WELCOME TO CONNECTICUT: A STATE WHERE WASTE IS OUR MOST IMPORTANT AND PROLIFIC PRODUCT.

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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: **Oral Testimony on the Integrated Resource Plan for Connecticut ("the EDCs Plan") dated January 1, 2009**

Dear Chairman and Members:

INTRODUCTION

In his may 14, 1957 speech at a banquet of the annual scientific assembly of St. Paul, Minnesota, Rear Admiral Hyman Rickover, father of the nuclear United States Navy, proclaimed the following about the nation's energy resources and its future:

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**.

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 that 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.

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.

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, industrial locations, and the grid.

THE PLAN

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. Nothing in § 16a-3a refers to an "Integrated Resource Plan." Nonetheless, it should more properly be called an "Integrated Resources Plan."

The plan's narrative and information was not identified with a specific subsection of the statutes to demonstrate responsiveness to the legislative mandate. For example, resource adequacy is not linked to any specific subsections; it is left for the reader to figure it out.

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. No consideration was given to the impact of plug-in hybrid motor vehicles on capacity and as energy storage devices. Finally, the Energy Return On energy Invested ("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.

According to the Integrated Resources Plan, Connecticut has sufficient capacity for the next 10 years, but **does it have a guaranteed fuel supply for the 10 years**?

NUCLEAR POWER

Nuclear power is not an economically viable source of electric power and provides a low EROEI because it requires fossil fuels for construction, operation, maintenance, and decommissioning and produces greenhouse gases from the use of such fuels.

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.

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 United Kingdom’s 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.

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 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 and low eroi.

CLIMATE CHANGE INITIATIVE

On June 2, 2008, Governor Jodi Rell signed into law hb5600, setting a statewide GHG reduction target of 10% below 1990 levels by 2020 and 80% below 2001 levels by 2050. In 2004, the governor signed sb595 to formally adopt the goals of the New England governors and eastern Canadian premiers (NEG-ECP) action plan, to which Connecticut is a signatory. The NEG-ECP calls for the following GHG targets: 1990 emission levels by 2010, 10% below 1990 levels by 2020, and further reductions in the long term as needed to prevent a dangerous threat to the climate. This means that by 2020, approximately 20% power generated by renewables. The state generates about 7,000 MWs. So, 20% power from renewables means about 1400 MWs. So, ct either buys power from the OPEC or other states producing the same result – net outflow of money. This is highly unlikely unless and until there is a dramatic technological breakthrough.

ALTERNATIVE SOURCES

First, in order for these alternative sources 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. 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 society were to average less than a 5 to 1 ratio of EROI, anything resembling our modern civilization would probably not function. 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.