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Chairman and Members
Connecticut Energy Advisory Board
C/o CERC
805 Brook Street, Building 4
Rocky Hill, CT 06067-3405

Re: **Comment s on the Integrated Resource Plan for Connecticut ("the EDCs Plan") dated January 1, 2009**

Dear Chairman and Members:

The CEAB invited interested persons to submit written comments that focus on the way in which the Electric Distribution Companies ("EDCs") Plan meets the statutory requirements of Connecticut General Statutes Section 16a-3a (Section 51 of Public Act 07-242, An Act Concerning Electricity and Energy Efficiency), and/or the ways in which the EDCs Plan should be modified to better conform to the statutory requirements.

EXECUTIVE SUMMARY

The Primary Findings, Recommendations and supportive information in the Integrated Resource Plan ("Plan") failed to adequately and fully address the individual requirements of Connecticut General Statutes, §§ 16a-3a(a) to 16a-3a(d) as more fully set forth below. The Plan's narrative and information was not identified with a specific subsection of the statutes to demonstrate responsiveness to the legislative mandate. Additionally, nuclear power is not an economically viable source of electric power and provides a low Energy Return On Energy Investment ("EROEI") because it requires fossil fuels for construction, operation, maintenance, and decommissioning and produces Greenhouse Gases from the use of such fuels. Furthermore, the Plan failed to address one of the most viable technologies as a demand side resource - electrical energy storage, and it failed to consider the future of the fuel supply for the energy sources given the realities of Peak Oil, Peak Natural Gas, and Peak Nuclear Fuel. Finally, the

EROEI of renewables is low compared to fossil fuels and will not within 30 years come close to replacing power generation using fossil fuels assuming no population or energy growth.

I. INTRODUCTION: ADMIRAL RICKOVER, *ENERGY RESOURCES AND OUR FUTURE*

The consideration of plug-in electric vehicles and other electrical energy demands without holistic consideration of their life cycle energy consumption necessitates review of excerpts from his May 14, 1957 speech at a banquet of the Annual Scientific Assembly of St. Paul, Minnesota by Rear Admiral Hyman Rickover, father of the nuclear United States Navy, who proclaimed the following about the Nation's energy resources and its future:

> We live in what historians may some day call the Fossil Fuel Age. Today **coal, oil, and natural gas supply 93% of the world's energy**; waterpower accounts for only 1%; and the labor of men and domestic animals the remaining 6%. This is a startling reversal of corresponding figures for 1850 - only a century ago. Then fossil fuels supplied 5% of the world's energy, and men and animals 94%. **Five sixths of all the coal, oil, and gas consumed since the beginning of the Fossil Fuel Age has been burned up in the last 55 years.**
>
> Our country, with only 6% of the world's population, uses one third of the world's total energy input; this proportion would be even greater except that we use energy more efficiently than other countries. **Each American has at his disposal, each year, energy equivalent to that obtainable from eight tons of coal. This is six times the world's per capita energy consumption.** Though not quite so spectacular, corresponding figures for other highly industrialized countries also show above average consumption figures. The United Kingdom, for example, uses more than three times as much energy as the world average.
>
> With high energy consumption goes a high standard of living. Thus the enormous fossil energy which we in this country control feeds machines, which make each of us **master of an army of mechanical slaves**. Man's muscle power is rated at 35 watts continuously, or one-twentieth horsepower. Machines therefore furnish every American industrial worker with energy equivalent to that of 244 men, while at least 2,000 men push his automobile along the road, and his family is supplied with 33 faithful household helpers. Each locomotive engineer controls energy equivalent to that of 100,000 men; each jet pilot of 700,000 men. Truly, the humblest American enjoys the services of more slaves than were once owned by the richest nobles, and lives better than most ancient kings. In retrospect, and despite wars, revolutions, and disasters, the hundred years just gone by may well seem like a Golden Age.

Possession of surplus energy is, of course, a requisite for any kind of civilization, for if man possesses merely the energy of his own muscles, he must expend all his strength - mental and physical - to obtain the bare necessities of life. Surplus energy provides the material foundation for civilized living - a comfortable and tasteful home instead of a bare shelter; attractive clothing instead of mere covering to keep warm; appetizing food instead of anything that suffices to appease hunger. It provides the freedom from toil without which there can be no art, music, literature, or learning. There is no need to belabor the point. What lifted man - one of the weaker mammals - above the animal world was that he could devise, with his brain, ways to increase the energy at his disposal, and use the leisure so gained to cultivate his mind and spirit. Where man must rely solely on the energy of his own body, he can sustain only the most meager existence.

How closely energy consumption is related to standards of living may be illustrated by the example of India. Despite intelligent and sustained efforts made since independence, India's per capita income is still only 20 cents daily; her infant mortality is four times ours; and the life expectance of her people is less than one half that of the industrialized countries of the West. These are ultimate consequences of India's very low energy consumption: one-fourteenth of world average, one-eightieth of ours.

In the face of the basic fact that fossil fuel reserves are finite, the exact length of time these reserves will last is important in only one respect: the longer they last, the more time do we have, to invent ways of living off renewable or substitute energy sources and to adjust our economy to the vast changes which we can expect from such a shift.

Fossil fuels resemble capital in the bank. A prudent and responsible parent will use his capital sparingly in order to pass on to his children as much as possible of his inheritance. A selfish and irresponsible parent will squander it in riotous living and care not one whit how his offspring will fare.

Today the automobile is the most uneconomical user of energy. Its efficiency is 5% compared with 23% for the Diesel-electric railway. It is the most ravenous devourer of fossil fuels, accounting for over half of the total oil consumption in this country. **And the oil we use in the United States in one year took nature about 14 million years to create.** Curiously, the automobile, which is the greatest single cause of the rapid exhaustion of oil reserves, may eventually be the first fuel consumer to suffer. Reduction in automotive use would necessitate an extraordinarily costly reorganization of the pattern of living in industrialized nations, particularly in the United States. It would seem prudent to bear this in mind in future planning of cities and industrial locations.

(Emphasis added.)

II. COMPREHENSIVE PLAN FOR ENERGY RESOURCE PROCUREMENT: STATUTORY REQUIREMENTS AND COMMENTS

The Connecticut General Statutes, Section 16a-3a(a) provides that the electric distribution companies (“EDCs”) consulting with the Connecticut Energy Advisory Board (“CEAB”) shall review the state's energy and capacity resource assessment and develop a comprehensive plan for the procurement of energy resources, including, but not limited to, conventional and renewable generating facilities, energy efficiency, load management, demand response, combined heat and power facilities, distributed generation and other emerging energy technologies to meet the projected requirements of their customers in a manner that minimizes the cost of such resources to customers over time and maximizes consumer benefits consistent with the state's environmental goals and standards.

The creation of the report entailed a collaborative effort by The Connecticut Light and Power Company (CL&P) and The United Illuminating Company (UI) ”), and *The Brattle Group*, an independent economic consulting firm, with guidance from CEAB’s IRP subcommittee. This 2009 report continues the effort started in the 2008 report, and consists of ten “whitepapers” addressing issues collaboratively identified by the Companies and the CEAB. It provides an assessment for the next three, five, and ten years, through 2019. The ten whitepapers constitute subsequent sections of the document and include discussion, analysis, and updates to previous work on the following topics: *Resource Adequacy; Demand-Side Management (DSM);Renewable Energy; Transmission; Nuclear Power Fact Finding; Combined Heat and Power (CHP); Environmental Regulatory Evolution; Energy Security; Resource Finance; and Emerging Technologies.*

A. Requirements

Section 16a-3a(b) requires that the companies annually submit to the CEAB an assessment of:

(1) Energy and capacity requirements of customers for the next three, five and ten years;
(2) Manner of how best to eliminate growth in electric demand;
(3) How best to level electric demand in the state by reducing peak demand and shifting demand to off-peak periods;

> (4) Impact of current and projected environmental standards, including, but not limited to, those related to greenhouse gas emissions and the federal Clean Air Act goals and how different resources could help achieve those standards and goals;
> (5) Energy security and economic risks associated with potential energy resources; and
> (6) Estimated lifetime cost and availability of potential energy resources.

A. Comments

(1) My review and comments focused on whether the Plan complied with the requirements of Section 16a-3a, which only governs electrical energy resources. Unfortunately, the report did not follow the individual requirements established in each of subsections (b) through (d) but, rather, created the above order from elements of each subsection. Although Section 16a-3a did not require any specific order for presenting the Plan, the arrangement made tracking information to requirements quite difficult. For example, the white paper on Resource Adequacy projected available resources to meet future needs to satisfy: Demand, Connecticut and Independent Service Operator ("ISO") - Wide Reliability Requirements, Generation Resources, Demand-Side Resources, Net Imports and Tie-Line Benefits, Resource Gap, and Scenarios. The approach is similar to ordering food off of a Chinese restaurant menu - one from column A and one from column B.

(2) The Plan avoided addressing the issues raised in §§ 16a-3a(b)(2) to (6).

B. Requirements

Section 16a-3a(c) requires that resource needs first be met through all available energy efficiency and demand reduction resources that are cost-effective, reliable and feasible. The projected customer cost impact of any demand-side resources considered pursuant to this subsection shall be reviewed on an equitable bases with nondemand-side resources. The procurement plan shall specify:

> (1) The total amount of energy and capacity resources needed to meet the requirements of all customers;
> (2) The extent to which demand-side measures, including efficiency, conservation, demand response and load management can cost-effectively meet these needs;
> (3) Needs for generating capacity and transmission and distribution improvements;
> (4) How the development of such resources will reduce and stabilize the costs of electricity to consumers; and

(5) The manner in which each of the proposed resources should be procured, including the optimal contract periods for various resources.

B. Comments

(1) The Plan was unresponsive to the detailed requirements in § 16a-3a(c) that "resource needs first be met through all available energy efficiency and demand reduction resources that are cost-effective, reliable and feasible." For example, the Plan stated on page 2-1, first paragraph that: "[r]equires pursuit of all cost-effective energy efficiency as the first resource to meet energy and capacity needs" but it failed to show how the demand can first be met by energy efficiency and demand reduction.

(2) The Plan neglected to consider off-peak demand fixed and mobile storage technologies for residential and commercial and vehicular applications as an essential resource component.

C. Requirements

Section 16a-3a (d) requires that the procurement plan consider:

(1) Approaches to maximizing the impact of demand-side measures;
(2) The extent to which generation needs can be met by renewable and combined heat and power facilities;
(3) The optimization of the use of generation sites and generation portfolio existing within the state;
(4) Fuel types, diversity, availability, firmness of supply and security and environmental impacts thereof, including impacts on meeting the state's greenhouse gas emission goals;
(5) Reliability, peak load and energy forecasts, system contingencies and existing resource availabilities;
(6) Import limitations and the appropriate reliance on such imports; and (7) the impact of the procurement plan on the costs of electric customers.

C. Comments

(1) The Plan failed to consider the future of the fuel supply for the energy sources given the realities of Peak Oil, Peak Natural Gas, and Peak Nuclear Fuel. Finally, the EROEI of renewables as shown in Attachment (1), Dr. Charles Hall's Balloon Graph and interpretation), is low compared to fossil fuels and will not within 30 years come

within range of replacing power generation using fossil fuels assuming no population or energy growth.

(2) Section 5 of the Plan presents Nuclear Power Fact Finding. It stated that:

> In considering Connecticut's future resource plan, the question of a new nuclear plant has arisen. In light of some of the concerns facing New England, nuclear generation has some advantages, though it also faces some obstacles. The purpose of this section is to explore factors affecting nuclear power as a potential future baseload resource addition, providing background and context that will help to encourage discussion. We do not attempt to reach a conclusion about the advisability of a new nuclear plant in Connecticut or to advocate any other particular position.

The opinion provided in Attachment (2) best addresses the economic fallacies of nuclear power. Additionally, the Energy Profit Ratio or Energy Return On Energy Investment ("EROEI)" for construction, operation, maintenance, and decommissioning would be low over the 30+ year life of a plant because of the need for fossil fuels, which would, also, produce Greenhouse Gases.

(3) Solar and other renewables are not viable substitutes for fossil fuels because of their: 1) insufficient energy density; 2) untransportability; 3) relatively high environmental impact per net unit of energy delivered to society; 4) relatively low EROI; and 5) unobtainability on a scale that society presently demands. See attached Balloon Graph of Dr. Charles Hall to support these claims.

Cordially,

Robert Fromer

Robert Fromer
Environmental and Public Interest Consultant

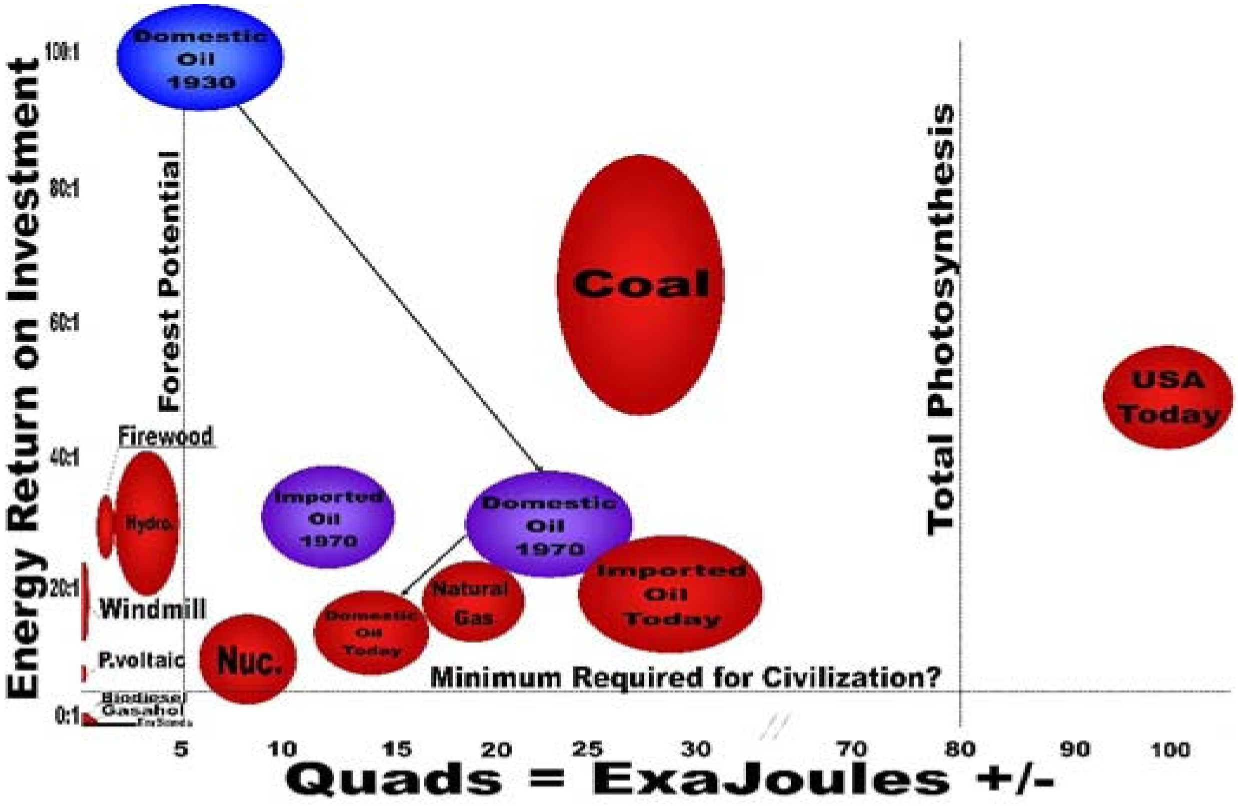
Attachment: (1) Dr. Charles Hall's Balloon Graph
(2) Lester Brown, The Flawed Economics of Nuclear Power

Energy researcher Charlie Hall's balloon graph challenges the notion that alternative energy sources will provide a smooth transition to a post-fossil fuel society. Scale and energy return remain huge obstacles.

Charlie Hall, professor, State University of New York College of Environmental Science and Forestry, Syracuse, New York 13210, is one the best-known energy researchers you've never heard of. That's because he puts his effort into understanding whole energy systems such as human civilization rather than perfecting headline-grabbing energy panaceas such as corn ethanol. From the early 1980s onward Hall and his colleagues--some of them former students--have been warning that a society hooked on fossil fuels would find itself up against limits not easily breached--probably sooner rather than later.

With the current boom in biofuels, wind, and solar, and even a revival in nuclear power, many people believe that a smooth transition to a post-fossil fuel economy is already a foregone conclusion. But a careful look at Charlie Hall's balloon graph tells a different and much more disconcerting story (1). (To view a larger version of the graph, click here or on the graph itself.)

First, let's look at the components of the chart. On the vertical axis we have energy return on investment (EROI) expressed as the ratio of energy output versus energy input for each energy source. (Hall, an ecologist by training, appears to have coined the term by adapting "yield per effort" concepts from fisheries.) It is not always obvious to modern industrial people that it takes energy to get energy. The more energy we spend on finding, extracting, refining, and transporting energy resources, the less we have for all the other activities of society. The horizontal axis of the graph represents quads or more precisely, quadrillion BTUs (British Thermal Units). The graph depicts energy use in the United States. But the principles it demonstrates apply to the world as a whole.



http://img519.imageshack.us/img519/5209/balloonchartic8.jpgThe various colors put focus on the annual production totals and energy return of oil at different times. The sizes for all the balloons represent a very rough guide to the uncertainties in calculating EROI ranges. (As we shall see, even with these uncertainties there is a very large discernible gap between what we currently get from fossil fuels and what we can expect to get from alternatives.)

Oil, which makes up the largest percentage of U.S. energy consumption today (40%), has shown a substantial increase in its total output even as its EROI has fallen. To see this on the graph look at the blue balloon labeled "Domestic Oil 1930," the purple balloons labeled "Imported Oil 1970" and "Domestic Oil 1970" and the red balloons labeled "Domestic Oil Today" and "Imported Oil Today." That same move to a lower EROI is also being seen for natural gas and coal though the balloon graph does not depict these trends.

Everyone knows that at some point fossil fuel supplies, which are finite, will begin to decline. To replace them we currently have biofuels such as biodiesel; other renewables such as wind, photovoltaic, and hydroelectric; and nuclear power. Oil from tar sands is also shown in the lower left-hand corner, but you have to look hard. And, that's just the point. You have to look pretty hard to see these alternatives on the graph. There are two reasons for this. First, some of these new sources are not very far along in their deployment. As they are more widely deployed, they will supply more total power and move to the right on the graph. Second, the EROI for biofuels such as biodiesel and for unconventional oil such as that extracted from tar sands is extremely low. Given current technology, these alternatives are not likely to move upward very much on the graph anytime soon.

Hall believes we have two problems illustrated by his balloon chart. First, in order for these alternative sources to move rightward on the graph--that is, produce much larger quantities of energy for society--they will have to be deployed on a vast scale which few people contemplate or understand. Two examples come to mind. The worldwide installed capacity of solar photovoltaic cells is 10.9 gigawatts. With the total worldwide installed electrical generating base at 3,872 gigawatts, it would take more than 2,000 years at the current rate of installation (1.74 gigawatts/year) to reach today's capacity. And that's without even considering future growth in electricity demand. If we include the installed base of wind (74.3 gigawatts) and the current rate of wind installations (14.9 gigawatts/year), we can bring the figure all the way down to about 230 years, again without considering growth in demand. Of course, the rates of installation will grow, and there are other renewable and nonrenewable energy sources available. But the challenge of scale remains huge.

When it comes to biofuels, the scale problem gets no better. Biofuels researcher Tad Patzek uses corn ethanol as an example. To fuel the American vehicle fleet using corn ethanol:

> [o]ne would have to grow corn on 1.8 billion acres, year-after-year, for decades. There are about 400 million acres of arable land now in cultivation in the U.S. Therefore, one would have to use the land area equal to 4.5 times the current arable land area....

If we want to continue living in the kind of energy-drenched civilization we now enjoy, we will have to move simultaneously rightward *and* upward on the balloon graph. Hall estimates that if society were to average less than a 5 to 1 ratio of EROI, anything resembling our modern civilization would probably not function. The balloon graph suggests a minimum EROI for the United States of around 40 to 1 for 100 quads of energy generated. Therefore, without major breakthroughs in the efficiency of alternative energy sources, no combination of those sources has the prospect of giving us both the high energy returns and the large total production we are accustomed to from our current energy sources.

(It's important to note that nearly all the good sites for hydro power in the world have already been taken. And, turning to firewood for fuel would simply result in the leveling of the world's remaining forests, leaving us with nothing for the future and destroying the habitability of the planet in the bargain. The upshot: Neither of these alternatives is going to move much to the right on the graph.)

Many are saying peak world oil production will soon be upon us with peak natural gas and coal following close behind. To live anything like we now live, we are going to have to see some astounding technical breakthroughs in alternative energy sources soon. And those breakthroughs will have to be followed by dramatic and costly efforts to deploy alternatives rapidly and ubiquitously. For now we appear to be on a course that will require drastic changes in the way we live.

Perhaps we will somehow muddle through. But when you look at Charlie Hall's balloon graph, it's easy to conclude that even muddling through might end up being a very unpleasant affair.

Notes:

(1) Hall, C.A.S., R. Powers and W. Schoenberg. (in press). Peak oil, EROI, investments and the economy in an uncertain future. Pp. xxx-xxx in Pimentel, David. (ed). *Renewable Energy Systems: Environmental and Energetic Issues*.

THE FLAWED ECONOMICS OF NUCLEAR POWER

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http://www.earthpolicy.org/Updates/2008/Update78.htm

Over the last few years the nuclear industry has used concerns about climate change to argue for a nuclear revival. Although industry representatives may have convinced some political leaders that this is a good idea, there is little evidence of private capital investing in nuclear plants in competitive electricity markets. The reason is simple: nuclear power is uneconomical.

In an excellent recent analysis, "The Nuclear Illusion," Amory B. Lovins and Imran Sheikh put the cost of electricity from a new nuclear power plant at 14¢ per kilowatt hour and that from a wind farm at 7¢ per kilowatt hour. This comparison includes the costs of fuel, capital, operations and maintenance, and transmission and distribution. It does not include the additional costs for nuclear of disposing of waste, insuring plants against an accident, and decommissioning the plants when they wear out. Given this huge gap, the so-called nuclear revival can succeed only by unloading these costs onto taxpayers. If all the costs of generating nuclear electricity are included in the price to consumers, nuclear power is dead in the water.

To get a sense of the costs of nuclear waste disposal, we need not look beyond the United States, which leads the world with 101,000 megawatts of nuclear-generating capacity (compared with 63,000 megawatts in second-ranked France). The United States proposes to store the radioactive waste from its 104 nuclear power reactors in the Yucca Mountain nuclear waste repository, roughly 90 miles northwest of Las Vegas, Nevada. The cost of this repository, originally estimated at $58 billion in 2001, climbed to $96 billion by 2008. This comes to a staggering $923 million per reactor--almost $1 billion each-assuming no further repository cost increases. (See data at www.earthpolicy.org/Updates/2008/Update78_data.htm).

In addition to being over budget, the repository is 19 years behind schedule. Originally slated to start accepting waste in 1998, it is now set to do so in 2017, assuming it clears all remaining hurdles. This leaves nuclear waste in storage in 121 temporary facilities in 39 states--sites that are vulnerable both to leakage and to terrorist attacks.

One of the risks of nuclear power is a catastrophic accident like the one at Chernobyl in Russia. The Price-Anderson Act, first enacted by Congress in 1957, shelters U.S. utilities with nuclear power plants from the cost of such an accident. Under the act, utilities are required to maintain private accident insurance of $300 million per reactor--the maximum the insurance industry will provide. In the event of a catastrophic accident, every nuclear utility would be required to contribute up to $95.8 million for each licensed reactor to a pool to help cover the accident's cost.

The collective cap on nuclear operator liability is $10.2 billion. This compares with an estimate by Sandia National Laboratory that a worst-case accident could cost $700 billion, a sum equal to the recent U.S. financial bailout. So anything above $10.2 billion would be covered by taxpayers.

Another huge cost of nuclear power involves decommissioning the plants when they wear out. A 2004 International Atomic Energy Agency report estimates the decommissioning cost per reactor at $250-500 million, excluding the cost of removing and disposing of the spent nuclear fuel. But recent estimates for some reactors, such as the U.K. Magnox reactors that have high decommissioning waste volumes, decommissioning costs can reach $1.8 billion per reactor.

In addition to the costs just cited, the industry must cope with rising construction and fuel expenses. Two years ago, building a 1,500-megawatt nuclear plant was estimated to cost $2-4 billion. As of late 2008, that figure had climbed past $7 billion, reflecting primarily the scarcity of essential engineering and construction skills in a fading industry.

Nuclear fuel costs have risen even more rapidly. At the beginning of this decade uranium cost roughly $10 per pound. Today it costs more than $60 per pound. The higher uranium price reflects the need to move to ever deeper mines, which increases the energy needed to extract the ore, and the shift to lower-grade ore. In the United States in the late 1950s, for example, uranium ore contained roughly 0.28 percent uranium oxide. By the 1990s, it had dropped to 0.09 percent. This means, of course, that the cost of mining larger quantities of ore, and that of getting it from deeper mines, ensures even higher future costs of nuclear fuel.

Few nuclear power plants are being built in countries with competitive electricity markets. The reason is simple. Nuclear cannot compete with other electricity sources. This explains why nuclear plant construction is now concentrated in countries like Russia and China where nuclear development is state-controlled. The high cost of nuclear power also explains why so few plants are being built compared with a generation ago.

In an illuminating article in the Bulletin of the Atomic Scientists, nuclear consultant Mycle Schneider projects an imminent decline in world nuclear generating capacity. He notes there are currently 439 operating reactors worldwide. To date, 119 reactors have been closed, at an average age of 22 years. If we generously assume a much longer average lifespan of 40 years, then 93 reactors will close between 2008 and 2015. Another 192 will close between 2016 and 2025. And the remaining 154 will close after 2025.

But only 36 nuclear reactors are currently under construction worldwide--31 of them in Eastern Europe and Asia. Although there is much talk of building new nuclear plants in the United States, there are none under construction.

What these numbers indicate, Schneider points out, is that plant closings will soon exceed plant openings--and by a widening margin in the years ahead. The trend is clear. From 2000 to 2005, an average of 4,000 megawatts of nuclear generating capacity was added each year. Since 2005, this has dropped to only 1,000 megawatts of additional capacity per year.

Even if all reactors scheduled to come online by 2015 make it, the projected closing of 93 nuclear reactors by then will drop nuclear power generation roughly 10 percent below the current level. Unless governments start routinely granting operating permits for reactors more than 40 years old, a half-century of growth in world nuclear generating capacity is about to be replaced by a long-term decline.

Despite all the industry hype about a nuclear future, private investors are openly skeptical. In fact, while little private capital is going into nuclear power, investors are pouring tens of billions of dollars into wind farms each year. And while the world's nuclear generating capacity is estimated to expand by only 1,000 megawatts this year, wind generating capacity will likely grow by 30,000 megawatts. In addition, solar cell installations and the construction of solar thermal and geothermal power plants are all growing by leaps and bounds.

The reason for this extraordinary gap between the construction of nuclear power plants and wind farms is simple: wind is much more attractive economically. Wind yields more energy, more jobs, and more carbon reduction per dollar invested than nuclear. Though nuclear power plants are still being built in some countries and governments are talking them up in others, the reality is that we are entering the age of wind, solar, and geothermal energy.

Lester R. Brown is president of Earth Policy Institute and author of Plan B 3.0: Mobilizing to Save Civilization, available at www.earthpolicy.org for free downloading.