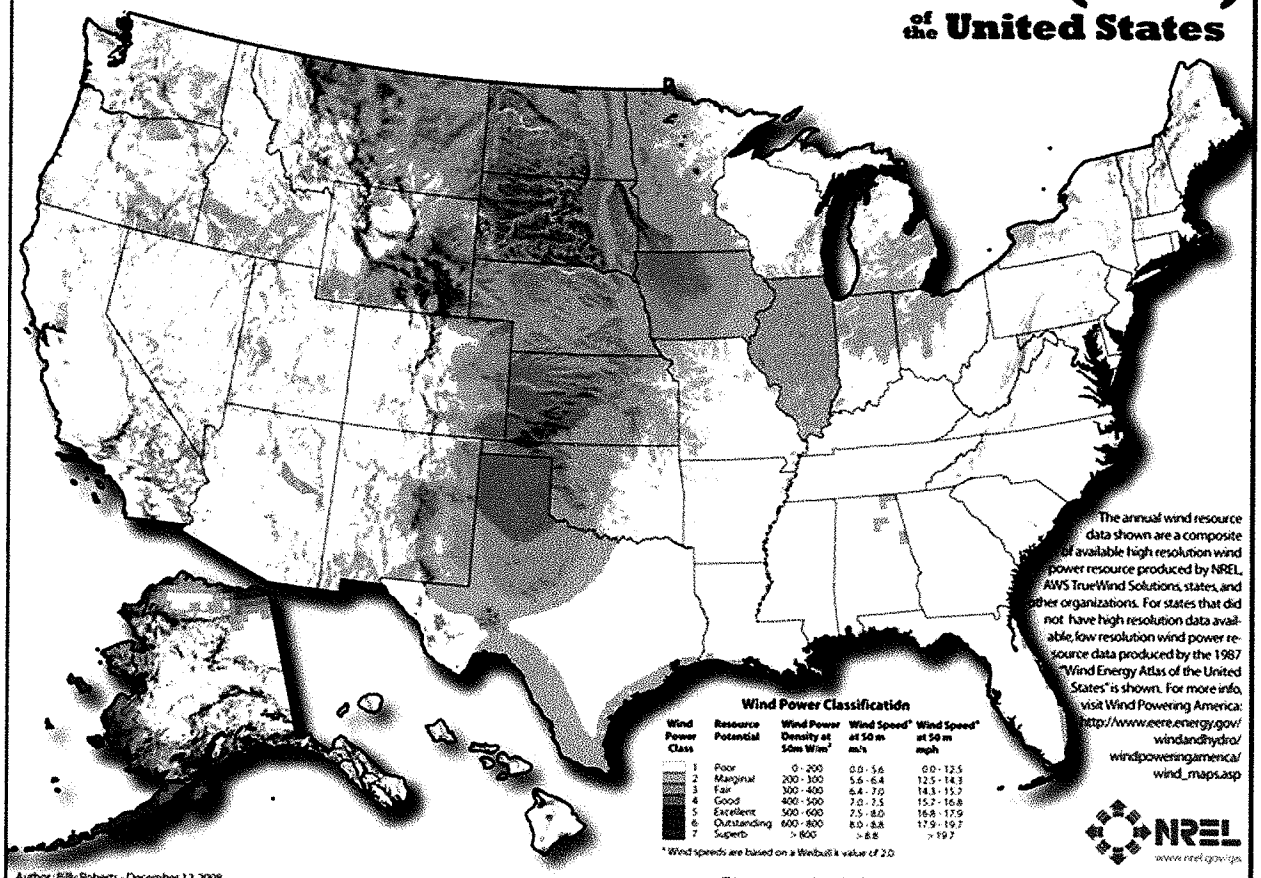
Class 3 areas could have higher wind power class values at 80 meters than shown on the 50-meter map because of possible high wind shear. Given the advances in technology, a number of locations in the Class 3 areas may suitable for utility-scale wind development.

This map shows the highest wind resources in Wisconsin are concentrated in the southern and eastern part of the state. Class 3 areas are predominately located on capes and exposed coastal locations along Lake Michigan and Green Bay. Particular locations in the Class 2 and Class 3 areas could have higher power class values at 80 meters than shown on the 50-meter map because of high wind shear. Given the advances in technology a number of locations in the southern and eastern part of Wisconsin may be suitable for utility-scale applications.

Note: Wind resource at a micro level can vary significantly; therefore, you should get a professional evaluation of your specific area of interest.


Wisconsin
50 m Wind Power
Lake Superior
Lake Michigan
Transmission Lines*
Voltage (kV)
10 - 69
115 - 161
230
345
* Source: POWERmap, ©2007 Platts, a Division of the McGraw-Hill Companies
The annual wind power estimates for this map were produced by AWS TrueWind using their Mesomap system and then interpolated to 50 m by NREL.
Wind Power Classification
Wind Power Class | Resource Potential | Wind Power Density at 50 m W/m² | Wind Speed[a] at 50 m m/s | Wind Speed[a] at 50 m mph
1 Poor 0 - 200 0.0 - 5.6 0.0 - 12.5
2 Marginal 200 - 300 5.6 - 6.4 12.5 - 14.3
3 Fair 300 - 400 6.4 - 7.0 14.3 - 15.7
4 Good 400 - 500 7.0 - 7.5 15.7 - 16.8
5 Excellent 500 - 600 7.5 - 8.0 16.8 - 17.9
6 Outstanding 600 - 800 8.0 - 8.8 17.9 - 19.7
[a] Wind speeds are based on a Weibull k of 2.0.
Indian Reservation
1 Red Cliff
2 Bad River
3 Lac Courte Oreilles
4 Lac du Flambeau
5 St. Croix
6 Potawatomi
7 Sokaogon Chippewa
8 Stockbridge Munsee
9 Menominee
10 Ho-Chunk
11 Stockbridge
12 Oneida
50 0 50 100 150 Kilometers
20 0 20 40 60 80 100 Miles
Marinette
Wausau
Eau Claire
Steven Point
Green Bay
Appleton
Manitowoc
La Crosse
Sheboygan
Fond du Lac
Madison
Janesville
Milwaukee
NREL
U.S. Department of Energy
National Renewable Energy Laboratory

Wind Resource (50m)
of the United States



Wind Power Classification

Wind Power Class	Resource Potential	Wind Power Density at 50m W/m²	Wind Speed* at 50 m m/s	Wind Speed* at 50 m mph
1	Poor	0 - 200	0.0 - 5.6	0.0 - 12.5
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	> 800	> 8.8	> 19.7

* Wind speeds are based on a Weibull k value of 2.0

The annual wind resource data shown are a composite of available high resolution wind power resource produced by NREL, AWS TrueWind Solutions, states, and other organizations. For states that did not have high resolution data available, low resolution wind power resource data produced by the 1987 "Wind Energy Atlas of the United States" is shown. For more info, visit Wind Powering America: http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp

NREL
www.nrel.gov/gis

Author: Billy Roberts - December 12, 2008

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy.

http://www.co.brown.wi.us/departments/page_1efd5d9c60d3/?department=097c0e79486a&subdepartment=7c17181709a3

Groundwater and Well Information

In 2006, the Town of Morrison experienced a never before seen well contamination problem. Over 34% of the wells tested exceeded the state drinking water standard for nitrate/nitrite (ppm N) of 10 ppm and 19% tested positive for bacteria. While the Department of Natural Resources offically stated that the source of the problem was undetermined, the karst features in the area proved that significant well contamination issues could continue to plague the area.

Karst is any terrain based on a layer of soluble bedrock, usually, though not always, of carbonate rocks. In Brown County, and most of northeast Wisconsin, karst forms on limestones (calcium carbonate) and dolomites (magnesium calcium carbonate), found primarily along the Niagara Escarpment or as locally refered to as "the ledge". Common natural Karst features include:

1. **Sinkholes** - Depressions in the ground surface caused when sediment overlying the bedrock washes into bedrock into bedrock channels and cavities or by the collapse of cave roofs. Sinkholes vary in size and have slopes ranging from gradual to severe. Surface water draining into sinkholes can enter nearby wells quickly.
2. **Bedrock outcroppings** - Limestone or dolomite bedrock protruding from the

ground surface.

3. **Springs** - Water flowing out of the ground from subsurface flow paths.
4. **Disappearing or sinking streams** - Small surface streams that enter subsurface flow paths.
5. **Earth cracks** - Cracks from a few inches to several feet formed when a limestone formation leans toward an unsupported area such as a valley.
6. **Flaggy soil** - Soil with "flags" of small limestone pieces mixed with the soil. The mapping of flaggy soils is a useful indentifier of linestone bedrock a short distance beneath the surface.

Karst makes for beautiful scenery, but it is very vulnerable to groundwater pollution, due to ease of water flow. Natural filtration is nearly non-existent in karst areas. To make matters worse, cave conduits act as natural sewer lines, and sinkholes become personal garbage dumps in small towns and rural areas, which puts the local drinking water supplies at risk. It is only recently that these problems are beginning to be addressed.

http://www.wind-watch.org/documents/wind-turbine-impact-study/

Wind Turbine Impact Study

[Alternate short URL for linking • HOME]

Author: Appraisal Group One

This is a study of the impact that wind turbines have on residential property value. The wind turbines that are the focus of this study are the larger turbines being approximately 389ft tall and producing 1.0+ megawatts each.

The study has been broken into three component parts, each looking at the value impact of the wind turbines from a different perspective. The three parts are: (1) a literature study, which reviews and summarizes what has been published on this matter found in the general media; (2) an opinion survey, which was given to area Realtors to learn their opinions on the impact of wind turbines in their area; and, 3) sales studies, which compared vacant residential lot sales within the wind turbine farm area to comparable sales located outside of the turbine influence.

The sponsor for this study was the Calumet County Citizens for Responsible Energy (CCCRE) (Calumet County, Wisconsin), which contracted our firm, Appraisal Group One, to research the value impact that wind turbines have on property value. Appraisal Group One (AGO) protected against outside influence from CCCRE by having complete independence to the gathering of facts, data and other related material and the interpretation of this data to the purpose of this study. AGO chose the location of the study, the search parameters, the methodology used and the three-step approach to the study. AGO does not enter into any contract that would espouse any preconceived notion or have a bias as to the direction of the study and its findings. The purpose of the study was to investigate the value impacts of large wind turbines, the issues influencing these impacts and to report these findings on an impartial basis. ...

The geographic area of this study was focused in Dodge and Fond du Lac Counties. These two counties have three large wind farms. They are:

- WE Energies – Blue Sky Green Field wind farm which has approximately 88 wind turbines and is located in the northeast section of Fond du Lac County, bordering Calumet County to the north.
- Invenergy – Forward wind farm which has approximately 86 wind turbines and is located in southwest Fond du Lac County and northeast Dodge County.
- Alliant – Cedar Ridge wind farm which has approximately 41 wind turbines and is located in the southeastern part of Fond du Lac County.

Of these three wind farms, only the WE Energies and Invenergy wind farms were used in the sales study since the Alliant – Cedar Ridge wind farm did not have enough viable sales within the turbine influence area to use as a base of comparison. The Realtor survey was limited to Fond du Lac and Dodge Counties, that being the area which had the three wind farms. …

Summary of Findings & Conclusion of Impact

The survey indicated that in all but two scenarios (those being Questions #8 and #9), over 60% the participants thought that the presence of the wind turbines had a negative impact on property value. This was true with vacant land and improved land. Where the group diverted from that opinion is when they were presented with a 10-20 acre hobby farm being in close and near proximity. In these cases 47% (close proximity) and 44% (near proximity) of the participants felt that the wind turbines caused a negative impact in property value.

The answers showed that bordering proximity showed the greatest loss of value at −43% for 1-5 acre vacant land and −39% for improved properties. Next in line was the close proximity showing a −36% value loss for 1-5 acre vacant land and −33% for improved property. Last in line was the near proximity, showing a −29% loss of value for a 1-5 acre vacant parcel and −24% loss in value for improved parcels. These losses show a close relationship between vacant land and improved land. This pattern was replicated regarding the bordering proximity for a hobby farm, whereas 70% believed it would be negatively impacted. Lastly, the opinions regarding the impact of the wind turbines due to placement, that being in front of the residence or behind the residence, showed that in both situations most participants believed there would a negative impact (74% said negative to the front placement and 71% said negative to the rear placement).

In conclusion, it can be observed that: (a) in all cases with a 1-5 acre residential property, whether vacant or improved, there will be a negative impact in property value; (b) with 1-5 acre properties the negative impact in property value in bordering proximity ranged from −39% to −43%; (c) with 1-5 acre properties the negative impact in property value in close proximity ranged from −33% to −36%; (d) with 1-5 acre properties the negative impact in property value in near proximity ranged from −24% to −29%; (e) in all cases the estimated loss of value between the vacant land and improved property was close, however the vacant land estimates were always higher by a few percentage points; (f) it appears that hobby farm use on larger parcels would have lesser sensitivity to the proximity of wind turbines than single family land use; and (g) placement either in front or at the rear of a residence has similar negative impacts.

My name is Sandra Johnson, and I wish to thank you for the opportunity to ask this committee to "Suspend the Rules" as sent to you by the PSC. I am a resident of the Holland township in southern Brown County.

As a retired Green Bay science teacher, several questions came to mind when a proposed wind turbine project in our community jumped from 4 or 5 turbines as told to our town board to 100 1.5 Megawatt 40-story turbines in four townships.

Why would a wind energy corporation keep the real number of turbines in their project quiet for over 2 years, and how did they accomplish that? Often turbine contracts have a confidentiality clause which prohibits a participating landowner to speak to anyone -- not the press, not their neighbors.

And the second clause often included is the "Right of First Refusal". If that landowner finds that for whatever

reason-- health or economic -- after the turbines go online that his family cannot live there, the wind project owner or investors get first bid on that home and the land that goes with it. And who ends up with that land?? It's a win for the wind corporation and a loss to the local community.

About ten years ago, when the Lincoln Township wind project in Kewaunee County went online, ground current problems rose and Scott Srynka said that ". . .trucks have grown more frequent hauling away the (cow) carcasses." He added, "Thirteen turbines were proposed for my land, but we decided to wait. Thank goodness we did, or we'd be out of farming." Is Wisconsin the "dairy state" or isn't it??

Some citizens are no longer waiting for answers. They are taking action. In the Dec. 7th. 2010 Contra Costa Times it was reported that a judge in California settled a two year case brought against NextEra Resources by that state and environmental groups. The 1,300 plus annual raptor

deaths (Golden Eagles, hawks, falcon and owls) in the Altamont Pass in the northern part of the state was unacceptable. NextEra got a $2.5 million fine, must replace 2,400 old turbines over the next 4 years. If that does not reduce greatly the bird kills, NextEra must remove even those newer turbines. High bird and bat kill numbers as reported here by our state DNR in 3 Wisconsin wind projects can't be seen as an asset to tourism which is another big Wisconsin industry.

Tom Tanton, engineer and former member of the California State Energy Board for 35 years says, " . . .most of the 'stimulus' cash grants to wind. . .actually ended up overseas. . . Wind energy is not economically competitive and utilities are forced . . .to pass along the higher costs to their customers. . .".

Finally, in a December show on Late Night with David Letterman, his guest reported that Texas billionaire T. Boone Pickens is working to get back $200 million dollars

that he invested in an order for industrial wind turbines. He has shifted away from wind to a focus on natural gas. What does he know about wind energy that you do not?

Thank you for your time.

Sandra Johnson

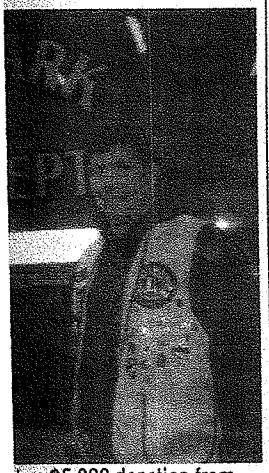
1893 Wayside Rd.

Greenleaf, WI 54126

(920) 532-4725

Emerging Energy built and sold this project. Now it is for sale again.

ns Club 5,000 Volunteer ment



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e 24 inch and the 48 inch
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and straps, also purchased
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her vehicle. This will keep
icle from moving while
s of Life are used during a
ion, to prevent any further
to occupants and lessens
ger of the firefighters per-
the rescue.
IT teams were formally
ed in Brown County a
of years ago, after the
f Green Bay Firefighter
Woulf in a house fire on
Bay's east side. Much
and practice is done on a
asis to participate on the
he Denmark RIT team
ipment is assigned to En-
12 at station one, located
illage of Denmark.. Den-
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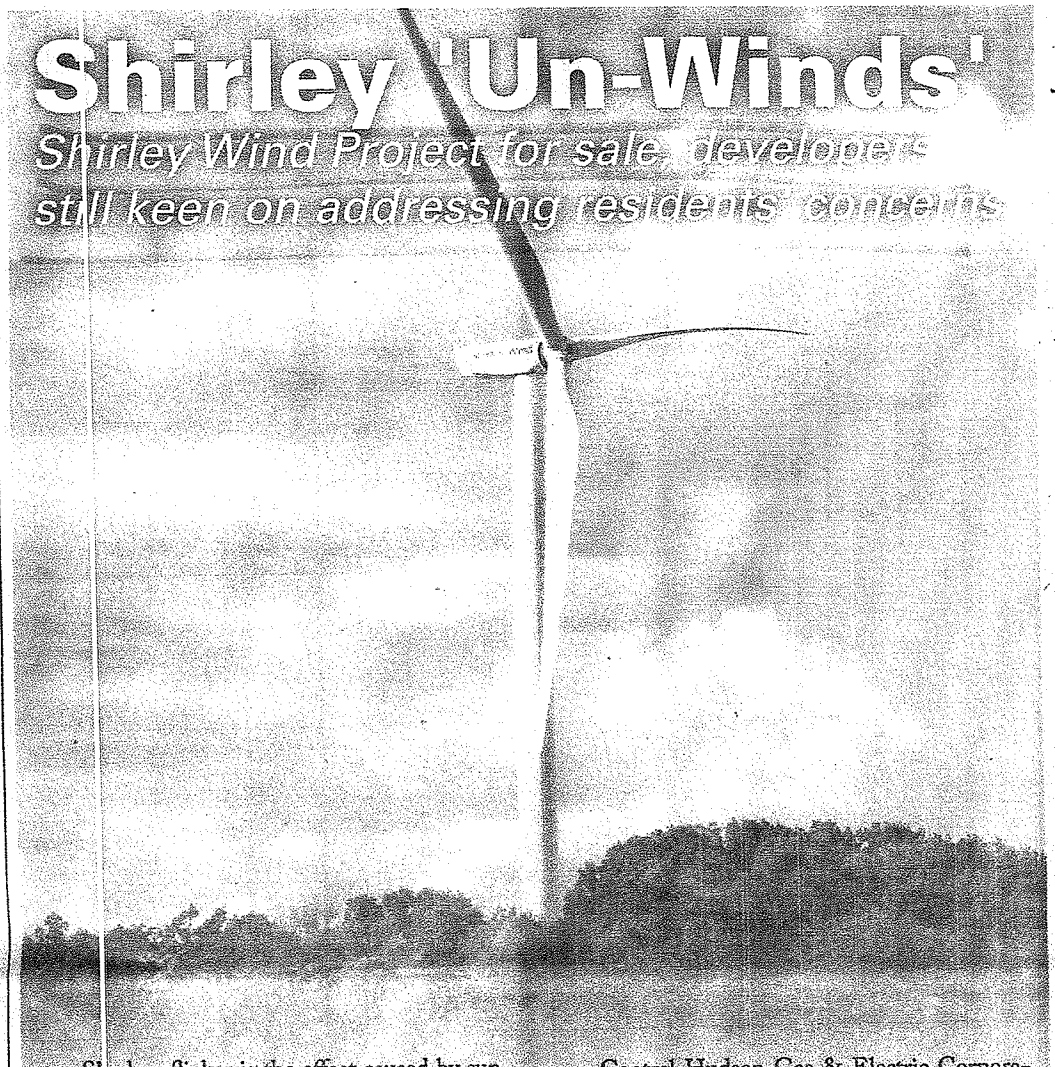
Shirley 'Un-Winds'

Shirley Wind Project for sale, developers still keen on addressing residents concerns



Shadow flicker is the effect caused by sunlight shining through the spinning blades of a wind turbine. This effect is most dramatic when it falls on windows, causing strobe-like lighting conditions. While this effect is typically minimized during the planning phase of a wind project by carefully selecting the locations of turbines, as wind farms move into more heavily populated areas, it becomes nearly impossible to avoid shadow flicker entirely.

Current zoning in the Town of Glenmore, where Shirley Wind LLC is nearing completion of the much debated 20 megaWatt wind farm, limits shadow flicker on residential structures, where it can most bother people, to 20 cumulative hours per year. Upon hearing complaints from one area resident about shadow flicker, Shirley Wind looks to take the high road.

According to sources at the wind farm, the renewable energy developer is investing in software upgrades that can read all of the variables that determine whether or not shadow flicker will fall on residences. John Maserjian of Central Hudson Gas & Electric (CHG&E) which owns roughly 90 percent interest in the facility says, "Shad-

Continued on page 3

Central Hudson Gas & Electric Corporation (CHG&E) of Poughkeepsie, NY, which owns roughly ninety percent of the Shirley Wind Project, has begun the process of selling the 20 megaWatt energy production facility. The project has yet to even be completed, and already the utility is courting buyers, although they say the move has more to do with a shift in corporate strategy versus the pros and cons of the Shirley installation itself.

John Maserjian, CHG&E spokesman for the Shirley Wind project confirms, "That is true. In October our Board of Directors announced a change in strategy for CH Energy Group, and we're looking to refocus the company on our utility operations in New York and also our fuel distribution operations in the Mid-Atlantic area. So we're looking also to 'unwind' our investments in renewable energies including the Shirley Wind investment. We're moving in that direction. We're not at the point where we can announce any prospects or interest, but we're taking the preliminary steps."

CHG&E also has minority investments of about $5 million in two other wind projects, a

Continued on page 3

...the 70 tax change on your ... Lawrence Lacenski

Continued from page 1

ow flicker is something that occurs during certain times of the day, certain times of the year. There's a lot of variables—cloud cover, wind direction, things like that. We anticipate that some residents may be affected for a limited time during limited times of the year. There are several options and ways that we can reduce shadow flicker, and we'll certainly employ those once the wind project testing is finished and we're actually running the wind farm."

Shirley Wind appears to have been prompt and responsive to residents' concerns. While many area residents have voiced concern over the project for various reasons—including property values, health and safety risks, and aesthetic conflicts, many wind advocates cite the Glenmore project as an example of how to do wind projects responsibly. Maserjian notes, "One of the things that interested us (CHG&E)in the Shirley Wind Project from the beginning was that the initial developer had really done an admirable job in laying out the ground work for the project—in involving the property owners and the community at large."

That initial developer, Emerging Energies LLP, says they are very proud of the project, and have plans in the works for additional projects in the state.

Shirley Wind has also received at least one complaint from a resident about the noise produced by the turbines. Shirley Wind officials report they met directly with the affected residents to discuss the issue. Project manager John Roberts says they are working on an adapted baffle for the nacelle, or rear generator housing part of the turbine, to abate some of the noise produced by the motor. Upon final completion of the construction phase of the project, developers will, as required by the town, measure noise levels to determine compliance with current ordinances.

Maserjian explains, "As with any project like this there may be some concerns raised, and of course it's always our goal to address those concerns head-on and to the best of our ability satisfy those citizens. We're going to work with the property owners on a case by case basis to see how we can satisfy them best. Some may have issues that may require us to do something else. We'll take that into consideration as we work with them."

Continued from page 1

7.5-megawatt wind farm located in Atlantic City, NJ and a 24-megawatt facility in Bear Creek, PA. Maserjian says CHG&E is 'unwinding' (a fancy term for selling) all of their investments in renewable, not just the Shirley project. "There's a biomass plant in upstate New York that produces steam and electricity from wood products that's located near a lumbering site that's for sale as well. We also have an interest in an ethanol plant in Nebraska that will be sold," he said.

In a press release dated October 28, 2010, just under two weeks before the quiet ribbon cutting for the Shirley Wind facility, CHG&E Chairman of the Board, President and C.E.O. Steven V. Lant said, "[W]e have concluded that we do not possess the same strong competencies and competitive advantages in renewable energy. These investments do not typically display the risk and return profiles that are consistent with our financial objectives, requiring higher levels of leverage and more volatility than we are comfortable with. As we announced last quarter, we have discontinued development efforts in this area, and we will now begin to unwind the existing investment portfolio in an orderly manner."

The unexpected news will probably excite wind farm critics, who in addition to any number of personal concerns, have called wind turbine development a costly mistake. Many critics of the subsidized fledgling wind industry claim the costs associated with wind energy raise the flag of increased electricity prices as well as irrecoverable tax moneys used to spur development.

Bill Rakocy, one of the founders of project developer Emerging Energies LLP, declined comment on the impending sale, but the move appears somewhat unexpected. Maserjian continues, "It was not our intention to sell the project when we first made the investment, but over the course of the year we reevaluated our strategy and our operations, and decided that it would be in the best interest of our investors to sell, or 'unwind', our renewable energy investments."

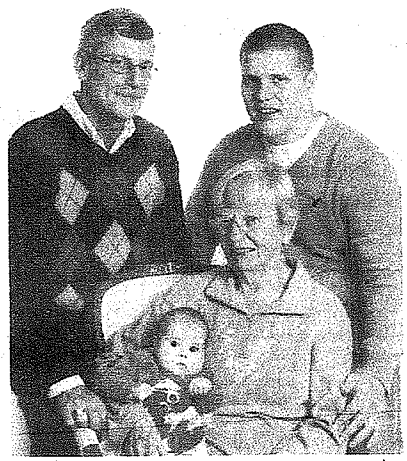
ENGAGEMENT

Jeff and Char Marcell of Schofield announce the engagement of their daughter Tara Ann Marcell to Garrett James Lancelle son of Paul and Nancy Lancelle of Denmark.

Tara graduated ...m D.C. E... ementary Education from St. Norbert College. Tara is currently employed at D.C. Everest School District teaching first grade at Rothschild Elementary School.

Garrett graduated from Denmark High School and earned a Bachelor's degree in Elementary Education from St. Norbert College. Garrett is currently a substitute teacher in the Edgar and D.C. Everest school districts.

.....and Olivia makes four



Four generations that is. The Lancelle ...

...Mollyman jr, Andy Nicholson and Troy Streckenbach, will be present.

In addition to the County

The Denmark Lit

The Denmark Library had a special visitor for story time on Wednesday, January 26. Corduroy the Bear joined the library's little friends for bear stories,

Brown County Ve

Brown County Veterans Services has changed the schedule for the Denmark Out Station Days. Beginning in 2011 Jerry Plolus, Veterans' Service

All Saints

All Saints Catholic Grade School proudly announces their 2nd Quarter Honor Roll.

Grade 8: "High A" Jared Phillips;

"A" Nick Kufalk, Jacolyn Younk & Victoria Younk

"B" Duncyn Neta & Heather Schaefer

Grade 7: "A" Nathan Ciriacks

"B" Colin Kafka, Chad Kropp, Johan Rau, Evan Rys

Our Savior's S

Our Savior's Lutheran Church is once again hosting their Sunday "Soup To Go". Chili and Creamy Chicken &

Altamont wind energy company to pay $2.5 million and replace turbines to reduce raptor deaths

By Denis Cuff
Contra Costa Times
Posted: 12/06/2010 12:11:30 PM PST
Updated: 12/06/2010 05:20:18 PM PST

The largest wind energy producer in the Altamont Pass area of eastern Alameda and Contra Costa counties has agreed to replace 2,400 wind turbines within four years and pay $2.5 million in a legal settlement to reduce deaths of eagles, hawks and other raptors hacked by turbine blades.

The settlement between NextEra Energy Resources, the state, and several environmental groups was announced Monday by the state Attorney General Jerry Brown.

One environmental leader praised the deal as a model for producing wind energy while minimizing the heavy toll the whirling turbine blades take on hundreds of raptors each year.

"We think that is a landmark agreement that balances the need for clean energy with protections for wildlife," said Michael Lynes, conservation director for the Golden Gate Audubon Society. "This is an aggressive schedule for replacing turbines with new ones. It will go a long way toward reducing the kills in the Altamont area."

The settlement resolves a debate about whether the company was making sufficient progress toward a previous legal pledge to reduce bird kills by 50 percent from 2007 to 2010.

"Rather than focus on the 50 percent debate, we agreed to get something in place that uses modern technology to

increase protections for the birds," Lynes said. "This does not resolve all the problems with avian mortalities, but it is a big step forward toward reducing them."

New wind turbines are much larger and produce

much more energy than old ones, reducing the number of blades that birds can fly into.

Under the deal, NextEra agreed to replace 2,400 of its turbines within four years. If it falls behind schedule, the company also pledges to shut down all its existing turbines no later than 2015.

The company also pledged to put the new turbines in environmentally friendly locations. Many turbines installed in the Altamont Pass in the 1970s and 1980s were placed in swales between ridges where golden eagles like to soar while looking for prey, biologists say.

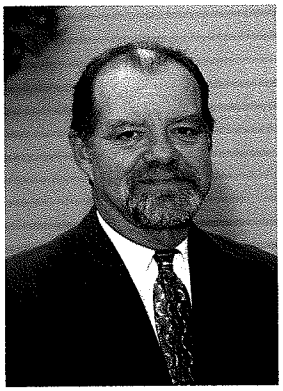
The wind company said it would contribute $1.25 million to the California Energy Commission for research on reducing bird kills at Altamont Pass.

The wind company will give another $1.25 million to the East Bay Regional Park District and the Livermore Area Recreation and Park to improve and protect raptor habitat.

According to an 2004 state study, wind turbines at Altamont Pass kill an estimated 1,766 to 4,271 birds annually, including 880 to 1,330 raptors such as golden eagles, hawks, falcons and owls.

The Altamont Pass is a prime breeding and migratory area for raptors.

Thomas Tanton



Mr. Tanton is President of T ^{2} & Associates, a firm providing consulting services to the energy and technology industries. T ^{2} & Associates are active primarily in the area of renewable energy and interconnected infrastructures, analyzing and providing advice on their impacts on energy prices, environmental quality and regional economic development. Mr. Tanton has 40 years direct and responsible experience in energy technology and legislative interface, having been central to many of the critical legislative changes that enable technology choice and economic development at the state and federal level. Mr. Tanton is a strong proponent of free market environmentalism and consumer choice, and frequently publishes and speaks against alarmist and reactionary policies and government failures.

As the General Manager at EPRI, from 2000 to 2003, Mr. Tanton was responsible for the overall management and direction of collaborative research and development programs in electric generation technologies, integrating technology, market infrastructure, and public policy. From 2003 through 2007, Mr. Tanton was Senior Fellow and Vice President of the Houston based Institute for Energy Research. Mr. Tanton was also a Senior Fellow in Energy Studies with the Pacific Research Institute until 2010.Until 2000, Mr. Tanton was the Principal Policy Advisor with the California Energy Commission (CEC) in Sacramento, California. He began his career there in 1976. He developed and implemented policies and legislation on energy issues of importance to California, and U.S. and International markets, including electric restructuring, gasoline and natural gas supply and pricing, energy facility siting and permitting, environmental issues, power plant siting, technology development, and transportation. Mr. Tanton completed the first assessment of environmental externalities used in regulatory settings. Mr. Tanton held primary responsibility for comparative economic analysis, environmental assessment of new technologies, and the evaluation of alternatives under state and federal environmental law. Mr. Tanton served as Guest Lecturer for the Master in Environmental Science program at California State University Sacramento (CSUS), lecturing on power plant and electric grid technologies and their comparative environmental impacts.

Main Concerns with Wind Energy Development
Tom Tanton 10/6/2010

Wind energy is primarily built for tax purposes
During the past decade, the wind and other renewable energy industries have been incredibly successful in getting federal and state government officials to grant them generous tax breaks and subsidies, including state Renewable Portfolio Standards. The wind industry, which has received nearly $4.5 billion in "stimulus" program cash grants during the past year from the Obama Administration, apparently has plenty of cash to finance its intense lobbying. Most of that money actually ended up overseas. Wind energy is subsidized 20-30 TIMES conventional sources per unit of production. Even so, it is not economically competitive, and utilities that are forced to produce or buy electricity from renewable energy facilities pass along the higher costs to their customers via their monthly bills.

Wind energy does not offset any petroleum or petroleum imports
A persistent myth is that increasing wind- and solar-generated electricity will reduce our dependence on foreign oil and thus boost our energy security. Less than 1% of our electricity is generated using petroleum, so any renewable generation will have no appreciable effect on petroleum demand.

Wind energy can easily INCREASE emissions of greenhouse gasses
As shown in several recent engineering studies the volatility (short term fluctuations in output on the order of minutes due to gusty winds) forces other power plants connected to the grid to operate in "mirroring" mode ramping quickly up and down. Just like your car in stop and go traffic, as opposed to thoroughfare speed, this drastically reduces those plants efficiency, leading to increased fuel consumption and GHG emissions. Only by sophisticated "dispatch" modeling of an individual grid along with wind data can it be determined whether, on net, fuel use and GHG emissions increase or decrease. To date, no wind developer have ever done such a modeling effort subject to peer or regulatory review.

Wind energy is a threat to wildlife and endangered species
Wind resource areas often are coincident with critical habitat and/or migratory flyways. Many of these conflicts are for protected, threatened and endangered species. Wind energy development has long had significant issues with avian and bat mortality, even given the relatively few wind turbines installed to date. More wind turbines will pose greater threats. For example, in California's Altamont Pass area, one of the nation's oldest development area, over 500 Golden Eagles are slaughtered each year. Further, the additional transmission lines necessary to serve wind developments pose special threats as well.

Living too close to wind turbines imposes health and safety risks to the public
The tip speed of modern wind turbines approaches 200 MPH when operating. Ice and blade throw, from the top of a 300 foot tower, while infrequent, poses serious safety risks to the public within about ¾ to a mile. Further, the noise from wind turbines can cause health effects, as documented by Dr. Nina Pierpont and others. Industrial wind turbines produce significant amounts of audible and low-frequency noise. Dr. Oguz A. Soysal, Professor and Chairman of the Dept. of Physics and Engineering at Frostburg State University in Maryland, measured sound levels over half a mile away from the Meyersdale, PA, 20-turbine wind farm. Typical audible (A-weighted) dB (decibel) levels were in the 50-60 range, and audible plus low-frequency (C-weighted) dB were in the 65-70 range. 65-70 dB is the loudness of a washing machine, vacuum

cleaner, or hair dryer. A difference of 10 dB between A and C weighting represents a significant amount of low-frequency sound by World Health Organization standards. The noise produced by wind turbines has a thumping, pulsing character, especially at night, when it is more audible. The noise is louder at night because of the contrast between the still, cool air at ground level and the steady stream of wind at the level of the turbine hubs. This nighttime noise travels a long distance. It has been documented to be disturbing to residents 1.2 miles away from wind turbines in regular rolling terrain, and 1.5 miles away in Appalachian valleys. At night, the World Health Organization (WHO) recommends, the level of continuous noise at the outside a dwelling should be 45 dB or less, and inside, 30 dB or less. These thresholds should be even lower if there is a significant low-frequency component to the sound, – as there is for wind turbines. Higher levels of noise disturb sleep and produce a host of effects on health, well-being, and productivity. Effects of noise-induced sleep disturbance include fatigue, depressed mood or well-being, decreased performance, and increased use of sedatives or sleeping pills. Measured physiologic effects of noise during sleep are increased blood pressure and heart rate, changes in breathing pattern, and cardiac arrhythmias.

The decibel is logarithmic. Increasing the dB level by 10 multiplies the sound pressure level by 10. Increasing the dB level by 20 multiplies the sound pressure level by 100 (and 30 dB multiplies by 1000, etc.). Thus the 65 dB measured day and night half a mile from the Meyersdale wind farm, for example, has a measured intensity 100 times greater than the loudest continuous outdoor nighttime noise (45 dB) recommended by the WHO.

Savage, Bill

From: BOB & KEVIN GEHRING [jordanelectric@nconnect.net]
Sent: Wednesday, February 09, 2011 10:02 AM
To: Rep.Pridemore
Subject: PSC 128 Hearing

February 9, 2011

State Representative Don Pridemore
Madison WI

Re: Public Hearing PSC 128 (CR-057)

Please present the following at the referenced hearing relating to siting of wind energy systems. I will be unable to attend the hearing.

I have lived in the Town of Herman southeast Dodge County for the past 19 years on my 150-acre farm. My family and I have lived within the Butler Ridge Wind Energy system for the past two years it has been operational. There are six 410' turbines within 2000 feet of our home.

We have been subjected to a never-ending assault on our quality of life. We are subjected to noise from the operation of the 1.5-mw gearbox GE turbines and blade noise.
The continual whine of the 2000 horsepower equivalent motor perched 200 feet in the air is unavoidable. Only the proper setbacks from dwelling spaces would eliminate this continual scourge. The existing setbacks do not provide adequate protection from this noise, the proposed rule change would.

We are subjected to shadow flicker from the rotating blades. It is just like placing a ceiling fan under a light bulb. Increasing the required setback distances would eliminate this problem.

The current setbacks were not scientifically developed but were advanced as a workable model by the wind turbine industry to get the projects built. I would not mind sacrificing if the wind energy system would provide a common benefit for the people. Wind energy does nothing to lessen our dependence on reliable, dispatchable electricity. It cannot be stored and creates a redundant expensive unreliable electric distribution system. The taxpayers and ratepayers have been forced to pay for an antiquated, unreliable form of energy, which was abandoned 80 years ago. Wind has not changed since.

The current setback is inadequate and does not protect my rights as a property owner.

Sincerely,

Kevin Gehring
W2017 Illinois Road
Iron Ridge, WI 53035

5

BENTEK Energy LLC

How Less Became More: Wind, Power and Unintended Consequences in the Colorado Energy Market

BENTEK Energy, LLC

Executive Summary

Study Objectives:

- To improve understanding of the electricity markets in Colorado and the Intermountain West
- To understand how wind, coal, and natural gas interact and what that interaction means for future natural gas use in electricity generation
- To help generate productive and informed discussions on how our nation will meet its future energy needs through the integration of various energy resources

Key Findings:

- State renewable portfolio standards (RPS) mandate that wind energy be considered a "must take" resource. As such, when wind blows, generation from coal and natural gas must be adjusted to accommodate wind generation. This adjustment, called cycling, is defined as the sudden increase or decrease in generation.
- Most coal plants are not designed to be cycled, and doing so makes their operations inefficient, increasing SO_2, NO_x and CO_2 emissions.
- Contrary to their stated goals, implementation of RPS in Colorado and Texas appear to be adding to the air pollution problem, especially in areas where older plants are cycled more frequently. This is particularly problematic when cycled coal facilities are located near major urban centers.
- Emissions issues related to cycling can be minimized by careful design of the generation mix. Inadequate flexible resources, such as that provided by natural gas, exacerbate the need to cycle coal, resulting in increased emissions. Alternatively, incorporating adequate flexible fuel capacity facilitates the goals of RPS without increasing emissions.

Summary

In 2004, Colorado became the 17th state to adopt renewable energy standards when voters passed Amendment 37. Colorado reaffirmed its commitment to wind and solar energy in 2007 when the Legislature passed HB 1281, increasing the requirement for utilities to purchase renewable energy

by 100%. Colorado also approved the *Climate Action Plan*, which relies on renewable energy to play a central role in the state's strategy of reducing "greenhouse gas emissions by 20% below 2005 levels by 2020"[1].

Policymakers' stated hope was that renewable energy would not only be a major tool to reduce carbon emissions, but also, by displacing conventional fuels, would reduce smog and other air pollution, presumably by reducing sulfur dioxide (SO_2) and nitrous oxides (NO_X), the principal components of ozone and smog.

This report, which examines four years of Public Service Company of Colorado (PSCO) hourly operational history, illustrates how coal cycling, which in part results from wind generation, negates the emission benefits of wind energy. Integrating an intermittent, must take resource, such as wind energy, requires PSCO to cycle its coal and natural gas-fired plants[2]. The incidents of coal cycling have risen markedly with the introduction of 775 MW of wind capacity since 2007.

Coal-fired power plants are designed to run most efficiently at stable rates and are not well-suited to accommodate the load variability imposed by the integration with wind generation. Cycling causes coal-fired power plants to operate less efficiently, and reduces the effectiveness of their environmental control equipment, which together drive up emissions. Paradoxically, using wind energy in such a way that it forces utilities to cycle their coal generation often results in greater SO_2, NO_X and CO_2 emissions than would have occurred if less wind energy were generated and coal generation was not cycled.

An analysis of the Electric Reliability Council of Texas (ERCOT), which also operates under a RPS mandate to utilize wind energy, validates the emissions findings for PSCO. The underlying problem is the same for both PSCO and ERCOT: wind generation frequently cannot be accommodated without forcing coal-fired units to cycle.

Whereas natural gas-fired combustion turbines and combined-cycle facilities are designed to accommodate cycling, coal equipment is not. Coal boilers are designed to be operated as a base load resource – in other words, to operate at a consistent output level all the time. Because gas resources are not fully utilized to offset wind energy produced in PSCO and ERCOT, coal units are being cycled. Emission levels are increasing, not decreasing, at PSCO and ERCOT coal units because the units are being cycled to compensate for wind generation.

The results of this study help explain why PSCO's coal-fired plants located in the Denver non-attainment area have experienced an increase in SO_2, NO_X and CO_2 over the past few years. Four of the five most frequently cycled coal plants are located in proximity to Denver. The results also suggest that this problem will worsen over time unless more gas generation is utilized to absorb wind generation variability.

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[1] "Colorado Climate Action Plan: A Strategy To Address Global Warming", November, 2007. P10. http://www.colorado.gov/energy/in/uploaded_pdf/ColoradoClimateActionPlan_001.pdf

[2] As used in this report the term cycling refers to sudden increases or decreases in power generation output. Cycling occurs for a variety of reasons including making way for alternative generation, maintenance and/or equipment failure or sudden changes in load size.

There are national implications as well. Congress and the Obama Administration are considering a national RPS. Before such a national standard is implemented, there is a compelling need to better understand how intermittent sources of energy such as wind can be integrated with existing nuclear, coal and natural gas capacity without producing cycling-induced emissions problems.

Conclusions:

- The use of wind energy by PSCO has resulted in increased levels of SO_2, NO_X and CO_2 from coal plants in the non-attainment area. Wind-induced coal cycling in ERCOT has resulted in increased SO_2 and NO_X, with only minimal savings of CO_2.
- The mechanism driving increased emissions is the need to cycle coal facilities in order to accommodate wind generation, which is considered a "must take" resource due to the RPS mandates.
- When coal plants are cycled, the heat rate rises, resulting in higher emissions of SO2, NO_X and CO_2 than would have been the case if the units had not been cycled. This problem can persist for up to 24 hours after cycling the facility, increasing emissions even further.

Recommendations:

Effective wind energy requires sufficient flexible natural gas generation in order to avoid cycling coal facilities. Enacting RPS's that require more than 5-10% of wind energy for electricity generation will significantly add to emissions unless more flexible natural gas generation is utilized. The report recommends:

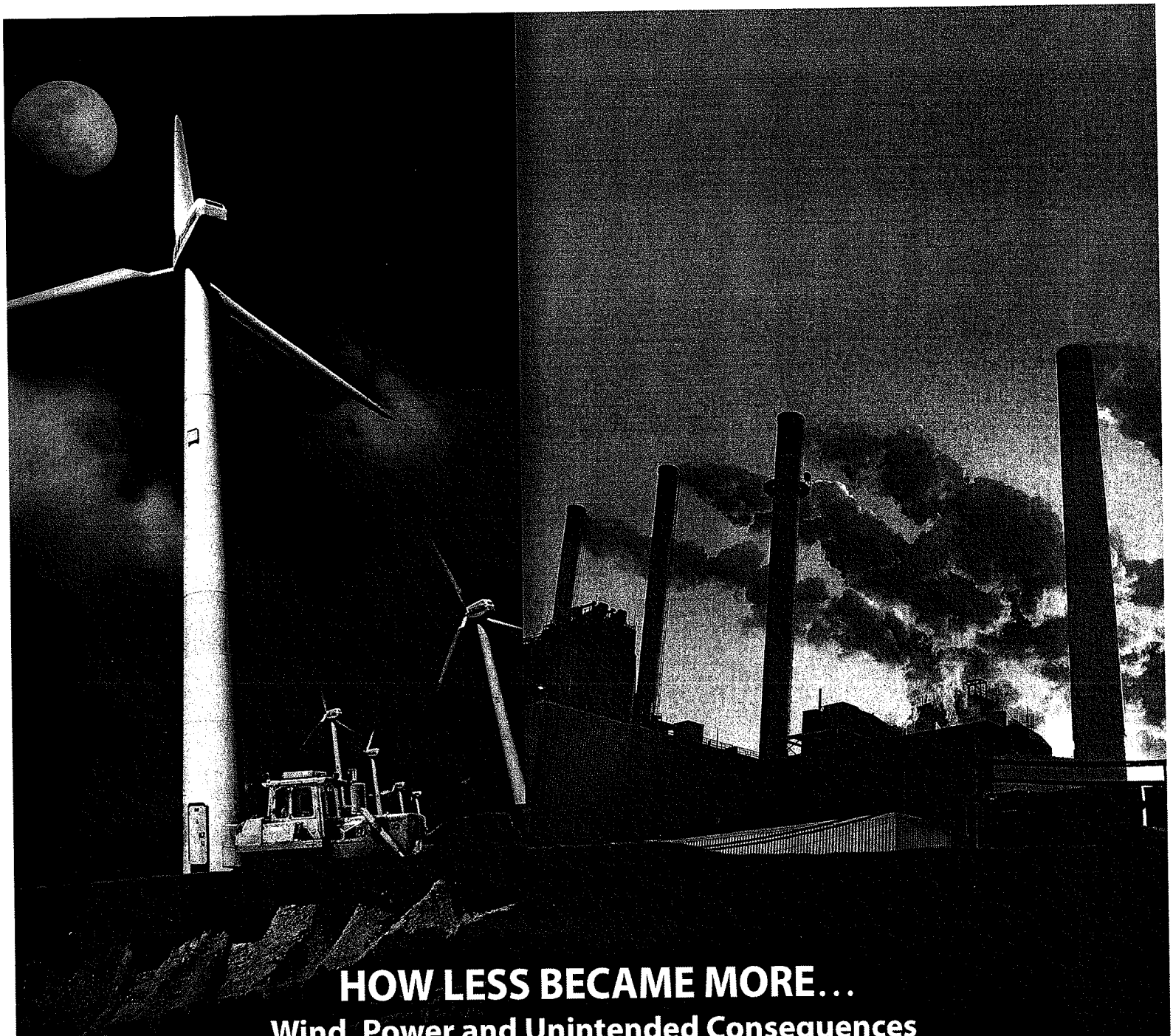
1. **Short term. (1-2 years)**
   Limit the utilization of wind generation to that which can be offset by cycling existing natural gas facilities.

2. **Long term (Beyond 2012)**
   Utilities operating under RPS should consider adding significantly more combined cycle and combustion turbine gas plants to their generation mix. Adding more natural gas plants will reduce the need to cycle coal facilities in all but the most extreme situations.

This report was prepared for the Independent Petroleum Association of Mountain States (IPAMS).

About BENTEK Energy, LLC

BENTEK Energy, LLC, is the leading energy markets information company. Based in Evergreen, Colorado, BENTEK brings customers the analytical tools and competitive intelligence needed to make time-critical, bottom-line decisions in today's natural gas and power markets. Additional information about BENTEK Energy is available on the Web at www.bentekenergy.com.



HOW LESS BECAME MORE...

Wind, Power and Unintended Consequences in the Colorado Energy Market

Wind energy promises a clean, renewable resource that uses no fossil fuel and generates zero emissions. Careful examination of the data suggests that the numbers do not add up as expected.

The "must take" provisions of Colorado's Renewable Portfolio Standard require that other sources of generation, such as coal plants, must be "cycled" to accommodate wind power. This cycling makes coal generating units operate much less efficiently... so inefficiently, that these units produce significantly greater emissions.

This study reviews the data that supports this conclusion, outlines mitigation measures which can be used to realize the full potential of wind generation, and provides recommendations for policy makers.

April 16, 2010

BENTEK Energy LLC

 www.bentekenergy.com

BENTEK Energy LLC

How Less Became More: Wind, Power and Unintended Consequences in the Colorado Energy Market

Prepared for

Independent Petroleum Association of Mountain States

April 16, 2010

About BENTEK Energy, LLC

BENTEK Energy, LLC, is the leading energy markets information company. Based in Evergreen, Colorado, BENTEK brings customers the analytical tools and competitive intelligence needed to make time-critical, bottom-line decisions in today's natural gas and power markets. Additional information about BENTEK Energy is available on the Web at www.bentekenergy.com. Questions? Contact BENTEK Energy at 303-988-1320.

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I.
Introduction

Sometimes things are not what they seem. Nowhere is this more evident than in the realm of state and federal energy policies. In 2004, Colorado became the 17th state to adopt renewable energy standards when voters passed Amendment 37. Colorado reaffirmed its commitment to wind and solar energy in 2007 when the state legislature passed HB 1281, increasing the requirement for utilities to purchase renewable energy by 100%, and by adopting the Climate Action Plan in which renewable energy plays a central role in the state's strategy of reducing "greenhouse gas emissions by 20% below 2005 levels by 2020."[1] The expected environmental benefit of these measures is perhaps best summarized in this quote from Environment Colorado:

> "Smog and air pollution continue to plague much of Colorado and part of the problem is caused by coal-fired power plants. Requiring a modest 10 percent of our electricity to come from renewable energy sources is equivalent to eliminating the pollution from 600,000 cars per year, thereby reducing smog and easing costly health problems."[2]

According to advocates, renewable energy will not only be a major tool to reduce our carbon output, but also, by displacing coal and natural gas, renewable energy will reduce smog and other air pollution, presumably by reducing sulfur dioxide (SO_2) and nitrous oxides (NO_X), principal components of ozone and smog.

This report, sponsored by the Independent Producers Association of Mountain States, concludes that the emissions benefits of renewable energy are not being realized as planned based on examination of four years of Public Service Company of Colorado (PSCO) operational history. Integrating erratic and unpredictable wind resources with established coal and natural gas generation resources requires PSCO to cycle its coal and natural gas-fired plants.[3] Cycling coal plants to accommodate wind generation makes the plants operate inefficiently, which drives up emissions. Moreover, when they are not operated consistently at their designed temperatures, the variability causes problems with the way they interact with their associated emission control technologies, frequently causing erratic emission behavior that can last for several hours before control is regained. Ironically, using wind to a degree that forces utilities to temporarily reduce their coal generation results in greater SO_2, NO_X and CO_2 than would have occurred if less wind energy were generated and coal generation were not impacted.

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[1] Colorado Climate Action Plan http://www.coloradoclimate.org/

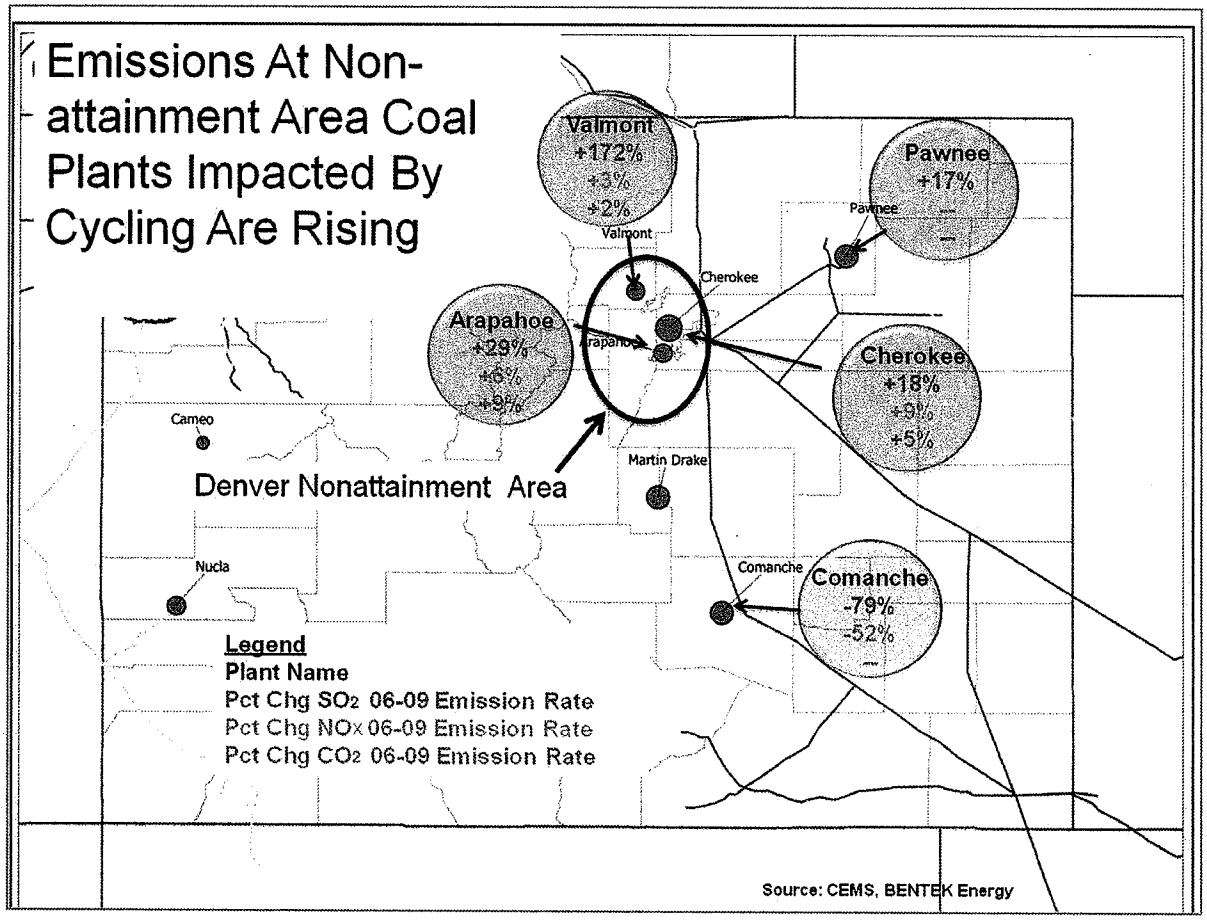
[2] Environment Colorado website, http://environmentcolorado.org/envcoenergy.asp?id2=22373

[3] As used in this report, the term cycling refers to sudden increases or decreases in power generation output. Cycling occurs for a variety of reasons including making way for alternative generation, maintenance and/or equipment failure or sudden changes in load size.

An analysis of the Electric Reliability Council of Texas (ERCOT), which also operates under a mandate to use renewable energy, validates the emissions findings for PSCO. The underlying problem is the same for both PSCO and ERCOT: the generation capacity of wind resources has become too large relative to the capacity that is available from coal and natural gas facilities. Natural gas-fired combustion turbines and combined-cycle facilities are designed to accommodate cycling. Because gas resources are insufficient to offset all of the wind energy produced in PSCO and ERCOT, coal units must be cycled to counterbalance the amount of wind that cannot be offset by natural gas. As a result, when the wind energy is generated at a high enough rate, PSCO is forced to scale-back generation from its coal-fired resources. But, coal equipment is not built for cycling. Coal boilers are designed to be operated as a base load resource – in other words, to operate at a consistent output level all the time. Cycling causes coal units to operate less efficiently and reduces the effectiveness of the environmental control equipment, substantially increasing emissions.

The results of this study help explain why PSCO's coal-fired plants located in the Denver non-attainment area have experienced an increase in SO_2, NO_X and CO_2 over the past few years. Figure I-1 below shows the change in emissions generated at the plants in proximity to the Denver non-attainment area – Valmont, Arapahoe, Cherokee and Pawnee, and the Comanche plant located outside of Pueblo. Between 2006 and 2009 despite the introduction of over 700 MW of wind energy, all of the Denver area plants except Cherokee show higher levels of SO_2, all show higher levels of NO_X and all but Pawnee show higher levels of CO_2. The Cherokee plant switched to a lower sulfur coal in 2008, thus, even the lower SO_2 readings at that plant cannot be attributed to the benefits of wind energy. Furthermore, during the 2006-to-2009 period, generation from the non-attainment area plants fell by over 37%, which makes the increase in emissions even more significant particularly in light of the EPA's announced intent to mandate tighter restrictions on SO_2 and NO_X emission levels by 2011.

Figure I-1
Denver Non-attainment Area Plants Have Experienced Higher Emissions Since 2006



The results also suggest that the problem will worsen over time unless mitigation measures are taken. The emission issues documented in this report are evident because PSCO has approximately 1,100 MW of wind capacity. Under the existing Renewable Portfolio Standard (RPS) and the current Integrated Resource Plan (IRP), wind capacity is anticipated to grow by a minimum of 100 MW annually through 2020. Moreover, the Colorado state legislature recently increased the RPS to 30% of sales by 2020, which will force PSCO to add even more wind capacity to its system. Unless the additional wind capacity is coupled with significantly more gas capacity, a reduction in coal capacity, or a combination of the two, the higher RPS will drive SO_2 and NO_X and possibly CO_2 emissions higher, further exacerbating the ozone non-attainment area problems for the Front Range of Colorado.

There are national implications as well. Congress and the Obama administration are considering a national RPS. Before such a national standard is implemented, there is a compelling need to better understand where intermittent sources of energy such as wind can be integrated with existing nuclear, coal and natural gas capacity without producing cycling-induced emissions problems. The study's findings relative to ERCOT in this respect are not

encouraging. ERCOT, which has one of the nation's largest natural gas-fired generation bases, acquires only about 23% of its energy from natural gas between the hours of 12:00 am and 8:00 am. Consequently, when wind comes online in ERCOT during the early morning hours, coal plants are forced to cycle. As cycling of coal plants is problematic in ERCOT, it is very likely that emissions will increase virtually everywhere else unless natural gas-fired generation is added simultaneously with wind.

Report Organization

This report is organized as follows:

- Chapter II provides an overview of PSCO's generation capacity and utilization, basic data and analysis describing the various utilities and fuel sources that generate power in the state.
- Chapter III describes why coal plants are cycled, and what happens as a result.
- Chapter IV examines two specific "wind events," quantifying the emissions and the implications of each, as well as how PSCO handled these events.
- Chapter V estimates the total incremental emissions that occurred as a result of using wind energy in the PSCO territory for 2008 and 2009.
- Chapter VI describes the interaction between wind, coal and natural gas in ERCOT, showing how the same dynamics evident in PSCO's territory have emerged as the magnitude of wind generation has grown.
- Chapter VII examines the emissions implications of one possible mitigation measure: retiring Cherokee and Valmont coal fired plants and replace their generation with power produced from either the existing or new gas-fired facilities.
- Chapter VIII draws conclusions and suggests several recommendations regarding mitigation measures that might be implemented to improve the impact of wind on the PSCO system.

Data Sources

This report is built on a variety of publicly available primary and secondary data sources. The general descriptive information generally comes from basic Energy Information Administration databases including Forms 860, 861 and 423; the Federal Energy Regulatory Commission Form 1; PSCO documents, including their annual 10K financial report, and other reports available on the PSCO public website.

The core of the analysis is based on detailed primary information reported to the Federal Energy Regulatory Commission (FERC) and the U.S. Environmental Protection Agency (EPA)

by PSCO. FERC Form 714 data provides hourly load generation for operational control areas such as that of PSCO. Additionally, the Continuous Emissions Monitoring System (CEMS) of the EPA is the source of boiler-specific hourly generation and emissions data. This information is relied on heavily for the analysis of the July 2, 2008, and Sept. 28-29, 2008, wind events discussed in Chapter IV. Finally, ERCOT requires generators to publish on a 15-minute basis their generation by fuel and type of facility, enabling analysis of the interaction between wind, coal and natural gas combustion turbines and combined-cycle facilities in the ERCOT region. These data provide the analytical basis for the analysis of ERCOT operations in Chapter VI.

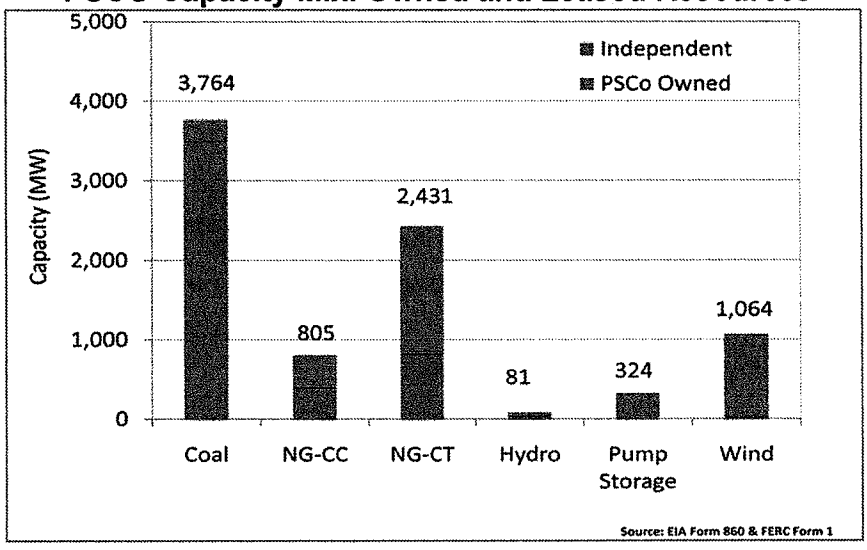
II.
Wind Energy and PSCO

PSCO is the dominant electric utility in Colorado. Owned by Xcel, the fourth largest electric utility holding company in the U.S., PSCO provides electricity service to approximately 1.4 million customers solely in the state of Colorado. Based on total sales, PSCO ranks 33rd in the U.S., and 25th in customer count.[4] While PSCO is less than 30% the size of some of the nation's largest utilities, it is one of the largest sellers of wind power. Its parent company, Xcel, is the largest provider of wind energy in the nation according to the American Wind Energy Association, and PSCO accounts for nearly one-third of Xcel's wind energy resource. This chapter describes PSCO's generation mix, load and key aspects of the regulatory context in which it operates in order to introduce many of the terms and factors that will become important to the discussion of the interaction between wind, coal and natural gas generation in subsequent chapters.

PSCO's Generation Mix

Today, PSCO is primarily a coal-fired utility. Figure II-1 depicts PSCO's current generation mix. Approximately 60% of PSCO's generation resources are PSCO-owned with the balance owned by a variety of third parties. Coal accounts for 44% of the total resource base, and PSCO owns virtually all of the coal-fired capacity. By contrast, PSCO owns 37% of its natural gas resources and only 2% of its wind resource.

Figure II-1
PSCO Capacity Mix: Owned and Leased Resources

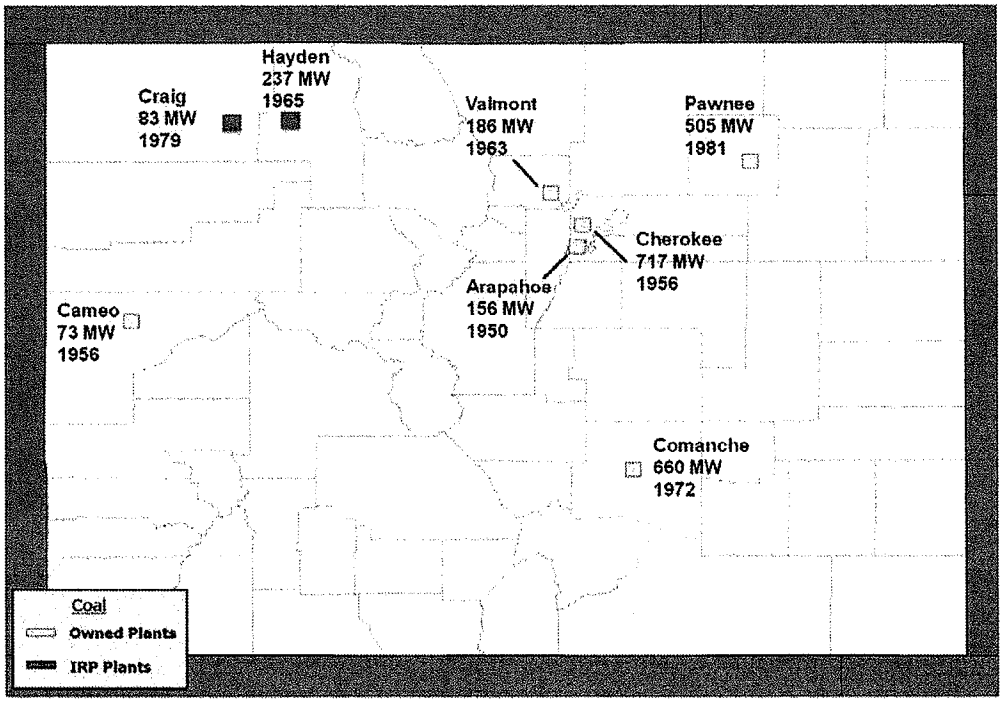


PSCO's coal resources are located on the western slope and along the Front Range. Figure II-2 shows the location size and age of PSCO's coal resources. The Comanche Unit Number

[4] EIA Form 861, 2007.

3 is coming into service in 2010, but all of the remaining coal-fired facilities were built prior to 1981. Arapahoe, Cameo and units of the Cherokee plant were built prior to 1960.

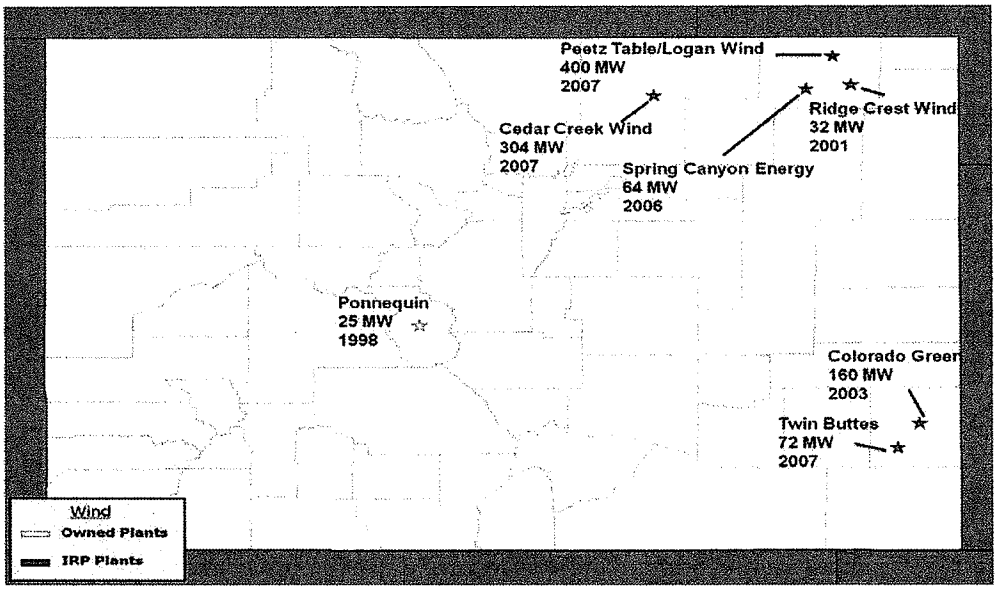
Figure II-2
PSCO's Coal-Fired Generation Resources: Location, Size and Age



The Ponnequin facility in Weld County was PSCO's first wind facility and remains its only company-owned wind farm. The Ponnequin facility consists of 29 units, totals 32 MW and came into service between 1999 and 2001. The remaining 1,032 MW of wind resource is comprised of five wind facilities, having capacities between 60 and 400 MW. Of the 1,032 MW total, 950 MW has come online since 2007. Figure II-3 shows the location, size and ownership of the wind facilities from which PSCO obtains power. [5]

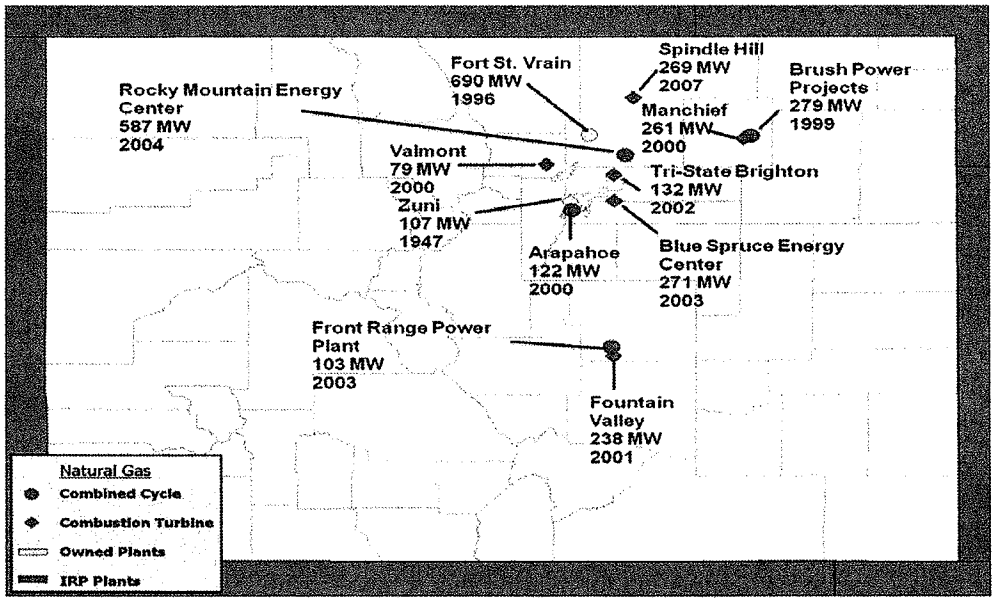
[5] American Wind Energy Association web-site, February 2010.

Figure II-3
PSCO's Wind Facilities: Location, Size and Age



Natural gas is a relatively new energy source for PSCO. The Zuni plant in Denver is the oldest plant on the system, burns natural gas and oil and is seldom used. The Fort St. Vrain plant, which is located near Platteville, CO, has six combustion-turbine units. Two of the six units, which have an aggregate capacity of 260 MW, came online in 2009.

Figure II-4
Natural Gas Generated Resources



PSCO obtains natural gas generated resources from several non-affiliated companies, which are also identified in Figure II-4. Combined-cycle plants account for 35% of the total gas-fired additions with the balance being combustion turbines. Combustion turbines operate with a heat rate of about 10,000 MMBtu/MW, and emit approximately 0.159 lbs of NO_X per MW. In contrast, combined-cycle plants operate at a heat rate of approximately 7,000 MMBtu/MW and have NO_X emissions of approximately 0.105 lbs per MW.[6] Because of the heat rate advantage associated with combined-cycle units, they are approximately 30% less costly to use than are combustion turbines. On the other hand, combustion turbines are designed to follow load and can be used to quickly offset unexpected outages.

While Colorado's Renewable Portfolio Standard (RPS) will be described more fully in a subsequent section, its impact on the PSCO generation stack (portfolio of energy producing resources) is clear. Between 2005, the year after the first RPS standard was approved with Amendment 37, and 2010, PSCO has added about 2,000 MW of electric generation capacity. Of that total, 40% has been in the form of wind, 23% (500 MW) coal and 36% natural gas combustion turbines.

PSCO's current Integrated Resource Plan (IRP), which the Public Utility Commission (PUC) approved in 2007, calls for further changes in the resource stack composition. By 2020 under the approved plan, 29% of the resource mix will be coal-fired, 44% natural-gas-fired, 21% wind, and the balance other renewables such as solar and biomass. These percentages include approximately 150 MW of integrated-gas, combined-cycle generation (IGCC) in 2016, a 480-MW combined-cycle plant at the Arapahoe location in 2013, and 2,148 MW in the form of one combined-cycle and 13 combustion turbines beginning in 2013. All together, the IRP calls for PSCO to add 5,764 MW of new capacity between 2011 and 2020. Between 2007 and 2015, the plan calls for the addition of approximately 2,500 MW of new capacity, of which 1,000 MW will be wind.

PSCO Demand

PSCO demand peaks during the summer. Total sales numbers for 2009 are not yet available. In 2008, average day hourly sales were approximately 4,113 MW, peak day demand was 6,757 MW. Figure II-5 shows average and peak day trends since 2006 as published in PSCO Annual Reports.[7] Average hourly demand has fallen by a rate of 3% since peaking in 2005. Peak day demand has fluctuated between 2005 and 2008. While 2008 was lower than 2007, it was still well above 2006. This fluctuation is due to the variability of summer temperatures.

[6] Page 2-259, 2-262 2007 CRP PSCo

[7] Public Service Company of Colorado, Form 10K for the fiscal year ended Dec. 31, 2008, pages 7 and 12.

Figure II-5
Average Daily Demand Is Falling At A 3% Average Annual Rate

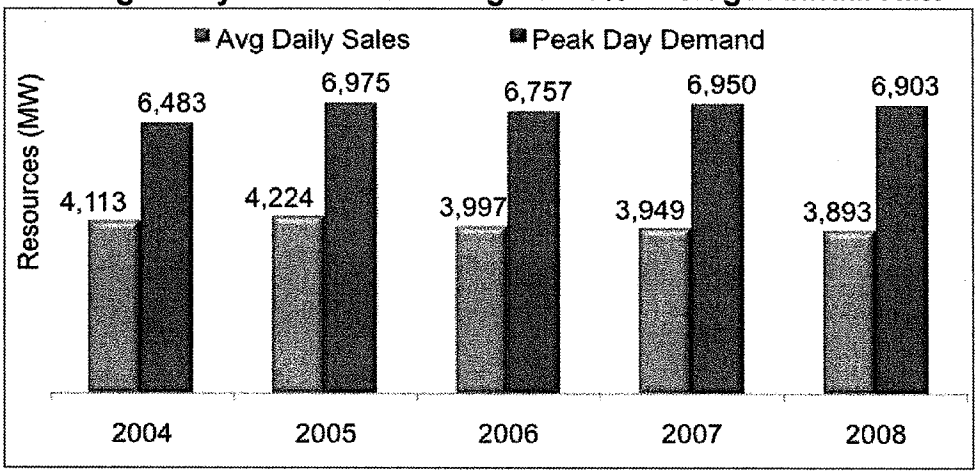
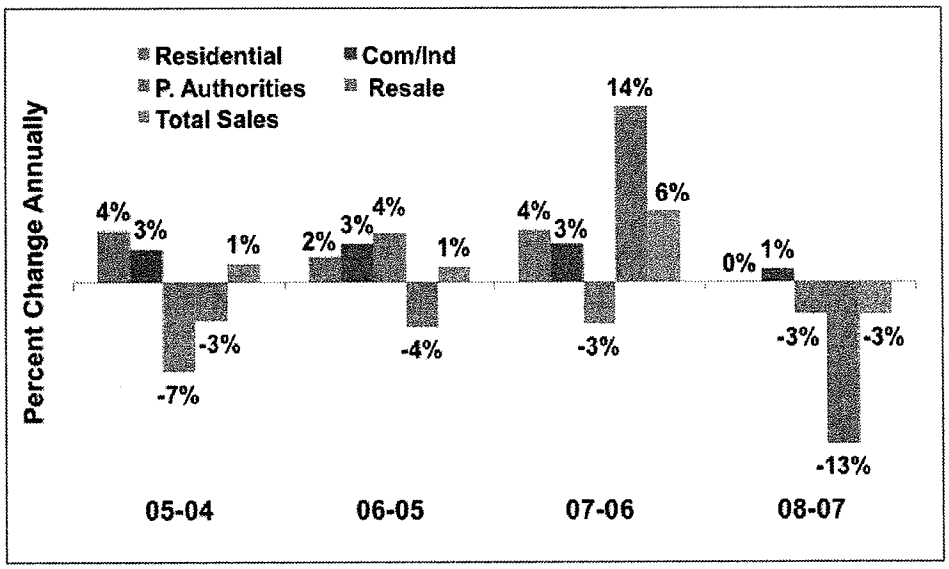


Figure II-6 details PSCO's sales. While total sales were off about 3% in 2008, the figure shows that most of the variation stems from the fluctuating sales for resale component. Sales for resale rose by 14% in 2007, and then fell by 13% in 2008 accounting for most of the 2008 total decline. PSCO's base – residential and commercial/industrial sales – both declined slightly in 2008 after growing annually between 2004 and 2007. Given the slowness of the 2009 economy and the efforts made to increase conservation, it is likely that total demand and demand from the residential, commercial and industrial customers continued to drop in 2009.

The 2007 PSCO IRP anticipates a 1.4% total annual load increase between 2009 and 2015, even accounting for declines in 2010 and 2012 due to expiring resale contracts. The average day energy requirement is projected to grow by 570 MW or 71 MW per year between 2007 and 2015, while peak day demand is projected to grow by 327 MW or 41 MW per year under the base case. Under the high case outlined in the IRP, peak day demand would increase by 610 MW between 2007 and 2015.

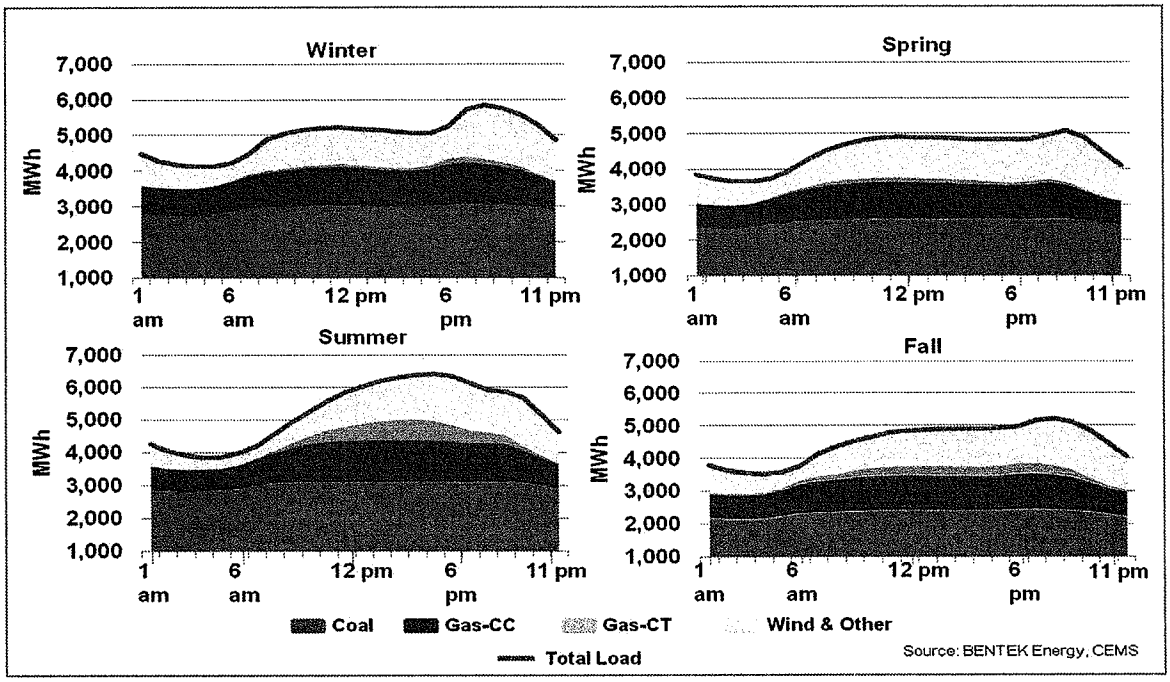
Figure II-6
Percent Annual Change in Sales (2004-08)



The graphs in Figure II-7 below describe PSCO's load profile across seasons based on hourly data reported to FERC. While there are differences, particularly in the timing and magnitude of the peak demand, the profiles are relatively consistent across the four seasons. Lowest hourly loads tend to occur between 10:00 pm and 6:00 am. Highest load levels are evident between about 2:00 and 9:00 pm. During the summer, the peaks are more pronounced and last for a longer period, reflecting air-conditioning demand. The added load, which is quite variable, requires significantly greater operation of PSCO's combustion turbines.

Figure II-7 also shows an average day's 24-hour generation stack for each season in 2008. The grey area depicts generation from coal-fired facilities, dark blue from combined-cycle, natural gas units and the light blue area depicts generation from natural-gas-fired combustion turbines. The light green area signifies generation from wind, hydro, pumped storage, other non-fossil fuel sources or off-system purchases. Regardless of season between 12:00 am and 8:00 am, coal fuels between 58% and 67% of total resource needs. Combined-cycle, gas-fired plants account for between 18% and 21%, while wind, hydro, pumped storage and off-system purchases account for the balance.

Figure II-7
Average Day Load Curve and Generation Mix



Accordingly, generation sources have different utilization rates. Table II-1 captures the utilization of each plant for each type of facility. As Figure II-7 suggests, coal facilities typically have utilization rates around 80% because they are run for base load generation. Utilization rates at gas-fired combined cycle facilities average about 60% due to their role as intermediate, load following generation. Combustion turbine units are only used during the day to meet the variable nature of net load. These units have utilization rates in the 20% range.

Table II-1
Utilization Rates by Plant

	Capacity	2007	2008	2009
Coal: Steam Turbine				
Arapahoe	156	79%	70%	63%
Cameo	73	43%	45%	43%
Cherokee	717	83%	79%	56%
Comanche	660	85%	83%	90%
Craig	83	49%	49%	47%
Hayden	237	98%	97%	87%
Pawnee	505	91%	85%	51%
Valmont	186	86%	77%	72%
Gas: Combined Cycle				
Fort St. Vrain	690	69%	75%	63%
Arapahoe	122	27%	26%	31%
Rocky Mtn. Energy Center	587	56%	51%	55%
Front Range Power	103	82%	58%	52%
Gas: Combustion Turbine				
Spindle Hill	269	22%	9%	41%
Manchief	261	N/A	9%	19%
Tri-State Brighton	132	21%	5%	10%
Blue Spruce Energy Center	271	21%	17%	19%
Valmont	79	3%	1%	1%
Zuni	107	1%	0%	0%
Fountain Valley	238	23%	19%	21%
Brush Power Projects	279	N/A	1%	3%

Regulatory mandates play a major role in determining what resources PSCO can draw on to meet demand requirements. The state RPS has the most direct influence on the stack structure, but the EPA's State Implementation Plan (SIP), which sets goals for SO_2 and NO_X emissions among other things, is also significant.

The state RPS originated as a result of the passage of Amendment 37 in the general election. This amendment mandated that the state's largest utilities, including PSCO, obtain 3% of their electricity from renewable resources by 2007 and 10% by 2015. Solar energy was required to meet 4% of the renewable set aside. As will be discussed in subsequent chapters, the requirements of the SIP and RPS are not aligned.

The requirements of Amendment 37 were changed in 2007. HB07-1281, which passed the Colorado legislature in 2007, increased the RPS mandate. Under HB07-1281, Colorado utilities must employ renewable technology to meet various portions of their energy sales as outlined below:

2007	3% of total retail electric sales
2008-10	5% of total retail electric sales
2011-14	10% of total retail electric sales
2015-19	15% of total retail electric sales
Beyond 2020	20% of total retail electric sales

While PSCO is charged with meeting this requirement, the bill also mandates that the "maximum retail rate impact" be 2% of the total electric bill annually for each customer."

In March 2010, the legislation passed and the Governor signed into law a new RPS. Under the new RPS, the Colorado legislature increased the above mandate to 30% of sales. At the time of this report, passage of the new compliance schedule will be:

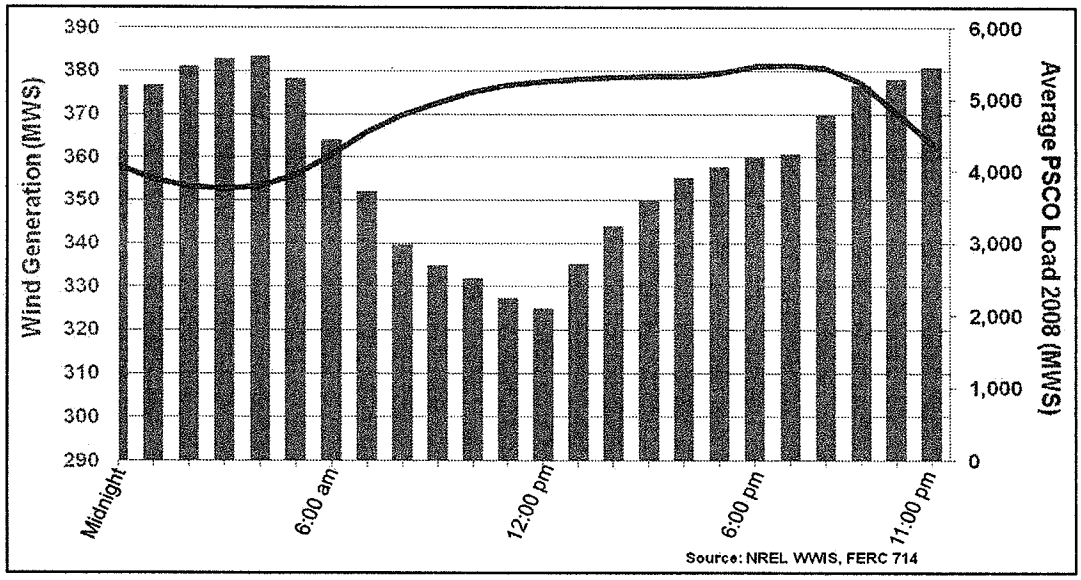
2007	3% of total retail electric sales
2008-10	5% of total retail electric sales
2011-14	12% of total retail electric sales
2015-19	20% of total retail electric sales
Beyond 2020	30% of total retail electric sales

III.
Wind, Gas and Coal Integration

Integrating wind generation with generation from other sources presents a number of challenges. The difficulty stems, fundamentally, from the unpredictability and intermittency of wind: predictive models are constantly improving, but one rarely can be absolutely certain precisely when wind will commence to blow or for how long it will continue to blow.

Historical analyses suggest that wind in the PSCO territory blows most frequently at night. Figure III-1 compares a wind profile of PSCO's territory published by NREL to PSCO's average daily load.[8] Wind generation tends to peak around 4:00 am, then declines until about noon before slowly increasing until about 8:00 pm. The wind peak usually occurs in the early morning hours when system demand (load) is relatively low. PSCO's load, on the other hand, peaks between late afternoon and early evening (2:00 pm to 9:00 pm).

Figure III-1
Wind Blows Strongest Between 9:00 pm & 5:00 am, When Demand Is Weakest



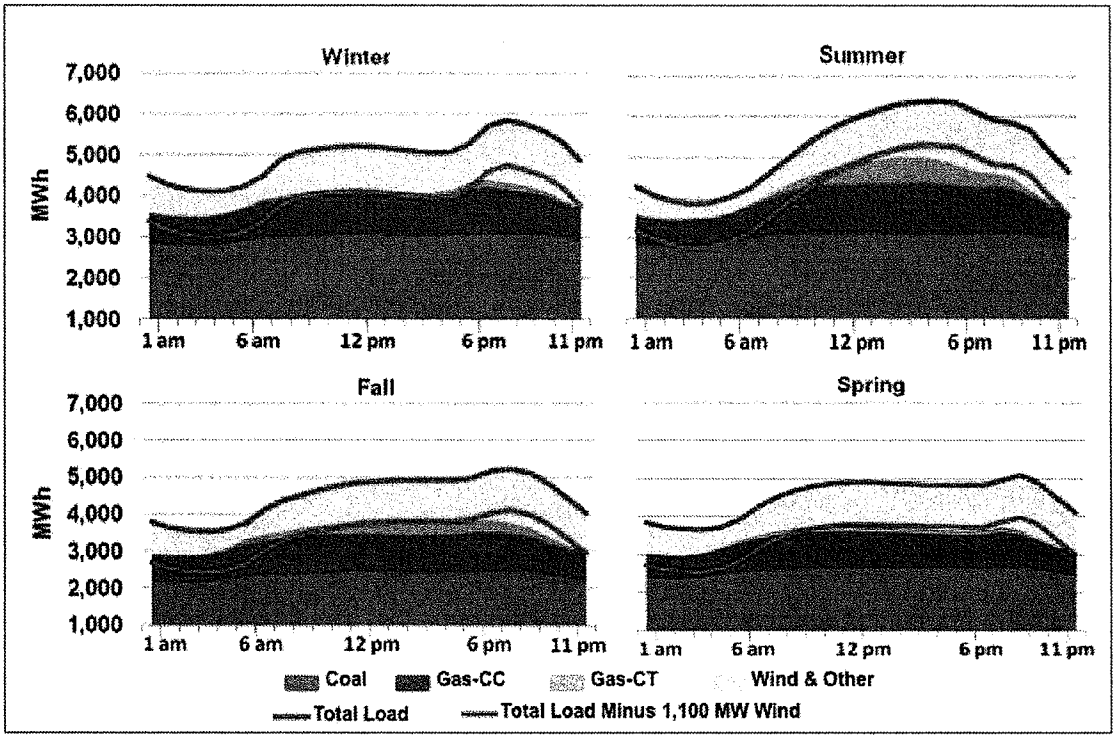
PSCO, like most other utilities, operates its wind generation as a "must-take" resource because of the RPS mandates. In other words, Xcel will operate its dispatchable resources (coal and gas-fired plants) in a manner that allows it to take as much generation from wind as possible without allowing generation from their fossil fuel facilities to fall below their design minimum generation levels.

[8] The wind profile source is taken from work produced in 2008 as part of the Western Wind Integration Study, an ongoing research effort by the National Renewable Energy Laboratory. The NREL URL is http://wind.nrel.gov/Web_nrel/. The PSCO load profile is the average daily load profile for 2007 and 2008 based on data provided in FERC Form 714.

When the wind kicks up, PSCO curtails generation from its dispatchable sources sufficient to accommodate the wind power. Then, when the wind dies down, generation from the dispatchable sources is brought back online as needed. The process by which generation is ramped up and down at a plant due to wind or any other factor is called *cycling.*

The must-take aspect of wind generation impacts the generation stack differently, depending on the season. Figure III-2 adds a purple line to the seasonal load and generation graphic shown in Chapter 1 (Figure II-7). The purple line indicates the portion of total load that can be met with the 1,100 MW of current wind capacity if used at 100% capacity.

Figure III-2
Impact of Wind on Generation Stack



As can be seen in Figure III-2, between 8:00 am and 10:00 pm, coal generation comprises between 49% (summer) and 60% (winter) of the generation mix. Accordingly, coal facilities are less likely to be cycled to compensate for wind generation because gas-fired generation (from combined-cycle and combustion turbines) is at sufficient levels to absorb the variability of wind generation. During periods of high load, it is also somewhat easier to sell excess power above what PSCO needs for its own load to neighboring utilities to help meet their peak requirements.

After 10:00 pm, the generation options are different. Wind resources tend to be strongest and most predictable at night. During that time period, generation from coal comprises approximately 62% of the generation mix and gas-fired generation falls to 20%. If there is not

enough gas-fired generation to safely cycle gas plants, coal plants must be cycled instead. Later in the night, coal-fired generation is the only resource available to absorb wind power and thus PSCO cycles its coal facilities. As wind energy begins to taper off around 6:00 am, the cycled power plants must be ramped up because load starts building for the day.

PSCO has another, somewhat restricted, option for offsetting wind generation. The company uses its 350 MW of pumped storage hydroelectric power to accommodate wind as much as possible. But when that facility is running at maximum capacity, it can only operate for four consecutive hours.

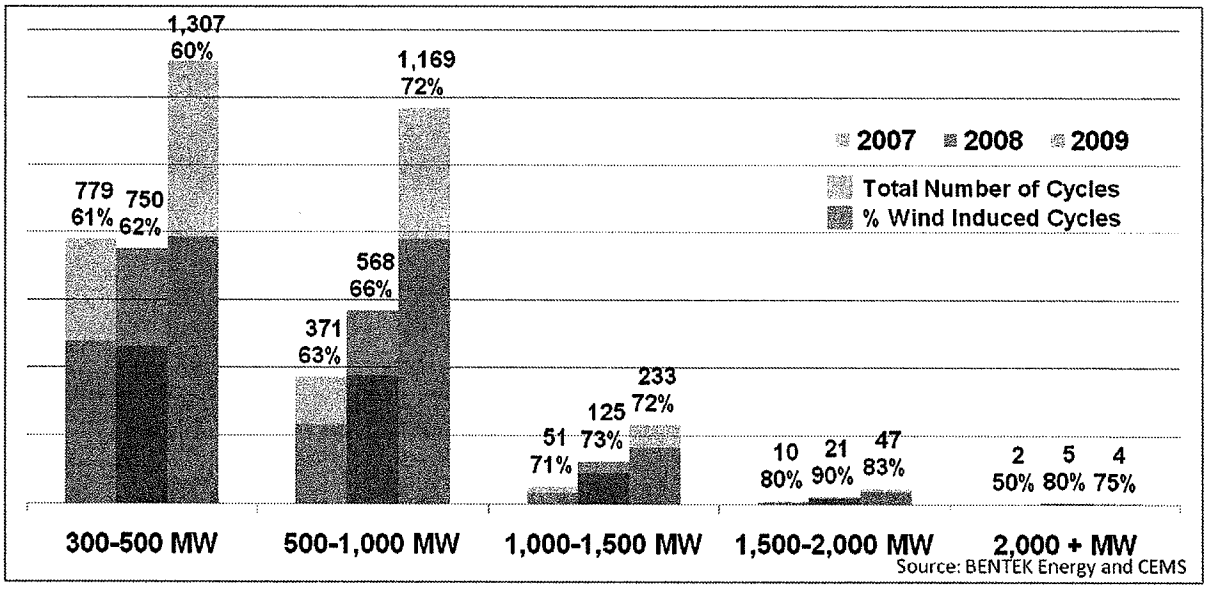
How frequently wind affects coal or natural gas-fired generation is difficult to determine because PSCO does not publish hourly wind generation data. Nevertheless, PSCO acknowledges that wind impacts coal as well as gas in its 2008 Addendum to the 2006 study "Wind Integration Study for Public Service of Colorado." In Appendix B of the 2008 Addendum Report, Xcel notes that:

> "There is a discrepancy between the Cougar modeling and the current experience when comparing the impacts on coal units. The modeling predicts almost no impact, but the company [PSCO] is already seeing some cycling that seems related to wind output."[9]

In other areas of the country, information on wind power is required as part of overall power generation reporting. For example, utilities in the ERCOT area of Texas are required to report their power generation every 15 minutes by fuel type. This data for 2007, 2008 and 2009 was used to compare coal-plant cycling with wind generation. The analysis identified the number of instances where coal-fired power plants cycled down by 300-500 MW, 500-1,000 MW and more than 1,000 MW during the same time periods where wind generation increased by at least a like amount. Figure III-3 shows the results.

[9] Page 47, "Wind Integration Study for Public Service Co. of Colorado" Addendum Detailed Analysis for 20% Wind Penetration. The Cougar model is used by Xcel to measure the cost impacts of integration.

Figure III-3
Distribution of ERCOT Coal Cycling Instances by Magnitude of Hour-over-Hour Change



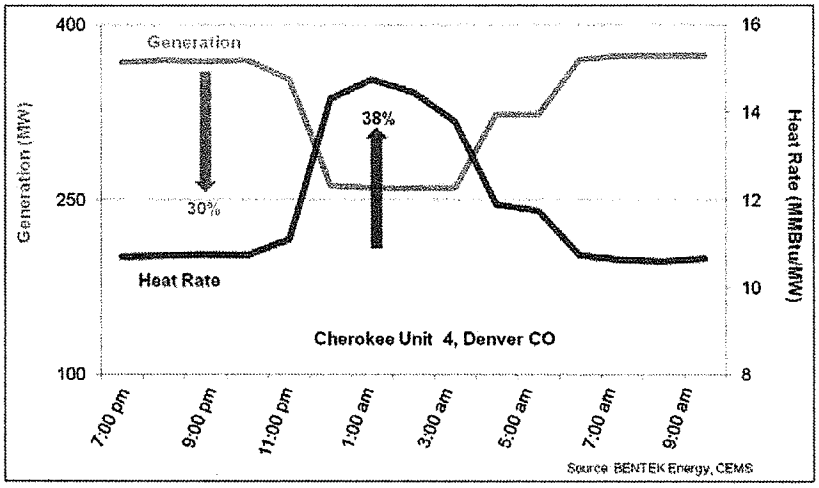
In 2009, there were 1,307 instances where coal plants were cycled at least 300 MW and 284 examples where plants were cycled more than 1,000 MW from one 15-minute period to the next. The table also indicates that the number of instances in all categories has increased annually since 2007. While Texas has more coal plants and wind farms than Colorado and the wind undoubtedly exhibits somewhat different behavior in Texas, this analysis concludes that the two systems are similar enough for a valid comparison. Even in Texas, which has one of the nation's largest gas-fired generation bases, coal plants are frequently cycled. It clearly stands to reason that the same happens in Colorado.

Impact of Cycling

Power plant cycling results in more fuel being used for every MWh generated. In fact in the first case study in the following chapter, coal consumption at the plant was actually 22 tons greater than if the plant had not been cycled and generation had remained stable.

Figure III-4 depicts operations at PSCO's Cherokee Unit 4, located in Denver, between 7:00 pm and 9:00 am on March 17 and 18, 2008. Total generation from the plant is shown in blue; the heat rate – defined as the MMBtu of fuel per unit of generation – is shown in red. Between 9:00 pm and 1:00 am, generation from the Cherokee 4 fell from 370 to 260 MW. It then increased to 373 MW by 4:00 am. During the period in which generation fell by 30%, heat rate rose by 38%. Heat rates are directly linked to cycling: as the generation from coal plants falls, the heat rate begins to climb. Initially, the heat rate climbs because generation of the plant is choked back and fewer MW are produced by the same amount of coal. Later in the cycle, the heat rate climbs further because more coal is burned in order to bring the combustion temperature back up to the designed, steady-state rate. Additionally, for many hours after cycling, the heat rate is slightly higher than it was at the same generation level before cycling the plant.

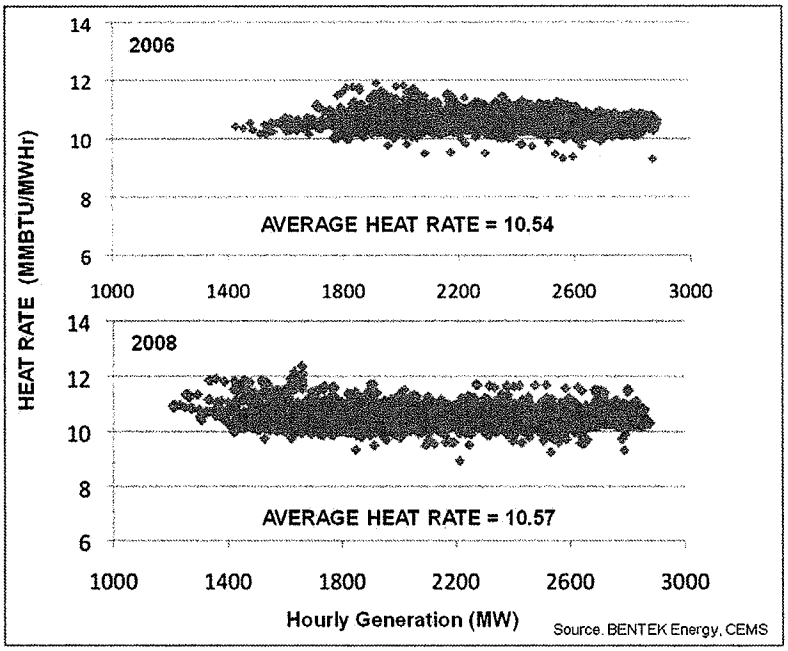
Figure III-4
Impact of Generation Decline on Heat Rate



While Xcel does not publish hourly wind generation data, it does publish hourly generation data for coal plants as part of their Continuing Emissions Monitor (CEMS) report. Using that data, it is possible to examine the behavior of PSCO's coal plants as reflected by their heat rates.

Figure III-5 below compares the hourly heat rate versus generation for all coal-fired plants in 2006 to their heat rate in 2008. The data show that the average heat rate rose slightly, from 10.45 to 10.57, but overall, the total system changed only slightly.

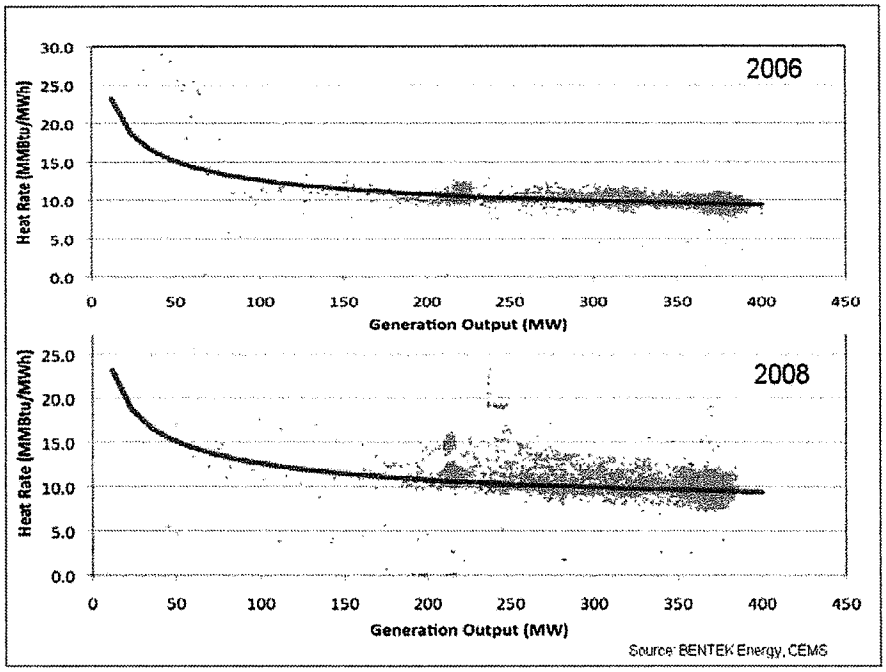
Figure III-5
Comparison of Heat Rate Vs Generation across All PSCO Coal Plants (2006 vs 2008)



These data, however, mask the impacts on specific facilities. For example, Figure III-6 below compares the hourly heat rates for the Cherokee 4 boiler in 2006 and 2008. [10] Each blue dot on the graphs represents the generation and associated heat rate for each hour of operation in 2006 and 2008. The red lines indicate the average heat rate for the boiler during the year. A comparison of the two graphs shows that in 2008 the Cherokee plant was operated in a manner that caused far greater variability in heat rate at different output levels compared to 2006. Why is there a difference? The only significant change in the operating environment between 2006 and 2008 is the addition and use of 775 MW of wind energy. A detailed analysis in Chapter III of two "wind events" will show concretely how the wind changes the operations at this and other plants. However, these data indicate that cycling coal has caused heat rates to become more variable at PSCO's coal plants.

[10] Cherokee 4 boiler is a 352-MW unit that is part of the 717–MW, coal-fired Cherokee plant located in Denver County, CO.

Figure III-6
Change in Heat Rate 2006-08 at the Cherokee Plant, Unit 4



Cycling of coal facilities impacts efficiency and, thus, emissions. To illustrate how cycling a power plant makes its operation less efficient, think about an automobile. When driven at its designed, high speed in a high gear, the automobile gets maximum mileage and minimizes emissions. If the driver allows the car to slow without lowering the gear, the car operates less efficiently, decreasing mileage and increasing emissions, until it eventually stalls. Conversely, driving at too high a speed for a given gear also makes the car operate less efficiently, resulting in excessive emissions and lower mileage.

A power plant operates in much the same way, but with only a single gear. Theoretically, coal-fired plants are designed as base load generators, meaning they are designed to operate at a high utilization rate (typically greater than 80%), which results in a flat generation profile. The boilers are "tuned" to combust the coal at a specified rate and temperature, and the emissions-control apparatus is synchronized to operate with maximum efficiency at the design rate of the boiler. If the plant has to cut back on its output, the input rate of the feed coal is cut, thereby allowing the boiler to cool, produce less steam, and thus, less power. As long as the boiler is throttled back, it may emit fewer emissions simply because it is consuming less coal, but the emission rate (emission per MW output) actually increases because the plant is operating less efficiently.

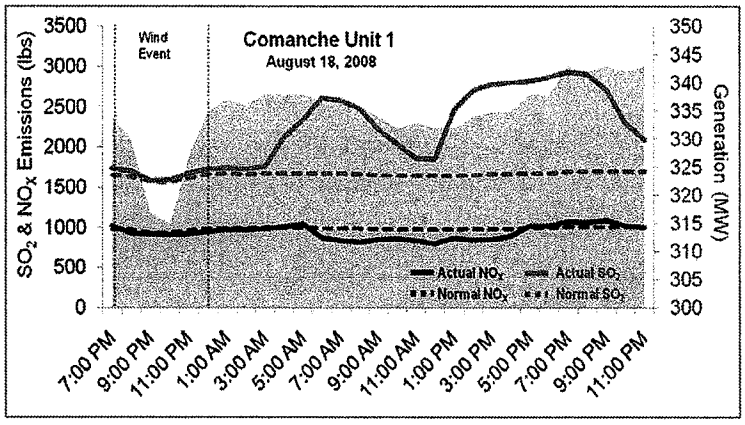
The emission rate increases further when the temperature of the boiler is increased in order to once again increase generation, as the wind energy loses strength. More coal has to be fed into the boiler in order to raise the temperature to the design threshold that it was operating at before being cutback. In addition, once the boiler has been brought back to the desired

temperature, the emissions scrubber equipment must be recalibrated and adjusted to achieve optimal control.

Below, the examples of SO_2 and NO_X impacts from wind events show how emissions rates are impacted by coal plant cycling. Each graphic shows generation during a specific period in the day in purple. Actual SO_2 and NO_X are depicted with the solid red and blue lines respectively. The red and blue dotted line show the average SO_2 and NO_X rates for the month multiplied by hourly generation to derive a "normal" emission rate. Days are chosen arbitrarily with the intent of showing some of the various excess emission patterns that occur after plants are cycled.

In Example III-A below, taken from the CEMS data for the Comanche Unit 1 on Aug. 18, 2008, cycling occurred between 7:00 pm on Aug. 17 and 1:00 am on August 18. Generation began to fall at about 8:00 pm; dropped by 4% between 8:00 and 9:00 pm; and dropped an additional 1% between 9:00 and 10:00 pm. After 10:00 pm, generation began to build: 4% between 10:00 and 11:00 pm, and another 3% between 12:00 am and 1:00 am. About three hours later, problems arose with the SO_2 emissions controls that were not re-stabilized until after midnight. During the night of Aug. 18, total SO_2 output was 16,464 lbs higher than if the average SO_2 emission rate had been achieved. NO_X controls appear to have worked well and actually, compared to the average emission rates for the month, the unit generated slightly lower NO_X.

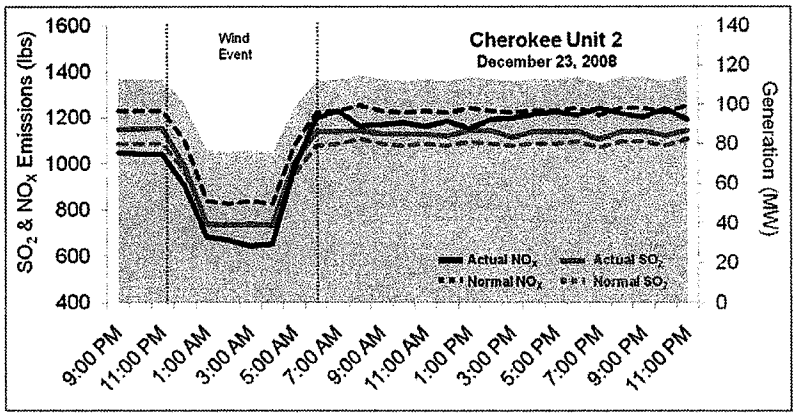
Example III-A



Example III-B below depicts Cherokee Unit 2 on Dec. 23, 2008, and is more extreme. Between 11:00 pm and midnight, generation was reduced by 11%; by 1:00 am, generation fell another 30%. It is important to note that this event may well have been triggered by wind due to the sudden steep generation reduction. Also, these examples show hourly data. In reality, these changes occur minute-to-minute, sometimes even more suddenly. As stressful on the equipment as the 24% reduction appears on an hourly basis, the reduction is potentially far more problematic if it occurred over a period of a few minutes. After the large decline, production was flat for about four hours, rose by 30% between 5:00 and 6:00 am, and another 13% before 7:00 am. Again, whether this sharp increase occurred smoothly over an hour or happened within a few minutes time cannot be determined from the data. In this example, the

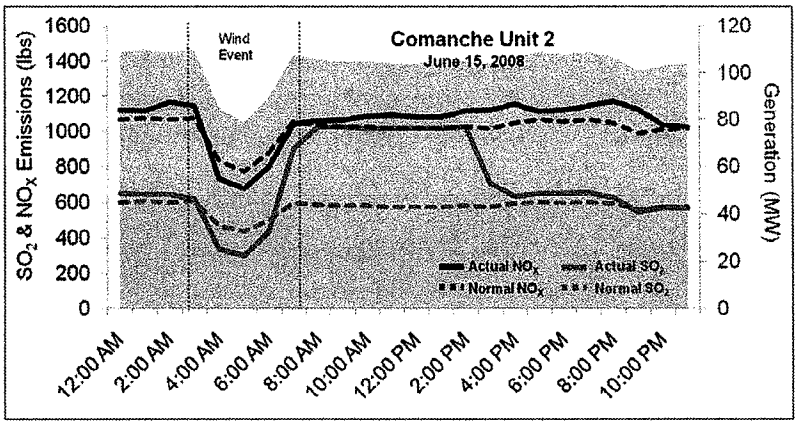
control equipment worked well: cycling induced extra SO_2 emissions amounted to 885 lbs. and NO_X emissions were below the average. This is an example in which the impacts of cycling were relatively minimal.

Example III-B



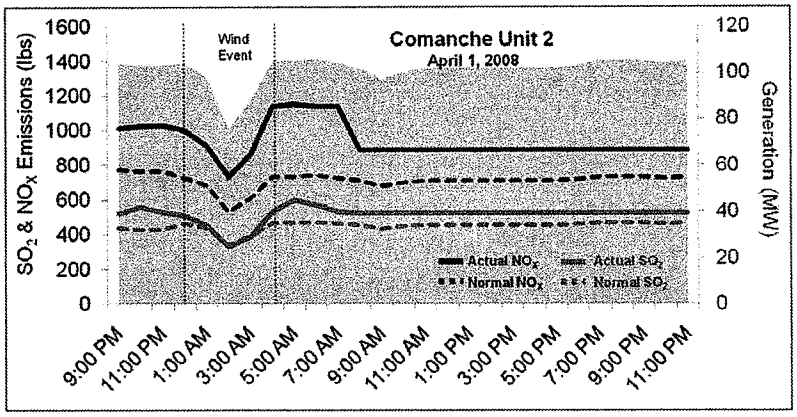
Comanche 2 provides Example III-C below. On June 15, 2008, generation fell by 23% between 3:00 and 4:00 am, and an additional 7% between 4:00 and 5:00 am. Between 5:00 and 6:00 am, generation rose sharply (14%), followed by another 20% before 7:00 am. The event produced 3,739 lbs. of SO_2 and 1,094 lbs. of NO_X – more than would have occurred had the plant's average emission rate for June 2008 been achieved.

Example III-C



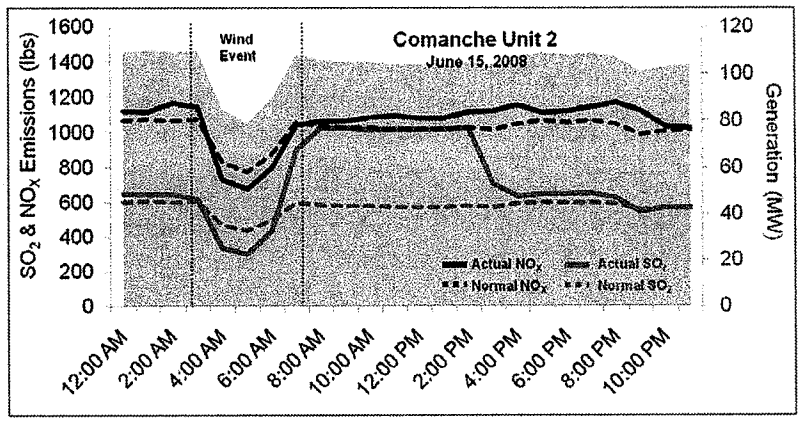
Example III-D below also shows a different day for Comanche 2. On April 1, 2008, generation fell by 6% between midnight and 1:00 am, and another 22% between 1:00 and 2:00 am. Between 2:00 and 3:00 am, generation rose by 14%, and another 20% before 4:00 am. This cycling incident generated 1,412 lbs. of SO_2 and 4,644 lbs. of NO_X – more than would have occurred had the plant's average emission rate for April 2008 been achieved.

Example III-D



Finally, Example III-E below depicts generation and emissions for May 2, 2008. On that day generation fell between 5:00 and 6:00 am by 17%, then fell another 7% before 7:00 am. Between 7:00 and 8:00 am, generation rose by 4%, and then shot up 21% by 9:00 am. This event produced 5,877 lbs. of SO_2 and 1,896 lbs. of NO_X – more than would have occurred had the plant's average emission rate for May 2008 been achieved.

Example III-E



From these examples it is clear that cycling causes difficulties for emission control equipment, and that higher than normal emission rates last several hours after the cycling event. It also appears that occasionally, the emission controls will immediately perform such that emissions are relatively normally, yet an hour or two after the event has ceased, problems occur. Cause and effect cannot be determined from this data, but the frequency of these occurrences in the data suggests more than a random relationship. Finally, it is also important to recognize that it is not possible to determine whether it is the magnitude of the increase or decrease, or the suddenness of the event that causes the problems. A 30% decrease over two or more hours may not have the impact of a 10% decrease that happens instantaneously.

The emissions instability associated with cycling is a function of the age and design of individual plants and reflects the inherent operational difficulties associated with coal-fired

plants. If a coal-fired plant has to cut back on its generation output, the input rate of the feed coal must be cut to produce a lower rate of steam generation, while keeping the right temperature to maintain low NO_X generation. This is not as simple as it sounds. The boiler was designed to run at certain heat output. At lower heat output, the boiler design may be too large to maintain the lower output at the desired temperature.

Think of the automobile example again: imagine a car engine is specifically designed to run on flat highways (just like a utility boiler). The engine and its cooling system were designed to operate at an optimal temperature to achieve the lowest energy consumption and lowest emissions level for the amount of power being produced. If you were to drive the same car downhill, the engine would generate too much power for the driving conditions. Therefore, it must be throttled back. With lower power output, the engine would tend to run at a lower temperature because the cooling system was designed to take away much higher amounts of heat than are being generated. Likewise, when the automobile must run uphill and much more power is required, the cooling system may not be capable of evenly cooling the engine. There will be uneven temperatures within the engine, again resulting in suboptimal operating conditions. Hot spots in the engine may cause premature ignition, resulting in lower mileage and higher emissions. The engine will now require more fuel to generate the same amount of power. and emissions levels will increase.

With any complex combustion system in which a precise and steady flame temperature coupled with just the right amount of fuel and air is required to maintain efficient and clean combustion, varying the operating conditions poses a great challenge, because boilers are designed to run most efficiently within a narrow, steady-state range of operating rates.

The process of controlling efficiency and proper emissions is a complex mix of computer-based technology and manual intervention. There are often over 50 required adjustments, involving everything from fuel-to-air mixes to the lime-slurry mixtures for proper SO_2 absorption that must be made in response to changing generation output[11]. Even though computerized controls are employed, finding the exact adjustments is not always a straight-forward process[12]. With changing conditions, the combustion processes are frequently suboptimal and the calculated adjustments do not have the expected impact on the boiler operation. These irregularities cause unstable operation of the plant and require further manual adjustments. It is when manual adjustments must be made that the plant is subjected to the greatest risk of instability. Significant emission excess could result from suboptimal flame, leading to lower efficiencies, sometimes to partial loss of flame and, in an extreme case, to a total plant shut down.

The other consequence of cycling coal plants is the damage to the plant itself. The financial cost of this damage would be seen in an immediate increase in plant maintenance and

[11] "Model Predictive Control and Optimization Improves Plant Efficiency and Lowers Emissions," M. Antoine, T. Matsko, P. Immonen, ABB Power Systems, "Retrofitting Lime Spray Dryers at Public Service Company of Colorado," R. Telesz, The Babcock & Wilcox Company, POWER-GEN International 2000, Nov. 14-16, 2000.

[12] "Balancing Low NO_2 Burner Air Flows Through the use of Individual Burner Airflow Monitors," S. Vierstra, AEP, D. Early, AMC Power, POWER-GEN International 1998, Dec. 9-11, 1998.

reduction of useful plant life – a cost that can be very high[13]. This is especially true for base load power plants that were not designed to cycle. While it is hard to quantify exactly the costs of cycling damage, it should be pointed out that the cost should be explicitly included in calculating wind integration costs. To date, however, most of the wind integration studies (including those of PSCO), have ignored this cost[14].

For power plants that were designed to operate at steady base load, cycling due to the wind is like driving the car calibrated for the plains of Nebraska in the mountains of Colorado. Not only will these plants burn more fuel, and cause higher emissions, their operation will also cost more money in the long run when maintenance and shorter life are fully accounted for.

[13] While most of the plant is designed to be able to cycle, the change in generation has direct impact on the plant water systems, pulverizers, boilers, scrubbers, heat exchangers, and generators. Catastrophic failures as a result of many unit cycles are most commonly in the form of fatigue, corrosion, and cycling-related creep. These failures may eventually cause plant shutdowns, and high capital cost due to necessary replacement of the damaged equipment.

[14] "Wind Integration Study for Public Service Company of Colorado." R. Zavadil, EnerNex Corporation, 2006.

IV.
Estimating the Emissions Impact of Wind Energy in PSCO's Territory

Increasing CO_2, SO_2 and NO_X emissions as a result of aggressively developing a wind energy program is a classic example of the Law of Unintended Consequences. The RPS was implemented without fully understanding the degree to which the intermittent nature of wind would stress existing generation facilities. Accommodating wind energy forces coal plants to operate less efficiently, unintentionally resulting in increased emissions. The previous chapter explained in theory how cycling coal-fired generation plants causes them to operate inefficiently, raising the heat rate and creating a host of other deleterious impacts. This chapter takes the analysis a step farther, examining two wind events that are described in detail by PSCO in training materials.

Data and Methodology

The data employed in these analyses is critical to their validity. The emission data for CO_2, SO_2 and NO_X derives from the CEMS database, which is maintained by the EPA. Electric utilities are required to report on an hourly basis their total generation, CO_2, SO_2 and NO_X emissions by boiler by plant for all boilers over 25-MW nameplate capacity. Total load is based on data reported by PSCO to the Federal Energy Regulatory Commission (FERC) on Form 714. This data is required of all control area utilities and is also reported on an hourly basis.

For any given utility territory, total load data, as reported in the FERC Form 714, equals the sum of generation from all plants reported in the CEMS data, plus generation from nuclear, wind, hydro and other renewable energy such as solar, plus other non-coal, gas or oil-generated purchases from other utilities (spot and contract).

Separating wind and hydro generation on an hourly basis is not possible for PSCO's territory because PSCO does not to report wind generation on anything other than a monthly and annual level[15]. Nevertheless, PSCO has published as part of other studies and training manuals hourly wind data for select days: July 2, 2008, and Sept. 29, 2008.[16] Using the hourly data provided for those two days, it is possible to examine in detail how coal, gas and wind interact and the resulting emissions implications.

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[15] BENTEK and IPAMS have repeatedly tried to obtain hourly wind generation for 2008 from PSCO. All requests have been denied since PSCO feels the data portrays confidential trading information.

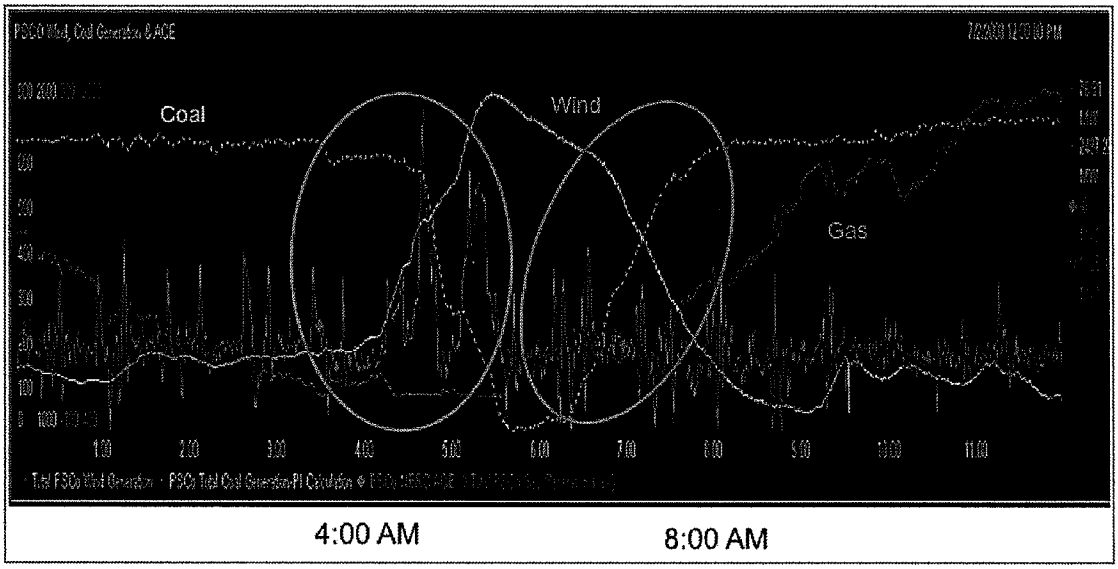
[16] Reference source of the two days data: http://www.xcelenergy.com/SiteCollectionDocuments/docs/CRPExhibit2PSCoIntegratedReliabilityTraining.pdf.

The July 2, 2008, Wind Event

The first wind event began at 4:15 am on July 2, 2008, and continued through 7:45 am on the same day. During that period, total wind generation jumped 400% from approximately 200 MW to approximately 800 MW over a 90-minute timeframe. Within the following 90 minutes, wind generation fell back down to approximately 200 MW. This event is depicted in Figure IV-1 taken from the PSCO training manual. Coal generation is shown in yellow, wind generation in blue and gas in green. The red line illustrates the Area Control Error (ACE) used by the National Electric Reliability Council (NERC) to measure system reliability. ACE measures too much or too little power on the system to safely serve total load. In short, it is a measure of reliability. As wind comes online rapidly, ACE spikes upward. Coal generation must be dropped in order to bring the ACE measure down to the appropriate level.

At the beginning of the event, gas-fired generation accounted for approximately 400 MW, 10% of total load. Coal-fired generation accounted for 2,500 MW, 60% of total load. When the wind commenced, PSCO had to curtail generation at either coal or gas plants to accommodate the incremental wind generation. As is shown in Figure IV-1, they chose to curtail generation from coal units rather than gas units. The motivation for this approach is not clear, but the most likely explanation is that the gas units were operating at near minimum levels and could not be curtailed further without significant risk to the facilities. In order to maintain system margin standards required by NERC, the sudden availability of wind forced PSCO to decrease total coal generation from 2,500 MW to 1,800 MW, then, back to 2,500 MW in a matter of 180 minutes.

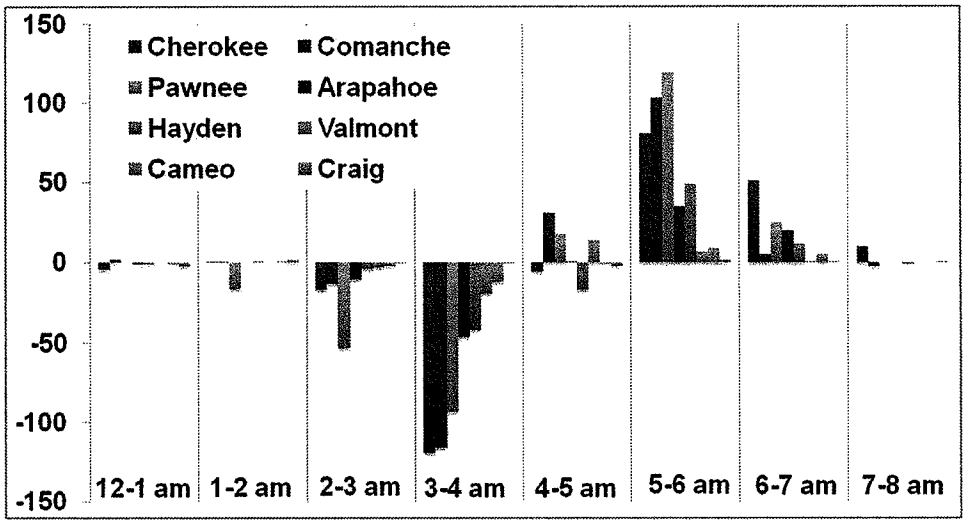
Figure IV-1
Wind Event on PSCO System (July2, 2008)



To draw coal-fired generation down, PSCO cycled three plants – Cherokee, Pawnee and Comanche. Figure IV-2 shows the hour-to-hour change in generation between 4:00 am and

5:00 am on July 2. All of PSCO's power plants can increase or decrease generation hour-to-hour. This hour-to-hour change is referred to as ramp rate.

Figure IV-2
Hour-to-Hour Change in Generation (MW)



As discussed in Chapter 2, exceeding the designed ramp rate places significant stress on the equipment, makes operation unstable and potentially shortens its life expectancy. The hour-to-hour changes shown in Figure IV-2 are compared to the published design ramp rates for PSCO's coal-fired plants as shown in Table IV-1. Cherokee's performance in this incident is within its designed ramp rate but Pawnee operated outside its design rate.

Table IV-1
Ramp Rate for Selected PSCO Plants

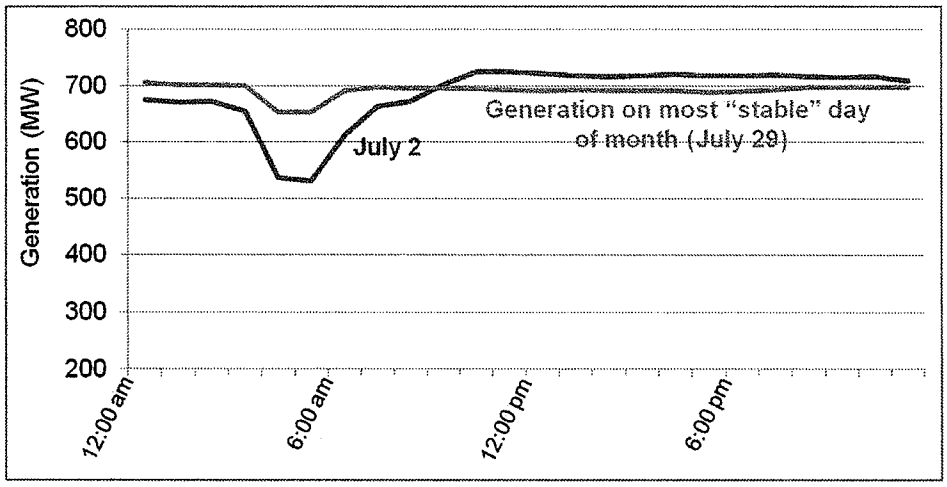
Plant	Fuel	Owned or IRP Resource	Capacity (MW)	10-Minute Ramp Rate (MW)	10-Minute Ramp Rate % Cap.
Arapahoe-3	Coal	Owned	45	6	13%
Arapahoe-4	Coal	Owned	111	5	5%
Cabin Creek-A	Hydro	Owned	162	95	59%
Cabin Creek-B	Hydro	Owned	162	150	93%
Cherokee-1	Coal	Owned	107	6	6%
Cherokee-2	Coal	Owned	106	6	6%
Cherokee-3	Coal	Owned	152	22	14%
Cherokee-4	Coal	Owned	352	20	6%
Commanche-1	Coal	Owned	325	22	7%
Commanche-2	Coal	Owned	335	22	7%
Fort St. Vrain	N. Gas	Owned	690	75	11%
Pawnee	Coal	Owned	505	16	3%
Valmont 5	Coal	Owned	186	14	8%
Valmont 6	Coal	Owned	43	43	100%
Arapahoe 5, 6, & 7	N. Gas	IRP	122	20	16%
Blue Spruce	N. Gas	IRP	271	81	30%
Brush1/3	N. Gas	IRP	76	18	24%
Brush 2	N. Gas	IRP	68	19	28%
Brush 4d	N. Gas	IRP	135	44	33%
Fountain Valley	N. Gas	IRP	238	34	14%
Manchief	N. Gas	IRP	261	97	37%
Rocky Mtn Energy	N. Gas	IRP	587	103	18%
Spindle Hill	N. Gas	IRP	269	119	44%
Thermo Fort Lupton	N. Gas	IRP	279	147	53%
Tristate Brighton	N. Gas	IRP	132	55	42%
Tristate Limon	N. Gas	IRP	63	27	43%
Valmont 7 & 8	N. Gas	IRP	79	38	48%

Operation of the Cherokee coal plant during this wind event is used to illustrate the emission impacts of cycling coal units. The Cherokee Plant was chosen due to its proximity to Denver and because it appears to be frequently cycled. The plant is comprised of four coal-fired boilers with summer nameplate capacity of 107 MW, 107 MW, 152 MW, and 352 MW, respectively. In 2008, the boilers were operated at 75%, 72%, 75% and 83% utilization rate, respectively.

Cherokee's hourly generation during this wind event is depicted in Figure IV-3. Between 2:00 am and 5:00 am generation at the plant fell by 141 MW, then, between 5:00 am and 7:00 am generation increased until it reached the high for the day of 725 MW at 10:00 am. From approximately 9:00 am through the balance of the day, generation was essentially flat.
The performance of the coal-fired plant on July 2, contrasts sharply with its performance on July 29, when there was less wind on the system and the plant operation was stable. The red line in Figure IV-3 depicts hourly generation on July 29. Although generation declined slightly

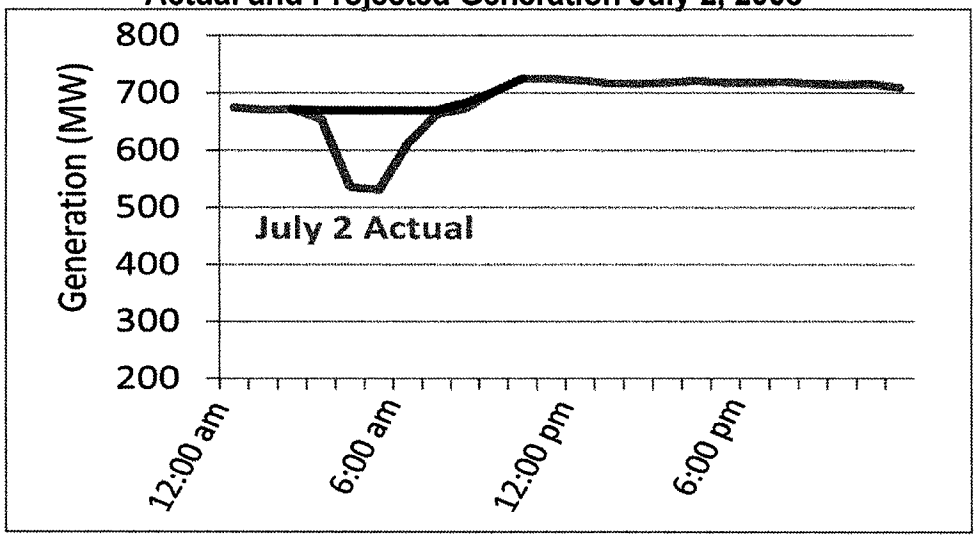
in the early morning hours on July 29, the rapid decline in generation evident on July 2 is clearly not evident. The July 29 curve is very similar in shape to the curve for the rest of July after the wind event. Total generation on July 29 was 16,603 MWh compared to 16,445 MWh for July 2.

Figure IV-3
Actual and Projected Generation at Cherokee Plant



The first step in estimating the emission impact of the July 2 wind event is to calculate the generation as if the event had not happened. A straight line estimates the generation avoided between 3:00 am and 7:00 am, the time period in which the plant was cycled (see Figure IV-4). Generation for the remainder of the day is approximately the same as for July 29 with little wind. Wind generation on the morning of July 2, 2008, caused Cherokee to cycle, reducing generation by 363 MWh.

Figure IV-4
Actual and Projected Generation July 2, 2008



Three methods are used to estimate the emission impact of the July 2 wind event. The simplest and most frequently used method is to multiply the design emission rates to the generation curve without a wind event (July 29) and to the generation curve with the wind event (July 2), then compare the results over the time period of the event. Table IV-2 summarizes the calculation. The measured emission rates for July 29 are presented in row one. The second row indicates total emissions for the no-wind scenario; row three shows total emissions associated with July 2 generation. Analyzing the emission impacts in this manner results in the estimate that the wind event reduced SO_2 by 730 lbs, NO_X by 1,386 lbs and CO_2 by 392 tons.

Table IV-2
Estimated Emission Savings Due to Wind on July 2, 2008 (Method A)

	SO_2 (lbs)	NO_X (lbs)	CO_2 (tons)
Est. Stable Day Emission Rates (July 29) (per MWh)	2.01	3.82	1.08
Stable Emission Rates, Est. No Wind Gen. (3:00 am – 7:00 am, Total Gen. = 3,360 MWh)	6,754	12,829	3,628
Stable Rates, Actual Gen. (3:00 am – 7:00 am, Total Gen 2,997 MWh)	6,025	11,443	3,236
Saved (Additional) Emissions	730	1,386	392

The limitation of Method A is that it replaces the actual emissions that occurred on July 2 with estimated emissions from a stable day, which are lower because of the inefficiency injected into the boiler by cycling as described above. Method B corrects the calculation by substituting the actual emissions on July 2 for the estimated emissions on July 2. The emission rates for these hours were actually much higher than the "stable day" rates used in Method A reflecting the impact of cycling on the facility. Table IV-3 compares the same timeframes but using the emission rates as reported in the CEMS data for the July 2 wind event. Using the actual emissions yields the result that cycling Cherokee resulted in 6,348 pounds more SO_2, 10,826 pounds more NO_X and 246 less tons of CO_2.

Table IV-3
Estimated Emission Savings Due to Wind on July 2, 2008 (Method B)

	SO_2 (lbs)	NO_X (lbs)	CO_2 (tons)
Est. Stable Emission Rates based on July 29 (per MWh)	2.01	3.82	1.08
Actual July 2 Emission Rates (per MWh)	4.37	7.89	1.13
Stable Emissions, Est. No Wind Gen (3:00 am – 7:00 am, Total Gen 3,360 MWh)	6,754	12,829	3,628
Actual Emissions, Actual Gen on July 2 (3:00 am – 7:00 am, Total Gen 2,997 MWh)	13,103	23,655	3,383
Saved (Additional) Emissions	(6,348)	(10,826)	246

The limitation of Method B is the fact that it only focuses on emissions associated with the Specific-Event, in this case between 3:00 am and 7:00 am. As was shown above, however, the sudden decrease, then increase, of generation at the Cherokee plant caused emissions variability that extended well beyond 7:00 am when the plant returned to its pre-cycle generation level. Table IV-4 captures these additional emission impacts as it extends the analysis to include generation and emissions for the entire day of July 2. Estimation Method C provides the most accurate analysis because it captures the total impact of cycling the plant.

Table IV-4
Estimated Emission Savings Due to Wind on July 2, 2008 (Method C)

	SO_2 (lbs)	NO_X (lbs)	CO_2 (tons)
Est. Stable Emission Rates based on July 29 (per MWh)	2.01	3.82	1.08
Actual July 2 Emission Rates (per MWh)	4.37	7.89	1.13
Stable Emissions, Est. No Wind Gen (3:00 am – 7:00 am, Total Gen 3,360 MWh)	33,787	64,175	18,151
Actual Emissions, Actual Gen on July 2 (3:00 am – 7:00 am, Total Gen 2,997 MWh)	71,897	129,799	18,561
Saved (Additional) Emissions	(38,109)	(65,624)	(410)

The net result is that cycling Cherokee on July 2 resulted in greater emissions even netting the emission avoided by using wind.

Figure IV-5 summarizes the results from the three calculation methods. If wind generation had not caused PSCO to cycle Cherokee on this day, 38,110 lbs of SO_2 or 53% of the day's total SO_2 emissions, 65,624 lbs of NO_X or 51% and 410 tons of CO_2 or 2.2% would have been avoided. The use of wind generation in a manner that forced PSCO to cycle Cherokee added a significant amount of emissions from the Cherokee plant on July 2, 2008. Additionally, assuming that the same quality of coal is used throughout the event, cycling the plant also required PSCO to burn approximately 22 tons more coal than would have been used if the plant had not been cycled.

Figure IV-5
Incremental Emissions Resulting From Cycling Cherokee on July 2, 2008

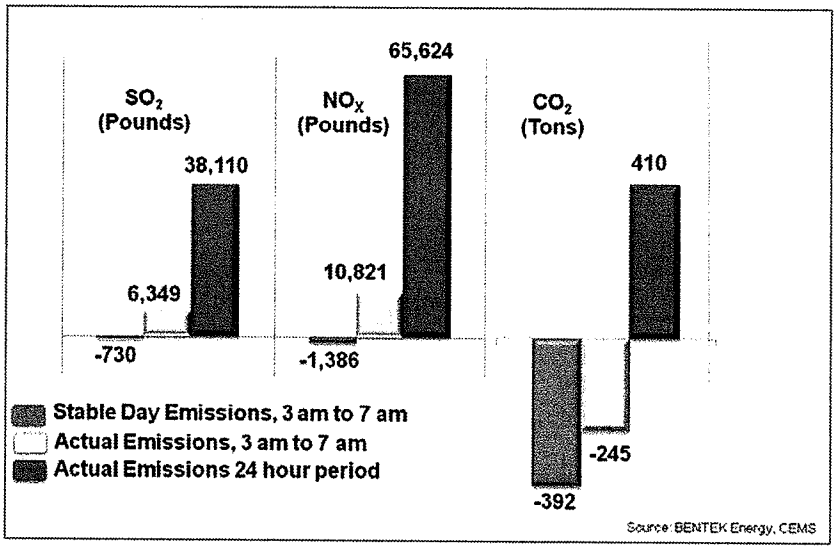
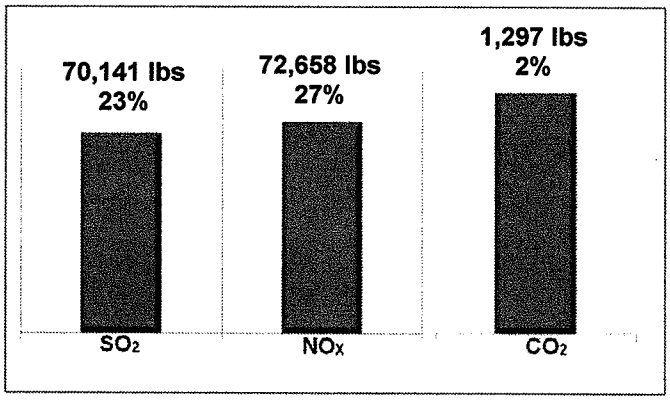


Figure IV-5 also shows how important the definition of event duration is to the estimated impact. If the narrow 3:00 am to 7:00 am definition is used, the impact of cycling is considerably less. However, this definition does not take into consideration the longer term difficulties of recalibrating the emission controls after a significant cycling event, which, as we have seen, can result in increased emissions over several hours. Clearly the longer term perspective is the most appropriate means to measure these impacts.

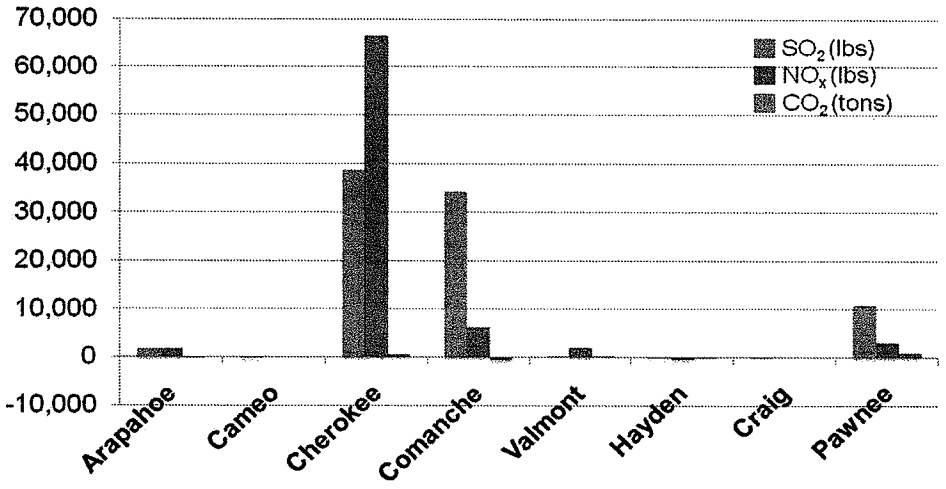
The same analysis was used to estimate the emissions implications of the July 2 wind event on all of the coal-fired plants in PSCO's resource base. The results are summarized in Figure IV-6. Using the 24-hour event definition (Method C) across the system, the July 2 wind event caused 70,141 pounds of SO_2 (23% of the total PSCO coal emissions), 72,658 pounds of NO_X (27%) and 1,297 more tons of CO_2 (2%) to be emitted than if the event had not caused the plants to be cycled.

Figure IV-6
Incremental Emissions Impact of Coal Plant Cycling
All Plants - July 2, 2008



As shown in Figure IV-7 most of the additional emissions came from three plants, Cherokee, Comanche and Pawnee. All of these plants are located near Denver, thus, directly impact emissions levels along the Front Range.

Figure IV-7
Incremental Emissions July 2, 2008 by Plant



Conclusions

System-wide, wind generation on July 2 caused 70,141 lbs of SO_2 (23% of total SO_2), 72, 658 lbs of NO_x (27% of total NO_X). Wind generation saved 1,249 tons of CO_2, 2% of total CO_2 emissions.

Compensating for wind generation on July 2 appears to have resulted in inefficient and abnormal operation at PSCO's coal plants which resulted in increased total SO_2 and NO_x

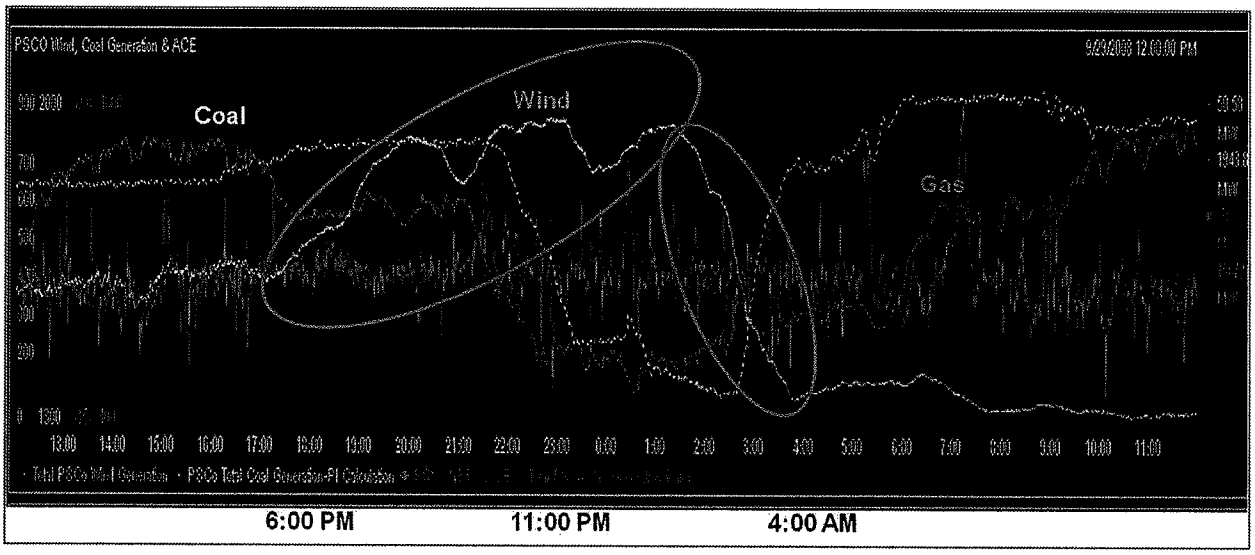
emissions. By netting out the emissions associated with the coal-fired generation that were avoided by using wind, the result is that due to wind generation, SO_2 and NO_X emissions were significantly higher (23% and 27%, respectively) than they would have been if the coal plants had not been cycled to compensate for wind generation.

Sept. 28-29, 2008

The second wind event begins during the night of Sept. 28-29, 2008. This event is depicted in Figure IV-8 taken from the PSCO training manual. Generation from coal is shown in yellow and gas load in green. The red line is the ACE.

As total load came down during the night, PSCO reduced generation at coal and gas units to allow wind to continue to generate. When the event commenced, PSCO was generating approximately 2,000 MW from coal and 1,500 MW from natural gas. Beginning at 10:00 pm and continuing until 2:00 am the following morning, coal generation was ramped down by approximately 25% to 1,487 MW until wind generation dropped to approximately 50 MW between 2:00 am and 4:00 am. In response, coal was ramped up from approximately 1,500 to 1,900 MW in 60 minutes beginning at 3:00 am.

Figure IV-8
Sept. 28–29, 2008, Wind Event



Generation from all PSCO coal plants on Sept. 28 and 29, 2008, contrasts to that of just a few days earlier on Sept. 22 and 23. Figure IV-9 details the hourly generation for these two sets of days. Wind generation availability on Sept. 28-29 resulted in a significant reduction in coal-fired generation. As was done for the July 2 case study, the emission rates associated with generation from the 22nd and 23rd will be applied to the 28th and 29th event.

Figure IV-9
Generation from Coal Plants Sept. 28–29, 2008, Compared to Sept. 22-23, 2008

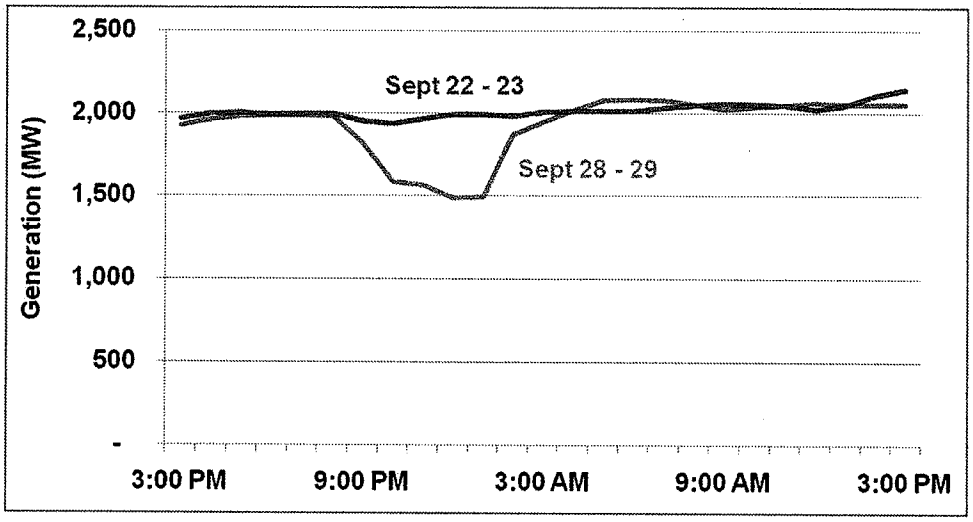


Figure IV-10 shows the plants that were cycled to accommodate wind on Sept. 28–29. Of those, the Pawnee, Comanche and Cherokee coal units were cycled to balance the load.

Figure IV-10
Hour-to-Hour Change in Generation Sept. 28–29, 2008

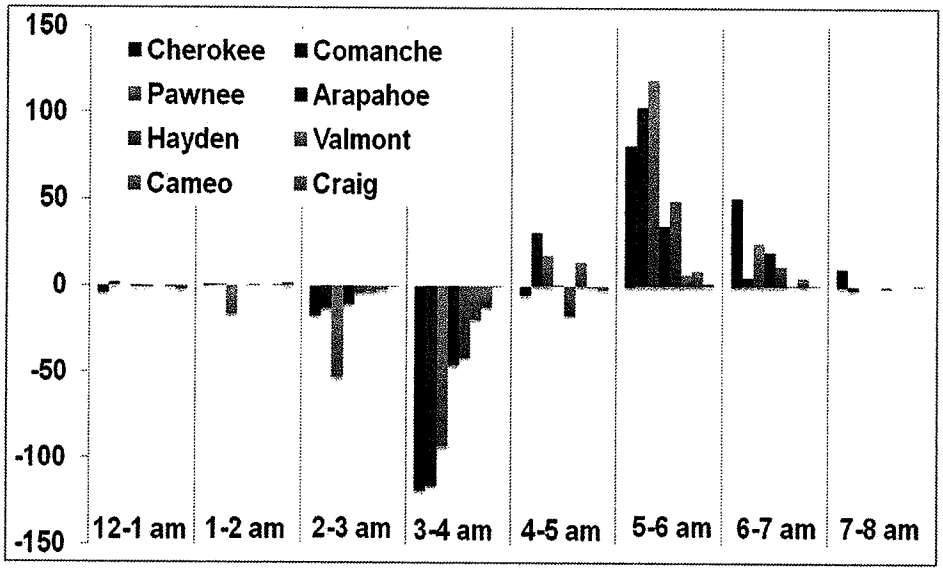
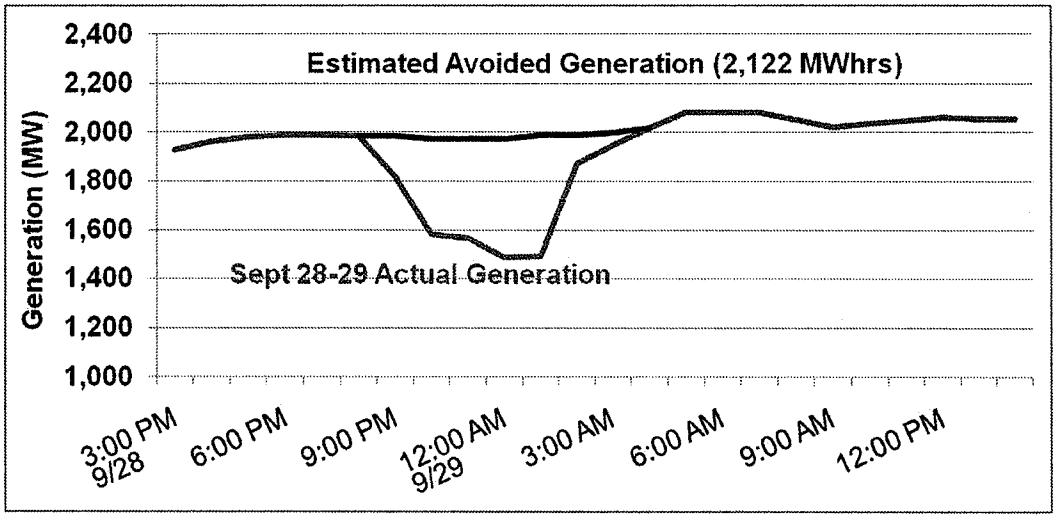


Figure IV-11 shows the coal generation that was avoided during the wind event aggregated to include all coal-fired plants. The event is estimated to have avoided approximately 2,122 MWh of coal-fired generation during the period between 8:00 pm and 4:00 am.

Figure IV-11
Estimated Avoided Generation Due to Wind Event Sept. 28–29, 2008



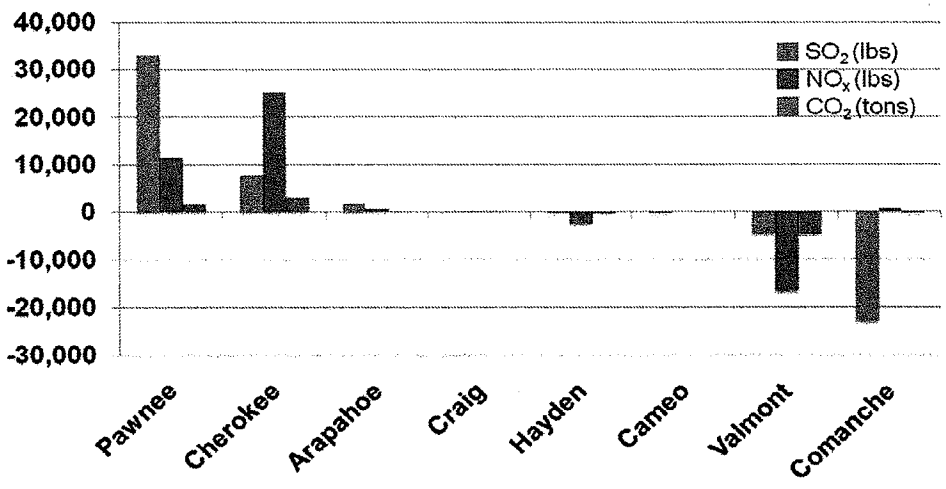
The estimated extra emissions generated by this event are shown in Table IV-5 using the same three calculation methods described earlier. As was the case with the July 2 event, the calculation method drives the results. If the additional emissions that occurred during Sept. 29 (after the wind fell off and coal generation resumed) are included, this wind event resulted in 28,823 lbs of SO_2 and 17,017 lbs of NO_x (18% of total SO_2 and 10% of total NO_x generated that day) more than would have been emitted had coal not been cycled. On the other hand, using wind to the degree it was used on Sept. 29 allowed PSCO to avoid generating 1,686 tons of CO_2 (3.2% of total CO_2).

Table IV-5
Excess Emissions Resulting from Sept. 28-29 Wind Event

	SO_2 (lbs)	NO_X (lbs)	CO_2 (Tons)
Method A			
Sept 22 Emission Rates (per MWhr Generated)	0.0305	0.0320	0.0110
Stable Emissions-Actual Gen 8 pm-3 am	48,370	50,778	17,457
Stable Emissions-Est Gen 8 pm -3 am	41,900	43,986	15,122
Saved (Additional) Emissions	**6,470**	**6,792**	**2,335**
Method B			
Sept 22 Emission Rates (per MWhr Generated)	0.0350	0.0320	0.0110
Sept 28 Emission Rates (per MWhr Generated)	0.0345	0.0361	0.0112
Actual Emissions-Actual Gen 8 pm-3 am	48,370	50,778	17,457
Stable Day Emissions-No Wind Gen 8 pm-3 am	47,430	49,580	15,356
Saved (Additional) Emissions	**940**	**1,198**	**2,101**
Method C			
Sept 22 Emission Rates (per MWhr Generated)	0.0350	0.0320	0.0110
Sept 28 Emission Rates (per MWhr Generated)	0.0345	0.0361	0.0112
Stable Day Emissions-No Wind Gen 8 pm-6 pm	131,823	150,909	53,696
Actual Emissions-Actual Gen 8 pm-6 pm	160,646	167,926	52,010
Saved (Additional) Emissions	**(28,823)**	**(17,017)**	**1,686**

Figure IV-12 shows the distribution of the emissions associated with the Methodology C calculation. Virtually all of the extra SO_2 and NO_X emissions were created at the Pawnee and Cherokee plants. The Arapahoe, Hayden and Comanche plants showed small NO_X savings.

Figure IV-12
Distribution of Extra Emissions by Plant Sept. 28-29, 2008



Conclusions

The two case studies reviewed in this chapter lead to two conclusions:

- When PSCO utilized more wind energy than it could absorb without cycling coal, net emission may occur. In these two examples, the additional emission levels amounted to significant percentages, greater than 10% of total SO_2 and between 2% and 10% of total NO_X on the days reviewed.

- The amount of extra emissions due to cycling depends on how narrowly a "wind event" is defined. When the definition is limited to the very narrow definition, i.e., the time between when the wind build-up begins and when it falls off, then using wind energy appears to create a net emissions savings. However, when the definition is broadened to include the balance of the day after the wind dies down, the emission impacts become much more significant. The difference between the two approaches is the fact that cycling coal often results in destabilizing the emission equipment effectiveness and produces extra emissions for a longer period of time than just the actual wind event. The entire day must be analyzed to fully understand the impact of coal plant cycling on emissions.

V.
Coal Cycling Impacts on PSCO Territory Emissions

The preceding chapter documented the SO_2, NO_X and CO_2 implications of two "wind events" defined as such by PSCO in their training manual. The important policy concern hinges on whether these types of events are common or whether the July 2 and Sept. 29, 2008, events are exceptional and rarely happen. To the degree that the events are exceptional, then the RPS standard appears to have little impact on levels of SO_2 and NO_X emissions. On the other hand, a troubling public policy question is raised if wind-induced coal cycling is common and generates higher levels of SO_2 and NO_X emissions. In that case, the mandates of the RPS standard are in direct conflict with the need to reduce SO_2 and NO_X in order to meet EPA ozone attainment requirements.

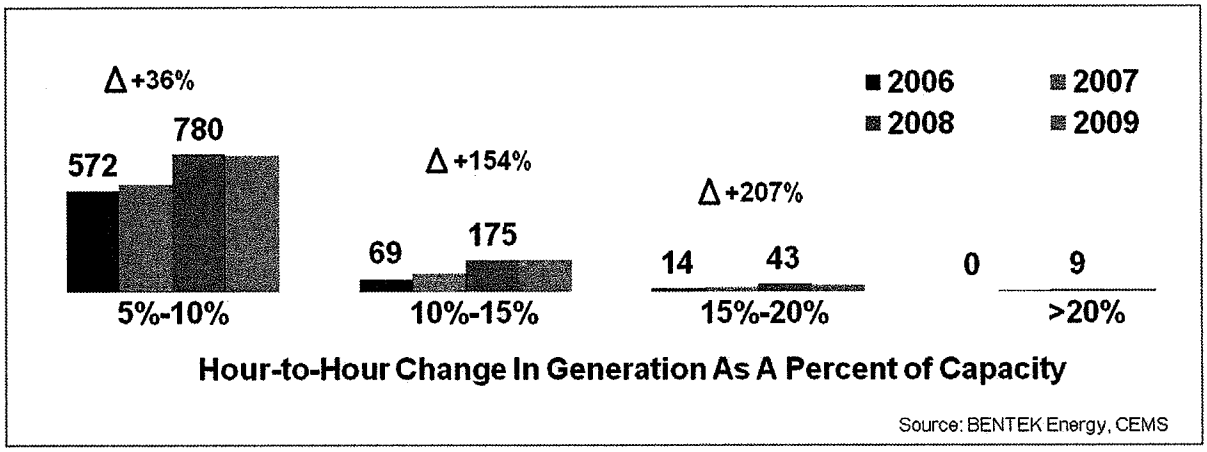
This chapter concludes that, although circumstantial, the evidence strongly suggests that the latter is in fact true: incidence of coal cycling is common and has risen sharply since introduction of wind generation, and in 2008 and 2009 the result has been significantly greater emissions of SO_2, NO_X and CO_2 than would have occurred if the coal units had not been cycled.

It has been stated before but is important to say it again here; it is not possible to understand precisely the interaction between wind generation and coal plant cycling in PSCO's territory because PSCO will not release its hourly wind generation data. In contrast to the methodology that is employed when wind-coal interaction is analyzed in Chapter VI for ERCOT where wind data is available, we can only identify coal-cycling events. We cannot conclusively associate the events with wind activity (as we can in ERCOT), thus, we cannot differentiate between the impacts of wind events and other non-wind-induced cycling events such as regular maintenance and other "unplanned" generation downturns. As a consequence, the results described in this chapter will be discussed as caused by coal cycling rather than wind. As will be shown, however, it is a fair inference to conclude that much of the cycling is wind-induced as the occurrence of cycling has risen sharply since the growth of wind energy availability in 2007.

Coal-fired Generation Cycling

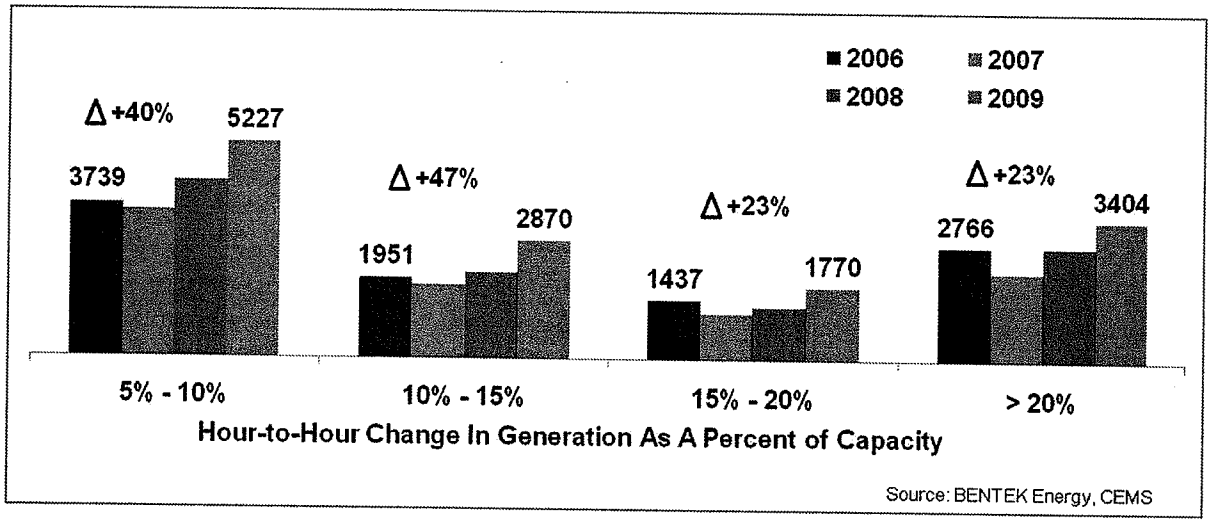
The incidence of coal-fired-generation cycling has risen sharply since 2007 when approximately 1,000 MW of wind energy was introduced into the PSCO generation mix. Figure V-1 shows the number of cycling events distributed by the magnitude of the cycle, which is defined as percent change in hour-to-hour generation for all PSCO plants taken in aggregate. Purple depicts 2006 information, green 2007, red 2008 and blue 2009. Looked at from this "system perspective," all magnitude categories increased substantially in 2008 after wind generation expanded. Cycling events that were between 5% and 10% of nameplate capacity increased by 36%, events between 10% and 15% more than doubled, and events between 15% and 20% tripled. There were nine events in 2008 over 20% where there were none in 2006.

Figure V-1
Distribution of Coal-Fired Plant Cycling Events: All Plants Combined



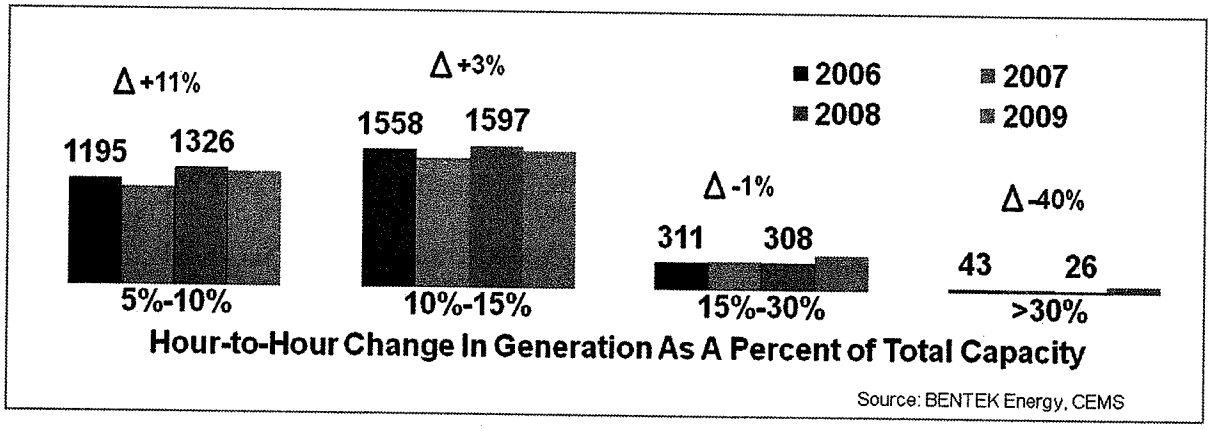
The increase in cycling is even more evident when the behavior of individual plants is analyzed. Figure V-2 uses the same approach as was used above, but counts cycling events at individual plants, again, based on the hour-to-hour change in generation level relative to each plant's nameplate capacity. The number of events at the individual plant level is significantly larger than when system-wide generation is considered, yet the number of events in each category has risen appreciably. The magnitude of change between 2006 and 2008-09 is even more impressive when the total generation from the plants is considered. According to the CEMS data series, the plants represented in these graphics generated 19,604 GWh in 2006 compared to 18,392 GWh in 2008 and 15,440 GWh in 2009. Between 2006 and 2009 generation from these plants fell by over 20%, yet the incidence of cycling events greater than 10% increased by between 47% and 23%. Even between 2008 and 2009 there were 24% more cycling events despite the fact that power production was down 16%.

Figure V-2
Distribution of Coal-Fired Plant Cycling Events: All Plants Calculated Individually



PSCO's use of its natural-gas-fired plants, which are designed to be cycled, contrasts sharply. Figure V-3 depicts the incidence of cycling among PSCO-owned gas-fired facilities (Zuni, Alamosa, Fruita, Ft. Lupton, Fort St. Vrain, Valmont, Fountain Valley, Front Range Power, Rocky Mountain Energy, Spindle Hill, Arapahoe, Blue Spruce, Limon, Rocky Mountain Reserve, Brush and Manchief). Between 2006 and 2008, the number of cycling events with a magnitude equal to between 5% and 10% of capacity increased 11%, events between 10% and 15% increased 3%, events between 15% and 30% actually declined slightly and large-scale events (greater than 30% of capacity) declined substantially. These changes occurred despite total generation from the facilities increasing from 7,498 GWh in 2006 to 7,977 GWh in 2008, a 6% gain.

Figure V-3
Distribution of Gas Plant Cycling Events: All Plants Combined



Cycling Caused Emissions

Multiple approaches were used to estimate the extra emissions that resulted from the increased cycling of coal. There are a number of important variables to consider and most tie back to the need to differentiate "wind induced" events from all sudden declines in coal-fired generation. As has been said several times in this report, it is impossible to do this precisely without good wind generation data. Nevertheless, by using several analytical approaches, it is possible to frame a range of emission outcomes that probably contain the actual number. In reality, however, the actual number is not as important as recognition that cycling coal plants does appear to increase emissions, particularly SO_2 and NO_X by a significant magnitude.

Specific-Event Approach

The first approach only included instances where generation from individual coal-fired plants decreased by more than 10% hour-to-hour between 12:00 am and 8:00 am. To be included as an event, plants must also operate all 24-hours, thus, eliminating events that would result from maintenance or unplanned outages. For each instance, the power not produced during the incident was estimated. "Stable day" emission rates were multiplied by the avoided power from the coal-fired plants to estimate avoided emissions. Then the actual emissions are compared to the avoided emissions as described in the case study using Methodology C (i.e., the stable day rates were applied to avoided generation and post-event generation for the balance of the day [See Chapter IV]).

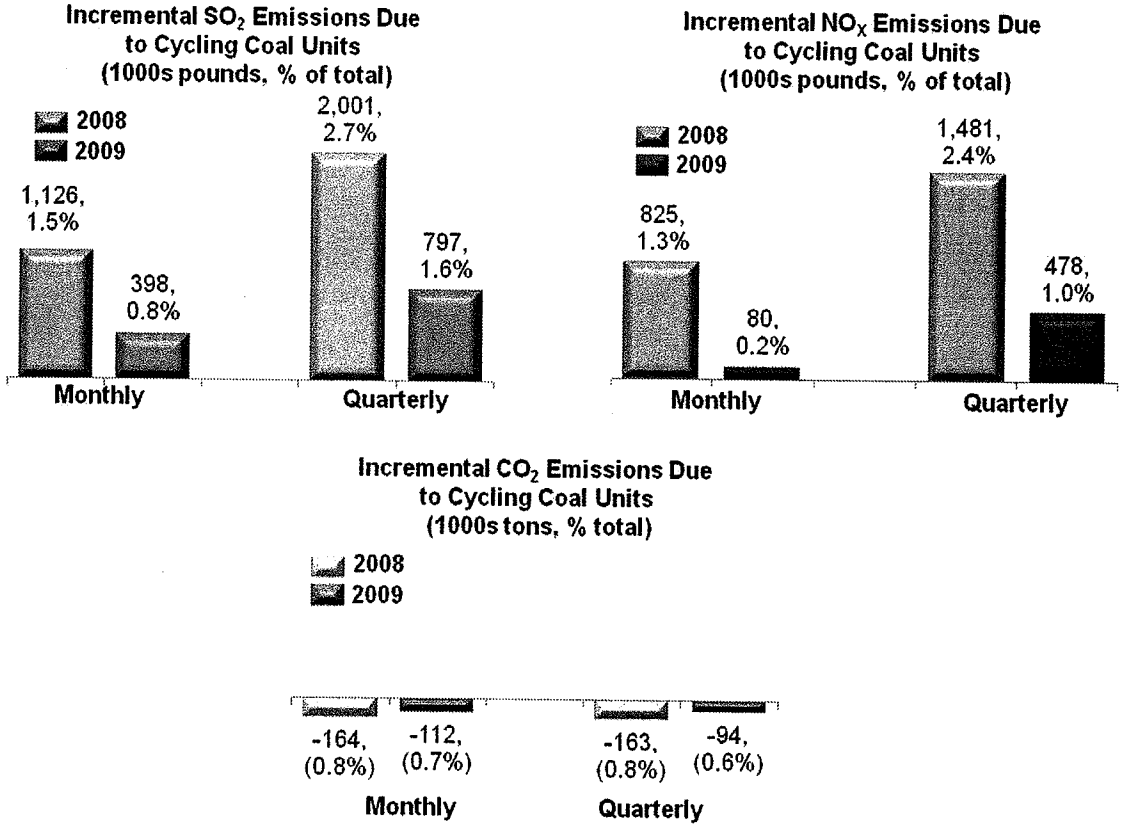
The "stable day" emission rate is a key aspect of this analysis and multiple options may be used in the calculation. One approach defines the stable day rate based on selecting the most stable emission rates evidenced at the plant during the month of the event. The advantage of using a monthly approach is that it incorporates any variation that results from monthly weather conditions. The disadvantage to using monthly data is that, if there are many small cycling events, or the large events perturb emissions over long periods of time, the "stable day" rate is inflated. Alternatively, stable day rates can be based on rates during the most stable period evidenced during a quarter or annually. Using a quarterly average rate is slightly less sensitive to monthly weather, but reduces the inflation effect associated with the monthly approach. Further, it is also possible to run the analysis using an annual stable day estimate. This further averages out emission variability, but also ignores seasonal variability that may be important. Table V-1 summarizes the stable day emission rates associated with each approach. The table shows the average rate across all coal plants and is intended only to provide a sense of how much impact the monthly/quarterly assumption makes on the stable rate estimate.

Table V-1
Comparison of Average Emission Rates Monthly vs. Quarterly

	SO_2 (lbs/MWhr)		NO_X (lbs/MWhr)		CO_2 (tons/MWhr)	
	Month	Quarter	Month	Quarter	Month	Quarter
2008	3.93	3.71	3.83	3.73	1.11	1.11
2009	3.90	3.73	3.82	3.70	1.11	1.11

Figure V-4 compares the results using "stable day" rates estimated on a monthly and quarterly basis. In all, there were 1,261 and 1,327 specific cycling events in 2008 and 2009, respectively, which met the 10% hour-to-hour criteria. Using the monthly stable day average for 2008, these events generated 1.1 million pounds of SO_2 and 825,455 pounds of NO_X and saved 164,304 tons of CO_2. In 2009, the lower number of events resulted in 397,782 pounds of SO_2, 79,654 pounds of NO_X and 111,506 tons of CO_2 more than would have been produced had the cycling not occurred.

Figure V-4
Incremental Emissions Resulting Coal Cycling (Specific-Event Approach)



Using the quarterly method for estimating the most stable day increases incremental emissions for all three types. In 2008, using the quarterly stable day average SO_2, emissions

were 2.0 million pounds higher than would have been produced without coal cycling. NO_X emissions were similarly elevated by 1.5 million pounds, but 163,146 tons of CO_2 were not emitted. In 2009, coal cycling resulted in 797,423 pounds SO_2, 477,762 pounds of NO_X and 94,428 tons of CO_2 being produced more than would have been produced without coal cycling.

Using the Specific-Event method to calculate emission suggests that coal cycling is causing PSCO to emit more SO_2 and NO_X than it would have if the coal plants are not cycled to this degree. This approach, however, underestimates the magnitude of the problem because it ignores all of the little short-term cycling events and does not account for situations where cycling causes the emissions control to enter into a prolonged period of erratic behavior. Due to these limitations, the Specific-Event Approach can be viewed as defining a minimal level of probable impact.

Full-Year Approach

The Full-Year Approach compensates for the limitations of the Specific-Event Approach. Instead of focusing simply on the days where there were 10% hour-to-hour declines as was done in the Specific-Event Approach, the Full-Year Approach applies the monthly and quarterly "stable day" emission rates to generation from every day of the year . Again, days when the plant is not running or days with planned outages are eliminated as a means of accounting for maintenance. Stable Day emission rates are the same as were calculated for the Specific-Event Approach.

The implicit assumption in this approach is that cycling is the root cause of all emission rates that exceed those of the "stable day." Another way of describing the underlying assumption for the Full-Year Approach is that it assumes the plants are run at their most stable emission rate consistently throughout the year. Due to these underlying assumptions, this estimation method may be viewed as calculating the upper end of incremental emissions associated with coal cycling.

Figure V-5 shows the results from the Full-Year Approach. Using the monthly stable day rates in 2008, coal cycling caused PSCO to emit between 6.7 and 10.5 million pounds of SO_2, between 4.5 and 6.3 million tons of NO_X and 152,000 tons of CO_2 more than would have been emitted had the plants been run stably throughout the year, depending on whether the monthly or quarterly stable day rate calculation is used. In 2009, cycling resulted in smaller levels of excess emissions for SO_2, NO_X and CO_2. The difference is most likely a result of the lower generation levels achieved by PSCO from these facilities in 2009, which were documented earlier.

Figure V-5
Incremental Emissions Resulting Coal Cycling (Full-Year Approach)

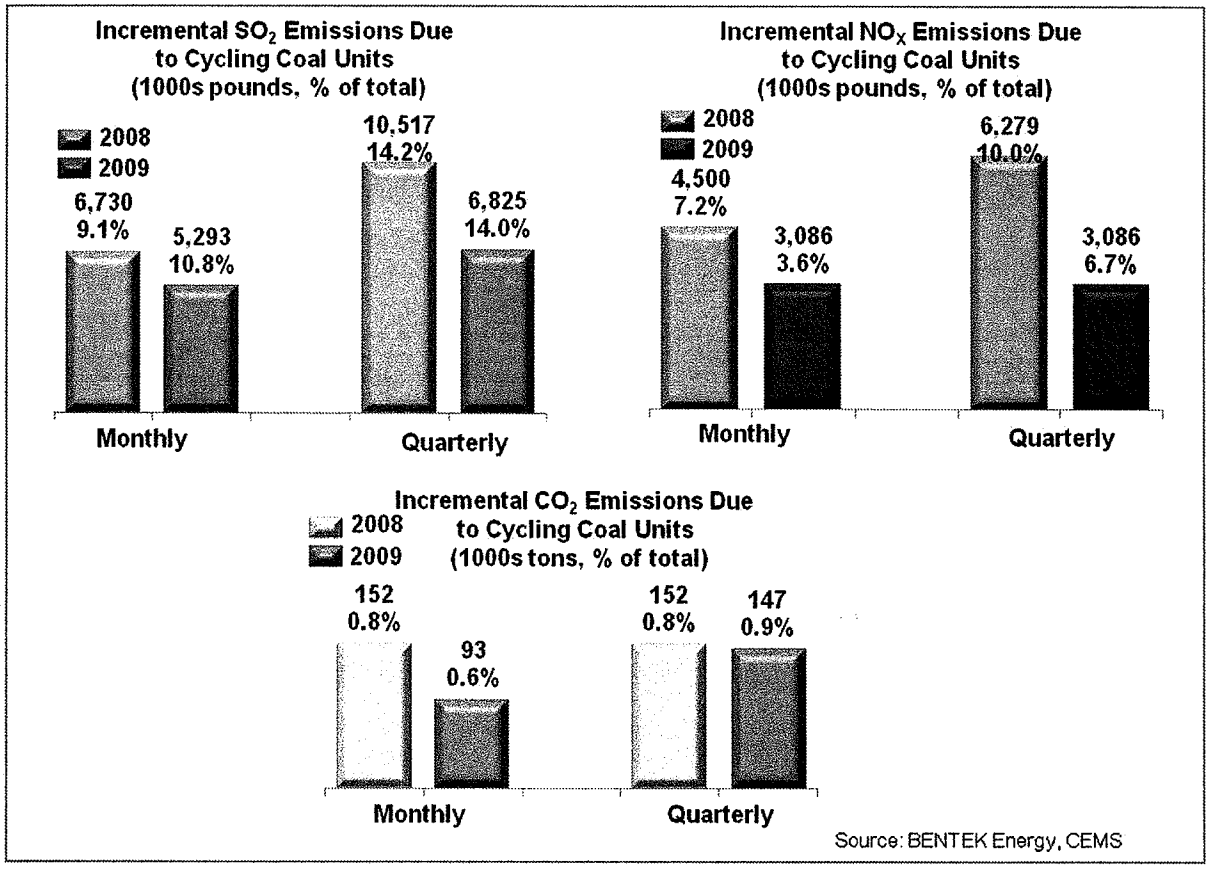
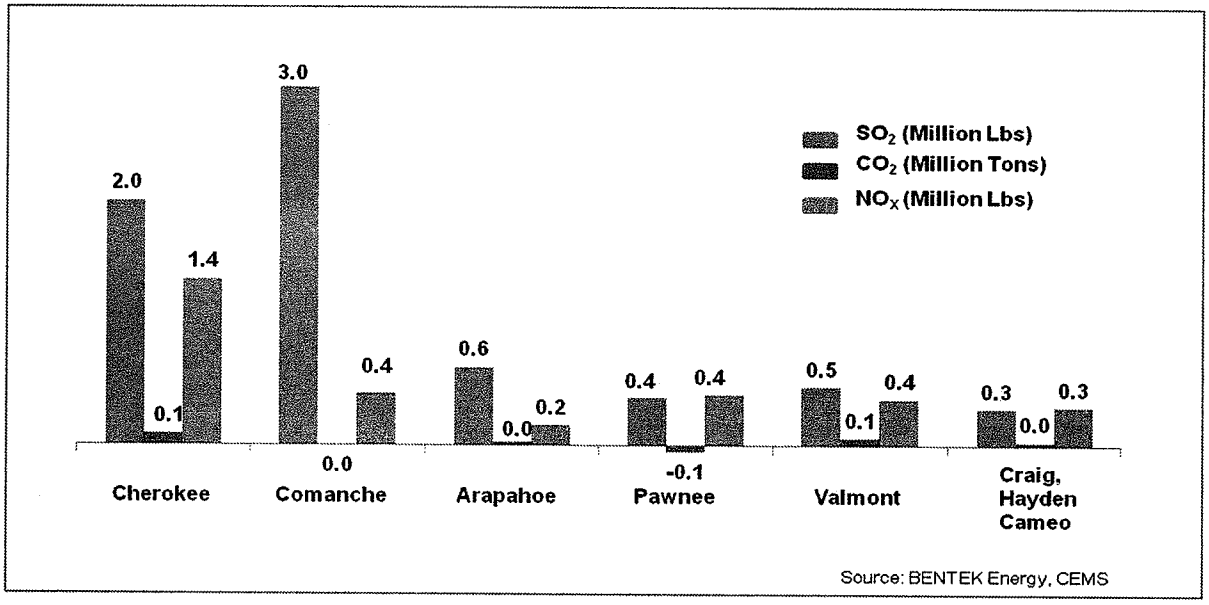


Figure V-6 shows the distribution of 2009 incremental emissions by coal-fired plants using the stable day method calculated on a quarterly basis. Cherokee and Comanche account for the largest share of the excess SO_2 with Arapahoe and Pawnee contributing smaller amounts. NO_X also comes primarily from Cherokee. The distribution for 2008 is similar to 2009, but Pawnee contributed relatively more of both SO_2 and NO_X and Comanche less. The distribution is significant because Cherokee, Arapahoe and Valmont are within the Denver non-attainment area, and Pawnee is located just northeast of the area.

Figure V-6
Incremental Emissions by Plant in 2009 (Quarterly Analysis)



Conclusions

The analysis presented in this chapter suggests that cycling of coal-fired facilities has increased significantly since 2007 as wind energy generation increased to its current levels. The number of cycling events where system-wide coal generation dropped between 5% and 10% increased by 40% in 2008, events where generation dropped between 10% and 15% increased by 47% and larger sized events increased by over 20% as well. Since the introduction of 775 MW of wind generation is the only real operational difference between 2007 and 2008, it is reasonable to presume that the operational needs associated with accommodating wind are what drove the increases.

In addition, the increased incidence of cycling has lead to emission of greater volumes of SO_2, NO_X and CO_2. In 2008, depending on the method of calculation, cycling coal plants caused between 1.1 and 10.5 million pounds of SO_2 to be produced that would not have been produced had the plants not been cycled. Similarly, cycling resulted in between 825,455 and 6.3 million pounds of incremental NO_X being generated. Cycling's impact on CO_2 is more ambiguous as the range is between creating a savings of 164,000 tons and a penalty of 151,000 tons.

In 2009, generation from PSCO's coal-fired plants fell off by about 20%, but their emissions did not diminish proportionately. Again, cycling appears to be a central factor. In 2009, there were 1,327 cycling incidents and they resulted in creating between 398,000 and 6.8 million pounds of SO_2, 80,000 and 3.1 million pounds of NO_X and between 94,000 and 147,000 pounds of CO_2 more than would have been generated had the plants been run stably.

VI.
Wind, Coal and Natural Gas Interaction in ERCOT

To gain a better understanding of the impact of wind events on coal-fired generation and to validate the findings relative to the PSCO territory, this chapter examines coal cycling within the Electric Reliability Council of Texas (ERCOT) system. The ERCOT and PSCO systems have aggressively pursued wind generation in the last decade due to legislative goals and incentives. Wind power is a must-take resource on both systems, but is curtailed more often in ERCOT because resources are much larger and when fully generating can create reliability problems. Finally, both systems are dispatched by central operators who attempt to utilize as much wind generation as possible without disrupting reliability standards. More important than these similarities, however, are the distinctions: ERCOT has far larger gas-fired generation capacity and ERCOT requires publishing of detailed wind generation data. This data combined with the CEMS data, enables precise definition of wind events, thus, facilitates a more precise understanding of the emission implications of wind use.

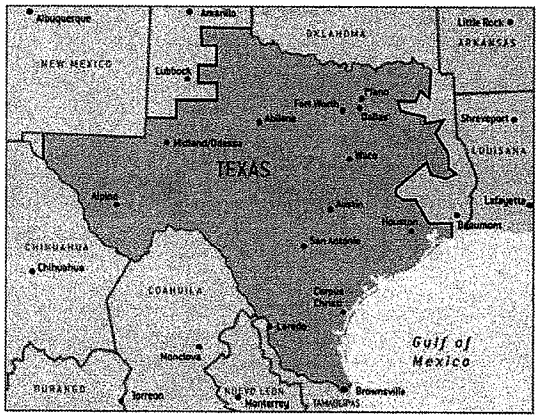
Accordingly, this chapter examines the interaction between wind, coal and natural gas in the ERCOT region of Texas as a means of further validating the results found in the PSCO territory. The chapter will demonstrate that while the scale of wind, gas and coal operations in ERCOT is larger than in PSCO's territory, the result is the same. Since the wind blows at night when gas generation is relatively low as a percent of total generation, coal plants are cycled, which results in higher SO_2, NO_X and CO_2 than would have been the case had those coal plants not been cycled.

Electric Reliability Council of Texas

ERCOT is an independent system operator (ISO), servicing most of Texas. ERCOT manages over 85% of power generation in Texas (as depicted in Figure VI-1), ensuring that power reaches over 22 million residents. The ISO schedules power offered by over 550 generation units[17] and manages demand levels. In 2009, the ERCOT system was responsible for handling nearly 300,000 GWh of generation, which amounts to 8% of the U.S. total. [18] The system reached its peak of 63,400 MWh in July 2009.

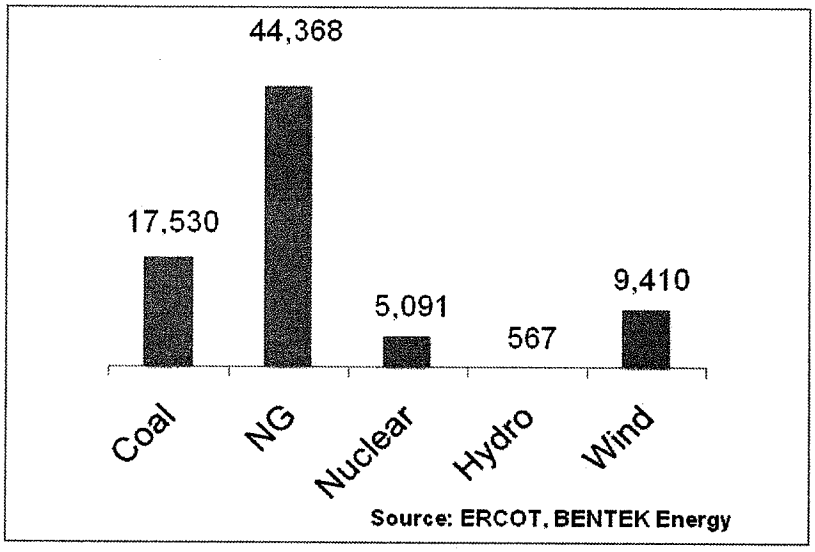
[17] http://www.ercot.com/
[18] EIA and ERCOT

Figure VI-1
ERCOT Encompasses 91% of Texas Consumers



Natural gas-fired capacity comprises the majority (58%) of total ERCOT capacity. Coal is the next largest component at 23%, followed by wind (12%) and nuclear (7%). The difference in structure between PSCO's territory and ERCOT lies in ERCOT's need to meet dramatic demand swings during the summer related to air-conditioning load. The generation capacity mix was designed around this understanding, allowing for more than twice as much installed gas capacity as coal capacity. Figure VI-2 captures the capacity mix in Texas during 2009.

Figure VI-2
2009 ERCOT Capacity Mix[19] (MW)



Nearly 8,000 MW of wind capacity have been installed in Texas since 2005. Figure VI-3 shows how wind generation has changed in Texas since 1994. In 2005, the PUCT enacted

[19]http://www.ercot.com/

S.B. 20, requiring that the state of Texas mandate certain levels of renewable capacity, which are summarized in Table VI-1.

Figure VI-3
Total Wind Generation Capacity in ERCOT

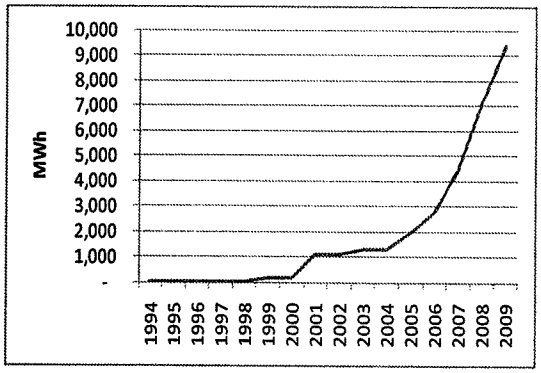
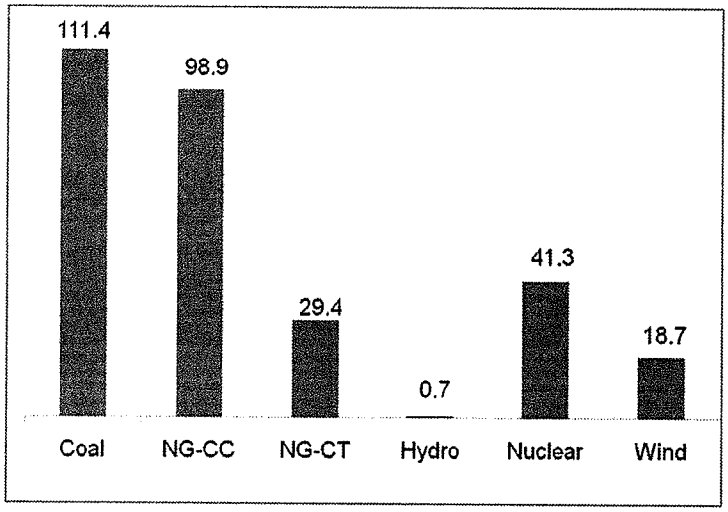


Table VI-1
RPS Capacity Standards for TX

Date	Installed Capacity
1/1/2007	2,280 MW
1/1/2009	3,272 MW
1/1/2011	4,264 MW
1/1/2013	5,256 MW
1/1/2015	5,880 MW
1/1/2025	10,000 MW

Figure VI-4 depicts the relative generation and utilization rates of the various fuel options in ERCOT for 2009. From the standpoint of total annual generation, natural gas and coal dominate the generation mix. Between combined-cycle and combustion turbines, natural gas provides about 43% of total generation, compared to 37% for coal, 14% for nuclear and 6% for wind. However, the relatively low utilization rate for gas-fired combustion turbines and combined-cycle units means that they are used less frequently than the coal and nuclear plants, which comprise the base load component of the supply stack.

Figure VI-4 2009
ERCOT Generation by Fuel Type (Ths of GWh)



The distinction between base load and non-base load generation is more evident in the seasonal depictions of the average daily generation profile for the ERCOT region in 2009. Figure VI-5 shows the differences between the average daily profiles of each season. Nuclear generation is shown in purple, coal in grey, natural gas combined-cycle in dark blue, gas-fired combustion turbines in light blue, wind in light green and hydro in orange. There are several differences between the seasonal generation patterns.

- During the summer season, peak demand, which reaches 55,000 MW, is nearly twice what it is during the other three seasons.

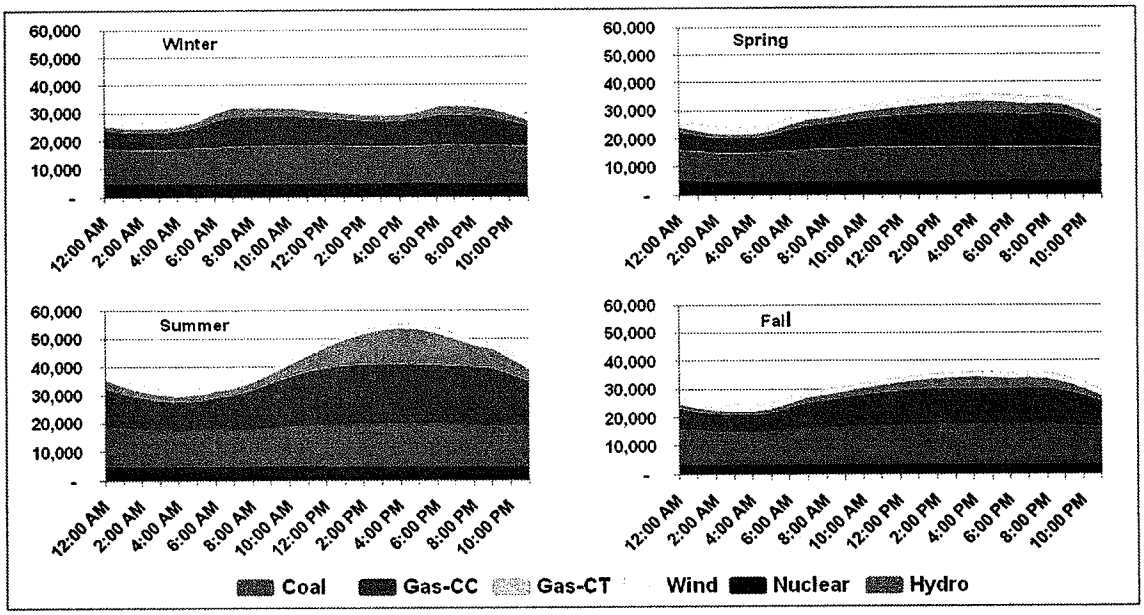
- All of the seasons have a late-afternoon peak. During the summer, the peak is slightly earlier and more pronounced. During the fall and spring, it has a slightly longer duration. During the winter, it is matched by an early morning peak, which reflects the large number of homes that use electric heating.

- Coal, nuclear and combined-cycle gas comprise the bulk of the base load generation stack. During the hours between 9:00 pm and 6:00 am, nuclear generation averages between 14% and 18% of total generation regardless of season. Coal averages between 36% and 39% of total night-time generation during the spring and summer seasons and between 42% and 44% during the winter and fall.

- Natural gas plays a larger role in the night-time base load stack during the summer season as combined-cycle and combustion turbines provide 43% of total night-time generation compared to between 32% and 34% during the other three seasons.

- Wind provides between 5% and 8% of the average generation overall, depending on the season, but at night its contribution rises slightly from 6% (summer) to 10% (spring).

Figure VI-5
ERCOT 2009 Average Hourly Generation by Fuel Type & Season (MW)



Data and Methodological Considerations

As was mentioned earlier, ERCOT publishes wind, coal, nuclear, natural gas and hydro generation data on a 15-minute basis. In addition, hourly generation and emissions data is also available through the CEMS system. Both the ERCOT 15-minute data and the CEMS 60-minute data were utilized to understand the emission implications of cycling units due to wind generation in ERCOT.

The same methodology was used for calculating emission implications of wind in ERCOT as was used in the PSCO analysis with one exception. Due to the availability of the 15-minute generation data, "wind events" can be calculated more precisely. For the ERCOT analysis, a "wind event" was defined as an instance where a 10% or greater dip in coal generation coincided with an increase in wind energy generation. Otherwise, the analysis is identical: identify the wind events; calculate the avoided generation from coal plants; calculate the monthly and quarterly "stable day" emission rate; calculate the difference between the actual emissions and the emissions that would have been generated if the avoided generation had been produced with the "stable day" emission rates.

Frequency of Coal and Gas Cycling

Coal plants are being cycled due to wind generation on the ERCOT system. The eight-day example shown in Figure VI-6 illustrates the mechanism. Coal generation is represented by the grey area, wind by the light green; the black ovals highlight cycling events. On each day as wind increases between 9:00 pm and 5:00 am, coal generation dips. On some days, such as Nov. 9 and 10, coal generation drops significantly. But even on days such as Nov. 8 when limited wind comes on the system, it appears to push a small amount of coal generation offline.

Figure VI-6
Coal Plants Are Cycled as Wind Generation Increases (Nov. 5-12, 2008)

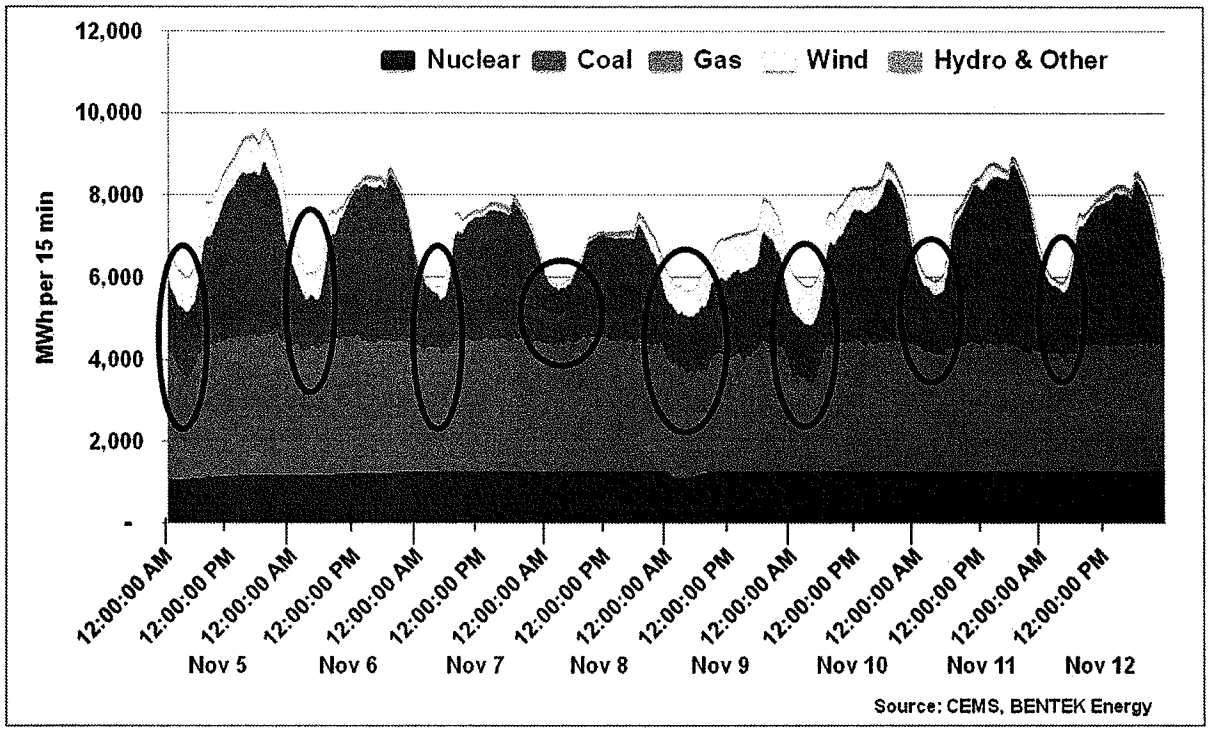
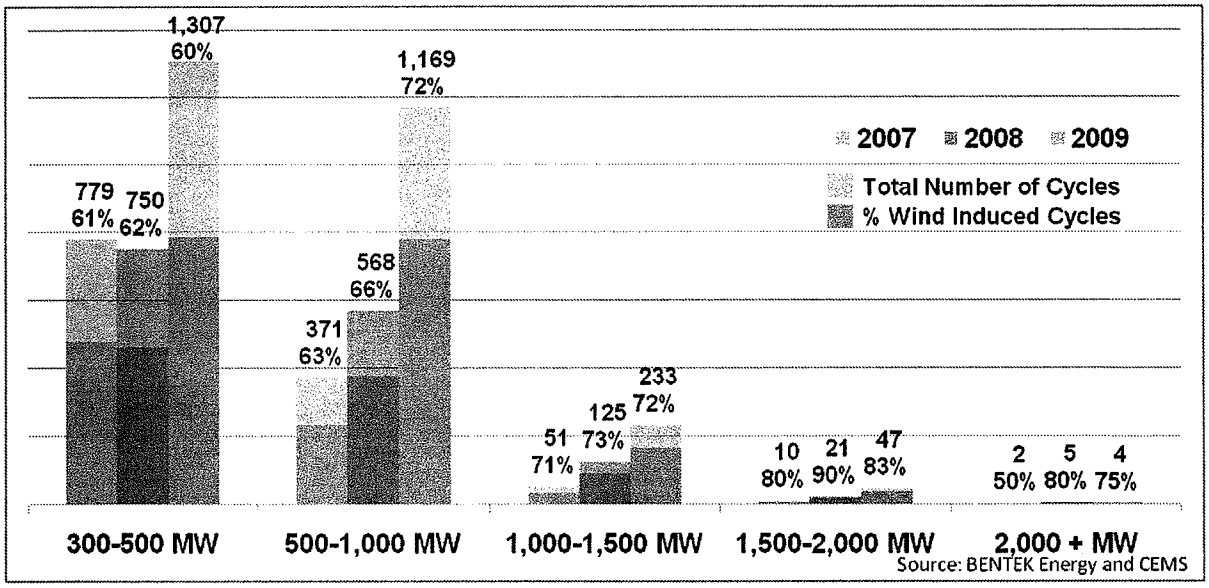


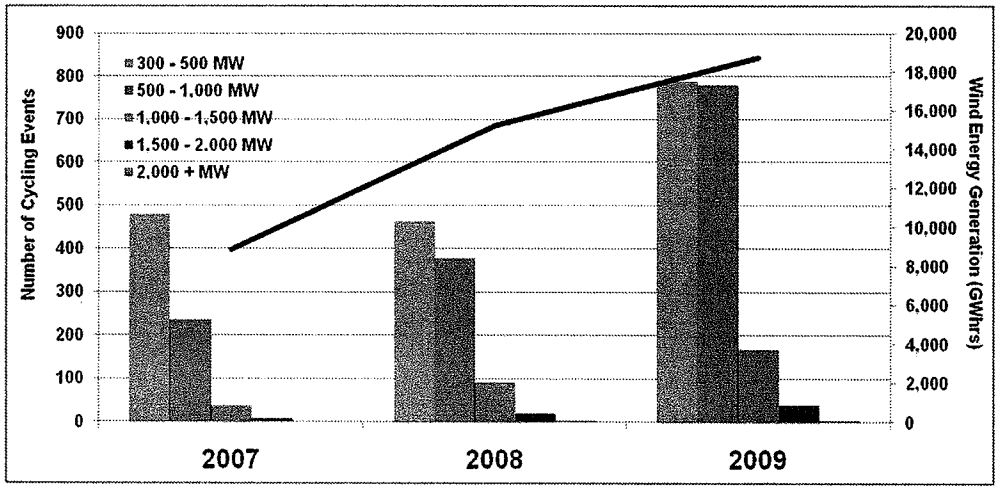
Figure VI-7 shows the impact of wind on coal cycling in ERCOT. The solid bars indicate the amount of wind induced cycle events. The shaded portion indicates the cycling events not related to wind. The categories capture the size of the cycling event. For example, the first category labeled 300-500 MW indicates that the number of instances in which the total coal-fired generation changed from 300 to 500 MW hour-to-hour.

Figure VI-7
ERCOT Coal Cycling Events



This data indicates that most coal cycling in Texas is due to wind generation. Additionally, the data indicates that the number of wind-induced cycling instances is increasing rapidly. Figure VI-8 compares wind-induced coal-cycling events from Figure VI-7 to the total wind generation for each year. In 2008, wind generation grew by 73% over 2007 and another 23% in 2009 over 2008. The incremental growth in 2009 appears to have had a more profound impact on the incidence of cycling than did the larger growth in 2008. This suggests that the impact of wind is cumulative: the more wind that comes on the system, without corresponding additions of other generation forms, the more wind-induced coal cycling happens.

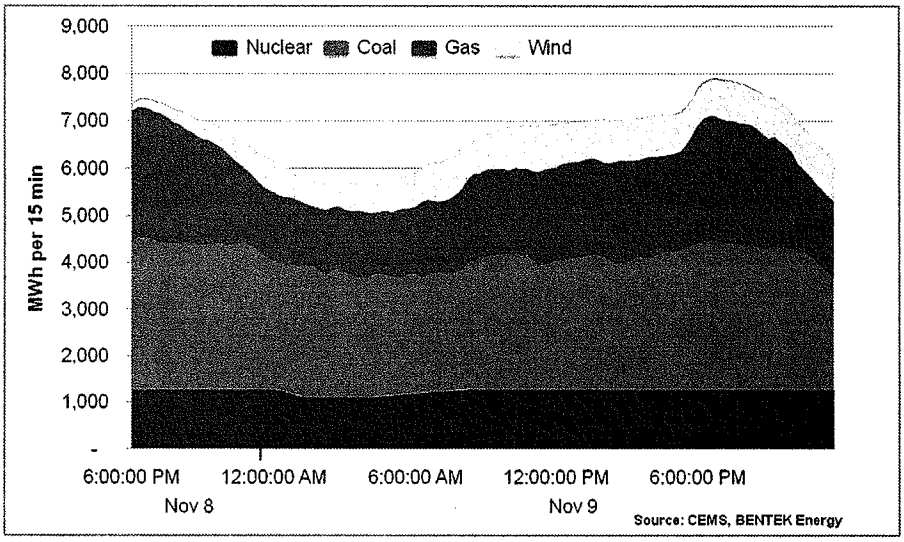
Figure VI-8
ERCOT, Wind Induced Coal Cycling & Wind Generation



Emission Impacts - The Deely Plant Case Study

The days of Nov. 8 and 9, 2008, are contrasting days on the ERCOT generation system. Figure VI-9 illustrates the generation mix for each of these days. The purple area indicates nuclear generation, the grey area shows coal generation, the blue area is gas-fired generation, and the light green area represents wind generation.

Figure VI-9
ERCOT Generation Mix: 11/8/2008 – 11/9/2008

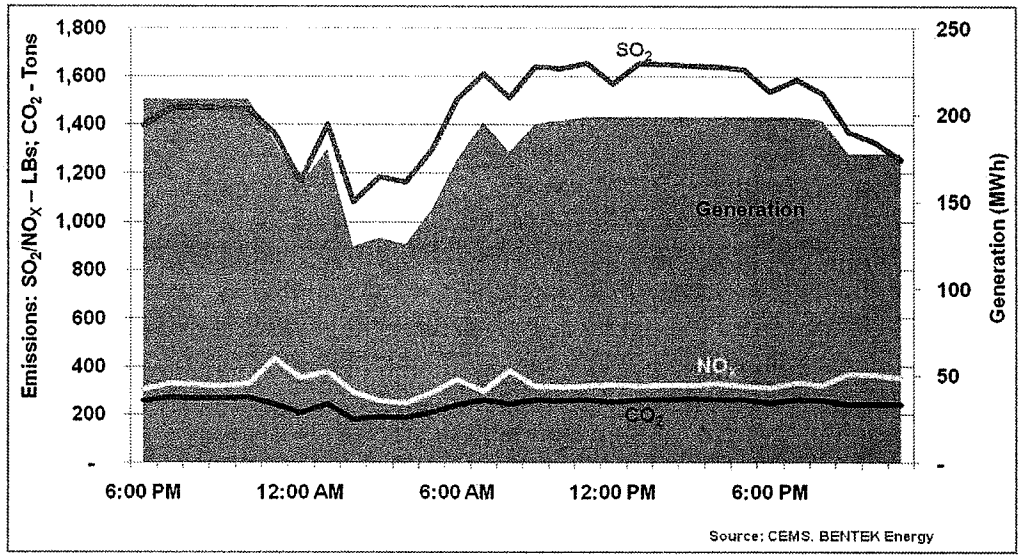


Nov. 8 had nearly no wind generation in the morning. Wind accounted for 2% of total generation on that day. As a result, coal-fired generation produced power on a consistent basis throughout the morning until late in the evening. About 8:00 pm on the 8th, wind

generation began coming online and grew until it peaked about 7:00 am on Nov. 9. However, through Nov. 9, wind generation was strong, accounting for 12% of total generation. Coal units were cycled throughout the day on Nov. 9 to accommodate wind generation.

One coal-fired plant was chosen to illustrate the impact of coal cycling. The J.T. Deely plant was one of the plants used to accommodate wind on that day. Figure VI-10 details hourly generation and emissions over Nov. 8 and 9. The blue area depicts generation, the red line shows pounds of SO_2, the green line indicates pounds of NO_X and the purple line is tons of CO_2. The graphic shows the sharp drop in generation, beginning about 9:00 pm. SO_2 initially followed suit and fell until generation began to rise about 4:00 am on the 9th. From that point, SO_2 rose with increased generation, but did not flatten out when generation reached its peak at about 7:00 am. For the remainder of the day, generation held at between 199 and 178 MWh, 10 MWh below the pre-event generation level, yet SO_2 emissions exceeded pre-event levels by an average of 161 pounds until 9:00 pm when it finally fell back as generation once again declined. NO_X and CO_2 both rose slightly as coal generation fell, but, as the generation came back online, emissions quickly came back and held at their pre-event levels.

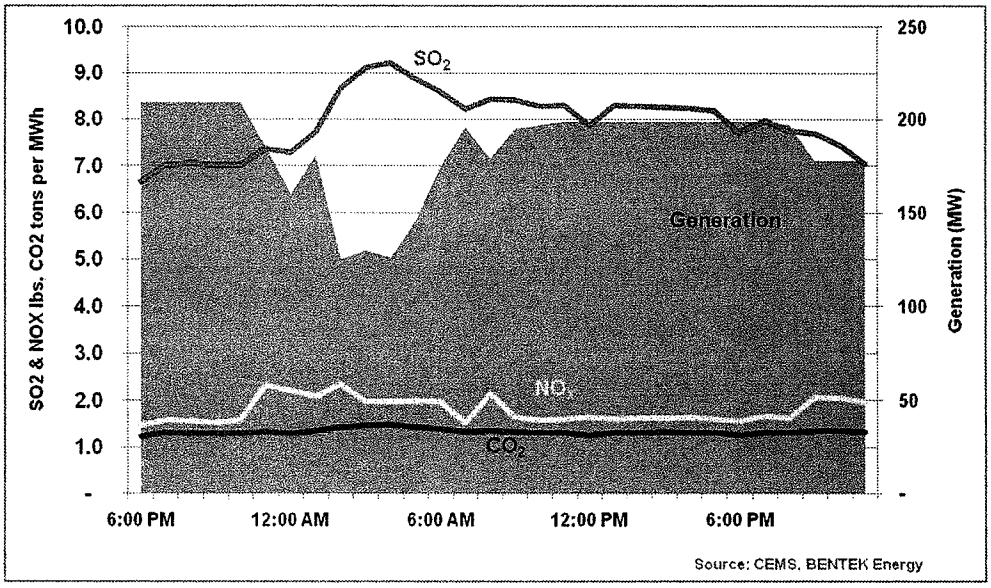
Figure VI-10
J.T. Deeley Generation & Emissions: Nov. 8-9, 2008



The behavior depicted in Figure VI-10 suggests that the emission rates did not fall proportionate to generation.

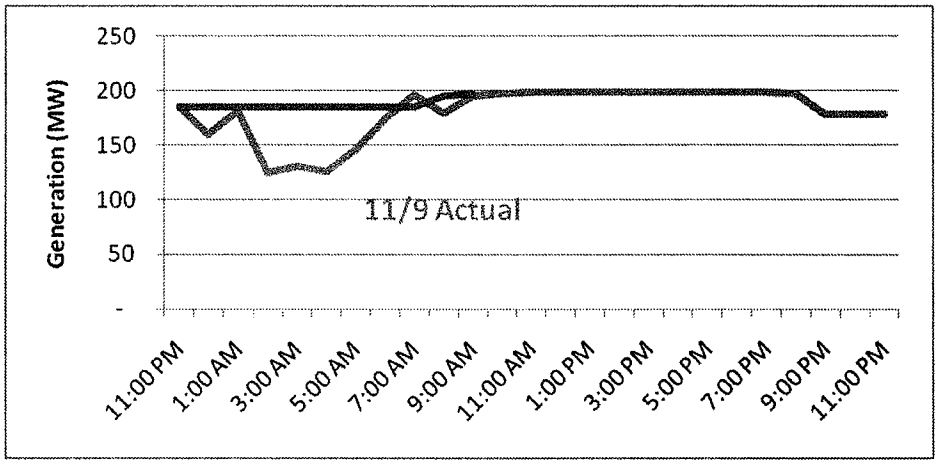
Figure VI-11 shows the impact of the Nov. 8-9 event on emission rates. Emission rates for SO_2, CO_2 and NO_X rose significantly immediately after Deeley generation was cycled and came back down as generation was brought back online. SO_2 rates did not return to their pre-event levels until late in the day. Interestingly, when generation dropped at about 10:00 pm on the 9th, NO_X rates, once again, went up.

Figure VI-11
J.T. Deeley Generation & Emission Rates: Nov. 8-9, 2008



Compared to the 8th, emission rates on the 9th are significantly higher. If generation at Deeley had remained constant on the 9th instead of variable, the emission rates would have been similar to the 8th. The blue line in Figure VI-12 depicts the 247 MW of avoided generation due to cycling for wind on Nov. 9.

Figure VI-12
J.T. Deeley Generation: Nov. 9, 2008



To calculate emissions associated with the event, Method C, which is discussed in Chapter IV was employed. The stable day rates evidenced on Nov. 8 prior to the wind event are used to

calculate avoided emissions and then compared to the actual emissions from Nov. 9. The event resulted in 2,506 pounds of incremental SO_2, 717 pounds of incremental NO_X and saved 120 tons of CO_2.

Cycling J.T. Deeley to compensate for wind generation caused more SO_2 and NO_X emissions than if J.T. Deeley had generated the same amount at a flat level. Due to cycling, J.T. Deeley emitted 8% more SO_2 and 10% NO_X, while saving 2% of CO_2 emissions.

This case study of the Deeley plant indicates that much like the PSCO examples, coal plants in Texas operate at the highest efficiency during steady-state operation at the levels for which they are designed. Operating these facilities irregularly or at non-design levels leads to inefficient operation and higher emission levels.

ERCOT General Analysis

The same methodology from the PSCO analysis is employed to understand the emission impact that wind generation had on the ERCOT system for an entire year. Stable days of generation are identified for each facility on monthly and quarterly bases. Wind events are defined as instances where coal generation dropped by at least 10% hour-to-hour with a corresponding increase in wind generation.

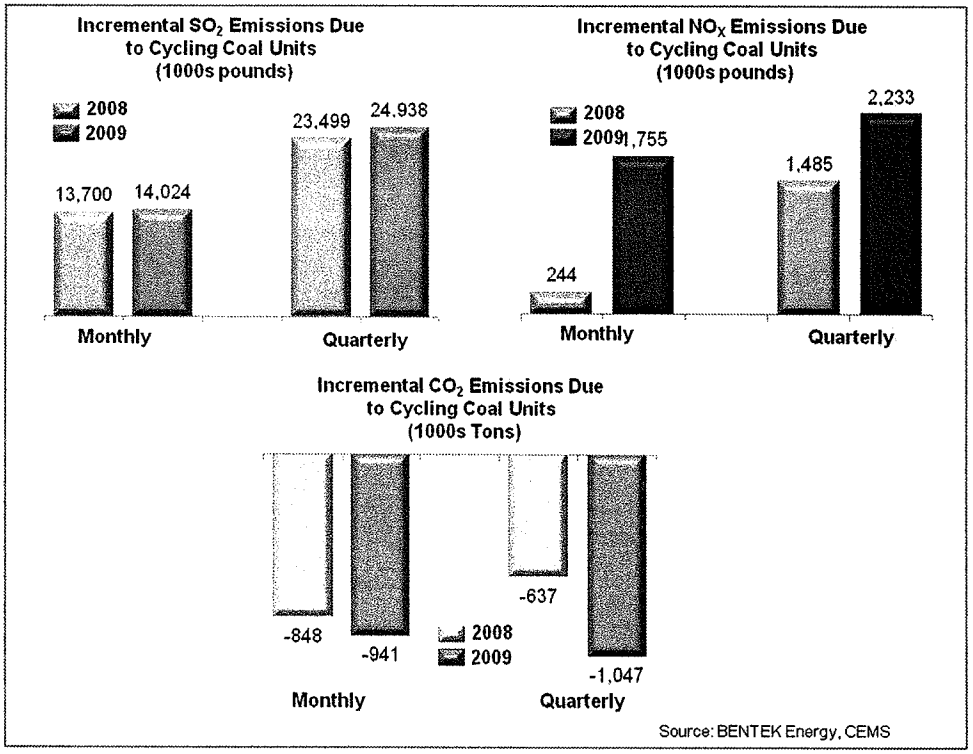
As was the case with the Colorado analysis, two techniques are used to estimate the emission impacts. The first is the Specific-Event Approach, the second, the Full-Year Approach. Both are described more fully in Chapter IV.

Specific-Event Approach

This approach identified all days where coal generation decreased or increased more than 10% hour-to-hour when total wind generation moved in an opposite direction over the same timeframe. The offset generation from coal plants during these instances is added into the stable day calculation. Stable days are identified on monthly and quarterly bases for a broad understanding of how emission rates can change. The key to this approach is that only emissions associated with the Specific-Events is included in the analysis.

Figure VI-13 summarizes the results for the Specific-Event Approach. Wind-induced cycling resulted in incremental production of SO_2 and NO_X, but resulted in less CO_2 being produced. Depending on whether quarterly or monthly averages are used for the stable day cycling, SO_2 emissions ranged between 13.7 and 14.0 million pounds (2%-3% of total SO_2), which is more than would have happened without the wind. Incremental NO_X emissions were between 0.2 and 2.2 million pounds (1% of total NO_X). CO_2 emissions were between 600 and 1,000 tons lower (less than 1% of total CO_2).

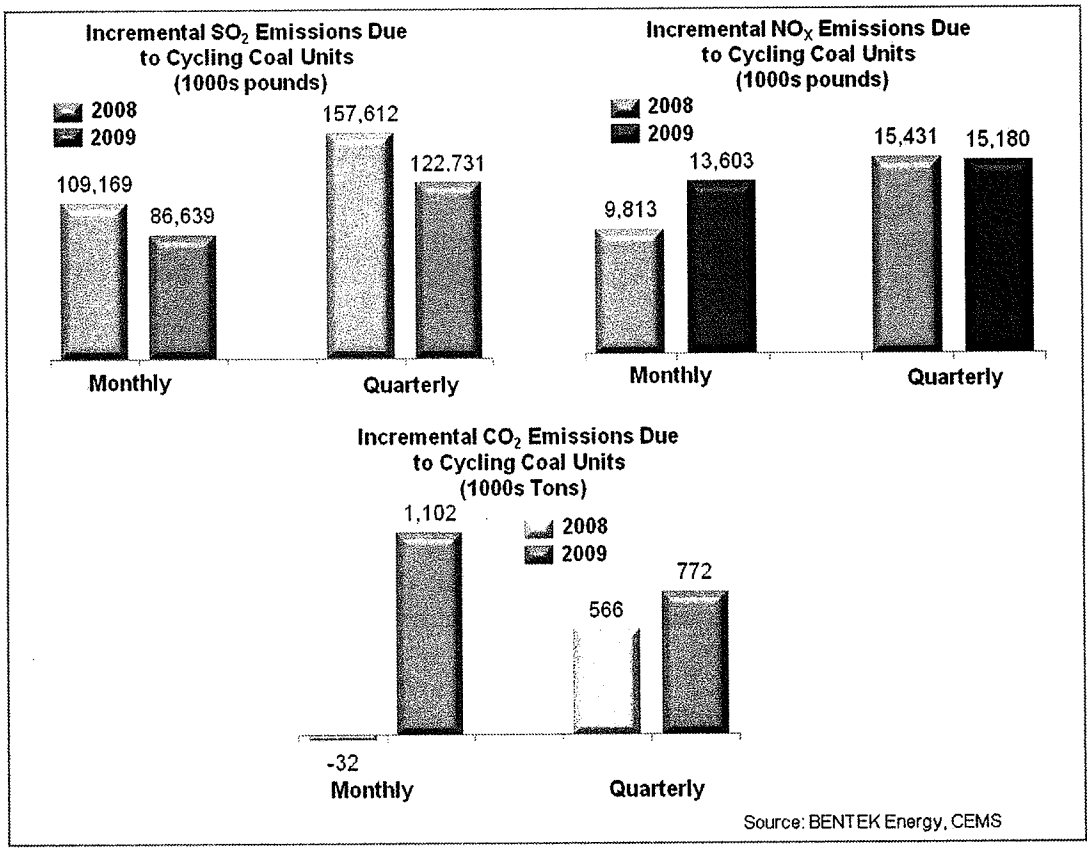
Figure VI-13
Incremental Emissions Resulting from Coal Cycling (Specific-Event Approach)



Full-Year Approach

As with the PSCO model, the Specific-Event Approach probably underestimates the emissions that result from cycling. It ignores the fact that the disruption to emissions controls and resulting abnormal emission rates can last beyond a day and that numerous other smaller events take place that are also brought about by wind forcing cycling at coal plants. To correct for this limitation the Full-Year Approach is also used. This approach compensates for the limitations of the Specific-Event Approach by taking all cycling events for all days into account for each unit. The same stable-day rates are used in this approach. While this approach probably overstates the impact, it provides solid upper bounds for the impact range. The results for the Full-Year Approach are captured in Figure VI-14.

Figure VI-14
Incremental Emissions Resulting from Coal Cycling (Full-Year Approach)



As shown in Figure VI-14, CO_2, SO_2 and NO_X emissions are all higher than they would have been had coal units not been cycled. SO_2 emissions were between 86.6 and 157.6 million pounds higher, which amounts to approximately 15% of total SO_2 emissions in 2008 and about 13% of SO_2 emissions in 2009. NO_X emissions were between 9.8 and 15.4 million pounds higher or about 7% and 8% of total 2008 and 2009 NO_X emissions, respectively. CO_2 emissions were higher in 2009 by between 0.8 and 1.1 thousand tons in 2009 and ranged from a very small savings to 0.6 thousand tons incremental emissions in 2008. The range amounts to less than 1% of total CO_2 emissions in either year.

Conclusions

The ERCOT system was studied due to the availability of wind data to correlate with coal cycling events and because of the larger gas-fired generation capacity resident on the system. Identifying days where wind generation resulted in the cycling of coal units allowed for a precise understanding of the emission impacts. The gravity and frequency of these events increased as more wind generation was introduced to the system. This mirrors the results found on the PSCO system, supporting the theory that the increased rate of cycling is due to the incremental integration of wind generation. Furthermore, these wind-driven, coal-cycling events resulted in significantly more SO_2 and NO_X emissions than if wind generation had not been utilized. The same results were found on the PSCO system. Not only does wind generation not allow ERCOT utilities to save SO_2, NO_X and CO_2 emissions, it is directly responsible for creating more SO_2 and NO_X emissions and CO_2 emission savings are minimal at best.

VII.
Toward a Solution: Substituting Gas-fired Generation for Coal

One major conclusion from the preceding chapters is that cycling coal-fired facilities – whether caused by accommodating wind or other factors – makes the units less efficient and increases emissions, particularly SO_2 and NO_X. Given the documented increase in coal cycling events over the past few years on the PSCO system, this dynamic is problematic because several of the plants that are cycled most – Cherokee, Arapahoe, Pawnee and Valmont are located within or in close proximity to the Denver Non-attainment Zone for Ozone. The Denver Non-attainment Zone for Ozone is the area around Denver in which the US Environmental Protection Administration (EPA) monitors ozone levels as part of their obligations under the Federal Clean Air Act (42 U.S.C Sec. 7401). As detailed in Chapters IV and V, all of these plants have experienced an increase in SO_2, while the Cherokee, Arapahoe and Valmont plants experienced increased NO_X and CO_2 emission rates between 2006 and 2009. Since the EPA has announced that it will tighten allowable ozone emission levels beginning in February 2011, continued cycling of these plants will make it more difficult to meet the new emission restrictions.

This chapter explores one approach to reducing the NO_X and SO_2 emissions within the Denver Non-attainment Zone, namely retire or cease to use the Cherokee and Valmont plants and replace the lost generation with natural gas-fired generation. These two plants are among the oldest of the Front Range coal units. Arapahoe is also relatively old, but it is already scheduled for retirement in 2012 according to the 2007 PSCO IRP. The Pawnee facility is also located in proximity to the Denver Non-attainment Zone, but because it is relatively new (1981) and equipped with more flexible generation capabilities, it is not as dramatically impacted by cycling as the other units and replacement would be more costly for the consumer.

Methodology

The capacity lost by retiring the Cherokee (710 MW) and the Valmont (166 MW) plants can theoretically be offset by increased utilization of existing gas-fired resources, whether PSCO or third-party owned. Alternatively, if those resources are insufficient, PSCO might replace the plants with gas-fired capacity, increased third-party purchases or a combination of the two options. Accordingly, a model was developed that calculated the total hourly generation from the Cherokee and Valmont plants over the three year period from 2007 through 2009. Next, the hourly coal generation from the retired plants is compared to the hourly available generation capacity from the combined cycle plants that are part of the 2007 IRP resource plan. If the combined cycle generation is insufficient, the available combustion turbine capacity is utilized. When the available combined cycle and combustion turbine capacity are inadequate to meet the demand, then a shortfall is identified. Both combined cycle and combustion turbines were assumed to run up to 90% of their nameplate capacity, thus, accounting for NERC reliability standards. The objective of the analysis is to determine whether or not the existing gas-fired facilities of PSCO are adequate to provide the power

generation that would be lost by the early retirement of Cherokee and Valmont or whether additional capacity is required.

Results

The existing combined cycle and combustion turbine resources appear adequate to absorb the generation lost by retiring Cherokee and Valmont. Table VII-1 summarizes the calculation on an annual basis. In all three years there was ample gas-fired capacity to make up for the lost generation from Cherokee and Valmont.

Table VII-1
Estimated Available Gas-fired Capacity after Replacing Cherokee and Valmont (Annual Calculation)

	2007	2008	2009
Total Available Combined Cycle Capacity	8,085,990	8,152,453	8,595,652
Total Generation From Cherokee and Valmont	6,611,206	6,203,178	4,720,685
Net Remaining CC Capacity	**1,474,784**	**1,949,275**	**3,874,967**
Total Available Capacity from Combustion Turbine	13,368,519	13,934,405	12,793,050
Net Remaining CC and CT Capacity	**14,843,304**	**15,883,680**	**16,668,017**

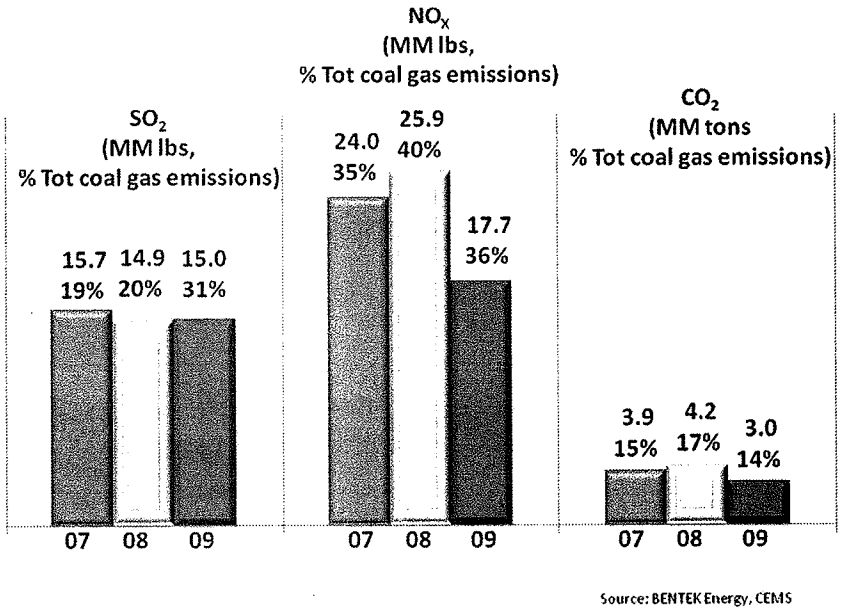
The annual calculation, however, masks the reality that capacity issues are immediate – the power is needed immediately when called upon. Annual averages mask hourly variability, thus, are of minimal value. The hourly granularity of the CEMS data allows analysis on an hourly basis. Table VII-2 shows the number of hours during 2007, 2008 and 2009 that the aggregated combined cycle and combustion turbine generation was not adequate to offset the lost coal generation. In 2007 the combined gas-fired capacity could offset 100% of the lost coal generation and in 2008 and 2009 there were 35 and 11 hours respectively when the gas-fired capacity was insufficient to handle the lost generation from Cherokee and Valmont.

Table VII-2
Number of Hours Installed Gas Capacity Cannot Meet Incremental Demand

	2007	2008	2009
Combined Cycle	3,158	2,353	1,067
Combined Cycle Plus Combustion Turbine	0	35	11

To calculate the emissions reduction inherent in using the existing gas plant more fully and retiring Cherokee and Valmont, the incremental emissions at gas-fired plants was multiplied by the average actual emission rates for combined cycle and combustion turbines in each. The total is then subtracted from the total emissions from Cherokee and Valmont to estimate the net savings or increase in emissions. Figure VII-1 summarizes the results below. Replacing Cherokee and Valmont will improve total SO_2 emissions by approximately 15.2 million pounds, NO_X by about 22.5 million pounds and CO_2 by 3.7 million tons.

Figure VII-1
Estimated Emissions Savings from Replacement of Cherokee and Valmont with Gas-fired Generation



Conclusions

Assuming that total demand is less than or equal to 2007 demand, the available capacity from the existing gas-fired plants appears adequate to absorb the generation lost by retiring Cherokee and Valmont. Once Arapahoe is retired in 2012, gas-fired generation will no longer be adequate, particularly as PSCO also plans to add some 300 MW of additional wind capacity by that year.

VIII.
Conclusions and Mitigation Suggestions

The overarching conclusion of this analysis is that, like many other public policies, there are unintended consequences to implementation of Colorado's RPS. Wind and renewable energy programs have been implemented in Colorado and around the country for the best of intentions: reducing air pollution (primarily CO_2 and other greenhouse gases). The research in this report, however, suggests that wind energy, as it has so far been developed by PSCO in Colorado and by numerous utilities in ERCOT, has had minimal, if any, impact on CO_2, yet has lead to a significant increase in SO_2 and NO_X. This chapter presents the study conclusions and makes a number of recommendations to improve the effectiveness of wind resources.

Conclusions

The study details the surprising conclusion that the use of wind energy in the PSCO and ERCOT context results in increased SO_2 and NO_X and, in the case of PSCO, CO_2. The mechanism driving increased emissions is the need to cycle coal facilities in order to accommodate wind, which is considered a "must-take" resource due to the respective states' RPS mandates. When wind generation comes online, generation from coal (and natural gas-fired) plants is curtailed until the wind subsides, then their generation is once again ramped up to meet demand. Cycling coal units in this manner drives their heat rate up and their operating efficiency down, resulting in higher emissions of SO_2, NO_X and CO_2 than would have been the case if the units had not been cycled.

For the PSCO territory, two methods are used to calculate the incremental emissions that result from coal cycling. The first method includes only specific instances where coal generation fell by 10% hour-to-hour between 12:00 am and 8:00 am. Results generated from this method represent the lower end of the estimate of incremental emissions due to wind because this methodology masks small, but sharp, generation changes that happen within an hour. The data suggests that these minimal events also result in significantly abnormal emission rates. The second method assumes that all variation in emission rates above stable day norms result from coal cycling events, and ignores maintenance. Maintenance events typically are controlled events where emission rates do not increase. Therefore, maintenane events are assumed not to contibute to significantly to the emission increases captured in this method. Nevertheless, the second method captures emission increases due to a much broader array of causes, only one of which is wind. Accordingly, this method over-estimates the potential impact of wind because many of the events are not wind induced.

In the ERCOT territory, wind events are defined precisely: a 10% or more decrease in coal generation simultaneous to a similarly sized increase in wind generation. For all scenarios, actual emissions associated with the events are compared to estimated emissions defined as avoided generation from coal multiplied by an estimated "stable day" emission rate based on stable coal-fired generation periods observed over the month and quarter.

Table VIII-1 shows the results of these analyses. The study estimates that coal cycling due to wind in PSCO's territory resulted in between 2.0 and 10.5 million pounds of SO_2 (2.7% to 14.2% of total PSCO SO_2 emissions) in 2008 and from 797,000 to 6.8 million pounds of SO_2 (1.6% to 14%) in 2009. NO_X emissions were also higher due to cycling. In 2008, they ranged from 1.5 to 6.3 million pounds (2.4% to 10.0%). In 2009, the range was from 478,000 to 3.1 million pounds (1.0% to 6.7%). CO_2 emissions results were more mixed. In 2008, they ranged from between a savings of 163,000 tons to an incremental 152,000 tons (-0.8% to 0.8%). In 2009, the range was from 94,000 to 147,000 tons (-0.6% to 0.9%). In all cases, the savings or gain amounted to less than 1% of total CO_2 emissions.

Table VIII-1

	2008			2009		
	SO_2 (Ths LBs)	NO_X (Ths LBs)	CO_2 (Ths Tons)	SO_2 (Ths LBs)	NO_X (Ths LBs)	CO_2 (Ths Tons)
PSCo Specific Event (Quarterly)	2,001	1,481	(163)	797	478	94
PSCo Full Year (Quarterly)	10,517	6,279	152	6,825	3,086	147
ERCOT Specific Event (Quarterly)	23,499	1,485	(637)	24,938	2,233	(1,047)
ERCOT Full Year (Quarterly)	157,612	15,431	566	122,731	15,180	772
	Pct of Total Annual Emissions					
PSCo Specific Event (Quarterly)	3%	2%	< 1%	2%	1%	< 1%
PSCo Full Year (Quarterly)	14%	10%	1%	14%	7%	1%
ERCOT Specific Event (Quarterly)	2%	1%	< 1%	3%	1%	< 1%
ERCOT Full Year (Quarterly)	15%	7%	< 1%	13%	8%	< 1%

In ERCOT, the results are somewhat different. The ERCOT study found that cycling coal due to accommodating wind resulted in increases between 23 and 157 million tons of SO_2 in 2008, and 25 and 123 million pounds of SO_2 in 2009. As a percent of total SO_2 emissions, these estimates range from 2% to 15% for 2008 and between 3% and 13% for 2009. Excess NO_X emissions due to coal cycling in 2008 ranged from 1.5 to 15.4 million pounds and between 2.2 and 15.2 million pounds in 2009. The 2008 numbers amount to between 1% and 7% of total NO_X emissions and between 1% and 8% in 2009. As was the case with PSCO's territory, CO_2 emissions due to cycling were mixed. In 2008, the range was between a savings of 637,000 tons and generation of an incremental 566,000 tons. In 2009, the range was a savings of 1.0 million tons to a gain of 772,000 tons. In all cases, these estimates were less than 1% of total CO_2 emissions.

In both the PSCO and ERCOT analyses, the overall conclusion is that coal cycling has significantly increased since wind generation was added to both systems. The above table clearly indicates that, regardless of how they are measured, SO_2 and NO_X emissions have increased due to the increased coal cycling. While it is not possible to precisely indicate how much of the increase is due to wind-induced cycling, as much as 70% of cycling events appear to be wind related in ERCOT. Thus, it is logical to assume that a significant portion of the incremental emissions due to cycling are, in fact, caused by the need to accommodate

wind. While meeting RPS-mandated wind generation requirements appears to have a minimal impact on CO_2, it appears to appreciably increase SO_2 and NO_X.

There are two caveats that must be understood when interpreting the results of this study. First, the study found no instances where PSCO violated any of its air permits as a result of cycling coal. Neither PSCO case study revealed instances where PSCO's emissions exceeded its permits. Furthermore, the study authors are not suggesting that PSCO violated permits in extrapolating the case study results to estimate annual emissions. The second caveat pertains to the data. For the ERCOT analysis, hourly generation data is available by plant and fuel type including wind. Thus, it is possible to precisely identify wind events based on a sudden decline in coal generation coupled with a simultaneous increase in wind generation. In the case of PSCO's territory, it is not possible to define wind events with the same precision since PSCO does not release its hourly generation data for its wind resources.

There are several other subsidiary conclusions from the analysis:

1. **Duration**. Cycling coal-fired power plants has short term and long term impacts. Studies that describe interaction between coal and wind often mention the cycling issue, but they generally discuss the impacts in a very narrow context: the period of time in which the coal plant reduces generation. This study concludes that the impacts frequently have much longer duration. Many instances were found where cycling causes bag-houses or other pollution controls to lose their calibration and take as long as 12 to 15 hours, sometimes as long as 24 hours, to settle back to the pre-event emission rates. During these periods, emission rates normally exceed what would be experienced if the plant were run at a "stable" generation level.

2. **Timing**. Wind-induced coal-plant cycling appears to be a nighttime phenomenon. Nearly 70% of the cycling instances identified for PSCO in 2008 occurred between 12:00 am and 8:00 am. Similarly, 82% of coal cycling events in ERCOT occurred during the same time of day.

3. **Non-wind renewable implications**. Coal-cycling issues do not appear to impact solar and other non-wind renewable energy forms. Solar energy is generated during daylight hours, thus, coincides with natural gas-fired generation. When solar energy peaks, there is a much greater likelihood that natural gas-fired generation can be cycled to accommodate the energy.

4. **Generation mix**. Composition of the generation stack is a critical factor. Since most wind driven cycling events appear to occur between 12:00 am and 8:00 am, they also occur during periods of lowest load. As a result, PSCO and the utilities in ERCOT are only operating their "base load" facilities. In the PSCO context, this means the coal plants supplemented with some combined-cycle natural gas and hydro are in operation. In the ERCOT context, base load includes nuclear, coal and combined-cycle plants. The extra emissions result because the RPS-mandated "must-take" wind resource exceeds the quantity of power being generated from combined-cycle gas.

PSCO's generation mix between 12:00 am and 8:00 am averages 62% Coal, 20% Combined Cycle, and 18% Hydro, Wind and Purchases. In ERCOT, the corresponding mix is 17% Nuclear, 40% Coal, 28% Combined Cycle, 6% Combustion Turbine, 9% Wind and 0% Hydro. Increasing the proportion of base load that is generated by more flexible generation equipment – such as natural-gas-fired combined-cycle plants – will enable systems to absorb wind without having to cycle their coal plants.

5. **Regulatory** conflict. The study results suggest that the RPS mandate is in conflict with the Colorado State Implementation Plan for air emissions. The RPS standard requires that more wind resources be utilized than can be offset with lower-emission, natural-gas generation equipment. That is the case today when wind resources account for about 9% of PSCO's total sales. Wind generation will increase in the coming years due to mandates to move toward the new 30% of total sales standard. Without substantially more natural gas generation being added to the PSCO system, the emission increases documented in this study will rise, further enlarging the degree to which Denver and the Front Range violates its SIP limitations.

6. **National implications.** Congress considering legislation that would mandate a federal RPS. While this study only paid cursory attention to areas other than the ERCOT and PSCO territories, it is doubtful that a national RPS can be imposed without creating the same emissions outcome found in ERCOT, the PSCO territory and in many other states. Unless other states have a sufficient natural gas cushion – remember Texas has the largest share of its generating capacity fueled by natural gas – imposition of an RPS standard greater than 5% will probably increase emissions of CO_2, NO_X and SO_2.

Mitigation Recommendations

This study suggests several mitigation measures that should be considered:

1. **Result validation.** It is recommended that IPAMS request a joint research effort with PSCO to validate the results of the study. Significant additional emphasis should be placed on analysis of hourly wind data similar to that provided in ERCOT to enable more precise identification of "wind events." In addition, PSCO's insight should enhance understanding of why significant impacts occur hours after what appears to be a wind event.

2. **Data publication.** It is in the state's best interest to understand the air emission implications of PSCO's generation behavior, particularly if state mandates are counter-productive to emission reduction goals. Without timely publication of the hourly generation from wind, it is not possible for third parties or the state to understand the regulatory interactions without making significant assumptions. The PUC should consider requiring the publication of hourly generation data by fuel source including wind as part of PSCO's ongoing reporting mandates. The posting does not need to be immediate; a time lag of 90 days would be reasonable and enable PSCO to maintain limited confidentiality to enhance its trading positions. True transparency around these issues is not possible without publication of this data.

5

3. **Short term.** In the short term (one to two years) there appear to be two options:

    a. Immediately reduce generation at Cherokee and Valmont to levels that eliminate the need to cycle by replacing the generation with power produced by the numerous under-utilized gas-fired combine cycle and combustion turbines that are part of the current IRP resource mix.
    b. Limit the utilization of wind generation to levels that may be offset by cycling non-coal facilities. This means that until new generation equipment can be brought online, PSCO may not be able to meet the RPS mandate to provide 12% of "sales" by 2014, but it could meet a mandate to have 12% of capacity in the form of renewable energy technologies by 2014. After 2014 provisions of the current RPS mandate can be met, provided that adequate gas-fired generation is added.

4. **Long term**. Beyond 2012, PSCO should consider adding significantly to its combined-cycle natural gas plant capacity and utilization. Combined-cycle plants are designed to operate as base load generation and emit significantly lower NO_X and CO_2 than combustion turbines. Adding more combined-cycle plants to the generation stack will provide a cushion that will obviate PSCO's need to cycle its coal facilities in all but the most extreme situations.

5. **Improved modeling**. PSCO, like most utilities, dispatches its plants based on forecast generation needs, anticipated emissions, and fuel and emission costs. The models used to accomplish this are driven by assumptions about emissions outputs that do not appear to take account of the actual variability evidenced by coal cycling. PSCO and the PUC should consider improving these models so that they incorporate the variability that is evident in the historic data. This would provide more accurate accounting of emissions and the associated costs of cycling coal-fired power plants.

    In addition, future wind integration studies should more dynamically account for the emission impacts of coal cycling. Modeling efforts should be calibrated to actual historical data, not hypothetical averages and recognize that emissions rates are adversely impacted over longer periods than the specific cycling timeframe. The impacts of cycling coal plants are not limited to boiler efficiency; the interactions of emission control technologies should also be considered.

6. **Reconcile RPS and SIP** mandates. This study documents the degree to which RPS and SIP mandates are counter-productive. The RPS promotes reduced CO_2, but if implemented inappropriately can result in greater SO_2, NO_X, and CO_2 emissions. It is this potential to increase SO_2 and NO_X which conflict with the mandates of the SIP. RPS mandates need to be structured so that they do not create this conflict.