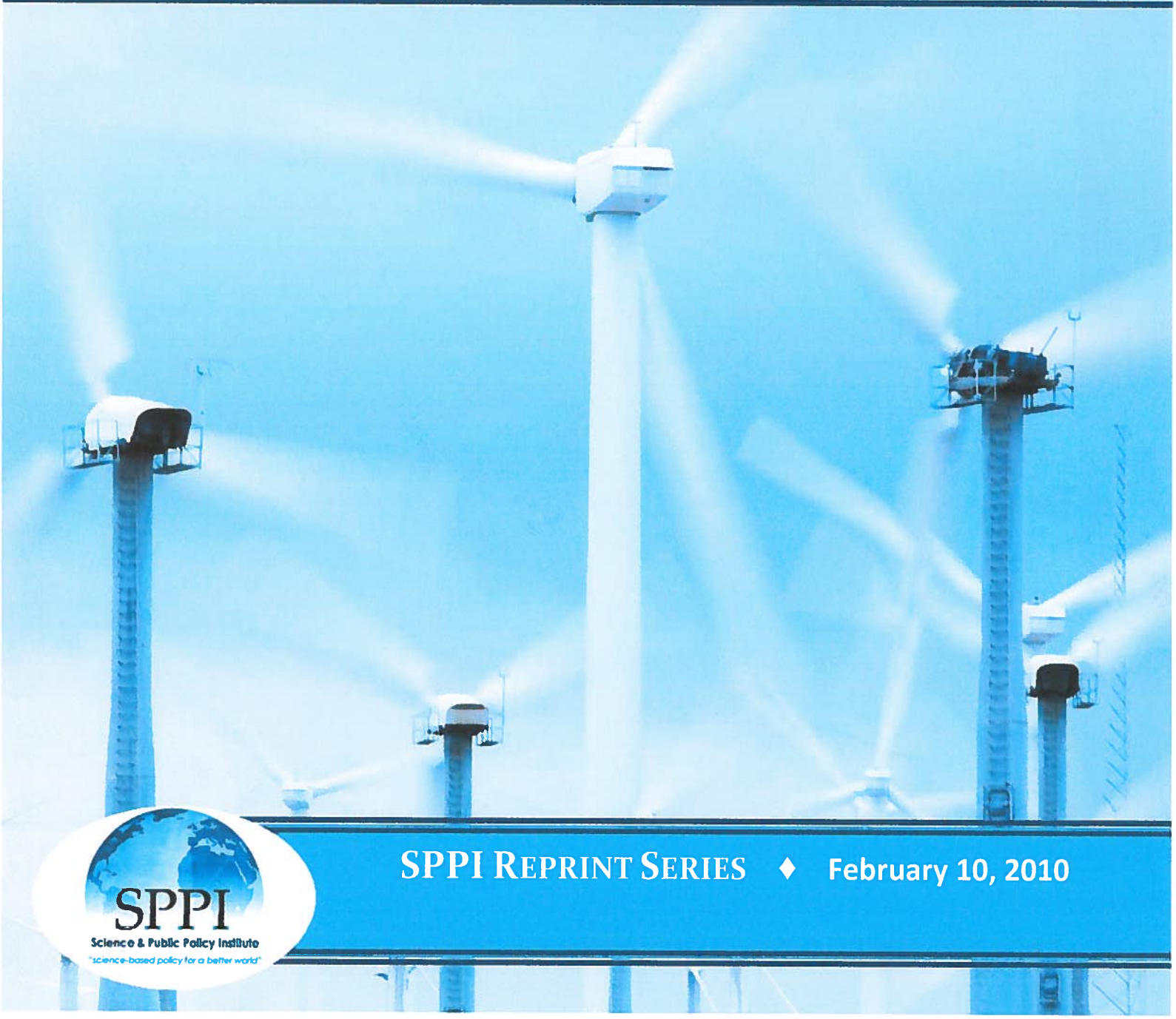
The True Cost of Electricity from Wind is Always Underestimated and its Value is Always Overestimated

by Glenn R. Schleede



SPPI Reprint Series ♦ February 10, 2010

SPPI
Science & Public Policy Institute
"science-based policy for a better world"

TABLE OF CONTENTS

INTRODUCTION 3

PERVASIVE MISUNDERSTANDING OF THE TRUE COST AND VALUE OF ELECTRICITY FROM WIND 3

IMPROVING PUBLIC, MEDIA AND POLITICAL LEADERS' UNDERSTANDING OF WIND ENERGY COSTS AND VALUE 4

SIX POINTS CRITICAL TO AN ACCURATE UNDERSTANDING OF THE HIGH TRUE COST AND LOW VALUE OF ELECTRICITY FROM WIND 5

POINT 1: There is a fundamental difference between wind turbines and reliable electric generating units. 6

POINT 2: Wind turbines have little or no "capacity value." 7

POINT 3: Electricity produced by wind turbines – i.e., the kilowatt-hours (kWh) – has less real value than electricity produced by reliable generating units.. 8

Point 4: Large parts of the true capital and operating costs of electricity from wind are hidden because massive federal, state and local tax breaks and subsidies shift much of its true cost from "wind farm" developers and owners to taxpayers and electric customers. 8

Federal tax breaks and subsidies. 9

State tax breaks and subsidies for "wind farm" owners. 14

Local government and economic development agency tax breaks and subsidies. 15

POINT 5: Other important elements of the full, true cost of electricity from wind are often hidden or ignored by wind energy advocates 16

POINT 6: No one really knows the true cost per kilowatt-hour (kWh) of electricity from wind turbines because all estimates of such costs are based on highly questionable assumptions – really guesses – that are untested. 18

THE PRECEDING POINTS ARE FOCUSED ON FINANCIAL COST AND VALUE, NOT EXTERNALITIES 20

CONCLUSIONS 20

THE TRUE COST OF ELECTRICITY FROM WIND IS ALWAYS UNDERESTIMATED AND ITS VALUE IS ALWAYS OVERESTIMATED

by Glenn R. Schleede | February 4, 2010

INTRODUCTION

Probably the most common wind energy question that I receive from analysts, reporters, and interested citizens deals with the cost of electricity from wind. The frequency of the question is understandable since estimates provided by the wind industry, federal and state agencies and contractors, and the media *understate* the true cost and ignore the fact that electricity from wind is very low in *value*.

Typically, those asking the question would like a simple way to compare the cost of electricity from wind with the cost of electricity from other sources. Unfortunately, that isn't possible. For those who insist:

- The first short answer is that the true financial cost of electricity from wind is huge compared to electricity from reliable generating sources.

- The second short answer is that the cost of electricity from wind should not be compared with the cost of electricity from reliable generating sources because the *value* of electricity from wind is much lower.

PERVASIVE MISUNDERSTANDING OF THE TRUE COST AND VALUE OF ELECTRICITY FROM WIND

In fact, few people in the general public, media or government know the facts about the high true cost and low true value of electricity from wind. For example, not long ago, the delegate to the General Assembly representing our district in Virginia stated repeatedly during a telephonic "town hall" that electricity from wind "is now competitive" with electricity from coal. The delegate has a degree in electrical engineering and a long record of accomplishments in electronics. His statement is consistent with claims often made by wind industry lobbyists but, unfortunately, the statement is *false*.

The delegate's false statement is understandable since the US Department of Energy (DOE), DOE's National "Laboratories" and other contractors (all paid with tax dollars), the wind industry; and other wind energy advocates have, for years, issued false and misleading claims about the cost and value of electricity from wind.

Critically important among the elements of true cost that are often understated or ignored by wind energy advocates is the huge cost of tax breaks and subsidies provided to the wind industry. Initially, tax breaks and subsidies for wind energy were justified on grounds that they were necessary to help an emerging technology compete with existing technologies for producing electricity until the technology was more thoroughly developed and demonstrated.

Federal, state and local government tax breaks and subsidies for wind energy have become so prevalent that it's virtually certain that the politicians and regulators who provide them have no understanding of their magnitude and cost. It's also virtually certain that they have not weighed benefits and costs. If they really have done either, there is no question but that they have decided to put the special interest of the wind industry ahead of the interests of taxpayers and electric customers who are paying for their largess.

Wind industry lobbyists have been exceedingly effective in winning huge tax breaks and subsidies from governments. When initially proposed, wind energy advocates argued that tax breaks and subsidies were necessary to permit a relatively "new and developing technology" to gain a foothold in competition with other sources of energy for producing electricity. *However, industry demands for continuation, expansion and extension of subsidies have made it clear that there are no longer any serious expectations that wind energy is competitive or that improvements in the technology will eventually make it competitive.*

Instead, it appears that the only hope that wind energy would become economically competitive with traditional energy sources is if the cost of electricity from traditional sources were driven much higher – with all the adverse impacts on electric customers and local and national economies that result from high electricity prices.

IMPROVING PUBLIC, MEDIA AND POLITICAL LEADERS' UNDERSTANDING OF WIND ENERGY COSTS AND VALUE

The false claims and the widespread misunderstanding about the full, true costs and the low value of electricity from wind demonstrate that it is time to focus on the facts. It would be "nice" if this could be done in a brief paper but brief papers have not been effective in getting through to people (particularly those in government and the media) who should be presenting the public and our political leaders with accurate information. Therefore, it apparently is necessary to "explain the basics" which, unfortunately, requires a long paper that delves into the details about the cost and value of electricity from wind.

Accordingly, this paper provides details on all the key factors that must be taken into account when making honest estimates of the true *cost* and *value* of electricity from wind energy. This paper will not provide numbers that can be compared because the development of valid and reliable *cost* and *value* data requires detailed information and assumptions that vary widely among "wind farms," the generation mix and electricity supply and demand situation within electric grid control areas, and other factors.

Hopefully, once the factors that affect true cost and value of electricity from wind are understood, analysts, investors, reporters, and others interested in honest comparisons of costs and value will be able to make realistic estimates of at least the *costs per kilowatt (kW of) wind generating capacity.*

But, as explained below, reliable estimates of the *cost per kilowatt-hour (kWh of) electricity produced by wind* farms will still not be possible because such estimates are entirely dependent on factors that are and will remain unknown. Assumptions (i.e., guesses) made by those who claim they know the cost per kWh of electricity from wind can easily be in error by a factor of two or more.

Whether estimating the true cost of wind generating capacity or cost of electricity produced from wind, the cost of federal, state, and local tax breaks and subsidies are dominant factors. There is no longer any serious doubt but that tax breaks and subsidies – not environmental, energy, or economic benefits – are the primary reasons that "wind farms" are being built.

SIX POINTS CRITICAL TO AN ACCURATE UNDERSTANDING OF THE HIGH TRUE COST AND LOW VALUE OF ELECTRICITY FROM WIND

Comparing the "cost" of electricity from wind with the "cost" of electricity from reliable generating units is a classic "apples to oranges" comparison (or perhaps crab apples to oranges!). The things being compared may "look" similar but, in fact, are vastly different. In summary, and as detailed below, those making comparisons of the cost of electricity from wind often overlook four critically important facts:

- The full, true *cost* of electricity from wind is seldom revealed because of massive federal, state, and local government tax breaks and subsidies for "wind farm" owners.

- No one really knows the true *cost* per kilowatt-hour (kWh) of producing electricity from wind turbines because all such calculations are always based on assumptions (i.e., guesses).

- The *value* of electricity that is produced by wind turbines is much lower than the *value* of electricity from reliable generating units because the output from wind turbines is intermittent, volatile, unreliable and most likely to be produced when least needed.

- The *value* of wind turbine generating *capacity* is much lower than the *value* of the capacity of reliable generating units because wind turbines produce electricity only

[1] so they cannot be counted on when electricity demand reaches peak levels.

POINT 1: There is a fundamental difference between wind turbines and reliable electric generating units.

There is a vast difference between electric generating units that produce electricity only *intermittently*, such as wind turbines, and *reliable generating units* that can be counted on to produce electricity when it is needed. To be more specific:

1. Electricity cannot be stored in significant amounts and, therefore, must be produced as it is needed (or "demanded") by customers. Demand for electricity by customers – whether residential, commercial, or industrial -- varies widely by time of day, day of week, season of the year, prevailing weather and temperature, strength of the economy, and other factors

2. Managers of electric grids are responsible for assuring that enough electricity is always available to meet customers' demand and, while doing this, must keep the gird in balance (in terms of supply & demand, voltage and frequency) . To do this, grid managers must always have available and under their control generating units that are:

   a. *Reliable,* that is, the unit(s) must be *available or operable and have necessary fuel* so that it can be counted on to produce electricity when its output is needed, and

   b. *Dispatchable,* that is, the unit(s) must be subject to the grid manager's control so that it can be brought on line (i.e., begin production) or taken off line (i.e., stop production), and, for a unit on line, it can be ramped up or down (i.e., increasing or decreasing its output).

   In addition to keeping the grid in balance at all times, grid managers must also have reliable and dispatchable generating capacity *in reserve* , which capacity can be called upon immediately if there is an unplanned outage of one or more on line generating units (or transmission lines), or if there is a significant, unexpected increase in electricity demand.

   The wind industry often pretends that this *operating reserve* of generating capacity should be or is a "free good" that should be available for its use – preferably at no cost – to make up for the fact that their wind turbines can't be counted on to produce electricity when it is promised or needed (i.e., the turbines have little or no real *capacity value*), especially at the time of peak electricity demand. However,

[1] They start producing with winds of about 6 mph, reach rated capacity around 32 mph, cut out around 56 mph, and restart about 45 mph. Much of the time they produce no electricity or only small amounts well below rated capacity.

cutting into a grid's *operating reserve* means that there would be less of a reserve available to its real purpose.

3. *Wind turbines are not reliable or dispatchable.* They produce electricity only when the wind is blowing within the right speed range (shown in footnote #1). Their output is intermittent, volatile, largely unpredictable, and unreliable. If wind turbines are connected to the grid serving the control area, the grid manager must have reliable generating capacity immediately available to "back up" the intermittent, volatile and unreliable output from wind turbines and keep the grid in balance.

4. Generating units that qualify as *reliable* and *dispatchable* are those with turbine-generators powered by natural gas, oil, coal, nuclear energy and hydropower.[2] How quickly a generating unit can be brought on line or ramped up or down varies widely, depending on such factors as the generating technology (e.g., using steam turbine or gas turbine), the energy source, and the age and condition of the unit.

POINT 2: Wind turbines have little or no "capacity value."

A critically important factor affecting the true *value* of the capacity of any generating unit is how much of the unit's "rated" or "nameplate" capacity can definitely be counted on to be available to generate electricity[3] and how much it can definitely be counted to produce *at the time of peak electricity demand in the control area.* This measure is referred to in the electric industry as the unit's "capacity value."

In fact, regardless of their "rated" or "nameplate" capacity,[4] wind turbines can't be counted on to produce any electricity at the time it is most needed; i.e., when electricity demand reaches peak levels.[5] Therefore, wind turbines really have little or no real "capacity value," as that term is used in the electric industry.

Because wind turbines have little or no real "capacity value," electric grid managers responsible for assuring the reliability of electric service must, instead, look to other generating units – i.e., those that are reliable and dispatchable for the capacity that is needed at the time of peak electricity demand. In most areas of the US, peak electricity demand is likely to occur in late afternoon on hot, weekdays in July or August.

When attempting to compare either the *cost* or *value* of electricity from wind turbines, it is important to recognize that the fact that wind turbines produce little or no electricity most

---

[2] In some cases, generating units powered by biomass, trash, geothermal energy, and perhaps, solar thermal energy may also qualify as "reliable" and "dispatchable."

[3] For a wind turbine, the unit must be both operable and *have enough wind.*

[4] A generating unit's rated or nameplate "capacity" is expressed in terms of kilowatts (kW) or megawatts (MW) which is a measure of the amount of electricity that could be produced by the unit at an instant in time if the unit was producing at full capacity.

[5] For most areas of the US, peak electricity demand is most likely to occur on hot, weekday late afternoons in July or August. During these times there is little or no wind and, therefore, little or no electricity from wind turbines.

of the time means that their "rated" or "nameplate" capacity is not comparable in value to the "rated" or "nameplate" capacity of a reliable generating unit. (A clear example of the "crabapple to orange" analogy.)

POINT 3: Electricity produced by wind turbines – i.e., the kilowatt-hours (kWh) – has less real value than electricity produced by reliable generating units.

The true value of a kilowatt-hour (kWh) of electricity *depends on when it is produced.* Specifically, a kWh of electricity produced during periods of high or peak electricity demand has much higher value than a kWh produced when demand is low[6] (e.g., during nighttime hours in most areas of the US).

This, too, is a critically important fact when attempting to compare either *cost* or *value* of electricity from wind turbines with electricity from reliable, dispatchable generating units. The fact is that electricity from wind turbines has a lower *value* per kWh because that electricity is not only intermittent, volatile, largely unpredictable and unreliable, but it is also most likely to be produced at night and in colder months when wind speeds are adequate to spin the blades, not at times of high or peak electricity demand.

Point 4: Large parts of the true capital and operating costs of electricity from wind are hidden because massive federal, state and local tax breaks and subsidies shift much of its true cost from "wind farm" developers and owners to taxpayers and electric customers.

Wind industry officials and lobbyists as well as the politicians, regulators, and other government officials, government contractors, and non-government organizations (NGOs) that support wind industry interests, often understate greatly the true cost of "wind farms" and electricity produced from "wind farms." Sadly, some electric utility officials also participate in hiding the true costs of electricity from wind.

When initially proposed, the rationale for providing tax breaks and subsidies for wind energy was to help a relatively new technology for producing electricity compete with established electric generating technologies until advances in technology would permit wind to compete without subsidies.

However, the massive tax breaks and subsidies now available and the wind industry's well-financed lobbying efforts to preserve, expand, and extend them makes clear that there is no longer any serious expectation that electricity from wind will become competitive or that significant advances in wind technology are likely to ever permit wind to become a competitive source of electricity.

---

[6] Indisputable evidence of this is available on web sites for Independent System Operators (ISOs) or Regional Transmission Operators (RTOs) that manage electric grids in the US. Such web sites generally provide hour by hour (or more frequent) data on the wholesale prices of electricity in competitive markets.

The US Energy Information Administration (EIA), in an April 2008 report,[7] indicated that federal tax breaks and subsidies during 2007 averaged $0.2337 per kWh of electricity produced by wind during 2007. However, that EIA report *underestimated the true cost of the tax breaks and subsidies for wind* because it:

- Failed to take into account either the value of 5-year double declining balance accelerated depreciation (described below) that is available for "wind farm" equipment, but not available for reliable generating units.

- Did not cover, of course, over $1 billion in additional tax breaks and subsidies for wind energy awarded in 2009 by the US Departments of Energy and Treasury (authorized by various "stimulus" measures) allegedly to create jobs in the US. As indicated below, a significant share of these awards were for projects owned by foreign entities, covered equipment manufactured in other countries, or flowed to owners of "wind farms" were already under construction or completed.

- Did not cover state and local tax breaks and subsidies for "wind farm" owners.

Among the many federal, state and local tax breaks and subsidies[8] that reduce "wind farm" developers' and owners' costs – while shifting those costs to ordinary taxpayers and electric customers – are the following:

A. Federal tax breaks and subsidies.

1. **Accelerated Depreciation (MACRS).**[9] Nearly all the capital cost of a "wind farm" – whether financed with equity or debt – can be recovered through deductions from otherwise taxable income using 5-year double declining balance accelerated depreciation (5-yr.-200%DB). These deductions from taxable income reduce tax liability at the owner's marginal tax rate, usually $35 for each $100 deduction. All of the eligible capital cost can be written off ("recovered") over 6 tax years at the following rates – illustrated with $100,000,000 in eligible capital cost:

---

[7] US EIA, "Federal Financial Interventions and Subsidies in Energy Markets 2007," table 35, page 106. http://www.eia.doe.gov/oiaf/servicerpt/subsidy2/pdf/chap5.pdf.

[8] This summary is limited primarily to tax breaks and subsidies that benefit industrial scale wind energy. There are others benefitting smaller scale installations installed by residential, commercial, industrial, educational, and "community" organizations.

[9] MACRS stands for IRS' "Modified Accelerated Cost Recovery Systems," which prescribes the methods that can be used to "write off" capital costs (i.e., deduct the capital cost of facilities, whether financed by equity or debt, from the organizations otherwise taxable income) over a period of time that is generally shorter than the useful life of the facilities. Details of MACRS can be found in IRS publication 946.

Tax Year	Deduction from Taxable Income		Further Reduction in Income Tax Liability (in addition to PTC)
	% of Capital Investment	Amount	
1st	20%	$20,000,000	$7,000,000
2nd	32%	$32,000,000	$11,200,000
3rd	19.2%	$19,200,000	$6,720,000
4th	11.52%	$11,520,000	$4,032,000
5th	11.52%	$11,520,000	$4,032,000
6th	5.76%	$5,760,000	$2,016,000
Totals:	100%	$100,000,000	$35,000,000

Note that these deductions from otherwise taxable income and from tax liability could be taken regardless of whether the $100 million "wind farm" investment is financed with debt or equity.[10]

Note also that, in addition to the further reduction in tax liability, this generous accelerated depreciation deduction for federal income tax purposes has two other huge benefits; specifically:

a. *Prompt recovery of all the owner's equity investment.* Quite likely, the equity investment by "wind farm" owners and their "tax partners"[11] would be no more than 30% with the remaining borrowed to reduce its cost. As the table above shows, all of the equity investment would be recovered thru depreciation deductions early in the second tax year and in less than 1 year if the project begins operating late in the first tax year. With no remaining *equity* investment, the owners' return on equity would be infinite.

b. *A large interest free loan.* The depreciation deduction continues even though all equity has been recovered. Thus, in effect, the owners receive an interest free loan, courtesy of US taxpayers for an amount equal to the debt financing.

2. **Wind Production Tax Credit (PTC).** A "wind farm" owner is eligible for a Wind PTC, currently $0.021 per kilowatt-hour (kWh), for electricity produced during the 1st 10 years of operation. The new expiration date for the PTC was extended to December 31, 2012. If the illustrative $100 million project had turbines with the combined,

[10] Note also that the US Congress enacted a 50% 1st year "bonus" deduction for many capital investments placed in service during 2008 and 2009 as an economic "stimulus." The effect of this "bonus" permitted "wind farm" owners to deduct 60% in the 1st, 16% in the 2nd, 9.6% in the 3rd, 5.76% in the 4th and 5th and 2.88% in the 6th tax years.

[11] To take advantage of the lucrative tax breaks, a "wind farm" owner must have substantial taxable income from sources other than the "wind farm." Developers who do not have enough taxable income merely find some other organization (often a large bank or "Wall Street" financial institution with large amounts of taxable income they wish to shelter from income taxes) that will be their "partner" and part owner for the period of time (years) that is necessary to capture the tax benefits. Then the full ownership "flips" to the developer. The developers and "tax partners" are the big winners and ordinary taxpayers who bear the burden escaped by the "wind farm" owners are the big losers.

"rated" capacity of 50 megawatts (MW) and they operated at a 30% capacity factor[12], the turbines would produce 131,400,000 kWh of electricity each year, the owners would receive a tax credit (a direct deduction form tax liability) of $2,759,400 per year during the first 10 years of operation, thus reducing federal income tax liability by $27,594,000 over 10 years.[13]

3. **Investment Tax Credit (ITC).** "Stimulus" legislation enacted during 2008 and 2009 permits "wind farm" owners to choose an investment tax credit (i.e., a direct deduction from taxes otherwise due) equal to 30% of capital costs in lieu of the Production Tax Credit. If the "wind farm" owner does not have sufficient tax liability to use all of the ITC deduction, unused amounts can be carried forward and deducted in future years. This tax break is available for projects placed in service during 2009 and 2010 or where construction has started by 2010 and placed in service before the end of 2012. The newly authorized ITC has substantial benefits for "wind farm" owners compared to the PTC because (i) the benefit is available immediately rather than over a 10-year period and (ii) the benefit is based on capital cost and, therefore, is available regardless of the amount of electricity produced by the "wind farm."[14]

4. **Cash Grant in Lieu of ITC.** The generous 2008-2009 "stimulus" legislation also made "wind farm" developers eligible for the ITC to elect to receive a cash grant of equal value from the US Treasury in lieu of the ITC. During September 2009, The US Departments of Treasury and Energy awarded grants for "wind farm" projects totaling about $900 million. $546 million or nearly 60% of the total[15] was awarded to the Spain-based firm, Iberdrola. The Iberdrola CEO has indicated that he expects to win another $470 million in grants from Treasury and DOE during 2010.[16]

   Creating jobs was, allegedly, a key reason for the $787 billion "stimulus" legislation but most of "wind farm" projects included in the $1 billion in grants awarded by Treasury and DOE on September 1 and September 22, 2009, were for (a) projects that were already completed, nearly completed or already fully committed to by the grant recipients, (b) were equipped with turbines manufactured primarily in other countries, and (c) were owned by foreign-based companies. Furthermore, "wind farms" result in very few new jobs, certainly fewer than would be created by similar investments in reliable generating units powered by traditional energy sources.

---

[12] "Capacity factor" is an "after the fact" measure determined by dividing the actual electricity production (in kilowatt-hours – kWh or megawatt-hours – MWh by the "rated" capacity times the hours in the period being analyzed (e.g., 8760 hours in a year). For the illustration above, the calculation would be as follows: Annual production of 131,400,000 kWh divided by 8760 hours x 50 MW (50,000 kW) capacity = 30% capacity factor.

[13] In reality, capacity factors may decrease somewhat as turbines age due to gearbox failures, blade cracking, and blades become fouled from insects, hitting birds and bats, etc.

[14] Separating the tax break from actual electricity production, in effect, reduces the owner's incentive to maintain turbines and other "wind farm" equipment so as to maximize production.

[15] http://www.greenjobs.com/public/industrynews/inews06694.htm.

[16] http://www.wind-watch.org/news/2009/12/17/iberdrola-chief-warns-on-cost-of-green-power/.

(Clearly, any claim that the huge expenditure of tax dollars that were given to owners of "wind farms" would provide significant job and economic benefits in the US cannot be taken seriously.)

5. **Loosened Requirements for tax breaks and subsidies.** The same stimulus legislation also relaxed a number of restrictions on that had applied to the tax breaks and subsidies. A report recently released by DOE's Lawrence Berkeley National "Laboratory" (LBNL) – while objectionable in several respects – provides a useful summary of generous tax breaks and subsidies now available for "wind farms." [17]

6. **US Department Agriculture Grants.** While not targeting large commercial "wind farms," a variety of renewable energy production incentives,[18] grants,[19] loans,[20] and low interest bond [21]arrangements are available for certain wind energy projects. These are also summarized in the LBNL report cited above. Some of these arrangements are available for large wind turbine projects owned by Rural Electric cooperatives and public power organizations owned by state and local governments.

7. **DOE Loan Program.** A DOE loan program intended to encourage the commercialization of "innovative energy technologies" was first authorized by the Energy Policy Act of 2005 and then was substantially expanded by the American Recovery and Reinvestment Act of 2009. Billions in loans and loan guarantees are available for various renewable energy (including wind) and energy efficiency projects. One wind project (Nordic Windpower) has been approved via this program for a $16 million loan. Final regulations for this DOE program were issued on December 7, 2009[22]

8. **Additional US Department of Energy (DOE) Subsidies.** The DOE provides several additional subsidies to the wind industry, all financed with tax dollars, including:

   a. Some $60 to $100 million per year for "wind energy R&D" contracts and grants.

   b. Additional millions in taxpayer dollars for "studies," "analyses," "reports," and other wind energy promotional information prepared by or for DOE's Office of Energy Efficiency and Renewable Energy (DOE-EERE), DOE's National Energy "Laboratories,"[23] state energy offices, and other DOE contractors and grantees.

---

[17] Bolinger, Mark, Lawrence Berkeley National Laboratory (LBNL), "Revealing the Hidden Value that the Federal Investment Tax Credit and Treasury Cash Grant Provide To Community Wind Projects," January 2010; pp. 6-16. Apparently, the objective of the report is to promote "community" wind projects by outlining the generous new tax breaks made available for such projects. The report makes no attempt to evaluate the exceedingly small benefits that result from the high cost to taxpayers and electric customers of community wind projects.

[18] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US33F&re=1&ee=1.

[19] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US05F&re=1&ee=1.

[20] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US46F&re=1&ee=1.

[21] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US45F&re=1&ee=1.

[22] http://www.lgprogram.energy.gov/press/FR-12709.pdf.

[23] Particularly the National Renewable Energy "Laboratory" (NREL) and the Lawrence Berkeley National "Laboratory" (LBNL).

While the National "laboratories" undoubtedly perform some objective work that is based on scientific methods and engineering principles, much of the information issued by these organizations that deals with wind energy is demonstrably biased, misleading, and even false. These "laboratory" activities are more akin to those carried out by trade associations that typically provide one-sided information (or propaganda) that is used to influence the public, media and government officials.[24]

c. More taxpayer dollars flowing though DOE and NREL to support various state government wind promotional activities and to state "wind working groups,"[25] consisting of wind industry representatives and other wind energy advocates (but seldom, if ever, include representatives from citizen groups opposed to "wind farms") that work in support of wind industry objectives.

9. **Mandated use of "renewable" energy by Federal Agencies.**[26] The Energy Policy Act of 2005 requires the following amounts of total electricity consumed by the Federal Government to come from renewable energy:

- No less than 3% in fiscal years 2007-2009
- No less than 5% in fiscal years 2010-2012
- No less than 7.5% in fiscal year 2013 and thereafter.

Presidential Executive Order 13423, issued in January 2007, requires that at least one-half of the required electricity from renewable energy come from "new renewable sources." In fact, much of the electricity from "renewable energy" purchased by federal agencies comes from wind turbines. Like mandated state "green energy" programs, this federal requirement in effect requires that federal agencies pay premium prices for part of the electricity they use, thus creating a special, high priced market that is available to "wind farms." The higher-than-market premiums that must be paid for electricity from wind are another subsidy for the wind industry. The higher prices are paid from agency appropriations which are financed through tax dollars.

10. **Public lands managed by the US Bureau of Land Management and US Forest Service.** Both agencies have policies and regulations dealing with the construction of "wind farms" and related transmission facilities on public lands that they manage. More than 300 MW of wind turbine capacity is now located on BLM-managed lands.[27]

---

[24] Examples include NREL's "Jobs and Economic Development Impact" (JEDI) model that overstates local and state benefits from "wind farms", and LBNL's recent report that claims, falsely, that "wind farms" do not adversely affect the values of nearby properties.

[25] http://www.windpoweringamerica.gov/state_activities.asp.

[26] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US01R&re=1&ee=1.

[27] http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/energy.Par.58306.File.dat/09factsheetmap_Wind.pdf.

Typically, rents charged by BLM and USFS are lower than those charged for comparable private lands.

11. **Tax breaks and subsidies for "wind farm" equipment manufacturers.** One 2009 economic "stimulus" measure[28] established a new $2.3 billion investment tax credit "to encourage the development of a U.S.-based renewable energy manufacturing sector. In any taxable year, the investment tax credit is equal to 30% of the qualified investment required for an advanced energy project that establishes, re-equips or expands a manufacturing facility that produces..."[29] something considered by the US Treasury and Energy Departments as an energy efficiency, conservation, or renewable energy technology, including wind energy.

    The application process conducted during the fall of 2009 resulted in the selection of dozens of projects that apparently exhausted the $2.3 billion authorization. Projects selected for this new tax break included 33 projects involving wind turbines, bearings, towers, and blades totaling more than $250,000,000. Treasury and DOE have announced that no more applications are being accepted for this program.[30] *However, President's FY 2011 budget requests an additional $5 billion for the program.*

B. **State tax breaks and subsidies for "wind farm" owners.** Many state governments have adopted generous tax breaks and subsidies that benefit "wind farm" developers and owners – adding more to the costs that are shifted from developers and owners to ordinary taxpayers and electric customers and "hidden" in their tax bills and monthly electric bills.

The specific tax breaks and subsidies vary widely among states. Information for each state can be found at a taxpayer financed web site, Database of State Incentives for Renewables & Efficiency, www.dsireusa.org. Among the scores of "incentives" for industrial scale "wind farms" provided by at least one and often more states are:

1. State production tax credits (e.g., Iowa).
2. Exemptions from all or part of property taxes (e.g., Iowa, West Virginia, New York).
3. Artificially low assessments on wind turbines (e.g., Illinois).
4. Exemptions from sales tax on "wind farm" equipment and materials (e.g., Minnesota).
5. Low cost loans (e.g., industrial development bonds).
6. Renewable Portfolio Standards (RPS) that typically prescribed some percentage of a distribution utility's sales must consist of electricity produced from wind or some other "renewable" energy source (about 20 states).
7. Purchases of, or markets for, "green energy" certificates earned by producers of electricity from wind (e.g., Massachusetts).

---

[28] The American Recovery and Reinvestment Act of 2009 (H.R. 1), enacted in February 2009.

[29] http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US52F&re=1&ee=1.

[30] http://www.whitehouse.gov/the-press-office/fact-sheet-23-billion-new-clean-energy-manufacturing-tax-credits.

8. "Green energy" programs by electric distribution companies that offer electricity produced from wind at a premium price – either required or encouraged by state PUC or legislature (many states).
9. Payments for "green energy attributes" using revenue collected via a "systems benefit charge" (effectively, a tax) added to electric bills (e.g., New York).
10. Higher allowed earnings for electric utility investments in renewable energy facilities (e.g., Virginia).

At least four of the above state requirements (6, 7, 8 and 9) have the effect of creating a special market where owners of "wind farms" and other renewable energy facilities can sell their electricity at above market prices. Of course, the electricity actually used by customers paying extra for "green" electricity is highly unlikely to be produced by a "renewable" energy facility.

The owners can receive the higher, above market prices for the electricity they produce even if their facilities are not producing at the time the electricity is being used.

Utilities' "green energy" programs are seldom self supporting. That is, the amounts collected in premiums from customers who agree to pay extra are not adequate to cover (i) the higher costs of the "green energy" and (ii) the utility's cost of administering the "green" program. Costs not recovered from premium payments are merely passed along to all of the utility's customers.

C. **Local government and economic development agency tax breaks and subsidies.** Some local government and economic development officials believe that construction of "wind farms" in their areas will provide new jobs and other economic benefits. Actual benefits tend to be much less than assumed by "wind farm" developers and local officials. Further, the cost of any such benefits is, in one way or another, shifted to ordinary taxpayers and/or electric customers.

There is no readily available, comprehensive source of information on locally provided tax breaks and subsidies. However, examples include:

1. **Low cost loans or bond financing.** County or regional "economic development authorities" may have authority to offer low cost or interest free loans or bond financing which significantly reduce a "wind farm" owner's capital cost.

2. **Acceptance of payments in lieu of taxes or PILOTS.** For example, local government and school board officials in some towns in New York accept PILOTS from "wind farm" owners and give up their statutory authority to override a state-authorized exemption from property taxes. PILOTs are attractive to local officials because they tend to be "front-end loaded"; that is, they provide significant early benefits that can be presented to local voters as an opportunity for near term reductions in home-owners' property taxes, new fire trucks or other equipment, restoration of historic buildings, or other measures that can't be accommodated in local budgets without

PILOTS are attractive to "wind farm" owners because their cost over the assumed life of the "wind farm" are much less than paying property taxes and the "front-end" benefits are often helpful in gaining support for projects from current town officials and, perhaps, citizens who do not take into account the lower long term benefits or impacts .

POINT 5: Other important elements of the full, true cost of electricity from wind are often hidden or ignored by wind energy advocates.

Tax breaks and subsidies are not the only elements of the full, true cost of electricity from wind that are not transparent and that are often ignored by wind energy advocates. For example, additional elements of the full, true cost of electricity from wind include:

A. **Providing reliable generation to backup intermittent, unreliable generation from wind.** Because electricity from wind turbines depends on availability and speed of wind, grid managers must always have immediately available enough reliable, dispatchable generating capacity to keep grids in balance as wind turbines start producing, vary widely in output, or stop producing.

   Adequate capacity is available on some grids to meet this requirement, but there are costs of providing this backup and balancing service, whether it is through the use of a unit running in automatic generation control (AGC) mode, otherwise less than full capacity, or in spinning reserve.

   Grid managers must have available and under their control reliable generating units that can be ramped up or down (i.e., output increased or decreased) or brought on line (start producing) or taken off line (stop producing). Ramping up and down to balance volatile wind turbine output may add to wear and tear on the backup units.

   A critically important objective in electric grid management is to have sufficient *operating reserve* capacity available to keep electric service reliable and keep the grid in balance in the event that key generating units (or transmission lines) unexpectedly become unavailable (e.g., mechanical failures or other "unplanned outages"), or if there is a significant, unexpected increase in demand. Wind industry advocates often assume, incorrectly, that this critically important grid *operating reserve* should be available as a free backup or balancing service for the intermittent, volatile, and unreliable output of wind turbines.

   Providing balancing and backup capability for intermittent, volatile, and unreliable wind turbine output involves cost that is properly considered a part of the cost of electricity from wind. For example, units that are available for ramping up must be running at less than full capacity and, therefore, at less than full efficiency. Units that are ramped down also run at less than full capacity. Units that are available to bring on line are likely to be

running in "spinning reserve" mode (i.e., connected to and synchronized with the grid but inputting little or no electricity) and using some fuel and putting out some emissions. These costs are really a part of the true cost of electricity from wind.

Furthermore, if adequate capacity from reliable generating units is not available, backup capacity would have to be constructed resulting in additional costs that are, at some point, passed on to customers. It must always be recognized that wind turbines do not provide reliable, dispatchable generating capacity and they cannot be counted as a substitute for such reliable capacity.

B. **"Wind farms" place an extra burden on grid managers.** Grid managers face a more difficult task in keeping grids in balance when winds are sufficient to permit wind turbines to produce electricity. Because the output from wind turbines varies with wind speed, the output that must be managed is volatile. The extent of the burden differs widely among "wind farms" and among grids depending on many factors, such as the energy source mix of generating capacity in the control area, the amount of wind generation and its volatility, and electricity demand.

The "challenges" of integrating into electric grids the intermittent, volatile and unreliable output from wind turbines has finally been acknowledged by the Chairman of FERC in a January 21, 2010, statement[31] announcing a FERC Notice of Inquiry.[32] Hopefully this proceeding will lead to greater official and media candor about the challenges of integrating the output of "wind farms" into electric grids.

C. **Electricity from wind results in higher cost of transmission.** Areas where winds are sometimes strong enough to power wind turbines are often located at considerable distance from areas where electricity is needed (i.e., "load centers"). Furthermore, "wind farms" are not welcome near residential areas, even if wind conditions may be adequate, because of the large size of the wind turbines (400+ feet or more than 40 stories tall), because of their noise and other nuisance impacts, because of their environmental damage, and because of their adverse impacts on neighbors' property values.

The net effect of the above conditions is that electricity from wind turbines entails high costs of transmitting that electricity to the areas where the electricity can be used. Three factors are involved:

1. First, because "wind farms" are likely to be located at some distance from load centers the losses during transmission (i.e., line losses) tend to be higher than in the case of electricity generated by units closer to load centers.

---

[31] http://www.ferc.gov/news/statements-speeches/wellinghoff/2010/01-21-10-wellinghoff-E-4.asp.

[32] http://www.ferc.gov/whats-new/comm-meet/2010/012110/E-4.pdf.

2. Second, "wind farms" make inefficient use of transmission capacity. Enough transmission capacity must be available to serve the full rated output of a "wind farm." However, because wind turbines produce at full rated capacity only when wind speeds are about 32 MPH or higher, the full transmission capacity is used only on a minority, part-time basis. The effect of this is that the unit cost per kWh of moving the electricity that is produced tends to be higher than for electricity from reliable generating units.

3. Third, and especially costly, is the fact that "wind farms" have been built or are being proposed in areas that have insufficient or no transmission capacity to move the electricity that is produced. This means that expensive new transmission capacity would have to be *built just to accommodate the new or proposed "wind farms."*

   Some areas where substantial wind generating capacity has been built or is proposed require major increases in transmission capacity (e.g., Texas) to serve the "wind farms." While the cost of building the additional capacity is clearly a cost that is properly attributed to the cost of the electricity from wind, the wind industry seeks to avoid this cost and have it allocated to – i.e., charged to – electric customers as a part of their month bills as if it is a "normal" part of the cost of providing their electric service.

   Sadly, some public utility regulators have acceded to the wishes of the wind industry. Billions of dollars are involved but the wind industry and utility commissioners hide the enormity of the costs by spreading them over all the electric customers in the area. Once again, regulators are providing another huge subsidy to the wind industry rather than protecting electric customers.

POINT 6: No one really knows the true cost per kilowatt-hour (kWh) of electricity from wind turbines because all estimates of such costs are based on highly questionable assumptions – really guesses – that are untested.

Many claims are made about the cost per kilowatt-hour of electricity produced from wind but, in fact, no one really knows the true cost.

Anyone interested in the facts should be very wary of claims made by the wind industry, its supporters employed by the federal and state governments, the DOE National "Laboratories" or other wind energy advocates. Data reported by the media are invalid because they typically are parroted from one of these sources.

A true, meaningful calculation of the cost of per kWh of electricity produced by wind turbines inevitably requires data that can be known only on an after-the-fact basis. Claims

that have been made about costs per kWh of electricity from wind turbines are rough estimates based on assumptions (guesses) and often do not include all elements of cost.[33]

Key factors that cannot be known in advance include at least the following:

- Total operating and maintenance (O&M) and replacement costs during the assumed life of the turbines.
- Useful, productive life of the turbine(s).
- Amount of electricity (kilowatt-hours – kWh) that will be produced during the useful life, taking into account turbine and equipment out of service time, and deterioration in output as turbines, blades and other equipment age.
- Decommissioning costs.

None of the wind turbines of the type now being installed in the US have operating histories long enough to provide valid, reliable estimates for these factors.

Claims that are made by wind energy advocates typically include assumptions about O&M costs and replacement costs, useful life (often assumed to be 20 years), and capacity factor (often assumed to be something in the range of 25% to 35%).

Two highly simplified examples illustrate the extent to which cost per kWh calculations can be misleading if before-the-fact guesses prove incorrect. In these simplified examples which uses a rough estimate of one element of cost (i.e., overnight capital costs), *only one key factor – the estimated useful life of the turbines -- is changed* but the impact on cost per kWh is doubled.

	Example #1	**Example #2**
Capacity of "wind Farm" (kW)	50,000	50,000
Assumed Capacity Factor	30%	30%
Annual Electricity Production (kWh)	131,400,000	131,400,000
Assumed Useful Life	20 years	10 years
Electricity Produced During Useful Life (kWh) (131,400,000 x years of useful life)	2,628,000,000	1,314,000,000
Overnight Capital Cost	$100,000,000	$100,000,000
Overnight Capital Cost per kWh During Useful Life	$0.038 per kWh	$0.076 per kWh

There is one potentially promising development in the long standing saga of DOE-NREL misinformation about the cost per kWh of electricity from wind. That is, a highly misleading, fact less, assumption based graph showing an 80% decline in the cost of electricity from

[33] For example, see Harper, John, Matt Karcher, Mark Bolinger. 2007. *Wind Project Financing Structures: A Review & Comparative Analysis*. LBNL-63434. Berkeley, Calif.: Lawrence Berkeley National Laboratory. http://eetd.lbl.gov/EA/EMP/reports/63434.pdf. See Table B1, page 61 in Appendix B for detailed list of costs.

wind – with further declines likely -- apparently has been abandoned. Even the highly biased DOE-EERE folks admit that their data show the cost per kWh of electricity from wind has been rising, not falling.[34] Unfortunately, there seem to be hundreds of reporters who remember the misleading graph and false 80% decline claim and will continue parroting that claim for years to come.

THE PRECEDING POINTS ARE FOCUSED ON FINANCIAL COST AND VALUE, NOT EXTERNALITIES

The foregoing discussion has been focused on the financial costs of producing electricity and the financial value of that electricity. It has not dealt with external costs, commonly referred to as externalities; i.e., the costs not reflected in the price charged for the electricity.

A discussion of externalities associated with each source of energy used to produce electricity is far beyond the scope of this paper. However, it should be noted that wind energy advocates generally assign high externality values to other sources of energy while assigning none for wind energy. In fact, producing electricity with wind energy does impose external costs, including adverse impacts on environmental, ecological, scenic, and property values.

Examples of adverse environmental and ecological impacts include noise, dead birds and bats, destruction of vegetation and disruption of ecosystems and wildlife habitat, and nuisance impacts such as shadow flicker. Claims that "wind farms" do not adversely affect neighbors' property values, such as those made recently in a report from the Lawrence Berkeley National "Laboratory" (LBNL) defy common sense and facts evident from around the world.

Fortunately, media stories reporting on the adverse impacts of "wind farms" have begun to appear in the media and even in the Journal of the American Bar Association.[35]

CONCLUSIONS

There are no longer any serious questions but that:

1. Wind industry officials and lobbyists continue to understate greatly the full, true cost of electricity from wind and have been successful in creating a false "popular wisdom" about wind energy.

2. The public, media and government officials have been misled and repeat false and misleading claims.

---

[34] DOE, 2008 Wind Technology Market Report, July 2009, Figure 13, page 26.
[35] http://www.abajournal.com/magazine/article/the_war_of_winds/.

3. Government officials – particularly legislators and regulators – are providing tax breaks and subsidies for wind energy without understanding or considering the benefits and costs of their actions, and they are helping to hide costs in tax and electric bills.

4. Government agencies, including the US Department of Energy (particularly its Office of Energy Efficiency and Renewable Energy – DOE-EERE), the DOE National "Laboratories" (particularly NREL and LBNL), other DOE contractors, and state energy agencies and public utility commissions are conducting and supporting activities and issuing information about wind energy that helps mislead the public, media and political leaders.

5. Claims that the hundreds of millions of tax dollars being thrown at "wind farm" projects are an efficient and effective way of creating jobs in the US are FALSE. (The fact that a large share of those tax dollars are flowing to foreign countries -- turbine manufacturers and "wind farm" owners – should be a clue that would give some pause to Obama Administration officials and members of Congress.)

6. Some investors in "wind farms" are highly likely to be making financial commitments without understanding the facts about the high true cost and low value of electricity from wind.

7. Land owners are leasing land to "wind farm" developers without understanding the adverse impact that "wind turbines" have on environmental, ecological, scenic and neighbors' property values.

8. Local government officials, misled by "wind farm" developers and lured by potential short-term financial benefits, are fracturing their communities, destroying home owners' property values, and ignoring long-term costs when they encourage or condone wind energy projects.

9. Energy economists and analysts in government and the private sector, as well as reporters and editors, need a far better understanding of the facts about wind energy cost and values than they have displayed thus far.

Glenn Schleede *is semi-retired after working on energy matters for more than 30 years in government and the private sector. He often writes about energy issues, particularly about policies and actions that adversely affect taxpayers and consumers.*

SPPI

Science & Public Policy Institute

"Science-based policy for a better world."

Robert Ferguson
SPPI President
bferguson@sppinstitute.org
202-288-5699

P.O. Box 209
5501 Merchants View Square
Haymarket, VA 20169

www.scienceandpublicpolicy.org