

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA



FILED
06/29/23
11:59 AM
R2301007

Implementing Senate Bill 846
Concerning Potential Extension of
Diablo Canyon Power Plant
Operations

Rulemaking 23-01-007
(Filed January 12, 2023)

**CALIFORNIANS FOR GREEN NUCLEAR POWER'S
PHASE 1, TRACK 2 COMMENTS**

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June 29, 2023

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I. VERIFICATION

The author below affirms under penalty of perjury that the information contained in this written testimony is true and correct, and is given in good faith to their best available knowledge, subject to modifications resulting from new findings.

/s/ Gene A. Nelson, Ph.D., President and Senior Legal Researcher

June 29, 2023

II. INTRODUCTION

Californians for Green Nuclear Power (CGNP) respectfully submits these comments in response to the Commission's Scoping Memorandum filed on April 6, 2023, the Administrative Law Judge's (ALJ's) Ruling filed on April 20, 2023, and the ALJ's CCUE Extension Request granted on May 3, 2023.

CGNP is an all-volunteer non-profit association of scientists, educated at top universities, considered to be specialists in their fields, each with decades of experience in energy, nuclear power, and environmentalism. CGNP's experts became involved before the Commission because they wish to help California make wise decisions for the benefit of future generations.

In 2017, CGNP intervened in Application 16-08-006, the Commission's proceeding to decommission Diablo Canyon. CGNP was the lone party advocating for the extension of operations at Diablo. There, CGNP pointed out:

- That Diablo Canyon currently supplies at least 17 percent of California's zero-carbon electricity and 8.6 percent of California's total electricity.
- That continuing to operate Diablo would be necessary to improve system reliability and reduce greenhouse-gas emissions.
- That preserving Diablo would be cost effective, and in the best interests of electricity customers.

In 2022, the state legislature and Governor Gavin Newsom came around to the above principles. SB 846, the subject of this Rulemaking, was the manifestation of their legislative and executive directives and intentions regarding Diablo.

In Decision 22-12-005, the Commission implemented certain directives with respect to preserving Diablo operations, but this OIR acknowledges that a few tasks remain, notably, that by 31 December 2023, and notwithstanding the separate 180-day requirement in Public Resources Code Section 25548.2(b), the Commission must direct and authorize extended operations at Diablo Canyon until 31 October 2029 (Unit 1) and 31 October 2030 (Unit 2).

However, the Commission wrote in the January 20, 2023 OIR that it may establish earlier retirement dates if certain conditions occur. CGNP objects to any earlier retirement dates. The focus of these comments will be on the need for extended Diablo Canyon operations for the foreseeable future.

III. COMMENTS

CGNP's comments assert that extending Diablo's operations as long as possible is the just and reasonable, prudent decision for the Commission. And that any analysis of cost is inextricably linked to reliability and the harms from anthropogenic carbon emissions.

First, CGNP will show in the following four sections that California energy policy is going in the wrong direction with the emphasis on aggressively - promoted solar and wind generation. CGNP's advocacy for the safety, ratepayer, and environmental benefits of nuclear power from Diablo Canyon is supported by a pair of 2011 studies requested of the eminent scientists and engineers of the California Council on Science and Technology (CCST) by the California Energy Commission.¹ A 3.5 page summary of the pair of CCST studies dated July 15, 2011 by Nobel laureate in Physics, Burton Richter, Ph.D. is attached as an Appendix.

"California's Energy Future: The View to 2050" Release Date: May 24, 2011 | Last Updated Date: February 19, <https://tinyurl.com/CCST-Nuclear-1>

... Nuclear power can provide constant, reliable emission-free energy with a much lower and more easily met requirement for load balancing. Roughly 30 new nuclear power plants could provide two-thirds of California's electric power in 2050. However, nuclear waste storage remains a significant problem with existing reactor technology, not to mention public concern, especially in the wake of Japan's recent earthquake and tsunami disaster....

"California's Energy Future – Powering California with Nuclear Energy" Release Date: July 1, 2011 | Last Updated Date: February 19, 2015 <https://tinyurl.com/CCST-Nuclear-2>

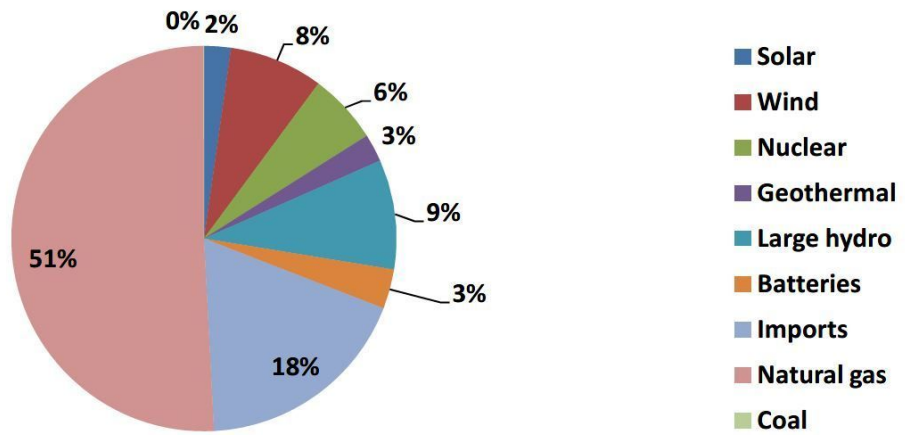
... Jane C.S. Long, associate director at large for Lawrence Livermore National Laboratory and co-chair of the California's Energy Future study. Population growth and energy demand will eventually force a decision on California's energy strategy, especially with the requirement for drastic reduction in emissions. "By 2050, California's population is expected to rise to 55 million people. That increase, accompanied by economic growth, will likely require a doubling in electricity production, but with virtually no emissions, to meet state goals," says Jane Long. "That is why nuclear power could prove one important option for meeting those strict and necessary standards."...

III. A DURING DEADLY HEAT STORMS SUCH AS THE ONE CALIFORNIA EXPERIENCED IN AUGUST - SEPTEMBER 2022, RELIABLE DIABLO CANYON WAS A LIFESAVER

The California Independent System Operator (CAISO) provides publicly-accessible records of California generation by energy source during five-minute intervals. CGNP obtained the data for the interval from August 7, 2022 to September 9, 2022. We examined the important evening hours from 6:00 PM to 11:00 PM when homes and businesses were cooling down their premises after the long, hot summer days. Given greater than month - long interval, failure to keep temperatures cool would have adverse health consequences for building occupants. During this interval, there were numerous alerts, warnings, and emergencies including the consequential Energy Emergency Alert 3, (EEA3) the most serious level on September 6, 2022.² Many natural gas fired power plants experienced unplanned outages during this interval.³ In contrast, Diablo Canyon Power Plant had exceptional reliability during the heat storm.

The relevant CAISO alerts, watches, and emergencies are shown on page 5 to page 43 of <http://www.caiso.com/Documents/Grid-Emergencies-History-Report-1998-Present.pdf> Archived June 27, 2023
California's Underperforming Natural Gas Plants, June, 2023, California Environmental Justice Alliance and Sierra Club and three other organizations.
<https://caleja.org/wp-content/uploads/2023/06/2023-Regenerate-Heat-Wave-Report.pdf>

For 8/7/22 to 9/9/22 Natural Gas and Mostly - Fossil Imports Supplied 69% of California's Evening 6-11 PM Power



Data Source: California Independent System Operator (CAISO)

Here's the summary chart:

Monthly Total MWh	Percentage
141,756	Solar
495,569	Wind
146,613	Geothermal
3,197,345	Natural gas
578,914	Large hydro
1,150,390	Imports
209,329	Batteries
372,506	Nuclear
1,805	Coal
<hr/>	
6,294,227	Total

The dominant energy source during this time interval is in-state natural gas fired generation at 51% followed by mostly fossil - fired imports at 18% for a total of

69%. Since this heat storm occurred during a profound drought, West - wide hydroelectric generation was mostly reserved for in-state use, likely limiting hydroelectricity to about 10% of interstate imports. Instead, large coal-fired power plants such as LADWP's Intermountain plant and PacifiCorp's Jim Bridger and Hunter plants exported large amounts of power to California. (Percentages were shown inside the pie chart for fossil generation with its attendant air and water pollution.)

During the month, California wind power was stifled by a large heat dome that settles over the Four Corners area during the summer. The effect of this heat dome extends hundreds of miles away. Contrary to the claims of California offshore wind advocates, offshore floating wind (already the most expensive per MWh) will also be stifled by this huge heat dome. There is no way that offshore wind could replace Diablo Canyon with an over 90% capacity factor (percentage full power output) Annual capacity factors for California offshore wind off the California central coast will likely have a 40% capacity factor based on review of NREL charts.

Non-emitting generation percentages were shown outside the pie chart with a total of 31%. It is important to recognize that if Intermountain were used to charge batteries, there would actually be increased emissions, since batteries are subject to thermodynamic inefficiency. Thus, the idea that battery power is non-emitting would only be true for a power grid with only non-emitting energy sources. As can be seen from the chart, the idea that somehow intermittent solar or wind could take over for dispatchable natural gas, coal, or even nuclear power is implausible within any practical time horizon, let alone by 2030. However, solar and wind advocates continue to make such counterfactual claims. The following section shows California's generating sector is using more natural gas,

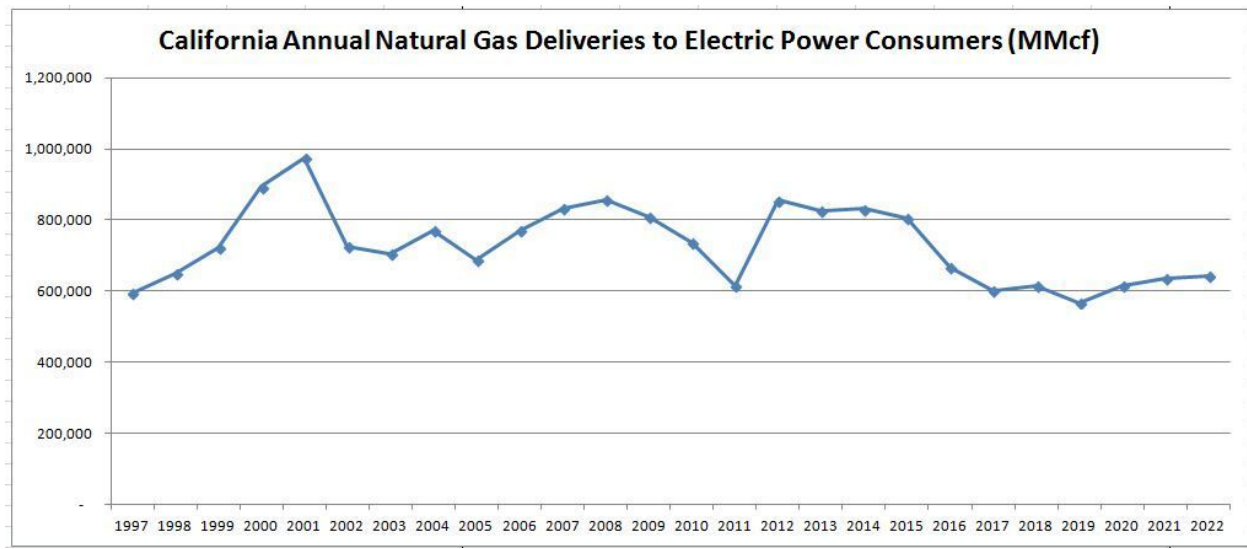
despite the misleading claims that deploying solar and wind would reduce the use of fossil generation.

III. B NATURAL GAS USE FOR CALIFORNIA ELECTRICITY GENERATION IS INCREASING

The U.S. Energy Information Administration (EIA) tabulates the annual California Natural Gas Deliveries to Electric Power Consumers (MMcf) in the data tabulation via sourcekey N3045CA2.

<http://www.eia.gov/dnav/ng/hist/n3045ca2a.htm>

Here's a 1997 - 2022 graph:



Since 2019, the California natural gas consumption has monotonically increased, implying that the greenhouse gas (GHG) emissions have also increased. Here's the detail. Values are shown in millions of cubic feet.

2019	568,341
2020	616,256
2021	637,382
2022	642,745

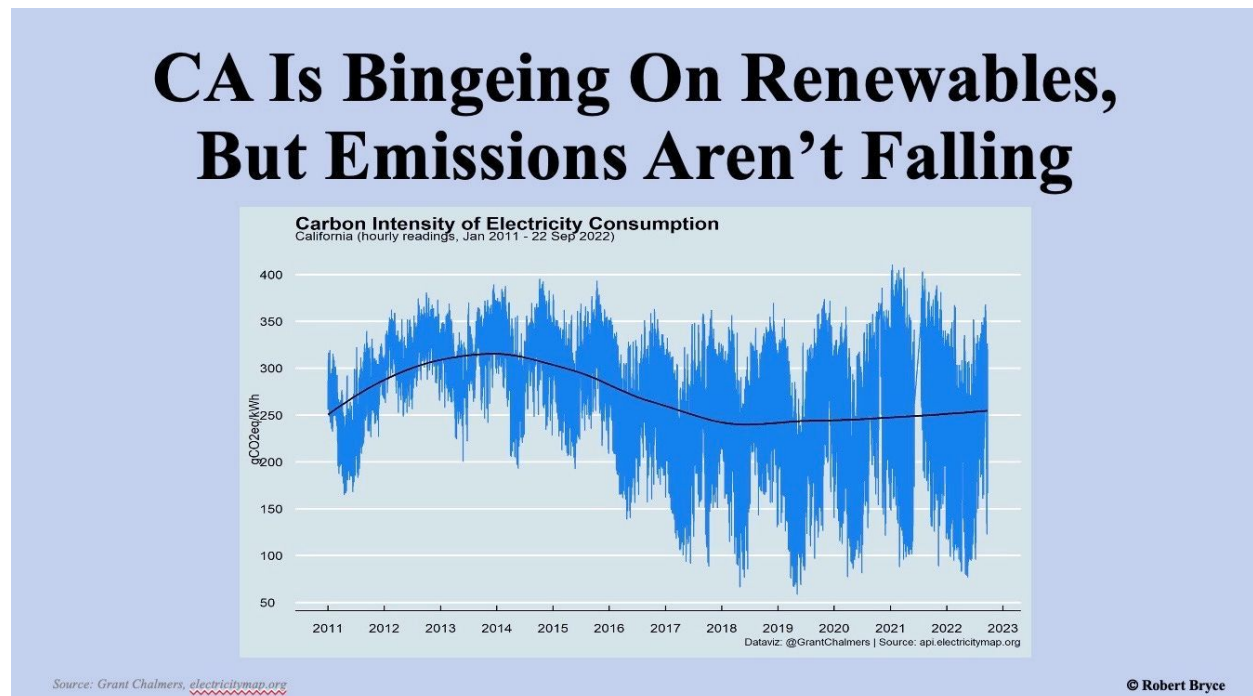
Since 2010, California has expended tens of billions of dollars purchasing solar and wind generators, ostensibly for their environmental benefits. The pace of acquisition has been accelerating. Where are the reductions in emissions? Solar and wind are inherently intermittent. CAISO informs us that as of March 9, 2023, there was 16,417 MW of California solar generation and 7,950 MW of California wind generation. Almost all of this 24,367 MW is integrated into the California power grid via natural gas fired generation compensating for the substantial intermittency of solar and wind. These dedicated natural gas fired generators are running about 2/3 of each day. The problem is best summarized via this August 11, 2016 *Washington Post* article.⁴ Vonab and Popp's research establishes empirically that about 25,585 MW of dedicated natural gas fired generators are required to integrate California solar and wind. To put this 25,585 MW of natural gas fired generation in perspective, recall that Hoover Dam's maximum generation capacity is 2,078 MW. Therefore, more than 12 Hoover Dams of intermittently and inefficiently dispatched natural gas fired generation are required for grid integration of California solar and wind. Solar and wind power costs routinely neglect this substantial grid integration cost and its pollution. No wonder fossil energy suppliers advocate for solar and wind, as it represents a significant business opportunity for these firms. (Batteries integrate a very small fraction of California's solar and wind.) The next section shows some adverse environmental consequences of these energy policies.

"Turns out wind and solar have a secret friend: Natural gas," by Chris Mooney, August 11, 2016, The Washington Post, <http://tinyurl.com/Natural-Gas-Secret> serves as an introduction to:

"Bridging the gap: Do fast-reacting fossil technologies facilitate renewable energy diffusion?" by Elena Verdolini, Francesco Vonab, and David Popp, *Energy Policy* 116 (2018) 242–256, <https://doi.org/10.1016/j.enpol.2018.01.058>

III. C CALIFORNIA ELECTRICITY SECTOR EMISSIONS ARE INCREASING WHILE THE COST OF ELECTRICITY SOARS

Robert Bryce's March 24, 2023 article is sharply critical of California's energy policies regarding the use of natural gas and electricity. ⁵ Here is the lead graphic and caption:



"California policymakers are mandating renewables. Ratepayers are being mauled by huge price increases. But the state's electric sector emissions aren't falling. Graphic by Grant Chalmers from ElectricityMaps.org data."

The next graphic has the stark headline, "Except for Hawaii, California has the highest Electricity Prices in the U.S." Later on is this paragraph: "It's not surprising that California's renewable craze is resulting in higher prices. A 2019 study by two academics at the University of Chicago, Michael Greenstone and

California Screamin' - California's headlong rush to renewables has resulted in soaring electricity prices -- up nearly 15% last year alone -- but the state's CO₂ emissions aren't falling, March 24, 2023, Robert Bryce Substack. <https://robertbryce.substack.com/p/california-screamin>

Ishan Nath, concluded that renewables “raise electricity prices more than previously thought” due to “hidden costs that have typically been ignored.” They also found that the mandates “come at a high cost to consumers and are inefficient in reducing carbon emissions.” Greenstone and Nath said “the intermittent nature of renewables means that back-up capacity must be added” and that “by mandating an increase in renewable power, baseload generation is prematurely displaced, and some of the cost is passed to consumers.” It continued, saying that renewable mandates lead to “substantial increases in electricity prices that mirror the program’s increasing stringency over time.” Bryce's article concludes, " The punchline here is obvious: California provides a stark warning to the rest of the United States about how NOT to manage an electric grid. Aggressive renewable energy mandates may be politically popular, but they come with exorbitant price tags that punish the poor and provide negligible (if any) cuts in CO2 emissions." Curtailments, described in the next section are one component of California's exorbitant power price tags.

III. D THE BALLOONING ANNUAL COSTS OF CALIFORNIA SOLAR AND WIND CURTAILMENTS

California solar generation and California wind generation must be curtailed when excess power could be generated. Below is a chart showing the annual curtailed amount in megawatt-hours and the approximate cost:

Annual California Curtailment Costs

Year	MWh	Approximate Annual Cost (\$)
2014	51,129	
2015	187,722	
2016	308,421	
2017	401,493	
2018	461,054	1,000,000,000
2019	961,343	2,090,000,000
2020	1,587,497	3,440,000,000
2021	1,504,840	3,260,000,000
2022	2,449,247	5,310,000,000
2023	1,946,070	4,220,000,000

Notes: Source URL: <http://www.aiso.com/Style%20Library/aiso/csv/curtailmentsMonthly.csv>

<http://www.aiso.com/informed/Pages/ManagingOversupply.aspx> - Scroll down to graph

Then download monthly CSV data from "Wind and Solar Curtailments by month." Calculate annual totals.

California Assemblyman Brian Dahle (now Senator) during the floor speeches on SB 100 said that the cost of curtailing California's excess solar and wind power was \$1 billion in 2018. Post-2018 ratios to 2018 annual curtailments were calculated. The 2023 annual total is only to May, 2023.

Comparison of monthly solar and wind curtailment appears here:

<http://www.aiso.com/Documents/MonthlyRenewablesPerformanceReport-May2023.html>

Select VER Curtailment | Economic Curtailment

Graphic is a bottom left of page. Use context menu to download the monthly data. Calculate totals.

Solar accounts for about 93% of the monthly curtailments.

Curtailed generation implies economic waste as ratepayers do not derive any benefits from this policy. This expensive policy is nonsensical for ratepayers. However, it provides significant economic returns to economic elites such as Warren Buffett whose firms are able to pay the substantial lobbying expenses to

accomplish such goals. Key provisions in PUHCA-1935⁶ were nullified in the 2005 PUHCA revisions which permit state regulators to be directly lobbied by the regulated firms. Multi-billionaire Warren Buffett explained the rationale for solar and wind generation in 2014:

"For example, on wind energy, we get a tax credit if we build a lot of wind farms. That's the only reason to build them. They don't make sense without the tax credit."⁷

IV. CONCLUSION

The Commission should not make the same mistake twice. Diablo Canyon is needed now, and in the foreseeable future, and its clean nuclear power can be beneficial to California ratepayers and the environment for decades to come.

June 29, 2023

Respectfully submitted,

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PUHCA is an acronym for important New Deal legislation, The Public Utilities Holding Company Act.
"Big Wind's Bogus Subsidies - Giving tax credits to the wind energy industry is a waste of time and money."
By Nancy Pfothenauer, Contributor | May 12, 2014, at 2:30 p.m. *US News & World Report*
<https://www.usnews.com/opinion/blogs/nancy-pfothenauer/2014/05/12/even-warren-buffet-admits-wind-energy-is-a-bad-investment>

CCST Report on Nuclear Power in California's 2050 Energy Mix

Burton Richter

July 15, 2011

Dr. Long explained this morning the analysis that led to the inclusion of nuclear power as part of the California energy mix in 2050. I will briefly summarize the main conclusions of the nuclear energy report, and then go on to the two issues that are probably most in the minds of all of us; the impact of the Fukushima accident and what will be done about spent reactor fuel.

Report Highlights

The report assumes 67% of California's electricity will come from nuclear while the rest is renewables as called for in AB-32. This would require 44 Gigawatts of nuclear capacity or about 30 large reactors. While reactor technology is certain to evolve over the period of interest, we assumed that they will be similar to the new generation of large, advanced, light-water reactors (LWR), known as GEN III+ that are now under review by the U.S. Nuclear Regulatory Commission. This allows us to say something about costs since these are under construction in Asia and Europe, and a larger number of similar systems have been built in Asia recently. Our main conclusions on technical issues are as follows:

- While there are no technical barriers to large-scale deployment of nuclear power in California, there are legislative and public acceptance barriers that have to be overcome to deploy new nuclear reactors.
- The cost of electricity from new nuclear power plants is uncertain in the United States because no new ones have been built in decades. Our conclusion is that six to eight cents per KW-hr is the best estimate today.
- Loan guarantees for nuclear power will be required until the financial sector is convinced that the days of large delays and construction cost overruns are over. Continuation of the Price-Anderson act is assumed.
- Nuclear electricity costs will be much lower than solar for some time. There is insufficient information on wind costs yet to allow a comparison, particularly when costs to back up wind power are included.
- Cooling water availability in California is not a problem. Reactors can be cooled with reclaimed water or with forced air, though air cooling is less efficient and would increase nuclear electricity prices by 5% to 10%.
- There should be no problem with uranium availability for the foreseeable future and even large increases in uranium costs have only a small effect on nuclear power costs.

- While there are manufacturing bottlenecks now, these should disappear over the next 10 to 15 years if nuclear power facilities world-wide grow as expected.
- There are benefits to the localities where nuclear plants are sited. Property taxes would amount to \$50 million per year per gigawatt of electrical capacity (GWe) in addition to about 500 permanent jobs.

The full report discusses all these issues in more detail including weapons proliferation issues in a world with many more nuclear plants, spent fuel issues, and future options (including fusion).

Fukushima

On March 11, 2011 a giant earthquake and tsunami struck Japan leaving 25,000 dead or missing and causing a huge amount of destruction. The complex of 6 nuclear power plants at Fukushima Dai-ichi was severely damaged with 3 of the 6 reactors suffering core meltdown and hydrogen explosions with a release of large amounts of radioactivity. The Fukushima accident is the first major reactor accident to be initiated by an extreme external event, rather than by some combination of equipment failures and human error. The investigation into exactly what happened is still going on, so we know only part of the story, but the events in Japan have triggered a review of nuclear reactor emergency response capabilities all over the world. Those reviews will or should look into organization issues as well as technical ones. In the US the regulators (the NRC) and the government promoters (the DOE) are independent, while in most of the world they are not. Japan has announced that it will make its regulators independent and India has already done so.

In the US our Nuclear Regulatory Commission is near the end of its 90-day study; the results will be out in a week or two. We have about 25 plants of the same design as the ones that were the problem in Japan; none in California. It is certain that there will be new requirements imposed on all.

Two potential problems are already clear. One is the possibility of multiple, simultaneous disasters. The catalogue that is considered in licensing includes earthquake, tsunami, fire, flood, hurricane, tornado, external power cutoff, etc. A design basis is set for each – how big an earthquake, how high a tsunami, how big a hurricane, etc., but consideration of multiple simultaneous disasters is not uniformly done.

The other issue is how long a plant has to be able to stand on its own. At Fukushima, it was 11 days before the external electrical grid was repaired enough to bring power to the reactor site. The required coping times in the U.S. are substantially shorter than this. Extending it will require more fuel to be stored at sites for emergency generators, more portable pumping and power generation equipment, more water, etc.

The reactor operators have begun planning for regional stores of emergency backup equipment.

Similar reviews are underway in most parts of the world. Personally, I think there will be a pause in the expansion of nuclear energy while the analysis continues and then it will begin again especially in Asia. Germany backed away from nuclear once before and then came back to it. Time will tell if they come back to it again. They will certainly import more nuclear generated electricity from France and from other countries where it will be generated from fossil fuels.

Spent Fuel Disposal

The Obama administration has terminated work on the Yucca Mountain nuclear waste repository for political reasons. It is said that what goes around comes around and since it was politics that picked the site, it should be no surprise that politics unpicks it.

First, how we got where we are. An act of Congress set Yucca Mountain in Nevada as the nation's first repository for storage of intensely radioactive used nuclear fuel. In 1982 Congress directed the Department of Energy to come up with three prospective sites in the western US where this material could be kept isolated for hundreds of thousands of years; Congress would make the final selection. This is what I call a top down process; the locations would not have any choice in the matter. DOE did its job, picking in 1986 sites in the states of Nevada, Texas, and Washington.

Back then George H. W. Bush was Vice-President and Texans were big powers in Congress; Tom Foley of Washington was Majority Leader (later Speaker) of the House, and no one from Nevada was in any position of influence. It was not a surprise that Nevada won the prize, and it has fought the project ever since on environmental grounds, legal grounds, and through denial of all required permits until forced to issue them by the courts. The protest is nonpartisan: every Nevadan candidate for state-wide office from any party has sworn to do his or her best to kill it, and their efforts have now been crowned with success (unless the courts force the administration to bring it back to life). Personally, I think it would make a fine repository, but that is beside the point.

It may come as a surprise to learn that we do have a repository operating in the US called the Waste Isolation Pilot Project (WIPP) near Carlsbad, New Mexico. It takes very-long-lived defense nuclear waste that has to be isolated for hundreds of thousands of years. The material goes into a 2000-foot thick salt bed 2000 feet underground that has been there for more than one hundred million years. There was consultation with the neighbors before the final Environmental Impact Statement was issued in 1981. It took about 20 years to get it opened, but it is working now and the residents of the area are said to have expressed an interest in becoming a repository for nuclear reactor waste too. I would call this a bottom up system. Find a likely site or sites, work with the people affected, and come to an agreement on the location. This is what has been done in Sweden, Finland, and France.

When the Yucca Mt. license program was suspended, a Blue Ribbon Commission (BRC) was created to make recommendations on how to proceed. It has 15 members, is non-partisan, is co-chaired by Lee Hamilton and Brent Scowcroft, and has membership that includes techies, environmentalists, industry representatives, and academics. Draft subcommittee reports are available at www.brc.gov and a commission interim report will be issued July 29. They recommend, among many other things, that we change to a bottom-up approach and have the program run by a quasi-governmental corporation like TVA.

The BRC will almost certainly recommend the creation of regional storage sites in dry casks for some of our spent fuel until a repository is opened. Based on what we have learned in the last 20 years the easiest sites to develop are in granite (Sweden's choice), salt (WIPP), or alkaline clay (France's choice). It will take about 20 years to get a repository opened if we get at it now. Until then reactor operators will have to store their spent fuel as they do now unless regional storage sites are opened soon.

In Summary: There are no barriers to nuclear expansion in California except legislative and public acceptance ones. The lessons of Fukushima are still being learned and will result in some new regulations. The repository problem is entirely political rather than technical.