November 19, 2008

MEMORANDUM FOR: Ms. Maria Jones, Division on Engineering & Physical Sciences, The National Academies

SUBJECT: Review of draft NRC report, "Electricity from Renewables: Technical Opportunities, Risks and Tradeoffs"

Thank you for your November 12, 2008, reminder concerning comments on the draft NRC report, "Electricity from Renewables: Technical Opportunities, Risks and Tradeoffs."

Based on Dr. Panos' November 8, 2008, email, I must withdraw as a "reviewer" of that report. I cannot accept the Academies "Institutional Policy" that reviewers should not disclose their comments. This condition seems quite unreasonable for an organization chartered by the Congress, subject to the Federal Advisory Committee Act (FACA), and engaged in work paid for at least in part with tax dollars.

Important issues of national and public interest are addressed in the report. Those issues warrant more – not less – public airing and open scrutiny. Academies' officials should not be prosecutor, judge, and jury on public disclosure of comments that question the objectivity, validity, opinions, and value judgments reflected in the draft NRC report. Furthermore, as noted in my November 5, 2008, email to Dr. Holmes, no restriction on public disclosure of comments was mentioned when Dr. Holmes and Ms. Kim asked that I serve as a reviewer.

Having read those portions of the report dealing with wind energy, I would not want my name associated with it in any way. At least with respect to wind energy, the report lacks objectivity, relies on dubious assumptions, overstates advantages of wind energy, and understates or ignores its disadvantages. I will return the draft report as Dr. Panos instructed.

While I will not be providing the detailed review and comments originally requested, I offer the following observations for whatever use, if any, you wish to make of them:

A. Panel Lacks Necessary Balance. The Panel assembled for the project clearly lacks balance. It apparently consists largely of individuals who are tied to and dependent upon spending for "renewable energy" technologies and products. It includes individuals from the wind industry with a direct interest in public policies, tax breaks, and subsidies benefitting the wind industry. There is an absence of representation of (a) interests of citizens, taxpayers, and electric customers who are adversely affected by wind energy or other renewable energy developments, (b) experts that have studied the adverse environmental, ecological, economic, scenic, property value, and capital investment decisions of wind energy developments, or (c) individuals who could help temper excessive enthusiasm on the part of panel members whose personal interests are so directly involved. This lack of balance appears to be contrary to the requirements of FACA and probably explains the lack of objectivity in the draft report.

B. Important Information Ignored by the Panel. Those making presentations to the Panel and the documents consulted do not reflect the full range of information that should have been considered by the Panel. Anyone following wind energy during the past five years should be well aware that:

1. The wind industry and other wind energy advocates (including DOE-EERE and NREL) have for more than a decade overstated the environmental, energy, and economic benefits of wind

energy and understated the adverse environmental, ecological, economic, scenic, and property value impacts. They have misled the public, media, and government officials and helped create a false "popular wisdom" about wind energy.

2. Experts less enamored with wind energy and citizens, electric customers, and taxpayers who have been adversely affected have, through experience and analysis, uncovered facts about the full, true costs of wind energy and demonstrated that many claims made by advocates are false or misleading. This information is available on various web sites but only recently has begun showing up in the media. It is beginning to be understood by some government officials.

The Panel's draft reflects advocates' claims and captures the "popular wisdom" about wind energy but fails to take into account countervailing facts uncovered by others.

C. Draft report summary does not adequately reflect the adverse impacts of wind energy. While the report is far from objective, the body of the report mentions some of the adverse considerations about wind energy (e.g., its intermittence, volatility, unreliability, and its low value because it cannot be counted on when electric demand is highest). However, the summary – i.e., the part most likely to be read – largely ignores adverse impacts and gives the impression that there are few if any serious negative considerations warranting the attention of the public, media, and government officials.

The summary does include many "sound bites" that can be used by special interests when dealing with the unwary. Almost certainly, this biased report would be used to support requests to continue and expand huge tax breaks and subsidies – measures that shift billions of dollars in costs to ordinary taxpayers and electric customers who receive only limited benefits but who are forced to bear the adverse impacts not acknowledged in the report.

D. Both renewables and traditional energy sources have "externalities." The draft report refers to "externalities" associated with traditional energy sources but largely ignores the fact that renewable energy sources also have external costs. The construction of wind turbines, including large "wind farms," has proven to be highly controversial in the US and other countries and helped reveal many of wind energy's externalities.

Adverse impacts of wind energy that are either downplayed or ignored in the draft report but which have become evident as wind projects have been proposed and/or constructed include: (a) noise, (b) bird and bat deaths and interference with migration patterns, (c) destruction of wildlife habitat, (d) damage to unique ecosystems (e.g., Tallgrass Prairie in Kansas), (e) land clearing for roads, turbines, and associated facilities, disturbing large land areas, (f) impairment of scenic and protected areas (e.g., mountain slopes and ridges, wildlife refuges), and (g) interfering with the everyday lives and destroying the property values of citizens who find themselves living in the shadow of huge (40+ story) structures with rotating blades that cover an area exceeding the length and wing span of a 747 aircraft.

The report even implies that legitimate citizen and local government objections of citizens to such installations as "wind farms" are matters that might be dealt with by "streamlining" permitting processes. The Panel's report, with its lack of objectivity, certainly does not justify "streamlined" processes at the federal or state level if the "streamlining" would override "home rule," and reasonable objections from citizens and local or state governments.

E. Should huge tax breaks and subsidies for wind energy be continued? For years, the wind industry and its advocates claimed that government-financed R&D, tax breaks, and other subsidies for wind

energy were temporary measures needed to help the technology get a "foot hold" in competition with lower cost traditional sources of electric generation. Meanwhile, the cost of traditional fuels has increased and there is now a flourishing wind industry with multiple sources of turbines, towers, blades and other equipment.

Now, it appears that the wind industry and the NRC panel are claiming – or conceding -- that the inherently high existing and prospective cost of electricity from wind energy means that the use of wind energy in the US will not increase unless "favorable government policies" are adopted; i.e., either (a) continuing or expanding huge tax breaks and subsidies for wind, (b) substantially increasing the cost of traditional electric generating technologies, and/or (c) assigning high externality costs to other electric generating technologies.

Such a major change in the rationale for wind energy or other renewable energy sources should be clearly acknowledged and justified with greater objectivity than demonstrated by the draft report.

F. Panel apparently is unaware of the full extent of tax breaks and subsidies for wind energy and its full, trust cost. The draft report doesn't acknowledge the full extent of the lucrative tax breaks enjoyed by "wind farm" owners and the temporary "partners" (often from the financial industry) they acquire so that they can take full advantage of huge federal and state tax breaks and subsidies. For example, the draft report does not even mention the tax break and subsidy resulting from "wind farm" owners' ability to recover the full capital investment costs of wind equipment – including both equity and debt --because it is eligible for exceedingly generous accelerated depreciation for tax purposes; specifically 5-year double declining balance accelerated depreciation (5-yr; 200% DB).

This generous subsidy means that "wind farm" owners, when calculating federal corporate income tax, can recover 20% of capital costs in the first tax year, 32% in the second tax year and the remaining 48% in the ensuing 4 tax years. As indicated, this accelerated depreciation deduction from taxable income applies to the all the wind equipment capital costs, including the portions financed with both equity and debt. Therefore, a "wind farm" owner using his own equity to cover 50% of capital costs (normally the equity share is lower) can recover his entire equity investment in less than 18 months and then enjoy (a) an infinite return on equity thereafter, and (b) in effect, an interest free "loan" for the balance not yet depreciated – all courtesy of US taxpayers.

States that conform their corporate income tax to the federal system allow the same depreciation deduction for state income tax purposes. Like all federal, state and local tax breaks, the tax burden escaped by "wind farm" owners and their financial partners is shifted to remaining taxpayers.

This 5-yr. 200% DB scheme for "wind farm" owners provides a huge benefit to "wind farm" owners not enjoyed by owners of traditional electric generating facilities which, in most cases, can be depreciated for tax purposes over 20 years, using 150% declining balance calculations.

This tax break and subsidy is one that was not even counted by the EIA in its recent, incomplete study of federal financial interventions in energy markets – even though that study highlighted the large size of tax breaks and subsidies for wind energy compared to those for most other energy sources. EIA's study did not include state or local tax breaks and subsidies nor did it cover a variety of federal and state regulatory subsidies.

It should be quite clear to anyone who studies the matter that the primary reason why "wind farms" are being built in the US is to capture tax breaks and subsidies, not because of environmental, energy or economic benefits.

G. Unsupported assumptions underlying the Panel's conclusions. During the past 35 years, many government energy research, development, demonstration and deployment (RDD&D) programs have been justified with two fundamental assumptions:

1. That additional government spending for R&D will produce advances that will make the technology economically and environmentally acceptable, and

2. "Economies of scale" will bring down costs.

However, the past 35 years of experience with dozens of energy technologies selected for tax breaks, subsidies and a wide variety of other government policies have demonstrated that these assumptions are unlikely to be fulfilled in practice. It's surprising that these assumptions – proven incorrect for many favored energy technologies -- are repeated so routinely and glibly by scientific and technical groups seeking to justify subsidies for new energy R&D.

There is no obvious reason why these assumptions, which underlie the Panel's draft report, should now be accepted as valid for wind and other "renewable" energy technologies.

H. Doubtful validity of assumptions underlying the Panel's claims about prospective costs of electricity. The Panel's claims about prospective cost per kilowatt-hour of electricity (kWh) from wind are based on assumptions that cannot be justified with available evidence. Key assumptions include:

1. Capital cost of installed wind turbines and associated facilities.
2. Useful, productive life of wind turbines.
3. Amount of electricity that will be produced (commonly measured as "capacity factor") during the useful life of wind turbines.
4. Cost of wind turbine O&M, repair and replacement during their useful life.

Often, wind energy advocates assume a useful wind turbine life of 20 years or more when making claims about cost per kWh of electricity from wind. In fact, none of the turbines of the type now being installed have more than about 5 years of actual operating experience and many have less.

If the useful life of a turbine turns out to be 10 years rather than an assumed 20 years, the calculated cost of electricity per kWh would be approximately double the costs that are typically claimed by the wind industry, DOE, EIA, NREL and others.

There is considerable evidence that capital costs of wind turbines now being installed are substantially (i.e., 25% or more) above the $1434 per kW (2007$) assumed as overnight capital by EIA when preparing its Annual Energy Outlook 2008. Other EIA wind assumptions are based on old (e.g., 1991) data. Evidence is lacking that would support the capacity factors for wind turbines assumed by EIA and various wind energy advocates.

Very little is known about the rate of decline in electricity production (capacity factors) of today's wind turbines as they age. Furthermore, the heavily front-end load tax breaks for wind turbines (6 tax years for accelerated depreciation; 10 years for production tax credits) may create a disincentive for "wind farm" owners to spend money needed to maintain turbines once tax breaks have been exhausted. (There may be a financial incentive to sell or abandon wind turbines once tax breaks

have been exhausted rather than spend the money needed to maintain output or pay for decommissioning.)

Other assumptions underlying some or all of the studies referred to in the draft report that apparently have not been critically evaluated include assumptions that (a) state RPS targets or requirements will be met, (b) that capacity factors claimed by industry and government wind advocates will be achieved, and (c) that transmission capacity will be built and its cost justified, and/or (d) that "wind farms" will be built first in areas with strongest winds.

I. Repeating misleading wind industry statistics and concepts. The Panel's draft report incorporates misleading techniques used by the wind industry and other wind energy advocates that have contributed to the prevailing false popular wisdom about wind energy. For example:

1. The draft report misleads by using percentages of growth in electricity from wind energy and other renewable energy sources. Use of percentages when dealing with exceedingly small numbers is misleading and is a classic example of "How to Lie with Statistics."

   An objective report would provide absolute numbers (rather than percentages of growth) on electricity produced from all energy sources so that readers could easily grasp the fact that the amount of electricity produced from various non-hydro renewables and projected for the future is and is expected to be a very small part of the nation's electricity requirements.

   Two tables, based on data from EIA's web site, are attached to this memo. Attachment A shows US electric generation by energy source for the period from 1994 through July 2008 in thousands of megawatt-hours (MWh). Attachment B shows the percentage shares for each energy source for the same period. These tables provide data that gives a far more accurate picture of the contributions from each energy source, including non-hydro renewables, than is presented by the misleading "growth percentages" shown in the Panel's draft report.

2. Overplaying "generating capacity" while underplaying the low capacity factors of wind turbines. The wind industry misleads the public, media, and government officials when it dwells on the rated generating capacity (measured in kilowatts or megawatts) while downplaying the fact that wind turbines produce electricity only when wind speeds are within a certain range. The output is, therefore, intermittent, volatile, and unreliable. The output from wind turbines (measured in kilowatt-hours or megawatt-hours) is much less than the output from reliable generating units that provide base or intermediate load service on electric grids.

   An objective report would help the public, media, and government officials understand, for example, that a "wind farm" with generating capacity of 1,500 megawatts (MW) would (a) produce only about as much electricity as a 500 MW natural gas fired generating unit operating in base load service, and (b) the natural gas fired unit would be a reliable or "dispatchable" (i.e., one that can be called upon to produce when needed) while the "wind farm" could not similarly be counted on.

J. Failure to describe the full implications of the intermittence, volatility, and unreliability of electricity from wind turbines. While the report, in its depths, admits some of the adverse implications, it does not make those implications sufficiently clear, particularly in the Summary. For example:

1. Low quality and value of electricity from wind turbines. As indicated above, wind turbines produce electricity only when wind speeds are in the right speed range (i.e., depending on the

turbine, they start producing with wind speeds around 6 or 7 mph, reach rated capacity around 32 mph, cut out about 56 mph and don't restart until about 45 mph). As the draft indicates, other generating units must be immediately available – while operating at less than fully efficient capacity or in spinning reserve mode -- to keep electric grids in balance. Providing this "backup" service adds cost which is properly counted as part of the full, true cost of electricity from wind.

Further, wind speeds required by wind turbines to produce electricity are most likely to occur at night in colder months – not on hot weekday late afternoons in July and August when electricity demand tends to be highest in most of the US -- when the true value of the electricity is highest. Thus, electricity from wind is very high in true cost but low in true value.

2. Can't be counted on when electricity is most needed. To assure reliability of electric service, grid managers need to have generating capacity available that is sufficient to meet customer demands at all times, including at the time of peak demand. Because wind and wind turbines cannot be counted on at the time of peak demand, wind turbines have little or no "capacity value" (i.e., capacity that can be called on when needed).

3. Can't substitute for reliable generating capacity. The fact that wind turbines have little or no "capacity value" at the time of peak electricity demand has serious implications for grid managers and government officials responsible for assuring reliable electric service. Specifically, areas experiencing growth in peak electricity demand or needing to replace aging generating capacity must add reliable generating capacity whether or not wind turbines are built. Officials can't reliably assume that wind turbines will produce when needed and electric customers may end up paying twice; i.e., once for wind turbines and again for reliable capacity.

4. "Integration" of unreliable wind capacity not easily accommodated. The draft report gives the false impression that a substantial amount of intermittent, volatile, unreliable wind generation capacity – perhaps 10% or even 20% of total capacity -- can be accommodated easily with little risk to reliability. Experience in California, Texas and New York in recent years have demonstrated that very little – sometimes zero or slightly above -- wind turbine capacity is actually producing electricity at the time of peak demand.

   If a grid planner has assumed that 10% of rated wind turbine capacity will be available at the time of peak demand and the actual amount is zero or some other percentage less than 10%, the "missing" electricity from wind turbines is, in effect, cutting into the grid's planned operating reserve; i.e., the reserve capacity needed to compensate for unplanned outages of generating units or transmission lines, or unexpected surges in electricity demand. To suggest otherwise is simply misleading.

Organizations that are looked to for objective, credible advice should not miss the opportunity to provide clear, valid, reliable information to the public, media, and government officials.

K. Questionable assertions about "energy security." The draft report implies that greater use of "renewable" energy to produce electricity will contribute to greater "energy security" – presumably through reducing the nation's dependence on imported oil. It's important to recognize that very little oil is used to produce electricity in the US. As indicated in Attachment B, petroleum liquids supplied only 1.2% of US electricity generation in 2007 and the percentage is trending downward.

In fact, electricity from "renewables" is unlikely to replace any significant part of that small use of

oil for electric generation because most of it is used in either (a) turbine or internal combustion powered generators that are called on during peak electricity demand, or (b) older oil-fired units that continue to be needed for voltage support in areas of high electricity demand.

L. Overestimating potential "economic opportunities." The draft report also refers to "economic benefits" of greater reliance on "renewable" energy. This assertion may be based, at least in part, on a spate of recent "studies," "analyses," and "reports" that purport to show large job or economic benefits when "wind farms" or other renewable energy generating units are added.

In fact, such studies, analyses and reports tend to grossly overestimate potential job and other economic benefits because of one or more of the following thirteen flaws and faulty assumptions – that are particularly common in the case of wind energy.

1. Ignoring the fact that much of the capital spending is for equipment purchased elsewhere, often imported from other countries. This is a common error in the case of "wind farms" where about 75% of the capital costs are for turbines, towers and blades – many of which are imported.

2. Assuming that employment during project construction results in new jobs for local workers -- when many of the construction jobs (particularly in the case of wind energy) are short term (6 months or less) and filled by skilled workers who are brought in temporarily.

3. Assuming that "permanent" jobs are new jobs filled by local workers – when, in the case of wind farms, the few permanent jobs are often filled by people brought in for short periods. Some "wind farm" owners enter into contracts with wind turbine and other equipment suppliers to perform maintenance work instead of adding to their own employment rolls.

4. Assuming that temporary workers who are brought in for short periods spend their pay checks and pay taxes locally when, in fact, these workers spend most of their wages where they and their families have permanent residences -- where the workers spend most of their weekends and pay taxes.

5. Assuming that the *full purchase price* of the goods and services purchased locally (often minimal in any case) has a local economic benefit. In fact, only the local value added may have a local economic benefit. This is illustrated by the purchase of a gallon of gasoline -- let's say for $2.50. Only the wages of the service station employees, the dealer's margin, and the taxes paid locally or to the state will have a local or state economic benefit. Economic benefits from the share of the $2.50 that pays for the crude oil (much of it imported), refining, wholesaling, and transportation generally flows elsewhere.

6. Assuming that land rental payments in the case of "wind farms" all have local economic benefit. In fact, these payments will have little or no local economic benefit when the payments are to absentee landowners OR if the money is *spent* or *invested* elsewhere or is used to pay income taxes that flow to Washington DC or state capitals.

7. Using "input-output" models that spit out "indirect" job and other economic benefits but which are based on untested or flawed underlying data and assumptions and on unproven "multiplier" effects.

8. Ignoring the COSTS imposed by the development. In the case of wind energy, these would include but are not limited to (a) the environmental and ecological costs associated with the

production of the equipment, (b) constructing and operating the "wind farm" (e.g., site and road clearing, wildlife habitat destruction, noise, bird and bat kills and interference with migration and refuges), (c) scenic impairment, (d) neighboring property value impairment, and (e) local infrastructure costs.

9. Ignoring the fact that electricity produced from wind, has less real value than electricity from reliable generating units -- because it is intermittent, volatile and unreliable and most likely to be produced at night in colder months, not on hot weekday late afternoons in July and August when demand is high and the economic value of electricity is high.

10. Ignoring the "backup power" costs; i.e., the added cost resulting from having to keep reliable generating units immediately available (often running at less than peak efficiency) to keep electric grids in balance when those grids have to accept intermittent, volatile and unreliable output from "wind farms.

11. Ignoring the fact that electricity produced from renewable sources located in remote areas result in high transmission costs, including (a) construction of additional transmission capacity, the costs of which are passed on to electric customers and which imposes other environmental, scenic and property value costs, (b) electricity "line losses" because part of the electricity that is produced by generating units never reaches customers or serves a useful purpose, and (c) inefficient use of transmission capacity because the output is intermittent and generally unpredictable – resulting in high unit costs of transmission.

12. Ignoring the true higher cost of the electricity (or other energy form) resulting from the renewable energy source -- and the associated fact that electric customers then have less money to save or to spend on other needs (food, clothing, shelter, education, medical care -- or hundreds of other things normally purchased in local stores), thus *reducing* the jobs associated with that spending.

13. *Perhaps most important, ignoring the very important fact that the investment dollars going to "renewable" energy sources would otherwise be available for investment for other purposes that will often produce greater economic benefits.* As noted in the draft report, "renewable" energy generating facilities have very high capital costs and relatively low operating costs compared to generating units using traditional energy sources. When considering job creation and local or state economic benefits, generating using traditional energy sources provide greater benefits than "wind farms" because they create more long term jobs.

M. Large renewable energy "resource bases"? The discussion of "resource base" for wind (and solar) energy, asserting its huge "potential" is misleading. The fact that the energy in wind can be captured to produce electricity means little unless it can be done cost-effectively and with an acceptable level of adverse environmental, ecological, scenic, and property value impacts. These realistic tests sharply limit the size of the wind "resource base" just as those tests reduce the size of the resource base for other energy sources, including the "traditional" sources.

N. "Fronting" for the Wind and other Renewable Industries. The panel was asked to "examine the technical potential …[of}…alternative sources such as wind, solar-photovoltaic…and focus on those renewable sources that show the most promise for commercial development…" and the draft report includes some useful information responding to that charge.

However, the bulk of the report – particularly the summary -- appears to be a thinly veiled "pitch" for extending tax breaks and expanding subsidies for renewable energy R&D and for the wind and

other renewable energy industries and their "financial partners" whose primary interest is in capturing the benefits of huge tax breaks and subsidies.

As demonstrated above, the portions of the draft report dealing with wind energy are far from objective. They are hardly distinguishable from presentations made by wind industry lobbyists which, understandably, are totally lacking in objectivity.

It seems unseemly for organizations purporting to provide advice on scientific and technical matters to parrot misleading information emanating from special interest groups rather than conducting objective evaluations and presenting information in a way that reflects the national and public interest. It is far from clear why the Academies and the NRC should be so heavily involved in supporting "policies," tax breaks, and subsidies for special interest groups – particularly when those measures result in:

1. Transferring hundreds of millions of dollars from the pockets of ordinary taxpayers and electric customers to the owners of "wind farms" and other "renewable" energy facilities, and

2. Divert capital investment dollars from other endeavors that would likely produce greater public benefits, while directing those investments to heavily subsidized projects that produce little energy.

O. Failure to acknowledge distortions in capital investment decisions and drain on privately financed R&D and entrepreneurial activity that result from massive federal & state tax breaks and subsidies. Like many government officials, those who have drafted the NRC Panel report seem not to even recognize the far reaching implications of federal and state government policies, tax breaks, and subsidies that steer huge amounts of capital investments into high cost renewable energy projects.

In fact, these well meaning "interventions" are now distorting energy markets and, in particular, capital investment decisions. Anyone with significant money to invest now understands that the safest investment with the highest return is to find something that qualifies for federal, state, and/or local tax breaks and subsidies or qualifies under a credit program. It makes little sense for them to invest in (a) producing energy -- e.g., from oil or natural gas -- because the risks are higher and returns less assured, or (b) investing with some entrepreneur who might develop a new energy technology that could turn out to have commercial applications -- which is also risky.

Instead, the smart money people "mine" Washington, state capitals, and local governments and "economic development agencies" for tax breaks, subsidies, and credit programs and, of course, they hire lobbyists. A prime example of "mining in Washington" was T. Boone Pickens announcement in April 2008 that he was going to make a 25% return by building a $10 billion "wind farm" -- which current tax breaks would permit him to do. Mr. Pickens has advertised both his planned "wind farm" and then his grand "energy plan" to make money by pursuing wealth via government subsidies. Others (e.g., GE, FPL, Goldman-Sachs) follow the same strategy but tend to "fly under the radar" while they capture tax breaks and subsidies rather than pursuing more productive endeavors in the private, competitive economy.

Meanwhile, political leaders, other government officials, and academics lament the "unacceptably low" private sector investments in R&D. The obvious answer is that governments, in their infinite wisdom, have made private sector decisions increasingly unattractive compared to following government dictates.

While I am not serving as a "reviewer" for the Panel's report, I hope you find the above comments of some value as you pursue the Academies' work on energy issues.

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Attachments:

Table A: US Net Electric Generation (All sectors) by energy source – 1994 through July 2008 – in Thousand Megawatt Hours

Table B: US Net Electric Generation (All sectors) by energy source – 1994 through July 2008 – in % of total US electric generation

Attachment A: US Net Electric Generation (All Sectors) by Energy Source -- 1994 through July 2008 -- in Thousand Megawatthours

	Traditional Energy Sources, Including Hydro									Non-Hydro Renewables						
Period	Coal [1}	Petroleum Liquids [2]	Petroleum Coke	Natural Gas	Other Gases [3]	Nuclear	Hydroelectric Conventional	Hydroelectric Pumped Storage	Other [4]	Wood [5]	Waste [6]	Geo-thermal	Solar/ PV [7]	Wind	Sub-Total Non-Hydro Renewables [8}	Total
1994	1,690,694	98,440	7,461	460,219	13,319	640,440	260,126	-3,378	3,667	37,937	19,129	15,535	487	3,447	76,535	3,247,522
1995	1,709,426	66,944	7,610	496,058	13,870	673,402	310,833	-2,725	4,104	36,521	20,405	13,378	497	3,164	73,965	3,353,487
1996	1,795,196	73,521	7,890	455,056	14,356	674,729	347,162	-3,088	3,571	36,800	20,911	14,329	521	3,234	75,796	3,444,188
1997	1,845,016	82,773	9,782	479,399	13,351	628,644	356,453	-4,040	3,612	36,948	21,709	14,726	511	3,288	77,183	3,492,172
1998	1,873,516	116,859	11,941	531,257	13,492	673,702	323,336	-4,467	3,571	36,338	22,448	14,774	502	3,026	77,088	3,620,295
1999	1,881,087	107,276	10,785	556,396	14,126	728,254	319,536	-6,097	4,024	37,041	22,572	14,827	495	4,488	79,423	3,694,810
2000	1,966,265	102,160	9,061	601,038	13,955	753,893	275,573	-5,539	4,794	37,595	23,131	14,093	493	5,593	80,906	3,802,105
2001	1,903,956	114,647	10,233	639,129	9,039	768,826	216,961	-8,823	11,906	35,200	14,548	13,741	543	6,737	70,769	3,736,644
2002	1,933,130	78,701	15,867	691,006	11,463	780,064	264,329	-8,743	13,527	38,665	15,044	14,491	555	10,354	79,109	3,858,452
2003	1,973,737	102,734	16,672	649,908	15,600	763,733	275,806	-8,535	14,045	37,529	15,812	14,424	534	11,187	79,487	3,883,185
2004	1,978,620	100,040	20,731	708,854	16,766	788,528	268,417	-8,488	14,483	37,576	15,497	14,811	575	14,144	82,604	3,970,555
2005	2,013,179	100,095	22,427	757,974	16,317	781,986	270,321	-6,558	12,468	38,681	15,479	14,692	550	17,811	87,213	4,055,423
2006	1,990,926	44,655	19,709	813,044	16,060	787,219	289,246	-6,558	13,977	38,649	16,110	14,568	508	26,589	96,423	4,064,702
2007	2,020,572	49,956	15,752	893,211	15,414	806,487	248,312	-6,994	13,815	38,515	16,885	14,839	606	32,143	102,988	4,159,514
2008																
January	182,579	3,136	1,313	72,090	1,249	70,686	22,358	-754	962	3,337	1,371	1,187	15	3,737	9,647	363,268
February	167,000	2,427	1,200	59,902	1,126	64,936	20,234	-375	778	3,075	1,220	1,075	33	3,275	8,679	325,906
March	161,102	2,135	977	60,904	1,611	64,683	22,907	-522	976	3,165	1,374	1,218	75	4,103	9,935	324,706
April	147,249	2,166	1,082	60,870	1,460	57,281	22,106	-98	1,160	2,940	1,465	1,200	87	4,487	10,178	303,455
May	156,098	2,260	1,005	61,350	1,358	64,794	28,239	-587	895	3,013	1,472	1,254	96	4,450	10,285	325,697
June	171,287	3,789	1,193	84,075	1,323	70,268	30,803	-372	908	3,166	1,462	1,261	120	4,349	10,357	373,632
July	187,377	3,006	1,126	99,535	1,437	74,266	25,873	-799	914	3,349	1,434	1,281	105	3,236	9,405	402,139
Total	1,172,691	18,919	7,896	498,726	9,565	466,915	172,521	-3,507	6,593	22,045	9,797	8,475	531	27,637	68,486	2,418,805
Yr-to-Date																
2006	1,145,354	25,150	11,922	455,012	9,499	459,169	191,394	-3,507	8,121	22,222	9,332	8,287	320	15,600	55,762	2,357,875
2007	1,163,193	32,147	9,425	479,532	9,318	467,514	164,593	-3,515	8,056	22,100	9,830	8,563	389	18,435	59,317	2,389,580
2008	1,172,691	18,919	7,896	498,726	9,565	466,915	172,521	-3,507	6,593	22,045	9,797	8,475	531	27,637	68,486	2,418,805

Source: US Energy Information Administration

[1] Anthracite, bituminous, subbituminous, lignite, waste coal, and coal synfuel.

[2] Distillate fuel oil, residual fuel oil, jet fuel, kerosene, and waste oil.

[3] Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

[4] Non-biogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuel, and miscellaneous technologies.

[5] Wood, black liquor, and other wood waste.

[6] Biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, and other biomass.

[7] Solar thermal and photovoltaic energy.

[8] Wood, black liquor, other wood waste, biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, other biomass, geothermal, solar thermal, photovoltaic, and wind.

Attachment B: US Net Electric Generation (All Sectors) by Energy Source -- 1994 through July 2008 -- Shown as % of Total US Electric Generation

	Traditional Energy Sources, Including Hydro									Non-Hydro Renewables							
Period	Coal [1}	Petroleum Liquids [2]	Petroleum Coke	Natural Gas	Other Gases [3]	Nuclear	Hydroelectric Conventional	Hydroelectric Pumped Storage	Other [4]	Wood [5]	Waste [6]	Geo-thermal	Solar/ PV [7]	Wind	Sub-Total Non Hydro Renewables [8}		Total
1994	52.06%	3.03%	0.23%	14.17%	0.41%	19.72%	8.01%	-0.10%	0.11%	1.17%	0.59%	0.48%	0.01%	0.11%	2.36%		100%
1995	50.97%	2.00%	0.23%	14.79%	0.41%	20.08%	9.27%	-0.08%	0.12%	1.09%	0.61%	0.40%	0.01%	0.09%	2.21%		100%
1996	52.12%	2.13%	0.23%	13.21%	0.42%	19.59%	10.08%	-0.09%	0.10%	1.07%	0.61%	0.42%	0.02%	0.09%	2.20%		100%
1997	52.83%	2.37%	0.28%	13.73%	0.38%	18.00%	10.21%	-0.12%	0.10%	1.06%	0.62%	0.42%	0.01%	0.09%	2.21%		100%
1998	51.75%	3.23%	0.33%	14.67%	0.37%	18.61%	8.93%	-0.12%	0.10%	1.00%	0.62%	0.41%	0.01%	0.08%	2.13%		100%
1999	50.91%	2.90%	0.29%	15.06%	0.38%	19.71%	8.65%	-0.17%	0.11%	1.00%	0.61%	0.40%	0.01%	0.12%	2.15%		100%
2000	51.72%	2.69%	0.24%	15.81%	0.37%	19.83%	7.25%	-0.15%	0.13%	0.99%	0.61%	0.37%	0.01%	0.15%	2.13%		100%
2001	50.95%	3.07%	0.27%	17.10%	0.24%	20.58%	5.81%	-0.24%	0.32%	0.94%	0.39%	0.37%	0.01%	0.18%	1.89%		100%
2002	50.10%	2.04%	0.41%	17.91%	0.30%	20.22%	6.85%	-0.23%	0.35%	1.00%	0.39%	0.38%	0.01%	0.27%	2.05%		100%
2003	50.83%	2.65%	0.43%	16.74%	0.40%	19.67%	7.10%	-0.22%	0.36%	0.97%	0.41%	0.37%	0.01%	0.29%	2.05%		100%
2004	49.83%	2.52%	0.52%	17.85%	0.42%	19.86%	6.76%	-0.21%	0.36%	0.95%	0.39%	0.37%	0.01%	0.36%	2.08%		100%
2005	49.64%	2.47%	0.55%	18.69%	0.40%	19.28%	6.67%	-0.16%	0.31%	0.95%	0.38%	0.36%	0.01%	0.44%	2.15%		100%
2006	48.98%	1.10%	0.48%	20.00%	0.40%	19.37%	7.12%	-0.16%	0.34%	0.95%	0.40%	0.36%	0.01%	0.65%	2.37%		100%
2007	48.58%	1.20%	0.38%	21.47%	0.37%	19.39%	5.97%	-0.17%	0.33%	0.93%	0.41%	0.36%	0.01%	0.77%	2.48%		100%
2008																	
January	50.26%	0.86%	0.36%	19.84%	0.34%	19.46%	6.15%	-0.21%	0.26%	0.92%	0.38%	0.33%	0.00%	1.03%	2.66%		100%
February	51.24%	0.74%	0.37%	18.38%	0.35%	19.92%	6.21%	-0.12%	0.24%	0.94%	0.37%	0.33%	0.01%	1.00%	2.66%		100%
March	49.61%	0.66%	0.30%	18.76%	0.50%	19.92%	7.05%	-0.16%	0.30%	0.97%	0.42%	0.38%	0.02%	1.26%	3.06%		100%
April	48.52%	0.71%	0.36%	20.06%	0.48%	18.88%	7.28%	-0.03%	0.38%	0.97%	0.48%	0.40%	0.03%	1.48%	3.35%		100%
May	47.93%	0.69%	0.31%	18.84%	0.42%	19.89%	8.67%	-0.18%	0.27%	0.93%	0.45%	0.39%	0.03%	1.37%	3.16%		100%
June	45.84%	1.01%	0.32%	22.50%	0.35%	18.81%	8.24%	-0.10%	0.24%	0.85%	0.39%	0.34%	0.03%	1.16%	2.77%		100%
July	46.60%	0.75%	0.28%	24.75%	0.36%	18.47%	6.43%	-0.20%	0.23%	0.83%	0.36%	0.32%	0.03%	0.80%	2.34%		100%
Total	48.48%	0.78%	0.33%	20.62%	0.40%	19.30%	7.13%	-0.14%	0.27%	0.91%	0.41%	0.35%	0.02%	1.14%	2.83%		100%
Yr-to-Date																	
2006	48.58%	1.07%	0.51%	19.30%	0.40%	19.47%	8.12%	-0.15%	0.34%	0.94%	0.40%	0.35%	0.01%	0.66%	2.36%		100%
2007	48.68%	1.35%	0.39%	20.07%	0.39%	19.56%	6.89%	-0.15%	0.34%	0.92%	0.41%	0.36%	0.02%	0.77%	2.48%		100%
2008	48.48%	0.78%	0.33%	20.62%	0.40%	19.30%	7.13%	-0.14%	0.27%	0.91%	0.41%	0.35%	0.02%	1.14%	2.83%		100%

Source: US Energy Information Administration

[1] Anthracite, bituminous, subbituminous, lignite, waste coal, and coal synfuel.

[2] Distillate fuel oil, residual fuel oil, jet fuel, kerosene, and waste oil.

[3] Blast furnace gas, propane gas, and other manufactured and waste gases derived from fossil fuels.

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