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MOTHERS for PEACE

PO Box 3608
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NRC public meetings, March 3 in San Luis Obispo, are an opportunity for the public to state environmental concerns about the proposed 20 year license renewal for Diablo Canyon Nuclear Power Plant.

BACKGROUND:

- As part of the license renewal process, this "Scoping" meeting will focus on environmental issues that the public wants the NRC to consider when reviewing PG&E's license renewal application.

- The current operating licenses are in effect until 2024 for Unit 1 and 2025 for unit 2; PG&E has applied to extend operations until 2044 and 2045.

SCHEDULE:

Embassy Suites Hotel
333 Madonna Road, San Luis Obispo

1st Meeting:

12:30pm	"Open House" to speak informally with NRC Staff
1:30 – 4:30pm	NRC Presentation followed by public comments

2nd Meeting:

6:00pm	"Open House" to speak informally with NRC Staff
7:00 – 10:00pm	NRC Presentation followed by public comments

NRC PLANNED PROCEDURES:

Members of the public who wish to make comments are asked to register within 15 minutes of the start of each meeting. (MFP has received verbal assurances that persons deciding later that they would like to speak will be able to fill out a speaker card and to be called upon in the order of sign-ups.)

NRC rules include a limited number of issues within the 'scope' of the environmental review. These are the items that the NRC calls 'Category 2' which are site-specific. These include: aging of components, degradation of the marine environment (entrainment and impingement of fish, thermal effects), severe accident scenarios, new and significant information, air quality, groundwater-use conflicts, archaeological resources, threatened or endangered species...

'Category 1' issues are those the NRC considers generic – meaning common to all plants *and thus not reevaluated in the environmental impact statements for license renewal for each site*. The issues that concern SLOMFP most are considered generic: disposal of high level radioactive waste, safety, geology (seismic), security and safeguards, emergency preparedness, need for power, economic feasibility...

However, if you can tie your concern to a Category 2 issue, it might be considered within the scope. Examples:

Seismic concerns (Category 1) + severe accident scenario + new information (Shoreline Fault) (Category 2)

Terrorism + severe accident scenario

On-site high-level radioactive waste storage + seismic + severe accident scenario

For more information on scoping, refer to... Frequently Asked Questions on License Renewal: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1850/sr1850_faq_lr.pdf

PG&E's Environmental Report is recommended reading: http://www.nrc.gov/reactors/operating/licensing/renewal/applications/diablo-canyon/dcpp-er.pdf

PG&E's License Renewal Application: http://www.nrc.gov/reactors/operating/licensing/renewal/applications/diablo-canyon/dcpp-lra.pdf

OBJECTIONS OF SAN LUIS OBISPO MOTHERS FOR PEACE TO PG&E'S APPLICATION FOR ANOTHER 20 YEARS OF DIABLO OPERATIONS:

Earthquakes:

- The license renewal application is premature since the results of many studies requested by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) are not complete. These studies include a 3D study of the new Shoreline Fault (to be completed sometime in 2013), ,economic and environmental costs and benefits of extended operation, plant reliability, available alternatives, and other studies as required by AB 1632.

- It is contrary to NRC regulations to license a nuclear facility next to an active, major earthquake fault. However, the NRC "grandfathered" the license for Diablo, accepting PG&E's excuse that it was unaware of the Hosgri Fault, located within 3.5 miles of the plant, when it first invested billions of ratepayer dollars in building the plant. The NRC is prohibited by its own regulations from taking into account corporate profits rather than public safety, but that is exactly what it did.

- The recently discovered Shoreline Fault, less than one mile offshore of the Diablo site, has not been thoroughly studied, and it clearly exacerbates an already precarious situation. The central coast of California is riddled with earthquake faults, including the Hosgri, Shoreline, Pecho, Olson, San Luis Bay, Crowbar, N40W, Los Osos, San Miguelito, Cambria, West Huasna, Oceano, and Widmer Avenue.

- The Diablo Canyon facility includes two nuclear reactors and the storage of all the high-level radioactive wastes generated by those reactors since licensing in1984. Most of the spent fuel (which is much more radioactive than the fuel in the reactors) is stored in over-crowded pools. During an earthquake there is the potential of a loss of coolant crucial to preventing uncontrolled fission or a fire, either of which would release radiation into the air.

Radioactive Waste:

- California law prohibits new plants until/unless the waste issue is resolved. To allow an existing plant to generate radioactive wastes for an additional 20 years would contradict the intent of this law.

- Ross Landsman, NRC inspector for the Midwest region, made the following comments on the Holtec casks of the type being used at Diablo Canyon: "I remain concerned about the safety of the Holtec Dry Casks. The NRC should stop the production of the casks, but they do not have the chutzpah to do it. This is the kind of thinking that causes space shuttles to hit the ground."

Safety :

- Recent NRC inspection reports on Diablo (August, 2009) indicate that PG&E is not meeting industry standards in its identification and resolutions of problems at Diablo. One recent example is that in October, 2009, it was discovered that for 18 months the Diablo Canyon plant had operated with defective control of some of the valves relied upon to flood the Unit 2 reactor with essential cooling water in the event of a serious accident or sabotage. An investigation by the Nuclear Regulatory Commission identified three violations of NRC regulations as the cause of the problem.

- There are an unacceptable number of human performance problems at Diablo, leading to violations of NRC regulations as well as failures to comply with safety requirements. Extensive re-training has not been effective in reducing the number of incidents.

- In the event of a major radiation release, those advised or choosing to evacuate would all have to drive in the direction opposite the wind carrying the radioactive material. Our few available roads are woefully inadequate.

Terrorism:

- MFP is currently pursuing a legal challenge in the Ninth Circuit of the U.S. Court of Appeals involving the dry cask storage facility for storing nuclear waste and its vulnerability to terrorist attack, especially from the air. If the court rules in favor of MFP as it did in 2006, the NRC might be ordered to require PG&E to make design changes. [Go to mothersforpeace.org for detailed information.]

- The air space over Diablo Canyon Nuclear Power plant is **NOT** a no fly zone.

- Instead of the casks being under berms or concrete and spread out in different locations, they are grouped in clear view from the air or ocean.

- The spent fuel pools are not protected by containment structures, making them vulnerable to terrorist attack.

- The proliferation of fissile material is a constant concern, as these materials have the potential to be used to make weapons if stolen.

Aging and Degradation:

- Diablo was designed in the 1960's. In the ensuing half century, not only have innumerable fixes been deemed necessary to keep the plant running, but replacement parts have become unavailable.

Uranium Supply :

- Optimistic projections of the availability of uranium fuel supplies show that resource running out in about 2020 – BEFORE the period at stake in the possible Diablo license extensions. [See December 1, 2009 publication of an article by Brian Wang titled "Uranium Supplies are Likely to be Adequate until 2020," available at www.theoildrum.com/]

Cost Concerns:

- Diablo is an out-dated and over-priced plant by any measure. By the time Diablo Canyon was licensed in 1984, it had cost PG&E's ratepayers some $5.5 billion – more than 10 times the original projected cost. Designed in the 1960's, it has needed constant updating and replacement of defective or worn-out parts. The earthquake bracing for Unit 2 was originally installed in mirror image of the plans and was re-done at huge expense. The rate-payer funds that would be required to keep the plant operating an additional two decades would be better spent on alternative technologies that would create additional jobs instead of nuclear waste.

- The dry casks will have to be relicensed every 20 years and, eventually, the waste will have to be transferred to another cask. This is very expensive since each cask costs about $1 million.

- The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC) are in the process of determining whether or not continued reliance on nuclear energy is in the best economic interests of the people of California. PG&E's decision to apply for license extensions 14 and15 years in advance of the expiration of the current licenses raises questions regarding PG&E's intentions toward the coming CPUC and CEC conclusions.

- PG&E spent $16.8 million on a feasibility study analyzing plant equipment and operation to determine whether to apply for a license extension. The study was paid for by PG&E's ratepayers but, even though PG&E has filed the application, the results of the study have not been published.

- A new once-through cooling system, to reduce the unacceptable loss of sea life, is projected to cost $3 billion. Replacement of Diablo Canyon's once-through cooling system, to reduce the unacceptable loss of sea life, is projected to cost $3 billion.

- The costs for relicensing have conservatively been estimated at $85 million.

CONCLUSION:
The history of Diablo Canyon shows that in terms of safety, security, and economics, it is not in the public interest to add an additional 20 years to the operating life of the two reactors at Diablo Canyon. The only advantage would be to the corporate profits of PG&E. PG&E should, instead, apply its considerable resources toward establishing itself as a leader in the development of renewable sources of energy.

Contact persons for questions or feedback on this advisory:
Jane Swanson, (805) 595-2605; janeslo@kcbx.net
Jill ZamEk, (805) 710-1143 after 3 pm on weekdays

Karen Swift, 3698 Clark Valley Rd, Los Osos, Ca, 93402
Public commentary regarding PG&E's Diablo Canyon renewal: 2010-03-03

Thank you NRC staff for hopefully taking into consideration public commentary on the relicensing of PG&E's Diablo Canyon plant application.
I am not affiliated with any organization though as a citizen of San Luis Obispo county, my views may reflect those of a larger group.
In the public commentary session between 1:30- 4:30 PM March 3, 2010 we heard views from those who wish to immediately shut down the Diablo Canyon nuclear plant due to safety concerns, particularly derived from there being not one, but two fault lines in the close vicinity of the plant—one a mere 1800 feet from the plant itself.

We also heard views from others who wished for relicensing with minimum delay, without further seismic studies to be completed prior to relicensing.

Yet there are two points of concern that reverberate between the conflicting views.

- One is a concern about the economy,
- The second is a concern about climate change and non-fossil fuel based energy

All are in favor of economic stability, more jobs, money flowing into the school system, and money flowing into the tax base. This in mind, I would like to look at a few studies regarding renewable energy and job creation:

A study released by Navigant consulting shows that if utility companies in the United States were required to produce 25% of energy from renewable sources, up to 274,000 jobs could be created.
Another study conducted by the University of Massachusetts Political Economy and Research Institute shows that per $ 1 million investment, the following number of jobs would be created in the following sectors:
Solar: 13.72
Biomass: 17.36
Smart grid: 17.36
Wind: 13.3
Coal: 6.86
Oil and gas: 5.18
Nuclear: 4.2
In regards the NRC's want to hear other options for renewable energy, I would like to name the German renewable energy act as an example. This was designed as a means of encouraging cost reductions based on improved energy efficiency. In this, feed in tariffs have been used to generate more competition and more jobs by giving incentives to every company involved in the energy generation business. This is especially to incentivize small and medium sized companies to invest in, and generate energy from renewable energy sources. Feed in tariffs decreases the initial market barrier for businesses and reduces the cost of production & consumption over a period of time. In Germany, individual households can sell their energy to the grid and make money on it.

Job Creation per $1 Million Investment

INDUSTRY	DIRECT	INDIRECT	INDUCED	TOTAL
Reforestation, Land and Watershed Restoration, and Sustainable Forest Management	17.55	12.95	9.2	39.7
Crop Agriculture	9.8	6.5	6.5	22.8
Livestock	8.4	7.1	6.2	21.7
Gas (heavy and civil construction for pipelines - 50% new and 50% repair)	12.05	3.93	5.912	21.888
Mass transit and freight rail construction	13	3.70	5.036	21.736
Roads and bridges: repair	11.1	3.69	5.527	20.317
Conservation (Parks and Land and Water Conservation Fund)	11.45	4.15	4.7	20.3
Water infrastructure	9.96	4.38	5.427	19.764
Aviation	9.7	4.30	5.264	19.266
School buildings	8.65	5.38	5.233	19.262
Building retrofits	7.7	4.70	4.96	17.36
Roads and bridges: new	8.7	3.94	4.834	14.474
Solar	5.4	4.40	3.92	13.72
Biomass	7.4	5.00	4.96	17.36
Smart grid	4.3	4.60	3.56	12.46
Wind	4.6	4.90	3.8	13.3
Electricity generation, transmission, distribution	5.32	4.50	4.696	14.512
Coal	1.9	3.00	1.96	6.86
Financial Industry	3.22	2.34	1.668	7.228
Oil and gas	0.8	2.90	1.48	5.18
Nuclear	1.2	1.80	1.2	4.2

Source: Heidi Garrett-Peltier and Robert Pollin, University of Massachusetts Political Economy and Research Institute.

Note: Multipliers derived using IMPLAN 2.0 with 2007 data. Infrastructure multipliers and assumptions are presented in "How Infrastructure Investments Suppo U.S. Economy: Employment, Productivity and Growth." Political Economy Research Institute, January 2009.

$1 billion green economic recovery package would create 4x total number of jobs than if spent w/in oil sector —

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Prepared for U.S.NRC Environmental scope meeting March 3, 2010
Re: PG&E Application License Renewal DCNPP

One of my concerns is the threat of the continued operation of the OTC system at DCNPP with regards to the accumulated death and injury to marine life, specifically the Green Sea Turtle...an endangered species. Not only because of entrainment and thermal effects but additionally due to underwater noise pollution caused by the massive impeller/pumps used to move the estimated 2.5 billion gallons of sea water each day through the system. Many researchers are becoming concerned including the U.S. Navy, who witnessed detrimental effects to sea mammals during sonar data transmission experiments. I heard a marine biologist interviewed telling us that in busy shipping lanes, the acoustic effect on sea life who depend on sound extensively, such as whales, would be similar to "running a vacuum cleaner in your house 24/7". I saw no mention of underwater noise pollution due to round the clock operation of OTC impeller/pumps listed in PG&E's Environmental Report.

Another area of concern is a major accident at DCNPP due to catastrophic seismic event such as the greatest California earthquake ever recorded, the Fort Tejon Quake, that occurred on January 9, 1857. The 7.9M quake was centered 48 mile NE of Diablo near Parkfield on the San Andreas Fault. Approximately 400 times more energy was released in that quake than was released during the 6.5M 2003 San Simeon event. U.S.G.S. has tracked an occurrence history of earthquakes of this magnitude in the nearby vicinity at a frequency of 143 to 200 years.

According to the Southern California Earthquake Data Center, this immense quake left an amazing surface rupture scar over 225 miles along the San Andreas fault. As a result of the shaking, the current of the Kern River (125 mi. East of epicenter, approx.) was turned upstream, and water ran four feet over its banks. The waters of Tulare Lake were thrown upon its shores, stranding fish miles from the original lake bed. The waters of the Mokelumne River (150 miles North of epicenter approx.) were thrown upon its banks, leaving the bed dry in places. The Los Angeles River was reportedly flung out of its bed, too. In Ventura the mission sustained considerable damage. Displacement of 30 feet in the Carrizo Plain area.

Elsewhere I read an account by otter hunters offshore the Santa Cruz Island south of Santa Barbara, reporting extensive sections of sea cliffs falling into the ocean.

These descriptions of the 7.9M quake along with the knowledge of the two faults in the immediate area, along with all the other concerns surrounding the dirty, dangerous, expensive Diablo Canyon Nuclear Power Plant, are more than enough justification to not only deny license renewal, but also suspend the current license.

I have heard many say that we need PG&E's Diablo Canyon power, that it supplies 8% of California's electric needs (550,000 homes), although aren't the reactors shut down 10% of the time for refueling and maintenance? And isn't 7% of electric energy lost to resistance in transmission and distribution? And I also hear that San Luis Obispo County acquires so much revenue from PG&E. Yet in PG&E's Environmental Report it is stated the company's contribution to San Luis Obispo County is "SMALL". When I looked at the county assessor's revenue summary and the SLO County Chamber of Commerce data, PG&E contributed approx. 4% of SLO County $12.1 billion gross product. For comparison, tourism generates $1.1 billion of that amount and employs 16,610 SLO County residents. Diablo employs about 1,200 people or a little over 1% if the 101,000 workers in SLO County. (REC Solar employs 400 people and they do not have to pay for guarding solar panels for 100,000 years.) Yes, recent annual property taxes PG&E paid were close to $22 million of the county's $425 million property tax revenues, yet the tourist generated transient occupancy tax in unincorporated San Luis Obispo County (basically my area...Cambria) generated $21.8 million tax revenue. It really does looks like if Diablo Canyon is shut down there would be no significant impact to the local economy and then there is the Bloom Box, asking the question ...is the grid on the way out anyway?

southern california

Home

Southern California Earthquakes

Chronological Earthquake Index > **before 1900**

Fort Tejon Earthquake

TIME January 9, 1857 / about 8:20 am PST

LOCATION 35° 43' N, 120° 19' W about 72 km (45 miles) northeast of San Luis Obispo, about 120 km (75 miles) northwest of Bakersfield, as shown on the map (epicenter location uncertain).

MAGNITUDE M_W 7.9 (approx.)

TYPE OF FAULTING right-lateral strike-slip - ANIMATION

FAULT RUPTURED San Andreas fault

LENGTH OF SURFACE RUPTURE about 360 km (225 miles)

MAXIMUM SURFACE OFFSET about 9 meters (30 feet)

The Fort Tejon earthquake of 1857 was one of the greatest earthquakes ever recorded in the U.S., and left an amazing surface rupture scar over 350 kilometers in length along the San Andreas fault. Yet, despite the immense scale of this quake, only two people were reported killed by the effects of the shock -- a woman at Reed's Ranch near Fort Tejon was killed by the collapse of an adobe house, and an elderly man fell dead in a plaza in the Los Angeles area (?).

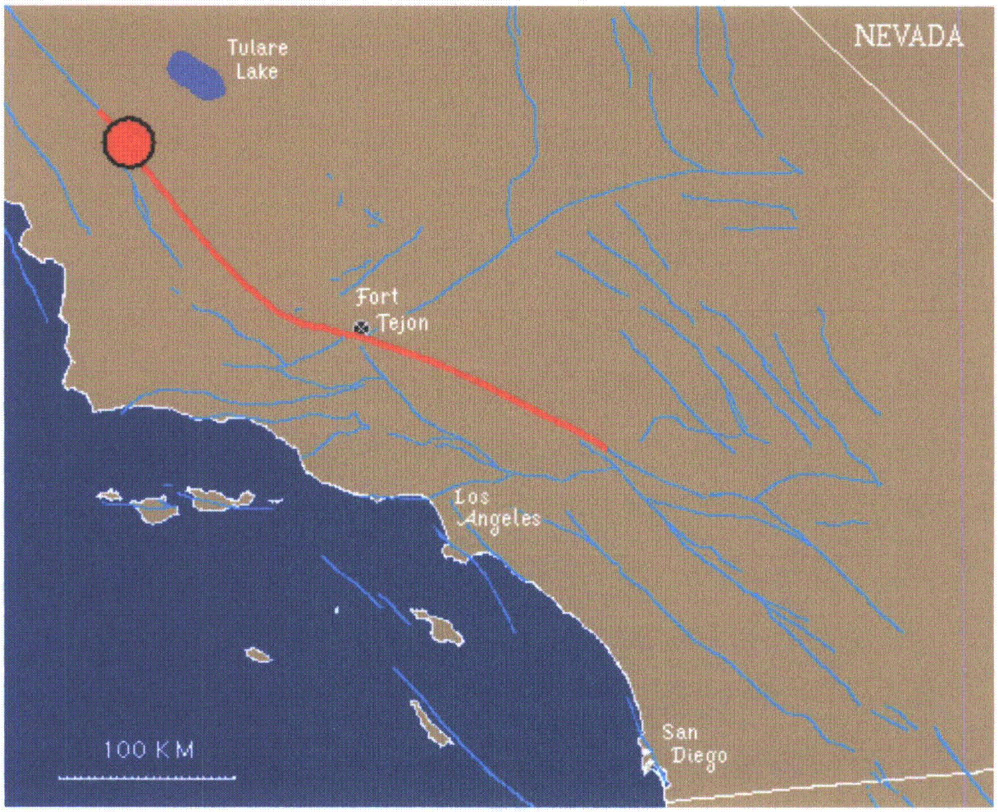
The fact that only two lives were lost was primarily due to the the nature of the quake's setting; California in 1857 was sparsely populated, especially in the regions of strongest shaking, and this fact, along with good fortune, kept the loss of life to a minimum. The effects of the quake were quite dramatic, even frightening. Were the Fort Tejon shock to happen today, the damage would easily run into billions of dollars, and the loss of life would likely be substantial, as the present day communities of Wrightwood, Palmdale, Frazier Park, and Taft (among others) all lie upon or near the 1857 rupture area.

As a result of the shaking, the current of the Kern River was turned upstream, and water ran four feet deep over its banks. The waters of Tulare Lake were thrown upon its shores, stranding fish miles from the original lake bed. The waters of the Mokelumne River were thrown upon its banks, reportedly leaving the bed dry in places. The Los Angeles River was reportedly flung out of its bed, too. Cracks appeared in the ground near San Bernadino and in the San Gabriel Valley. Some of the artesian wells in Santa Clara Valley ceased to flow, and others increased in output. New springs were formed near Santa Barbara and San Fernando. Ridges (moletracks) several meters wide and over a meter high were formed in several places. In Ventura, the mission sustained considerable damage, and part of the church tower collapsed. At Fort Tejon, where shaking was greatest, damage was severe. All around southern and central California, the strong shaking caused by the 1857 shock was reported to have lasted for at least one minute, possibly two or three!

The surface rupture caused by the quake was extensive. The San Andreas fault broke the surface continuously for at least 350 km (220 miles), possibly as much as 400 km (250 miles), with an average slip of 4.5 meters (15 feet), and a maximum displacement of about 9 meters (30 feet) (possibly greater) in the Carrizo Plain area. Kerry Sieh (1978) noted that the **Elkhorn Thrust**, a low-angle thrust fault near the San Andreas, may have slipped simultaneously in the 1857 quake -- an observation that a team of researchers (1996) have recently used to support the idea that future movements along the San Andreas fault zone might produce simultaneous rupture on thrust faults in and near the Los Angeles area, causing a terrible "double earthquake".

The location of the epicenter of the Fort Tejon earthquake is not known. As the name suggests, one idea is to locate it near the area of strongest reported shaking -- Fort Tejon. However, because there is evidence that foreshocks to the 1857 earthquake may have occurred in the Parkfield area, it is located on this map near the northwestern end of the surface rupture, just southeast of Parkfield, near Cholame.
(Note: locating it near Fort Tejon would also have caused interference on the map between this quake's symbol and that of the 1952 Kern County quake. Hence, for both these reasons, the Cholame location was chosen.)

Below is a map of southern California with various place names marked, and the surface traces of major faults drawn in blue-green. The theoretical "Cholame" epicenter of the 1857 earthquake is marked with the large red dot -- Fort Tejon is shown by a white "x" on black -- and that part of the San Andreas fault which exhibited surface rupture during the earthquake is shown in red.



REFERENCES

February 3, 2010
To the NRC -

Thank you for holding these public hearings.

When the Diablo Canyon plant was built, it was known that there are at least four earthquake faults in the area. Then in 2008, an additional fault was discovered one half mile off-shore from the power plant.

After that fault was discovered, in a letter written April 8, 2009, an NRC Project Manager wrote ..."based on the currently available information, the NRC staff concludes that the design and licensing basis evaluations of the DCPP structures, systems, and components are not expected to be adversely affected and the current licensing basis remains valid and supports continued operability of the DCPP site."

I am not reassured by the phrase "based on currently available information". I am concerned about the effect of an earthquake on the reactor and on the storage tanks for the spent fuel.

And, to digress for a moment, it looks to me as though spent but still highly radio-active fuel will always have to be stored at the sites of nuclear power plants. Let's face it -- no one wants to have that stuff in their neighborhood – and for very understandable reasons. So, the safety of the radio-active spent fuel storage will need to be considered for the next ... well, I don't know how many years. But I know that at the proposed Yucca Mountain site, one of the criteria for the signs informing people of the radioactive danger was that signs had to be something that a future civilization could understand. That would be a civilization that comes so long after us that they don't recognize our words or our symbols. That indicates a very, very long time.

Diablo Canyon's current licenses allow them to operate for the next 15 years. You are now considering whether to renew Diablo Canyon's operating licenses for the 20 year period between 2025 and 2045. Since their current licenses allow them to operate for the next 15 years anyway, it seems to me there is no need to rush.

I request that you postpone consideration of their license renewals until definitive seismic studies, particularly of this new fault, are complete.

Thank you.

Della Barrett
(Della Barrett)
9519 Carmel Road
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From Mark Phillips.

Nuclear Power: Climate Fix or Folly?

Amory B. Lovins, Imran Sheikh, and Alex Markevich

April 2008 *RMI Solutions* article "Forget Nuclear," updated and expanded by ABL 31 Dec 2008

Nuclear power, we're told, is a vibrant industry that's dramatically reviving because it's proven, necessary, competitive, reliable, safe, secure, widely used, increasingly popular, and carbon-free —a perfect replacement for carbon-spewing coal power. New nuclear plants thus sound vital for climate protection, energy security, and powering a vibrant global economy.

There's a catch, though: the private capital market isn't investing in new nuclear plants, and without financing, capitalist utilities aren't buying. The few purchases, nearly all in Asia, are all made by central planners with a draw on the public purse. In the United States, even new 2005 government subsidies approaching or exceeding new nuclear plants' total cost failed to entice Wall Street to put a penny of its own capital at risk during what were, until autumn 2008, the most buoyant markets and the most nuclear-favorable political and energy-price conditions in history—conditions that have largely reversed since then.

This semi-technical article, summarizing a detailed and documented technical paper[1], compares the cost, climate protection potential, reliability, financial risk, market success, deployment speed, and energy contribution of new nuclear power with those of its low- or no-carbon competitors. It explains why soaring taxpayer subsidies haven't attracted investors. Capitalists instead favor climate-protecting competitors with lower cost, construction time, and financial risk. The nuclear industry claims it has no serious rivals, let alone those competitors—which, however, already outproduce nuclear power worldwide and are growing enormously faster.

Most remarkably, comparing all options' ability to protect the earth's climate and enhance energy security reveals why nuclear power *could never deliver* these promised benefits even if it *could* find free-market buyers—while its carbon-free rivals, which won more than $90 billion of private investment in 2007 alone[2], do offer highly effective climate and security solutions, far sooner, with higher confidence.

Uncompetitive Costs

The Economist observed in 2001 that "Nuclear power, once claimed to be too cheap to meter, is now too costly to matter"—cheap to run but very expensive to build. Since then, it's become severalfold costlier to build, and in a few years, as old fuel contracts expire, it is expected to become severalfold costlier to run.[3] Its total cost now markedly exceeds that of coal- and gas-fired power plants, let alone the even cheaper decentralized competitors described below.

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[1] A.B. Lovins & I. Sheikh, "The Nuclear Illusion," *Ambio*, forthcoming, 2009. RMI Publ. #E08-01, preprinted at www.rmi.org/images/PDFs/Energy/E08-01_AmbioNucIllusion.pdf, to be updated in early 2009 for publication.

[2] Justin Winter for Michael Liebreich (New Energy Capital, London), personal communication, 1 Dec 2008, updating that firm's earlier figure of $71b for distributed renewable sources of electricity. The $90b is bottom-up, transaction-by-transaction and excludes M&A activity and other double-counting. Reliable estimates of investment in no-carbon (recovered-waste-heat) or relatively low-carbon (fossil-fueled) cogeneration are not available, but total global cogeneration investment in 2007 was probably on the order of $20b or more.

[3] Due to prolonged mismanagement of the uranium and enrichment sectors: *Nuclear Power Joint Fact-Finding*

Construction costs worldwide have risen far faster for nuclear than for non-nuclear plants. This is not, as commonly supposed, due chiefly to higher metal and cement prices: repricing the main materials in a 1970s U.S. plant (an adequate approximation) to March 2008 commodity prices yields a *total* Bill of Materials cost only ~1% of today's overnight capital cost. Rather, the real capital-cost escalation is due largely to the severe atrophy of the global infrastructure for making, building, managing, and operating reactors. This makes U.S. buyers pay in weakened dollars, since most components must now be imported. It also makes buyers worldwide pay a stiff premium for serious shortages and bottlenecks in engineering, procurement, fabrication, and construction: some key components have only one source worldwide. The depth of the rot is revealed by the industry's flagship Finnish project, led by France's top builder: after three years' construction, it's at least three years behind schedule and 50% over budget. An identical second unit, gratuitously bought in 2008 by 85%-state-owned Électricité de France to support 91%-state-owned vendor Areva (orderless 1991–2005), was bid ~25% higher than the Finnish plant and without its fixed-price guarantee, and suffered prompt construction shutdowns for lax quality.

The exceptionally rapid escalation of U.S. nuclear capital costs can be seen by comparing the two evidence-based studies[3,4] with each other and with later industry data (all including financing costs, except for the two "overnight" costs, but with diverse financing models—*cf.* cols. 3 *vs.* 4):

Date	*Source*	*Capital cost (2007 $/net el. W)*	*Levelized busbar cost, 2007 $/MWh*
7/03	MIT[4]	2.3	77–91
6/07	Keystone[3]	3.6–4.0	83–111
5/07	S&P	~4	
8/07	AEP	~4	
10/07	Moody's	5–6	
11/07	Harding	4.3–4.6	~180
3/08	FPL filing	~4.2–6.1 [3.1–4.5 overnight]	
3/08	Constellation	[3.5–4.5 overnight]	
5/08	Moody's	~7.5	150
6/08	Lazard	5.6–7.4	96–123
11/08	Duke Power	[4.8 overnight]	

As the Director of Strategy and Research for the World Nuclear Association candidly put it, "[I]t is completely impossible to produce definitive estimates for new nuclear costs at this time...."[5]

By 2007, as Figure 1 shows below, nuclear was the costliest option among all main competitors, whether using MIT's authoritative but now low 2003 cost assessment, the Keystone Center's mid-2007 update (pink bar), or later and even higher industry estimates (pink arrow).[6] For plants ordered in 2009, formal studies haven't yet caught up with the latest data, but it appears that their

(June 2007. Keystone Center. www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf) estimated new fuel contracts will rise from the canonical ~0.5¢/kWh to ~1.2–1.7¢ for open or ~2.1–3.5¢ for closed fuel cycles.

4 This is very conservatively used as the basis for all comparisons in this article, but we show some later variants.

5 S. Kidd, *Nucl. Eng. Intl.*, 22 Aug 2008, www.neimagazine.com/storyprint.asp?sc=2050690.

6 All monetary values in this article are in 2007 U.S. dollars. All values are approximate and representative of the respective U.S. technologies in 2007 except as noted. Capital and fuel costs are levelized over the lifespan of the capital investment. Analytic details are in ref. 1, and for the underlying 2005 analysis, in A.B. Lovins, "Nuclear Power: Economics and Climate-Protection Potential," RMI Publ. #E05-14, 6 Jan 2006, www.rmi.org/images/PDFs/Energy/E05-14_NukePwrEcon.pdf, summarized in A.B. Lovins, "Mighty Mice," *Nucl. Eng. Intl.*, pp. 44–48, Dec 2005, www.rmi.org/images/PDFs/Energy/E05-15_MightyMice.pdf.

new electricity would probably cost (at your meter, not at the power plant) around 10–13¢/kWh for coal rather than the 9¢ shown, about 9–13¢/kWh for combined-cycle gas rather than the nearly 10¢ shown, but around 15–21¢/kWh for new nuclear rather than the 11–15¢ shown.[7] However, nuclear's decentralized competitors have suffered far less, or even negative, cost escalation: for example, the average price of electricity sold by new U.S. windfarms *fell* slightly in 2007.[8] The 4.0¢/kWh average windpower price for projects installed in 1999–2007 seems more representative of a stable forward market, and corresponds to ~7.4¢/kWh delivered and firmed—just one-half to one-third of new nuclear power's cost on a fully comparable basis.

Non-central-station competitors

Cogeneration and efficiency are "distributed resources," located near where energy is used. Therefore, they don't incur the capital costs and energy losses of the electric grid, which links large power plants and remote wind farms to customers.[9] Wind farms, like solar cells[10], also require "firming" to steady their variable output, and all types of generators require some backup for when they inevitably break. Figure 1 reflects these costs.

Making electricity from fuel creates large amounts of byproduct heat that's normally wasted. Combined-cycle industrial cogeneration and building-scale cogeneration recover most of that heat and use it to displace the need for separate boilers to heat the industrial process or the building, thus creating the economic "credit" shown in Figure 1. Cogenerating electricity and some useful heat from currently discarded industrial heat is even cheaper because no additional fuel is needed, so no additional carbon is released—only what the factory was already emitting.[11]

End-use efficiency, by far the cheapest option, wrings more (and often better) services from each kilowatt-hour by using smarter technologies—substituting brains for dollars and carbon. That's mainly how California has held per-capita electricity use flat for the past 30 years, saving ~$100

[7] Based, as in Figure 1, on the June 2007 Keystone findings adjusted to Moody's May 2008 capital cost, on the assumption that a somewhat stronger dollar might partly offset escalation. Anecdotal reports suggest that real capital cost escalation remains rapid in Europe and Asia, depending on exchange rates: for example, eight recent Asian plants look to end up costing ~$4/W, consistent with mid-2007 U.S. cost estimates.

[8] From 4.8 in 2006 to 4.5¢/kWh, 0.9¢ higher than shown in Figure 1. U.S. wind turbines became 9% costlier during 2006–07, and may rise another ~10% in 2008, largely because rapid growth bottlenecked some key component supplies, but capacity factors improved too: *e.g.*, the average kW of Heartland wind projects installed in 2006 produced 35% more electricity than one installed in 1998–99, due mainly to better-designed turbines, higher hub heights, and better siting. All windpower data in this paper are from R. Wiser & M. Bolinger, "Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2007," USDOE/EERE, LBL-43025, May 2008, www1.eere.energy.gov/windandhydro/pdfs/43025.pdf. All windpower prices are net of some minor Renewable Energy Credit trading and of the U.S. Production Tax Credit whose levelized value is 1.0¢/kWh, far smaller than subsidies to central thermal power plants: D. Koplow, "Energy Subsidy Links Pages," Earthtrack (Washington DC), 2005, http://earthtrack.net/earthtrack/index.asp?page_id=177&catid=66.

[9] Distributed generators may rely on the power grid for emergency backup power, but such backup capacity, being rarely used, doesn't require a marginal expansion of grid capacity, as does the construction of new centralized power plants. Indeed, in ordinary operation, diversified distributed generators *free up* grid capacity for other users.

[10] Or *any* other plant. Solar power isn't included in Figure 1 because its delivered cost varies greatly by installation type and financing method. As will be shown in Figure 5 below, photovoltaics (PVs) are currently one of the smaller sources of renewable electricity, and solar thermal power generation is even smaller. However, PVs have probably *already* passed cost crossover with new coal, gas, or nuclear plants, as summarized on p. 6 below.

[11] A similar credit for displaced boiler fuel can even enable this technology to produce electricity at negative net cost. The graph conservatively omits such credit (which is very site-specific) and shows a typical positive selling price. The cogeneration results shown are based on actual projects considered representative by a leading developer.

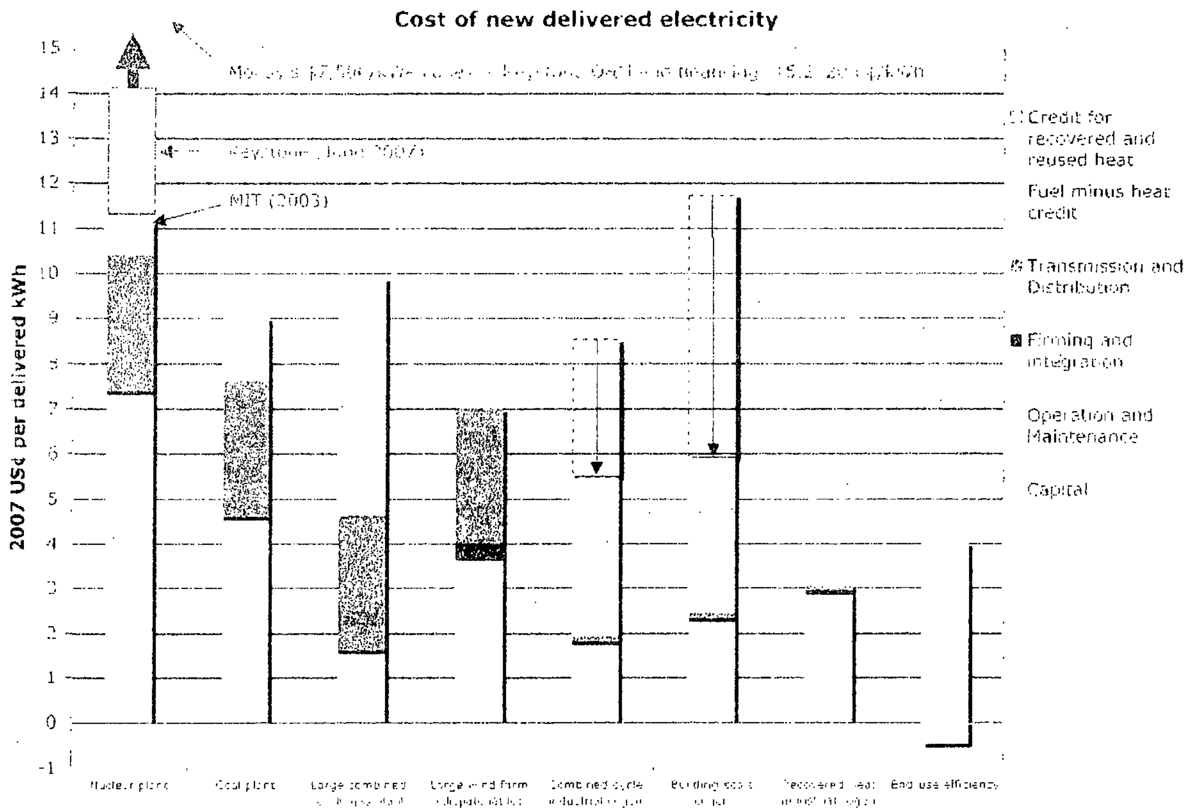

Figure 1: An apples-to-apples comparison of the cost of making and delivering *a new firm kWh of electrical services in the United States, based on empirical ~2007 market costs and prices.*

billion of investment to supply electricity, while per-capita real income rose 79% (1975–2005). Its new houses, for example, now use one-fourth the energy they used to. Yet California is further accelerating all its efficiency efforts, because there's so much still to save. McKinsey has found that efficiency can profitably offset 85% of the normally projected growth in U.S. electricity consumption to 2030.[12] Just using all U.S. electricity as productively as the top ten states now do (in terms of Gross State Product per kWh consumed, roughly adjusted for economic mix and climate) would save about 1,200 TWh/y—~62% of the output of U.S. coal-fired plants.[13]

Saving electricity costs far less than producing and delivering it, even from *existing* plants. California investor-owned utilities' efficiency programs cost an average of 1.2¢/kWh in 2004, and 83 Pacific Northwest utilities' cost 1.3¢/kWh.[14] The national average is about 2¢, but hundreds of utility programs (mainly for businesses, where most of the cheap savings are) cost less than 1¢.[15]

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[12] McKinsey&Company, "Reducing U.S. Greenhouse Gas Emissions: How Much at What Cost?," National Academies Summit on America's Energy Future, Washington DC, 14 Mar 2008, slide 7.
[13] Preliminary RMI analysis (K. Wang, kwang@rmi.org, personal communications, Dec 2008).
[14] C. Rogers, M. Messenger, & S. Bender, "Funding and Energy Savings from Investor-Owned Utility Energy Efficiency Programs in California for Program Years 2000 Through 2004," Aug 2005, www.energy.ca.gov/2005publications/CEC-400-2005-042/CEC-400-2005-042-REV.pdf; Tom Eckman, 1 May 2008 Northwest Power Planning Council memo "Conservation Savings—Status Report for 2005–07," www.nwcouncil.org/news/2008/05/3.pdf. For total societal cost, add ~30–80% depending on the sector.
[15] *E.g.*, S. Nadel, *Lessons Learned*, NYSERDA 90-8, ACEEE, 1990. These 1980s results remain valid today because most U.S. utilities have invested so little in efficiency that their opportunities are more like those of the 58 firms

A major power engineering firm helped investment firm Lazard compare observed U.S. prices, finding that efficiency and many renewables cost less than a new central plants (Figure 2):[16]

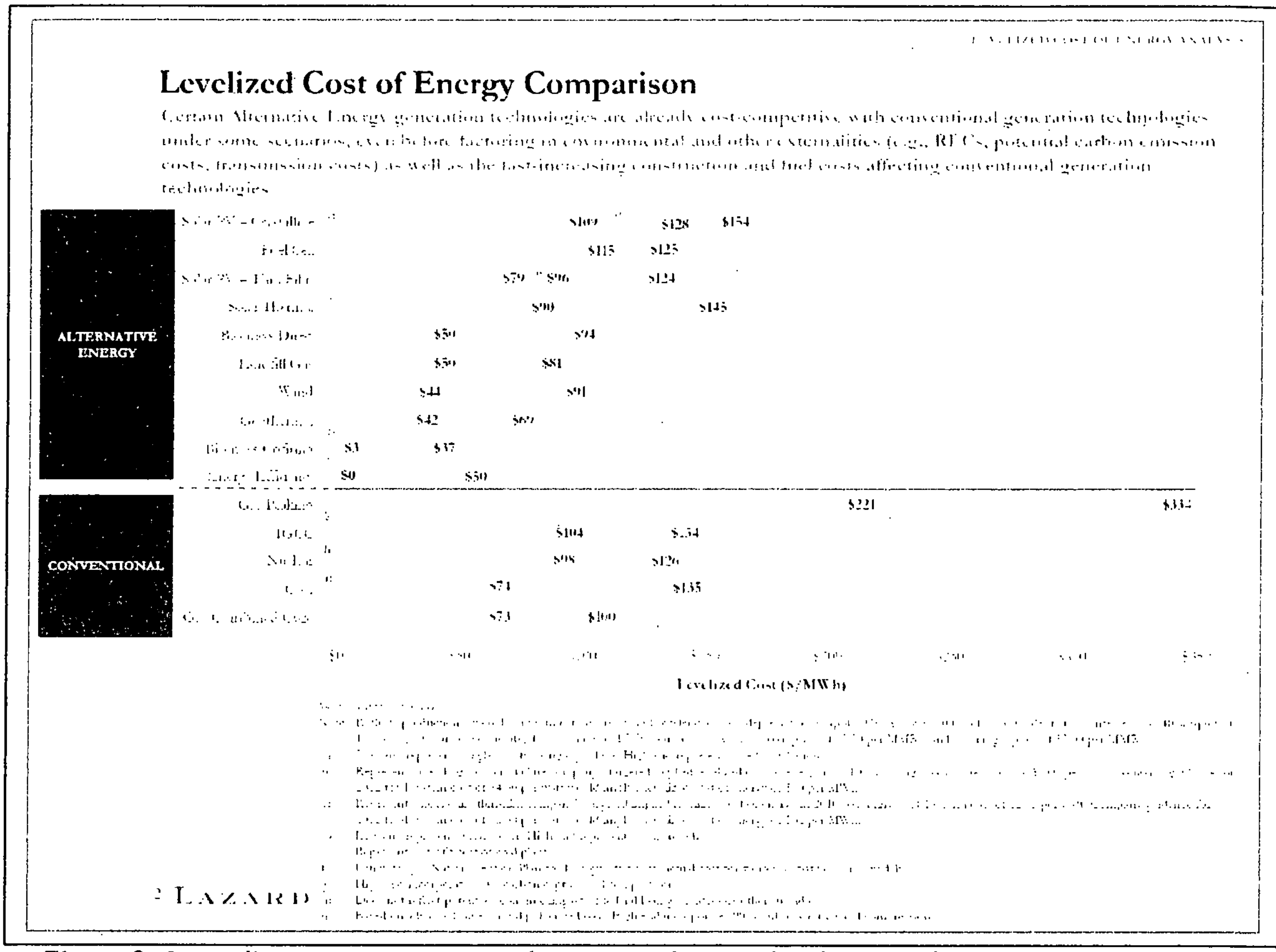

Figure 2: Lazard's recent comparison shows most decentralized options beating all new central stations; this chart omits cogeneration, overstates wind costs, and understates nuclear costs.

Why these comparisons understate nuclear power's uncompetitiveness

These conventional results and assessments greatly understate the size and profitability of to-day's electric-efficiency potential. In 1990, the utilities' think-tank EPRI and RMI, in a joint article, assessed that potential respectively as ~40–60% and ~75%, at respective average 2007-$ costs of about 3 and 1¢/kWh.[17] Now both those estimates look conservative, for two reasons:

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whose 237 programs through 1988 yielded median program costs of 0.3¢/kWh for industrial savings, 0.9¢ for motor rebates, 1.2¢ for loans, and 1.4¢ for new construction rebates.

[16] Lazard (New York), "Levelized Cost of Energy Analysis, v. 2.0," June 2008. www.narucmeetings.org/Presentations/2008%20EMP%20Levelized%20Cost%20of%20Energy%20-%20Master%20June%202008%20(2).pdf.

[17] A. Fickett, C. Gellings, & A.B. Lovins, "Efficient Use of Electricity," *Sci. Amer.* **263**(3):64–74 (1990). The difference, analyzed by E. Hirst in ORNL/CON-312 (2001), was nearly all methodological, not substantive (A.B. & L.H. Lovins, "Least-Cost Climatic Stabilization," *Ann. Rev. En. Envt.* **16**:433–531 (1991), www.rmi.org/images/PDFs/Energy/E91-33_LstCostClimateStabli.pdf, at pp. 8–11): *e.g.*, EPRI excluded but RMI included saved maintenance cost as a credit against efficiency's capital cost, so their respective average costs of commercial lighting retrofits (~1986 $) were +1.2 and −1.4¢/kWh: EPRI examined potential savings only to 2000

- As EPRI agrees, efficiency technologies have improved faster than they've been applied, so the potential savings keep getting bigger and cheaper.[18]
- As RMI's work with many leading firms has demonstrated, integrative design can often achieve radical energy savings at *lower* cost than small or no savings.[19] That is, efficiency can often *reduce* total investment in new buildings and factories, and even in some retrofits that are coordinated with routine renovations.[20]

Wind, cogeneration, and end-use efficiency already provide electrical services more cheaply than central thermal power plants, whether nuclear or fossil-fuelled. *This cost gap will only widen*, since central thermal power plants are largely mature and getting costlier, while their competitors continue to improve rapidly. Indeed, a good case can be made that photovoltaics (PVs) can *already* beat new thermal power plants: if you start in 2010 to build a new 500-MW coal-fired power plant in New Jersey, plus an adjacent photovoltaic (PV) power plant, then before the coal plant comes online in 2018, the solar plant will produce a slightly larger amount of annual electricity at lower levelized cost, but with 1.5× more onpeak output, and the PV manufacturing capacity used to build your plant can then add 750 more MW *each year*.[21] Of course, the high costs of conventional fossil-fuelled plants would go even higher if their large carbon emissions had to be captured—but this coal/solar comparison assumes a carbon price of *zero*.

The foregoing cost comparison is also conservative for four important *additional* reasons:

- End-use efficiency often has side-benefits worth 1–2 orders of magnitude (factors of ten)

(including 9–15% expected to occur spontaneously) while RMI counted the full long-term retrofit potential: and EPRI assumed drivepower savings 3× smaller and 5× costlier than EPRI adopted elsewhere in the same *Sci. Amer.* article. RMI's assessment summarized a 6-volume 1986–92 analysis of ~1,000 technologies' measured cost and performance (RMI/COMPETITEK, *The State of the Art* series, 2,509 pp., 5,135 sourcenotes, later summarized in the *Technology Atlas* series now maintained by spinoff firm E SOURCE, www.esource.com).

[18] RMI estimated that during 1984–89, U.S. efficiency potential roughly doubled while its real cost fell by threefold. Since 1990, mass production (often in Asia), cheaper electronics, competition, and better technology, according to James K. Rogers PE, cut the real cost of electronic T8 ballasts by >90% to 2003 (while lumens per watt rose 30%), turned direct/indirect luminaires from a premium to the cheapest option, and cut the real cost of industrial variable-speed drives by ~83–97% (some vendors of midsize motors now give them away). Compact fluorescent lamps became 85–94% cheaper during 1983–2003; window air-conditioners got 69% cheaper since 1993 while becoming 13% more efficient; and low-emissivity window coatings became ~84% cheaper in just five years.

[19] Integrative design produces these expanding (not diminishing) returns to efficiency investments: A.B. Lovins, "Energy End-Use Efficiency," 2005, www.rmi.org/images/PDFs/Energy/E95-28_SuperEffBldgFrontier.pdf, further elucidated in the senior author's five public lectures, "Advanced Energy Efficiency," delivered at Stanford's School of Engineering in March 2007 and posted at www.rmi.org/stanford. RMI's recent redesigns of over $30 billion worth of industrial projects consistently found ~30–60% energy savings on retrofit, typically paying back in 2–3 years, and ~40–90% savings in new projects, nearly always with *lower* capital cost.

[20] For example, an RMI design for retrofitting a 200,000-ft^2 curtainwall office building when it needed reglazing anyhow could save three-fourths of its energy at slightly *lower* cost than the normal 20-year renovation that saves nothing: A.B. Lovins, "The Super-Efficient Passive Building Frontier," *ASHRAE J.*, pp. 79–81, June 1995, www.rmi.org/images/PDFs/Energy/E95-28_SuperEffBldgFrontier.pdf.

[21] This is simply because PVs can ride down the cost curve (they'll clearly continue to get 18% cheaper for each doubling of cumulative global production volume, which is nearly doubling every year), they produce the most output on summer afternoons when most utilities' loads peak, and they can start producing energy and revenue in year one, reducing their financial risk. Many technological and institutional breakthroughs are in view that could well make PVs' costs drop even faster than their historic cost curve. Thomas Dinwoodie, SunPower Corporation, Systems (Founder and CTO), Richmond CA, "Price Cross-Over of Photovoltaics vs. Traditional Generation," 2008.

more than the saved energy.[22]

- End-use efficiency and distributed generators have 207 "distributed benefits" that typically increase their economic value by an order of magnitude.[23] The *only* "distributed benefit" counted above is reusing waste heat in cogeneration.
- Integrating variable renewables with each other typically saves over half their capacity for a given reliability[24]; indeed, diversified variable renewables, forecasted and integrated, typically need *less* backup investment than big thermal plants for a given reliability.
- Integrating strong efficiency with renewables typically makes both of them cheaper and more effective.[25]

New nuclear power's uncompetitiveness is clear without these five conservatisms and overwhelming with them. As we'll see, the marketplace concurs—and that's good news for climate.

Uncompetitive CO_2 Displacement

Nuclear plant operations emit no carbon directly and rather little indirectly[26]. Nuclear power is therefore touted as the key replacement for coal-fired power plants. But this seemingly straightforward substitution could instead be done using *non*-nuclear technologies that are cheaper and faster, so they yield more climate solution per dollar and per year.

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[22] *E.g.*, ~6–16% higher labor productivity in efficient buildings, higher throughput and quality in efficient factories, better clinical outcomes in efficient hospitals, fresher food in efficient refrigerators, better visibility with efficient lighting, etc. Just counting such side-benefits can, for example, double the efficiency gains in a U.S. steel mill at the same cost.

[23] The biggest of these come from financial economics: *e.g.*, small fast modular projects have lower financial risk than big slow lumpy projects, and renewables hedge against fuel-price volatility risk. These 207 phenomena are explained and documented in an *Economist* book of the year: A.B. Lovins, E.K. Datta, T. Feiler, K.R. Rábago, J.N. Swisher, A. Lehmann, & K. Wicker, *Small Is Profitable: The Hidden Economic Benefits of Making Electrical Resources the Right Size*, 2002, Rocky Mountain Institute (Snowmass CO). www.smallisprofitable.org.

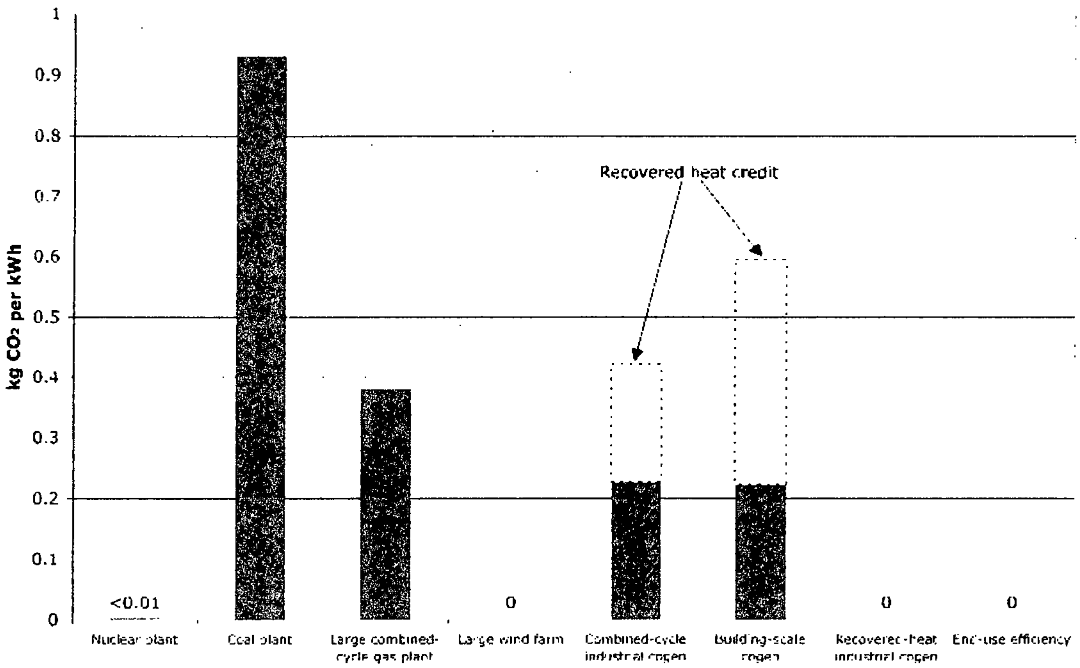
[24] For windpower in the three power pools that span the central U.S. from Canada to Texas: J. Traube, L. Hansen, B. Palmintier, & J. Levine, "Spatial Interactions of Wind and Solar in the Next Generation Utility," Windpower 2008, 3 Jun 2008 (to be posted shortly at ert.rmi.org).

[25] *E.g.*, an integrated retrofit of efficiency, demand response, and 1.18 MW of PVs at the Santa Rita Jail in Alameda County CA easily met a 10%/y IRR hurdle rate—the \$9-million project achieved a present-valued 25-year benefit of \$15 million and hence would have made money even without its \$4-million state subsidies—because on the hot afternoons when the PVs produced the most power, the efficient jail used little, leaving a bigger surplus to resell to the grid at the best price. Or my own household can run on ~120 average W (a tenth the U.S. norm), obtainable from 3 m² of PVs—a system cheaper than connecting to wires 30 m away. If built today, my household would need only ~40 average W, from 1 m² of PVs—a system cheaper than connecting to wires already on the side of the house. Both these comparisons assume free electricity; their point is that superefficient end-use can make the breakeven distance to the grid, beyond which it's cheaper to go solar than to connect, drop to about zero.

[26] We ignore here the modest and broadly comparable amounts of energy needed to build any kind of electric generator, as well as possible long-run energy use for nuclear decommissioning and waste management or for extracting uranium from low-grade sources and restoring mined land afterwards. B.K. Sovacool, *En. Pol.* **36**:2490–2953 (Aug 2008) surveyed these issues. He screened 103 published studies of nuclear power's energy inputs and indirect carbon emissions; excluded the 84 studies that were older than 10 years, not in English, or not transparent; and found that the other 19 derived gCO_2e/busbar kWh figures ranging from 1.4 to 288 with a mean of 66, which is roughly one-seventh the carbon intensity of combined-cycle gas but twice that of photovoltaics or seven times that of modern onshore windpower. This comparison, or its less favorable dynamic equivalent described by A.B. Lovins and J. Price in 1977 (*Non-Nuclear Futures*, Ballinger, Cambridge MA, Part II), is however scarcely relevant, since the unarguable *economic opportunity cost* shown in this section is far more important and clear-cut.

As Figure 2 shows, various options emit widely differing quantities of CO_2 per delivered kilowatt-hour:[27]

Figure 2: Operating CO_2 emitted per delivered kWh



Coal is by far the most carbon-intensive source of electricity, so displacing it is the yardstick of carbon displacement's effectiveness. A kilowatt-hour of nuclear power does displace nearly all the 0.9-plus kilograms of CO_2 emitted by producing a kilowatt-hour from coal. But so does a kilowatt-hour from wind, a kilowatt-hour from recovered-heat industrial cogeneration, or a kilowatt-hour saved by end-use efficiency. And all three of these carbon-free resources cost far less than nuclear power per kilowatt-hour, so they save far more carbon per dollar.

Combined-cycle industrial cogeneration and building-scale cogeneration typically burn natural gas, which does emit carbon (though half as much as coal), so they displace somewhat less net carbon than nuclear power could: around 0.7 kilograms of CO_2 per kilowatt-hour[28]. Even though cogeneration displaces less carbon than nuclear does per kilowatt-hour, it displaces more carbon than nuclear does *per dollar spent on delivered electricity*, because it costs far less. With a net delivered cost per kilowatt-hour approximately half of nuclear's (using the most conservative comparison from Figure 1), cogeneration delivers twice as many kilowatt-hours per dollar, and therefore displaces around 1.4 kilograms of CO_2 for the same cost as displacing 0.9 kilograms of CO_2 with nuclear power.

Figure 3 compares different electricity options' cost-effectiveness in reducing CO_2 emissions, counting both their cost-effectiveness (kilowatt-hours per dollar), and any carbon emissions:

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[27] Conservatively assuming industry claims that nuclear power indirectly emits about one-seventh as much carbon as the mean of the 19 studies analyzed by Sovocool's literature review (ref. 26), and similarly omitting the probably even smaller carbon footprint of renewables, recovered-heat cogeneration, and efficiency.

[28] Since its recovered heat displaces boiler fuel, cogeneration displaces more carbon emissions per kilowatt-hour than a large gas-fired power plant does.

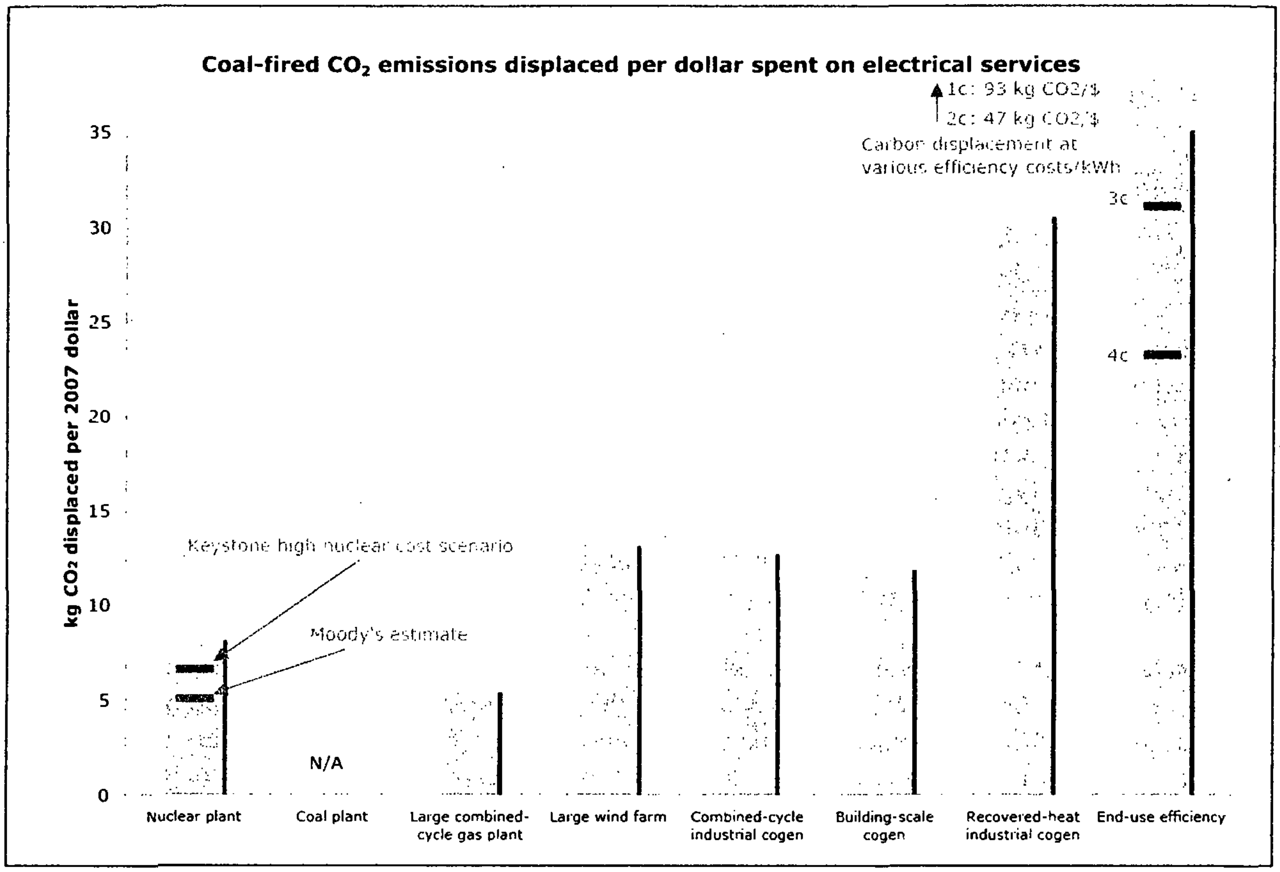

Figure 3: How much net carbon emissions from coal-fired power plants can be displaced by buying a dollar's worth of new electrical services using different technologies. Note that realistic efficiency investments' carbon savings are far above the upper-right corner of the chart.

Nuclear power, being the costliest option, thus delivers less electrical service per dollar than its rivals. So not surprisingly, it's also a climate-protection loser, surpassing in carbon emissions displaced per dollar only centralized, non-cogenerating combined-cycle power plants burning natural gas[29]. Firmed windpower and cogeneration are at least 1.5 times more cost-effective than nuclear at displacing CO_2—or about 3 times using the latest nuclear cost estimates. So is efficiency at even an almost unheard-of seven cents per kWh. Efficiency at normally observed costs, say around one cent per kWh, beats nuclear by about 10–20-fold.

New nuclear power is so costly that shifting a dollar of spending from nuclear to efficiency protects the climate severalfold more than shifting a dollar of spending from coal to nuclear. Indeed, under plausible assumptions, spending a dollar on new nuclear power *instead of* on efficient use of electricity has a worse climate effect than spending that dollar on new coal power!
If we're serious about addressing climate change, we must invest resources wisely to expand and accelerate climate protection. Because nuclear power is costly and slow to build, buying more of it rather than of its cheaper, swifter rivals will instead reduce and retard climate protection.

[29]However, at long-run natural-gas prices lower than assumed here (a levelized 2007-$ cost of $7.72 per million BTU) and at today's high nuclear costs, the combined-cycle plants may save more carbon per dollar than nuclear plants do. This may be true even at the prices assumed here, if one properly counts combined-cycle plants' ability to load-follow, thus complementing and enabling cleaner, cheaper variable renewable resources like windpower.

Questionable Reliability

All sources of electricity sometimes fail, differing only in how predictably, why, how often, how much, and for how long. Even the most reliable giant power plants are intermittent: they fail unexpectedly in billion-watt chunks, often for long periods. Of all 132 U.S. nuclear plants built (52% of the 253 originally ordered), 21% were permanently and prematurely closed due to reliability or cost problems, while another 27% have completely failed for a year or more at least once. The surviving U.S. nuclear plants produce ~90% of their full-time full-load potential, but even they are not fully dependable. Even reliably operating nuclear plants must shut down, on average, for 39 days every 17 months for refueling and maintenance, and unexpected failures do occur too. To cope with such intermittence by both nuclear and centralized fossil-fuelled power plants, which typically fail about 8% of the time, utilities must install a roughly 15% "reserve margin" of extra capacity, some of which must be continuously fuelled, spinning ready for instant use. Heavily nuclear-dependent regions are particularly at risk because drought, a serious safety problem, or a terrorist incident could close many plants simultaneously.

Nuclear plants have an additional disadvantage: for safety, they must instantly shut down in a power failure, but for nuclear-physics reasons, they can't then be quickly restarted. During the August 2003 Northeast blackout, nine perfectly operating U.S. nuclear units had to shut down. Twelve days of painfully slow restart later, their average capacity loss had exceeded 50 percent. For the first three days, just when they were most needed, their output was below 3% of normal.

The big transmission lines that highly concentrated nuclear plants require are also vulnerable to lightning, ice storms, rifle bullets, cyberattacks, and other interruptions.[30] The bigger our power plants and power lines get, the more frequent and widespread regional blackouts will become. Because 98–99 percent of power failures start in the grid, it's more reliable to bypass the grid by shifting to efficiently used, diverse, dispersed resources sited at or near the customer.

A portfolio of many smaller units, too, is unlikely to fail all at once: its diversity makes it more reliable even if its individual units are not.[31] The same logic applies to the two renewable electricity sources—windpower and photovoltaics—whose output varies with weather or daytime. Of course the sun doesn't always shine on a given solar panel, nor does the wind always spin a given turbine. Yet if properly firmed, both windpower, whose global potential is 35 times world electricity use[32], and solar energy, as much of which falls on the earth's surface every ~70 minutes as humankind uses each year, can deliver reliable power without significant cost for backup or storage.[33] These variable renewable resources become *collectively* reliable when diversified in type and location and when integrated with three types of resources: steady renewables (geothermal, small hydro, biomass, etc.), existing fuelled plants, and customer demand response.

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[30] A.B. & L.H. Lovins, report to DoD republished as *Brittle Power: Energy Strategy for National Security*. Brick House (Andover MA), 1981, posted with summaries #S83-08 and #S84-23 at www.rmi.org/sitepages/pid114.php; Defense Science Board, *More Fight, Less Fuel*, 13 Feb 2008, www.acq.osd.mil/dsb/reports/2008-02-ESTF.pdf

[31] These arguments are elaborated and documented in ref. 23.

[32] C.L. Archer and M.Z. Jacobson, "Evaluation of global windpower," calculated at 80 m hub height. www.stanford.edu/group/efmh/winds/global_winds.html.

[33] Wiser & Bolinger, ref. 8, p. 27, document 11 recent U.S. utility studies showing that even variable-renewable penetrations up to 31% generally cost <0.5c/kWh to "firm" to central-plant reliability standards. The two studies that found costs up to 0.8c didn't assume the sub-hourly market-clearing that most grid operators now use.

Such integration uses weather forecasting to predict the output of variable renewable resources, just as utilities now forecast demand patterns and hydropower output. In general, keeping power supplies reliable despite large wind and solar fractions will require *less* backup or storage capacity than utilities *have already bought* to manage big thermal stations' intermittence. The myth of renewable energy's unreliability has been debunked both by theory and by practical experience.[34]

Large Subsidies to Offset High Financial Risk

The latest U.S. nuclear plant proposed is estimated to cost $12–24 billion (for 2.2–3.0 billion watts), many times industry's claims, and off the chart in Figure 1 above. The utility's owner, a large holding company active in 27 states, has annual revenues of only $15 billion. Even before the current financial crisis, such high, and highly uncertain, capital costs made financing prohibitively expensive for free-market nuclear plants in the half of the U.S. that has restructured its electricity system, and prone to politically challenging rate shock in the rest: a new nuclear kilowatt-hour costing, say, 18 cents "levelized" over decades implies that the utility must collect ~30 cents to fund its first year of operation.

Lacking investors, nuclear promoters have turned back to taxpayers, who already bear most nuclear accident risks, have no meaningful say in licensing, and for decades have subsidized existing nuclear plants by ~1–5¢/kWh. In 2005, desperate for orders, the politically potent nuclear industry got those U.S. subsidies raised to ~5–9¢/kWh for new plants, or ~60–90 percent of their entire projected power cost, including new taxpayer-funded insurance against legal or regulatory delays. Wall Street still demurred. In 2007, the industry won relaxed government rules that made its 100 percent loan guarantees (for 80%-debt financing) even more valuable—worth, one utility's data revealed, about $13 billion for a single new plant, about equal to its entire capital cost. But rising costs had meanwhile made the $4 billion of new 2005 loan guarantees scarcely sufficient for a single reactor, so Congress raised taxpayers' guarantees to $18.5 billion. Congress will soon be asked for another $30+ billion in loan guarantees, or even for a blank check. Meanwhile, the nonpartisan Congressional Budget Office has concluded that defaults are likely.

Wall Street is ever more skeptical that nuclear power is as robustly competitive as claimed. Starting with Warren Buffet, who recently abandoned a nuclear project because "it does not make economic sense," the smart money is heading for the exits. The Nuclear Energy Institute is therefore trying to damp down the rosy expectations it created. It now says U.S. nuclear orders will come not in a tidal wave but in two little ripples—a mere 5–8 units coming online in 2015–16, then more if those are on time and within budget. Even that sounds dubious, as many senior energy-industry figures privately agree. In today's capital market, governments can have at most about as many nuclear plants as they can force taxpayers to buy. Indeed, the big financial houses that lobbied to be the vehicles of those gigantic federal loan guarantees are now largely gone; a new Administration with many other priorities may be less supportive of such largesse; and the

[34] The nuclear industry's claim that because a modern economy needs highly reliable electricity, it also needs "24/7" power *stations* of billion-watt scale is absurd. *No* power source is 100% reliable: that's why utilities must use redundancy and elaborate operating techniques to ensure reliable supply despite unpredictable failures, which are especially damaging when the failed units are large. The same proven techniques apply similarly, but more easily, to large numbers of diverse renewables whose variable elements can be readily forecast. Without exception, more than 200 international and 11 U.S. studies have found this (see ref. 1, pp. 22–27). Wind-rich regions of Germany, Spain, and Denmark have already proven it by meeting 20–39% of all annual electrical needs (and at times over 100% of regional needs) with variable renewables, without encountering instability nor significant integration costs.

"significant" equity investment required to qualify for the loan guarantees seems even less likely to come from the same investors who declined to put their own capital at risk at the height of the capital bubble. The financial crisis has virtually eliminated private investment in big, slow, risky projects, while not materially decreasing investment in the small, fast, granular ones that were already walloping central plants in the global marketplace.

The Micropower Revolution

While nuclear power struggles in vain to attract private capital, investors have switched—and the financial crisis has accelerated their shift[35]—to cheaper, faster, less risky alternatives that *The Economist* calls "micropower"—distributed turbines and generators in factories or buildings (usually cogenerating useful heat), and all renewable sources of electricity *except* big hydro dams (those over ten megawatts). These alternatives surpassed nuclear's global capacity in 2002 and its electric output in 2006. Nuclear power now accounts for about 2 percent of worldwide electric capacity additions, *vs.* 28 percent for micropower (2004–07 average) and probably a good deal more in 2007–08.[36]

Despite subsidies generally smaller than nuclear's, and many barriers to fair market entry and competition[37], negawatts (electricity saved by using it more efficiently or timely) and micropower have lately turned in a stunning global market performance. Figure 5 shows how micropower's actual and industry-projected electricity production is running away from nuclear's, not even counting the roughly comparable additional growth in negawatts, nor any fossil-fuelled generators under 1 megawatt.[38]

The nuclear industry nonetheless claims its only serious competitors are big coal and gas plants. But the marketplace has already abandoned that outmoded battleground for two others: central thermal plants *vs.* micropower, and megawatts *vs.* negawatts. For example, the U.S. added more windpower capacity in 2007 than it added coal-fired capacity in the past five years combined. By beating *all* central thermal plants, micropower and negawatts together provide about half the world's new electrical services. Micropower alone now provides a sixth of the world's electricity, and from a sixth to more than half of all electricity in twelve industrial countries, though the U.S. lags with ~6%.

In this broader competitive landscape, high carbon prices or taxes can't save nuclear power from its fate. If nuclear did compete only with coal, then far-above-market carbon prices might save it; but coal isn't the competitor to beat. Higher carbon prices will advantage all other zero-carbon resources—renewables, recovered-heat cogeneration, and negawatts—as much as nuclear, and will partly advantage fossil-fueled but low-carbon cogeneration as well. The nuclear industry doesn't understand this because it doesn't consider these competitors important or legitimate.

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[35] New Energy Finance found only a 4% drop in 3Q08 renewables financing, and recent data suggest a robust, even growing, solar sector despite grave financial distress and accelerating decline in the central-station business.
[36] A thorough database of industry and official data sources is posted and updated at www.rmi.org/sitepages/pid256.php#E05-04. Similar renewable energy data are at www.ren21.net.
[37] A policy agenda for removing many of these obstacles is in the last section of *Small Is Profitable* (ref. 31).
[38] Data for decentralized gas turbines and diesel generators exclude generators of less than 1 megawatt capacity.

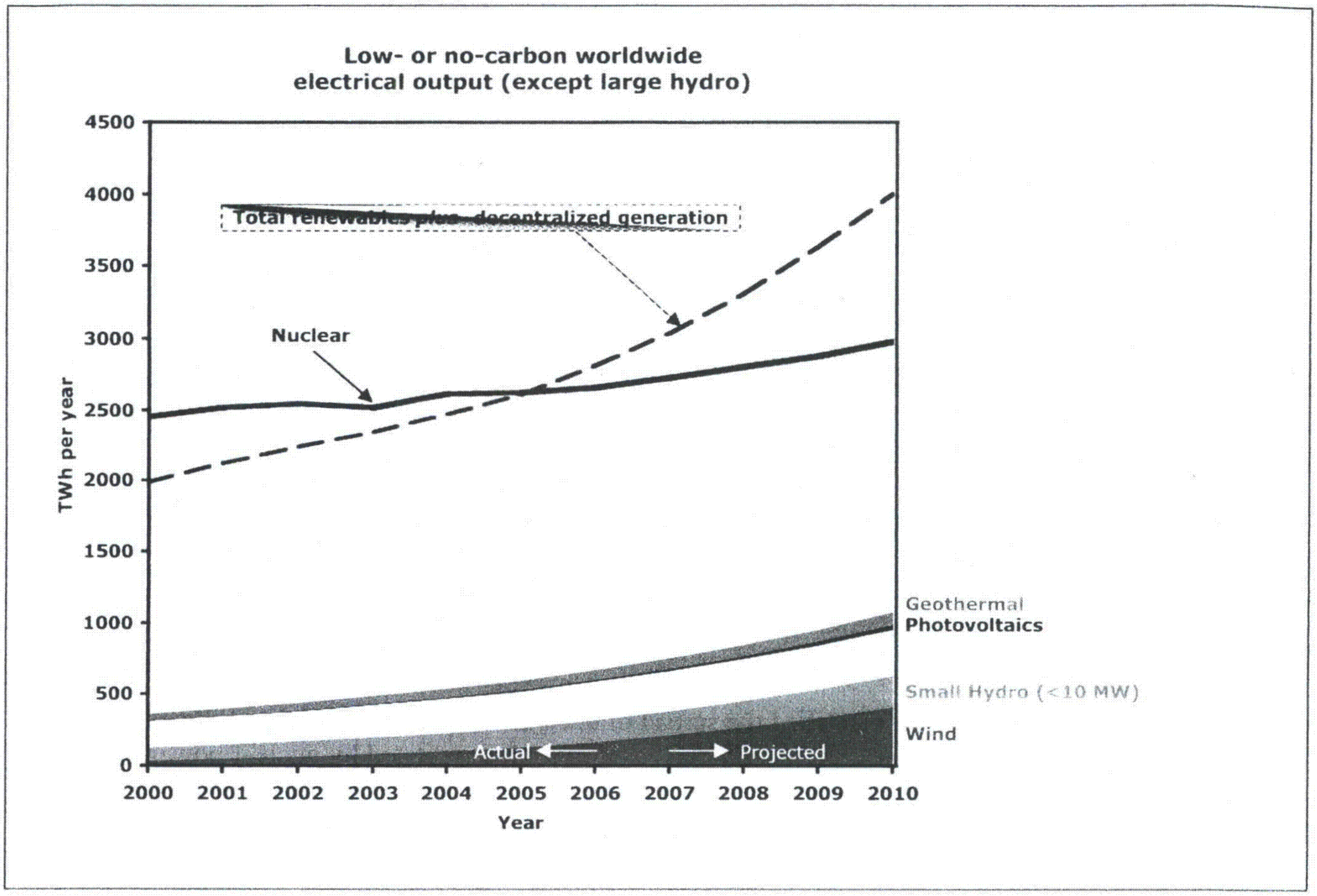

Figure 5. Global electricity produced, or projected by industry to be produced, by decentralized low- or no-carbon resources—cogeneration ("CHP"), mostly gas-fired, and "distributed" renewables (those other than big hydroelectric dams). Micropower got over $100 billion of new private capital in 2007—roughly an eighth of total global energy investment.

Small Is Fast, Low-Risk, and High in Total Potential

Small, quickly built units are faster to deploy for a given total effect than a few big, slowly built units. Widely accessible choices that sell like cellphones and PCs can add up to more, sooner, than ponderous plants that get built like cathedrals. And small units are much easier to match to the many small pieces of electrical demand. Even a multi-megawatt wind turbine can be built so quickly that the U.S. will probably have a hundred billion watts of them (matching its nuclear capacity) installed before it gets its first one billion watts of new nuclear capacity, if any. As noted earlier, this speed reduces financial risk and thus makes decentralized, short-lead-time projects more financeable, especially in hard times.

Despite their small individual size, and partly because of it, micropower generators and electrical savings are already adding up to huge totals. Indeed, over decades, negawatts and micropower can shoulder the entire burden of powering the economy. The Electric Power Research Institute (EPRI), the utilities' think-tank, has calculated the U.S. negawatt potential (cheaper than just running an existing nuclear plant and delivering its output) to be two to three times nuclear power's 19 percent share of the U.S. electricity market; RMI's more detailed analysis found even more. Cogeneration in factories can make as much U.S. electricity as nuclear does[39], plus more in buildings, which use 69 percent of U.S. electricity. Windpower at acceptable U.S. sites can cost-effectively produce several times the nation's total electricity use[40], and other renewables can make even more without significant land-use, variability, or other constraints. Thus just cogeneration, windpower, and efficient use—all profitable today—can displace nuclear's current U.S. output ~6–14⁺ times over. This ratio becomes arbitrarily large when photovoltaics are included.

Nuclear power, with its decade-long project cycles, difficult siting, and (above all) unattractiveness to private capital, simply cannot compete. In 2006, for example, it added less global capacity than photovoltaics did, or a tenth as much as windpower added, or 30–41 times less than micropower added. Renewables other than big hydro dams won $56 billion of private risk capital; nuclear, as usual, got zero. China's distributed renewable capacity reached seven times its nuclear capacity and grew seven times faster. And in 2007, China, Spain, and the U.S. each added more windpower capacity than the world added nuclear capacity. The nuclear industry does trumpet its growth, yet micropower is already bigger and is growing 18 times faster.[41]

Security Risks

President Bush has rightly identified the spread of nuclear weapons as the gravest threat to America. Yet that proliferation is largely driven and greatly facilitated by nuclear power's flow of materials, equipment, skills, and knowledge, all wrapped in an innocent-looking civilian disguise. (Reprocessing nuclear fuel, which President Bush tried to revive, greatly complicates waste management, increases cost, and boosts proliferation.) Yet acknowledging nuclear power's market failure and moving on to secure, least-cost energy options for global development would unmask and penalize proliferators by making bomb ingredients harder to get, more conspicuous to try to get, and politically costlier to be caught trying to get. This would make proliferation far more difficult, and easier to detect in time by focusing scarce intelligence resources on needles, not haystacks.[42] The new Administration has an extraordinary opportunity to turn the world away from its rush toward a "nuclear-armed crowd" by setting a good example in domestic energy policy and by helping all developing countries with the nonviolent, cheaper, faster energy alternatives that are already winning in the market.[43]

Nuclear power has other unique challenges too, such as long-lived radioactive wastes, potential for catastrophic accidents, and vulnerability to terrorist attacks. But in a market economy, the technology couldn't proceed even if it lacked those issues, so we needn't consider them here.

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[39] O. Bailey and E. Worrell, "Clean Energy Technologies: A Preliminary Inventory of the Potential for Electricity Generation." LBNL-57451. Apr 2005. http://repositories.cdlib.org/lbnl/LBNL-57451/.
[40] U.S. Department of Energy. *20% Wind Energy by 2030*. www.20percentwind.org/20p.aspx?page=Report. Ch. 2. p. 2.
[41] All documented in ref. 1.
[42] A.B. and L.H. Lovins and L. Ross, "Nuclear power and nuclear bombs." *Foreign Affairs* **58**(5):1137–1177 (Summer 1980), www.foreignaffairs.org/19800601faessay8147/amory-b-lovins-l-hunter-lovins-leonard-ross/nuclear-power-and-nuclear-bombs.html or www.rmi.org/images/other/Energy/E05-08_NukePwrEcon.pdf, and *Foreign Affairs* **59**:172 (1980). Had that paper's market-driven strategy been adopted 28 years ago, the world would not today be worrying about Iran and North Korea.
[43] This would satisfy the intent of the "nuclear bargain" in Article IV of the Non-Proliferation Treaty. See also C.A. Ford (Hudson Institute), "Nuclear Technology Rights and Benefits: Risk, Cost, and Beneficial Use under the NPT's Article IV." Conference on "Comparing Electricity Costs." NPEC/Carnegie Corporation of New York. 1 Dec 2008.

Conclusion

So why do otherwise well-informed people still consider nuclear power a key element of a sound climate strategy? Not because that belief can withstand analytic scrutiny. Rather, it seems, because of a superficially attractive story, an immensely powerful and effective lobby, a new generation who forgot or never knew why nuclear power failed previously (almost nothing has changed), sympathetic leaders of nearly all main governments simultaneously, deeply rooted habits and rules that favor giant power plants over distributed solutions and enlarged supply over efficient use, the market winners' absence from many official databases (which often count only big plants owned by utilities), and lazy reporting by an unduly credulous press.

Isn't it time we forgot about nuclear power? Informed capitalists have. Politicians and pundits should too. After more than half a century of devoted effort and a half-trillion dollars of public subsidies, nuclear power still can't make its way in the market. If we accept that unequivocal verdict, we can at last get on with the best buys first: proven and ample ways to save more carbon per dollar, faster, more surely, more securely, and with wider consensus. As often before, the biggest key to a sound climate and security strategy is to take market economics seriously.

* * *

Mr. Lovins, a physicist, is cofounder, Chairman, and Chief Scientist of Rocky Mountain Institute (www.rmi.org), where Mr. Sheikh, an engineer, was a Research Analyst (now a graduate student in the Energy and Resources Group at the University of California at Berkeley), and Dr. Markevich, a physicist and management consultant, was a Vice President until mid-2008. Mr. Lovins, a student of this subject for over four decades, has consulted for scores of electric utilities, many of them nuclear operators. Published in 29 books and hundreds of papers, his wide-ranging innovations in energy, security, environment, and development have been recognized by the Blue Planet, Volvo, Onassis, Nissan, Shingo, and Mitchell Prizes, a MacArthur Fellowship, the Benjamin Franklin and Happold Medals, ten honorary doctorates, an Hon. AIA and FRSA, Foreign Membership of the Royal Swedish Academy of Engineering Sciences, and the Heinz, Lindbergh, Right Livelihood, and World Technology Awards. He advises governments and major firms worldwide on advanced energy and resource efficiency and its integration with energy supply, and recently led the technical redesign of more than $30 billion worth of facilities in 29 sectors to achieve very large energy savings at typically lower capital cost.

The authors are grateful to RMI Senior Fellow Dr. Joel Swisher PE for insightful comments and to many cited and uncited sources for research help. A technical paper (www.rmi.org/sitepages/pid257.php#E08-01) preprinted for *Ambio* (Royal Swedish Academy of Sciences) supports this summary with full details and documentation (ref. 1), and will be updated for press in early 2009. RMI's annual compilation of global micropower data from industrial and governmental sources is periodically updated at www.rmi.org/sitepages/pid256.php#E05-04.

To:- NRC Scoping Meeting Committee, SLO

3rd Mar '10

From :- W.H. Wadman PhD

805-782 0766

232 Broad St

whuwad@gmail.com

SLO CA 93405

Re :- Long term safety of spent nuclear fuel

I am concerned that as the protective shield of rapidly decaying fission products diminishes the potential for attempts to divert the transuranics for antisocial or terrorist uses will increase since the deterrent radiation shield diminishes by a factor of ten every hundred years. The plutonium content remains essentially undiminished and mature 'Purex' type technologies might become more easily implemented to isolate bulk plutonium. I am aware that the plutonium from current reactors falls well below preferred weapons grade by virtue of too low a ratio of the 239/240 isotopes. However even this spent fuel grade of plutonium is capable of supporting criticality events . While problems of higher thermal output of the 240 isotope, together with poorer control of ignition triggering, make it a very difficult, **but not impossible source,** for a nuclear weapon.

For the forgoing reasons I would argue that as we consider the relicensing of Diablo reactors this is an appropriate time to consider how the spent fuel might be made less attractive as a source for misuse. Is one possible method to require some modification of core geometry so that at each refueling fuel elements that are near the end of their useful life are exposed to higher fast neutron fluxes ? The more obvious route is to require reactor operators to include sufficient plutonium from recycled fuels to raise the proportion of the 240 isotope to a level making the plutonium in their spent fuels unusable for bomb devices. Obviously if ,or when, FBR s become widespread the problem will largely be over.

While I realize that the NRC regulatory mandate may be unclear that it currently allows you to respond very energetically to this concern may I suggest this could be a time to ask for the necessary expanded jurisdiction.

I would appreciate any opportunity you can afford to enable me to contribute more to this fairly widely recognized concern.

Thanks! W.H. Wadman

Introduction

NOTICE

This is to announce the publication of a forthcoming book, "Protest Diablo, Living and Dying Under the Shadow of a Nuclear Power Plant", by Judith Evered.

This personal memoir begins with an English power plant accident and the protests to the construction of another plant: Diablo Canyon Nuclear Power Plant (DCNPP).

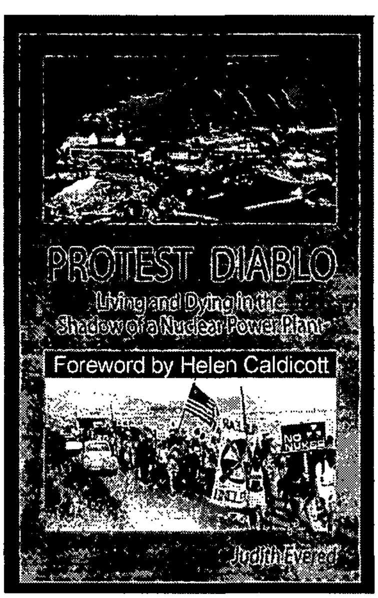
The explosion in 1957 of the Windscale Atomic research experiment, (now named Sellafield) caused a huge personal tragedy for the author.

Judith had first-hand experiences during the 1981 protests to PG&E's opening of DCNPP. It includes blockading, arrests and jail. This set her on a mission to expose irrational decisions by the NRC which impact areas even over 100 miles from DCNPP, putting all our lives at risk. We need to know. The truth is in this book.

My thesis and reasons for writing the book are:

- Radiation kills.
- Accident conditions exist at Diablo Cove.
- Helen Caldicott's book "Nuclear Power is not the answer" covers all the reasons why we should shut down the world's dangerous nuclear plants.

Judith Evered 805 685-8822 3rd March 2010



February 9, 2010

To: The Nuclear Regulatory Commissioners.

RE: the application to extend the two reactors at Diablo Canyon Nuclear Power plant a further 20 years.

Dear Commissioners,

There are three compelling studies/ reasons for you to deny this application.

1. Radiation kills surrounding populations. The precise research shows statistical evidence of increasing deaths downwind from nuclear plants. This is in a book by Jay Gould and others called "The Enemy Within".

2. Conditions conducive to accidents are present at Diablo Canyon especially in regard to the earthquake factor and the two aging plants. Charles Perrow, the author of "Normal Accidents", maintains the absence of an accident at Diablo Canyon Nuclear Plant is because not sufficient time has yet elapsed for an accident to happen. He advocates these reactors should be closed down immediately.

3. Compelling arguments to not continue expanding nuclear power are found in the book: "Nuclear Power is Not the Answer", by Helen Caldicott. Her research covers almost all the reasons why Diablo Canyon reactors should not be given longer lives. Waste is an overriding problem. Environmental racism and enormous costs are also well exposed by this researcher.

The arguments found in the above three books involve outstanding thinking about these reactor flaws and potential damage to humans.

Please facilitate the reading of these books by your staff and aides who will I trust write at least a one page conclusion of the results outlined for your honest attempt to predict the future and rationally decide on no extension time for reactors Diablo 1 and 2.

This is morally imperative. A precautionary action is needed now.

Judith Evered, a member and co-chair of the Santa Barbara Women's International League for Peace and Freedom.

Contact information:

(805) 685-8822 (805) 720-4336 PO Box 8153 Goleta CA. 93118

Statement of U.S. Representative Lois Capps
Statement at NRC Scoping Meeting on the
Diablo Canyon Nuclear Power Plant Relicensing Application
March 3, 2010

I would like to read the following statement from U.S. Representative Lois Capps:

Thank you for the opportunity to comment on the environmental issues the Nuclear Regulatory Commission should consider in its review of the proposed license renewal application for the Diablo Canyon nuclear plant.

I represent the 23rd Congressional District, in which this facility is located.

As a member of the House Energy and Commerce Committee, I am very interested in issues relating to the relicensing process of nuclear power plants.

I appreciate the NRC holding this forum to assess all of the environmental impacts that would result if this plant were to be relicensed.

Given the scale of this renewal, as well as the complex technical issues contained in the licensee's application, it is critically important that this assessment be comprehensive and independent.

The NRC must fully assess and address safety and security impacts, including any measures available to mitigate them, as they relate to the environment.

That means the assessment must include updated and completed analyses to ensure:

- the surrounding natural and marine environment is protected,

- the plant—including aging infrastructure—can withstand potential earthquakes and is not vulnerable to a terrorist attack, and
- that any on-site storage of waste be done safely.

I believe failure to fully assess these issues would do a disservice to the review process by disallowing a look at the overall, collective impacts of this renewal on the environment.

For example, the recently discovered Shoreline Fault, less than one mile offshore of the plant, has not been thoroughly studied.

This clearly exacerbates an already precarious situation. The central coast of California has a number of major and active earthquake faults.

To reduce the likelihood or severity of a severe accident due to these faults, the NRC must include severe accident mitigation alternatives—supported by new seismic hazard data—as part of this review process.

Only with an all-inclusive review of the safety and security impacts will the NRC ever be able to come to an accurate conclusion as to the degree of the severity of a planned or unplanned event at the plant.

Accordingly, the NRC must require site-specific assessments to address the potentially catastrophic and far-ranging impacts on the environment during the license renewal process.

Again, I urge the NRC to act deliberatively in this matter, based on a thorough public record.

My constituents deserve assurance that everything possible is being done to insure this facility is operated in a safe and sound manner, and that the relicensing process is focused on protecting their health and safety.

Thank you for this opportunity to comment on this proposal.

Comments on the

U.S. NUCLEAR REGULATORY COMMISSION'S ENVIRONMENTAL SCOPING FOR DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2 LICENSE RENEWAL APPLICATION REVIEW

March 3, 2010

Barbara Byron
Senior Nuclear Policy Advisor
California Energy Commission

Good afternoon/evening. My name is Barbara Byron. I am the Senior Nuclear Policy Advisor with the California Energy Commission. We appreciate the opportunity to provide comments here today regarding the scope of the environmental review for the Diablo Canyon Nuclear Power Plant license extension application. My comments will be brief, since we plan to submit written comments later this month.

In November 2008, as required by California statutes Assembly Bill 1632, the California Energy Commission completed a comprehensive assessment of the Diablo Canyon and San Onofre Nuclear Power Plants. This assessment included studies of the seismic hazards at the Diablo Canyon and San Onofre sites and the seismic vulnerabilities of these plants. We found through this assessment that important data on Diablo Canyon's seismic hazard and vulnerabilities are incomplete or outdated. In addition, just prior to the completion of this assessment, PG&E announced the discovery of the Shoreline Fault less than half a mile offshore from Diablo Canyon. As a result, the Energy Commission recommended that PG&E conduct a number of additional seismic hazard and plant vulnerability analyses. The California Public Utilities Commission (CPUC) also directed PG&E in 2009 to report on the major findings and conclusions from these studies as part of its license renewal feasibility studies for Diablo Canyon.

These important studies include:

- Updated seismic/tsunami hazard studies, including using three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon;
- Assessments of the long-term seismic vulnerability and reliability of the plant, focusing on switchyards and other non safety-related components;
- An evaluation of additional pre-planning or mitigation steps that the utility could take to minimize plant outage times following a major seismic event, such as the earthquake that struck the Kashiwazaki-Kariwa plant in 2007; and
- An evaluation of the adequacy of access roads to Diablo Canyon and surrounding roadways for allowing emergency personnel to reach the plants and local communities and plant workers to evacuate.

PG&E's completion of these seismic studies is particularly important in light of the nearly 3-year outage of the Kashiwazaki-Kariwa nuclear power plant following the 2007 earthquake in Japan and the recently discovered Shoreline Fault near Diablo Canyon.

The Energy Commission and the CPUC have also identified a number of other studies that are needed in order to determine the economic, environmental, and reliability implications of relicensing Diablo Canyon. These studies would answer the following questions:

1. What would be the local economic impacts of continuing to operate the nuclear plant, and how would these impacts compare with potential alternate uses of the Diablo Canyon site?
2. What would be the low-level nuclear waste disposal costs for waste generated through a 20-year plant license extension, including the low-level waste disposal costs for any major capital projects that might be required during this period? In addition, what are PG&E's plans and estimated costs for the storage and disposal of low-level waste and spent fuel from the plant's operation and decommissioning?
3. What alternate power generation options could be used in place of power from Diablo Canyon? What would be the reliability, economic, and environmental impacts of these options compared to the impacts of Diablo Canyon?
4. What mitigation plans may be needed to ensure the integrity of the Diablo Canyon reactor pressure vessel over a 20-year license extension in light of any updates to the estimated seismic hazard at the site?
5. What are the options and costs for complying with California's once-through cooling policy?

The seismic studies and these additional studies are all needed to assess the cost and benefit to the state of continuing to operate Diablo Canyon for an additional 20 years. In addition, some of these same studies are also relevant to the NRC's evaluation of the environmental and safety implications of continuing to operate the plant. For example, an updated seismic hazard assessment is needed to assess the vulnerability of aging plant components to an earthquake. This is especially important for those reactor components, such as the reactor pressure vessel, that have been embrittled by neutron bombardment. In addition, the environmental assessment should consider possible changes to Diablo Canyon's cooling system resulting from the State's emerging once-through cooling regulations, required by provisions of the U.S. Clean Water Act, and updated assessments of site evacuation plans.

We, therefore, request that the NRC evaluate the safety and environmental implications of all of the AB 1632 recommended studies and issues identified by the CPUC and the Energy Commission and require that these seismic studies and the other state-mandated studies be reviewed as part of the Diablo Canyon's license renewal review proceeding before the Atomic Safety and Licensing Board.