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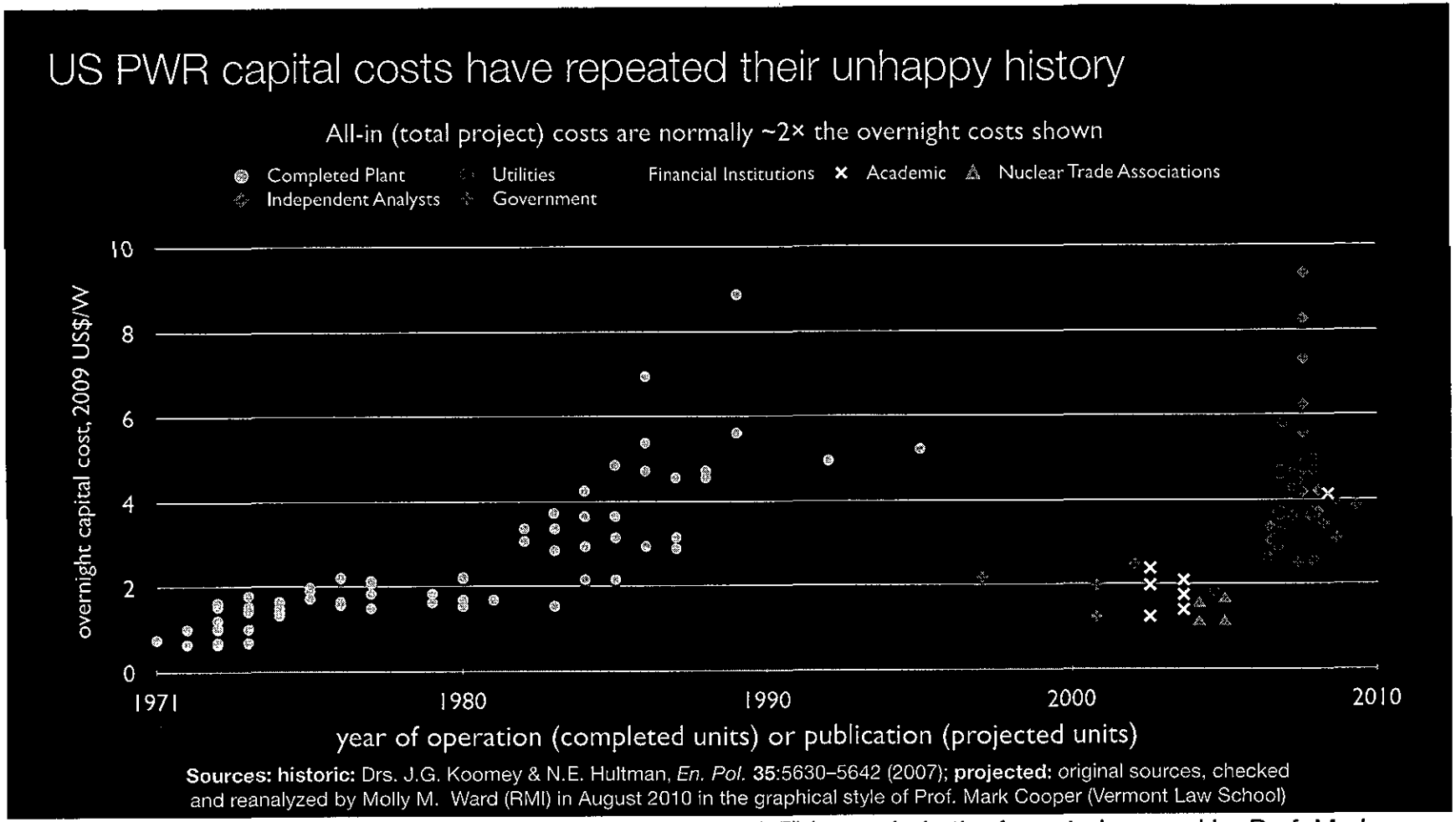
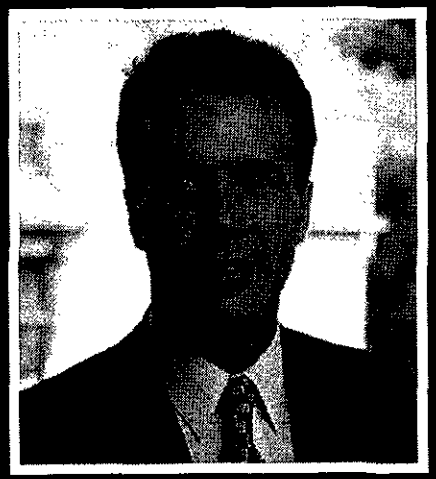


...especially because their capital costs have stood up on end. This graph, in the format pioneered by Prof. Mark Cooper, combines the historic evolution of real overnight capital cost per net installed watt (the yellow dots) with the evolution of projections from various sources. The apparent rapid escalation around six years ago turns out to have been due not, as claimed, to the runup in commodity prices, which would explain only about 1% of total project cost, but rather to shifting definitions. The early, low estimates were mere marketing claims by vendors and promoters; the buyer would take all the price risk. The later estimates were firm or fixed costs, so the *seller* would take most or all of the price risk and thus had an incentive to estimate more realistically. *

A reasonable and honest conclusion...

"What is clear is that it is completely impossible to produce definitive estimates for new nuclear costs at this time..."

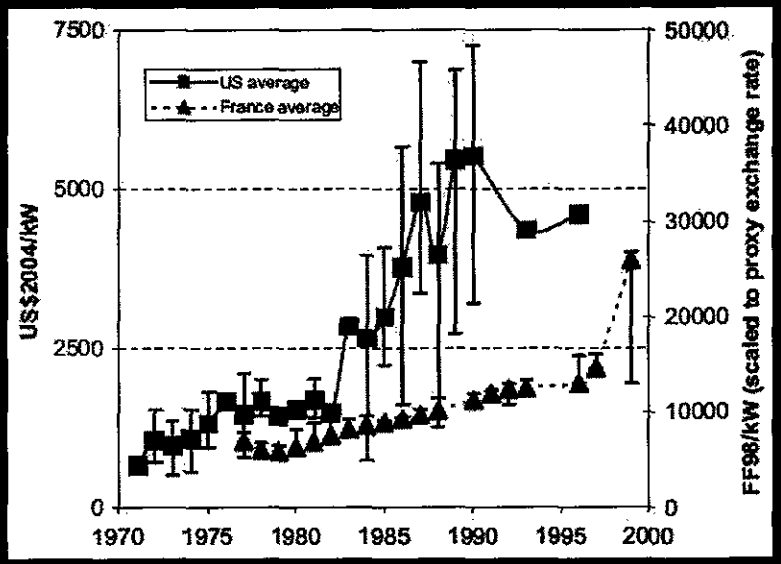
—Steve Kidd, Director of Strategy & Research, World Nuclear Association, *Nuclear Engineering International*, 22 August 2008, www.neimagazine.com/storyprint.asp?sc=2050690

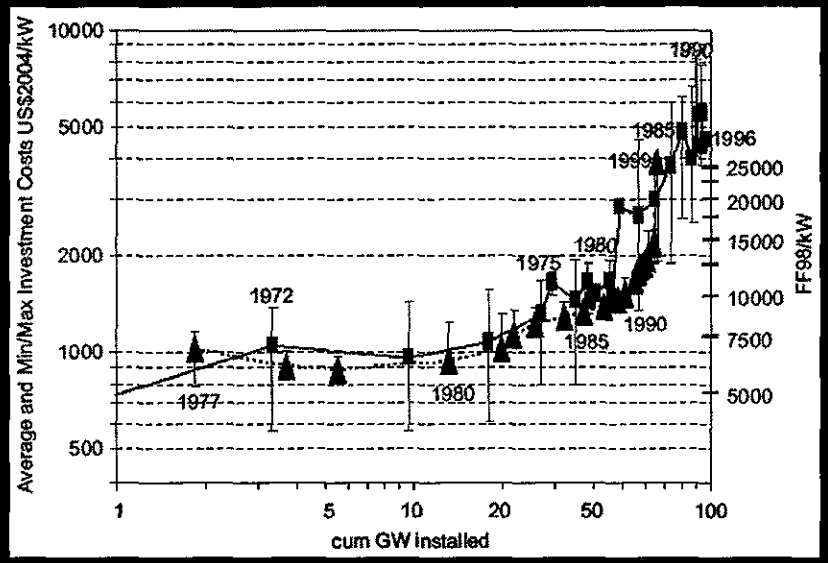


Apparent steep escalation reflected *who bears the risk* of capital-cost overruns

Amid such steep escalation and prohibitive capital cost, as the industry's Steve Kidd rightly said, nobody really knows what new reactors would cost to build. Impressively low costs have been claimed for new Korean and Chinese reactors, but not yet transparently demonstrated, so the capital markets haven't chosen to bet their own money. Since August 2005, the United States has offered 100+% construction subsidies for new nuclear plants, plus operating subsidies slightly bigger than windpower's, without making a single reactor financeable with private risk capital. [The five under construction are being built under special laws that transfer all cost and all risk to the customers or taxpayers or both.] *

French nuclear power's "unlearning curve" (no country has yet clearly demonstrated an actual nuclear learning curve)





Source: A. Grübler, En. Pol. 38(9):5174–5188 (2010), doi:10.1016/j/enpol.2010/05.003

Unfortunately, despite strong and devoted effort, nobody has shown how to overcome nuclear power's prohibitive costs. No country has yet demonstrated a "learning curve" where building more plants makes them cheaper. The French program's more than doubled real capital cost and construction time resembles the even stronger U.S. escalation whose fundamental causes, driven by the growth itself, were understood decades ago.

Advocates of small modular reactors claim series factory production can overcome their higher capital cost (reactors don't scale down well), but there's *no evidence this is true. Even if it were, small modular renewables,* which *do* scale down well, are decades ahead in exploiting *their* enormous economies of mass production, so reactors could never catch up.

Hypothetical new (or, usually, revived old) kinds of reactors can't win either, because even if the nuclear ~35% of the plant's total capital cost were *free*, the non-nuclear ~65% would still be grossly uncompetitive, as we'll see.

But even more importantly, *what are nuclear power's competitors?*

Conventional theology:

Only other central thermal plants (coal, combined-cycle gas)

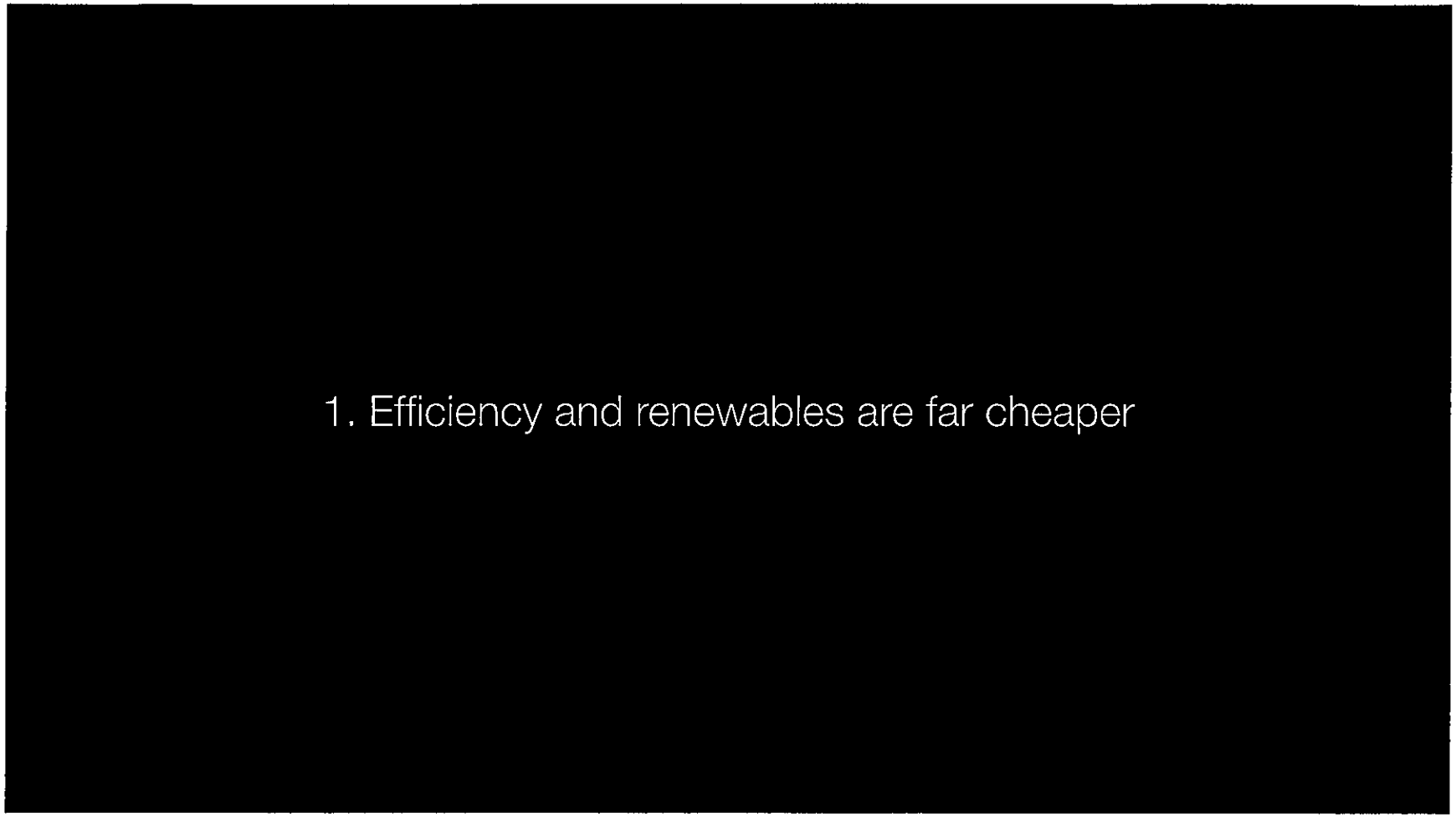
- Efficiency and renewables are worthy but minor
- Variable renewables (wind and photovoltaics) are not "24/7" or "baseload" and hence can contribute little "reliable" supply without huge backup or bulk-power-storage costs
- Carbon pricing will benefit nuclear power

Heresy based on observed market behavior:

Not central plants, which are *all* uncompetitive, but negawatts (saved electricity) and micropower (cogeneration + renewables – big hydro)

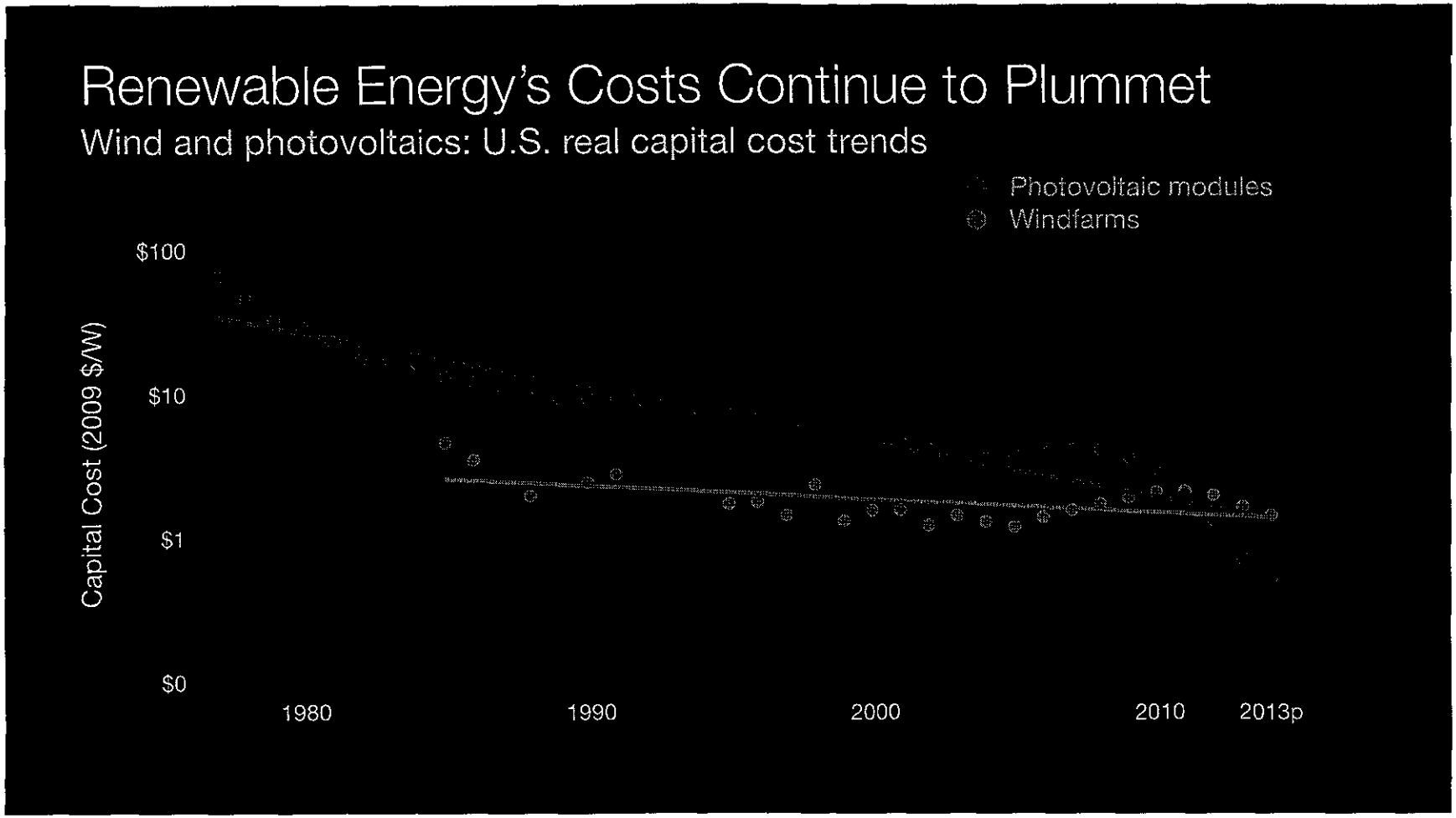
- They're cheaper, faster, more reliable, more attractive to investors, eclipsing nuclear, and winning wherever they're allowed to compete
- Variable renewables can cost-effectively provide reliable power with little or no bulk storage, if properly diversified, forecasted, and integrated—and can scale at least as fast as nuclear power
- Carbon pricing benefits them and nuclear equally, and fueled cogeneration partially

But *uncompetitive with what?* That's the crux. * The nuclear industry claims its only realistic competitors are *other central thermal power plants* * burning coal or gas. But in fact, the evidence shows that its * arguments for excluding other competitors aren't valid, and that * *all* central thermal plants cannot compete in the U.S., or probably anywhere else, with end-use efficiency, no- or low-carbon cogeneration, or carbon-free renewables. So I'll next summarize *those* overlooked but potent competitors' cost, reliability, speed, and cost-effectiveness for displacing fossil carbon emissions. *



The cheapest competitor is more efficient use of electricity. U.S. use of electricity peaked in 2007, then fell 2.4% while real GDP grew 6%. In 2012 alone, almost unnoticed, weather-adjusted electricity use per dollar of real GDP fell 3.4%—equivalent to increasing U.S. nuclear output by 130 TWh or one-sixth in a single year. Utilities' "new normal" is stagnant or declining demand as efficiency outpaces economic growth. The resulting revenue erosion will heighten incentives for decoupling and shared savings, accelerating utilities' efficiency efforts ($7b in 2013) as they did for gas.

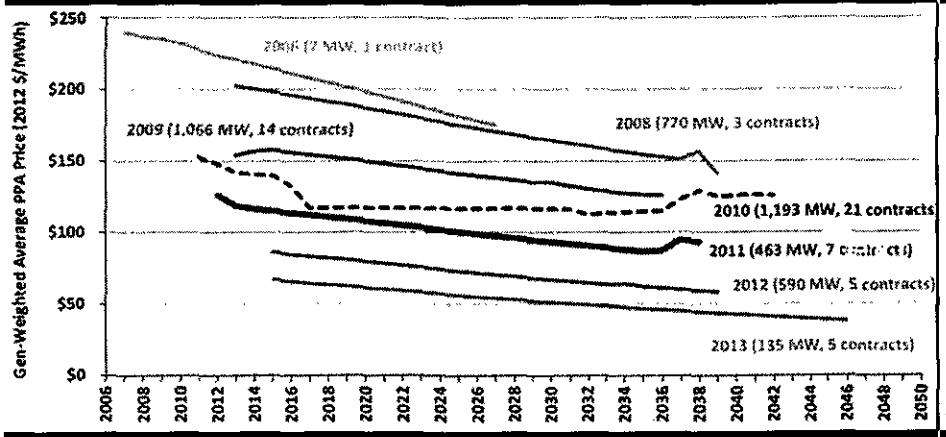
As we'll see later, over 4,000 program-years of experience in 31 states reveal average costs of efficiency around 2¢/kWh. Well-designed negawatts now cost only a third as much as in 1980—especially when integrative design is included, as it often makes very large savings cost *less* than small or no savings, turning diminishing returns into expanding returns. That's how our retrofit of the Empire State Building is saving two-fifths of its energy with a 3-y payback; how our latest deep retrofit of a big office building is saving 70% cost-effectively; and how our *Reinventing Fire* analysis found a 75% reduction in U.S. electric intensity would have a technical cost of only 0.64¢/kWh based solely on private internal costs and benefits, and all meeting market hurdle rates. We showed how U.S. buildings' energy productivity could triple to quadruple with a 33% Internal Rate of Return, and how industrial energy productivity could double with a 21% IRR. No wonder the IEA estimates the world is investing ~$0.15–0.3b/y in energy efficiency—and that's still a gross underinvestment.



As for modern renewables, here on a logarithmic scale are the declining real market prices of photovoltaic modules (blue) and windfarms (green). Mass-producing these modular renewables makes them cheaper, so they grow faster, so they get cheaper, so they grow faster. In 20 states today, entrepreneurs can put solar power on your roof with no money down and beat your utility bill. Soon they'll offer cash back. Some recently contracted utility-scale solar systems have a total installed cost of $1.50/W, and some developers expect to be at or below $1.30 by year-end as they apply and improve the streamlined installation methods already common in Germany and Australia. That's how, last year, Solar City's installed system costs fell 30% even though its module prices rose 3%. Already 10–15% of Hawai'ian homes use solar power, and many are dropping off the grid because solar plus full battery storage is cheaper. RMI's new report "The Economics of Grid Defection" shows such "utility in a box" or "virtual utility" offerings will reach retail grid parity across the country well within the lifetimes of existing utility assets. *

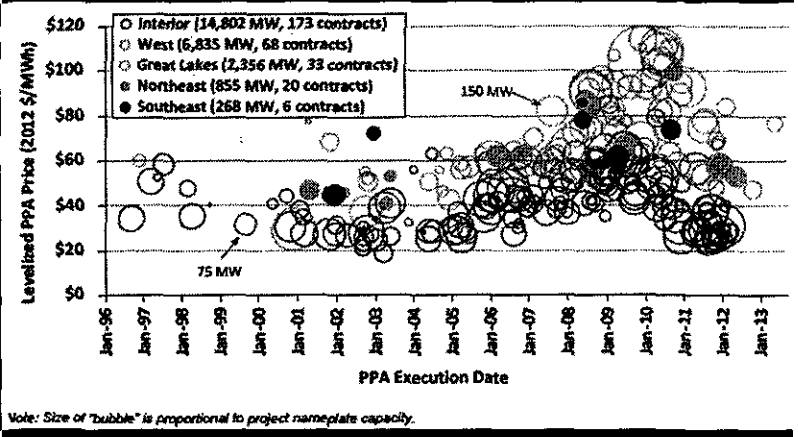
Wind and even solar power in good sites now sell for well below the levelized cost of electricity from new combined-cycle gas plants

Utility-scale photovoltaics



DOE, *2012 Wind Technologies Market Report*
DOE/GO-102013-3948 (Aug 2013), p. 50

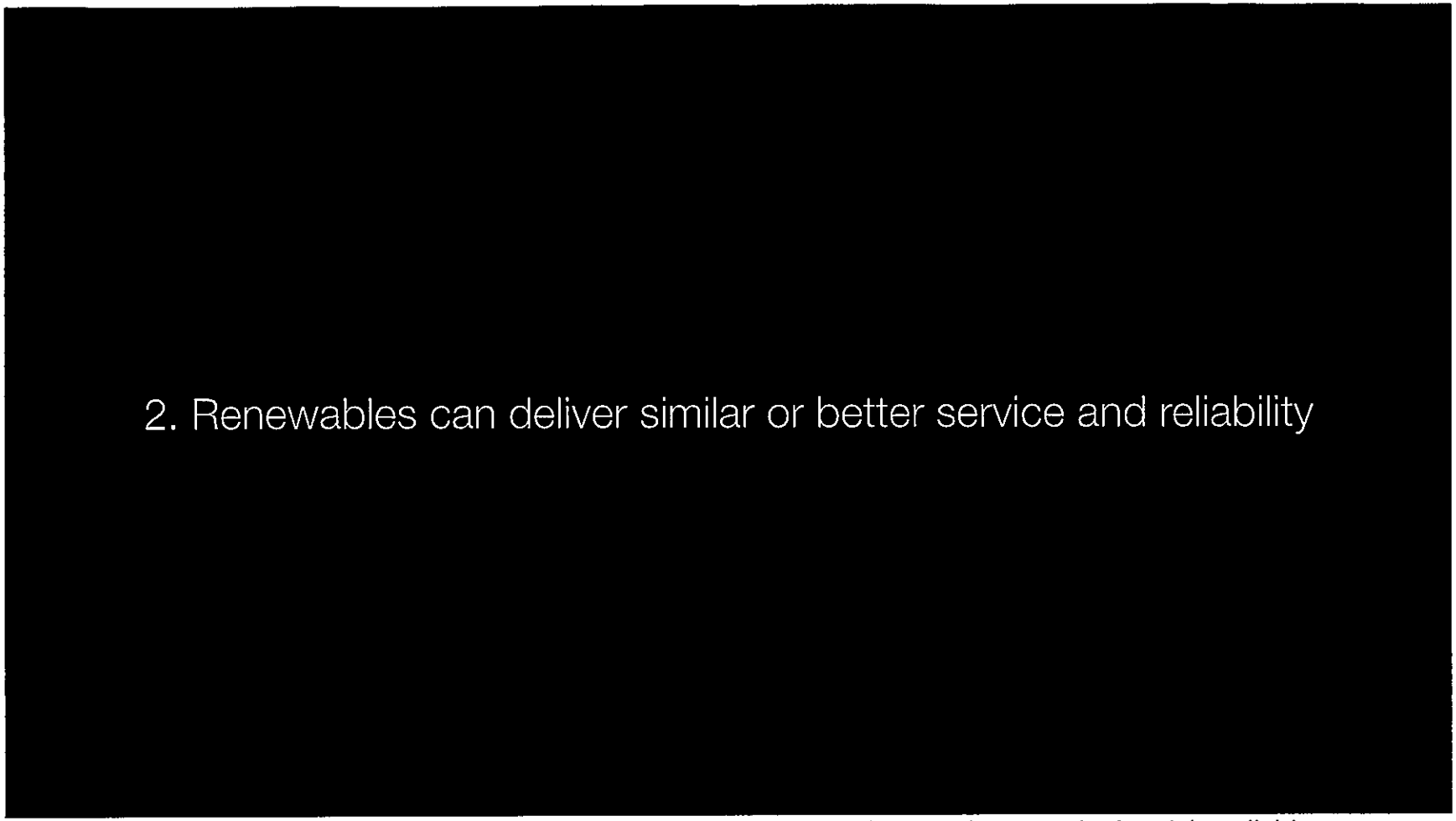
Windpower



LBNL, *Utility-Scale Solar 2012*
LBNL-6408e (Sep 2013), p. 24

...so these modern renewables are manyfold cheaper than nuclear power, and even beat the levelized cost of combined-cycle natural-gas generation

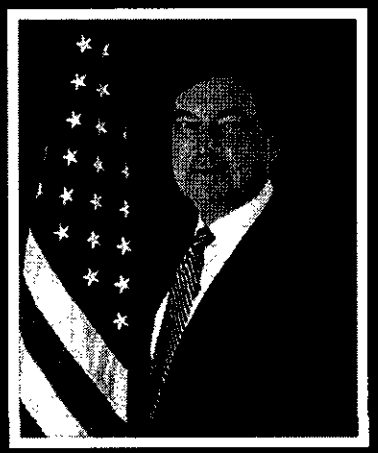
The Power Purchase Agreements that profitably sell the output of U.S. photovoltaic power and windpower projects, typically at constant nominal price and hence declining real price, empirically show dramatic and continuing price drops. Solar power in 2013 sold at levelized prices ~5–5.5¢/kWh (now just below 5¢) with a 30% Federal subsidy, corresponding to an unsubsidized price ~7¢ and falling. Midwestern windpower in 2013 sold for around 2–2½¢/kWh with Federal subsidy, ~4–5¢ without it, and falling. These prices are consistently beating new combined-cycle gas plants in the marketplace today. By the way, grid integration of variable renewables typically costs a few tenths of a cent, even for very large wind fractions, and are probably lower than the uncounted grid integration costs of central thermal plants. [For example, most studies find windpower needs balancing reserves equivalent to ≤5% of wind capacity—one-third of the reserve margin and spinning reserve normally required for large thermal generating units.] *



Yet many people still claim solar cells and windpower are too "variable" to produce much electricity reliably, because we can't cheaply store huge amounts for when the sun doesn't shine or the wind doesn't blow.
That's a myth. We don't need a storage breakthrough or *supposedly "24/7," "baseload" coal and nuclear plants to keep the lights on.* *

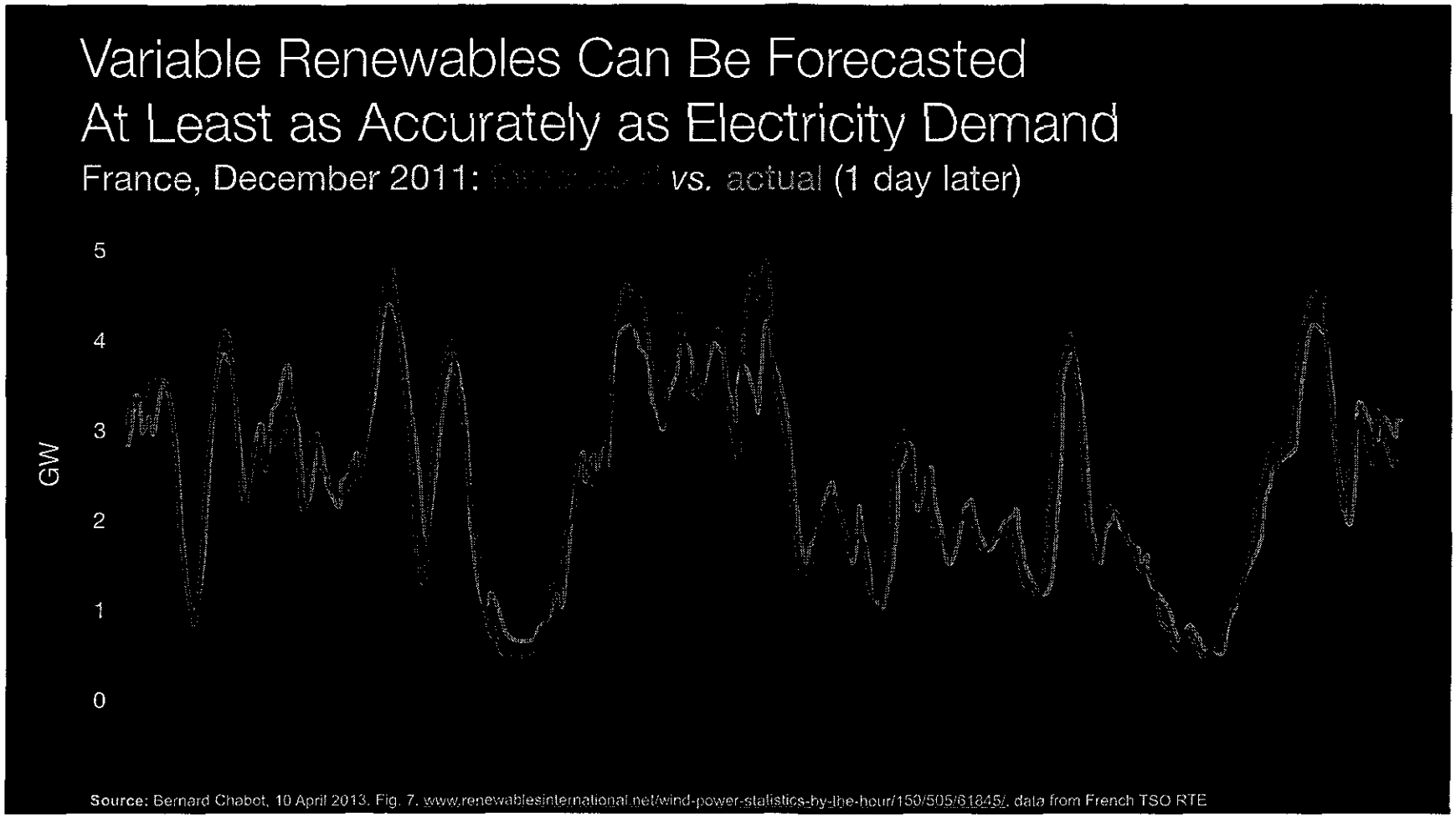
We won't need big thermal plants to keep the lights on

"I think baseload capacity is going to become an anachronism....You don't need fossil fuel or nuclear [plants] that run all the time....We may not need any [more], ever."

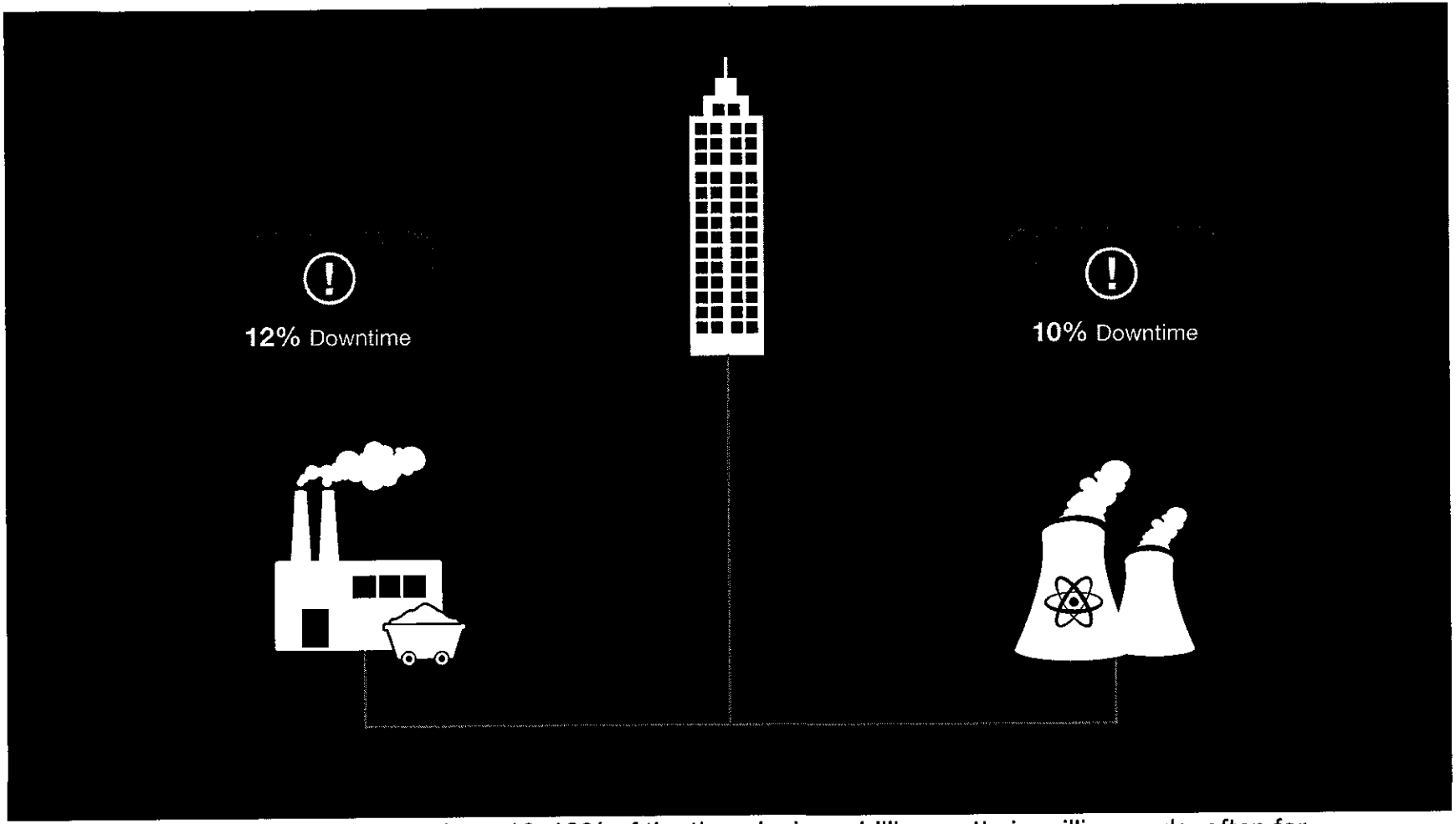


—Jon Wellinghoff, Chairman
Federal Energy Regulatory Commission
22 April 2009

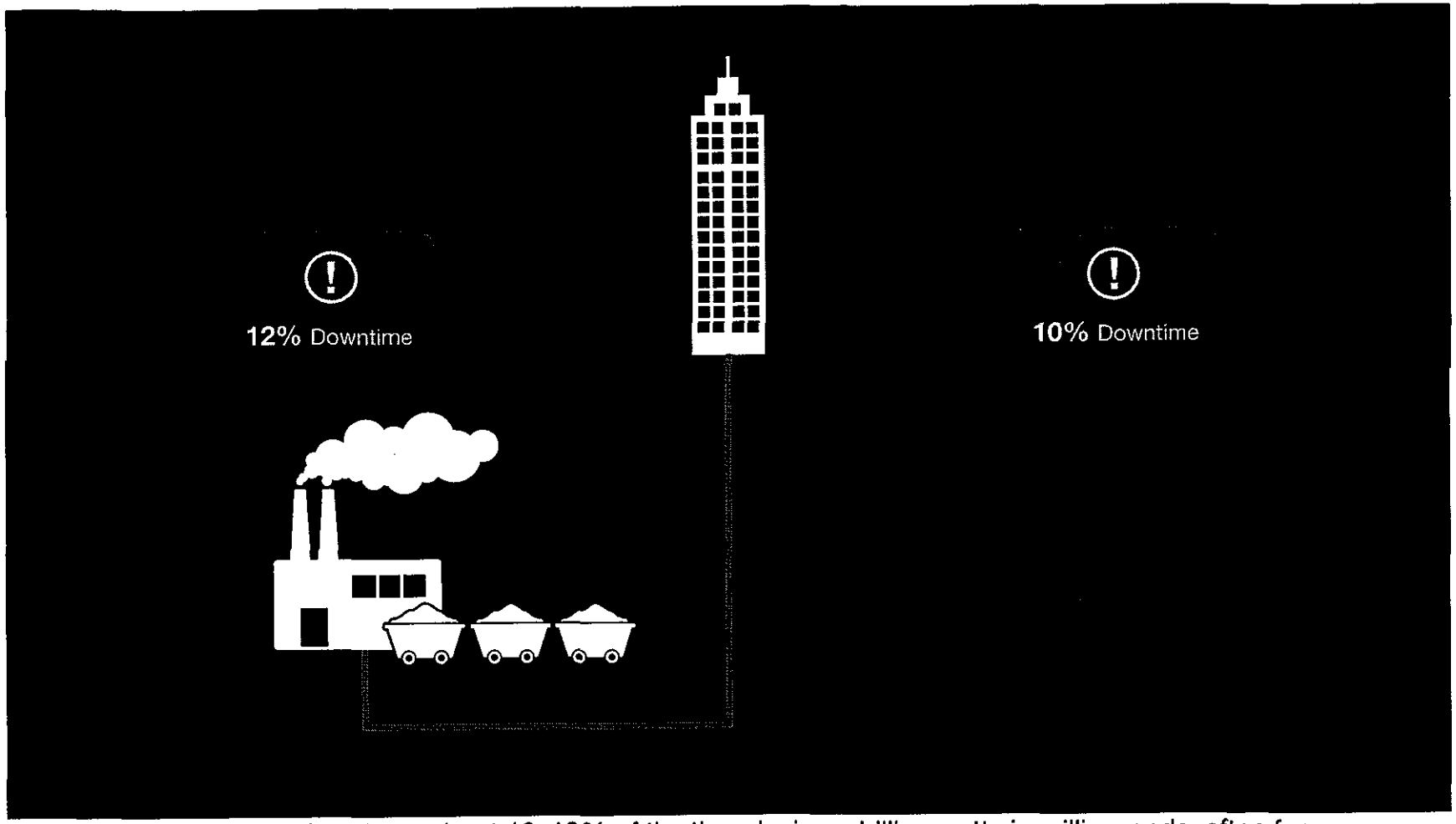
America's * chief utility regulator said so five years ago. Here's why he was right. *



First, "variable" does not mean "unpredictable." We can predict solar and windpower at least as accurately as demand: * in this stormy winter month, forecast output from all French windfarms almost exactly * matched their actual output a day later. The small remaining errors vanished in the hours before actual dispatch. *



Those giant plants are shut down about 10–12% of the time, losing a billion watts in milliseconds, often for weeks or months, * often without warning. The grid handles * this intermittence by backing up * failed plants with working plants. *



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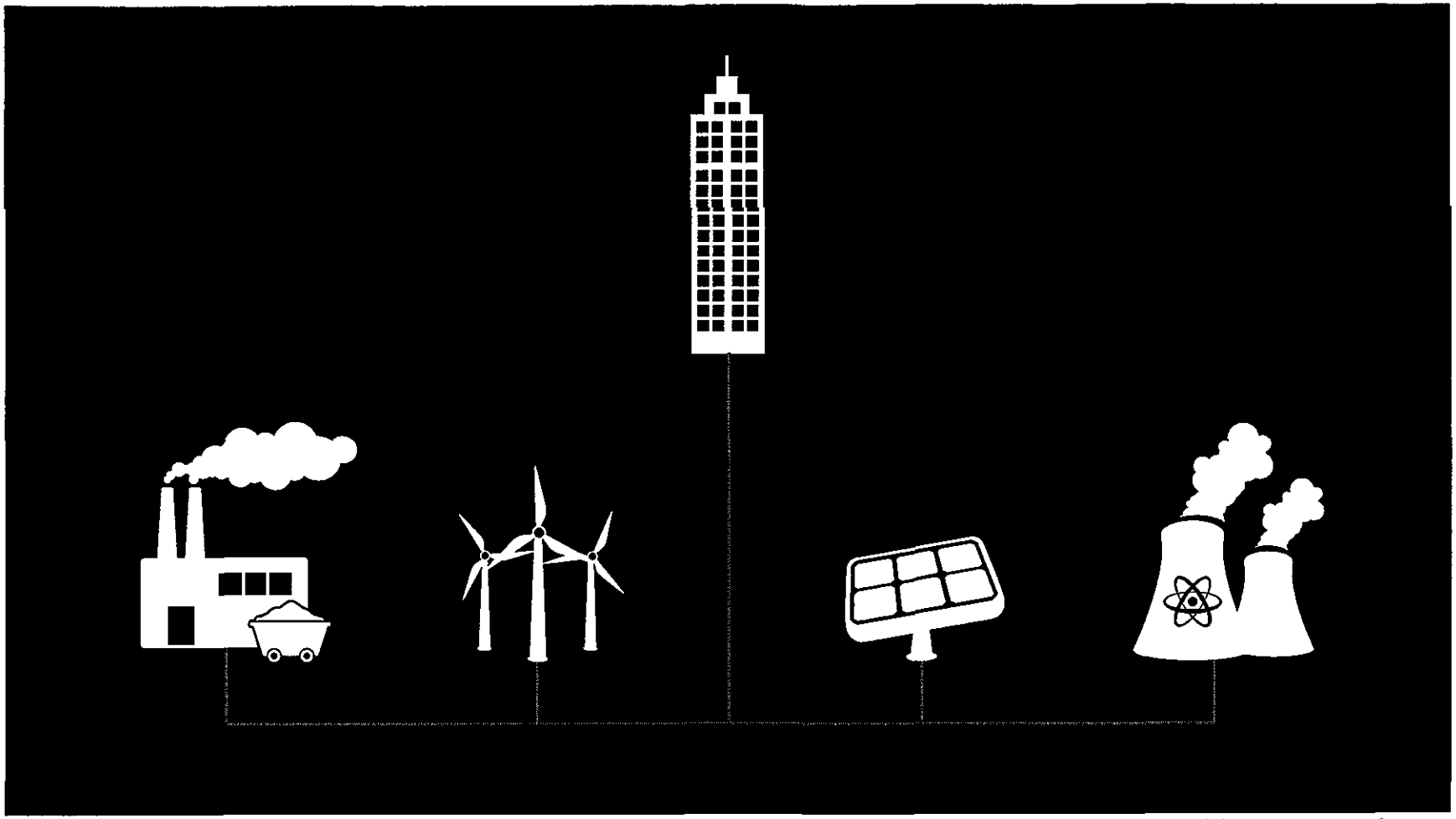
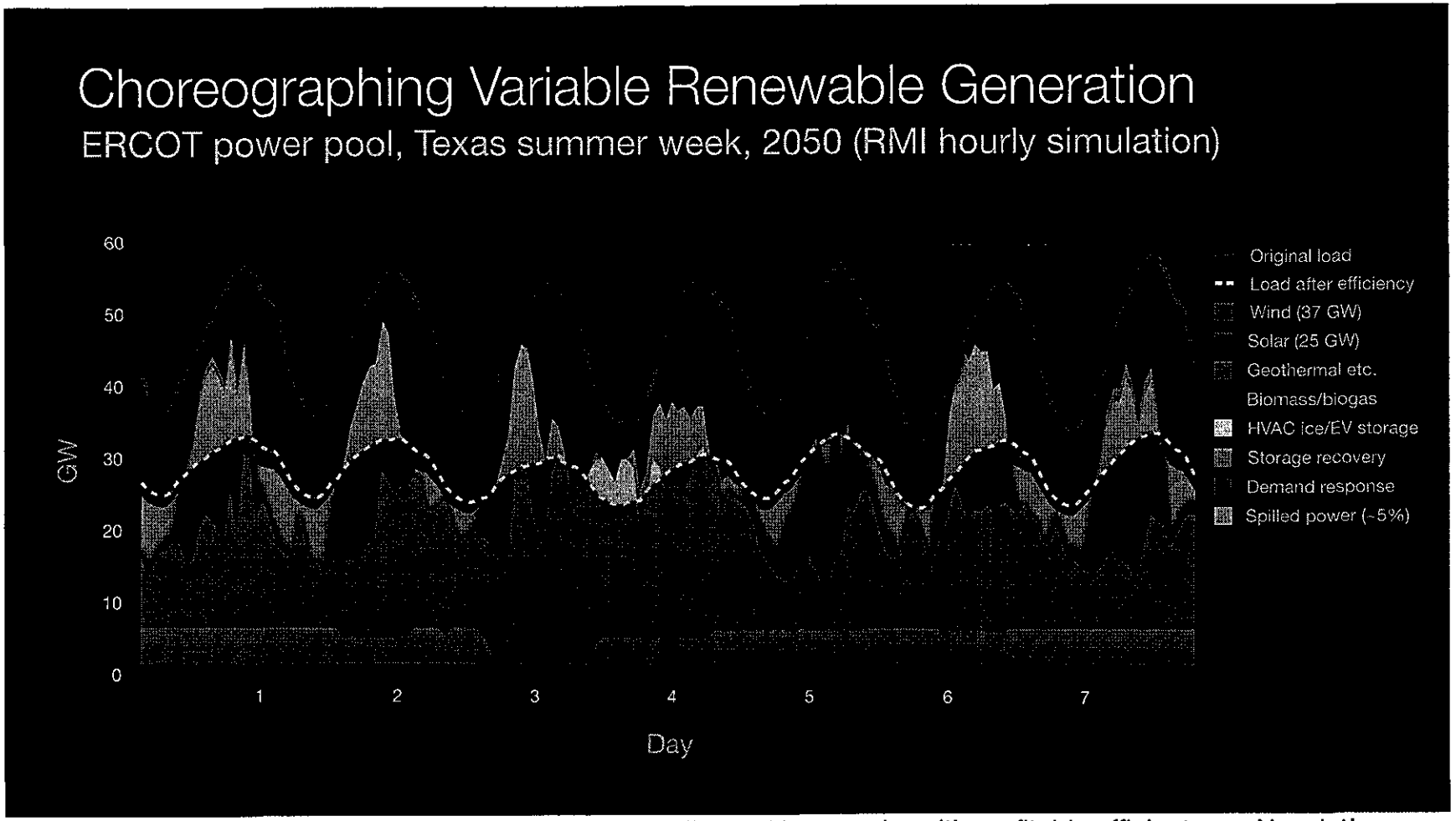
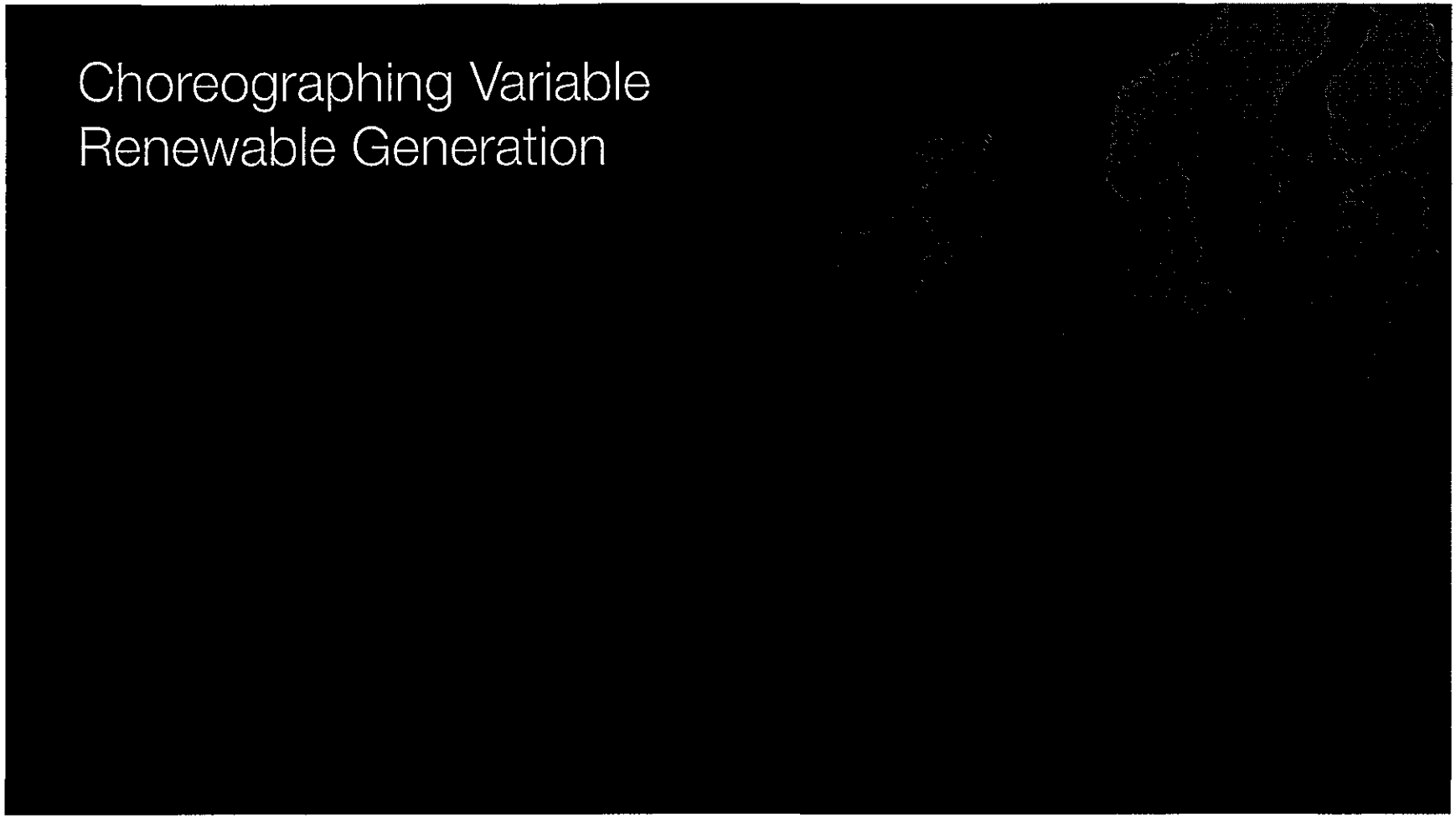


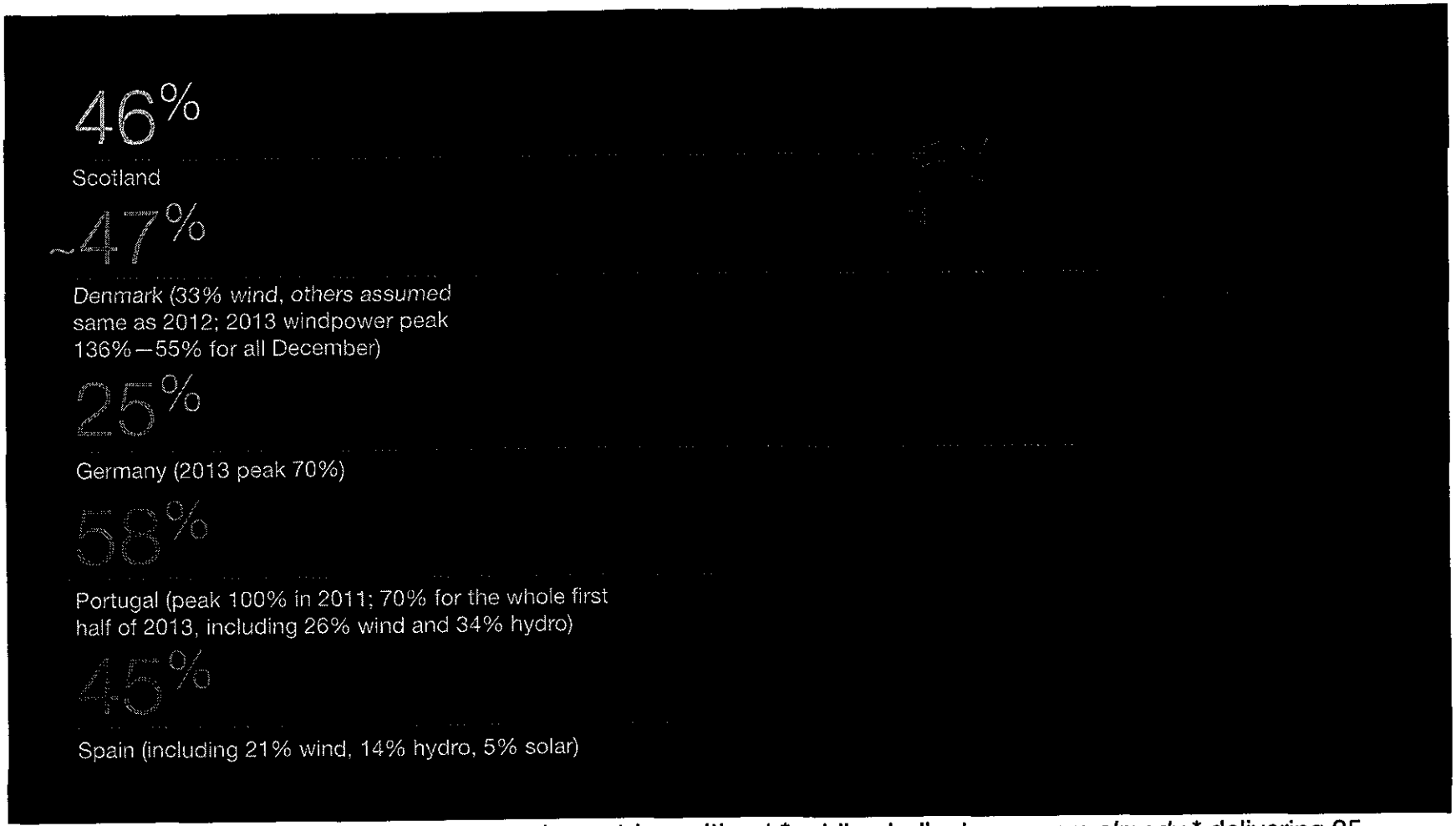
[animation runs 10s] In the same way, but often more cheaply, the grid can manage the forecastable variation of solar and windpower by combining them with renewables in other places or of other kinds. Let me show you how this can work. *



The varying * loads on the isolated Texas grid get * smaller and less peaky with profitably efficient use. Now let's make that electricity 86% from * wind and * photovoltaics, and 14% from * other, dispatchable renewables like geothermal, small hydro, solar thermal electric, and burning * feedlot biogas, urban wastes, and obsolete energy studies. The resulting diversified, all-renewable supply leaves * surpluses to charge up ice-storage air-conditioners and smart electric autos, both assumed here to be fully built out by 2050. * Then recovering that distributed storage when needed and filling the last gaps with * unobtrusively flexible demand makes all the moving parts fit together: now we can deliver 100% renewable electricity every hour of the year, *with no bulk storage* and * with only 5% left over. *



Using such choreography, some European * countries, without * adding bulk storage, are *already* * delivering 25–58%-renewable * electricity far more * reliable than America's. Iowa and South Dakota, too, are over one-fourth windpowered today. So they and Europe have far transcended renewable power's supposed reliability limits. * Whatever exists is possible. *



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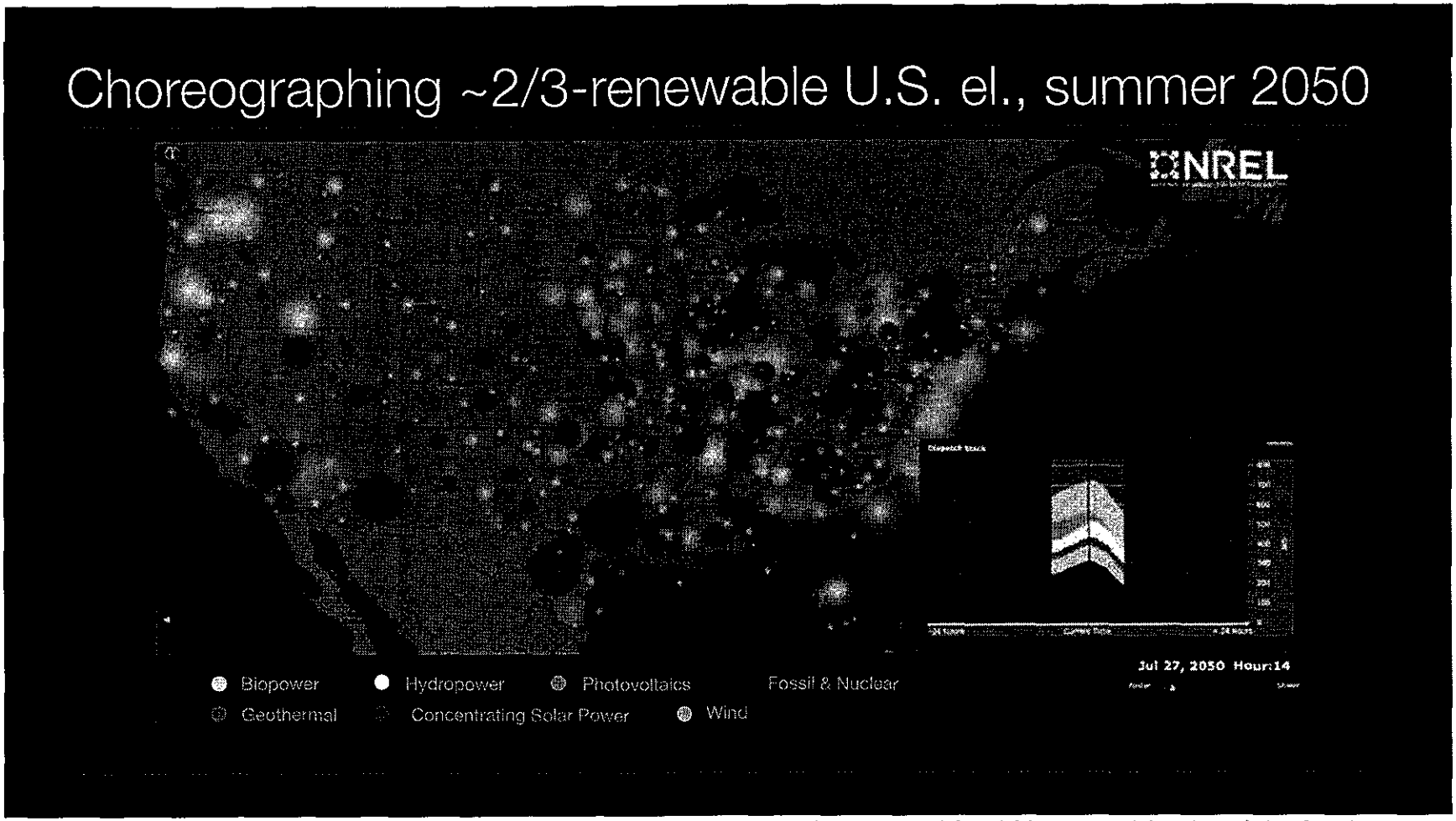
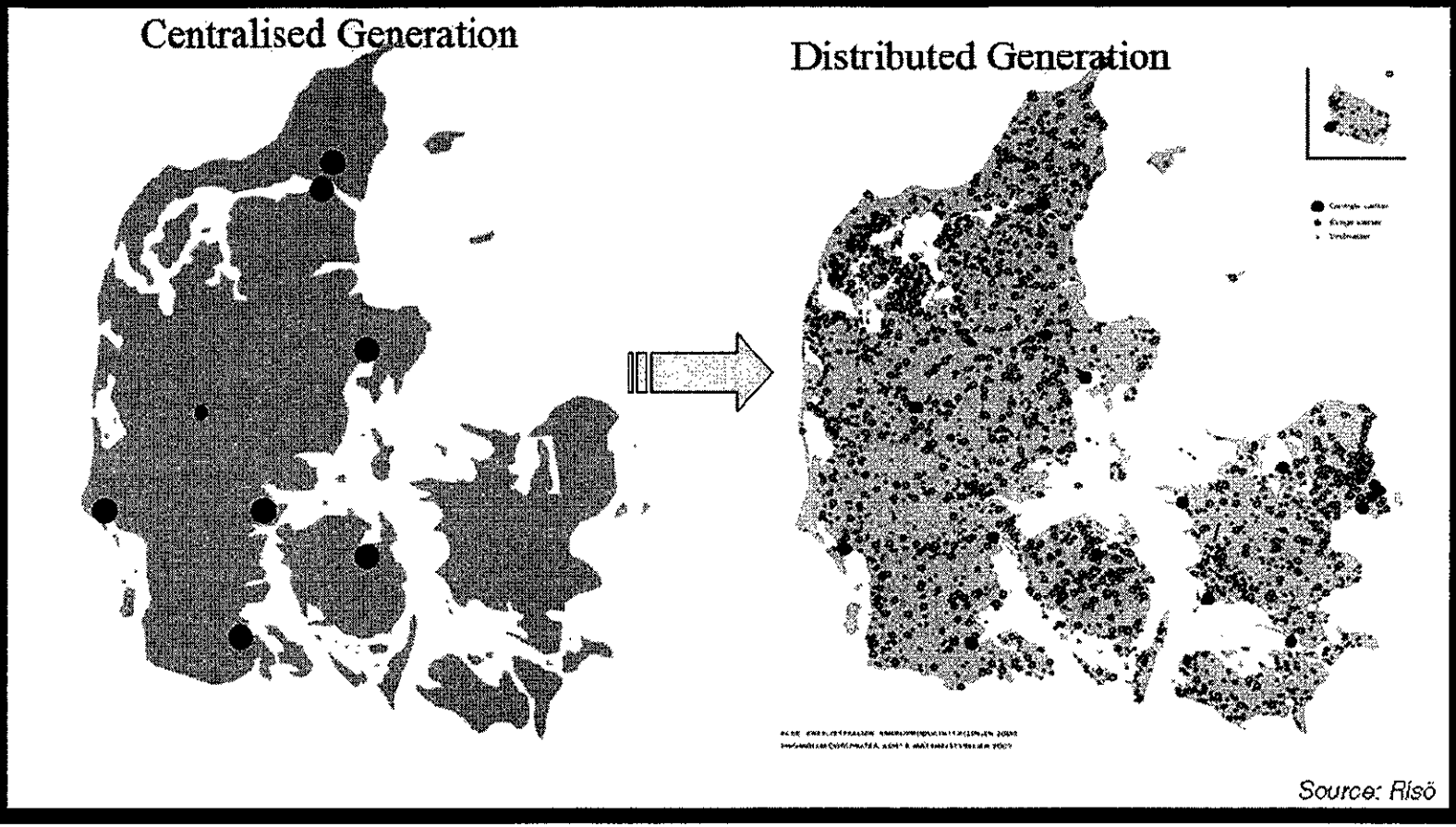


The National Renewable Energy Lab has also choreographed reliable, up to 80–90% renewable electricity for the lower 48 United States.

Bottom line: Bulk electricity storage and fossil-fueled backup are the costliest flexibility resources, so we'd use them last, not first. A breakthrough in cheap bulk storage would be helpful but not vital. We needn't wait for it—and the market isn't waiting. *

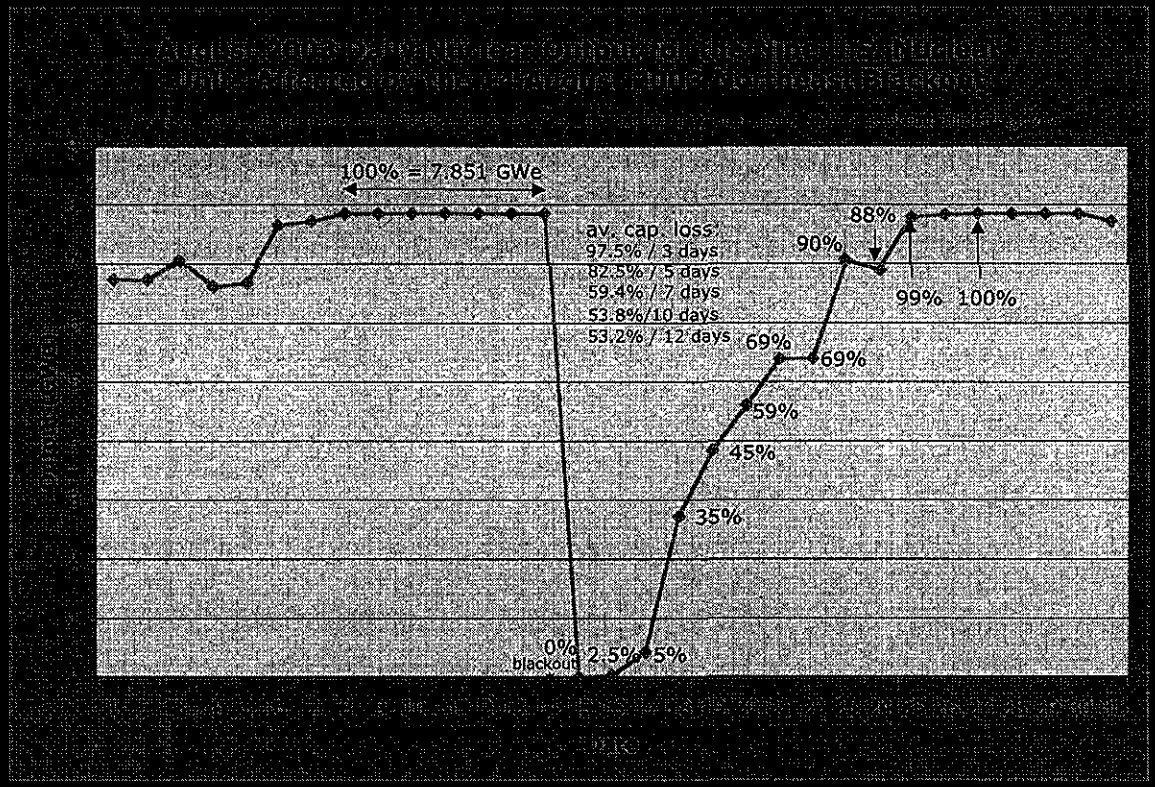
Denmark's transition to distributed electricity, 1980–2012



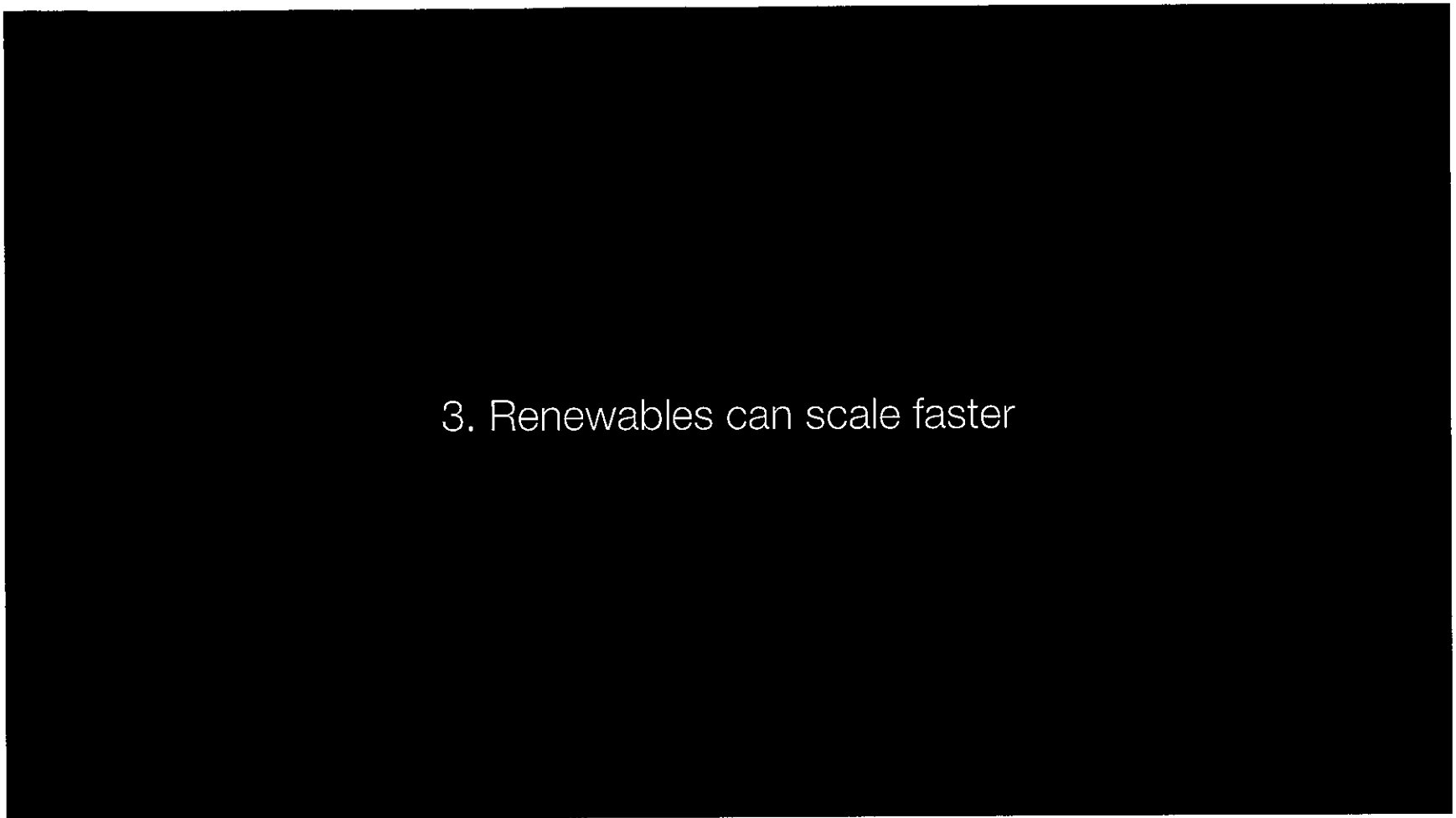
About 98–99% of power failures originate in the grid, so distributed supply that bypasses the grid can boost day-to-day *reliability*. Denmark has nearly completed its transition from centralized power stations, mainly burning coal, to distributed wind turbines (86% owned by farmers and their communities) and cogeneration (often burning agricultural wastes). Partly in consequence, Denmark has Europe's most reliable power, slightly ahead of Germany's and about ten times more reliable than America's.

Denmark is also reorganizing its grid in a highly *resilient* "cellular" architecture that makes cascading blackouts impossible. A similar approach reduced Cuba's serious blackout days from 224 in 2005 to zero in 2007, and sustained vital services the next year when two hurricanes in two weeks shredded the eastern grid.

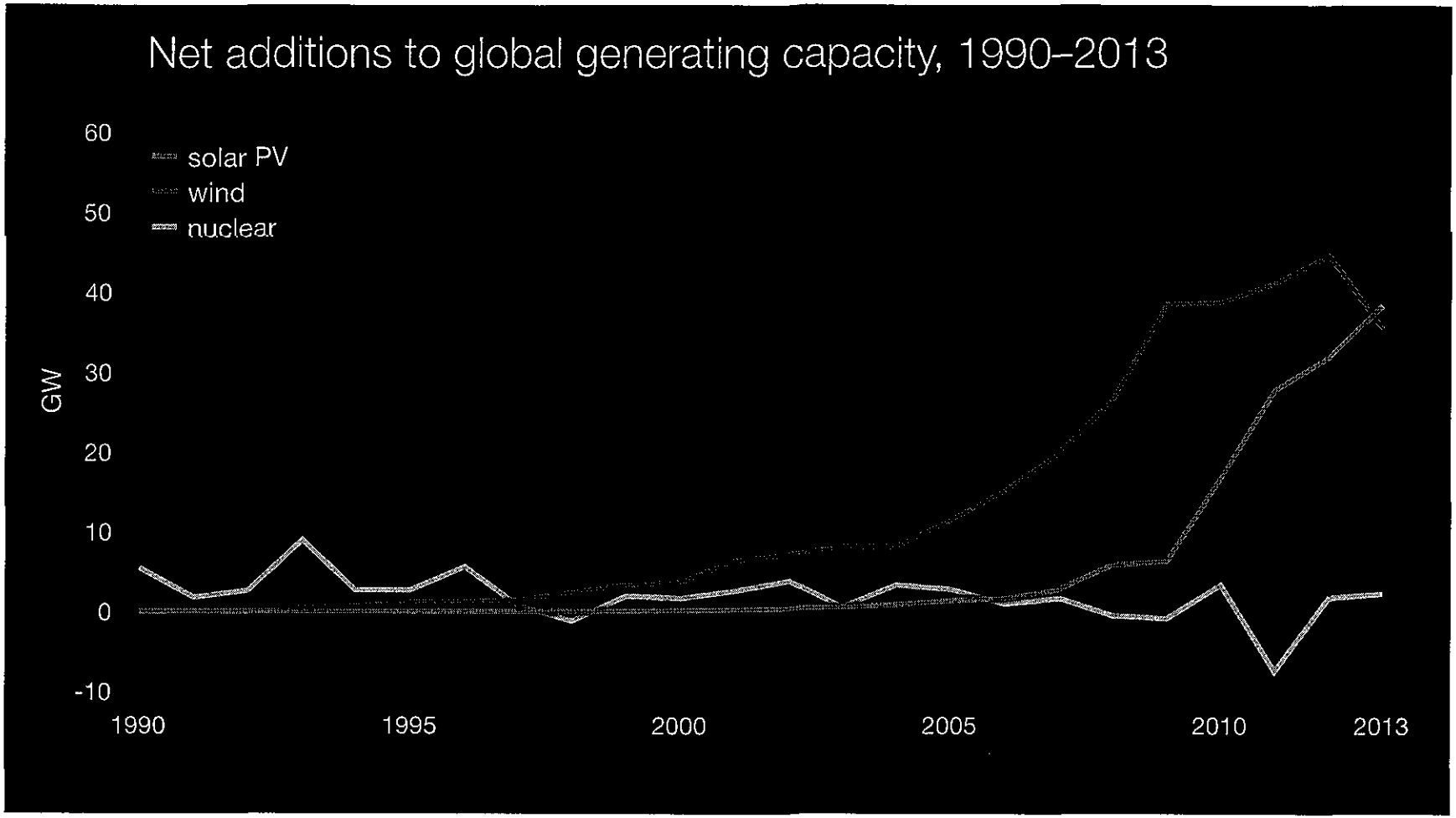
Slow post-scram restart, drought, heat, etc. can make even nuclear fleets unreliable



In contrast, the normally reliable nuclear fleet's occasionally unresilient behavior is illustrated by Fukushima Daiichi (and four years earlier by the earthquake that shut down the the world's largest nuclear plant, the 7-unit Kashiwazaki-Kariwa complex, some of which is still down); by mass deratings and shutdowns in U.S. and European droughts and heat waves; and by the Northeast Blackout in 2003. As shown here, nine U.S. reactors, running perfectly, automatically scrammed for safety, but then took 12 days to regain full power, and in the first few days, produced practically nothing because xenon and samarium poisoning robbed the reactivity needed for restart with stable and homogeneous neutron flux. This "anti-peaker" attribute of being assuredly unavailable when most needed has no parallel in diversified portfolios of modern renewables. *



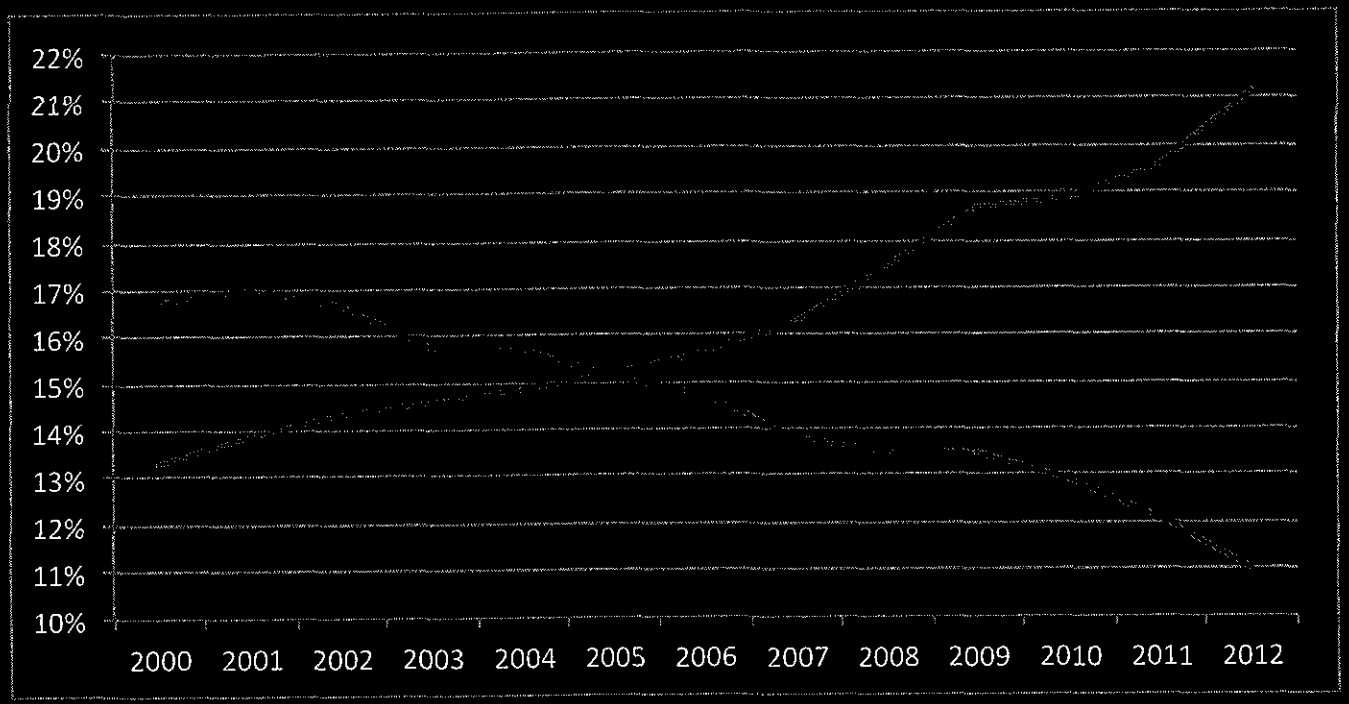
Next, let's examine recent claims that only nuclear power can scale up fast enough to meet global electricity needs, or protect the climate timely, or both. The data show the opposite. *



Worldwide, starting in 2008, half of all new generating capacity has been renewable. This graph shows the amount of * wind and * photovoltaic generating capacity *added* worldwide in each year. In 2012, renewables were 49% of new U.S. and 69% of new European capacity, so America now has more solar jobs than coal or steel jobs. Also in 2012, China generated more windpower than nuclear power, and more new electricity from non-hydro renewables than from fossil fuels plus nuclear power. In 2013, China added more photovoltaic capacity than the U.S. *has*.

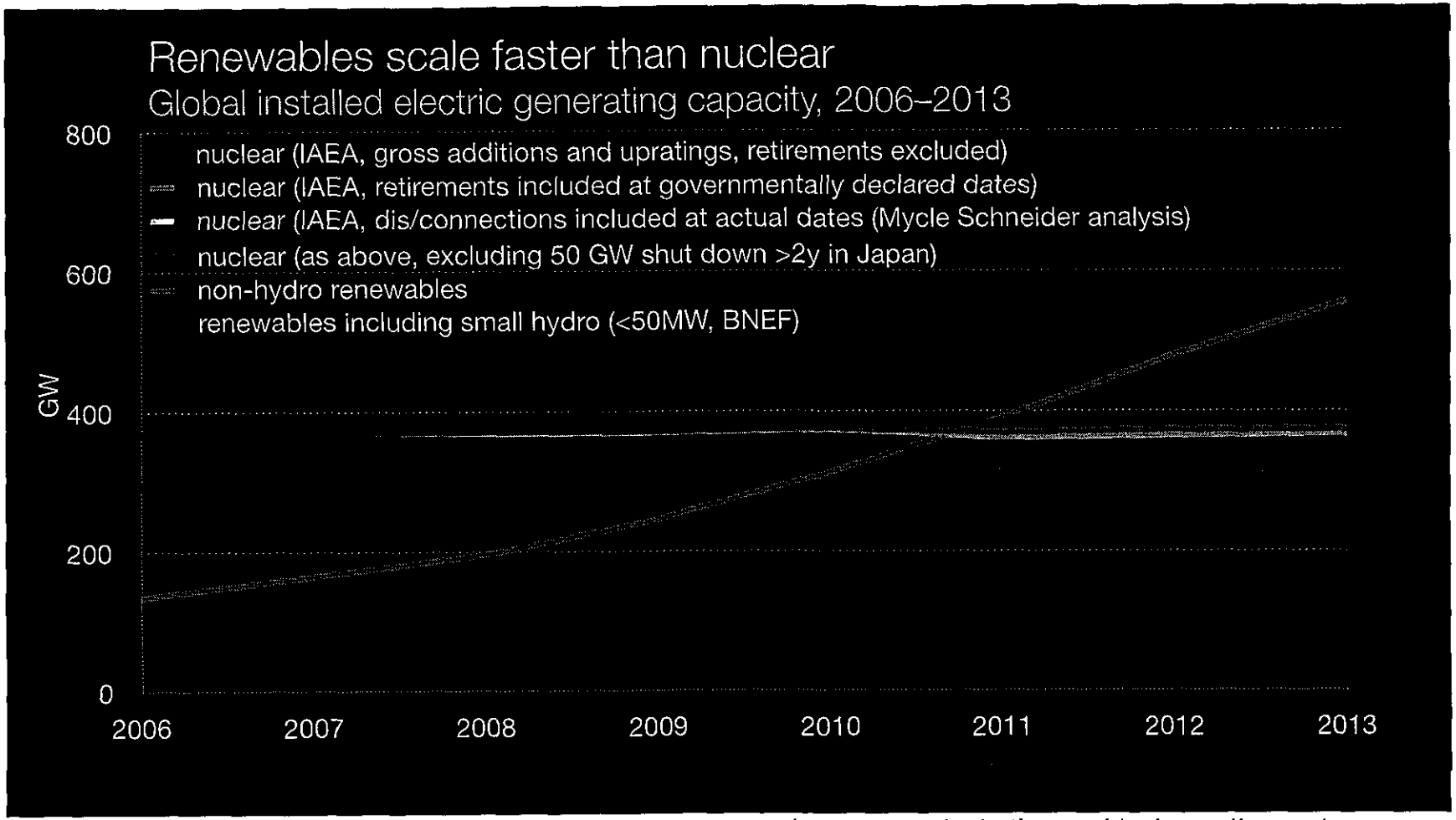
In *each* of the past three years, these modern renewables got a quarter-trillion dollars of global private investment and added >80 GW. In 2011 (or 2008 if we include small hydro) they surpassed the total global installed capacity of nuclear power, whose dwindling annual net additions, as I noted earlier, * had turned negative even before Fukushima. In contrast, global orders for nuclear *and* coal plants keep fading because they *cost* too much and have too much *financial risk* to attract investors. Gas-plant investments held up better, but only because most buyers foolishly bet on the gas's bare commodity spot price without including the market value of gas's price volatility, which roughly doubles its risk-adjusted price. *

Nuclear and micropower generation have more than swapped roles, reflecting market perceptions of their relative costs and risks ("micropower" = cogeneration + renewables – big hydro)

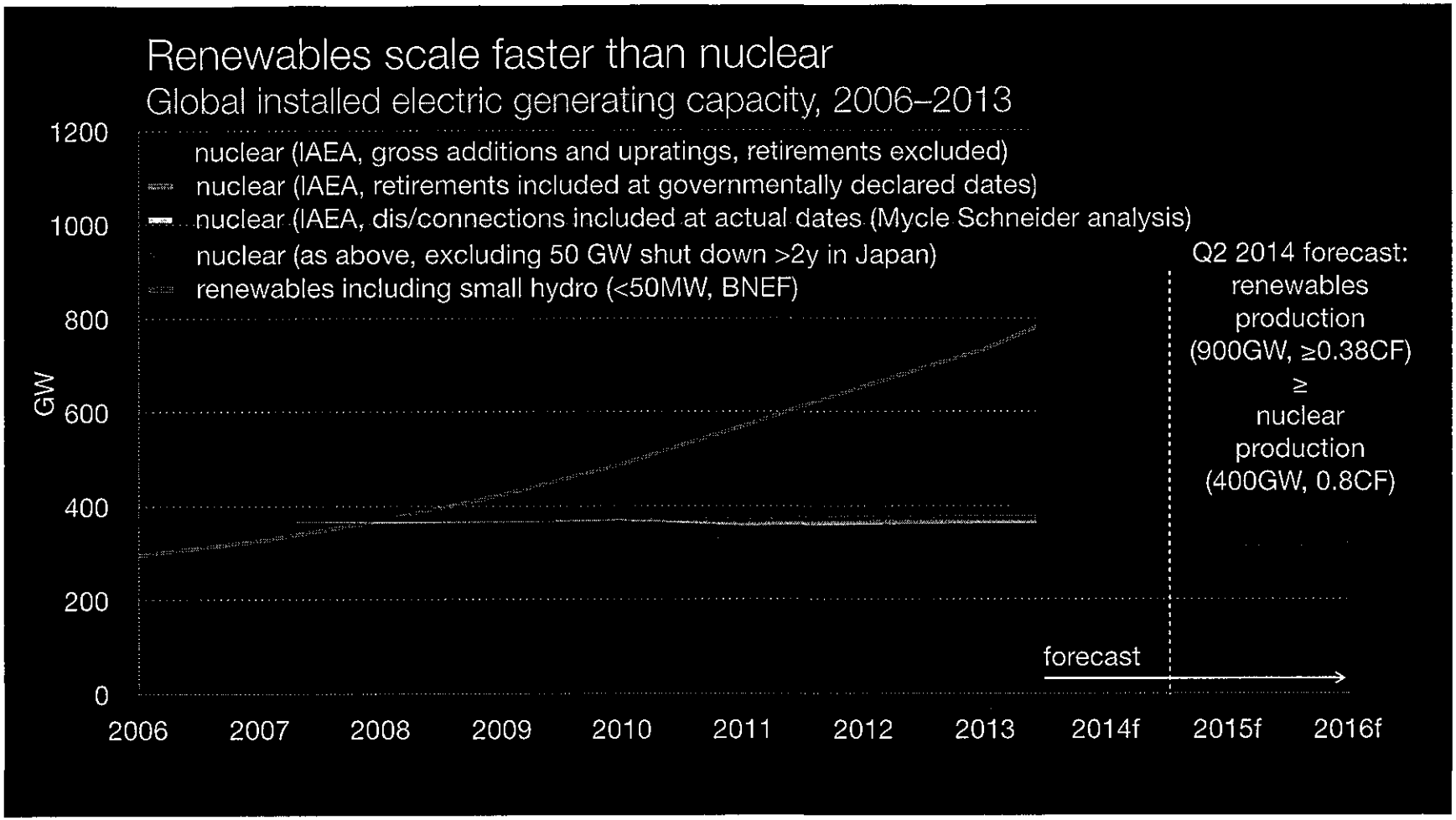


Sources: nuclear and total: BP Statistical Review of World Energy 2013; micropower: RMI detailed bottom-up analysis from industry sources (www.rmi.org/rmi/Library/2010-06_MicropowerDatabase). BP generation data are gross, renewables generally net (understating their relative share).

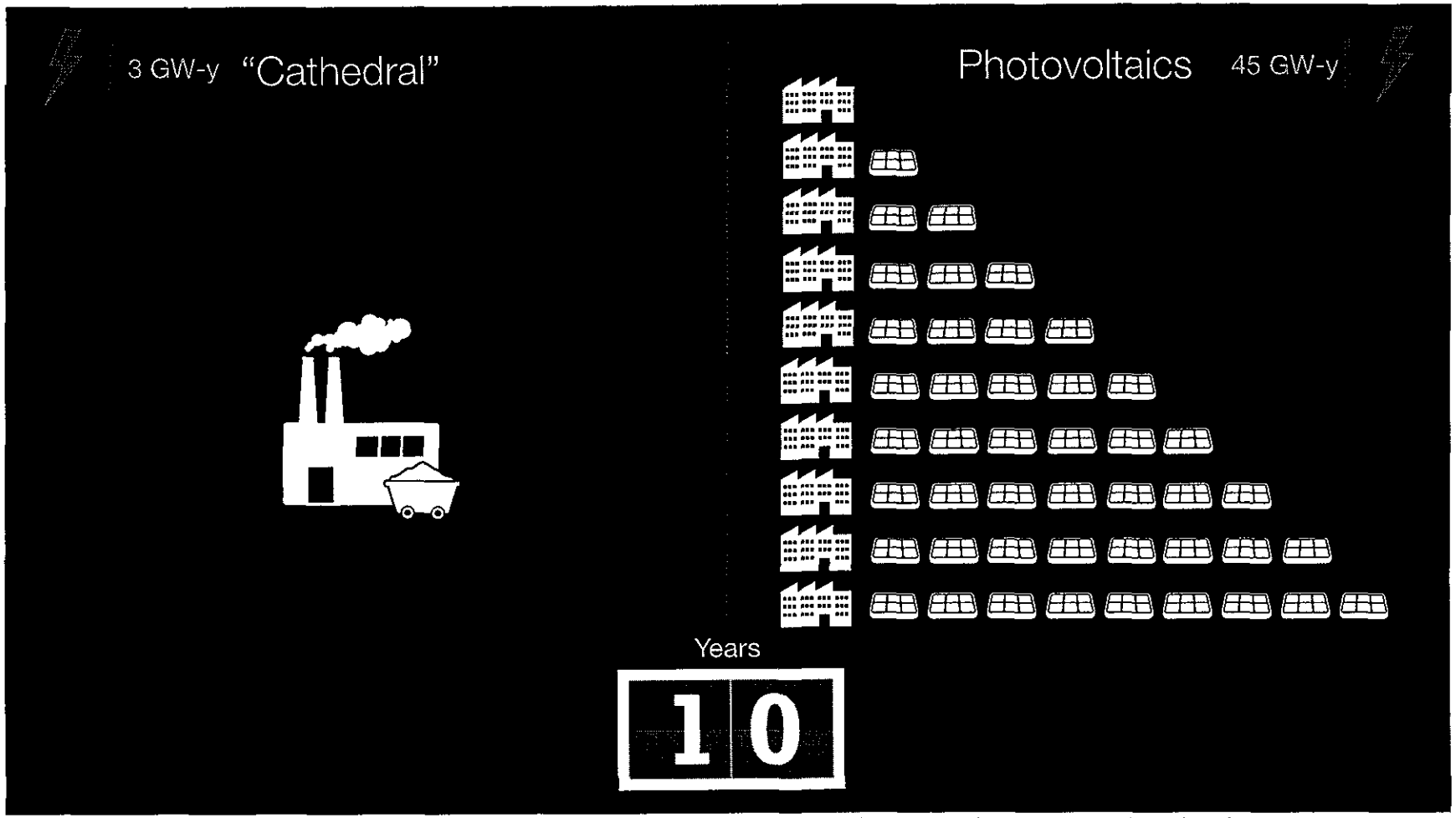
Cogenerating electricity with useful heat is another big competitor to central stations. Cogeneration combines with a smaller amount of renewables, excluding big hydro, to make up the "micropower" (as *The Economist* magazine calls it) that since 2000 has more than swapped its share of global electricity generation with nuclear power. Due to sparse and heterogeneous data, I won't further analyze cogeneration here, but that's a major conservatism, because it's already outproducing nuclear power, has a strong business case, continues rapid growth, and is low- to no-carbon depending on its heat source.



Definitions of * installed nuclear capacity depend on uprates and rerates, on * whether and * when retirements are counted, and on whether one assumes, as the * IAEA optimistically does, that all ~50 GW of Japanese capacity that's been shut down for over two years will return to service even though their owners think at least ~30 GW won't. But under all definitions, nuclear capacity has at best held steady over the past seven years, while * renewables excluding big hydro have tripled their capacity. The average kilowatt of nuclear capacity produces about twice as much annual electricity as the average kilowatt of renewable capacity (excluding big hydro), but based on these global trends...*

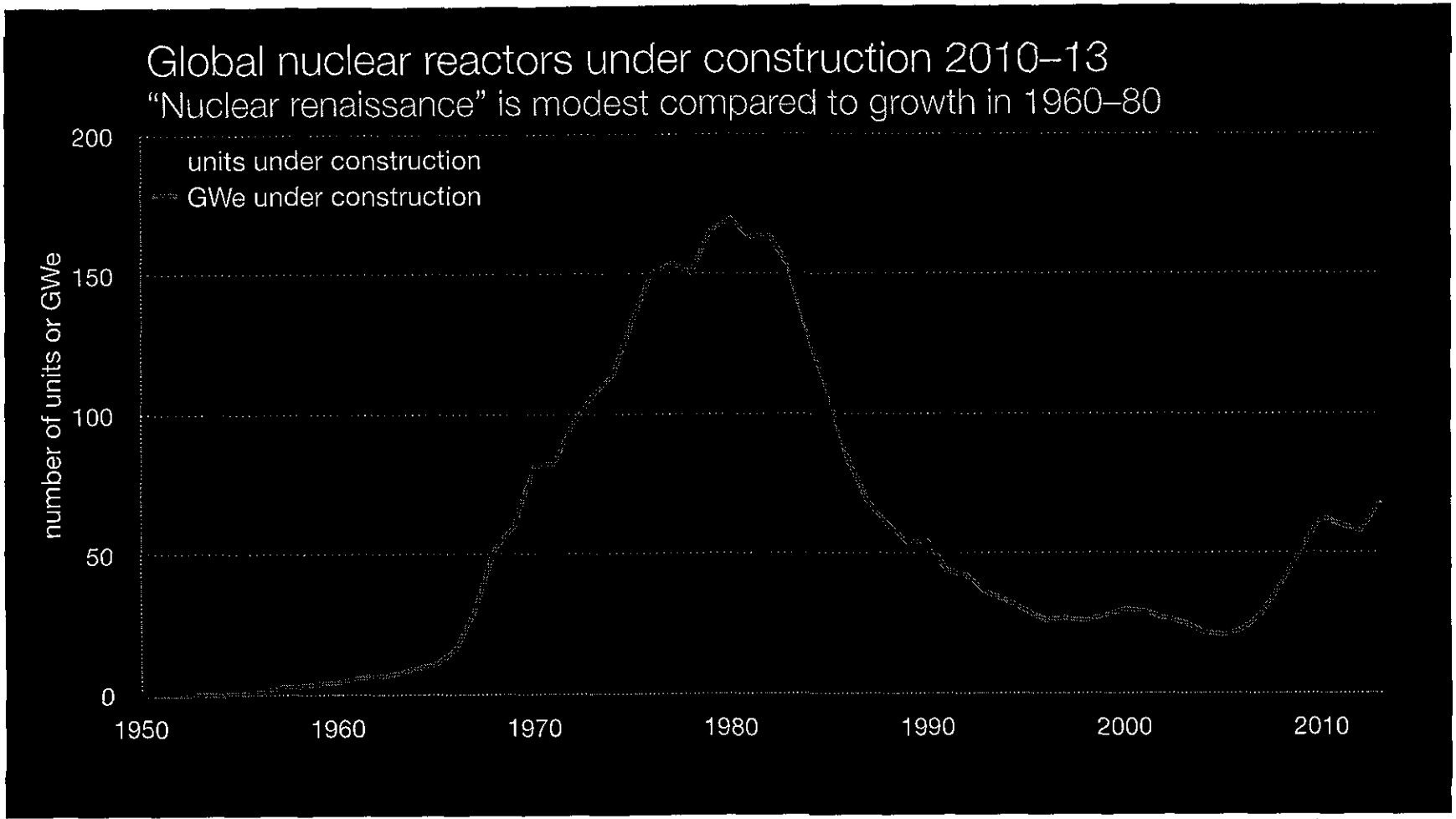


... those renewables, which the nuclear industry doesn't even acknowledge as a serious competitor, should surpass its own annual electricity production sometime during 2014.



[animation plays for 17s] This is happening because mass-produced renewables *scale up in a fundamentally different way*. Traditionally, we built giant cathedral-like power plants, each costing billions of dollars and taking many years to license and build—9.4 years for the average nuclear plant in the past decade [through July 2013]. But now approximately *each* year, you can build a factory that produces *each year thereafter* enough solar cells to generate *each year thereafter* as much electricity as your "cathedral" ultimately will. So solar output scales up incredibly quickly. Photovoltaics worldwide are scaling faster than cellphones.

Indeed, modular, short-lead-time technologies accessible to many market actors can add more total capacity sooner than big, long-lead-time technologies requiring specialized institutions. RMI's motto is "'In God we trust'; all others bring data." So here are the data....*



Since * 1950, the nuclear units * (blue) and capacity * (green) that the IAEA lists as "under construction" worldwide have peaked, declined, and modestly rebounded. The 72 units so listed [as of 22 March 2014]—including about a half-dozen listed for >20 years—are 68% in four centrally planned and rather untransparent power systems (China, Russia, India, and Korea), often building designs with unknown Western licensability. Another five U.S. units enjoy special nonmarket conditions. Ten other countries have one or two units each. Many of these 72 under-construction units are late, most have no official startup date, and not a single one was chosen by a competitive or analytic process that fairly compared them with the modern slate of available alternatives.

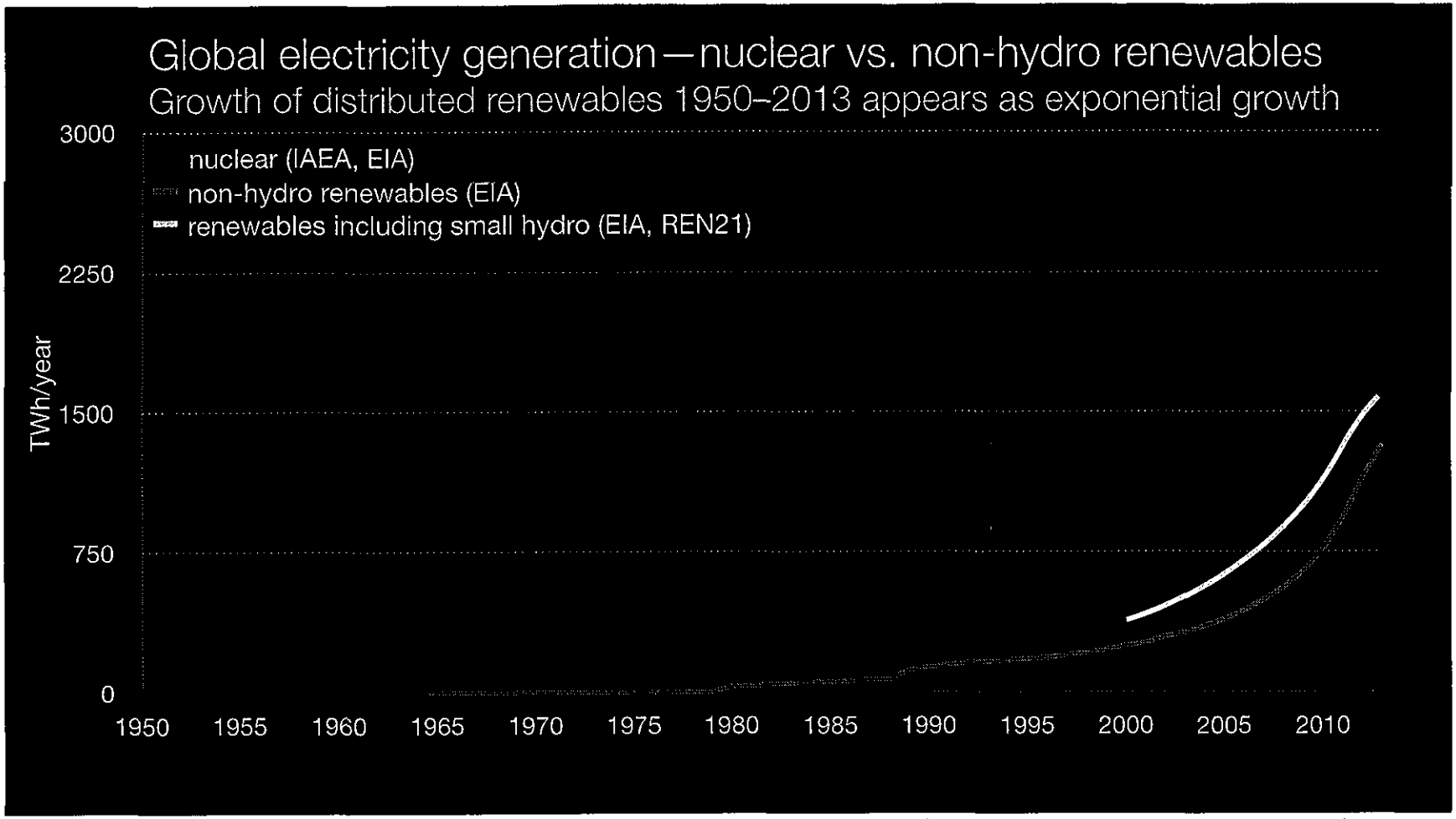
But leaving economics aside and focusing solely on speed, what got built in global nuclear power's most aggressive phase when this under-construction slope was steepest? *

Maximum global capacity (GW_e) ever added to the grid
using April 2014 preliminary Bloomberg New Energy Finance data for 2013

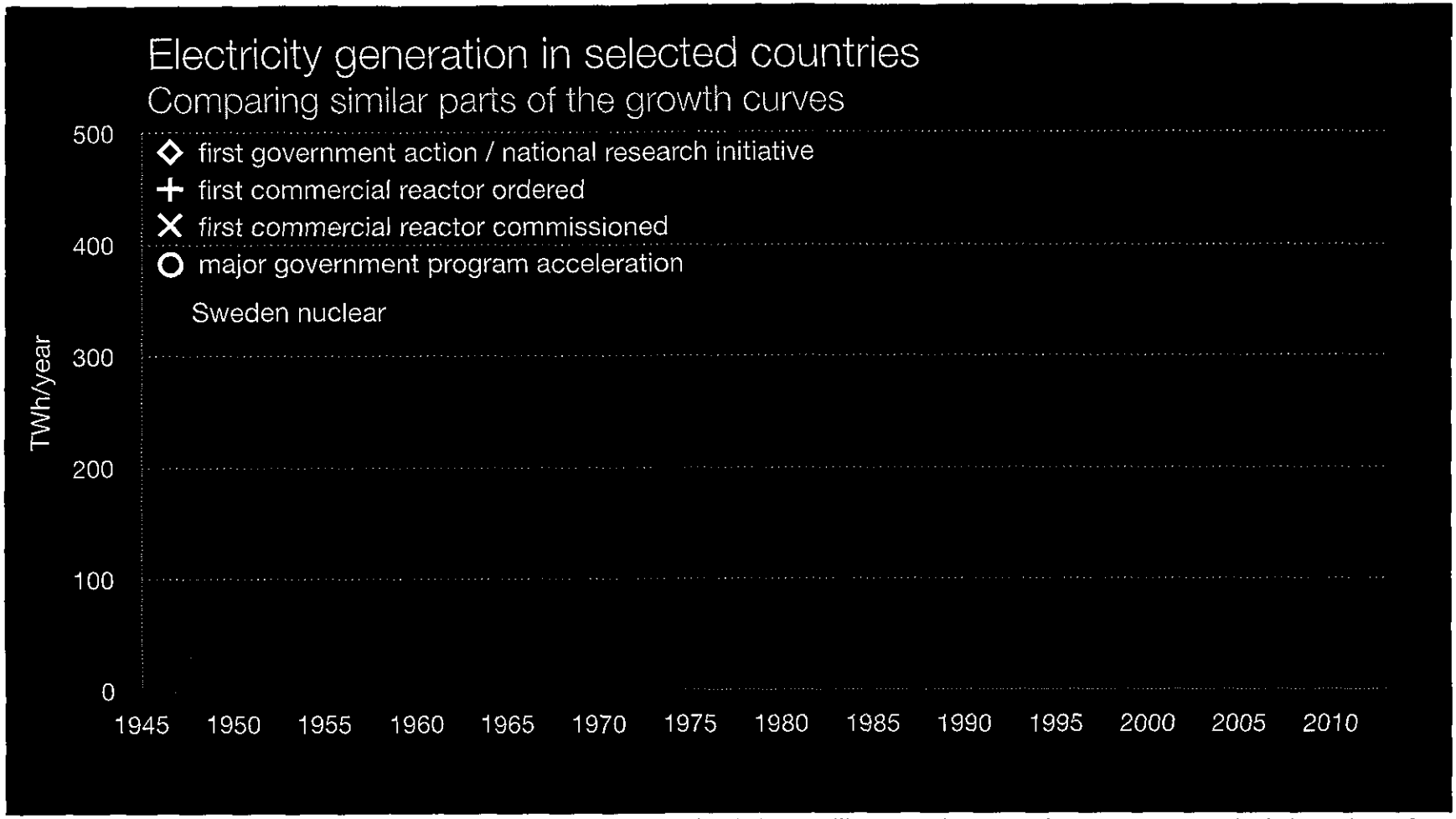
nuclear	during	renewables (including small hydro <50MW)	during	renewable / nuclear ratio
31.8	1985	88	2012	2.77
91.8	1984–86	251	2012–14	2.74

Sources: nuclear: N.L. Char & B.J. Csik, *IAEA Bull.* 3:19–23 (1987), http://www.iaea.org/Publications/Magazines/Bulletin/Bull293/29304781925.pdf; *renewables:* BNEF (Apr 2014 NY Summit). Omitting small hydro reduces additions to 84 GW of renewables in 2012 and 238 GW in 2011–2013.

In the peak year 1985, nearly 32 GW of gross nuclear capacity was added to the grid worldwide. The most successful three–year period, 1984–86, added nearly 92 GW. In contrast, non-hydro renewables added 88 GW in 2012 and 251 GW during 2011–13, adding capacity more than 2.7x as fast as nuclear's all-time high. But average capacity factors are nearer 2.1 than 2.7 times higher for nuclear than for non-big-hydro renewables, which have therefore lately been adding more electrical *output* each year than nuclear power ever did.



Comparing electricity outputs since 1950, we see that the * steepest part of nuclear power's growth curve had a similar slope to * non-hydro renewables' recent growth. But then nuclear growth flattened and reversed as its costs rose for the reasons explained in the '80s, while renewables are growing ever faster as their costs fall for today's equally durable reasons. * If we add the output from small hydro up to 50 MW, we see even stronger growth for all renewables excluding big hydro—which, by the way, is even larger and also growing rapidly, but is omitted here as a conservatism. *



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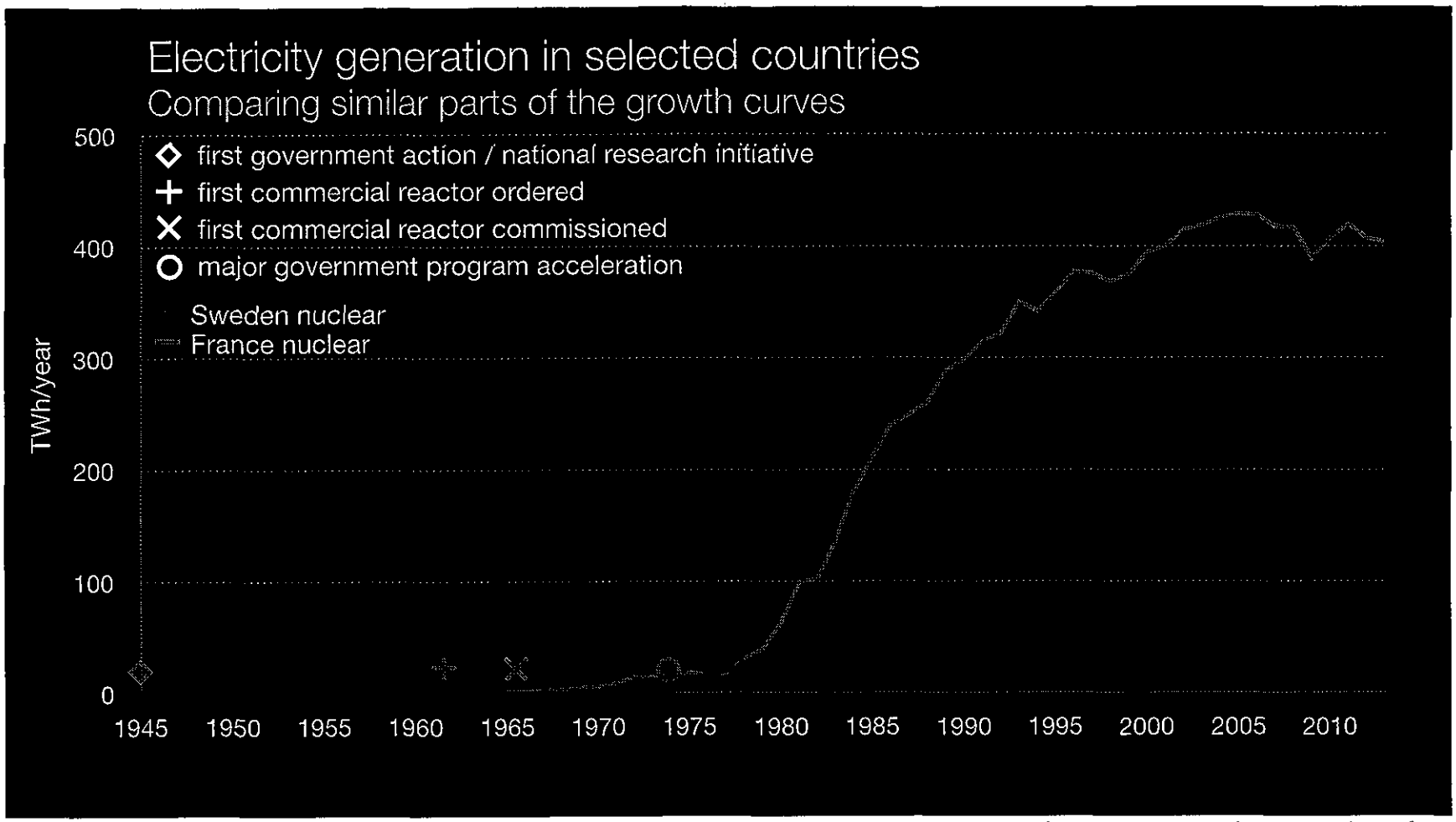
France and China show broadly comparable slopes of electricity production growth for the world's most aggressive nuclear and non-hydro-renewable programs, respectively. Also, Germany's renewables, 25% of electricity consumption last year, already far outproduce Europe's most ambitious nuclear programs except, of course, that of France, whose policy for 40 years was not to maximize competition but to prevent it. *



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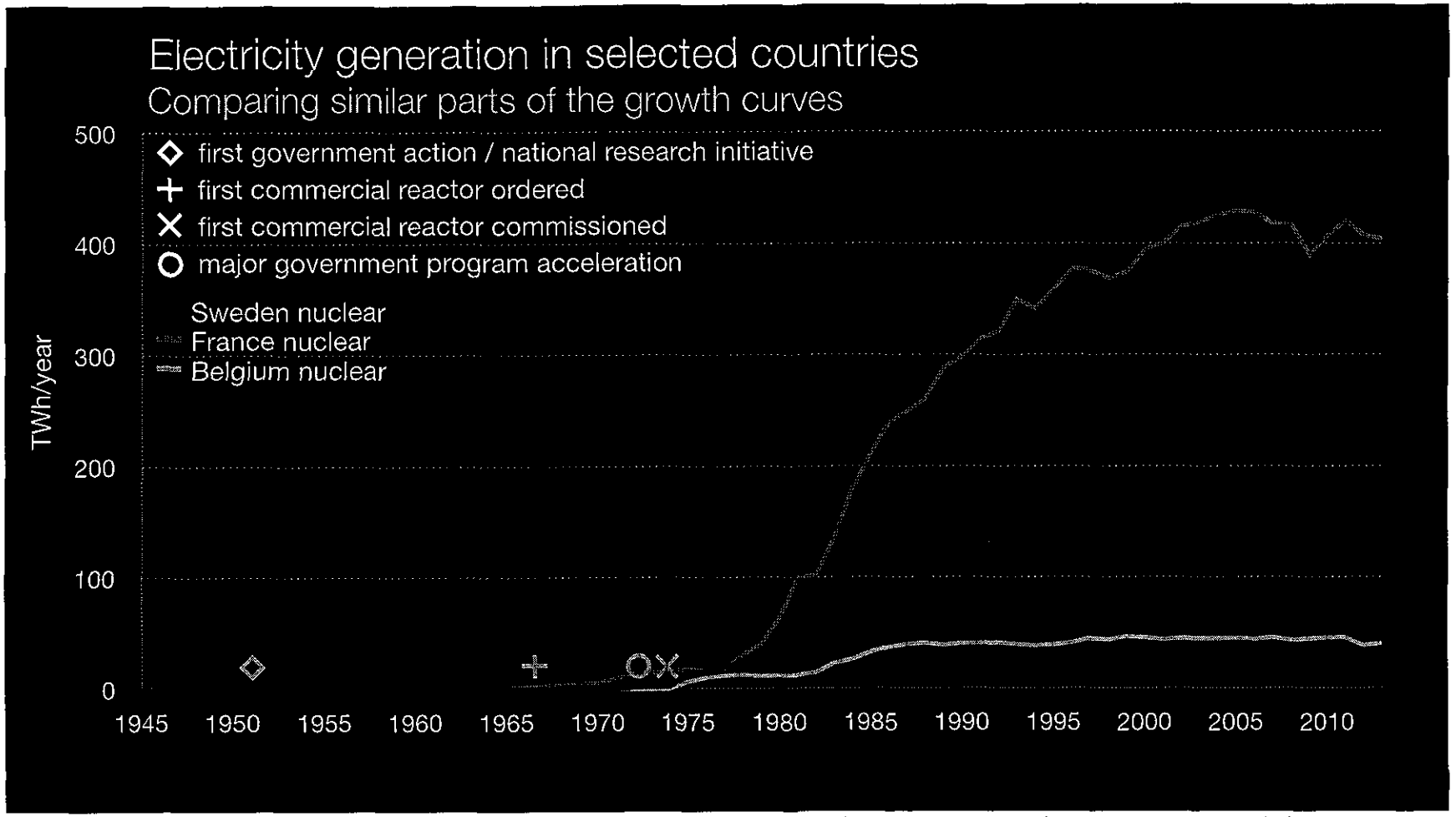

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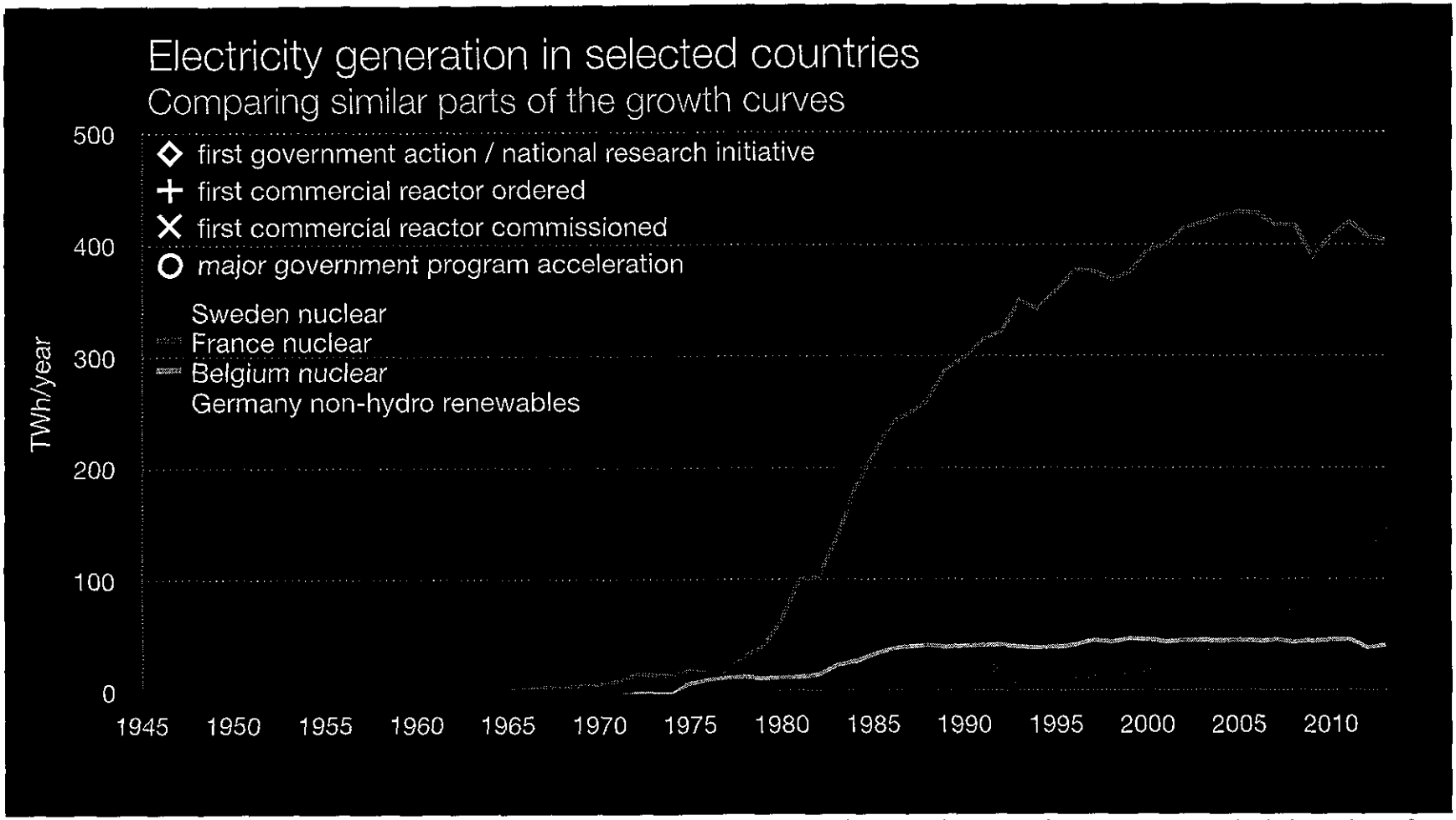

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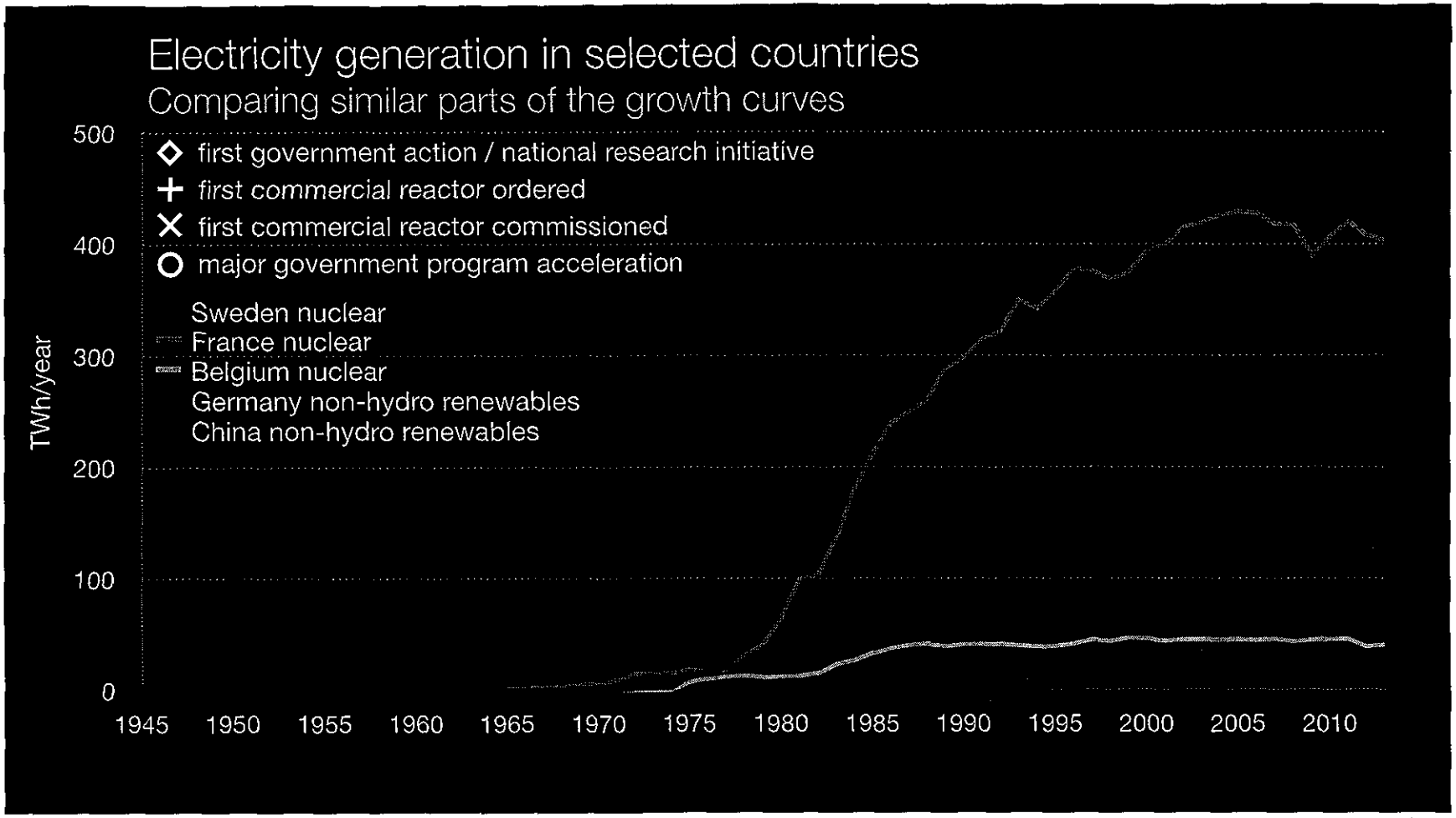

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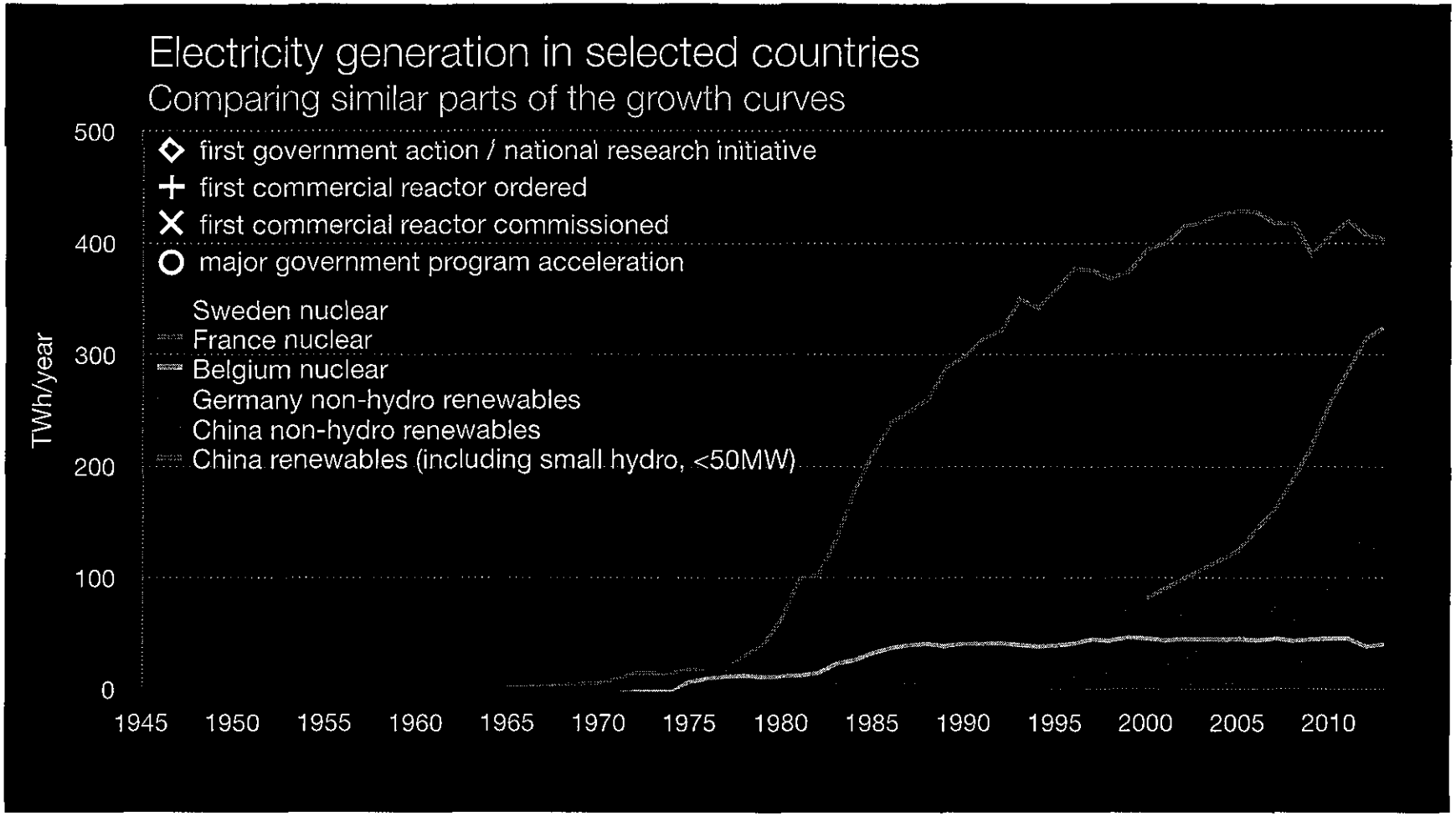

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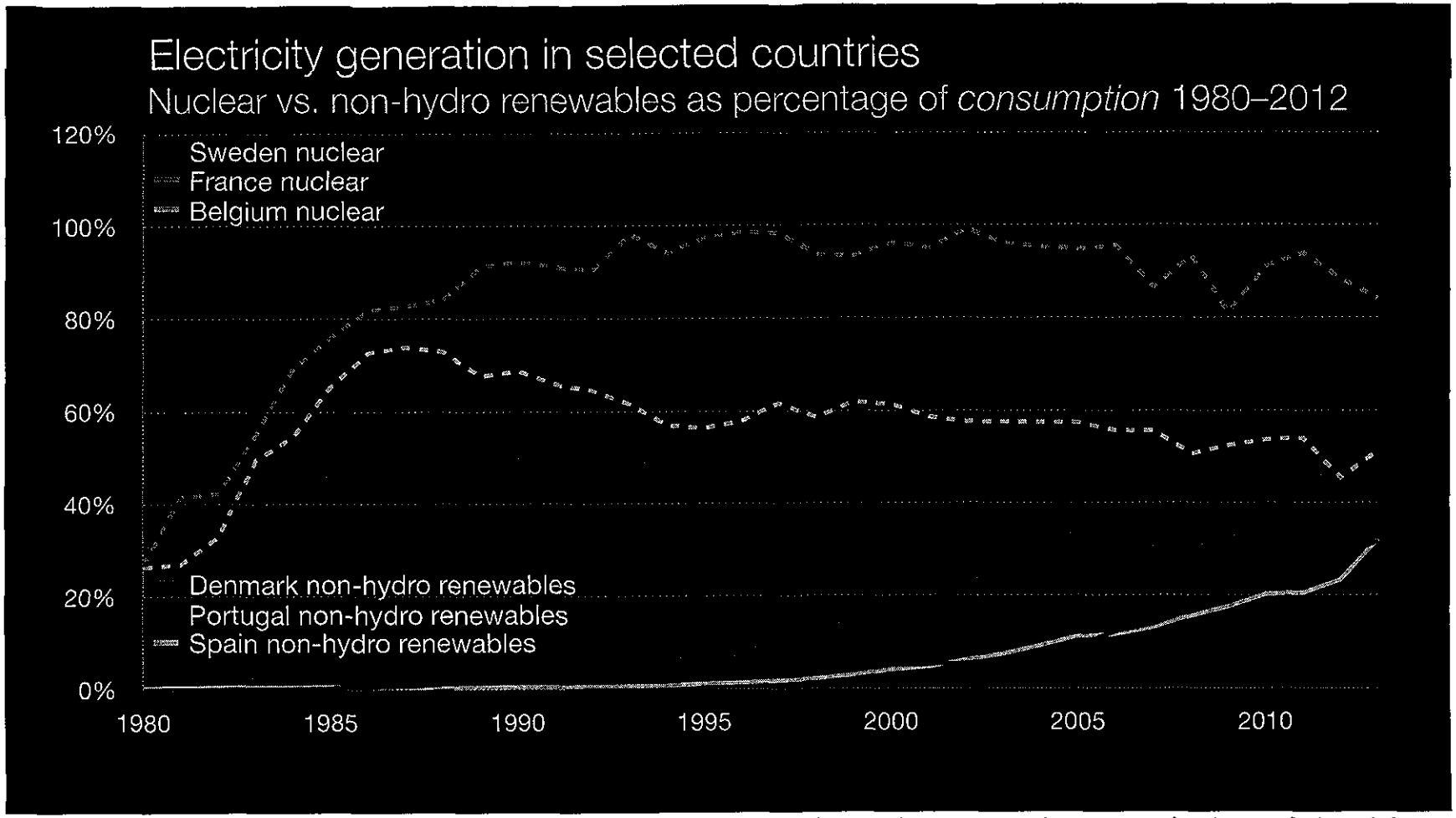
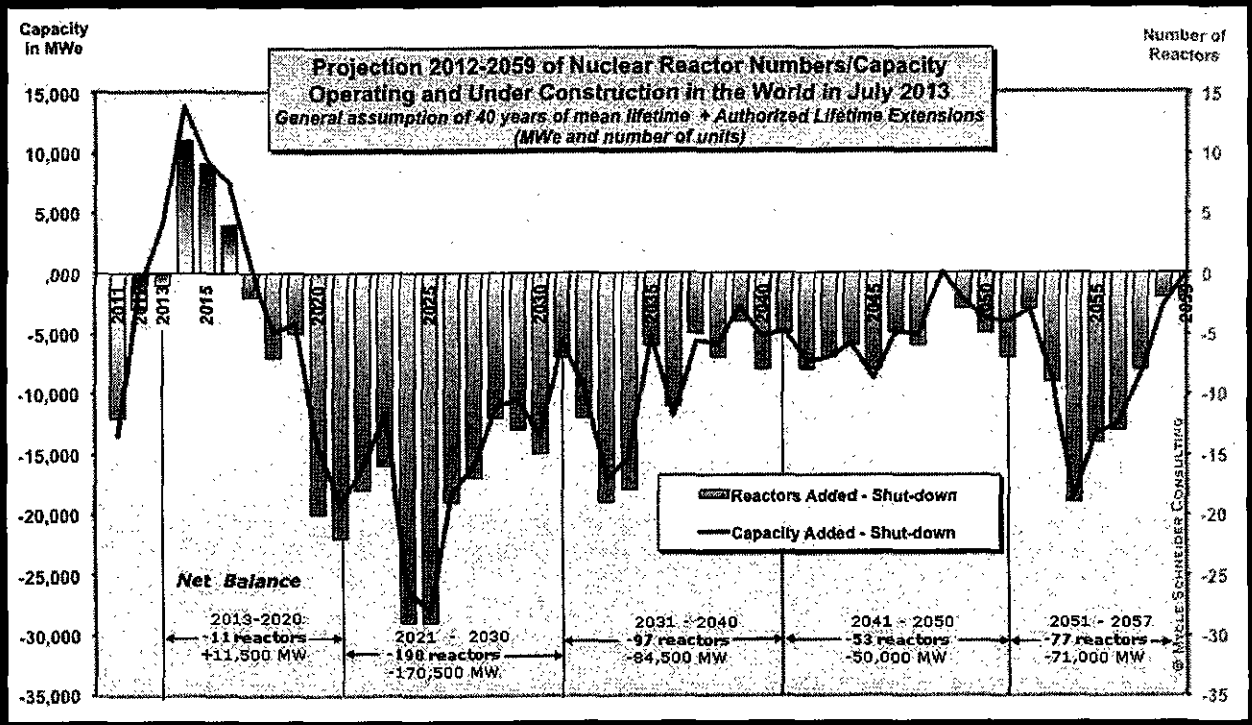


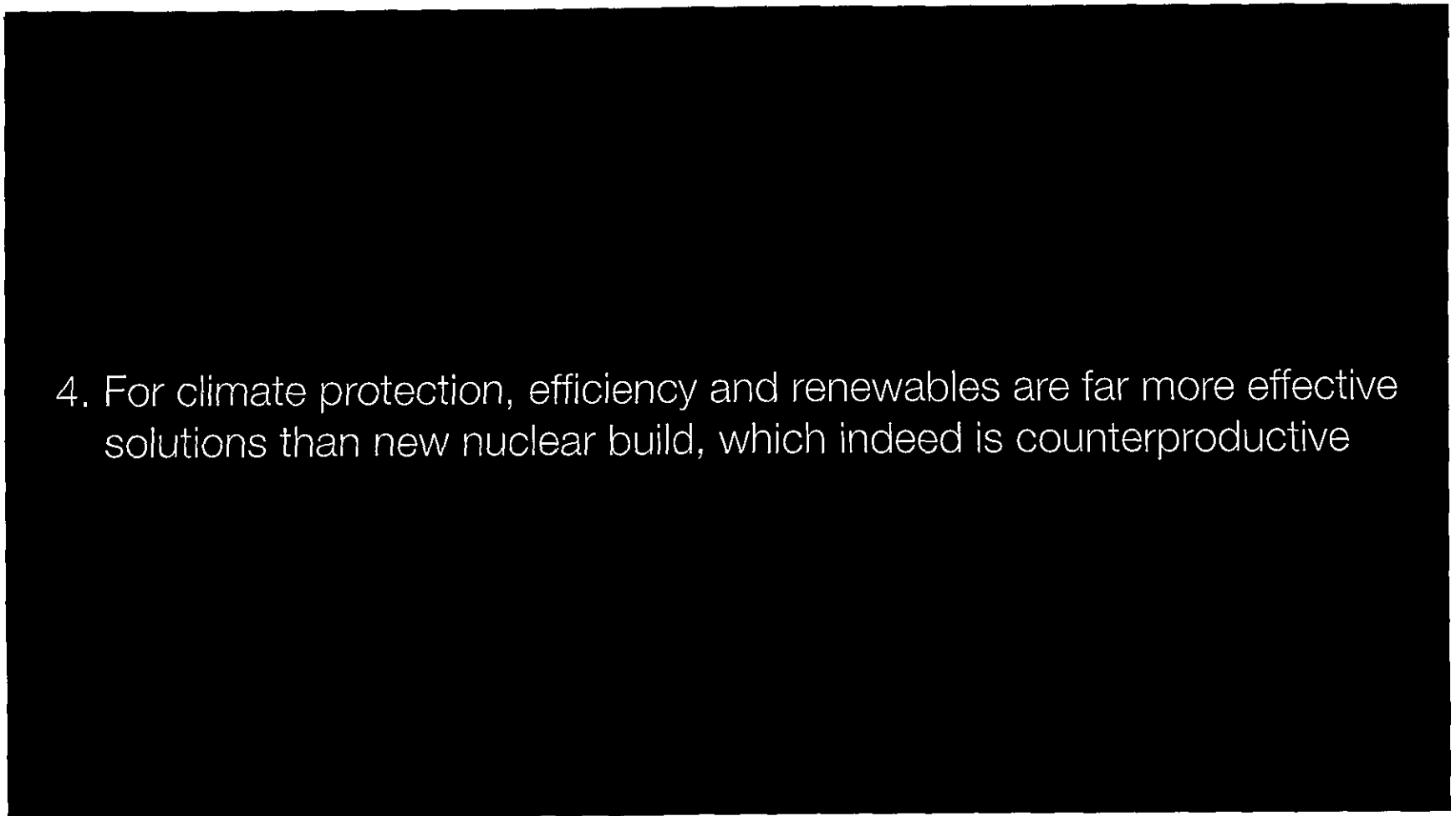
Here's a different lens on these data: after a long windup and initial growth spurt, nuclear power's *share of electricity consumed* in * Sweden, * France, and * Belgium is slipping, while the renewable share in * Denmark, * Portugal, and * Spain is growing to respectable size—even without hydropower, which would bring Portugal to 58% and Spain to 45% in 2013. But all these graphs don't show two other big, competitive, and fast-growing distributed resources: renewables *plus* efficiency *plus* cogeneration, all growing together, are far faster than renewables alone, and together leave any central-station solution in the dust. If we had better negawatt data, we could graph that trifecta. *

Even with all lifetime extensions approved through July 2013, planned global nuclear additions can't offset retirements after 2016

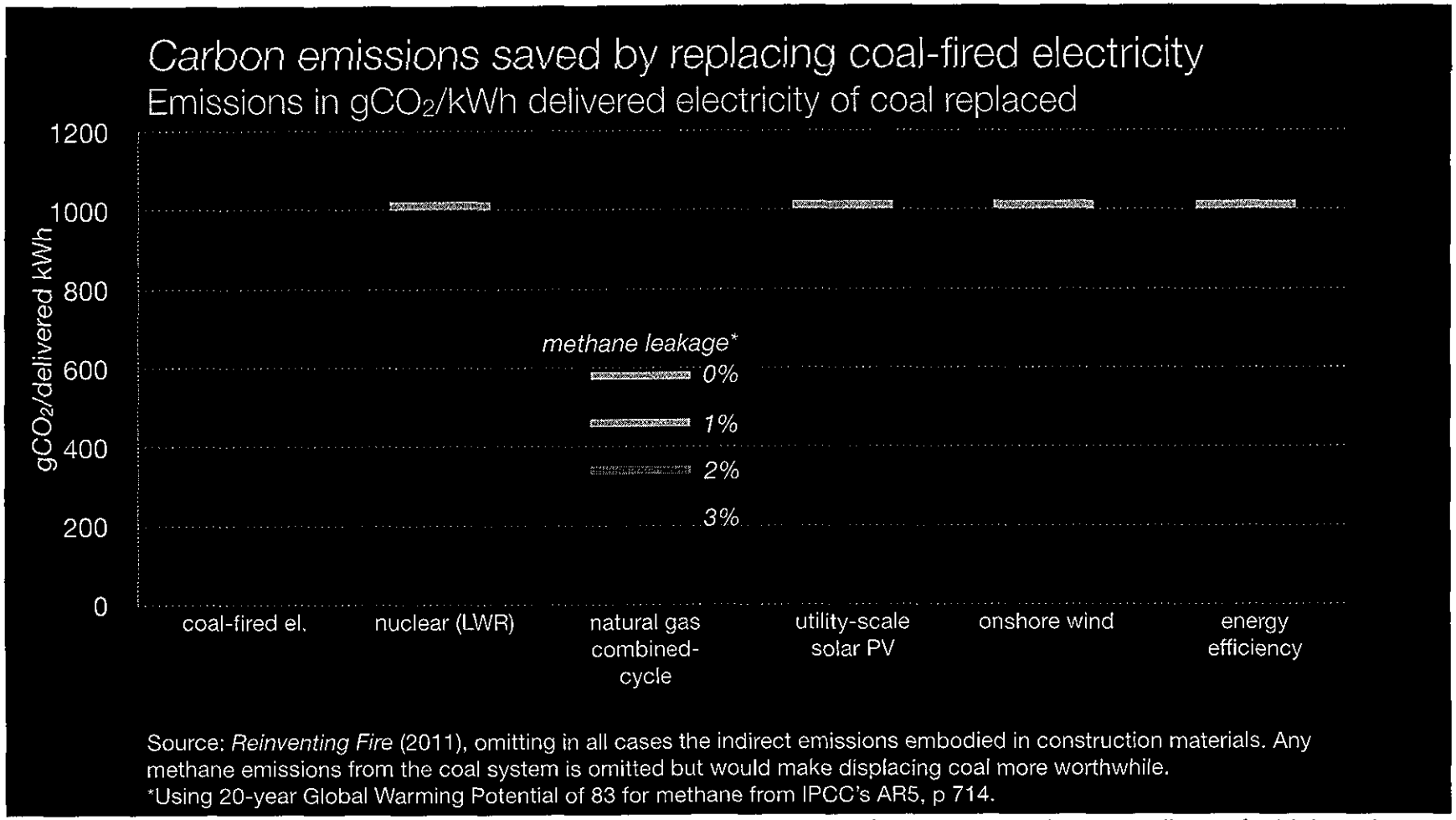


Source: Mycle Schneider *et al.*, *World Nuclear Industry Status Report 2013*, based on IAEA-PRIS data and Schneider's analysis. The graph is based on all Japanese reactors except the 10 Fukushima Daiichi and Daini units' returning to operation—a highly conservative assumption.

Nuclear power also has to run ever faster to stay in the same place as its 1970s and 1980s growth turns into a bulge of retirements. After the next few years, retirements will exceed all planned or conceivable global nuclear additions, even with all license extensions as shown here. Power reactors' terminal decline will be over by about 2060—and in view of both competition and aging, this projection by Mycle Schneider is more likely to overstate its longevity than its brevity. *

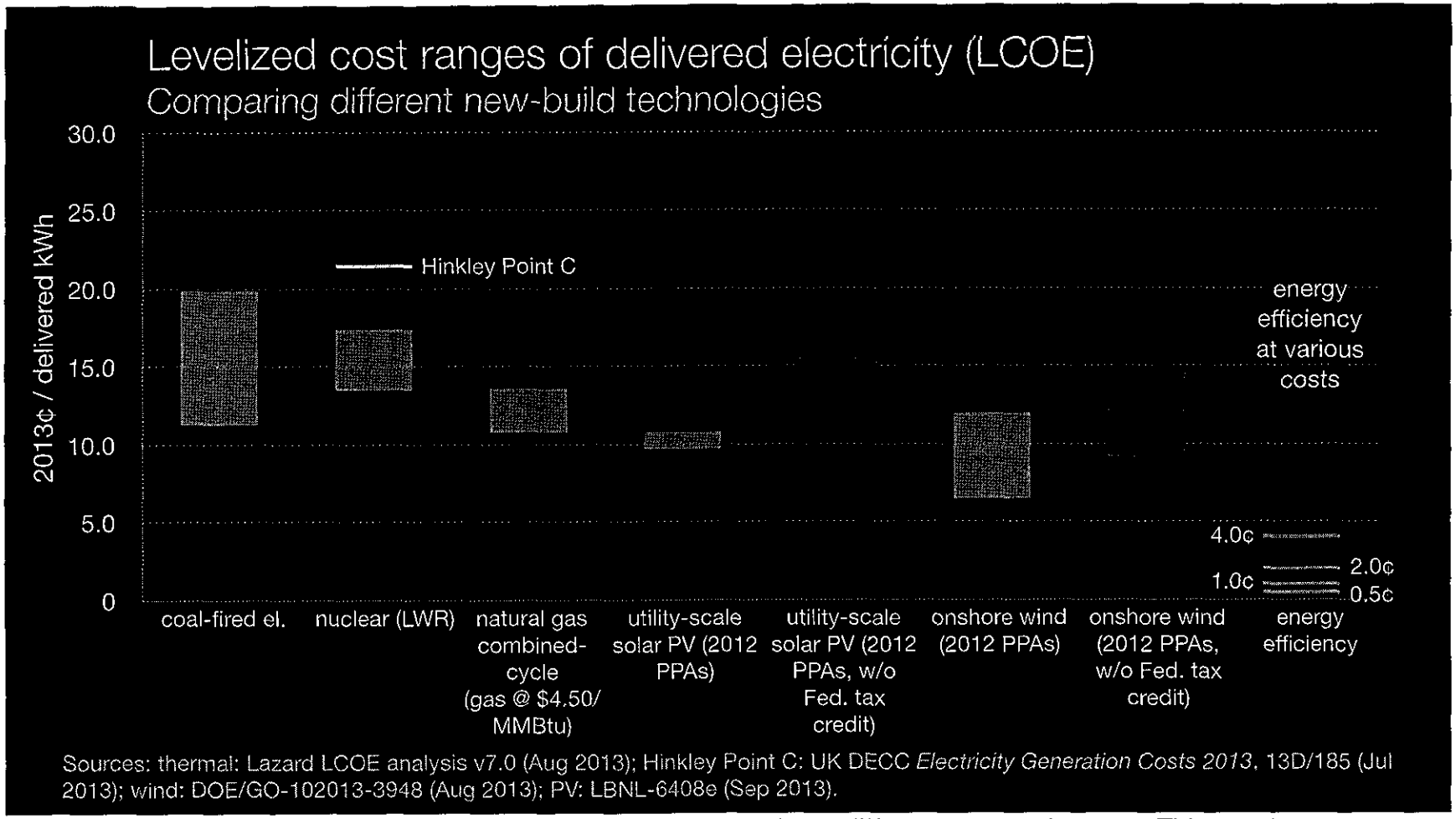


Nuclear power's commercial collapse is actually *good* for climate protection. To explain why, I'll conclude by examining the view almost universally held, even among nuclear critics, that new nuclear build could help protect the earth's climate. My colleagues and I have pointed out for three decades, but the business press has never reported, that this is untrue, for a straightforward reason economists call "opportunity cost." Let me explain. *



Displacing 1 kWh of coal-fired electricity displaces the same amount of carbon emission regardless of which carbon-free substitute is chosen. (Gas-fired generation emits carbon but less than coal-fired generation, so gas plants can also save carbon if not too much * methane leaks.) *

Carbon-free substitutes, whether nuclear or renewable or efficiency, would all be equally advantaged by *pricing* carbon. But they're not all equally *effective* at saving carbon, for two reasons: first, technologies that can be built sooner and scaled up faster will save more carbon over time, and second, technologies that save more carbon per dollar invested will buy more solution.

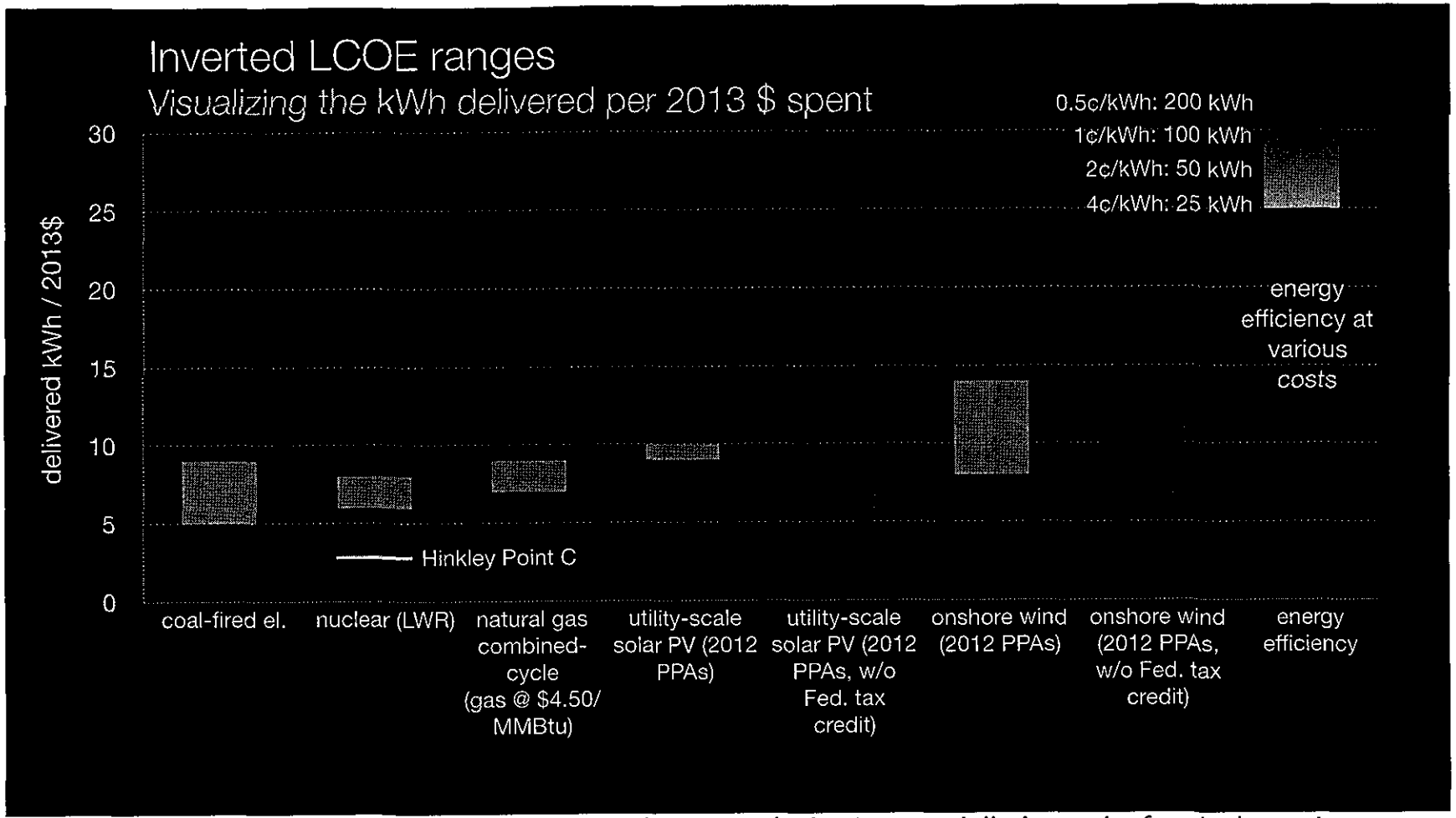


Different ways of displacing delivered coal-fired electricity also have different economic costs. This graph compares a range of current costs of delivered electricity, using Lazard's conservatively low estimates for thermal plants—especially nuclear, where the latest reality check is the market price for the proposed new British nuclear station (after subsidies that the EU says may cost more than the plant). Farther to the right are the 2013 market prices for U.S. solar and windpower, shown in blue with and in red without their temporary federal subsidies—which are generally less than the permanent subsidies received by the big thermal plants shown to their left. And at the far right are placeholders, which I'll fill in momentarily, for the costs of using electricity more efficiently.

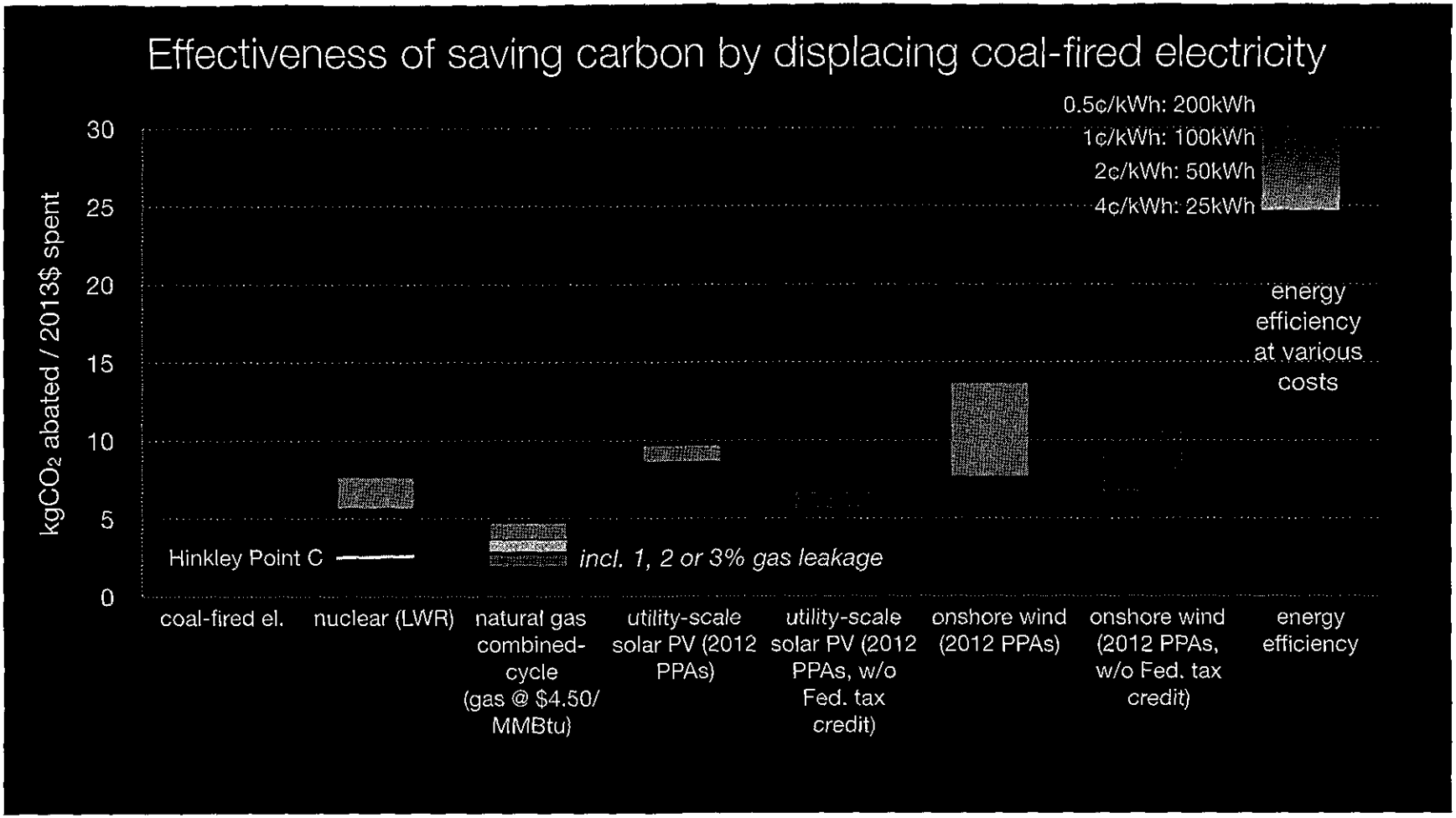
*If we now take the reciprocal of all these ¢/kWh costs of delivered electricity,... **

N.B. Delivered costs include:
Loss factor of 0.9258 for each series but energy efficiency.
T&D costs of 4.26 2013¢
Firming and integration cost of 0.11 2013¢ for coal, nuclear and natural gas and 0.43 2013¢ for wind (none for solar).

Lazard 7 nuclear costs: overnight $3.8–5.2/W, total $5.4–8.2/W, unspecified $, assumed ~2013; Hinkley Point C: total $6–8/W in 2009 $ @ $1.65/£, per p 58, DECC, *Electricity Generation Costs 2013*, 13D/185 (Jul 2013), https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223940/DECC_Electricity_Generation_Costs_for_publication_-_24_07_13.pdf.

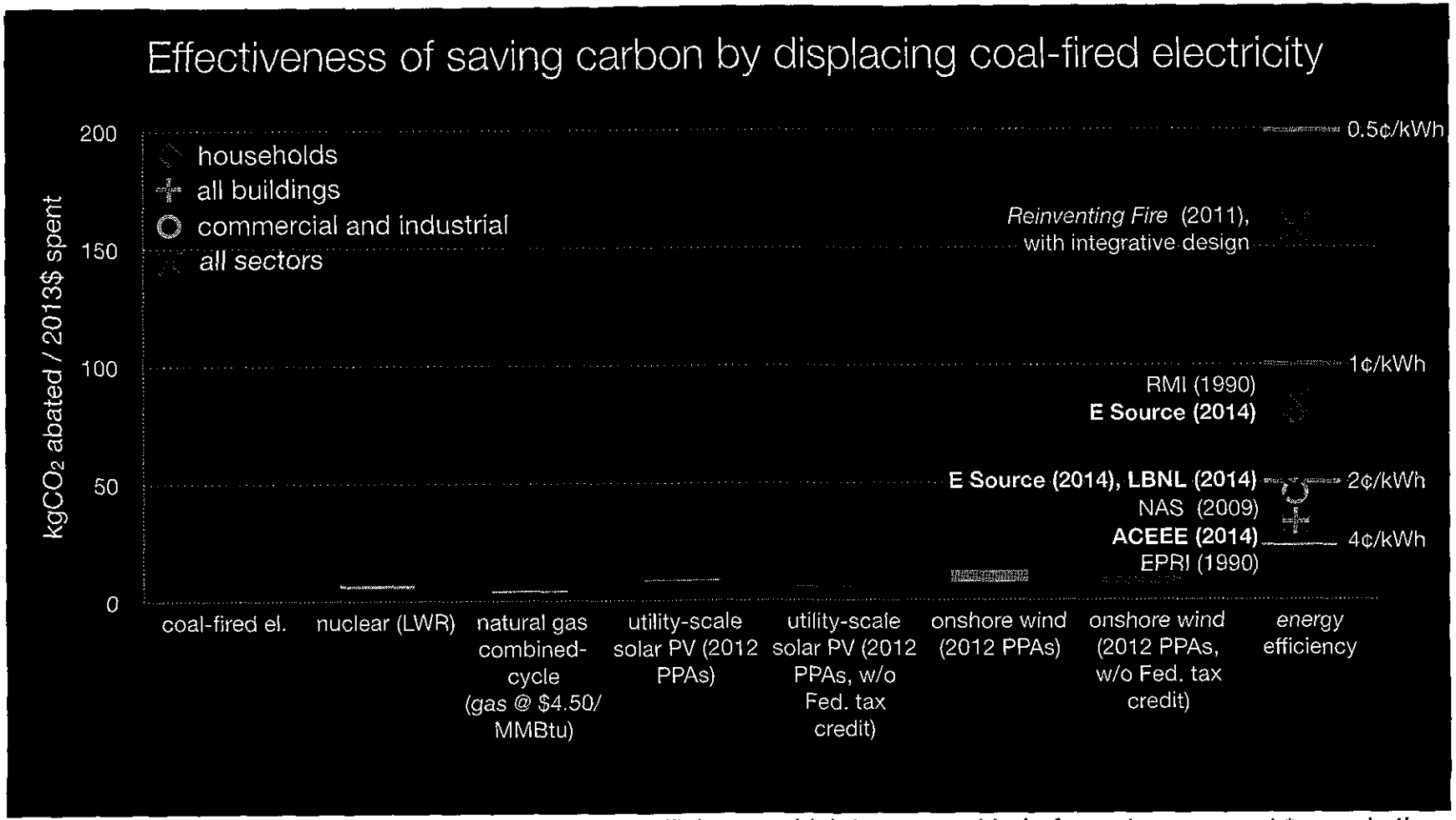


...we get the * number of delivered kWh you can make or save by buying one dollar's worth of each alternative. Now combining this graph with the earlier graph of how much coal-fired carbon each kWh displaces will show how much carbon we can displace by investing a dollar in each alternative. *



Here's the resulting "climate figure of merit" range. New-build * nuclear power's * market price makes it about as cost-effective a carbon-saver as a new combined-cycle gas plant with * 1½% gas leakage, or about 3–5x worse than new solar or windpower in good U.S. sites. Cogeneration, not shown, ranges from about 4x better than nuclear if it's gas-fired and in buildings (but less with methane leakage) to about 10x better than nuclear (more with methane leakage) if run on industrial waste heat.

Thus as the costliest option, new nuclear build is the least effective supply-side carbon-saver per dollar—and also per year, because it's slower than its cheaper competitors. *

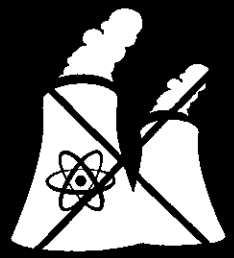


But to compare the costs of the * best buy—energy efficiency, which beats any kind of supply—we must * rescale the whole graph by sixfold. Here are recent data on efficiency's costs. Measured large-scale utility program costs are listed in boldface. In lightface are some detailed, empirically based analyses of the average cost of saving far more electricity than all U.S. reactors make. Either way, efficiency is clearly cheaper than average nuclear *operating* costs, which exceed 4¢/kWh at the busbar and 8¢ delivered. Thus overall, for saving coal plants' carbon emissions, efficiency is about 10–50x more cost-effective than new nuclear build—or about 2–12x more cost-effective than just *operating* the average U.S. nuclear plant.

Thus new-build nuclear power is...

- ... not an effective means of climate protection, which it actually reduces and retards compared to buying more effective options instead
- ... not needed for a reliable grid largely or wholly renewably powered
- ... unable to scale faster than its carbon-free competitors
- ... incapable of saving money or supporting a reasoned business case—especially if one understands what its real competitors are

So why build it?



So whether you choose efficiency, cogeneration, or renewables, just being nearly carbon-free does * not make new nuclear build an effective climate solution. Rather, because it saves ~3–50x less carbon per dollar than its main competitors, and deploys slower, new nuclear build *reduces and retards* climate protection. If climate is a problem, we must invest judiciously, not indiscriminately, to get the most solution per dollar and per year. Anything less makes the problem worse.

Nor do we need nuclear power to * offset PVs' and windpower's variability, or to * scale faster than renewables, or to * save or make money, because, as we've seen, nuclear power cannot do any of these things. So * there is no reason to build more nuclear plants. Capital markets, seeing big new costs and risks without offsetting benefits, * long ago reached the same conclusion.

Existing nuclear plants, a future idea whose time has passed, will simply retire; the only choice is how quickly and at what cost to whom. End of story.

America's Largest Grid Operator: Massive Renewables Push Won't Be a Problem

NRDC's John Moore looks at why PJM is bullish on the feasibility of renewables integration.

John Moore

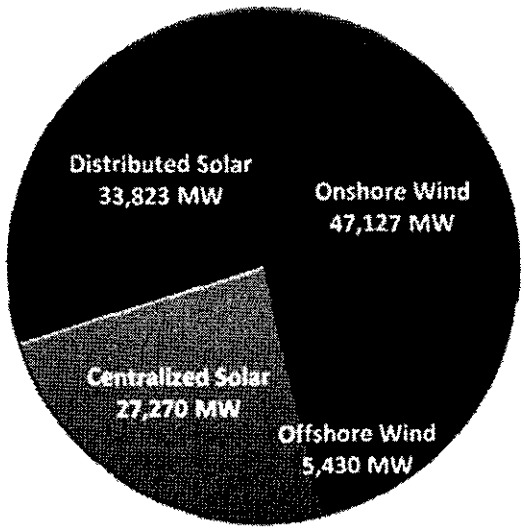
March 17, 2014

PJM Interconnection, the nation's largest power transmission grid organization, announced recently that wind and solar power could generate about 30 percent of PJM's total electricity for its territory covering the Mid-Atlantic region and part of the Midwest by 2026 without "any significant issues."

That's engineer-speak for "no big deal." Even better, we would see more clean power at less cost and with far less pollution than our current mix of coal and natural gas power plants.

PJM's new renewables integration report, prepared by General Electric, is required reading for anyone who questions the ability of the electric grid to handle large amounts of wind, solar and other renewable energy. GE estimates that about 113,000 megawatts of installed wind and solar power resources (including distributed/generation), could produce about 30 percent of the region's total energy. That's enough energy to power 23.5 million homes annually.

Here's the breakdown of the resource mix in one of the scenarios studied in the report:



Significant benefits from more clean energy

The report estimates that 30 percent penetration levels of wind and solar power in PJM territory would bring the following benefits:

- 40 percent less carbon pollution than "business as usual"
- Lower average energy prices across PJM's footprint, because wind and solar would avoid $15.6 billion in coal and natural gas fuel costs
- Very little additional power (only 1500 megawatts) needed to support the minute-to-minute variability of the renewable power
- No additional operating (known as "spinning") reserves needed for backup power
- 44 percent less gas-fired generation and 21 percent less coal-fired generation, which also reduces the amount of carbon pollution emitted into the atmosphere

The benefits derive primarily from several facts: 1) solar and wind power have zero fuel cost, which makes up most of the price of energy; 2) these resources are now commercially available and competitive with other power; 3) they produce zero carbon and other pollution; and 4) PJM's large size across fourteen states significantly reduces the magnitude of weather-caused variations in power output that can occur during the day and night.

What grid changes may be necessary?

Getting all of this additional clean energy will require more transmission lines, which PJM's study estimated would cost $8 billion. That is still far less the $15.6 billion in energy savings. But even that's probably an exaggeration, since PJM's study looked only at renewable energy expansion inside PJM. It didn't consider, for example, the savings from importing some of the wind power from the Dakotas, Minnesota, Iowa, or other parts of the wind-rich Midwest and Great Plains. When you factor in those possibilities, the total transmission cost of achieving the 30 percent renewables integration could be lower than PJM's predictions.

The study also recommends several relatively modest steps that PJM can take to successfully integrate these resources into the system. They include changes in the way PJM operates its energy markets and dispatches power on a minute-to-minute basis, taking a more detailed look at reserve requirements, and potentially improving the "flexibility" of baseload plants to better integrate them with renewable energy resources.

Looking to the future and taking next steps

This study gives consumers, states, utilities, and others some things to think about in several areas.

First, it's clear that the grid can handle high levels of renewable power without compromising reliability. Of course, we already know this because the Midwest and Texas grids have seen wind energy constitute a significant portion of the power on the grid at a given time. The PJM study affirms that the grid can handle much higher power levels. It also provides a stepping stone to evaluating the impacts and savings of even more renewable power on the grid, which will be a top priority for states looking to satisfy the U.S. Environmental Protection Agency's upcoming carbon pollution rules for existing power plants.

Second, as conventional power sources come to constitute less of the total energy production mix, power markets will need to evolve to encourage the development of complementary conventional resources. This is a critical point. PJM's study shows that existing coal and gas resources are going to suffer revenue losses; indeed, PJM even suggested that it might be necessary to consider raising energy prices to compensate for the lost revenue. No, no, no.

A better approach is to look into redesigning PJM's existing long-term power supply market (called a "forward capacity market") so that it, in combination with reasonable state power preferences, assures the right supply of conventional power sources are available to support renewable power.

Third, PJM's study was done in a relative vacuum; it didn't consider how several grid regions, working together, could manage significantly more clean power. PJM and the other grid operators across the country need to work in a more cooperative manner to conduct the studies and other work necessary to show states across the country that power-sharing saves even more money than for each region to plan for its own resources. FERC has encouraged this cooperation by issuing interregional coordination requirements in its landmark Order 1000 (more about that here), but the regions can do more -- and they don't need to wait for further instructions from Washington.

***

John Moore is a senior attorney with the Natural Resources Defense Council. This piece was originally published on NRDC's Switchboard blog and was reprinted with permission.

PJM Interconnection (PJM)

Section 6 – PJM Performance Metrics and Other Information

PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

- Acting as a neutral, independent entity, PJM operates a competitive wholesale electricity market and manages the high-voltage electricity grid to ensure reliability for more than 51 million people.
- PJM's long-term regional planning process provides a broad, interstate perspective over a 15-year horizon that identifies the most effective and cost-efficient improvements to the grid to ensure reliability and *economic benefits on a system-wide basis.*
- An independent board, representing various knowledge and experience requirements, provides oversight on behalf of PJM's 600+ members. Through effective governance and a collaborative stakeholder process, PJM is guided by its vision: "To be the electric industry leader – today and tomorrow – in reliable operations, efficient wholesale markets and infrastructure planning."

Founded in 1927 as a power pool, PJM opened its first bid-based energy market on April 1, 1997. Later that year, the Federal Energy Regulatory Commission (FERC) approved PJM as an independent system operator (ISO). ISOs operate, but do not own, transmission systems in order to provide open access to the grid for non-utility users.

PJM became a regional transmission organization (RTO) in 2001, as FERC encouraged the formation of RTOs to operate the transmission system in multi-state areas as a means to advance the development of competitive wholesale power markets.

From 2002 through 2005, PJM integrated a number of utility transmission systems into its operations. They included: Allegheny Power in 2002; Commonwealth Edison, American Electric Power and Dayton Power & Light in 2004; and Duquesne Light and Dominion in 2005. These integrations expanded the number and diversity of resources available to meet consumer demand for electricity and increased the benefits of PJM's wholesale electricity market.

Currently, PJM administers a day-ahead energy market, real-time energy market, capacity market, financial *transmission right congestion hedging market, day-ahead scheduling reserve market, synchronized reserve market* and regulation market. PJM ensures sufficient black start service to supply electricity for system restoration in the unlikely event that the entire grid would lose power. PJM also administers demand response programs that help increase operational efficiency and improve resource diversity which in turn can reduce customer costs and reduce wholesale prices.

A. PJM Bulk Power System Reliability

The table below identifies which NERC Functional Model registrations PJM has submitted effective as of the end of 2009. Additionally, the Regional Entities for PJM are noted at the end of the table with a link to the websites for the specific reliability standards. To date, PJM has had no self-reported or audit-identified violations of NERC or applicable Regional Entities' standards, though certain potential violations are under review based on a first quarter 2010 standards audit. Also, PJM has not shed any load in the PJM region due to violating a NERC or Reliability Entity operating standard.

NERC Functional Model Registration	PJM
Balancing Authority	✓
Interchange Authority	✓
Planning Authority	✓
Reliability Coordinator	✓
Resource Planner	✓
Transmission Operator	✓
Transmission Planner	✓
Transmission Service Provider	✓
Regional Entities	ReliabilityFirst and SERC

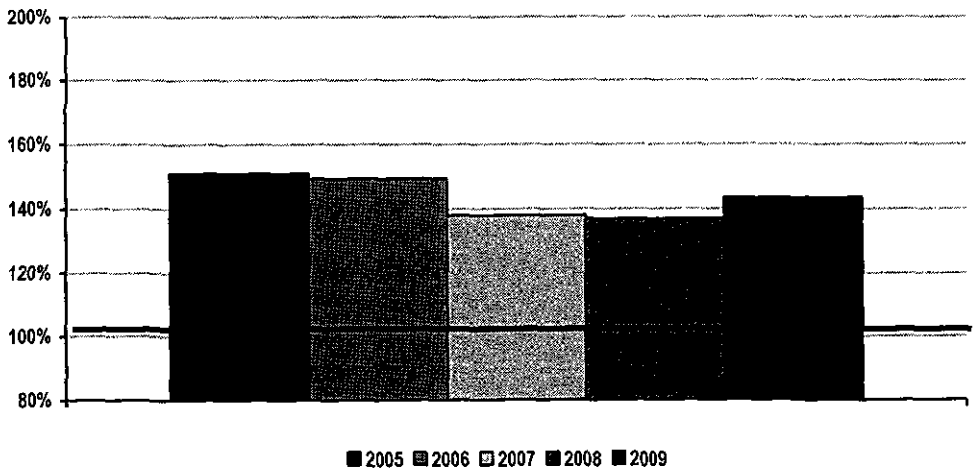
Standards that have been approved by the NERC Board of Trustees are available at:
http://www.nerc.com/page.php?cid=2|20

Additional standards approved by the ReliabilityFirst Board are available at:
http://www.rfirst.org/Standards/ApprovedStandards.aspx

Additional standards approved by the SERC Board are available at:
http://www.serc1.org/Application/ContentPageView.aspx?ContentId=111

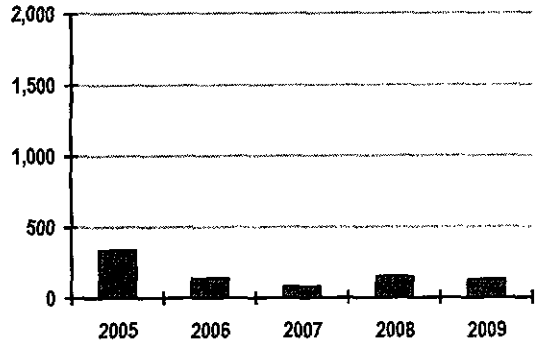
Dispatch Operations

PJM CPS-1 Compliance 2005-2009



Compliance with CPS-1 requires a performance level of at least 100% throughout a 12-month period. PJM was in compliance with CPS-1 for each of the calendar years from 2005 through 2009. PJM began participating in a field trial to replace CPS-2 as a performance measure in August 2005 and was granted a waiver from the CPS-2 measure at that time. This new control performance measure is the Balancing Authority ACE Limit (BAAL). The BAAL performance measure combines the CPS-1 performance measure with a specific limit known as a Frequency Trigger Limit (FTL). In order to be compliant with the BAAL standard, a Balancing Authority must recover from a FTL excursion within a 30-minute period of time. PJM was in compliance with the BAAL performance standard for each calendar year from 2005 to 2009.

Transmission Load Relief or Unscheduled Flow Relief Events 2005-2009

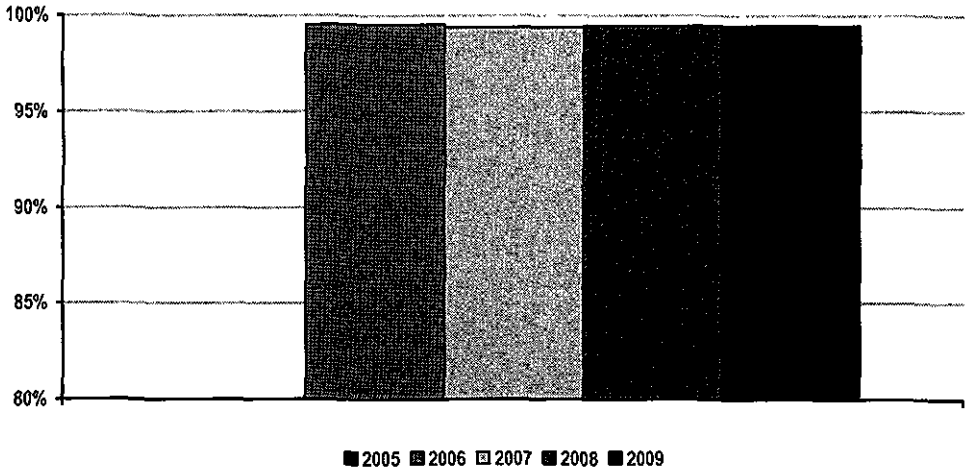


PJM data reflects the number of Transmission Load Relief (TLR) events. PJM's TLRs are almost exclusively level 3 and 4 TLRs with less than 1% of TLRs called from 2005 through 2009 being level 5. The number of TLRs in the PJM region has decreased since the integration of several transmission zones in 2003 – 2005. The levels of TLRs are also impacted by lower overall congestion levels in the past few years.

Transaction curtailments implemented under the TLR process are an extremely costly mechanism for reducing the flow on constrained transmission elements when compared to much more specifically targeted security constrained economic dispatch procedures. The TLR process relies on the administrative curtailment of wide area, control area-to-control area transactions in order to maintain flow within established ratings on transmission system elements. These transaction curtailments do not in any way reflect the economic desires of the market participants by which they are scheduled, but rather are conducted in a priority order determined by the length and firmness of the transmission service on which they are tagged. Because of the nature of this priority order, the curtailed transactions may have a five percent or smaller flow impact on the transmission constraint being controlled, and transmission system operators may therefore be required to implement thousands of MW of curtailments to achieve the necessary relief on constrained facilities. PJM, on the other hand, relies on security constrained unit commitment and economic dispatch in order to maintain transmission system reliability. This mechanism minimizes out-of-merit dispatch by economically redispatching resources that have the greatest impact on a constrained facility first, and has significantly reduced the transaction curtailments PJM has been required to implement in order to maintain transmission facilities within limits. From 2004 to 2007, PJM transaction curtailment requests were reduced in excess of 1,000,000 gigawatt hours. PJM production cost simulation results conservative estimates of the savings realized from the reduction in these inefficient transaction curtailments between $78 million and $98 million per year.

There are additional reliability benefits to the reduced reliance on the TLR procedure that are less quantifiable as a dollar value. Because TLR relies on curtailments of interchange transactions, relief from implementation of that process on a transmission facility cannot begin to be realized until at least 30 minutes after the constraint is recognized. This is because an inherent time delay exists between when a constraint is recognized, applicable transaction curtailments can be determined by the Reliability Coordinator, and those transaction curtailments can actually be implemented via the NERC electronic transaction tagging system. Additionally, because the transactions being curtailed under the TLR process are scheduled from control area to control area, it is impossible for the Reliability Coordinator to know specifically which generation resources will respond to accomplish the curtailments. The relief actually provided can therefore vary from that which was expected based on differences among unit-specific distribution factors on the constraint being controlled. Security constrained economic dispatch, on the other hand, sends electronic dispatch signals to individual generators within minutes of a constraint being identified. Within a few additional minutes, individual generators can respond to those signals and begin to provide relief on the constrained facility. While a monetary quantification is difficult, the reliability benefit of providing much more timely and targeted relief on transmission constraints is undeniable.

PJM Energy Market System Availability 2005-2009

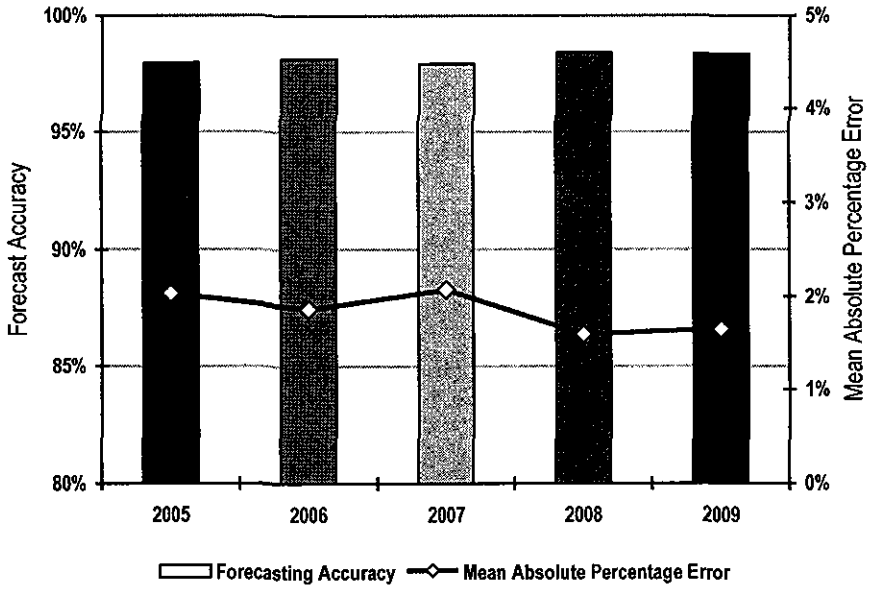


Availability of the Energy Management System (EMS) is key to reliable monitoring of the electric system in the PJM region. For the past four years, PJM's EMS has been unavailable less than 1% of all hours in each year. The majority of the time PJM's EMS system was unavailable to operators reflects challenges with data communications links, not EMS software or hardware issues. With the implementation of PJM's second control center, PJM will have dual, independent data communication links to the EMS systems at each control center to reduce the EMS availability impact of potential data communication link lapses. PJM does not have EMS availability data for 2005.

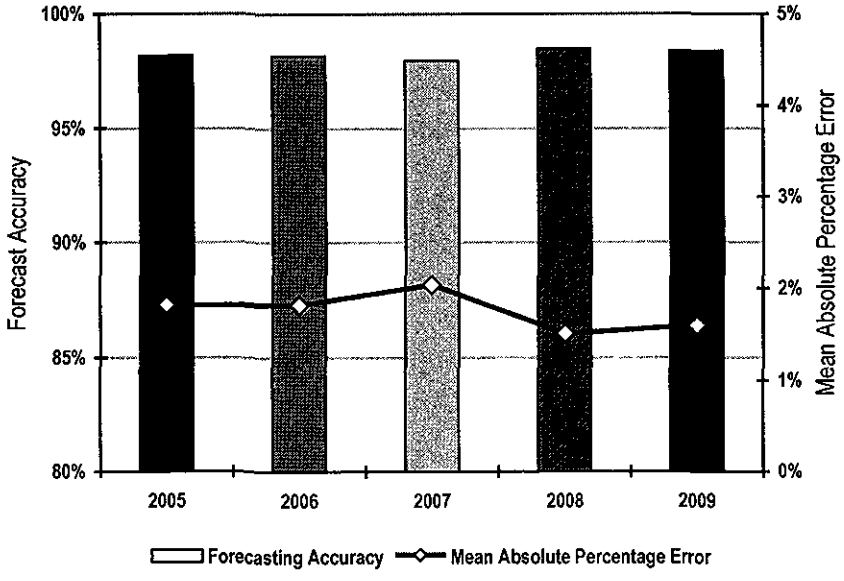
Load Forecast Accuracy

ISO/RTO	Load Forecasting Accuracy Reference Point
PJM	Noon prior day

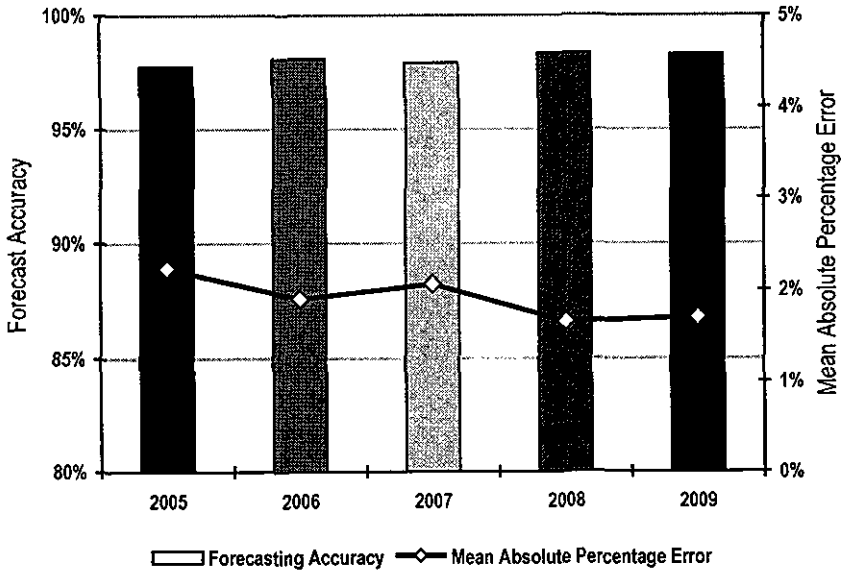
PJM Average Load Forecasting Accuracy 2005-2009



PJM Peak Load Forecasting Accuracy 2005-2009



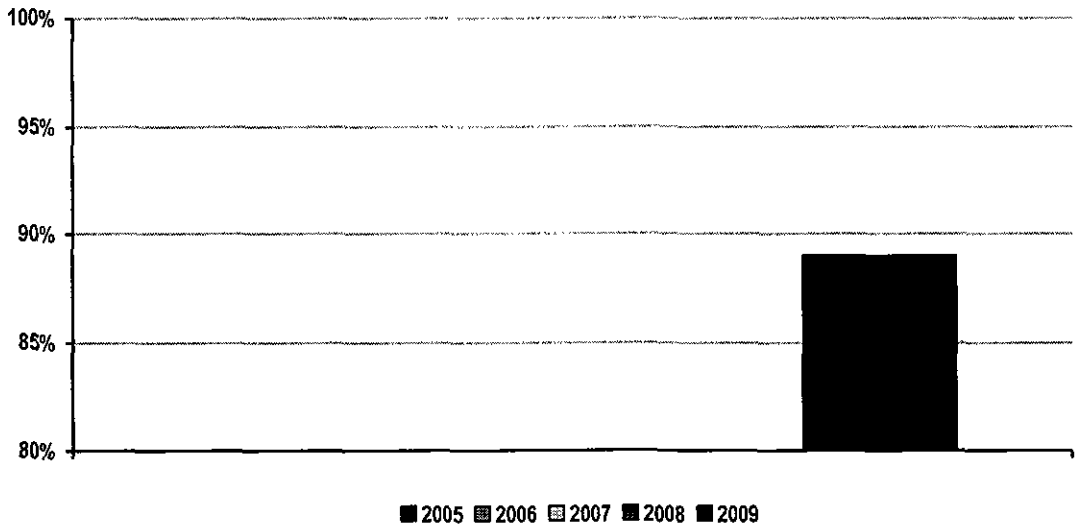
PJM Valley Load Forecasting Accuracy 2005-2009



PJM has maintained its approximate 98% load forecasting accuracy for the aggregate PJM region for the years 2005 – 2009. This accuracy level is consistent for the average, peak and valley load forecasting during those years. This means that PJM is forecasting the total generation needs, as well as the daily maximum and minimum generation requirements, for the PJM region within a 2% variance to the actual needs.

Wind Forecasting Accuracy

PJM Average Wind Forecasting Accuracy 2005-2009 [1]



(1) PJM data represents the month of December 31, 2009 when PJM began tracking this data.

PJM began tracking wind forecasting accuracy during December 2009. The data in this report includes the results of that single month and does not yet support any trend analysis. The potential output from a wind generation resource can be impacted by its geographic location, hub height, turbine type, turbine capacity, manufacturer's power curve, and ambient temperature operating limits.

PJM's approach to wind forecasting focuses on gathering the operating and historical data for each wind generation resource and incorporating that information in a forecast model that forecasts anticipated generation output based on predicted future operational and weather conditions. PJM's objective is to improve its wind forecasting accuracy as it gathers more historical data and experience with the current wind generators in the PJM region.

Hydroelectric and pump storage resources are scheduled in PJM's day-ahead energy market and as such do not impact forecast variability. Penetration of variable energy resources aside from wind generation are not significant enough at this time to impact the accuracy of the PJM load forecast.

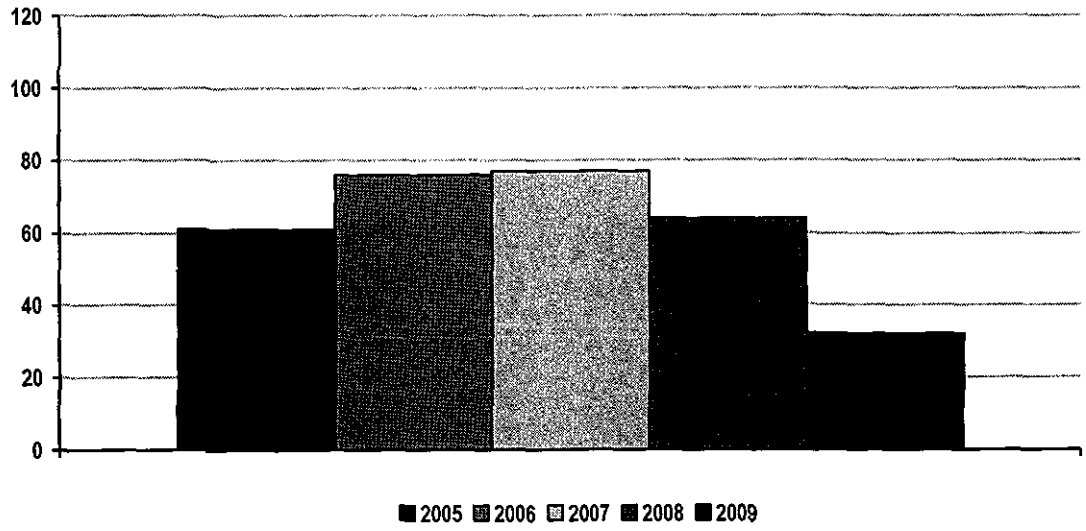
PJM Wind Forecasting Future Enhancement:

During 2010 and early 2011, PJM plans to continue to focus on wind forecasting accuracy by:

- Working with wind farms to provide more accurate turbine outage data; and
- Integrating PJM's wind power forecast application with PJM's other dispatch tools, such as security constrained economic dispatch.

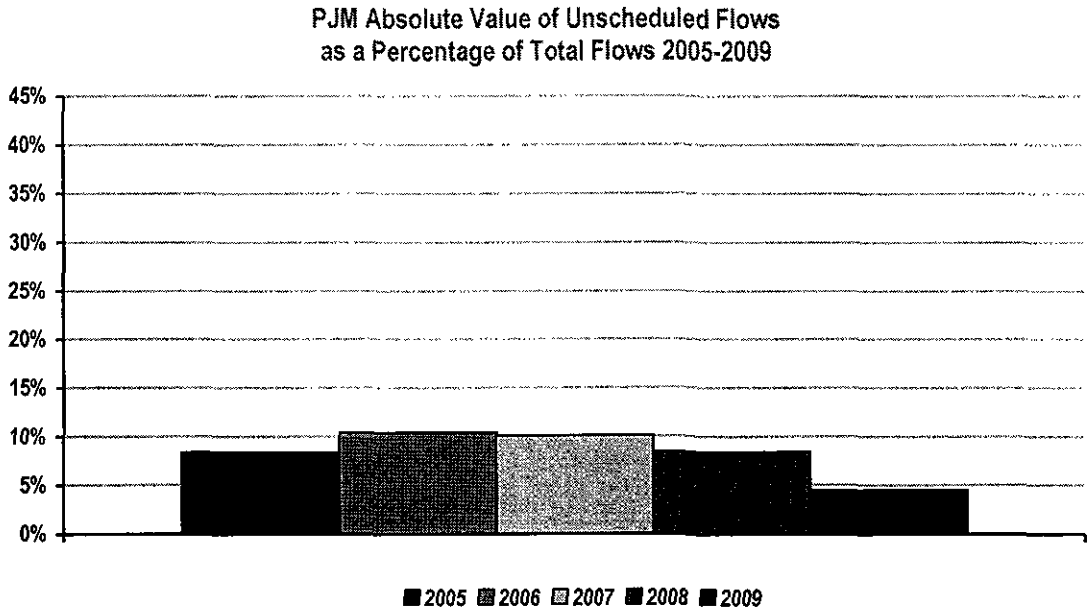
Unscheduled Flows

PJM Absolute Value of Total Unscheduled Flows 2005-2009
(terawatt hours)



For context, the table below notes the number of external interfaces in 2009 over which PJM may have experienced unscheduled flows.

ISO/RTO	Number of External Interfaces
PJM	19



PJM's unscheduled flows in both absolute terms and as a percentage of total flows have decreased over the past few years. This downward trend is primarily a function of a slower economy and milder weather in both 2008 and 2009 that resulted in lower transaction volumes into, out of, and through the PJM transmission system. Also, PJM has been actively engaged in the Broader Regional Markets effort with the NYISO, the Independent Electric System Operator of Ontario, and the Midwest ISO to develop effective solutions to continue to reduce unscheduled flows around Lake Erie.

(in terawatt hours)

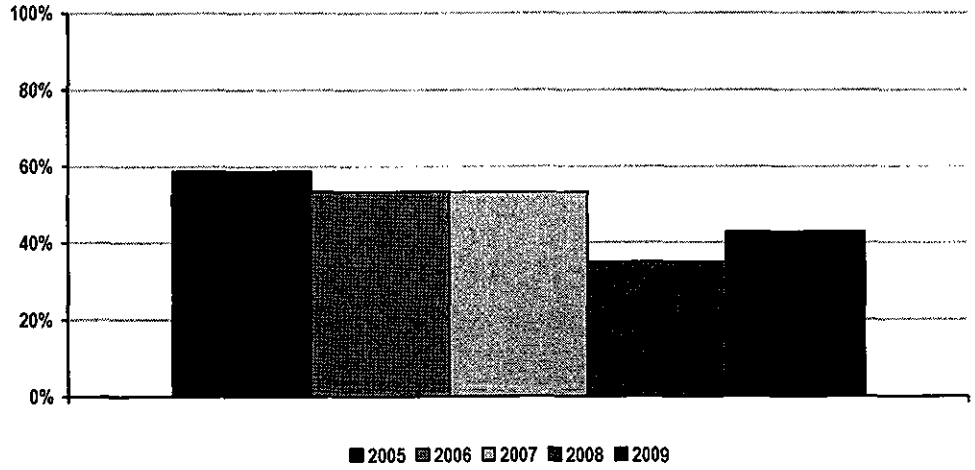
PJM Unscheduled Flows by Interface	2005	2006	2007	2008	2009
Progress Energy Carolinas	(4)	(3)	(5)	(6)	(7)
Midwest ISO [1]	—	(10)	(14)	(3)	7
Ohio Valley Electric Cooperative	1	(1)	(1)	2	4
Tennessee Valley Authority	(10)	(10)	(6)	(4)	(4)
Duke Energy Carolinas	3	5	6	4	3

(1) Inadvertent flows with Midwest ISO tracked commencing in 2006.

PJM's list of the highest magnitude unscheduled flows by interface demonstrates the primary unscheduled flow patterns involving the PJM region – flows from west of PJM through PJM and then out to the regions south of PJM. PJM is working on joint operating agreements with its neighboring balancing authorities to identify means to minimize such unscheduled flows. For example, PJM has been working actively with Progress Energy and Duke Energy on enhancements to the current Joint Operating Agreement to provide for enhanced congestion management between the respective organizations.

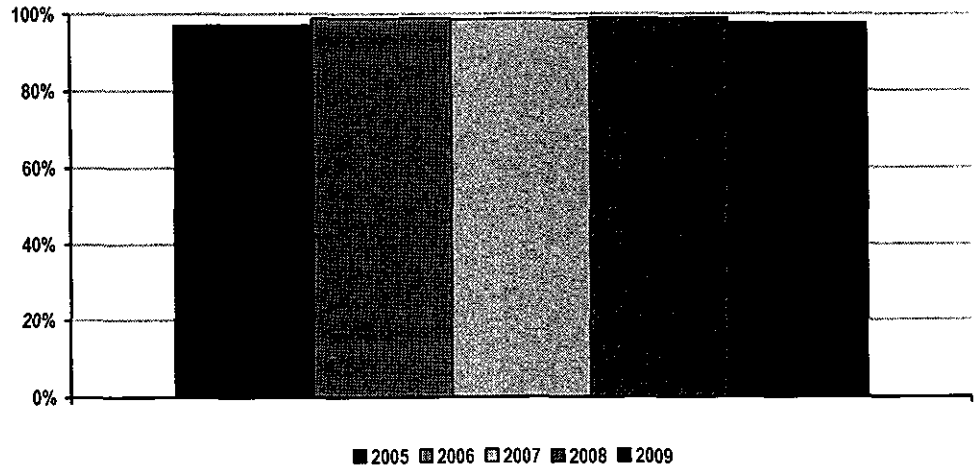
Transmission Outage Coordination

PJM Percentage of ≥ 200kV Planned Outages of 5 Days or More that are Submitted to ISO/RTO at least 1 Month Prior to the Outage Commencement Date 2005-2009



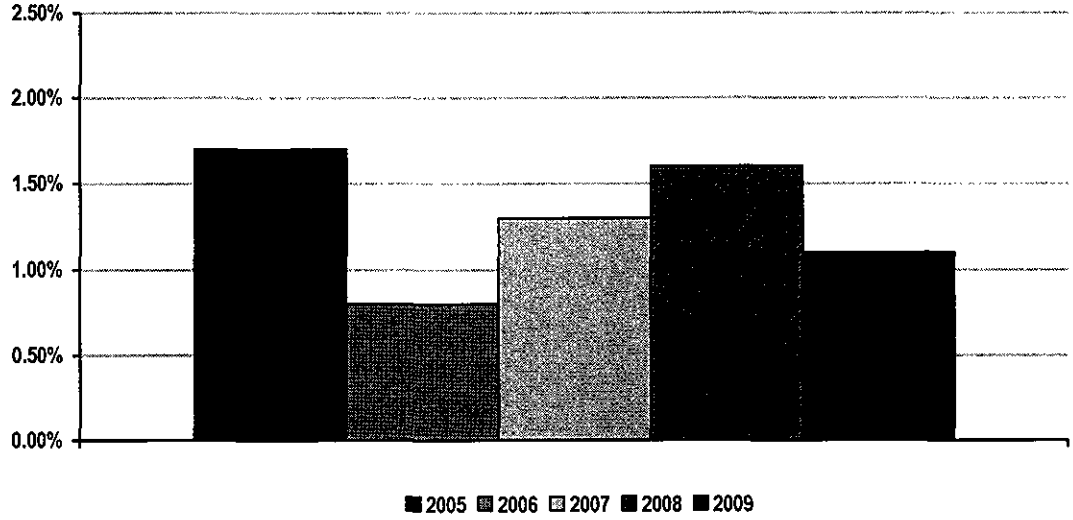
PJM's Tariff requires transmission owners to provide PJM at least five days notice of a planned transmission outage for 200 kV or higher transmission facilities. Longer term outages should be reported to PJM at least one month prior to the target outage commencement date. As noted in the preceding chart, a significant portion of the planned outages in the PJM region have been reported to PJM well before the minimum reporting requirements in the PJM Tariff.

PJM Percentage of Planned Outages Studied in the PJM Tariff/Manual established timeframes 2005-2009



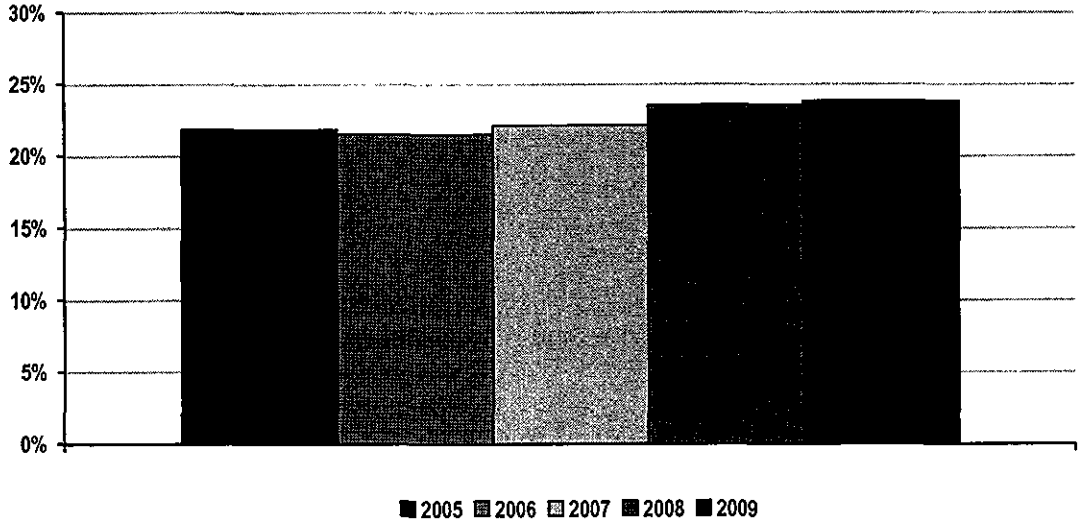
The data in the preceding chart indicates its members' substantial compliance with the PJM Tariff minimum transmission outage 5-day reporting requirement. These five days allow PJM to study the proposed transmission facility outage for potential reliability implications before the transmission outage commences. The very small percentage of outages not reported to PJM at least five days prior to the target outage commencement date will only be approved by PJM if that requested outage does not cause increased congestion or have any adverse reliability impacts.

PJM Percentage of ≥ 200 kV Outages Cancelled by PJM After Having Been Previously Approved 2005-2009



PJM has the authority to cancel or reschedule previously-approved planned transmission outages if such outages would jeopardize system reliability conditions at the time the outage is ready to commence. As such, an outage that would require an emergency procedure will be cancelled and rescheduled. When a transmission outage would impact generation availability, PJM works to schedule the transmission outage at a time where the impact is mitigated (such as when the generation would be on a maintenance outage) where possible. Historically, PJM has only needed to cancel or reschedule a very small percentage of transmission outages that it had previously approved.

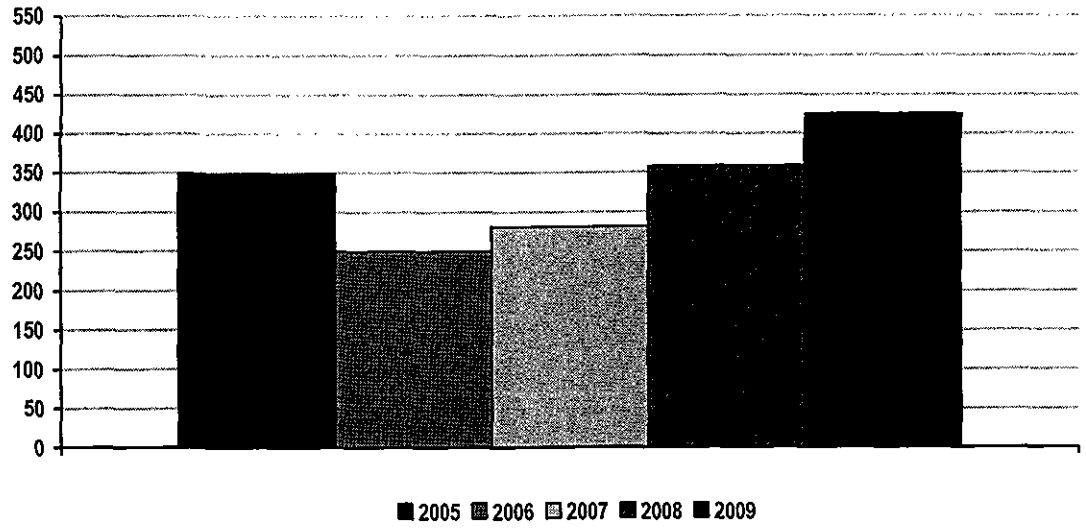
PJM Percentage of Unplanned ≥ 200kV Outages 2005-2009



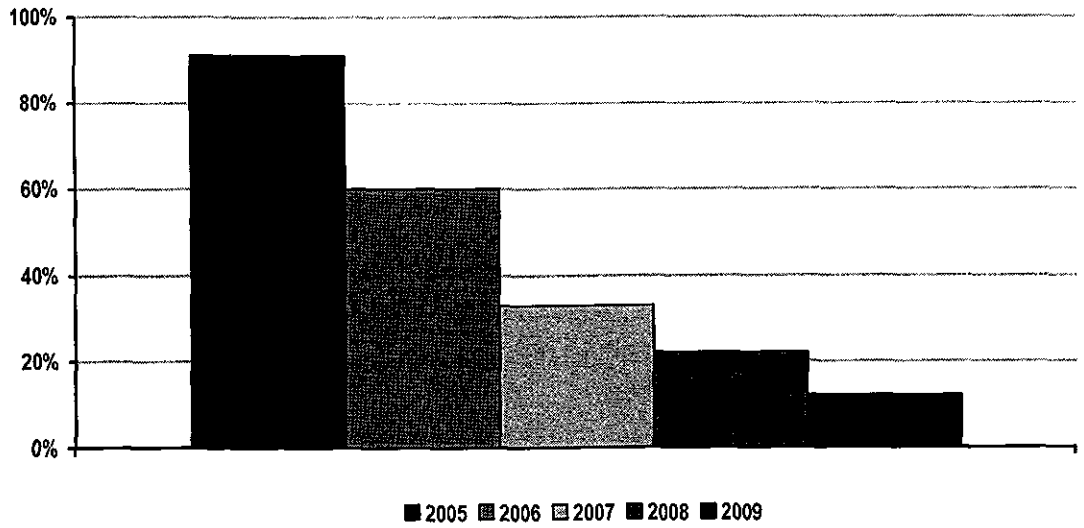
Unplanned transmission outages may occur due to equipment malfunctions on the transmission line or an adjacent substation. They can also occur due to weather conditions that cause a transmission facility to trip out of service. Historically, 22 – 24% of the outages of transmission assets in the PJM region with 200 kV or higher voltages have been unplanned.

Transmission Planning

PJM Number of Transmission Projects Approved to be Constructed for Reliability Purposes 2005-2009



PJM Percentage of Approved Construction Projects In-Service by December 31, 2009



PJM's Regional Transmission Expansion Plan (RTEP) identifies transmission system additions and improvements needed to keep electricity flowing to 51 million people throughout 13 states and the District of Columbia. Studies are conducted that test the transmission system against mandatory national standards and PJM regional standards. These studies look 15 years into the future to identify transmission overloads, voltage limitations and other reliability standards violations. PJM then develops transmission plans in collaboration with the stakeholders' Transmission Expansion Advisory Committee (TEAC) which provides advice and recommendations to aid in the development of

the RTEP to resolve violations that could otherwise lead to overloads and black-outs. This process culminates in one recommended plan – one RTEP – for the entire PJM region that is subsequently submitted to PJM's independent governing Board for consideration and approval.

PJM's RTEP process includes both five-year and 15-year dimensions. Five-year-out planning enables PJM to assess and recommend transmission upgrades to meet forecasted near-term load growth and to ensure the safe and reliable interconnection of new generation and merchant transmission projects seeking interconnection within PJM. PJM's 15-year planning horizon permits consideration of many long-lead-time transmission options. These options often comprise larger magnitude transmission facilities that more efficiently and globally address reliability issues. Typically, these are higher voltage upgrades that simultaneously address multiple NERC reliability criteria violations at all voltage levels. A 15-year horizon also allows PJM to consider the aggregate effects of many system trends including long-term load growth, impacts of generation deactivation, and broader generation development patterns, including renewable resources and storage technologies that may be under development across PJM.

PJM's RTEP process throughout 2009 culminated in a series of upgrades approved by the PJM Board. PJM identified and recommended these upgrades to resolve reliability criteria violations identified through 2024. Now part of PJM's RTEP, 2009 upgrade plans have been integrated with those RTEP upgrades which were approved by PJM's Board between 1999 and December 31, 2008. Consistent with findings in prior years, 2009 RTEP transmission upgrades and enhancements cover a range of power system elements: circuit breaker replacements to accommodate increased current interrupting duty cycles, new capacitors to increase reactive power support, new lines, line reconductoring, new transformers to accommodate increased power flows and other circuit reconfigurations and upgrades to accommodate power system changes.

Load growth remains a fundamental driver of transmission expansion plans. Over time, experience has demonstrated that load growth in eastern PJM load centers, if not coupled with increases in new generation and demand response, leads to increased west-to-east flows on transmission facilities in the PJM region, potentially aggravating an already heavily-loaded system. Incorporating the impacts of the economic downturn in the US since the fall of 2008 has resulted in revised dates when certain extra high-voltage (EHV) transmission lines are projected to be needed to avoid reliability standard violations.

Various state renewable portfolio standard initiatives promote demand response and energy efficiency programs. Such programs can have the effect of moderating peak demand and energy growth. PJM supports these programs and is closely monitoring developments. Currently, PJM includes demand response and energy efficiency values into its RTEP process based on the degree to which such programs clear in Reliability Pricing Model capacity auctions and are factored into reliability analyses based on the circumstances under which the programs are expected to be implemented in actual operations.

Within PJM, demand response participation may be price responsive, contractually obligated, or directly controlled. As more experience with these programs is gained, PJM will be better able to assess their impact on energy usage and peak load. PJM sensitivity studies in 2010 will attempt to provide as assessment bracketing the potential effect of states' demand response and energy efficiency programs on reliability criteria violations which drive the need for new transmission.

Through the end of 2009, the PJM RTEP process has resulted in about $15 billion of actual and planned transmission infrastructure development in the PJM footprint. In addition to their reliability benefits, the transmission upgrades planned under the PJM RTEP process have resulted in significant economic efficiencies. As of 2007, PJM incorporates economic efficiency analysis into the regional planning process in order to supplement the reliability criteria on which transmission infrastructure development decisions are based. PJM's analysis indicates that for the year 2012 alone, the transmission upgrades in the current RTEP will result in over $390 million of increased economic efficiency for the footprint. This single-year value provides a conservative estimate of the annual economic value of the PJM reliability planning process, because this value can be expected to accrue year over year into the future, and will increase with every transmission project constructed and implemented in future years as well.

The 2009 RTEP reaffirmed the need for several major transmission line projects that the PJM Board of Managers previously had authorized to address power supply problems. These transmission backbone projects are:

- Trans-Allegheny Interstate Line (TrAIL), 502 Junction to Loudon: Construction is well under way on TrAIL, and it will be in service in 2011. This 500-kV transmission line will run from near the border of Pennsylvania and West Virginia to northern Virginia. .
- Potomac-Appalachian Transmission Highline, (PATH), Amos to Kemptown: This 765-kV transmission line will extend about 300 miles from the Amos Substation in West Virginia to the Kemptown Substation in Maryland.
- Susquehanna to Roseland: This 500-kV line will run approximately 130 miles from northern Pennsylvania to northern New Jersey.
- Mid-Atlantic Power Pathway Project (MAPP): This 500-kV line will connect the Possum Point Substation in Virginia to Indian River Substation on the Delmarva Peninsula.

Market efficiency simulation results have indicated that approved RTEP upgrades will significantly reduce PJM constrained operations. These simulations project that PJM annual system congestion costs will decrease 90% (or approximately $1.7 billion) compared with the congestion costs expected absent the upgrades. The majority of the congestion cost reduction can be attributed to the addition of the new 765-kV and 500-kV RTEP backbone projects listed above.

In compliance with FERC's Order 890, PJM expanded its stakeholder process in 2008 to enhance coordinated, open and transparent planning at both the regional and local level. PJM and stakeholders already conduct a compliant planning process filed with the Commission and incorporated in Schedule 6 of the PJM Operating Agreement. Valuable stakeholder discussions culminated in the establishment of three Sub-Regional RTEP Committees – Mid-Atlantic, Western and Southern – commissioned to review proposed upgrades of more local concern. Each Sub-Regional RTEP Committee increases the opportunity for direct stakeholder participation in the planning process from initial assumption setting stages through review of the planning analyses, violations and alternative transmission expansions. The Subregional RTEP Committee provides a more local forum for gathering and considering planning issues.

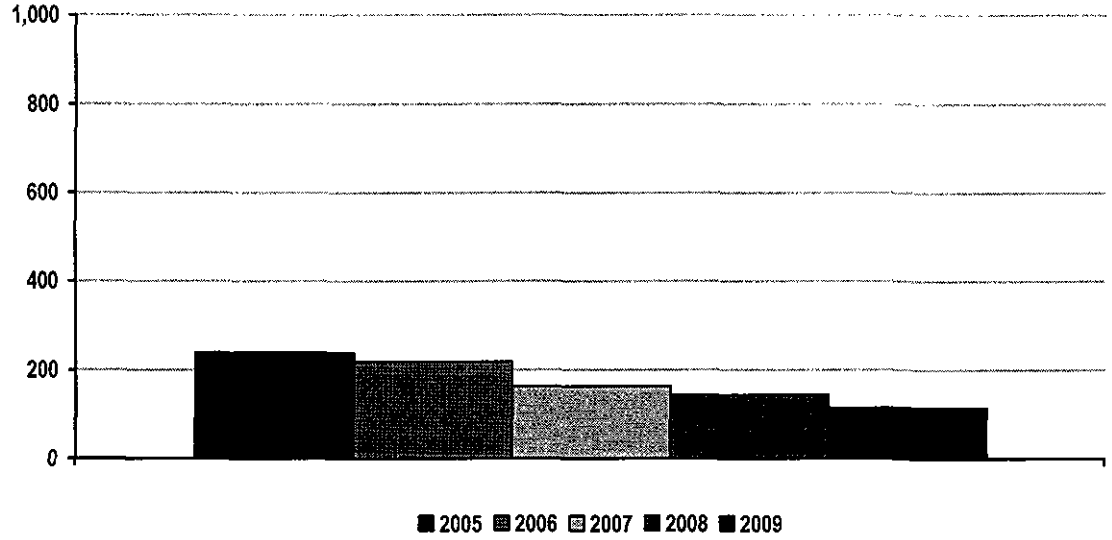
Recent developments in such areas as renewable energy resources are greatly expanding the scope of interregional planning efforts. Not least among these are the following:

- Eastern Interconnection Planning Collaborative (EIPC)
- Joint Coordinated System Planning Study (JCSP)
- Eastern Wind Integration Transmission Study (EWITS)
- PJM / MISO Joint Operating Agreement studies
- PJM / NYISO / ISO-NE Northeast Coordinated System Plan
- PJM / NYISO Focused Study
- North Carolina Planning Collaborative Coordination

In particular, the PJM-NYISO study is based on a more expansive scope than similar studies in prior years. The current study includes extensive reliability analysis of the northern New Jersey / southeast New York interface.

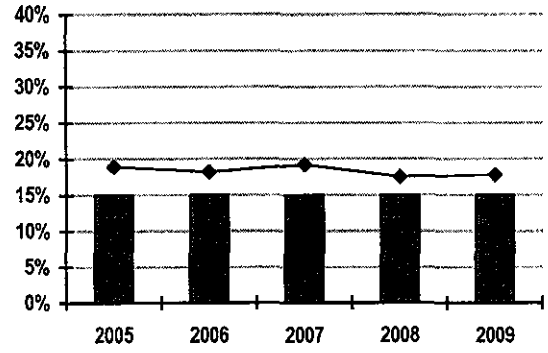
Generation Interconnection

PJM Average Generation Interconnection Request Processing Time 2005-2009
(calendar days)



PJM has made timely processing of generation interconnection study requests a high priority for the past few years with additional engineering staff and contractors engaged to complete these studies and the implementation of clustering of geographically similar studies to expedite study completion.

PJM Planned and Actual Reserve Margins 2005 – 2009



Bars Represent Planned Reserve Margins	Lines Represent Actual Reserves Procured

In 2007, PJM implemented a forward capacity market, the Reliability Pricing Model (RPM), which provides incentive for forward investment in generation and demand response by requiring capacity contracts to be procured three years prior to the delivery year. The RPM utilizes variable resource requirement curves to optimize the amount of installed capacity procured to minimize costs while satisfying the capacity requirements of the region. Assuming sufficient capacity resources are available, the variable resource requirement curve will allow the market to clear at quantities between the regional planned installed reserve margin (IRM) and the IRM plus five percent. Quantities

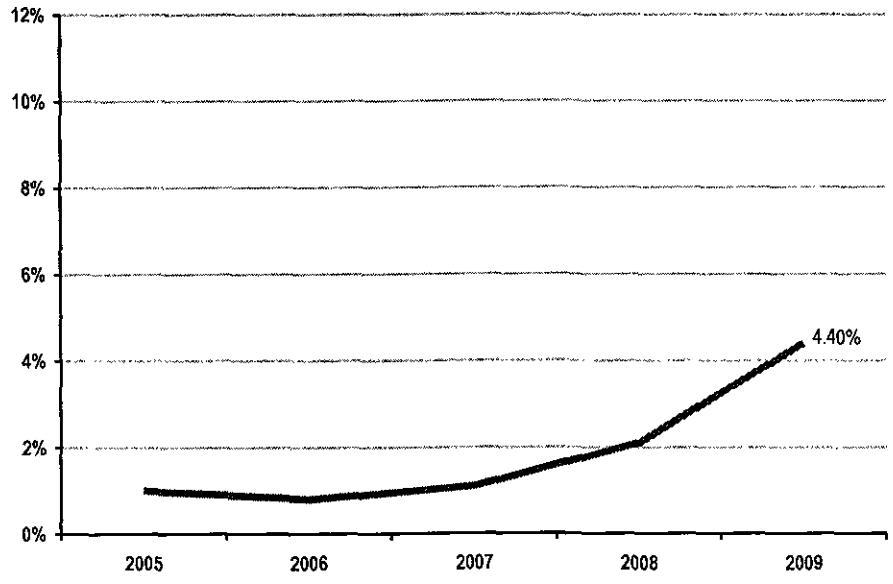
above the IRM will only clear if the total procurement cost is reduced when compared to clearing at the reserve margin. Therefore, in PJM, the actual reserve margins resulting from RPM are expected to be and have been between the IRM and the IRM plus 5%.

One of the parameters of each RPM auction is the annual load forecast for the planning year for which the RPM auction is procuring capacity resources. Given RPM auctions occur three years prior to the planning year for which capacity is being procured, the planning year load forecasts will vary from the date of the initial RPM base residual auction and the actual planning year. To be able to adapt to future load fluctuations, PJM's RPM auction incorporates two features – short-term resource procurement targets and incremental auctions. In each RPM auction, the capacity that clears will reflect 2.5% less than the forecasted resource requirement to avoid over-procurement of capacity due to potential variability in the short-term resource procurement target and the uncertainty of the economic recovery. To address the risk of under-procurement, PJM also has the ability to hold incremental RPM auctions to procure additional capacity if forecasts project greater capacity needs than procured in the RPM base residual auction.

Since the implementation of the RPM auctions in 2007, approximately 11,600 MWs of incremental capacity resources have offered into PJM's RPM auctions. This incremental capacity includes 6,400 MWs of new capacity, 4,700 MWs of uprates to existing capacity resources, and 500 MWs of capacity from reactivated units.

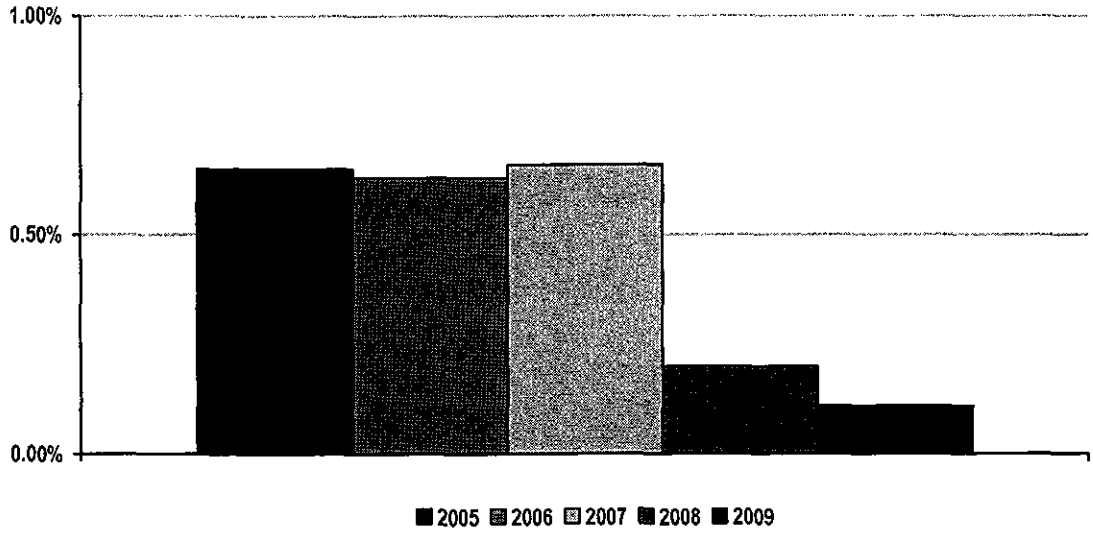
With the 2007 implementation of PJM's forward capacity market, demand resources can offer demand response as a forward capacity resource. Under this model, demand response providers can submit offers to provide a demand reduction as a capacity resource in the forward RPM auctions. If these demand response offers are cleared in the RPM auction, the demand response provider will be committed to provide the cleared demand response amount as capacity during the delivery year and will receive the capacity resource clearing price for this service.

PJM Demand Response Capacity as Percentage of Total Installed Capacity 2005-2009



Additional generation infrastructure investment savings is realized through the commitment of demand response resources to provide reliability assurance. If reliability can be maintained through the commitment of demand resources to reduce load during times of system peaks, the cost of building generation facilities to provide the additional required capacity is avoided. The PJM RPM provides a mechanism by which generation, demand response and transmission can compete on equal footing, thereby providing a transparent mechanism by which demand response can participate in the capacity market. Through this mechanism, the quantity of demand response that is providing capacity in the PJM footprint has increased by over 1,800 MW. The resulting avoidance of infrastructure development represents savings to the region of approximately $275 million per year.

Percentage of Generation Outages Cancelled by PJM 2005-2009



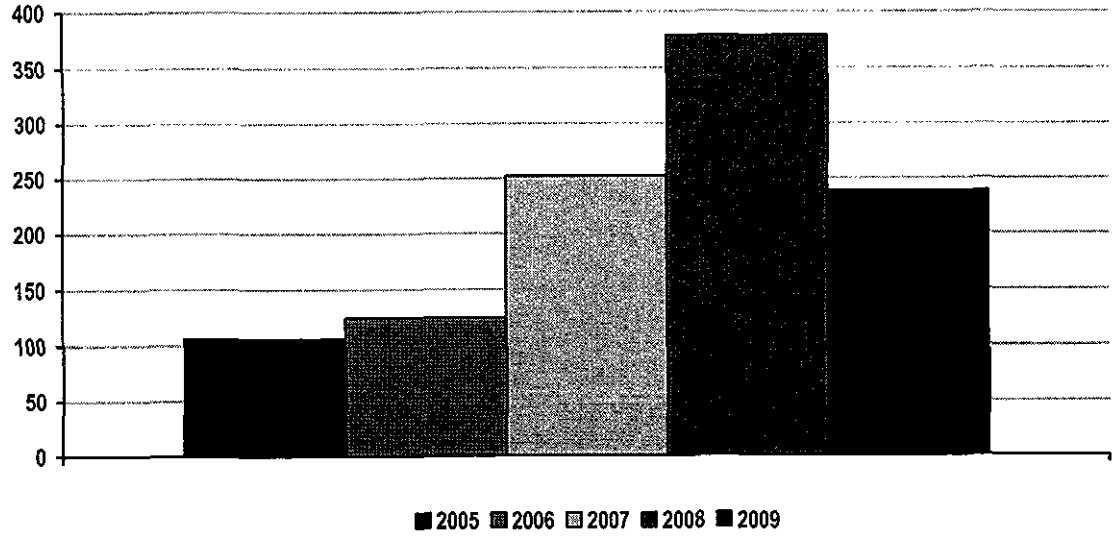
Less than 1% of planned generation outages were cancelled by PJM from 2005 through 2009. This low cancellation rate allows generation owners to complete maintenance as they have planned without incurring rescheduling costs or delays due to PJM cancellation.

PJM Generation Reliability Must Run Contracts 2005-2009

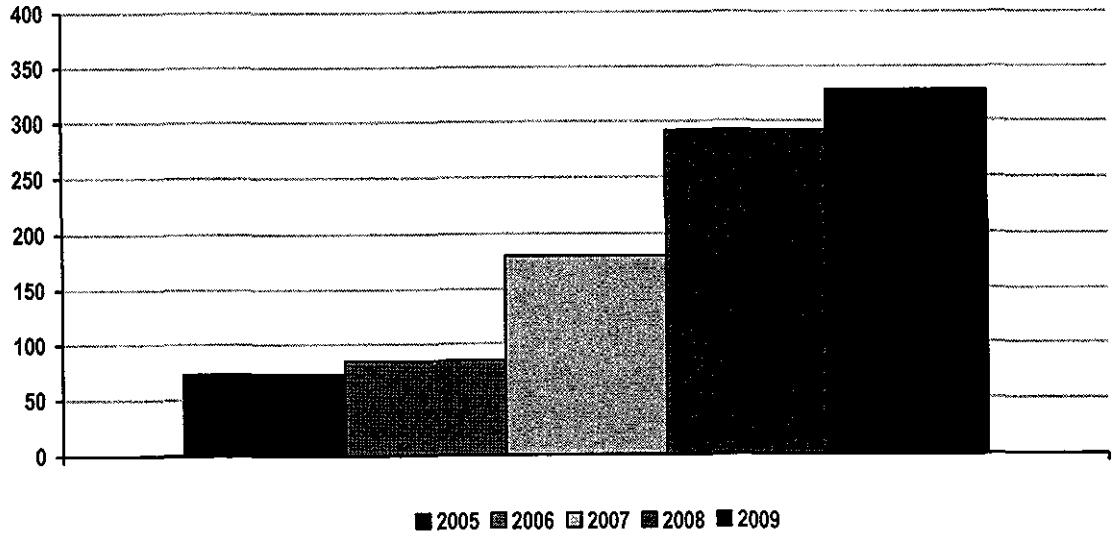
PJM did not have any generating units under Reliability Must Run (RMR) contracts from 2005 through 2008. During 2009, PJM placed one 383 MW nameplate capacity generation station under an RMR that is scheduled to expire during 2010.

Interconnection / Transmission Service Requests

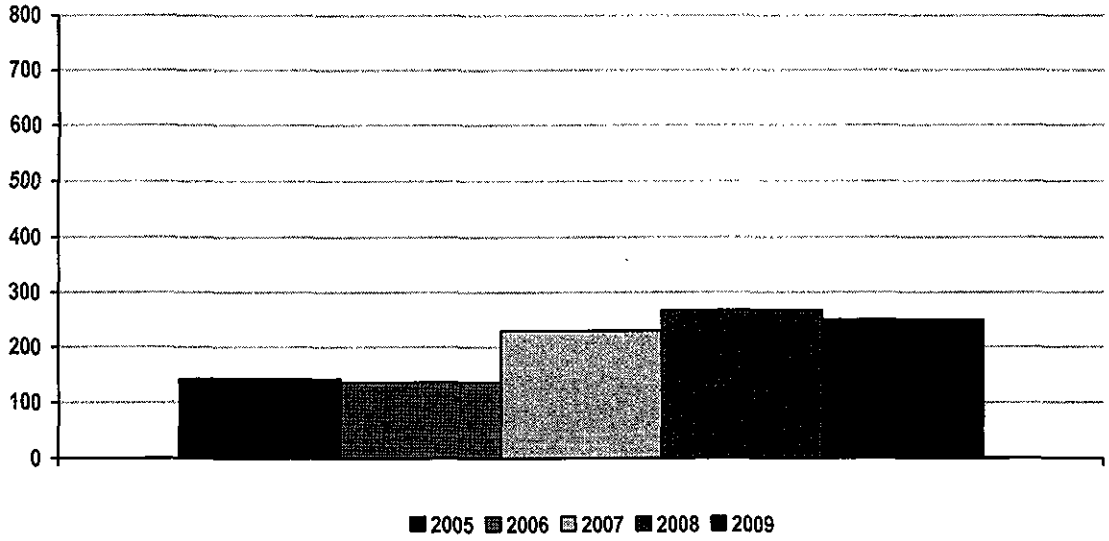
PJM Number of Study Requests 2005-2009



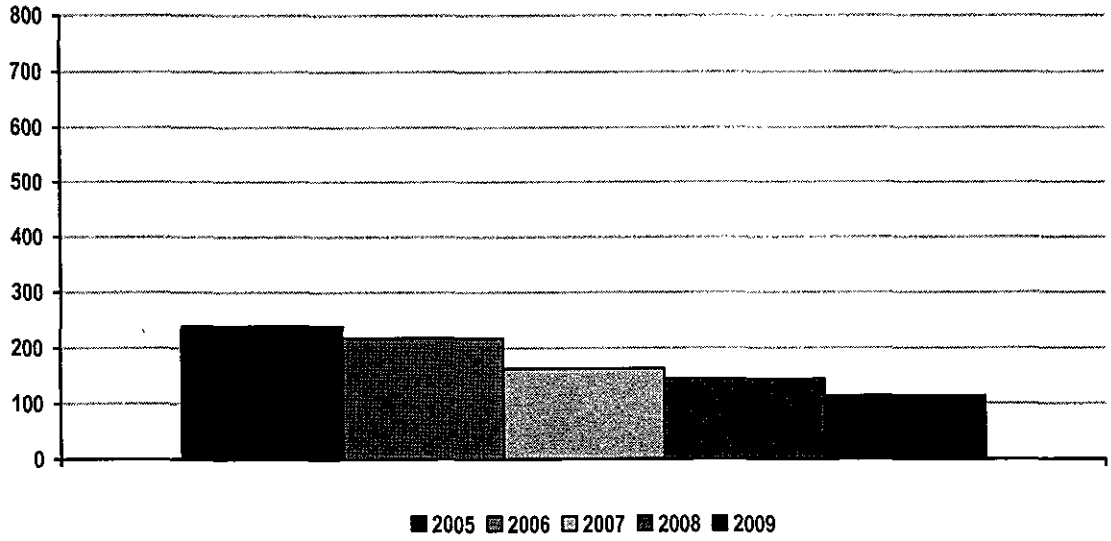
PJM Number of Studies Completed 2005-2009



PJM Average Aging of Incomplete Studies 2005-2009
(calendar days)



PJM Average Time to Complete Studies 2005-2009
(calendar days)



From 2005 through 2009, PJM received approximately 1,100 study requests from companies interested in adding new generation or upgrading current generation output in the PJM region. On average, approximately 12% – 15% of megawatts of potential generating capacity in interconnection study requests progress to the execution of an interconnection service agreement to commence construction of the new generating capacity. So, over 80% of the studies completed by PJM relate to potential projects that withdraw from the generation interconnection queue.

A large number of those study requests were geographically concentrated in the western part of the PJM region with an increasing number of the potential developers investigating the use of storage technologies such as batteries, flywheels and compressed air, as well as wind and solar fuel sources. In terms of megawatts of potential new generating capacity, more than 50% of PJM's year-end 2009 interconnection queues relates to potential wind or solar plants. It is significant to note that the total potential new generating capacity in PJM's year-end 2009 interconnection queues represent 46% of the year-end 2009 generating capacity installed in the PJM region.

PJM completed study requests faster each year from 2005 through 2009, as represented by the more than 50% reduction in average time to complete studies during that period. At the same time, the average age of incomplete studies has actually increased. The decreasing number of incomplete studies represents older study requests that are concentrated in areas of the PJM region where transmission system complexity and study data availability have delayed completion of the feasibility portion of the study process. PJM has reduced the number of incomplete studies significantly in the past few years. For example, PJM reduced the number of open studies by more than 35% during 2009.

PJM's generation interconnection process includes three potential types of studies – feasibility studies, system impact studies and facility studies. Feasibility studies assess the practicality and cost of transmission system additions or upgrades required to accommodate the interconnection of the generating unit or increased generating capacity with the transmission system. System impact studies provide refined and comprehensive estimates of cost responsibility and construction lead times for new transmission facilities and system upgrades that would be required to allow the new or increased generating capacity to be connected to the transmission system in the PJM region. Facility studies develop the transmission facilities designs for any required transmission system additions or upgrades due to the interconnection of the generating unit or increased generating capacity. PJM has had no formal complaints regarding the interconnection processes in recent years.

The table below reflects the average costs incurred by PJM for each type of generation interconnection study. These costs are billed to and collected from the entities requesting each type of study, not from PJM's administrative costs charged to its members.

Average Cost of Each Type of Study

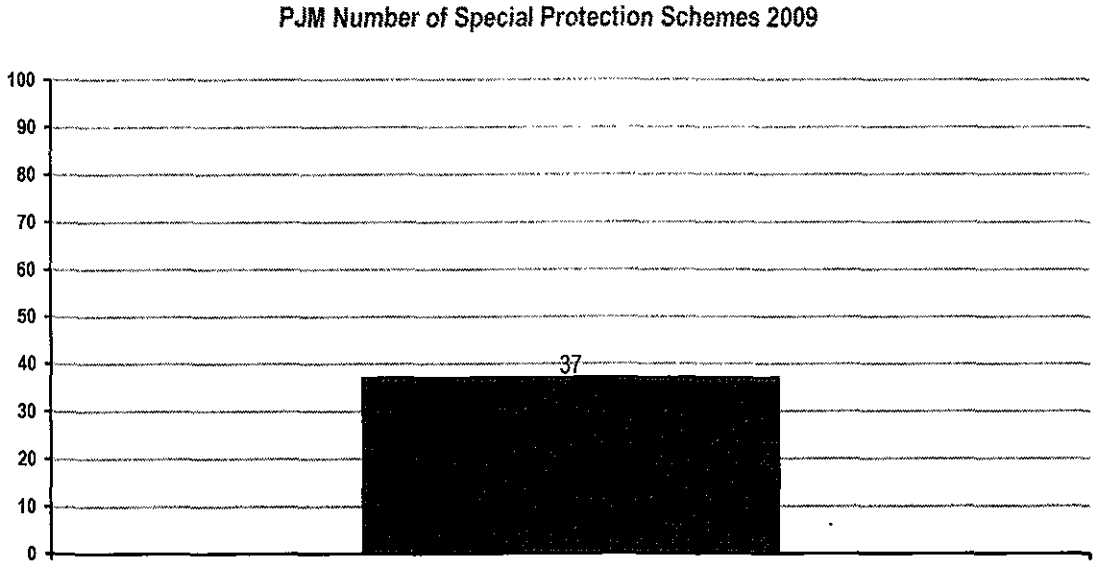
	2005	2006	2007	2008	2009
Feasibility Studies	$5,474	$4,121	$4,538	$3,514	$4,057
System Impact Studies	$12,015	$10,537	$11,224	$10,263	$14,406
Facility Studies	$30,137	$29,458	$28,635	$66,648	$54,380

PJM's average costs incurred for feasibility and system impact studies have not varied materially in the past five years. The complexity of each proposed generation project impacts primarily the costs of completing facility studies, the average cost of which has varied accordingly in the past five years.

PJM Interconnection / Transmission Service Request Future Enhancement:

- During 2010 and 2011, PJM plans to focus on process improvements to reduce both the number of incomplete generation interconnection studies and the average aging of such incomplete studies.

Special Protection Schemes



There are 37 Special Protection Schemes (SPSs) in place in the PJM region. These SPSs are automatic protection systems designed to maintain system reliability by detecting abnormal or predetermined system conditions and isolating selected equipment. All SPSs in the PJM region must be reviewed and approved by PJM to ensure they support all applicable reliability standards. Those SPSs are established throughout the PJM region as a source of automatic system protection that is in addition to the manual system adjustments available to PJM system operators.

In PJM, there were no misoperations of SPSs during 2009. There were no intended or unintended activations of SPSs during 2009.

B. PJM Coordinated Wholesale Power Markets

For context, the table below represents the split of the $26.6 billion dollars billed by PJM in 2009 into the primary types of charges its members incurred for their transactions.

(dollars in millions)	2009 Dollars Billed	Percentage of 2009 Dollars Billed
Energy Markets	$ 11,163.1	42.0%
Capacity	8,752.4	33.0%
FTR Auction Revenues	1,902.2	7.2%
Transmission Service	1,352.5	5.1%
Transmission Losses	1,267.6	4.8%
Transmission Congestion	784.6	3.0%
Operating Reserves	323.5	1.2%
Reactive Supply	239.5	0.9%
Regulation Market	226.3	0.9%
Transmission Enhancement	164.2	0.6%
PJM Administrative Expenses	155.6	0.6%
Other	217.8	0.8%
Total	**$ 26,551.3**	**100.0%**

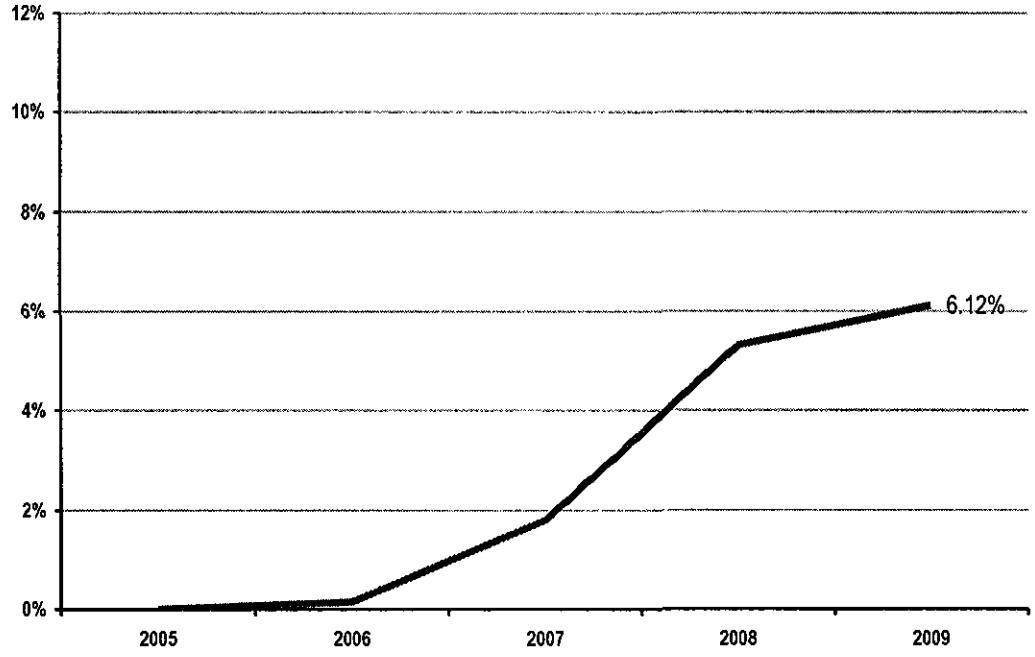
PJM has conducted an annualized, production cost analysis of the savings attributable to operating a single footprint compared to operation of the previously independently operated control areas. As is typical in such analyses, hurdle rates were utilized to simulate the ability of these independent control areas to transact with the remainder of the footprint without the benefit of a centrally operated dispatch. Based on this analysis, the energy production cost impact of the expanded PJM RTO operation is between $240 million and $345 million per year. PJM also has enhanced the efficiency of its dispatch since these integrations. The benefits of this enhanced efficiency are realized in reduced make-whole payments to generators known as Balancing Operating Reserve costs. Reduction in these costs has resulted in additional savings exceeding $100 million per year.

In addition to the production cost benefit of operating the larger footprint, the transparent price signals produced by the operation of the LMP energy market enable demand response to actively participate and compete directly with generation. Because the value of energy is made transparent in real time, demand responders that otherwise would have no incentive to reduce demand can do so in response to real time prices, thereby competing directly with generation resources. This ability, although difficult to quantify as an annual average value, has the effect of reducing the cost to all load by reducing real-time prices, most particularly during times of high system demand.

PJM maintains synchronized reserve in the amount of the largest single contingency in the entire RTO footprint and procures regulation from the most cost-efficient resources across the entire footprint. The savings attributable to the procurement of these services utilizing a market mechanism that spans the RTO footprint is between $80 million and $105 million per year.

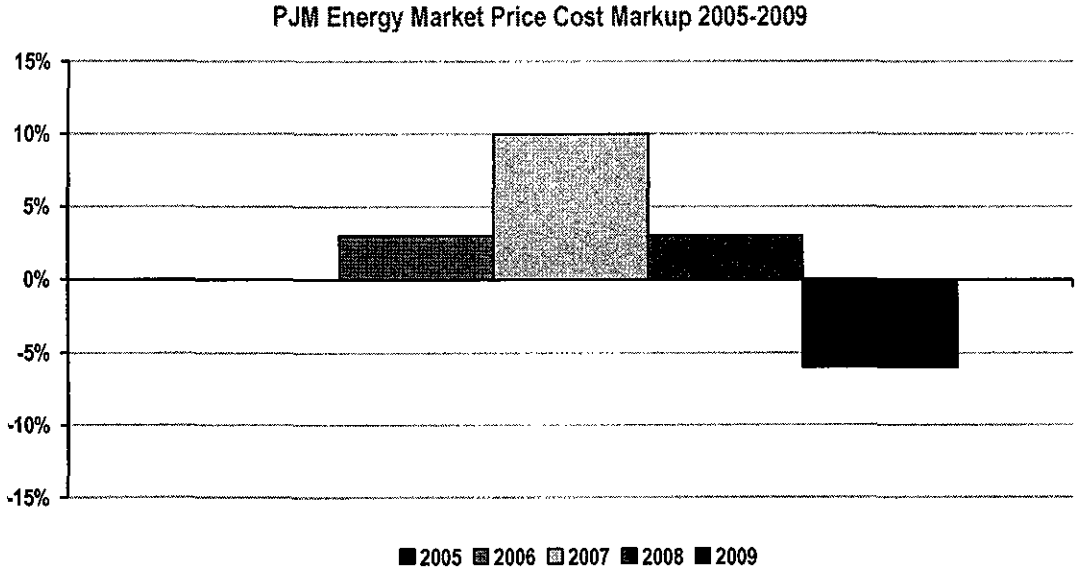
Demand response resources are eligible to participate in PJM's Regulation and Synchronized Reserve Markets. Through the end of 2009, demand response resources have not yet participated in the PJM regulation market. During 2009, demand side responders earned over $300 million through PJM energy, capacity and ancillary services markets.

PJM Demand Response as a Percentage of Synchronized Reserve Market 2005-2009



Market Competitiveness

Note: The data in this Market Competitiveness section was obtained from the 2005 – 2009 State of the Market Reports issued by PJM's independent market monitor.

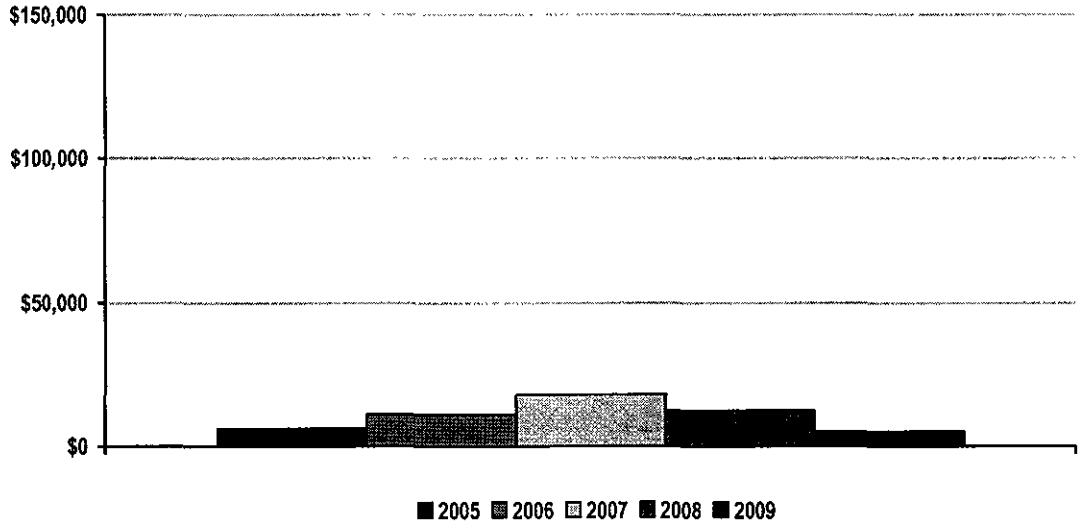


The overall price cost markup percentages for the past four years support the conclusion that prices in PJM are set, on average, by marginal units operating at or close to their marginal costs. PJM does not have data for this metric for 2005.

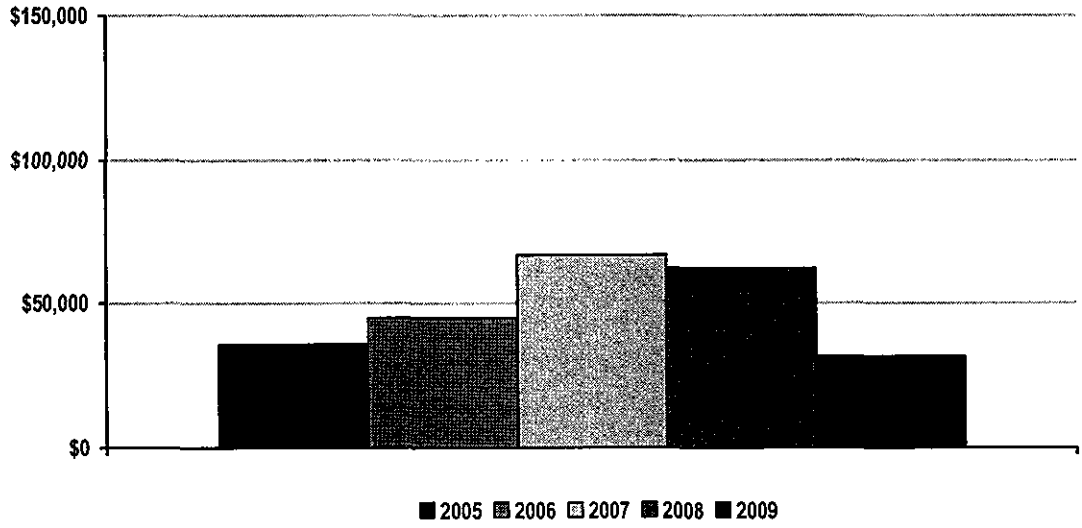
A substantial portion of the 2007 markup occurred on high-load days during the summer of 2007. Markup on high-load days is likely to be the result of appropriate scarcity pricing rather than market power. For reference, PJM's annual 2007 load was 763 terawatt hours, which is the highest annual load ever served in the PJM region. These high usage volumes drove higher locational marginal prices (LMPs) and contributed to the higher 2007 energy market price cost markup percentage.

During 2009, both coal steam units and combined cycle units that use gas as their primary fuel source had negative price cost markup percentages due to the low usage volumes that resulted in lower 2009 LMPs that were insufficient to cover those units' costs.

PJM New Entrant Gas-Fired Combustion Turbine (CT) Net Generation Revenues 2005-2009
(dollars per installed megawatt year)



PJM New Entrant Gas-Fired Combined Cycle (CC) Net Generation Revenues 2005-2009
(dollars per installed megawatt year)



For both the CT technologies and the CC technology, RPM revenue has provided an adequate supplemental revenue stream to incent continued operations in PJM for units that do not recover 100 percent of fixed costs through energy market revenue.

In 2009, total net revenues were not adequate to cover annualized total fixed costs for a new entrant CT or CC in any zone. While the results varied by zone, the net revenues for the CT and CC technologies generally covered a larger proportion of total fixed costs, reflecting their greater reliance on capacity market revenues. Energy net revenues are

generally lower for each technology in most zones compared to 2008, while capacity market revenues are higher in every zone compared to 2008. For the CT and CC technologies, the increase in capacity revenue offset the reduction in energy market revenue.

There is a set of sub-critical coal units in 2008 and 2009 and a set of super-critical coal units in 2009 that did not recover avoidable costs even with capacity revenues. The total installed capacity associated with coal units that did not cover avoidable costs in 2009 was 11,250 MW. There were 122 coal units in PJM in 2009 with capacity less than or equal to 200 MW. Of those units, 35 did not cover avoidable costs and 52 were close to not covering avoidable costs.

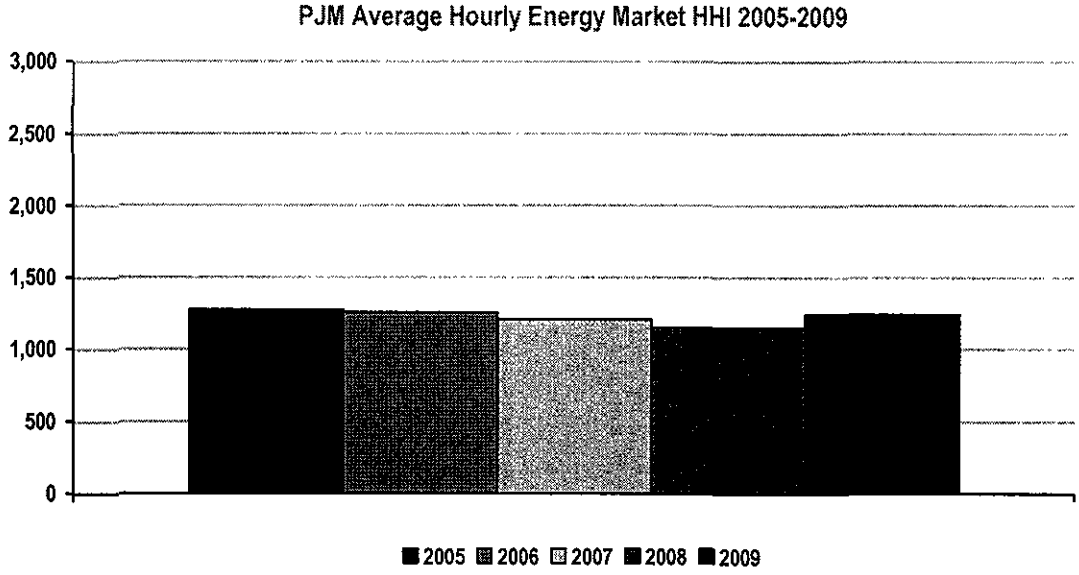
The coal plant technologies have higher avoidable costs and are more dependent on net revenues received in the energy market. In 2009, with lower load levels and, generally, lower price levels relative to operating costs, some coal-fired units in PJM did not fully recover avoidable costs even with capacity revenues. If this result is expected to continue, the retirement of these plants would be an economically rational decision.

Market Concentration

Concentration ratios are a summary measure of market share, a key element of market structure. High concentration ratios indicate comparatively smaller numbers of sellers dominating a market, while low concentration ratios mean larger numbers of sellers splitting market sales more equally. High concentration ratios indicate an increased potential for participants to exercise market power, although low concentration ratios do not necessarily mean that a market is competitive or that participants cannot exercise market power. Analysis of the PJM Energy Market indicates moderate market concentration overall. Analyses of supply curve segments indicate moderate concentration in the baseload segment, but high concentration in the intermediate and peaking segments.

Despite their significant limitations, concentration ratios provide useful information on market structure. The concentration ratio used here is the Herfindahl-Hirschman Index (HHI), calculated by summing the squares of the market shares of all firms in a market. Hourly PJM Energy Market HHIs were calculated based on the real-time energy output of generators, adjusted for hourly net imports by owner.

Actual net imports and import capability were incorporated in the hourly Energy Market HHI calculations because imports are a source of competition for generation located in PJM. Energy can be imported into PJM under most conditions. The hourly HHI was calculated by combining all export and import transactions from each market participant with its generation output from each hour. A market participant's market share increases with imports and decreases with exports. Hourly HHIs were also calculated for baseload, intermediate and peaking segments of generation supply. Hourly Energy Market HHIs by supply curve segment were calculated based on hourly Energy Market shares, unadjusted for imports.

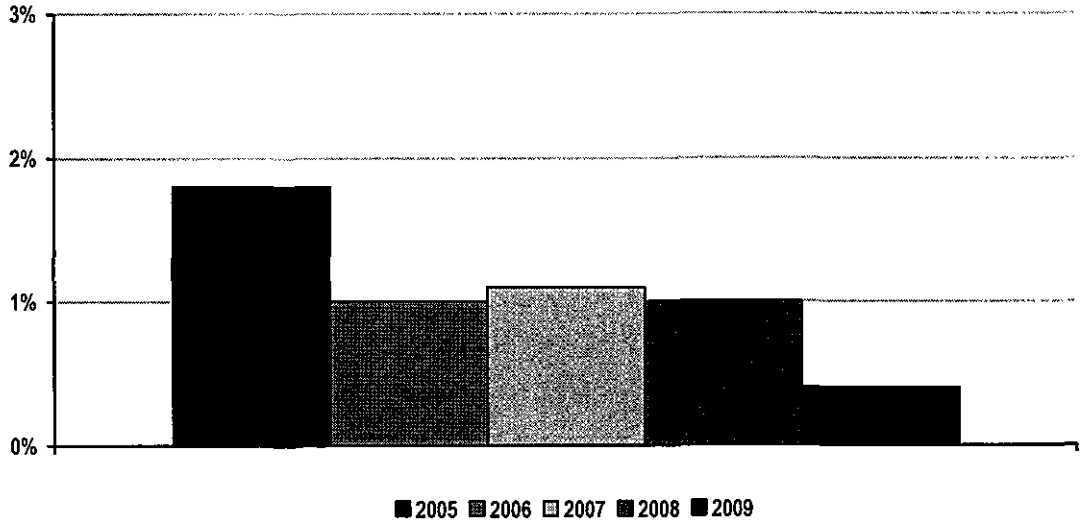


The "Merger Policy Statement" of the Federal Energy Regulatory Commission states that a market can be broadly characterized as:

- Unconcentrated. Market HHI below 1000, equivalent to 10 firms with equal market shares;
- Moderately Concentrated. Market HHI between 1000 and 1800; and
- Highly Concentrated. Market HHI greater than 1800, equivalent to between five and six firms with equal market shares.

Calculations for hourly HHI indicate that by the FERC standards, the PJM Energy Market was moderately concentrated each of the years 2005 through 2009. For the same time period, an examination of the supply curve on a segment basis, including base, intermediate and peaking plants, the hourly HHI measure indicated that, on average, intermediate and peaking segments of the supply curve are highly concentrated, while the baseload segment is moderately concentrated.

PJM Real-Time Energy Market Percentage of Unit Hours Offer Capped due to Mitigation 2005-2009

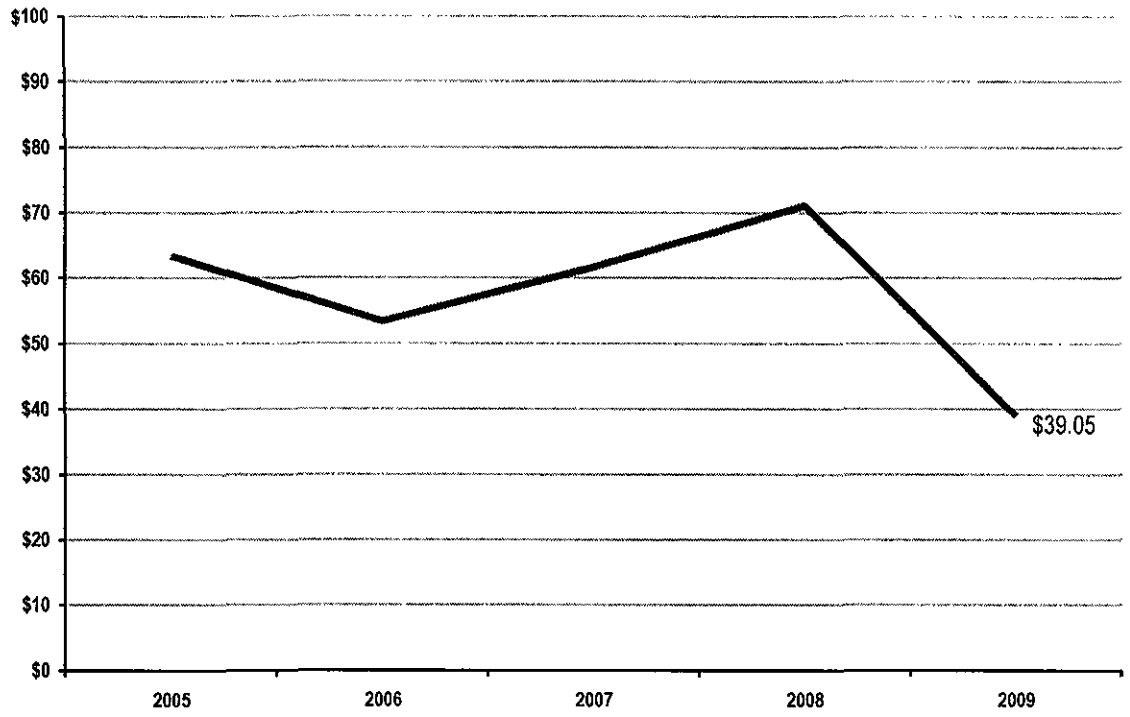


Noncompetitive local market structure is the trigger for offer capping. PJM applied a flexible, targeted, real-time approach to offer capping (the three pivotal supplier test) as the trigger for offer capping in 2009. PJM offer caps units only when the local market structure is noncompetitive. Offer capping is an effective means of addressing local market power. Offer-capping levels have historically been low in PJM. In the Real-Time Energy Market offer-capped unit hours fell from 1.0 percent in 2008 to 0.4 percent in 2009.

The analysis of the application of the three pivotal supplier test to local markets demonstrates that it is working successfully to offer cap pivotal owners when the market structure is noncompetitive and to ensure that owners are not subject to offer capping when the market structure is competitive.

Market Pricing

PJM Average Annual Load-Weighted Wholesale Energy Prices 2005-2009
($/megawatt-hour)



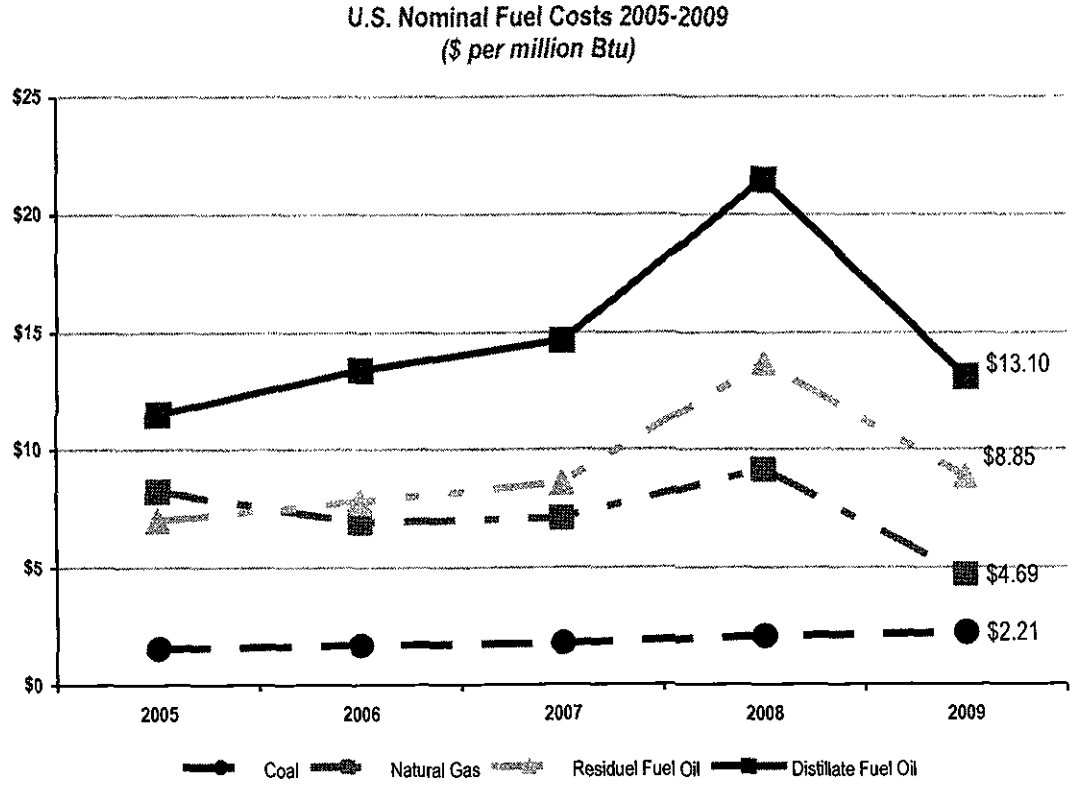
The PJM average load-weighted wholesale energy prices varied during the 2005 – 2009 period due in part to variances in underlying fuel costs and also due to 4.6% lower customer demand in 2009. For example, approximately 72% of the 2008 to 2009 reduction in wholesale electricity prices in the PJM region was due to fuel cost decreases, while the remaining 28% of the reduction was due to lower customer demand. In nominal terms, that means the fuel cost reductions from 2008 to 2009 led to a 32% decrease in wholesale electricity prices in the PJM region, while lower demand contributed an additional 13% reduction in wholesale electricity prices in the PJM region.

Conservation during heat waves not only stretches power supplies, it saves money. Reductions in electricity use during the early August 2006 heat wave produced price reductions estimated to be equivalent to more than $650 million in payments for energy for the week. Customers in the 13-state PJM region set a new record for power consumption of 144,796 megawatts on August 2, 2006. On that day alone, voluntary reductions in electricity use through demand response resulted in price reductions estimated to be equivalent to more than $230 million in payments for energy.

These voluntary curtailments through PJM's Demand Response program reduced wholesale energy prices by more than $300 per megawatt hour during the highest usage hours in early August 2006. While many wholesale customers, such as utilities, were hedged against high real-time spot-market prices, all customers benefit from the

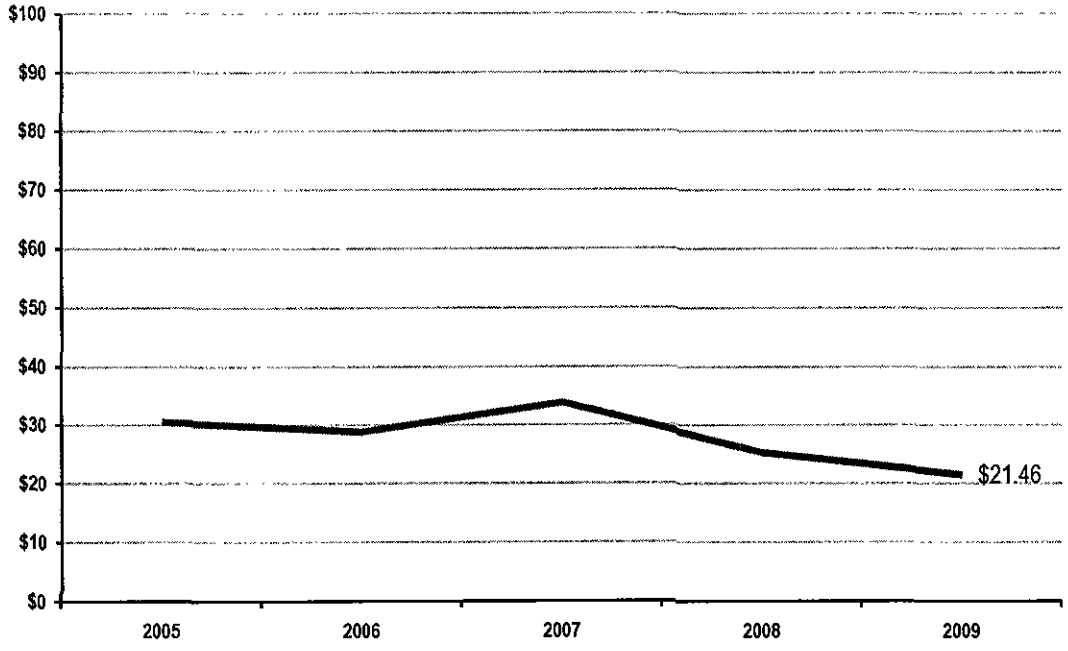
dramatic price reductions because future longer-term electricity sales are based on prices set in the real-time market, where prices were lower as a result of demand response.

The chart below from the U.S. Energy Information Administration is a visual representation of the fuel cost inputs from 2005 – 2009 that influenced the energy prices in the PJM region. The consistency in the trends between the preceding chart and several of the fuel cost trends on the chart on the following page are significant, because they illustrate the high correlation between wholesale energy prices and underlying fuel costs.



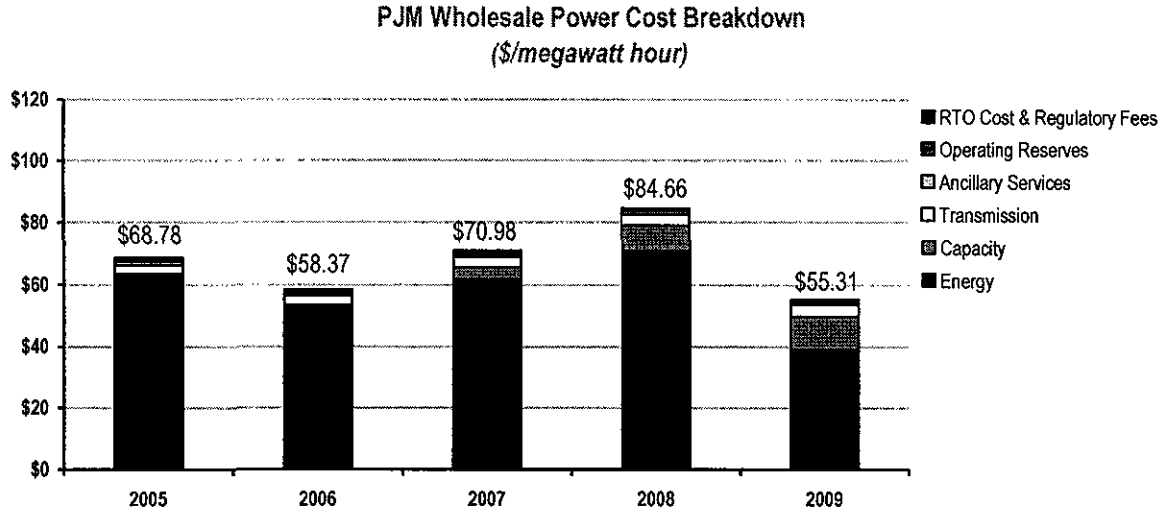
Source: U.S. Energy Information Administration, Independent Statistics and Analysis

PJM Average Annual Load-Weighted
Fuel-Adjusted Wholesale Spot Energy Prices 2005-2009
($/megawatt-hour)



For the five-year period ended December 31, 2009, the load-weighted fuel-adjusted wholesale spot energy prices in the PJM region have decreased 30% from $30.45 to $21.46. The trend in these fuel-adjusted prices reflects the lower demand particularly in 2008 and 2009 that resulted from both the economic downturn and mild weather patterns. With the lower demand, the prices of electricity decreased in the past few years in the PJM region.

PJM's base year for fuel cost references is 1999 as this is the first full year that PJM administered both spot and day-ahead energy prices.



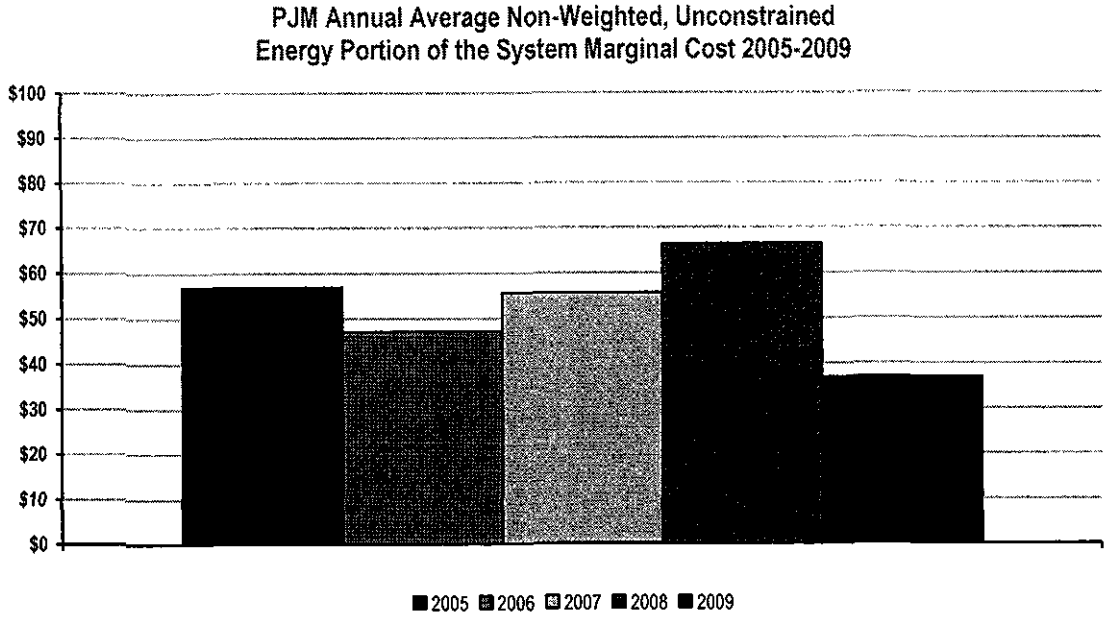
On an annual basis, energy costs have comprised 70 – 90% of PJM's total wholesale power costs for the past five years. PJM implemented its three-year forward capacity market, the Reliability Pricing Model (RPM), in 2007. Capacity revenues earned through RPM are netted against the energy cost component of total power costs per megawatt hour. If combined, the energy plus capacity components represent more than 90% of total power costs per megawatt hour for each of the five years in the period 2005 – 2009.

Recent sensitivity analyses indicate that the completion of all transmission backbone projects in PJM's Regional Transmission Expansion Plan (RTEP) would reduce total RPM capacity costs by about $3 billion (or more than 30%) annually.

And, as noted previously, fuel costs drive approximately 70% of wholesale electricity price changes in the PJM region. So, it is again logical that the trends in total wholesale power costs in the PJM region have moved consistently with fuel cost trends.

All other components of PJM's wholesale power cost per megawatt hour, exclusive energy and capacity, account for less than 10% of the total costs per megawatt hour. In particular, the operating reserve costs (sometimes referred to as uplift) have been less than $1.00 per megawatt hour of the total wholesale power cost in the PJM region. In 2005 through 2009, such uplift costs represented 1.4% or less of the total wholesale power cost per megawatt hour during that five-year period.

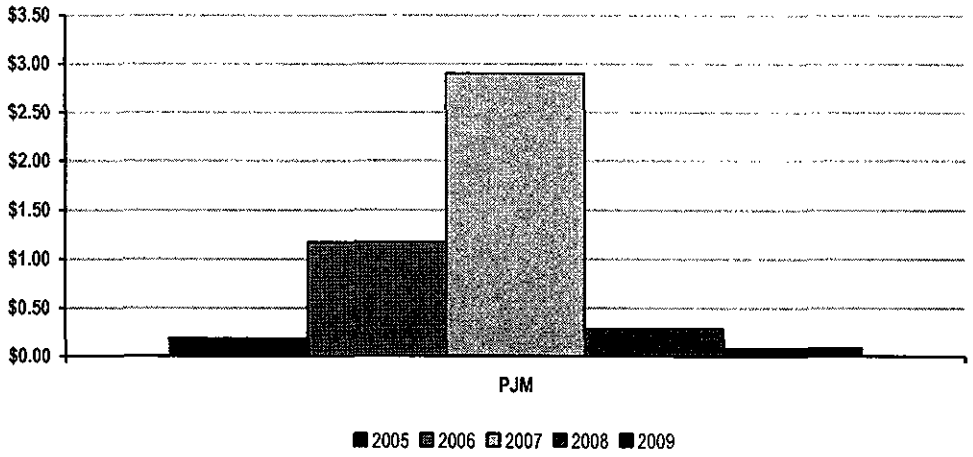
Unconstrained Energy Portion of System Marginal Cost



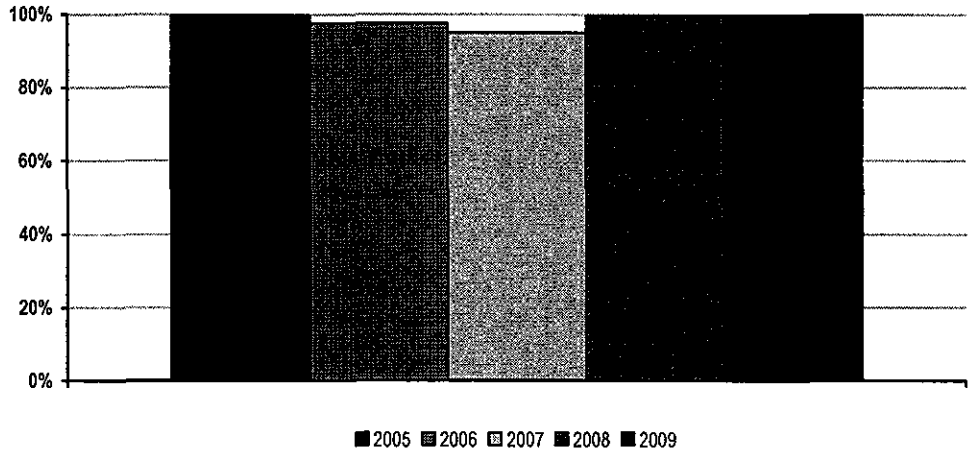
The unconstrained energy portion of system marginal cost is the marginal price of maintaining power balance in the economic dispatch in the PJM region ignoring transmission limitations. This trend chart reflects the annual average marginal price of energy across the PJM region over all hours. The trend closely follows the trend of aggregate fuel prices from 2005 through 2009, which illustrates the fact that marginal energy price fluctuations are primarily driven by fuel prices.

Energy Market Price Convergence

PJM Day-Ahead and Real-Time Energy Market Price Convergence 2005-2009



PJM Percentage of Day-Ahead and Real-Time Energy Market Price Convergence 2005-2009



PJM's nominal difference between day-ahead and real-time prices was highest in 2007 when there was greater volatility in real-time prices, reflecting high constraint levels in fall 2007 when weather remained hot in the PJM region as the fall transmission maintenance season commenced. However, the percentage of day-ahead and real-time price convergence in the PJM electricity markets averaged over 98% from 2005 through 2009.

To improve reliability and reduce potential competitive seams issues, PJM and its neighbors have developed, and continue to work on, joint operating agreements. These agreements are in various stages of development and include a reliability agreement with the NYISO and an implemented operating agreement with the Midwest ISO. One objective of such interregional coordination agreements is the harmonization of border prices. Price convergence

between PJM's and bordering region's wholesale competitive market prices is one data point to assess the effectiveness of these agreements.

The 2009 real-time hourly average interface prices for PJM/Midwest ISO and Midwest ISO/PJM were $29.67 and $29.68, respectively. The simple average difference between the real-time Midwest ISO/PJM Interface price and the PJM/Midwest ISO Interface price decreased from $1.17 per megawatt hour in 2008 to $0.01 per megawatt hour in 2009. These differences represent 97.68% and 99.97% price convergence, respectively, for 2008 and 2009. This is consistent with the fact that PJM's net exports in 2009 were significantly lower than in 2008, as the price convergence in 2009 did not provide the incentives to purchase power from PJM and export to or through the Midwest ISO.

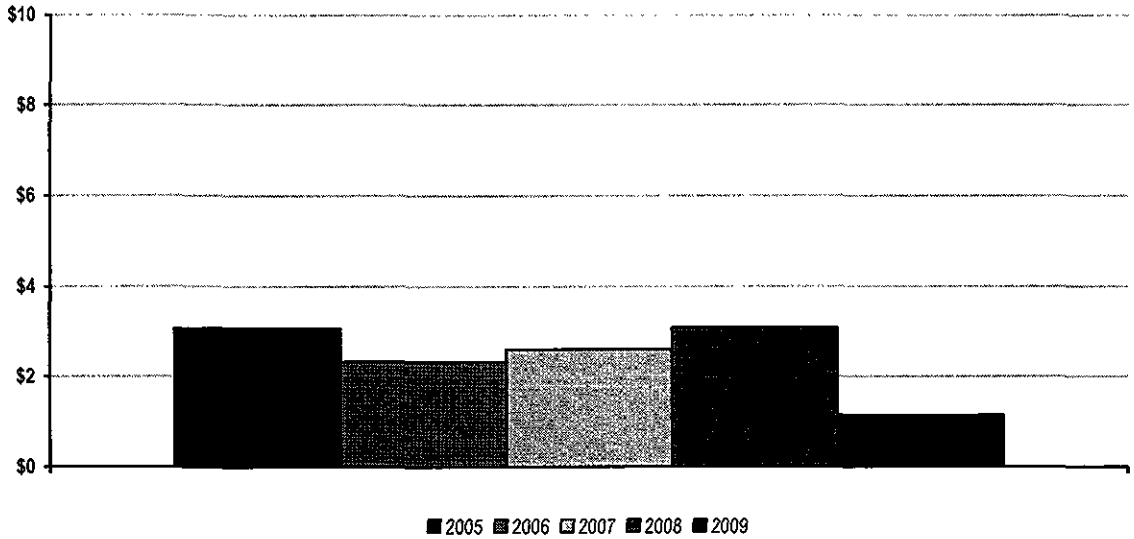
Several factors are responsible for the relationship between interface prices. The simple average interface price difference suggests that competitive forces prevent price deviations from persisting, an observation further supported by the frequency with which price differential switches between positive and negative. In addition, there is a significant correlation between the real-time monthly average hourly PJM/Midwest ISO and Midwest ISO/PJM Interface prices during the 2009 period.

PJM's price for transactions with the NYISO (excluding those transactions across the Neptune and Linden lines), termed the NYIS Interface pricing point by PJM, represents the value of power at the PJM/NYISO border, as determined by the PJM market. PJM defines its NYIS Interface pricing point using two buses. Similarly, the NYISO's price for transactions with PJM, termed the PJM proxy bus by the NYISO, represents the value of power at the NYISO/PJM border, as determined by the NYISO market. In the NYISO market, transactions are required to have a price associated with them. Import transactions are treated as generator offers at the NYISO/PJM proxy bus. Export transactions are treated as load bids. Competing bids and offers are evaluated along with the other NYISO resources and a proxy bus price is derived.

The 2009 real-time hourly average PJM/NYIS Interface price and the NYISO/PJM proxy bus price were $37.37 and $39.16. The simple average difference between the PJM/NYIS Interface price and the NYISO/PJM proxy bus price increased from $0.86 per megawatt hour in 2008 to $1.79 per megawatt hour in 2009. These differences represent 98.81% and 95.32% price convergence, respectively, for 2008 and 2009. PJM's net export volume to the NYIS Interface for 2009 was significantly higher than in 2008. This is consistent with the fact that the PJM/NYIS price was, on average, lower than the NYISO/PJM price in 2009.

Congestion Management

PJM Annual Congestion Costs per Megawatt Hour of Load Served 2005-2009

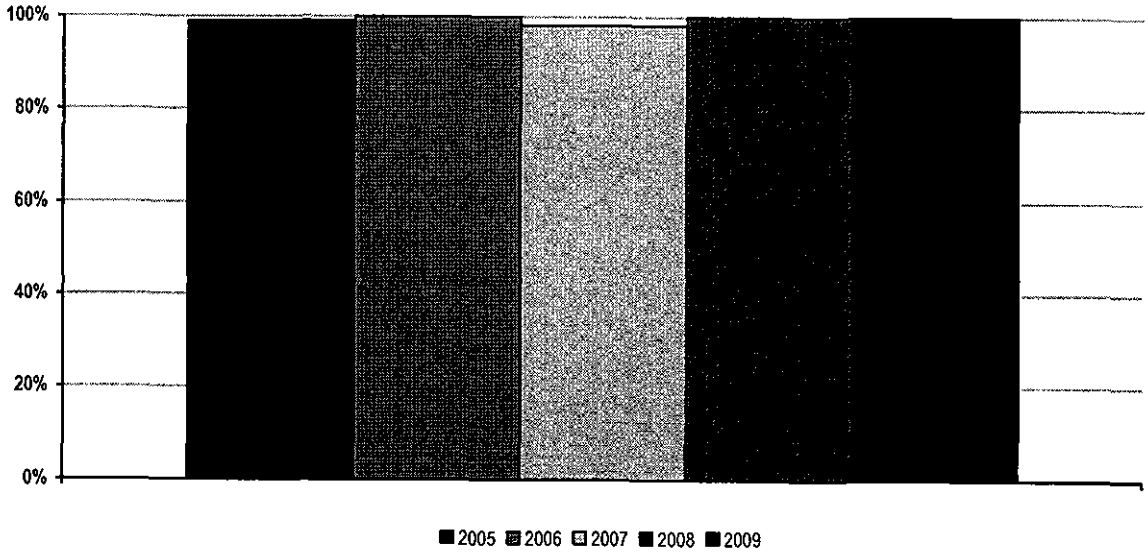


Congestion costs in the PJM region are influenced by weather, energy prices and available transmission system capacity. For example, the higher wholesale energy prices in 2008 resulted in a higher congestion cost per megawatt hour of load served that year, while lower wholesale energy prices and lower demand in 2009 caused per megawatt hour congestion to fall over 60%.

PJM's Regional Transmission Expansion Plan (RTEP) includes several extra high voltage transmission lines that will increase the available transmission system capacity in the PJM region. In the aggregate, those transmission lines are expected to alleviate 90% of the current congestion costs in the PJM region.

In order to address the need for long-term transmission rights, PJM added a stage to its FTR market. In stage 1A of the allocation process, each network service user may request auction revenue rights (ARRs) for a term covering 10 consecutive PJM planning periods. ARRs allocated in stage 1A will be modeled in a 10-year analysis in which a zonal growth rate will be applied and anticipated ARR allocation increases will be determined. If during any year of this 10-year analysis it is determined that the anticipated ARRs will not be feasible, then PJM will recommend transmission upgrades into the PJM RTEP to ensure the 10-year feasibility of stage 1A ARRs.

PJM Percentage of Congestion Dollars Hedged Through PJM's Congestion Management Markets 2005-2009



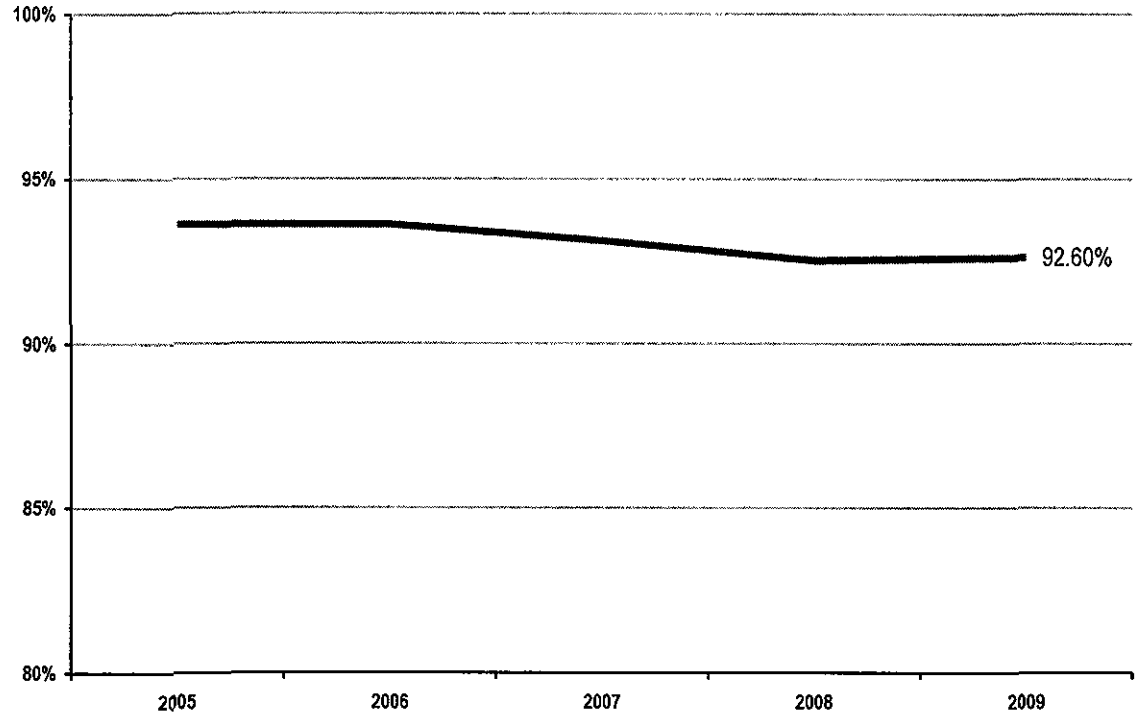
PJM's financial transmission rights (FTR) are financial instruments that entitle the holder to a stream of revenues (or charges) based on the hourly congestion price differences across a transmission path in the Day-Ahead Energy Market. FTRs provide a hedging mechanism that can be traded separately from transmission service. Market participants are able to hedge against their congestion costs by acquiring FTRs that are consistent with their energy deliveries. Participants use PJM's FTR market tool to post their FTRs for bilateral trading as well as to participate in the scheduled monthly, annual and long-term (three-year) FTR auctions.

For the past five years, PJM's FTR market has had sufficient liquidity and capacity to allow the overwhelming majority (98 – 100%) of congestion to be hedged. PJM's FTR market was 93% and 96% revenue adequate in 2005 and 2006, respectively, and 100% revenue adequate from 2007 through 2009. FTR market revenue adequacy reflects the relationship of actual FTR revenues to the target allocations for all FTR holders in the aggregate.

Resources

Balancing customer demand and available resources can be achieved by a combination of changing generation output and/or reducing the total customer demand. The charts and discussion below reflect PJM's history with generation and demand response resources being available when called upon by PJM to revise output or usage levels.

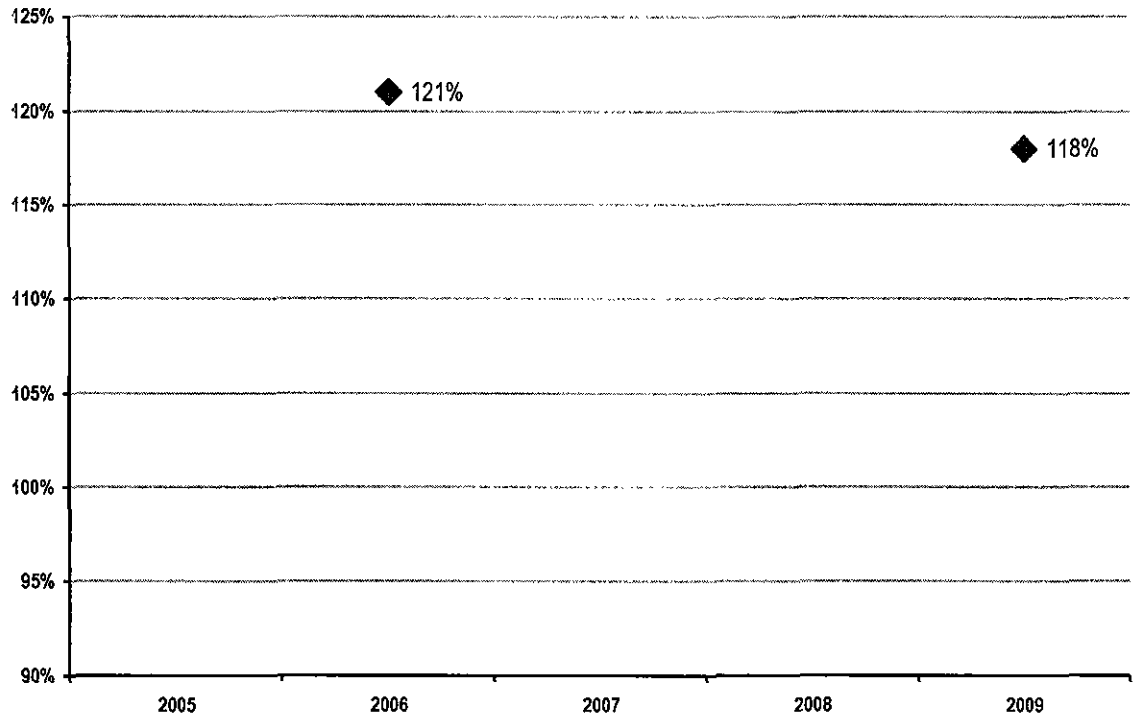
PJM Annual Generator Availability 2005 – 2009



Generator availability in the PJM region has been strong during the last five years. Older coal-fired generating units in the PJM region have had decreased availability approximately 1% in the past few years. These units have run less frequently based on their costs, and investments in upgrades to those units have become challenging financial decisions for their owners in light of the uncertainty over the impact on those units of potential future state and federal environmental legislation.

The incentives provided by PJM's transparent, single clearing price energy market have directly resulted in improved generator performance and reduced outage rates, further decreasing the required reserve margin. The PJM average forced outage rate has decreased over 2% since the initiation of the PJM locational marginal pricing (LMP) energy market in 1998. Multiplying the megawatts of reduced reserve margin times the cost of installing the additional capacity that would be required absent centralized dispatch and the improved generator availability yields a savings of between $366 million and $900 million each year.

PJM Annual Demand Response Availability 2005 – 2009



Historically, load serving entities in PJM have had the ability to meet their capacity requirements through the commitment of demand side resources. With the advent of the Reliability Pricing Model, demand side resources are able to participate in the capacity procurement process as either demand resources or interruptible load for reliability.

The 2006 Demand Response Availability represents the actual response PJM received when PJM called on demand resources in August 2006.

The 2009/2010 delivery year marks the first time PJM has required demand side resources to test their capability to deliver the reductions committed to meet capacity requirements. The test results for the 2009/2010 deliver year demonstrate that in aggregate, committed demand side resources performed at 118% of their committed capacity values.

Demand resources in 16 of the 17 transmission zones in the PJM region tested at more than 100% of their respective commitment levels. These commitments were made by 80 Curtailment Service Providers (CSPs) in 17 transmission zones with a total of 336 CSP/zone combinations.

PJM Demand Response Future Enhancements:

In 2007 and 2008, PJM worked collaboratively with its members and regulators to identify a Demand Response (DR) Roadmap of the opportunities for the evolution of DR resource participation in PJM. The DR Roadmap for the PJM region includes potential improvements in the following areas: dispatch of demand resources, data management, settlement of DR activity, DR in the planning process, and forward price signals for DR.

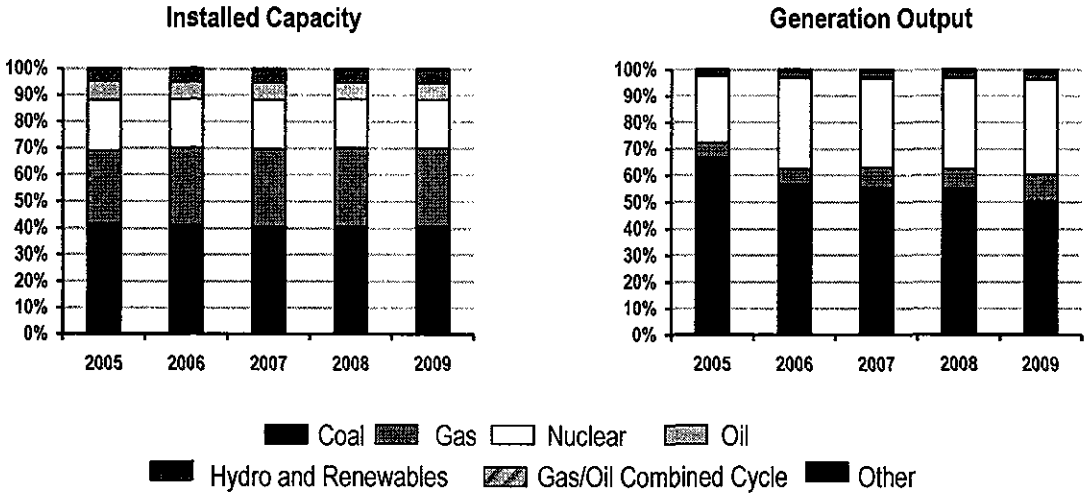
The suggestions in PJM's DR Roadmap were assembled from a variety of sources. These include Mid-Atlantic Demand Resources Initiative (MADRI) activities, recommendations from PJM Symposium on Demand Response, state commission demand response working groups, PJM's Demand Side Response Working Group, and the NARUC/FERC demand response collaborative. The next steps in PJM DR Roadmap include:

- Shortage Pricing implementation in 2011 – Shortage pricing allows for the joint optimization of energy and ancillary services in the real-time dispatch algorithm together, as well as incorporates demand curves to set energy and reserve prices during periods of operating reserve shortage. Managing ancillary service requirements simultaneously with energy in real time and calculating prices every five minutes together with locational marginal pricing (LMP) promotes more efficient commitment of resources for energy or ancillary services and clearing prices that are reflective of actual operating conditions. The joint optimization of energy and ancillary services provides benefit to the system by lowering overall production costs and the resulting five-minute pricing for reserves will enhance opportunities for innovative resources, such as storage devices, to provide ancillary services. Developing a shortage pricing mechanism will adapt market design to more readily provide shortage price signals to take advantage of innovations in demand response and smart grid technologies.

- Price Responsive Demand (PRD) implementation in 2011 – PRD is the predictable reduction in consumption in response to changing wholesale prices. In the PJM region, Smart Grid investment is under development for many market participants and this evolving Advance Metering Infrastructure will enable the enhanced measurement and control required for the implementation of PRD. As a new PJM market option, to the extent retail rates are directly linked to varying wholesale prices, PRD can enable end-use sites with load reduction capability to reduce energy bills by reducing usage during times of high wholesale prices. PRD implementation will enhance market efficiency by increasing the direct participation by demand in the wholesale market.

Fuel Diversity

PJM Fuel Diversity 2005-2009

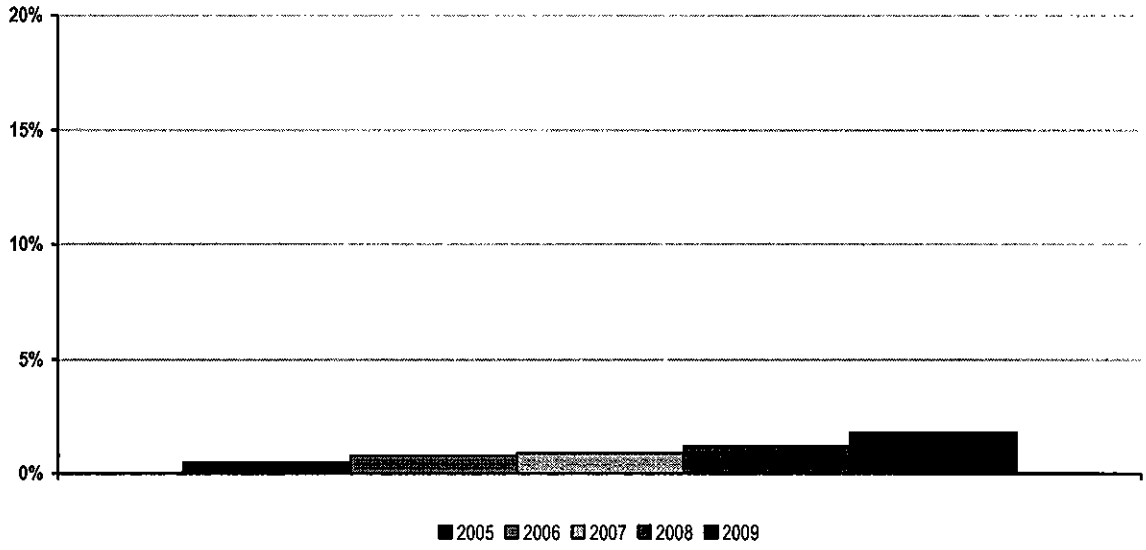


The installed generating capacity in the PJM region is roughly 40% coal, 30% gas and 20% nuclear. However, based on the costs of running the generators in the PJM region, security-constrained economic dispatch actually results in the energy for the PJM region being comprised of 55 – 65% coal, 25 – 35% nuclear and less than 10% from all other fuel sources.

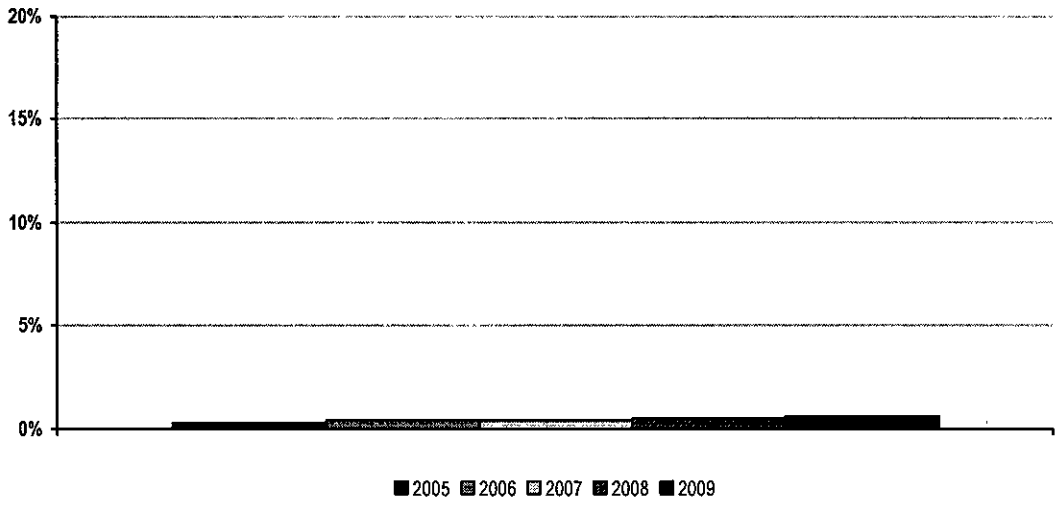
Generation in the PJM footprint does not typically encounter issues around fuel availability or deliverability. PJM has identified approximately 12,000 to 19,000 MW of coal-fired generation that may be at risk of retirement due to potential environmental policy considerations. This range of potential generation at risk represents 7 – 12% of the installed generation capacity in the PJM region. PJM is examining the issue so that reliability may continue to be maintained at the lowest possible cost.

Renewable Resources

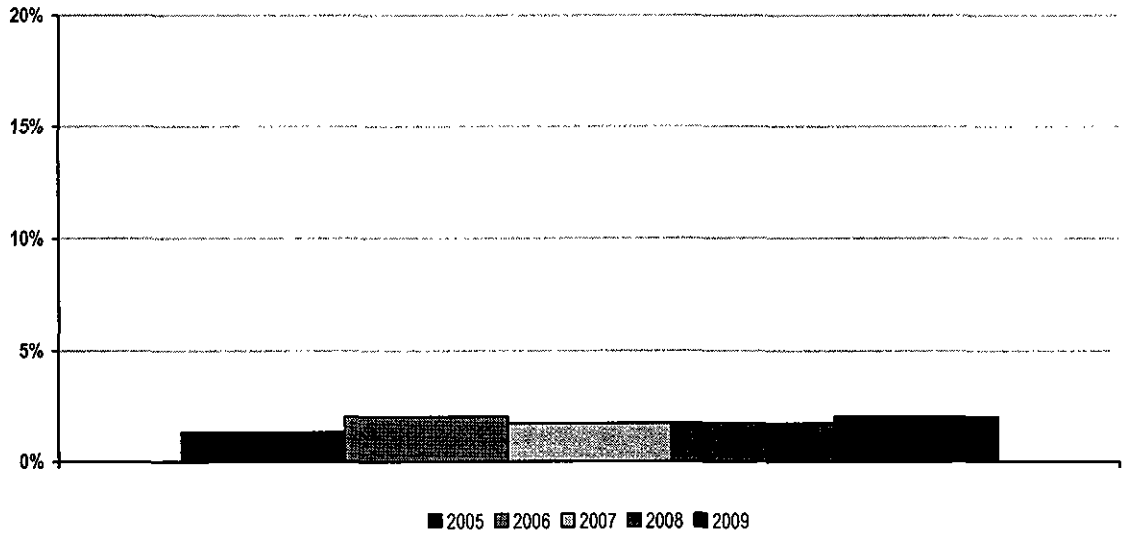
PJM Renewable Megawatt Hours as a Percentage of Total Energy 2005-2009



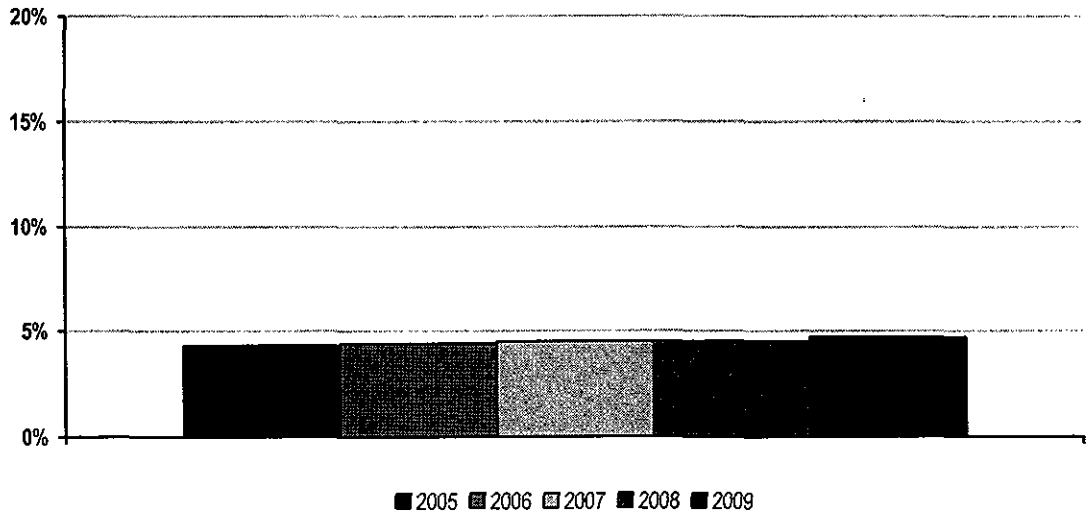
PJM Renewable Megawatts as a Percentage of Total Capacity 2005-2009



PJM Hydroelectric Megawatt Hours as a Percentage of Total Energy 2005-2009



PJM Hydroelectric Megawatts as a Percentage of Total Capacity 2005-2009



Energy and installed capacity contributions from renewable fuel has been growing in the PJM region in the past few years, with tens of thousands of megawatts of potential renewable capacity currently being studied for potential future construction. Installed hydroelectric capacity in the PJM region has not changed materially in the past few years and there are few hydroelectric plants under consideration by generation developers.

PJM's operating, planning and market rules enable the incorporation of renewable resources into the electric system in the PJM region and into the markets administered by PJM. As of March 31, 2010, PJM had over 75,000 MWs of proposed new generation under consideration in its interconnection queues, including nearly 42,000 MWs of wind generation. At the same time, there were 3,648 MWs of nameplate wind generation in operation at 46 facilities, and 2,752 MWs under construction. In addition, there are 5.5 MW of solar on line at two facilities in the PJM region.

Renewable resources offer into the PJM markets and are subject to security constrained economic dispatch, just as any other generating resource. Renewable resources like wind tend to bid in at zero cost or a negative cost, and this value is considered when economically dispatching units for reliability reasons. In the aggregate, wind resources in the PJM region have a 13% capacity factor, and solar resources in the PJM region have a 38% capacity factor.

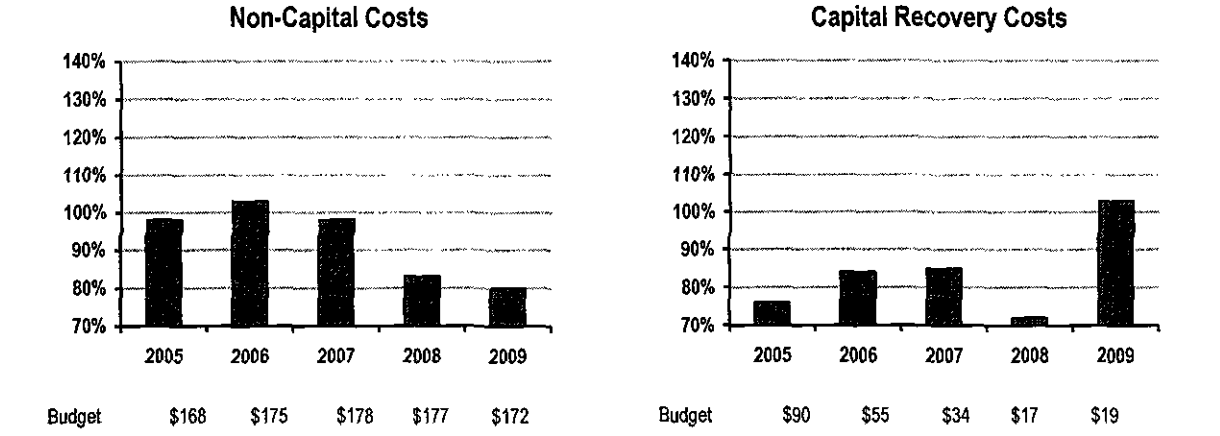
The Renewable Energy Dashboard at www.green.pjm.com illustrates a user-friendly snapshot of the amount and type of generation that currently provides power to the 51 million people in the PJM region. The dashboard also features a map indicating where proposed renewable energy projects are planned and a summary of how much electricity has been produced by renewable sources since 2005.

The amount of renewable energy proposed changes throughout the year as new projects are added and some are withdrawn from the process. The dashboard reflects PJM's on-going commitment to examine energy-related issues and provide information as it relates to the power grid and wholesale power market to help inform public policy discussions.

C. PJM Organizational Effectiveness

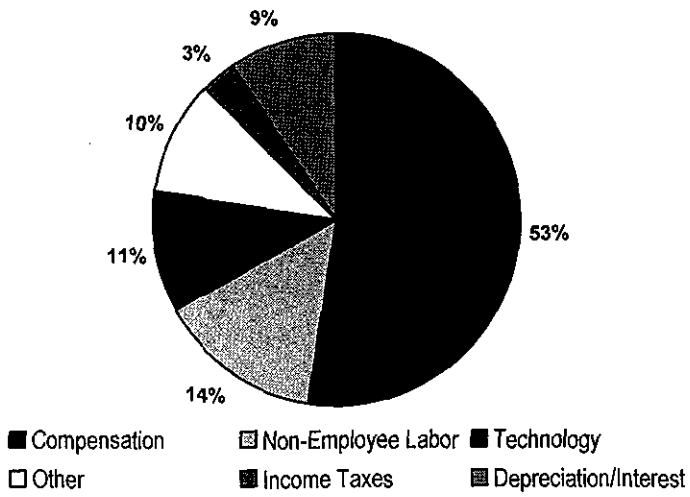
Administrative Costs

PJM Annual Actual ISO/RTO Costs as a Percentage of Budgeted Costs 2005-2009



Bars Represent % of Actual Costs to Approved Budgets; Dollar Amounts Represent Approved Budgets (in millions)

PJM's actual total costs for 2005 through 2009 averaged 90% of the approved budgets, without exceeding the total approved budget in any of those years. As represented in the chart below, PJM's 2005 through 2009 costs were primarily comprised of compensation, non-employee labor and technology expenses. These cost components are consistent with a service organization that utilizes significant people, hardware, software and telecommunications resources to serve its customers.



PJM develops its annual expense and capital budget in consultation with the PJM Finance Committee. The PJM Finance Committee is comprised of two member representatives elected by each of the five member voting sectors plus two members of the PJM Board of Managers. PJM's Chief Financial Officer acts as the non-voting chair of the PJM Finance Committee. PJM's Finance Committee reviews and provides feedback on PJM's preliminary expense and capital budgets during August each year. Then, after PJM management incorporates feedback, the sector-elected representatives to PJM's Finance Committee issue a written recommendation letter to the PJM Board of Managers on the subsequent year's proposed expense and capital budgets. The PJM Board of Managers includes these recommendations in their consideration of the proposed expense and capital budgets no later than October 31st of the year prior to which the proposed budgets apply.

PJM's annual expense and capital resource allocations are based on its service obligations to its members and new initiatives, regulatory directives, industry standards and market rules to be implemented. Prior to the PJM Board of Managers considering the proposed expense and capital budgets, the proposed initiatives and projects are reviewed with several stakeholder committees to ensure the alignment of priorities between the proposed budget resource allocations and the annual plans for those stakeholder committees.

In addition to the recurring review and recommendations on the annual proposed expense and capital budgets, the PJM Finance Committee meets at least quarterly to discuss actual costs compared with approved budgets and the most recent forecast of expenses and capital expenditures for the current year. The PJM Finance Committee is also consulted and asked to provide recommendations regarding (a) proposed multi-year capital projects estimated to cost $25 million or more, and (b) any potential changes to PJM's administrative cost recovery and rates in its Tariff.

PJM recovers its administrative expenses through stated rates applicable to market participants' transaction volumes, such as megawatt hours of load served, generation sold, and FTRs held. PJM is not authorized to charge its members rates higher than these stated rates without a FERC-approved rate filing. So, the stated rates act has long-term ceilings to how much PJM can charge members for the administrative costs of their transactions. If PJM's actual costs are less than the revenues resulting from the application of the stated rates, then PJM refunds the difference to members on a quarterly basis.

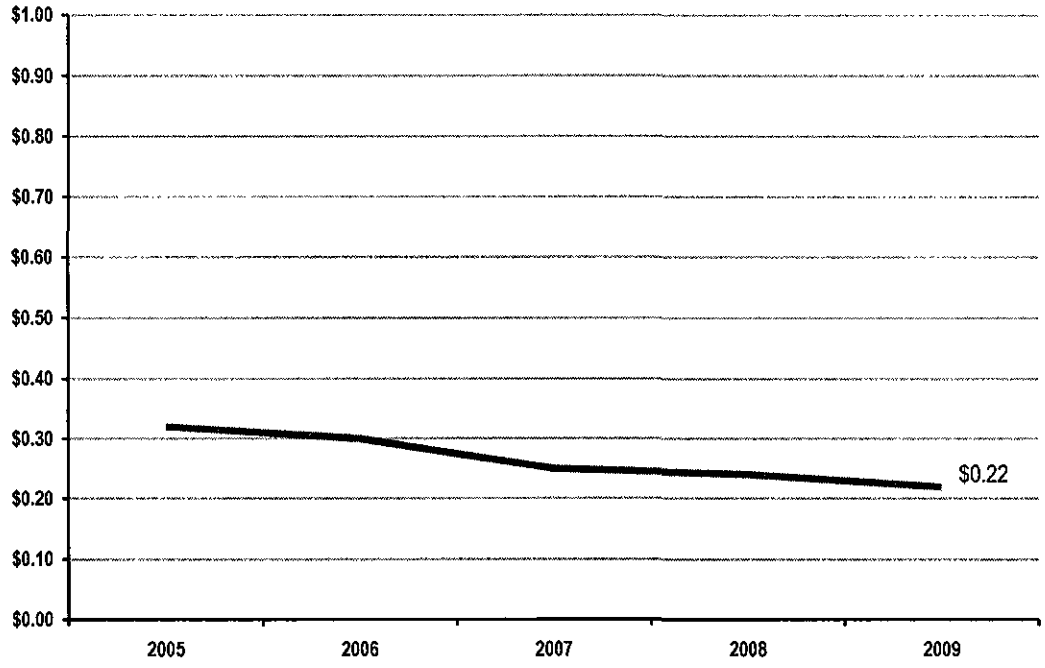
PJM's 2005 through 2007 actual non-capital expenses did not vary materially from the approved non-capital budget for those years. PJM's 2008 actual non-capital expenses were 17% lower than budget primarily due to lower consulting and contracting costs required during the development of PJM's second control center and lower income tax expenses. In June 2009, PJM's Board of Managers approved revisions to PJM's postretirement medical plan resulting in a non-recurring $26 million income tax benefit which was the primary driver of the 20% variance in PJM's actual and budgeted non-capital expenses. The variances in 2008 and 2009 lowered PJM's administrative rate per MWhr of load served by about $0.04 compared with each year's forecasted rates.

PJM's capital recovery costs in the previous chart reflect depreciation and interest expense in each year, as PJM's Tariff stipulates that capital investments are recovered from PJM's members after the related assets are placed in service. PJM's 2005 actual capital recovery costs were approximately 24% lower than its approved budget primarily due to lower than budgeted technology investment related to the integration of additional transmission zones into the PJM region. PJM's 2006 actual capital recovery costs were lower than budgeted for a few reasons – the lower 2005

actual capital spending, lower interest expense on lower than budgeted borrowing levels, and the shift of a few capital projects from 2006 to 2007. PJM's 2007 actual capital recovery costs were lower than budgeted due to lower interest expense due to lower borrowings required to fund PJM's capital expenditures.

PJM's 2008 actual capital recovery costs were 28% lower than budget due to the impact on depreciation and interest expense of the revised completion dates of certain projects such as the market settlement system replacement and lower interest expense from lower borrowings than budgeted. PJM's 2009 actual capital recovery costs did not vary significantly from its budgeted capital recovery costs. With the planned completion of PJM's second control center in 2011, PJM's capital recovery costs are projected to increase from 2011 forward to reflect the depreciation and interest expenses associated with that approximate $140 million capital investment.

PJM Annual Administrative Charges per Megawatt Hour of Load Served 2005-2009
($/megawatt-hour)

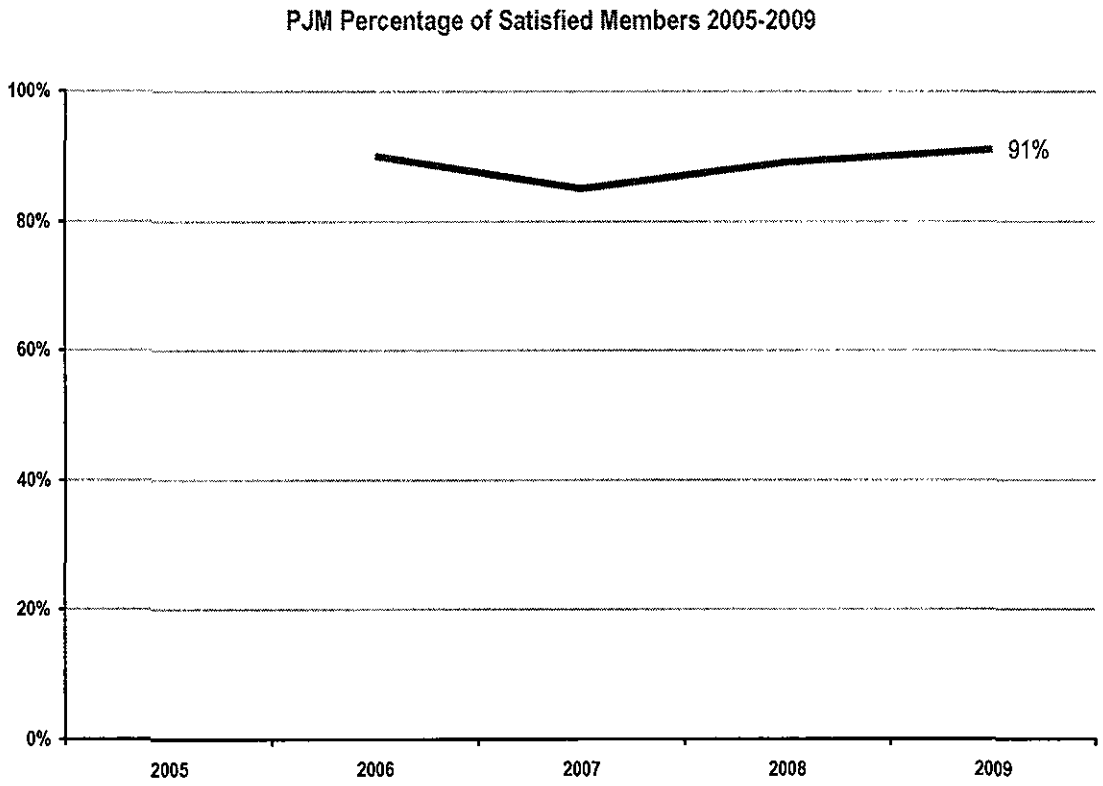


The administrative costs per MWh of load served data in the chart above should be reviewed in the context of the PJM annual load served noted in the table below.

ISO/RTO	2009 Annual Load Served *(in terawatt hours)*
PJM	710

PJM's actual to budget variances in 2008 and 2009 lowered PJM's administrative rate per MWh of load served by about $0.04 compared with each year's forecasted rates. Prospectively, PJM forecasts its annual administrative rates will be approximately $0.31 per MWh of load served as recovery of the investments in (1) a second control center and (2) new reliability and markets software and hardware commence in 2011.

Customer Satisfaction



PJM's 2005 stakeholder survey did not ask the same satisfaction questions as were asked in 2006 through 2009; hence, there is no comparable 2005 satisfaction statistic for PJM. PJM's stakeholder survey requests anonymous feedback to an independent firm on levels of satisfaction and stakeholder value derived from numerous PJM functions. Based on survey takers' self-selected description, PJM's 2006 through 2009 satisfaction percentages have not differed significantly among member sectors, e.g. electric distributors, end-use customers, generation owners, other suppliers and transmission owners. In the 2009 survey, the reliability management and training functions received the highest satisfaction ratings with the system planning and communications areas demonstrating opportunities for improvement.

PJM implements action plans to address areas for which there are opportunities for improvement. In the past few years, PJM has focused on feedback to improve stakeholder access to PJM information and stakeholder communications with the PJM Board of Managers. For example, PJM and its members established the Liaison Committee in 2007 to provide greater opportunities for direct communications between stakeholders and the PJM Board of Managers. Also, in 2008, PJM redesigned its website to facilitate stakeholder access to information on operations, markets and stakeholder committee activity. In 2009, PJM's members responded with the highest value rating in PJM's ten-year history of surveying its members.

PJM Customer Satisfaction Future Enhancements:

Based on feedback received during PJM's 2009 customer satisfaction survey, PJM will implement the following improvements during 2010:

Long-Term System Planning:

- Augment staffing levels
- Re-establish the Regional Planning Process Working Group as a member forum to address transmission planning concerns

PJM Web-site:

- Improve web-site speed
- Improve web-site, generation interconnection and planning queue searches
- Implement Issues Tracking
- Increase frequency of communications to members on web-site changes

Billing Controls

ISO/RTO	2005	2006	2007	2008	2009
PJM	Unqualified SAS 70 Type 2 Audit Opinion	Unqualified SAS 70 Type 2 Audit Opinion	Unqualified SAS 70 Type 2 Audit Opinion	Unqualified SAS 70 Type 2 Audit Opinion	Unqualified SAS 70 Type 2 Audit Opinion

In 2009, PJM's market settlement billing controls passed the stringent SAS (Statement on Auditing Standards) 70 Type 2 audit for the ninth consecutive year, even with the significant 2009 change from a monthly to a weekly billing cycle. In keeping with governance rules, such as those in the Sarbanes-Oxley Act of 2002, PJM's SAS 70 report is designed to provide an understanding of its internal controls to the auditors of the companies that use the organization's services, i.e. PJM's members. PJM's internal controls and processes related to all billing line items are included in the scope of testing completed during each twelve-month SAS 70 audit period.

PJM focuses on the accuracy of both prices posted and amounts billed to ensure members can rely on prices for transacting and have confidence in the amounts included in their PJM invoices.

- In the five years ended December 31, 2009, PJM reposted hourly energy prices once in 2006, twice in 2007 and five times in 2008. There were no energy price corrections in 2005 or 2009. The energy price corrections applied to either one pricing point or one hour's prices for each of the affected days and prices were revised from 0.06% to 6.43% for these hours. For the five-year period ended December 31, 2009, PJM achieved 99.99996% energy price posting accuracy.
- For the five-year period 2005 through 2009, PJM's billing accuracy based on dollars of billing adjustments divided by total dollars billed averaged 99.8%.

D. PJM Interconnection Specific Initiatives

Perfect Dispatch: PJM's Perfect Dispatch metric provides a measure of PJM's performance in dispatching the system in the most efficient manner possible and optimizing locational pricing as a reflection of the dispatch solution. The objective of the Perfect Dispatch measure is to compare PJM's actual dispatch solution against the ideal case if all system conditions, including actual electricity usage, had been known before the dispatch signals were sent to the generators in the PJM region. During 2009, PJM improved its generation dispatch sufficiently to reduce annual generation production costs by $122 million.

PJM Perfect Dispatch Future Enhancement:

During 2010, PJM will expand its Perfect Dispatch initiative to evaluate and optimize steam generating unit commitment actions outside of the Day-Ahead Market schedule to allow PJM to identify areas for further operational improvement in dispatch that result in dollar savings in generation production costs to members.

Credit Risk Management: PJM implemented more than a dozen improvements to its billing and credit practices during 2009 to reduce the risk of socialized default charges to its members. In particular, PJM replaced its previous monthly billing cycle with weekly billing and settlement on June 1, 2009. This change resulted in a $2.9 billion (70%) reduction in the total credit risk exposure to PJM's members. Further, PJM returned $1.0 billion of financial security to its members due to lower credit requirements under accelerated settlements.

PJM Credit Risk Management Future Enhancement:

During 2010, PJM asked its members and the Federal Energy Regulatory Commission to support revisions to PJM's Operating Agreement and Tariff to clarify PJM's legal capacity as the central counterparty for members' non-bilateral transactions billed by PJM effective January 1, 2011.

Demand Response and Energy Efficiency Capacity Market Participation: During 2009, PJM implemented capacity market rule changes that increased the opportunities for demand response and energy efficiency to participate in PJM's capacity market auction for the 2012/2013 planning year. The 5,682 megawatt increase in demand resources over the last Reliability Pricing Model auction in 2008 is enough capacity that would be equivalent to the power needs of about five million households. A total of 67% of the demand resources cleared in constrained regions, reflecting its value in helping to reduce congestion. For the first time, energy efficiency participated in the sixth RPM auction bringing 569 megawatts of new energy efficiency resources to PJM. Total revenues earned by demand response resources in 2009 from energy, capacity and ancillary service market participation exceeded $300 million, nearly a 60% increase from 2008.

Market Liquidity: Another measure of the efficiency and effectiveness of wholesale power markets is the ability for financial derivative products to be developed and utilized by physical market participants to mitigate price risk, such as swap futures. The development of such products that are settled against wholesale market outcomes also signals confidence in the accuracy and relevance of the prices determined in the wholesale market. Currently, the New York Mercantile Exchange (NYMEX) trades 52 PJM-based contracts that are differentiated by location, peak or off-peak, and day-ahead or real-time markets. Open interest in day-ahead and real-time contracts traded at locations within

PJM reflects the total megawatt hours (MWhs) of energy hedged by these Swap Futures, which is 9 – 12.5% of total load in the reference PJM transmission zones. The percentage of load hedged through financial contracts is even more significant if one considers that 17% of the real-time load was served out of the real-time market, with the remainder self-supplied or served by bilateral contracts. Such statistics indicate that the combination of wholesale power markets with financial instruments facilitates less than 10% of total load served in the PJM region likely being exposed to the potential volatility of real-time prices. Further, during 2009, PJM began hosting a long-term contracting bulletin board for all the ISOs/RTOs to enable buyers and sellers interested in longer-term contracts to contact each other.

Industry Innovation / Collaboration: PJM's ability to deliver value also involves leveraging its intellectual resources and vast stores of data to assess the impact of potential public policy initiatives on the grid and markets. An example is the widely referenced study of the potential impact of climate-control legislation that PJM published early 2009. PJM also sponsored symposiums on plug-in hybrid electric vehicles and demand response and Price Responsive Demand in order to provide members and policy-makers with knowledge on the issues and how their development might affect the grid and the PJM region.

Grant Collaboration: To further broader transmission planning, the Eastern Interconnection Planning Collaborative was formed in 2009. The collaborative and the states received a total of $30 million in federal grants to address the need for wide-area planning to deal with the massive growth of wind energy and other renewable sources resulting from new energy policies in Washington. Also, the combined efforts of PJM and 12 transmission-owning members gained $14 million in matching federal stimulus funds to support a massive expansion of the number of synchrophasors throughout 91 substations in 10 states. This will vastly expand our ability to see and quickly react to abnormal conditions, thereby strengthening both the reliability and digital intelligence of the bulk electric system.

PJM Value Proposition: The following summarizes the impact of specific elements of PJM's role that produce benefits and economic value for the region it serves. **Annual savings: as much as $2.2 billion**

Reliability – resolving constraints and economic efficiency – **from $470 million to $490 million in annual savings**

Energy production cost – efficiency of centralized dispatch over a large region – **from $340 million to $445 million in annual savings**

Generation investment – decreased need for infrastructure investment – **from $640 million to $1.2 billion in annual savings**

Grid services – cost-effective procurement of synchronized reserve, regulation – **from $80 million to $105 million in annual savings**

A. Reliability Savings

PJM's ability to direct changes in the output of generating resources (redispatch) rather than curtail power-sales transactions to deal with transmission congestion enables it to deal with transmission constraints more effectively. By reducing the need for curtailments over a wide area – transmission loading relief procedures, or TLRs – PJM's narrowly targeted redispatch procedures resolve transmission constraints more quickly. This approach has significantly reduced the need for transaction curtailments to maintain transmission system reliability.

Annual savings: $78 million to $98 million

By planning for future reliability needs on a region-wide rather than a utility-by-utility or state-by-state basis, PJM's Regional Transmission Expansion Planning (RTEP) process helps focus on transmission upgrades that meet reliability criteria and increase economic efficiency.

Annual savings: $390 million

B. Generation Investment Savings

The large size of the PJM market area, combined with its diversity of demand and resources, reduces the overall level of capacity needed to ensure adequate reserves of electricity to meet peak demand or emergency situations. This capacity buffer, known as the reserve margin, would need to be higher without PJM. Consumers avoid the costs of additional generation to meet higher levels of reserves.

Annual savings: $366 million to $900 million

The commitment of demand-response resources to reduce load during system peaks also forestalls the cost of building additional generating facilities. Through the Reliability Pricing Model (RPM), demand response competes on an equal footing with generation and transmission in the capacity market. Through RPM, the quantity of demand response that is providing capacity in the PJM footprint has increased by more than 1,800 megawatts.

Annual savings: $275 million

C. Energy Production Cost Savings

PJM's centralized dispatch of the numerous resources over its expanded territory produces significant efficiencies and cost savings compared with the previous operation of independent control areas across the region. The increasing effectiveness of PJM's dispatch operations also has reduced operating reserve costs.

Annual savings: $340 million to $445 million

D. Grid Services Savings

By operating markets for grid services, also known as ancillary services, across its footprint, PJM achieves economies in providing services that are essential to the reliability of the electric system. Synchronized reserve service supplies electricity if the grid has an unexpected need for more power on short notice, while regulation helps match generation and load by correcting for short-term changes in electricity use that might affect system stability.

Annual savings: $80 million to $105 million

Comments re: Davis-Besse 20 year license extension vis a vis our environmental coalition's 5th Cracking Contention Supplement dated 8 16 12

[posted online at:
www.beyondnuclear.org/storage/FOIA Appendix B contention supplement 8 16 2012.pdf]

Document B/1 [undated; Davis-Besse Nuclear Power Plant, Unit Licensing Basis Seismic Ground Motion Concern. (3 pages)], pages 7-10/101 in the supplement:

The ACRS and NRC Staff expressed concerns about D-B's seismic qualifications. Where ACRS called for a factor of 0.20g ground acceleration as a conservative Safe Shutdown Earthquake, a mere 0.15g acceleration factor was called for in D-B's Updated Safety Analysis Report (USAR).

Given the Aug./Sept. 2013 revelations of worsening cracking, and the Feb. 2014 revelations of SB wall gaps and rebar damage from hydro-demolition activities to open the access opening, our concluding paragraph re: Document B/1 is more relevant than ever:

"NRC FOIA Response Number 1's inclusion of Document B/1 shows that 36 years [now 38] after ACRS and NRC Staff first expressed seismic risk concerns at Davis-Besse, these concerns still haunt the facility – now, frighteningly, in the context of a severely cracked shield building."

Of course, the 2011 Fukushima nuclear catastrophe should compel FENOC, NRC and ACRS to take seismic risks at D-B all the more seriously.

Document B/2 [10/14/11; Email from P. Hernandez, NRR to J. Zimmerman, NRR RE: 2011-10-13, POP – Davis-Besse Containment Shield Building. (1 page)], p.10/101:

Despite NRC's early hopes and optimistic assumptions that the SB cracking would prove to be a "non-issue," it actually rendered the Outer Face Rebar Mat structurally dysfunctional. Combined with 2013's worsening cracking and 2014's wall gap and rebar damage, this is now all the more significant.

Document B/4 [10/18/11; Email from S. CuardadoDeJesus (sic), NRR to R. Auluck, NRR et al. on Davis-Besse Shield Building Issue Summary. (2 pages)], p.11-12/101:

Based on Bechtel and Sargent and Lundy's "expert opinion the indications found in the concrete were a product of the hydro-blasting operations and not a pre-existing condition...The NRC inspectors concur with the actions taken to date by the licensee and continue to evaluate the licensee's preliminary conclusions that the indications are related

to the hydro-demolition and do not appear to be preexisting flaws in the concrete shield building."

Although FENOC et al. backed away from this root cause theory, once cracking was discovered across the SB, far from the hydro-blasted access opening, Intervenors nonetheless asserted that hydro-demolition can inflict damage to the SB. In fact, FENOC et al. concurred that it was the first, most likely explanation for the cracking. Therefore it *must be possible that hydro-demolition can, in fact, damage the SB.*

Intervenors' warning, that the second access opening in three years (2011 and 2014) made necessary by D-B's unexpected early failure of the replacement reactor lid after just 7 years of service life, proved prescient, given not only the 2011-2014 SB wall gap, but also the rebar damage inflicted by hydro-blasting open the access opening for the steam generator replacements:

"This added breach by hydro-blasting in 2014 risks inflicting yet more damage on the shield building. This is an aging-related safety issue that could very well increase the safety and environmental risks of the proposed license extension operations from 2017 to 2037."

Intervenors again assert that early failure resulting from a botched steam generator replacement project (challenged by Intervenors in a separate ASLB proceeding), or yet another early failure of a replacement lid, could well necessitate yet another access opening the SB before 2037, risking yet more hydro-blasting damage.

Document B/9 [11/04/11, Email from P. Hernandez, NRR to E. Sanchez Santiago, RIII on Questions about Davis Besse Shield Building Report from DORL. (2 pages)], p.12-14/101:

NRC Staffer Hernandez wrote "I think the greater concern is will the SB stay standing and not whether or not the decorative concrete will fall off. Because the licensee has not performed core bores to see if there is cracking in the credited concrete, do they have a basis to say that the structural concrete will maintain a Seismic II/I condition?"

He wrote this about the sub-surface laminar cracking at the SB Outer Face rebar mat. The worsening of the cracking would not be revealed until Aug./Sept. 2013, and the added risks of SB wall gaps and rebar damage would not be revealed until Feb. 2014. These recent revelations only make his question, "will the SB stay standing," all the more relevant now.

Till now, the SB Inner Face rebar mat has not been checked for cracking impacting its structural integrity, even though Intervenors have documented that the Inner Face was open to exposure to the elements (including moisture saturation and penetration, as well as freezing conditions, just as was the exterior of the SB from the early 1970s till August 2012) for several long years, before the SB dome was added, and before the Initial

Construction Opening was closed. This vulnerability of SB Inner Face rebar and concrete to degradation was especially true at the very top of the SB wall before the dome's installation, as previous Intervenor cracking contention/supplement filings have noted, based on NRC questioning and FENOC/PII responses.

Document B/10 [11/07/11; Davis Besse Shield Building Issue NRC Technical Reviewer Focus Questions. (1 page)], p.14-15/101:

Re: NRC's question and Intervenors' response ("Is extent of condition adequately understood, given limited data points?" echoes Intervenors' questions along t he same lines), we still feel the same way. The sites on the SB where cores bores are required should be increased significantly, as should the frequency of such testing.

Re: [Does the licensee's analysis provide reasonable assurance that the shield building will perform its design function? Why or why not?

a. If yes, does the shield building remain in conformance with all licensing and design basis requirements including required Codes and required safety margins? **Note that if the shield building is functional but nonconforming, then the licensee would be able to restart the plant, but would be expected to have a plan in place to restore conformance (additional analysis, repairs, or license amendment) at the next reasonable opportunity. (emphasis added)**], I'm not at all clear where this stands. Did FENOC provide that "restoration of licensing and design basis" by Dec. 1, 2012, as they were committed to do at the Oak Harbor High School show down in August 2012?

Re: NRC's question [3. Has the licensee provided reasonable assurance that the shield building will remain capable of performing its design function **in the near and distant future (i.e. the condition will not worsen)?** Why or why not? If not, are we comfortable until the next refuel outage (May 2012) and why, and **what additional actions from the licensee, if any, do we think are necessary going forward?** (emphasis added)], what's remarkable is that these questions have not been answered in the past two years, and are as relevant now as they were in 2012, if not more so.

Document B/13 [11/09/11; Email from P. Hernandez, NRR to R. Auluck, NRR et al. Re: Davis Besse Shield Building teleconference. (1 page)], **Document B/15** [11/11/11; Email from J. Zimmerman, NRR to M. Evans, NRR re: DB shield building. (1 page)], and **Document B/16** [11/12/11; Discussion points relayed to the licensee after our internal technical discussion (1 page)], p. 15-19/101:

The tail-wagging-the-dog, where NRC aided and abetted FENOC's rush to restart the reactor despite unanswered questions and unanalyzed risks re: SB cracking, may also very well account for the SB wall gap discovered in Feb. 2014. It appears likely that, as the repair on the access opening was rushed, the gap resulted from carelessness in the

rush job. Intervenors' protested this rush job in their original cracking contention filed on Jan. 10, 2012, as well.

At page 18/101, we documented the NRC "Concern that sampling did not eliminate I.F. [Inner Face] cracking at top of SB **(different undefined failure mechanism Then [sic] in the shoulder).** Thus, core bore, chemical analysis, etc. testing, and on a frequent basis, of the Inner Face rebar and concrete should be part and parcel of the AMP going forward. Also, the current re-do of the root cause report further bolsters challenges Intervenors' have been raising for over two years, but have yet to receive any relief for from NRC or ASLB, such as in the form of a hearing on the merits of our cracking contention and its supplements.

Also, on p. 18/101, we documented NRC's concern that the extensive cracking 20 feet down from the top of the SB in an area of dense rebar "Challenges Prof. Darwin [a FENOC expert witness] concern that rebar splices be outside cracked region," and "Any splice in cracked regions require further evaluation – Prof. Darwin...Design calc – fully effective rebar, **unverified assumption (ACI 349.3R not applicable to laminar cracking)". [emphasis added]**

The damage to the rebar at the edges of the access opening in Feb. 2014 due to hydro-demolition raises the specter that Professor Darwin's caveats are being violated. The damaged rebar also raises questions about mistakes made during the access opening repair work in late 2011. Recurring mistakes (SB wall gaps, rebar damage) during SB access opening repairs (2002, 2011) raise the specter that such mistakes will again be made in 2014, which will decrease radiological containment safety margins during the 2017-2037 license extension.

Document B/18 [11/15/11; Email from P. Hernandez, NRR to J. Zimmerman, NRR on Draft email. (1 page)], p.19/101: "This document states "**The licensee requested a delay of the public meeting to give them more time to finish the splice evaluation.** The NRC accepted so that we would have time to review the documents before the meeting," (emphasis added). Again, as at p.18/101, FENOC's struggle to account for structural integrity and design function of rebar splice areas is still a concern now, given indications of worsening cracking in Aug./Sept. 2013, as well as rebar damage from hydro-demolition revealed in Feb. 2014.

Document B/19 [11/15/11; Email from P. Hernandez, NRR to M. Evans, NRR et al. RE: Updated Davis-Besse Containment Shield Building POP. (1 page)], p.20/101:

The safety significance of rebar splice regions in the context of cracking, as shown in preceding entries, is further reflected by NRC and FENOC's efforts to hastily postpone a public meeting "so that the licensee has more time to finish their calculations of the rebar splices and so that [NRC] can review them beforehand. It was at the licensee's request that it was changed." FENOC's struggle to account for structural integrity and design function of rebar splice areas is still a concern now, given indications of worsening

cracking in Aug./Sept. 2013, as well as rebar damage from hydro-demolition revealed in Feb. 2014.

Document B/22 [11/17/11; Email from P. Hernandez, NRR to E. Sanchez Santiago, RIII on Davis Besse Operability question. (1 page)] and **Document B/24** [11/17/11; Email from P. Hernandez, NRR to M. Evans, NRR et al., on Davis Besse Operability question. (2 pages)], p.24/101:

Given that FENOC is currently re-doing its RCR, yet again, and the fact that restoration of licensing and design bases at D-B are still dubious, Intervenors made this prescient observation nearly two years ago:

"...NRC's Hernandez said, **"The basis for continued operation should be frequently and regularly reviewed until corrective actions are successfully completed."** Of course, few if any corrective actions were "successfully completed" between this November 17, 2011 email, and Davis-Besse's restart. But the corrective action schedule leading up to, and during, the proposed 2017-2037 license extension period also leaves a lot to be desired. FENOC's Aging Management Plan for shield building cracking includes only infrequent and irregular reviews of the basis for continued operation. In fact, apart from than applying weather sealant 40 years late, there are no corrective actions planned by FENOC. Impulse Response monitoring tests and bore hole sampling are very few and far between under the proposed FENOC AMP."

Intervenors' concerns have yet to be rectified, despite FENOC's admission to worsening cracking (Aug./Sept. 2013), as well as SB wall gaps and rebar damage (Feb. 2014).

Document B/23 [11/17/11; Davis-Besse Containment System Primary Steel Containment and Shield Building. (1 page)], p.27-28/101:

We asserted:

"This document also claims "The shield building was designed to withstand forces generated by design bases seismic events," but this assertion is challenged, if not outright undermined, by Document B/1's revelations. Intervenors cite NRC's admission, "The existing as-found condition of cracking in the concrete of the shield building has raised questions on the ability of the structure to maintain its ability to perform its design functions under conditions that would introduce active forces (such as a seismic event or potentially rapid changes in the environmental conditions)," as supportive of its call for a hearing on the merits of these issues."

Abdul Sheikh warned in Document B/26 (see below) that **"I am concerned that the concrete will fail in this region due to bending in this region even under small loads."** (emphasis added). That added "small load" could be a seismic one, especially in an era of artificial earthquakes spawned by natural gas fracking, an activity that takes

place in the region surrounding Davis-Besse. After Fukushima, such risks are inexcusable.

Document B/25 [11/21/11 (date barely visible on actual document, due to it being printed on top of NRC's letterhead); Davis-Besse Nuclear Power Station Containment Shield Building Issue. (8 pages)], p.28-39/101:

p.32/101

"...[T]he shield building cracking is also SAMA-related, for FENOC's Severe Accident Mitigation Alternatives analyses undoubtedly assumed an intact and functional shield building, not the severely cracked one of doubtful functionality that exists in reality. In fact, NRC concludes page 2 by acknowledging this: The existing as-found condition of cracking in the concrete of the shield building has raised questions on the ability of the structure to maintain its ability to perform its design functions under conditions that would introduce active forces in the structure (such as a seismic event or potentially rapid changes in environmental conditions).

...Dr. Darwin is quoted: "Thus, if the splices in the circumferential steel are located outside of the crack region, I agree with and support the conclusion..." But NRC itself (as in Document B/16, above) confirmed rebar splices are located inside the crack region: cracking at the "Top of shield building – 360° around 20' down from the top...Challenges Prof. Darwin concern that rebar splices be outside cracked region."

p.33/101

...Dr. Darwin is also quoted: "they [the lap splices in the laminar crack region] are currently carrying the normal environmental loading (such as seasonal thermal gradient) and have since the structure was constructed." In other words, since the building is still standing, it must be strong enough to handle relatively normal circumstances. But given the severe cracking, can the shield building withstand added stresses, such as due to natural disasters (earthquakes, tornadoes, tornado missiles, etc.) or a reactor accident?

...In Paragraph 2 on page 5, FENOC responds to NRC questioning: Lap splices entirely within the crack zone are conservatively assumed to give way and fail to transfer load. In a large concrete structure the reinforcement steel and concrete act in a membrane fashion. If a local lap splice is ineffective the load will transfer to the adjacent load carrying members. Local structural failures would only exist if a large number of lap splices were to line up in the same crack area. The horizontal reinforcement bars in the shield building were well staggered to preclude this very issue.

p.34/101

This is an entirely qualitative argument – and a very optimistic one at that -- not backed up by empirical data. Intervenors seek a more rigorous, conservative analysis, such as might occur via a hearing on the merits.

Page 5, paragraph 3 carries forth in the same qualitative manner. No empirical data is provided to ensure that cracks will not line up in a catastrophic way. Although FENOC and its experts assure us that the risk is low, no probability figure is actually given for the risk of a shield building failure with potentially catastrophic consequences.

Page 5, paragraph 4 of FENOC's response states:

Since the reinforcement steel development specified staggered bar splices and the reinforcement steel is lightly loaded, Dr. Darwin suggested that the development could be evaluated on a percentage basis. That is, if the loading in the section is one third of the allowable, then at least one third of the section must contain solid (uncracked) regions to fully utilize the reinforcement steel.

To Intervenors, such an overly simplistic analysis, based on unsupported assumptions, is a very risky basis for reasonable assurance of shield building function for the next quarter century (2012 to 2037)."

Also on p.34/101

"FENOC goes on to state in the fifth paragraph on page 5, "Conservative assumptions have been made to limit the extremely difficult data collection efforts." Intervenors are concerned that, due to the expense and time required to undertake such "extremely difficult data collection efforts," FENOC's assumptions are not conservative, and its data collection efforts (IR testing, core bore sampling) are too few and far between, both spatially across the shield building structure, but also temporally (testing is much too infrequent under FENOC's AMP) over months, years, and even decades."

Given the added risks of worsening cracking, SB wall gaps, and rebar damage, Intervenors re-assert no effort should be spared under the SB cracking AMP. Neither difficulty nor expense of testing methods or frequency is an excuse.

On p.35/101

"It is curious that the NRC did not require investigation of less-accessible areas, as well as whole sections of the shield building that FENOC simply assumes are not cracked, given the safety and environmental risks."

If a simple, basic acoustic test had been done on the access opening repair of 2011, it would have instantly revealed the gap.

On p.36/101

"On page 6 at "4)", even though NRC requests that FENOC "Confirm that both vertical and horizontal rebar if located in a crack region are not considered in the strength

evaluation," FENOC nonetheless responds by assuming that half of the outside hoop reinforcement is effective, even though it has not investigated to make sure that cracking in those areas has not rendered outside hoop reinforcement completely ineffective."

Given the worsening cracking revealed in Aug./Sept. 2013, as well as the SB wall gap and rebar damage revealed in Feb. 2014, NRC must require FENOC be more conservative in its assumptions about rebar structural integrity. These assumptions must be tested to confirm their accuracy.

p.36/101

"In the second paragraph under "4)", FENOC explicitly states that the only places on the shield building where zero credit is taken for vertical reinforcement credit is at the flute shoulders and main steam penetrations. But this does not account for the cracked upper 20 feet of the shield building and the large uninvestigated portions of the remainder of it. Under the circumstances, FENOC should be made to empirically verify that the portions of the shield building being counted on to maintain safety margins are, in reality, still solid."

The 2011-2014 damaged rebar at the SB access opening repair location shows that FENOC's simple assumptions of rebar structural integrity across vast stretches of the SB are inaccurate and undermine "adequate protection" of public health, safety, and the environment.

p.36-37/101

"FENOC's statement, "Note that the vertical and hoop reinforcement is actually present and sufficiently bonded and will provide the necessary serviceability requirements such as crack control as it has under normal operating conditions since the structure was built," appears to assume, inappropriately, that the cracks will not grow worse over time. That question and concern, and the risks it raises, are at the very heart of Intervenors' contention, as supplemented. Not only does the "It-Must-Still-Be-Functional-Because-It-Hasn't-Failed-Yet" approach fail to account for worsening cracking over time from 2012 to 2037, but it also fails to address the impact of added stresses on the severely cracked shield building, such as natural disasters, reactor accident conditions, daily/seasonal/annual thermal cycles, and freeze/thaw cycles. These are aging-related concerns and disputes with the application."

The cracking was shown to be growing worse with age, in Aug./Sept. 2013. Simply assuming rebar, as well as concrete, functionality, with AMP monitoring and testing, is indefensible.

p.37/101

[On page 7, under "5)", NRC requests that FENOC "Ensure that the required rebar bond strength will carry the entire design load (18.5 ksi) plus adjacent load from adjacent rebar

in cracked area. FENOC responds that 12.4 ksi loads due to normal circumstances have been supported since the shield building was constructed, so the shield building is proven capable of withstanding at least that much stress. But: ...The Table also shows that a maximum stress of 21.7 ksi is expected in this reinforcement under combined dead, seismic and thermal load and 13.7 ksi for dead, wind and normal thermal load. Since we assume that outside reinforcement is to be treated ineffective in carrying any additional stress beyond 12.4 ksi, under accident thermal loads that may cause stresses in excess of what the rebar can carry (assumed to be 12.4 ksi), the reinforcement is assumed to detach itself from the outer section of the shell. Because there is no restraint provided by the reinforcement, the accident thermal gradient will tend to self relieve, albeit trying to cause an increase in the crack width until the section finds a new balance. (emphasis added)

Such an admission, that additional stress could "increase ... the crack width," is an admission of age-related degradation potential. It is also evidence that a strong enough stress could even "fail" the shield building, at least to the extent that the rebar will detach from the outer section of the concrete shell. The risk of such a failure would grow more likely, even under small additional stresses, if cracking worsens over time, such as during the license extension.]

The worsening cracking revealed in Aug./Sept. 2013 shows that additional stresses, other than time, may not even be required to further damage the SB. Certainly, additional stresses would simply hasten the damage.

Document B/26 [11/22/11; Email from A. Sheikh, NRR to E. Sanchez Santiago, RIII on Questions for the Conference Call. (1 page)], p.39-42/101:

Given the significance of rebar lap splice located in cracking zones, as affirmed by none other than FENOC's expert witness, Dr. Darwin, himself, the following statements by NRC Staffer Abdul Sheikh are very significant:

p.40/101

"At "3.", Sheikh seems to identify problems with FENOC's work regarding the "lap splice issue." This is most significant, for FENOC's own expert, Dr. Darwin, emphasized the importance of lap splice regions, pointing out that his endorsement of FENOC's hypotheses only holds so long as the cracking does not exist in lap splice regions. At "4.", Sheikh identifies a related disconnect, stating: "If this is the assumption, stress used for lap splice calculation should account for 100% increase in the stress."

p.41/101

At "5.", Sheikh wrote: "The licensee justification for ignoring the dead (DL) and normal (To) in calculation of rebars splice does not appear to be justified. The stresses due to dead load and thermal loads will be locked in the rebars and cannot

be ignored." Given that Sheikh had already warned of his concern that even "small loads" could cause concrete failure "due to bending," and Dr. Darwin's warning on the significance of lap splice regions, Intervenors are most concerned about FENOC unjustifiably ignoring any stresses on the shield building in its analyses and calculations.

Similar concerns are elaborated in Sheikh's point "6.": "The licensee considers the allowable stress in the rebar to be 60 ksi and ignores a phi factor (0.9) in his evaluation for lap splice. In addition, the licensee has not accounted for any additional uncertainty due the field conditions." Per Sheikh's concerns, it is imperative that there be a full account of all such phi factors and uncertainties due to the field conditions."

Given worsening cracking, SB wall gaps, and rebar damage, this rebar lap splice/cracking risk deserves focused attention in a hearing.

Documents B/27 [11/23/11; Email from A. Howe, NRR to S. West, RIII et al. on Where do we stand on Davis Besse? (1 page)] and **B/28** [11/23/11; Email from A. Howe, NRR to M. Evans, NRR et al., on Call with Steve West on Davis Besse. (1 page)], p.42-44/101:

This document clearly lays out NRC's rush, under pressure from FENOC, to approve reactor restart, despite deepening complexities and unanswered questions about the safety-significant SB cracking. NRC Staffers worked over time, including on weekends, evenings, and even over holidays, to provide FENOC the green light it was pressuring for. This rush now appears to have included a poor job repairing the SB access opening of late 2011, introducing a SB wall gap, as well as damaging rebar. This was followed by over two years (Dec. 2011 to Feb. 2014) of full power operations with a severely compromised SB.

Document B/30 [11/27/11; Email from J. Zimmerman, NRR to M. Evans, NRR Re: Davis-Besse Draft CAL. (2 pages)], p.46-47/101:

Further documents NRC's rush – over a holiday weekend -- to approve D-B reactor restart, despite unfinished safety-significant calculations, etc.

Document B/31 [11/28/11; Email from B. Lehman, NRR to S. CuadradoDeJesus, NRR RE: Shield building discussion with Melanie next week. (1 page)], p.47/101:

NRC OGC attorney Brian Harris's assertive insistence to attend NRR Staff meetings re: the cracking in D-B's SB shows the license extension significance and relevance of the issue – he is the lead NRC attorney opposing our intervention.

Document B/32 [12/01/11; Email from R. Haskell, NRR on New OpE Forum Possting (sic): Davis Besse – Cracks Discovered in Shield Building During Reactor Vessel Head Replacement. (1 page)], p.48-49/101:

p.48/101

"No explanation is given by this NRC FOIA response as to how the deepening complexity of questions and concerns about Davis-Besse's shield building cracking could be resolved so quickly, in mere days or even hours, allowing NRC to confidently assure safety and authorize restart so quickly. As shown by NRC's allowing FENOC until February 28, 2012 to submit its root cause report, only to allow it to amend the root cause report in mid-May because the original was so badly flawed and incomplete, it is now retrospectively clear that NRC's questions and concerns were not resolved by the time the CAL was issued on December 2, 2011. Not just FENOC's, but even NRC's behavior, harkens back to the 2002 Hole-in-the-Head Fiasco, about which the NRC Office of Inspector General concluded that not only FENOC, but also NRC itself, was guilty of prioritizing FENOC profits over public safety (NRC OIG, "Event Inquiry Regarding NRC's Regulation of Davis-Besse

p.49/101

Regarding Damage to the Reactor Vessel Head," OIG-02-03S, 12/30/2002, http://www.nrc.gov/reading-rm/doc-collections/insp-gen/2003/02-03s.pdf).

Intervenors fear this NRC attitude of "reactor operations approval at any cost," so clearly exemplified by the rushed December 2, 2011 CAL authorizing rushed restart, will affirm the supposed legitimacy of the politicized decision-making culture during the proposed 2017-2037 period, as well. That decision-making culture will be fleshing out the Davis-Besse AMP for cracking. A hearing is warranted to assure that politicization of aging management is as unlikely as possible."

The NRC has now saw fit to require of FENOC yet another revision to the root cause report, due to the worsening cracking discovered in Aug./Sept. 2013. NRC has given FENOC till mid-2014 to complete it.

Document B/34 [12/01/11; Email D. Morey, NRR to S. CuadradoDeJesus, NRR Re: Davis-Besse Shield Building. (1 page)], p.50/101, and **Document B/35** [12/02/11; Email from D. Morey, NRR to B. Lehman, NRR et al RE: Davis-Besse Shield Building. (1 page)], p.51/101:

Further documentation of NRC's mad dash to approve rushed restart of D-B despite the SB cracking, despite a lack of even basic information about the cracking, and despite significant incomplete analyses and unanswered questions, perhaps in an effort to approve the restart before FENOC, tail wagging the dog fashion, simply did it anyway.

Such a rush job, it now appears, included a hasty repair of the access opening, which left a large gap in the wall, as well as damaged rebar.

Document B/36 [12/02/11; Email from B. Lehman, NRR to S. Sakai, NRR et al. FW: Davis Besse POP. (2 pages)], p.52/101:

Any remaining questions within NRC's ranks were silenced by the decision to issue the CAL, slamming the door shut. NRC's internal contradictions are on full display, when you compare this email of finality, to ones sent just hours earlier, laying out significant areas of questioning, concern, and uncertainty not yet resolved.

Document B/40 [12/06/11; Email from B. Lehman, NRR
to S. CuadradoDeJesus, NRR on Shield Building RAI. (1 page)]:

p.60/101:

"...So many different forms of cracking, in widely different areas of the shield

p.61/101:

building, likely involve multiple root causes, which FENOC has not identified nor accounted for. Nor has NRC required FENOC to do so. Intervenors fear that such unaccounted-for root causes, as well as incomplete accounting of the extent of the cracking and safety/environmental risk significance, and consequently inadequate corrective actions, will lead to worsening of known cracks, not to mention initiation and worsening of unknown cracks. This, of course, would increase the risks."

The worsening cracking admitted to in Aug./Sept. 2013, as well as FENOC's need to re-do its RCR yet again by mid-2014, seem to confirm Intervenors' August 2012 warnings and concerns as accurate and well founded.

Document B/41 [12/06/11; Presentation Slides on Dav
is-Besse Shield Building Crack. (6 pages)]:

p.62/101

..."Intervenors are concerned that FENOC's response, based on Dr. Darwin's advice, is inadequate – that merely broad *strokes* of understanding are good enough, that not "every square inch" of the building need be checked. Intervenors assert that neglecting to perform confirmatory tests on vast areas of the shield building could miss large areas of severe cracking, which have rendered the shield building unfit for safety or

environmental duty, and will cause this to only worsen over time, due to age-related degradation worsening both known, and currently unknown, cracking."

Compare this to the access opening repair put in place in late 2011. A significant gap in the SB wall, combined with damaged rebar, made this area of the containment prone to failure, if it had been tested by additional stresses. Luckily, it was not. Are there other areas of gaps or damaged rebar across the SB wall of which FENOC, and NRC, are currently unaware? Why is testing to confirm structural integrity across the SB not being required?

p.62/101:

"...NRC also states that the "Licensee's Position" is that "Primary concern is ability of outside rebar to perform its intended function. **Observations of construction opening and testing indicate concrete is firmly attached to rebar mat".** But this flies in the face of the admission, by both NRC and FENOC, that the outer rebar layer is dysfunctional." (emphasis added)

Ironically, it was FENOC's – and NRC's – lack of observation that led to the SB wall gap and rebar damage, revealed in Feb. 2014. That lack of observation allowed for more than two years of full power operations (Dec. 2011 to Feb. 2014), with a severely compromised SB.

Re: p.63/101

["...NRC mentions the need for FENOC to "Determine root cause and develop a long-term monitoring program (due 2/28/12)". FENOC failed on both scores. Although FENOC did submit a root cause report by 2/28/12, NRC identified so many

p.64/101

holes in it that FENOC was forced to submit a revised root cause analysis report in mid-May. David Lochbaum, Director of the Nuclear Safety Project at the Union of Concerned Scientists, pointed out to NRC Region 3 Administratrator, Chuck Casto, in late May that this was a prima facie violation of 10CFR50.9 requirements that FENOC submit complete and accurate information by the February 28, 2012 deadline. But NRC has done nothing to enforce this regulation, nor hold FENOC accountable for its violation. In addition, FENOC did not publish its "long-term monitoring program" (its AMP) till April 4, 2012 -- over a month late. Even then, FENOC's AMP was woefully inadequate, and remains so to this day."]

That was nothing. Now, in the aftermath of the Aug./Sept. 2013 worsening cracking, FENOC is again re-doing its RCR. The latest version is not due till mid-2014 – well over two years later than the original deadline for the RCR.

Re: p.64/101

["...NRC also mentions requiring FENOC to "Select multiple un-cracked areas to investigate to verify the cracking is not spreading (due 90 days)". But the only un-cracked areas to be examined are located right next to already known cracks. A shield building-wide look is not being required, so severe cracking in large areas of the shield building could be occurring, that FENOC has simply assumed is not there."]

This is all the more ironic in light of the fact that a single, basic acoustic test would have revealed the SB wall gap of 2011-2014. Simply assuming structural integrity is not adequate to protect public health, safety, and the environment.

Document B/44 [12/13/11; Email from M. Galloway, NRR to A. Sheikh, NRR et al., RE: Davis-Besse Shield Building. (1 page)], p.66/101:

NRC Staffer Abdul Sheikh admits "Davis Bessee [sic] shield building has not been designed for containment accident pressure and temperature."

If the Davis-Besse concrete, steel reinforced shield building was not even designed for the levels of pressure and temperature that would result from a steel containment accidental breach, then it stands to reason that a severely cracked shield building would be even more vulnerable to catastrophic failure than an un-cracked shield building. In fact, Abdul Sheikh himself, in Document B/26, stated "I am concerned that the concrete will fail in this region due to bending in this region even under small loads."
As Sheikh indicates above, a breach of the steel containment vessel at Davis-Besse would subject the severely cracked shield building not to "small loads," but to accident pressures and temperatures that it was never designed to withstand, even when brand new and un-
cracked!

The following is provided as public comment on the NRC draft EIS re: Davis-Besse's proposed 20 year license extension

I have previously submitted comments regarding our environmental coalition's contention, dated Jan. 10, 2012, seeking a hearing, on Shield Building cracking at Davis-Besse, submitted to the NRC ASLB.

The following comments stem from our coalition's five supplements to that contention, submitted between Feb. and August of 2012.

INTERVENORS' **[FIRST] MOTION TO AMEND** 'MOTION FOR ADMISSION OF CONTENTION NO. 5'
(February 27, 2012)

Posted online at:
http://www.beyondnuclear.org/storage/Coalition%20filing%20contention%20amdt%202%2027%202012.pdf

At page 2/102, we quoted U.S. Representative Kucinch (D-OH), who stated:

"...The reports showed conclusively that the cracking was not in "architectural" or "decorative" elements of the wall, as FirstEnergy publicly claimed, but ran throughout the line of the main outer rebar.

In fact, the cracking is so extensive that the NRC required FirstEnergy to assume, in its calculations of the strength of the wall, that the vertical outer rebar mat did not even exist.

When FirstEnergy made its presentation at the January 5 public hearing, its Site Vice-President, Mr. Barry Allen, admitted for the first time that the cracking was located along the line of the main outer rebar. But, Mr. Allen, did not mention FirstEnergy's previous misrepresentations or explain the significance of the new description. When I asked him about this discrepancy, his response was that FirstEnergy's investigation of the cracking had been ongoing, and that FirstEnergy had revealed all new information as it was discovered.

That would be a very appropriate response, if it were true. But, it is not true.

FirstEnergy knew in early October that the cracking was in the area of the main outer rebar. That is shown in the very first photo released by the NRC. Most of the tests that showed that cracking in the line of the main outer rebar were performed before FirstEnergy issued a statement to its shareholders on October 31, 2011 that repeated their misrepresentations. And, even as late as December 29, 2011, the NRC was still repeating this misleading description from FirstEnergy—"Cracking has been identified primarily in the architectural regions...." ("Q-and-As for Davis-Besse Shield Building Issues,"

12/29/11).

(Emphasis added)."

At page 3/102, we went on to state:

"A January 31, 2012 inspection report, ML12032A119, shows that FENOC discovered on October 31, 2011 that there were other areas of cracking, but also:

On October 31, 2011, the licensee identified additional indications of concrete cracking during IR testing towards the top of the SB wall, approximately between the 780 ft and 800 ft elevations. This area of indications was yet another one different from the laminar cracking initially identified adjacent to the RRVCH opening. The licensee entered this extent-of-condition issue for the SB cracking into their CAP as CR 2011-04648, informed the NRC via the Resident Inspectors' Office on site, and continued to investigate further to determine if any additional adverse conditions existed. P. 48 of report (p. 52 of .pdf)."

The public is indebted to Congressman Kucinich for clearly showing the severity of the cracking in Davis-Besse's Shield Building, which FENOC and even NRC had downplayed up to that point. The seriousness of the matter is all the more clear now, since the August/September 2013 revelation of worsening old cracks, and discovery of new ones.

Re: the Jan. 31, 2012 NRC Inspection Report confirmation of cracking in the top 20 feet of the Shield Building wall, near the dome, it is still unclear, at this late date, whether the originally formulated cracking AMP, or any update to it, is comprehensive enough to account for the status of cracking damage at the upper reaches of the Shield Building.

That Jan. 31, 2012 NRC Inspection Report, cited in the contention supplement, also reported on NRC intercepting sub-standard rebar, which FENOC was about to install in the access opening repair in late 2011. Although NRC Staff claimed to have prevented that mistake from being made, what's to explain the rebar damage done by the hydro-demolition to open the 2014 access opening? Did sub-standard rebar get installed in 2011 after all?

INTERVENORS' **[SECOND] MOTION TO AMEND AND SUPPLEMENT** PROPOSED CONTENTION NO. 5 (SHIELD BUILDING CRACKING) **(June 4, 2012)**

Posted online at:
http://www.beyondnuclear.org/storage/June%204%202012%20Motn%20to%20Amend%20Supp%20Contn%205%20COMPLETE-1.pdf

At p. 8/16, we stated:

"FENOC is developing a comprehensive engineering plan to re-establish the design and licensing basis conformance of the Shield Building. The plan is scheduled to be completed and issued by December 1, 2012. The plan will include a detailed structural analysis of the Shield Building and consider applicable effects."

As also stated further below, in regards to our FOURTH MOTION TO AMEND AND/OR SUPPLEMENT (July 23, 2012):

It's fair to say, at this late date (April 2014), that FENOC's supposed re-establishment of licensing basis design conformance is shaky at best. In fact, NRC has granted FENOC till mid-2014 to re-figure the root cause of Shield Building cracking, after the August/September 2013 revelation of worsening old cracks, and initiation of previously unseen new cracking.

At p.12/16, we also stated:

"Moreover, Davis-Besse has other water problems inside the shield building. In RAI responses dated May 24, 2011 (ML11151A90), the NRC staff had noted a "history of ground water infiltration into the annular space between the concrete shield building and steel containment." During a 2011 AMP audit, NRC staff also reviewed documentation that: [I]ndicated the presence of standing water in the annulus sand pocket region. The standing water appears to be a recurring issue of ground water leakage and areas of corrosion were observed on the containment vessel. In addition, during the audit the staff reviewed photographs that indicate peeling of clear coat on the containment vessel annulus area, and **degradation of the moisture barrier, concrete grout, and sealant in the annulus area that were installed in 2002-2003**." (emphasis added)

It has since come to light that there were more problems with the access opening patch job in August/September 2002. Specifically, just as occurred in late 2011, the patch job in 2002 left air spaces or gaps in the resealed Shield Building wall. This growing, worsening accumulation of problems with both the Inner Steel Containment Vessel, as well as the Shield Building, are aging-related concerns with the Davis-Besse containment system, structures, and components (SSCs), that Intervenors' sought to address in the ASLB license extension proceeding, but thus far have been denied.

INTERVENORS' **THIRD MOTION TO AMEND AND/OR SUPPLEMENT**
PROPOSED CONTENTION NO. 5 (SHIELD BUILDING CRACKING)
(July 16, 2012)

Posted online at:
http://www.beyondnuclear.org/storage/3rd%20%20Motion%20COMPLET%20supp%20cracked%20concrete%20containment%20contention%20July%2016%202012.pdf

At section #1 (p. 3), our "Micro-cracking Present in Core-Bore Samples" challenge to FENOC should have been taken seriously, instead of denied. CTL had detected and reported micro-cracking to FENOC. FENOC essentially ignored the findings.

FENOC went on to claim that the cracking did not grow worse in 2011 and 2012. However, in August/September 2013, FENOC was forced to admit the old cracking had grown worse, and new cracking had initiated. However, FENOC has attempted to blur the issue, by claiming its 2013 testing techniques are more sensitive, implying the cracking "discovered" in 2013 were likely there all along in 2011 and 2012, but just couldn't be detected (yet).

Intervenors urged that micro-cracking in core bore tests be taken more seriously in July 2012, a full year before FENOC began to do so in 2013. However, FENOC continues to downplay the significance of the micro-cracks it "discovered" in 2013. If its April 15, 2014 RAIs are any indication, however, NRC Staff seems to understand the 2013 micro-cracking "discovery" has serious implications for the 2017-2037 Shield Building cracking AMP.

In section #2, entitled "Radial Cracking" (pages 5-6), we cited NRC Staff criticism that FENOC had also ignored evidence of radial cracking in core bore samples. We concluded that "In effect, FENOC admits to multiple forms of cracking from multiple root causes."

Grudgingly admits to them, we should add, for, no matter how many times we have raised concerns about multiple forms of cracking, likely of various root causes, and requiring a diversity of corrective actions, as well as aging management plans, FENOC has downplayed the significance, remaining focused on sub-surface laminar cracking, but has taken inadequate corrective action, and devised inadequate aging management plans, even on that.

At section #3 on p. 6, entitled "Deletion of Need for Further Investigation of Reinforcing Steel," we challenged NRC's suggestion that FENOC do less testing on reb. We urged that more testing on rebar, across the Shield Building, was needed. This is all the more clear now, that the 2014 hydro-demolition damaged rebar at the access opening.

But of course, revelations of outer rebar mat dysfunction due to the severe cracking (brought to light not by FENOC nor NRC transparency, openness, and accountability, but rather despite their obscurantism and secretiveness, thanks to Congressman Kucinich's assertive devotion to public service), and exposed rebar on the exterior Shield Building surface, have long made it clear that the Davis-Besse Shield Building's steel reinforcement structural integrity needs to be taken much more seriously by both FENOC and NRC.

After all, as revealed by Intervenors' 2012 FOIA intervention, NRC Staffer Abdul Shiekh warned that a small addition stress could fail the Shield Building to the 90% level.

However, the Shield Building's Inner Face exposure to the elements, for several long years in the 1970s, before the dome was put in place, and before the Initial Construction Opening was closed, calls into question the structural integrity of the Inner Face rebar mat, as well. Was Abdul Sheikh's dire prediction too optimistic? As a part of Intervenors' years-long call for more frequent testing, in more locations, using diverse testing methodologies, we extend our call for comprehensive testing of the Shield Building's Inner Face.

As pointed out in our section #4, "Laminar Cracking in Main Steam Line Room" (pages 6-7), "The NRC Staff pointed out (RRCA at 6) that 'The root cause report has insufficient Impulse Response documentation to conclude that laminar cracking initiated in the shoulder regions and propagated to areas of high density reinforcement, specifically in the areas of the Main Steam Line Penetrations.' "

As mentioned immediately above, we too have called for more Impulse Response testing across the Shield Building, especially at strategic locations, such as those of high-density rebar, the Inner Face, and the access openings subjected to multiple rounds of piercing. The status of the Inner Face rebar mat, as mentioned above, is of high significance to the structural integrity of the entire Shield Building wall, given the degradation of the Outer Face rebar mat functionality due to severe concrete cracking. As mentioned, the Inner Face rebar mat's exposure to the elements for years on end calls its structural integrity into question.

Section #5 (p. 7-8) documents "Shield Building Dome Parapet Cracking" dating back to August 15, 1976. However, FENOC, and its predecessor Toledo Edison Co., kept this secret from the public until May, 2012 – for over 35 years! Of course, 1976 predates 1978, so this cracking can't possibly have the Blizzard of 1978 as its root cause. The August/September 2013 discovery of worsening cracking has sent FENOC back to the drawing board, for yet another revision to its already revised Root Cause Report. Unless and until FENOC understands the likely multiple root causes for multiple forms of cracking, it cannot determine the likely multiple corrective actions, and aging management plans, needed to address the worsening problem.

At section #6, "AMP Omits to Inspection of 2002 Shield Building Opening for Cracking." (p. 8). we called for Impulse Response tests on the 2011 access opening repair area of the Shield Building wall.

If this had been done, the huge air space or gap would have shown up clearly, instantly. Any acoustic test of that area of the Shield Building wall, even very basic ones, would have readily revealed the gap.

Yet, rather than require or perform even the most basic acoustic test, NRC Staff and FENOC both fought our contention and its supplements at every turn, throughout summer and autumn of 2012. At the end of the year, the ASLB simply rejected our contention and supplements, including this one.

If our warning had been heeded, another year or more (July 2012 to Feb. 2014) of full power operations with a Shield Building wall with a significantly reduced margin of safety (the gap, not to mention the cracking) could have been avoided.

Isn't a gap in the Shield Building wall a *prima facie* reduction in safety margin? And yet FENOC came out on day one saying it was not so. NRC has not contradict nor corrected FENOC, yet, on this assertion, two full months later.

Our charge, in section #7, "No Examination of Admitted Cracking of SB Dome Or Below-Grade Shield Building" (pages 8-9), that "the AMP is unduly narrow in scope, which provides a means of avoiding issues of aging management of the whole shield building and as well, other safety-related structures at Davis-Besse," is all the more relevant and compelling now, in light of the August/September 2013 admission of worsening cracking.

Re: section #8, "Use of Other Safety-Related Structures as Comparables Instead of as Inspection Targets" (pages 9-10), given the visual discovery of an "invisible" safety-related problem that has lurked unseen during many years of full power operations (the gaps in the Shield Building wall access opening area, not only from 2011 to 2014, but even from 2004 to 2011), we again call on more extensive, frequent, and diverse testing to check for both the "invisible" (sub-surface cracks and gaps) and the visible (as through visual examination not blocked by metal plates left in place, for no good reason, in the access opening from 2011 to 2014 – blocking visual identification of a large gap in the Shield Building wall).

Re: section #9, "Ettringite Penetration Beyond Outer Rebar Layer" (pages 10-11), the discovery of worsening cracking in August/September 2013, the discovery of repeated Shield Building wall gaps during many years of full power operations (2004-2011, and 2011-2014), as well as damage inflicted on the rebar by the hydro-demolition process in 2014, underscores the need for a clear and comprehensive status report of reinforcing steel across the structure, to ensure its ongoing integrity, and design functionality, from 2017 to 2037.

Re: section #10 (page 11), "Insufficiently-Detailed Extent of Condition Corrective Action #1," we point out that while Impulse Response as well as core bore testing can still – and should still – be conducted across the Shield Building's exterior face, the white wash of 2012 now precludes the visual examination of surface defects, such as surface cracking. A comprehensive visual examination of the Shield Building exterior should have been conducted prior to the white washing of 2012, but was not. Now, ongoing visual examination is impossible, as the evidence has been covered up. Thus, the importance of core bore and Impulse Response, as well as other testing methods, increases.

Re: section #11, "Slip-Form Friction Fiction" (pages 11-13), the 2014 damage to the access opening rebar from hydro-demolition, the recurring wall gaps (2002-2011; 2011-2014), and the severe, worsening cracking (1978-2014, although FENOC admitted in May 2012 that dome cracking had been documented in 1976) make clear that cumulative stresses on the Shield Building (including the slip-form friction dating back to earliest

construction, in the early 1970s) are a very serious and growing concern, demanding comprehensive root causes analyses, continuously updated monitoring of the status of the extent of conditions over the full structure and over time, and multiple corrective actions, as well as multiple aging management plans, to address multiple root causes and multiple worsening conditions.

INTERVENORS' **FOURTH MOTION TO AMEND AND/OR SUPPLEMENT** PROPOSED CONTENTION NO. 5 (SHIELD BUILDING CRACKING)
(July 23, 2012)

Posted online at:
http://www.beyondnuclear.org/storage/4th%20Motion%20PII%20COMPLET.pdf

Re: p.3-5/56, re: NRC's first line of inquiry, given the Aug./Sept. 2013 revelations of worsening cracking, chemical analyses to guard against carbonation, chloride, sulfate, and other chemical attack should be significantly strengthened.

Re: p.5-6/56, re: NRC's second line of inquiry, FENOC contractor PII's admission of no "reliable information about the rate of crack propagation" is now, clearly, all the more significant, given the revelations of Aug./Sept. 2013. Beginning on Feb. 27, 2012, with the publication of its Root Cause Report, blaming the Blizzard of 1978 as the culprit, and continuing through its Revised Root Cause Report of mid-May 2012, FENOC attempted to maintain the position that Shield Building cracking was frozen in time – that the damage was done over a few days in January 1978, but had not worsened since. This could no longer be maintained after revelations of worsening old cracking, and initiation of new cracking, in Aug./Sept. 2013. Thus, a much larger number of Shield Building locations must be tested, at a greater frequency, given this fundamental, and safety-significant, blind spot regarding "rate of crack propagation."

Re: NRC's third line of inquiry (p.7/56), "PII and FENOC need to develop better testing methods" for carbonation -- now more than ever, given the Aug./Sept. 2013 revelations. They indicate that the root cause(s) are insufficiently understood, and hence the corrective actions, and aging management plans, needed. In addition, such revelations as a mere one inch of concrete covering the outer rebar mat are exacerbated by additional rebar damage – as occurred due to the access opening hydro-demolition in Feb. 2014. The Shield Building concrete cracking, and rebar degradation/damage, are cumulative, aging-related risks, as Intervenors have repeatedly warned in their intervention.

Re: NRC's fourth line of inquiry (p.7-8/56), the contradiction between FENOC contractors CTL and PII re: micro-cracking is all the more significant in light of the Aug./Sept. 2013 revelations. PII's attempted elimination of "a fatigue/progressive failure mechanism" is not defensible, given the discovery of worsening old cracking, and

initiation of new cracking – revealed, reportedly, due to a new testing method, better able to detect micro-cracking (which PII earlier attempted to deny was present or possible).

Re: NRC's fifth line of inquiry (p.8-10/56), the Aug./Sept. 2013 revelations of aging-related cracking, combined with the added risks of recurrent Shield Building wall gaps (2002-2011, 2011-2014), and even hydro-demolition damage to rebar, demand that top-notch, careful, and comprehensive analyses, such as sensitivity studies, be carried out on all aspects of Shield Building cracking and rebar degradation. This is all the more important, given the doubts and concerns still swirling around conformance to design and licensing bases.

At p. 9/56, we stated:

"FENOC – which admitted in its February 2012 RCA [Root Cause Analysis] that the shield building cracking has left the shield building "non-conforming to the current design and licensing bases" - has also wrestled with this challenge. Perhaps seeking its own "path of least resistance" (not unlike a propagating crack in the Davis-Besse shield building), the nuclear utility chose the approach that allowed immediate return to full power operations, while kicking the can down the road on "re-establishing" licensing basis design conformance. The NRC Staff did not object to this, even as it struggled to understand the legal and regulatory justification for such a move. In fact, the Staff generously granted FENOC a grace period until December 2012, during which time FENOC will attempt to complete a design basis conformance re-evaluation, in order to address significant licensing non-conformances created by the severe shield building cracking."

It's fair to say, at this late date (April 2014), that FENOC's supposed re-establishment of licensing basis design conformance is shaky at best. In fact, NRC has granted FENOC till mid-2014 to re-figure the root cause of Shield Building cracking, after the August/September 2013 revelation of worsening old cracks, and initiation of previously unseen new cracking.

Re: NRC's seventh line of inquiry, we would simply like to repeat, verbatim, our concluding observations and assertions, in light of the Aug./Sept. 2013 revelations of worsening, age-related cracking:

"...could not the various cracking and other degradation at diverse locations on the shield building be attributable to not only the Blizzard of 1978's wind-driven precipitation into the exterior side walls, but also to a top-down dynamic, if not other causes to boot? Without a comprehensive root cause analysis, PII and FENOC cannot guarantee that age-related degradation of the shield building is comprehended, and that appropriate protections are in place to defend against it.

Intervenors also challenge the acceptability of FENOC performing only three full depth core bores. Three core bores across the entire surface of the huge shield building is not acceptable, is much too small a sample size. It provides a mere snap shot, frozen in time,

of mere cubic inches (and mere square inches of surface concrete), versus the thousands or tens of thousands or hundreds of thousands of cubic feet of shield building structures, which very well may be suffering worsening cracking over time."

On Feb. 14, 2014, in *Toledo Blade* coverage of the revealed Shield Building gap, a FENOC spokeswoman claimed that the gap had not diminished any safety margins. This claim was repeated several days later, in the NRC event notification. However, as a member of the public asked on the Feb. 20, 2014 NRC Webinar re: steam generator replacement at Davis-Besse, how could the gap *not* have decreased safety margins? It appears on its face that safety margins must have been decreased. The questioner also pointed out to NRC that it had previously pledged to correct FENOC publicly when the utility made indefensible safety claims – but it has yet to do so regarding the Shield Building gap.

Given repeated Shield Building gaps (2002-2011, 2011-2014), worsening age-related cracking revealed in Aug./Sept. 2013, rebar damage from hydro-demolition in 2014, etc., the Shield Building risks at Davis-Besse are numerous and growing. Combine that with the lack of a sound root cause analysis (already clearly evident in 2012, as revealed in our contention supplement assertions cited here, but made all the more clear by the Aug./Sept. 2013 discoveries, and the need for FENOC to prepare yet another revised root cause analysis report by mid-2014), it's clear that Intervenors' contentions are worthy of hearing.

Also, NRC's questions about the structural integrity of the Inner Face of the Shield Building's concrete and rebar mat are similarly all the more significant now, that worsening cracking has been documented, as well as recurrent gaps, and still mysterious root cause(s). As revealed by Intervenors' FOIA request in 2012, NRC Staffer Abdul Shiekh warned about the risk of a 90% failure of the Shield Building, under the stress of even small additional loading. Intervenors cited this warning repeatedly in contention supplements in 2012. But now it must be asked, ***isn't 100% failure possible***, given concerns about Inner Face concrete and rebar, including questions asked by NRC in 2012, which have never been answered or adequately addressed by FENOC since? As in 2012, Intervenors are still calling for comprehensive, and ongoing, testing of the Shield Building, including on its Inner Face – something entirely lacking from FENOC's AMP.

Re: NRC's eighth line of inquiry (p.16/56), NRC Staff question the very basis for FENOC's Blizzard of 1978 root cause explanation – whether or not moisture penetrating and freezing in concrete can account for the cracking. Given the fact that worsening crack was discovered in Aug./Sept. 2013, this does call into question the Blizzard of 1978 hypothesis. In fact, FENOC has currently undertaken a revision to its revised root cause analysis, due out by mid-2014.

NRC's ninth line of inquiry (p.16-18/56) asks:

"It appears if ice forms within this joint it would create radial stress on the parapet and top of SB [shield building] wall, at roof (and tensile loads on inside SB wall near roof).

Were any examinations (other than visual) performed on the roof or parapet? If not, why not. Were any type of examinations conducted at the inside surface of the SB wall just below the parapet to identify cracking? If not, why not? What actions proposed preclude this scenario from causing further cracking (e.g. is top surface sealing identified)?"

Intervenors have previously expressed concerns about this potential top-down moisture intrusion potential, caused by cracking in the dome/parapet area dating as far as back as 1976, before the Blizzard of 1978. Intervenors have also urged that a diverse array of testing methodologies (including visual and Impulse Response, but others beyond these as well) be used to ascertain the structural integrity of the Shield Building across its surface area and cross section, including on its Inner Face. Thus far, Intervenors' calls have fallen on deaf ears.

Re: NRC's tenth line of inquiry (p.18-19/56), given evidence of micro-cracking, as well as multiple directions of potential moisture penetration of the Shield Building wall (outside-in, inside-out, and top-down), much more rigorous and extensive testing of the Inner Face, thickness, and Outer Face of the Shield Building than FENOC's AMP plans is called for. This is all the more necessary, after the Aug./Sept. 2013 revelations of worsening cracking of still unexplained origin.

Re: NRC's eleventh line of inquiry (p.19-20/56), FENOC contractor PII admitted that its conclusion, that the Blizzard of 1978 – but not the similar Blizzard of 1977 – is the singular root cause of Shield Building cracking "is based on engineering judgement. There was no sensitivity analysis performed."

Intervenors surmised that:

"NRC's questions point out compellingly that there is not a single root cause to shield building cracking, but potentially multiple root causes. Despite this, PII and FENOC cling to their ultimate root cause theory, that the Blizzard of 1978 was the only explanation for shield building cracking. But given the presence of multiple kinds of cracking, located at diverse places across the huge shield building, NRC's questions raise the specter that PII and FENOC have not adequately explained the origin of all cracking. This would leave the shield building vulnerable to yet unidentified cracking initiation and propagation dynamics."

The discovery, in Aug./Sept. 2013, of worsening cracking, deepens the doubts about the Blizzard of 1978 root cause explanation's accuracy. In fact, FENOC is currently re-evaluating its root cause hypothesis, with a new final report due out by mid-2014. Thus, currently, without a compelling understanding of the root cause(s) of Shield Building cracking and rebar dysfunction, there can be no confidence that merely weather sealing the Shield Building's exterior some 40 years late will prevent further cracking. In fact, the findings of Aug./Sept. 2013 – one year after weather sealant was applied – show the opposite.

NRC's twelfth line of inquiry (p.20-24/56) was very significant, for it questioned the practice of FENOC and its contractors of using non-conservative figures and assumptions in its Shield Building cracking analyses. Intervenors showed the unacceptability of using such unjustifiable figures and assumptions, quoting NRC Staff such as Pete Hernandez and Abdul Shiekh, from communications obtained via FOIA. The two NRC Staff warned about downplaying the cracking's significance, not doing enough core bore testing to validate Impulse Response testing of limited usefulness, not adequately establishing the Shield Building's structural integrity, and not accounting for all stresses already endured by the Shield Building. They warned that small additional stresses could fail the Shield Building through 90% of its depth, with the reinforcing steel at the Outer Face detaching itself from the Shield Building structural concrete. They questioned whether or not the Shield Building will "stay standing."

Given the added stress on the Shield Building created by a large wall gap, from 2011 to 2014, recently revealed in Feb. 2014, it is all the more important that these faulty and questionable assumptions by FENOC and its contractors be comprehensively re-examined, as in a hearing on the merits of this contention.

A thirteenth area of NRC inquiry (p.24-26/56) involved out-of-level friction forces during construction, which have been little analyzed by FENOC, its contractors, or their predecessors. We quoted PII's admission: "We do not have information regarding the method of correcting the problem and whether it caused excessive friction forces." To the "growing list of stresses borne by the Davis-Besse shield building (which, during construction alone, included the following: "Noteworthy deviations during construction of the shield building walls were issues such as concrete with the wrong water to cement ratio, concrete with smaller coarse aggregate size, concrete with the wrong type of cement, exceeding shield building wall tolerance for plumb, installation of reinforcing steel, embeds, or reglets, and omission of blockouts. The shield building construction deviations are described in attachment 8.)," must now be added Shield Building wall gaps (2002-2011, 2011-2014), as revealed in Feb. 2014.

NRC's fourteenth area of inquiry (p.26-27/56) questions how evidence of varying depths of cracking comports with the Blizzard of 1978 root cause conclusion. This underscores a strong suspicion that another root cause, or multiple root causes, are to blame for the cracking. This suspicion was deepened considerably when worsening old cracking, and the initiation of new cracking, were discovered/admitted in Aug./Sept. 2013. In fact, FENOC has embarked on yet another round of revising its root cause explanation, a report due out later this year.

Thus, various kinds of cracking and other Shield Building degradation, caused by multiple root causes and growing worse over time, are added to the risks created by recurring Shield Building wall gaps (2002-2011, 2011-2014).

Similarly, NRC's fifteenth area of inquiry (p.27-28/56), concerning dense rebar, adds yet another element of risk to the long list mentioned just above. To this now must be added the rebar damaged by hydro-demolition to create the access opening in Feb. 2014, which

may be related to sub-standard rebar, documented in the Jan. 31, 2012 NRC Inspection Report, potentially installed to repair the 2011 access opening. As mentioned above, we cited this is INTERVENORS' **[FIRST] MOTION TO AMEND** 'MOTION FOR ADMISSION OF CONTENTION NO. 5' **(February 27, 2012).**

Along similar lines, NRC's sixteenth area of inquiry raised questions of sub-standard concrete, vulnerable to excessive thermal diffusivity (conductivity, specific heat) allowing deep penetration of not only moisture infiltration (for lack of exterior weather sealant for over four decades) but also heat flow, leading to severe cracking. Such questions have still not been addressed, and must be, given the latest developments (worsening cracking in Aug./Sept. 2013, Shield Building wall gap revealed in Feb. 2014), and the increased risks associated with them.

NRC's seventeenth line of inquiry (p.30-31/56) questioned FENOC's and its contractors' tendency to take non-conservative approaches, such as neglecting to account for the "abnormally" and "uniquely high thermal conductivity" measurements of the Davis-Besse Shield Building concrete in stress analyses. Such non-conservative approaches are even less defensible, given the 2013 revelations of worsening cracking, and the 2014 revelation of a large wall gap.

Re: NRC's eighteenth line of inquiry (p.31-32/56), PII's admission that "the [tensile and compressive] strengths of concrete can decrease over time due to aging-related mechanisms such as freeze-thaw cycles and chemical attacks" bolsters Intervenors' arguments that the cracked concrete containment contention is aging-related, and points to the obligation of a full
hearing on the merits, as we stated in our 2012 motion to supplement. The worsening cracking revealed in 2013, combined with added risks such as the Shield Building wall gap revealed in Feb. 2014, add yet more weight to Intervenors' arguments of 2012.

NRC's nineteenth line of inquiry (p.32-34/56), concerned the build up of water and snow/ice on the Shield Building dome area due to poor to no drainage. NRC raised questions about the added stress from the weight of off-center loading, as from snow and ice. FENOC's contractor PII admitted pent up water would be just as bad. Combined with cracks in the Shield Building dome, as well as flaws with the weather sealant on the dome, both documented as early as 1976, pent up water, or melting snow or ice, was acknowledged by FENOC, PII, and even NRC as the second most likely root cause for the sub-laminar cracking. Despite this, it has been even been mentioned in the Feb. 27, 2012 Root Cause Report, nor the mid-May 2012 Revised Root Cause Report. Perhaps it will be mentioned in the mid-2014 revision to the Revised Root Cause Report? After all, cracking was documented as worsening in Aug./Sept. 2013, and questions linger about the weather sealant functionality at the dome/parapet intersection.

Re: NRC's twentieth line of inquiry (p.34-35/56), Intervenors re-affirm the need for FENOC to comprehensively age-manage the entire Shield Building, not cherry-picked areas thereof. This is all the more important now that aging-related cracking was documented in Aug./Sept. 2013, undermining FENOC's NRC-blessed Blizzard of 1978

root cause conclusion. As but one example, if Impulse Response, or any other basic acoustic test, had been performed on the access opening after the 2011 repair, the air space or gap would have been readily detected. This would have prevented over two years of full power operations with a clearly compromised containment. Relying on sheer luck – that the compromised containment was not tested between Dec. 2011 and Feb. 2014 – is a very risky form of nuclear safety regulatory policy.

Re: cherry-picking areas of the Shield Building for analysis, NRC's twenty-first line of inquiry prompted Intervenors to ask "what about a combination of adverse forces acting simultaneously on a severely compromised shielding building structure, not only at the 30' crack location, but also at equally vulnerable, or even more vulnerable, locations?" The Feb. 2014 Shielding Building wall gap shows this question to be quite significant, for this was a severely compromised, very vulnerable structure. The recurring wall gaps (2002-2011, 2011-2014) shows that neither FENOC nor NRC knows how to avoid them. What is to guarantee that current access opening repairs won't leave Shield Building wall gaps that will represent a serious decrease in containment safety margin for the period of extended operation (2017-2037)? What testing, to guard against further gaps within the various perimeters of past access openings, is NRC requiring of FENOC, if any? If no testing is being required, why not? Wouldn't such testing have instantly revealed the gap introduced in 2011, and thus prevented over two years of full power operations with a severely compromised containment structure?

To NRC's twenty-second area of inquiry (p.36-37/56), Intervenors responded:

"NRC's questions ("Why wasn't a similar FE model developed to evaluate the potential for growth of the existing cracking? Why isn't a more refined FE model or other applicable analysis needed as part of the corrective actions to monitor crack growth to ensure monitoring plans are adequate?") show that Intervenors' request for a hearing on these aging-related matters is reasonable as well. PII's inadequate responses and FENOC's AMP fail to answer or account for the NRC's safety-significant, aging-related questions. The daily and seasonal thermal forces, as well as environmental stresses, could pose a challenge to the already multiply-challenged shield building over the 2017 to 2037 license extension period. PII and FENOC, have not adequately accounted for all the cumulative loads and stresses."

The revelation of worsening cracking in Aug./Sept. 2013 underscores the importance of Intervenors' demand that FENOC's AMP be strengthened considerably. Intervenors also point out that such revelations as recurring Shield Building wall gaps (2002-2011, 2011-2014) must now be considered in light of other risk factors – such as increasing temperature extremes, including both summer highs, and winter lows, large temperature swings over short periods of time, and extreme weather, all attributable to human-caused climate change. Have FENOC and NRC, in both required safety and environmental reports, accounted for this "global weirding" weather wild card in their analyses of Shield Building functional integrity? In its Shield Building cracking root cause analyses and reports, FENOC, and its contractor PII, seem to have inappropriately assumed past weather norms, past daily and seasonal temperature fluctuations, as appropriate for

analyzing on-going Shield Building stresses, as has NRC in its analyses, such as the license extension EIS. As hinted at by the title of the Oscar-winning documentary "An Inconvenient Truth," and as attested to by the on-going scientific work of the United Nations Intergovernmental Panel on Climate Change (which, along with the documentary's filmmaker, Vice President Al Gore, were awarded the Nobel Peace Prize for their efforts to protect the climate), such assumptions are no longer conservative.

The NRC's twenty-third line of inquiry (p.37-38/56) focuses on the importance of areas of the Shield Building incorporating a dense concentration of rebar. This issue is all the more significant now, given the Feb. 2014 admission of hydro-demolition damage to rebar, which itself raises doubts about rebar quality installed into the Shield Building access opening repair work in late 2011. The degradation and damage to structural reinforcing steel across the Shield Building must be considered in light of other damage and degradation, including worsening cracking, recurring Shield Building wall gaps, etc.

NRC's twenty-fourth area of inquiry (p.38-40/56), regarding "crack initiation depth or growth rate," prompted this response by Intervenors:

"Intervenors assert that a rigorous sensitivity study should have been, and still should be, performed. PII and FENOC should model growth rate, as this is essential for an adequate shield building aging management plan and monitoring program over time, including any 2017 to 2037 license extension period."

After all, FENOC's contractor PII, as evidenced by NRC's line of questioning, admitted to very deep cracking of 14 inches in depth, about halfway through the 30 inch thick Shield Building wall.

Given the Aug./Sept. 2013 revelation of new crack initiation and old crack worsening, as well as no clear root cause(s) conclusion(s), extent(s) of condition(s), nor course(s) for corrective action(s) needed (all made clear by yet another revision to the root cause report, due out later this year), a clear and comprehensive understanding/determination of "crack initiation depth or growth rate" is all the more called for now. This could be provided by an ASLB hearing on the merits. This is all the more needed, given such added risks as recurring Shield Building wall gaps (2002-2011, 2011-2014), as revealed in Feb. 2014. Such recurring wall gaps demonstrate the inability of both FENOC and NRC to guarantee containment safety during the period of extended operations (2017-2037), an area that Intervenors continue to hope to address in an ASLB hearing on the merits.

To NRC's twenty-fifth area of inquiry (p.40-42/56), PII responded:

"Damage in the flute shoulders is concentrated on the southwest side of the building, which coincides with the predominant wind direction. Other parts of the building will still get wet. Based on the IR mapping, the laminar cracks that are not on the southwest side of the building are limited to regions with weak planes of concrete (due to high density

rebar). Weak planes of concrete will require less force to initiate cracks. Therefore, the observed result is expected."

But FENOC has never provided empirical evidence even establishing, with statistical significance, that the cracking on the southwest face of the Shield Building is in fact worse than the cracking on the other faces.

Intervenors responded to FENOC's and PII's arguments thus:

"...the entire shield building surface containing high density rebar should be carefully examined for cracking. Davis-Besse is located on the Lake Erie shoreline. It has been exposed to countless episodes of moisture drenching, followed by freezing temperatures. Combined with information on the substandard heat transfer characteristics of Davis-Besse's shield building concrete, discussed above, allowing deep freezing of water into the thickness of the shield building, the admission that high wind was not even needed to cause extensive cracking must be addressed across the structure. Weather-sealing the shield building 40 years late does not reverse the damage already inflicted. Nor does it preclude the need for a comprehensive aging management plan and corrective actions for damaged areas of the shield building which by PII's admission above extends to all areas of dense rebar, if not beyond."

FENOC has not undertaken a robust testing regimen for the areas of the Shield Building with densely concentrated rebar, nor has NRC required it. Given the worsening old cracking, and newly initiated cracking, revealed in Aug./Sept. 2013, FENOC has undertaken yet another revision to its Revised Root Cause Report of mid-May 2012. Thus, neither root cause(s), extent(s) of condition(s), corrective action(s), nor aging management plan(s) can be said to be adequate. In addition, other forms of damage, degradation, and decreased safety margins – due to rebar damage from hydro-demolition, Shield Building wall gaps, etc. – increase the risks of containment failure, both now and during the license extension period (2017-2037).

Responding to NRC's twenty-sixth line of inquiry (p.42-43/56), Intervenors stated:

"Intervenors are concerned that PII's assumption of concrete strength values, which are over-optimistically high, would tend to underestimate cracking and other damage across the shield building structure. Such faulty assumptions and dangerous underestimates must be addressed in a hearing."

Intervenors continue, two years later, to assert the need for a hearing on the merits regarding Shield Building cracking, damage, and decreasing safety margins. The recurring Shield Building wall gaps (2002-2011, 2011-2014) revealed in Feb. 2014 prompts this latest call, for there is clearly no guarantee that FENOC nor NRC will prevent another round of Shield Building wall gaps in current access opening repairs, which means such containment failure risks will remain into the license extension period. Combined with the added risk of rebar damage, as was inflicted by hydro-demolition activities and revealed in Feb. 2014, as well as the specter of worsening cracking

(revealed in Aug./Sept. 2013), the overall stresses on the Shield Building merit close examination, before the 2017-2037 license extension approval is granted.

Re: NRC's twenty-seventh area of inquiry (p.43-44/56), concerning ever more significant "shield building crack initiation, crack growth, and crack arrest," Intervenors re-assert that:

"...PII not be allowed to cherry-pick select areas of the shield building to test, which fit its predetermined theory, but exclude testing other areas of the shield building structure that could also be cracked or otherwise damaged. NRC itself has questioned the logic of PII's and FENOC's Blizzard of 1978 root cause conclusion for sub-surface laminar cracking – given that areas not in the direction of wind driven rain are also cracked, inexplicably. But the Blizzard of 1978 cannot explain shield building dome cracking that was documented as early as 1976. Nor can applying weather sealant 40 years late reverse damage already inflicted, as through the top-down moisture penetration model, where cracks and weather sealant failures in the dome area have allowed moisture penetration via that route downwards – moisture that originated not only from the Blizzard of 1978, but other precipitation events on the Lake Erie shoreline over the course of years and perhaps even decades.

Intervenors urge that their cracked concrete containment and Severe Accident Mitigation Alternatives (SAMA) contentions are inextricably interlinked because FENOC assumes a functioning shield building in its SAMA analyses. Given the severe cracking and other degradation of the shield building, that assumption no longer holds water."

Intervenors' objections are still valid, further bolstered by the Feb. 2014 revelations of recurring Shield Building wall gaps (2002-2011, 2011-2014) and rebar damage from hydro-demolition. Intervenors had warned that repeated creation of access openings could damage the Shield Building, as the Feb. 2014 hydro-demolition has done. To Intervenors' validated concerns must be added the growing risk revealed, in Aug./Sept. 2013, of worsening old cracks, and even the initiation of new ones.

The following is provided as public comment on the NRC draft EIS re: Davis-Besse's proposed 20 year license extension

Link to original Jan. 10, 2012 cracking contention filed with the NRC ASLB:

http://www.beyondnuclear.org/storage/FINAL%20Contention%205%20Cracking%20January%2010%202012.pdf

It is noteworthy to point out that, after an initial period of support for our contention, NRC Staff opposed it after the publication of FENOC's Aging Management Plan in early April, 2012

At point #20, on p.21-22, we stated:

"Those patches are, of course, weak spots themselves, both the welded area on the inner steel containment, a mere 1.5 inches thick, as well as the "patched" area on the concrete shield building/secondary reactor containment structure, a mere 2.5 feet thick. As explained below, on January 4, 2012, David Lochbaum of UCS questioned whether the multiple holes cut in containment, and thus the multiple "patches" applied afterwards, overlapped, and how so. The "welds" on the inner steel container, and "repours" of concrete on the outer shield/secondary containment building, are themselves weak spots – perhaps repeatedly so in spots that have been involved in more than one cut-through and repair. This is a safety-significant issue that will grow all the more so with age-related degradation, and the prospect for yet one more cut-through and "repair" (patch) for the 2014 steam generator replacement project. In fact, FENOC has answered Lochbaum's question about the overlap of the breaches. In its January 5, 2012 Camp Perry power point presentation cited previously, on Slide #18 (page 9 of the hardcopy handout), FENOC documents that indeed all of the first three breaches – 1970, 2002, and 2011 – have already overlapped, specifically in the top left-hand quadrant."

As revealed via our FOIA request (dated Jan. 26, 2012), by documents NRC provided us in summer 2012, contractors Bechtel and Sargent and Lundy themselves at first suspected that the hydro-demolition process itself, used to breach the Shield Building, was responsible for the cracking. Although the cracking proved to be far more widespread than the access opening area impacted by the hydro-demolition activity, Bechtel and Sargent and Lundy's concern is a strong indication that hydro-demolition can in fact be a concern in terms of damage.

In fact, in Feb. 2014, it was revealed that the hydro-demolition just carried out as part of the steam generator transplant operation had damaged the rebar in the Shield Building access opening area. On April 15, 2014, NRC Staff included this concern about rebar damage issue in Requests for Additional Information (RAIs) regarding the 2017-2037 Aging Management Plan (AMP).

Davis-Besse has breached its Shield Building four times: the Initial Construction Opening in the 1970s; the 2002 reactor lid replacement access opening; the 2011 reactor

lid replacement access opening; and the 2014 steam generator replacement access opening. This is more than any other nuclear power plant. Each breach of the Shield Building risks more damage to the structure. Davis-Besse cannot guarantee not needing to breach the Shield Building yet again before 2037.

At point #22, on p.23-24, we stated:

"This approach appears more attuned to an arbitrary outage schedule, with a speedy return to economically-profitable "production" rather than taking a conservative, analytical approach to determination of root causes, extent, and safety-significance of cracking in the shield building. Such an approach imperils Intervenors, the people they represent, and countless residents downwind and downstream of the aged and aging Davis-Besse atomic reactor in the Great Lakes Basin."

NRC's OIG reported at the end of 2002, after the Hole in the Head fiasco revealed earlier that year, that NRC – in addition to FENOC – had prioritized the company's bottom line above public safety. NRC has repeated that behavior since 2011 – allowing the company to rush reactor restart in Dec. 2011, before knowing the root cause, extent of condition, and corrective actions needed, regarding Shield Building cracking. In fact, given revelations of the worsening of previously known cracking, and the initiation of previously unknown cracking, in August/September 2013, NRC has postponed FENOC's due date for a "revised revised" root cause report and corrective action (aging management) plan until mid-2014 – more than two years after the original Feb. 28, 2012 deadline. As David Lochbaum of UCS indicated in May of 2012, FENOC's failure to provide complete, accurate information by Feb. 28, 2012 constituted a 10CFR50.9 violation, but NRC has never taken enforcement action.

At point #23, on p.24, we stated:

"Of additional concern is that the pour of new concrete to re-seal the shield building foreclosed significant investigatory options for examination and further analysis of the cause, extent, and significance of the cracks, such as direct visual examination, direct measurement, direct sampling, etc. In effect, evidence of the cracking has been buried under inches or feet of concrete, due to FENOC's rush to re-start, and NRC's letting them get away with it."

In fact, in Feb. 2014 we learned that, by leaving in place metal forms in late 2011, FENOC had concealed a 25 foot long, 6 to 12 inch wide, air space or gap of yet to be revealed depth through the 30 inch thick Shield Building wall. The metal forms prevented visual examination of the gap. Thus, not only did the rushed resealing of the access opening involve an incomplete concrete pour – it also prevented visual examination and discovery of the very gap resulting from the rush-job conducted during the rush to restart the reactor in Dec. 2011. Thus, Davis-Besse operated at full power for over two years –

from early December 2011 to Feb. 1, 2014 – with a significant void space in its Shield Building wall, of yet-to-adequately-be-determined impact on containment safety margins.

Such risky behavior by FENOC and NRC, working in collusion and complicity, cannot be endured for an additional 20 years.

At point #25, on p.26, we stated:

"If the shield building loses its ability to perform its safety- and security-related functions, Davis-Besse should be immediately shut down, of course. But this very risk, the potential loss of shield building safety and security function over time, is exactly the kind of analysis that should be included in FENOC SAMA analyses regarding the Davis-Besse license extension. Such analyses have not been done. Similarly, the potential for Davis-Besse's cracked shield building to cause its early retirement, before its current license expiration in 2017, or before its extended 2037 license expiration proposed by FENOC, should be addressed by FENOC's reliability analyses, and its energy alternatives analyses. For, if Davis-Besse's days are numbered, due to its cracked shield building, then Intervenors' wind, solar, and compressed air energy storage contentions increase in merit. FENOC, and the Region of Interest as a whole, should be preparing now to replace Davis-Besse and the NRC should reflect such a reality through its own independent analysis in the Draft Environmental Impact Statement on the license extension proposal."

FENOC's SAMA analyses assume a safe, sound Shield Building capable of performing its designed containment function. However, the severe cracking known since October 2011, combined with wall gaps in resealed access openings in 2002 and 2011, seriously undermine any such optimistic assumptions. As Intervenors' SAMA contentions have challenged since the beginning of this license extension application proceeding, FENOC's SAMA analyses need fundamental re-evaluation.

NRC's draft EIS does not adequately address these needed SAMA re-evaluations, if it addresses them at all.

Mark Cooper, an energy economist at Vermont Law School, warned on April 10, 2014 that nuclear utilities must plan for replacement power – as from efficiency upgrades and development of renewable sources of electricity – in advance of the inevitability that atomic reactors will one day close, lest our electric grids lurch from crisis to crisis. In fact, in July 2013, Cooper identified Davis-Besse as one of a dozen reactors most at risk of near-term shut down, due to a variety of factors, including economic factors (cost, old age, stand alone status, and only a 25-year future even if it gets an extension), operational factors (lack of reliability, long-term outages), as well as multiple safety factors. (see Exhibit ES-1: Retirement Risk Factors of the Nuclear Fleet, page iv, posted online at http://216.30.191.148/071713%20VLS%20Cooper%20at%20risk%20reactor%20report%20FINAL1.pdf).

At point #40, on p. 38-39, we stated:

"A problem with this examination protocol is that this visual inspection program is limited to external surfaces. The present cracking controversy involves internal cracking, not visible to the naked eye on the surface. That is another reason that Interveners are concerned that the early December pouring of the concrete to patch the shield building hole may have covered up evidence of cracking that could only be obtained through direct visual inspection, but is now under inches or feet of concrete."

The rushed access opening reseal, in the lead up to the rushed reactor restart, in late 2011, not only concealed primary evidence of severe Shield Building wall cracking, it also introduced a substantial gap in the resealed access opening, concealed from visual examination by metal plates that had been left in place. FENOC's ability to detect serious problems with the Shield Building without direct visual examination seems quite limited. The substantial Shield Building wall gap introduced in 2011, for example, remained undiscovered until Feb. 2014, when visual examination revealed it during the steam generator replacement cut of yet another access opening through the Shield Building. During the Dec. 2011 to Feb. 2014 time frame, not a single acoustic test that could have revealed the wall gap was performed.

Along the same lines, the white wash applied to the exterior of the Shield Building in August 2012 has concealed visual evidence of surface cracking ever since. Intervenors called for comprehensive root cause, extent of condition, and corrective action examination, documentation, and analyses throughout late 2011 and all of 2012 (in fact, still call for it) – for all forms of cracking and other Shield Building problems, not just sub-surface laminar cracking. FENOC's and NRC's priority on production (company profit), rather than public safety, has glossed over serious Shield Building problems, of deep safety and environmental concern on the brink of approval of a 20-year license extension. In fact, we addressed this concern at the very end of point #45, on p.46-47, stating:

"Intervenors question with alarm the safety significance of the potential for worsening concrete shield building cracking over the next five years of licensed operations. Contemplating such worsening cracking for the next quarter century, considering the 20 year license extension proposed, raises the level of alarm considerably. Interveners cont end that Davis-Besse should be shut down on Earth Day (April 22), 2017 – its last licensed date for operations under the original 40 year license – at the very latest.

In fact, by Sept. 2013, FENOC admitted worsening of previously identified cracking, as well as initiation of newly discovered cracking – that is, age-related cracking. This is clear evidence that Intervenors' cracking should have been admitted for ASLB hearing in the first place – it still should be.

At point #48, on p.50, we stated:

"In request for additional information (RAI) B.1 4-1, issued on May 19, 2011, the staff asked the applicant to describe the programmatic activities that will be used to continually identify aging issues, evaluate them, and as necessary, enhance the aging management programs (AMPs) or develop new AMPs for license renewal. In its response dated June 24, 2011, the applicant stated that it currently has a procedurally controlled operating experience review process, as required by NUREG-0737, "Clarification of TMI Action Plan Requirements," Item I.C.5, "Procedures for Feedback of Operating Experience to Plant Staff." The applicant stated that this process provides for the systematic identification and transfer of lessons learned from site and industry experience into fleet and station processes to prevent events and enhance the safety and reliability of its operations."

The irony of this, of course, is that the Three Mile Island precursor incident at Davis-Besse, 18 months before the TMI meltdown, could have prevented the TMI meltdown, had that OE [Operating Experience] been shared with TMI by Davis-Besse, or even NRC. But that did not happen, and the rest is history. This TMI precursor incident was described, in summary, in a backgrounder about Davis-Besse's numerous close calls with disaster, previously put on the record in this proceeding, posted online at http://www.beyondnuclear.org/storage/Davis%20Besse%2020%20More%20Years%20of%20Radioactive%20Russian%20Roulette%20Nov%202010%20corrected%20Dec%2028%202010.pdf (see pages 1-2).

Given NRC Staff's April 15, 2014 RAIs, it is clear that NRC Staff is still not clear that FENOC has aging-related cracking of the Shield Building, and associated "adequate protection" concerns associated with Shield Building safety-related design functionality, comprehensively covered, under its 2017-2037 AMP.

At point #51, on p.55, we stated:

"NRC's DB RAI 3.1.2.2.16-3, on page 6, also directly touches upon Intervenors' present contention. This is due to the fact that degradation of the steam generators will require their premature replacement, requiring yet another breach of the Davis-Besse concrete shield building. FENOC already plans such an organ transplant in 2014. But if FENOC screws up this aging management program badly enough, it could very well have to replace steam generators yet again in the future, during the license extension, even after the 2014 steam generator replacement. Given the fact that Davis-Besse currently has its third lid, with no guarantees that a fourth lid will not be needed, necessitating yet another concrete shield building breach, it is not far fetched to raise the concern about yet more steam generator replacements post-2014. Each breach of the concrete shield building risks introducing more weakness into the structure, and undermining its vital safety function.

The late Jan., 2012 San Onofre (CA) steam generator tube rupture occurred a few weeks after this Jan. 10, 2012 contention was filed. The defective San Onofre replacement steam generators led to the permanent shutdown of San Onofre Units 2 and 3 in June 2013.

Although we also filed a steam generator replacement contention at Davis-Besse in May, 2013, which included concerns about Shield Building breaches, that contention was summarily dismissed by the ASLB. Thus, the steam generator replacement "experiment" at Davis-Besse is now well underway, and only time will tell how long they will last, and how soon the Shield Building must again be breached, if FENOC chooses to replace large nuclear components located within the Shield Building.

[Submitted by Joe DeMare]

Comments on the Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Supplement 52

Regarding Davis-Besse Nuclear Power Station

Report number NUREG-1437, Supplement 52, Docket ID NRC-2010-0298

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The following comments are in response to the Draft Generic Environmental Impact Statement (DGEIS), Report number NUREG-1437, Supplement 52, in regards to the Davis-Besse relicensing application, Docket ID NRC-2010-0298.

In reviewing the DGEIS, it is important to keep in mind the central purpose of the NRC, that is "to protect health and safety and minimize danger to life or property." This report fails to do so because it is filled with errors: errors in judgement; errors of omission; and errors of fact. These errors consistently prioritize protecting the profits and investments of FENOC over the health and safety of the public. In fact, events which have occurred and information which has come to light since the original Environmental Impact Statement was submitted, have made it increasingly clear that the only way for the NRC to fulfill its primary mission is to transition from an agency which promotes nuclear power to one which oversees an orderly transition away from nuclear power and towards the safe decommissioning of all nuclear power plants.

These new and significant events include: the nuclear disaster in Fukushima, Japan; numerous studies published since the original EIS which show a link between living near a nuclear power plant and increased cancer rates; and increasing demonstrations that non-polluting energy sources such as wind and solar power can reliably replace nuclear power.

Section One: Errors of Judgement

The clearest demonstration of the NRC's bias towards promoting nuclear power and against protecting the health and safety of the public shows up in this report whenever the agency is required to make a judgement or an estimate. In these cases, the NRC makes judgements and predictions that fly in the face of reality and common sense in order to justify the license renewal. For example, the agency estimates in Appendix F (Section F.2.1) that the frequency of a core damaging accident is once every hundred thousand years. This fanciful estimate comes despite the fact that there have been numerous core damaging accidents within the last fifty years, including Enrico Fermi 1, Three Mile Island, Chernobyl, and the three nuclear meltdowns at Fukushima. A more accurate estimate, based on actual real world experience, is that nuclear plant meltdowns occur approximately once every 10 years.

Not surprisingly, the factors that led to NRC's incorrect estimate are also wildly wrong. Tornadoes, floods and other external events are estimated to occur, cumulatively, once every 100,000 years. On page F11, the NRC States, "Based on this result, the applicant concluded that these other external hazards would be negligible contributors to overall core damage and did not consider any plant-specific SAMAs for these events." However, Davis-Besse has already been hit by a tornado. On June 24, 1998 the plant was struck by an F2 tornado. Contrary to the estimates of the NRC, this does not mean that we are good for another 100,000 years. Instead, it demonstrates that

Davis-Besse is in a location that is uniquely prone to tornadoes. In fact Lake High School, less than 25 miles from Davis-Besse, was destroyed by an F4 tornado on June 5, 2010. The applicant (FENOC), is clearly wrong and it is the responsibility of the NRC to reject incorrect assertions on relicensing applications. Tornadoes are a site specific risk for the Davis-Besse nuclear plant. The questions that need to be answered in regard to this are not "When will DB be hit by another tornado?" but "What happens if Davis-Besse is hit by an F4 tornado, as Lake High School was?"

The containment dome was designed to protect the nuclear core from external attacks such as tornadoes. However, since the EIS was submitted, it has come to light that the containment dome (or "shield building") around the reactor core is full of large cracks. Also the structure has been operating with large voids in the concrete shell. The initial explanation of the cracks was that they occurred during construction as a result of the blizzard of 1978. NRC and FENOC concluded that these cracks were, therefore, stable and posed no threat to the structure. However, in 2013 it was discovered that these cracks are, in fact, growing. This means that the original explanation for their formation is wrong. It also means that the structure is, by definition, unstable. Whether that instability could lead to structural failure requires study before an accurate answer can be given. The original answer, based on estimates and judgements was clearly wrong.

Numerous other tornadoes have touched down in the area surrounding Davis-Besse since its construction. Tornado frequency is influenced by topography. Low, flat areas like the area where DB is located are more prone to tornadoes. Also, the frequency of severe weather events such as tornadoes is predicted to increase as a result of climate change. An estimate based on reality and real world experience suggests that the odds that Davis-Besse could be hit by an F4

or higher tornado during the period it would operate if its liscence were renewed are much higher than 1 in 100,000. Oklahoma City, Harvest, Alabama, and Cordell, Kansas have all experienced multiple tornado strikes in the same location.

Similarly, flooding is estimated to occur only once every 100,000 years. But the Davis-Besse site was flooded by a seiche in November of 1972, before the plant was operational. DB is uniquely vulnerable to seiche events because of its location on Lake Erie. While the plant does have some protective measures in place, the size and extent of those measures have been limited by the costs involved, just as the tsunami barriers were at the Fukushima nuclear plants. The NRC's four step process to judge whether or not a risk such as flooding needs to be mitigated starts with an estimation of the risk involved. This estimate has been demonstrated to be incorrect. Therefore all the other steps in the process have also produced incorrect results.

One of those steps, the cost/benefit analysis, prioritizes profitability for FENOC over the public health and safety. If FENOC determines that it costs too much to mitigate or eliminate a risk, they will not do it. However, with the chances of those risks being estimated as miniscule, almost no mitigation can be justified through a cost/benefit analysis. Turbine room flooding, for example, is estimated at once every 10 million years. No mitigation measures could be justified for something that happens so rarely. However, the Fort Calhoun nuclear plant experienced turbine room flooding in July of 2011. Clearly, it happens more frequently than once every 10 million years.

Loss of offsite power is also estimated at twice every hundred thousand years. In April of 2013, snipers systematically destroyed a power substation near San Jose, California. It took almost a month to restore the station's function. The power grid, and

its vulnerable points such as substations are a potential target for a variety of potential aggressors. Terrorists, criminals, or agents of hostile governments could all attack vital parts of the grid system, causing prolonged loss of outside power. A study published in the May, 2014 issue of Ecological Economics, entitled "Human and nature dynamics (HANDY): Modeling inequality and use of resources in the collapse or sustainability of societies" suggests that we are most likely entering a period of societal instability. This instability could create multiple sceanarios that would lead to long term disruption of off site power, from severe weather events, to wars, to civil unrest. There have also been many local examples of prolonged power outages. The estimate of twice every hundred thousand years is clearly wrong. All the estimates of "initiating events" in Section 5 that could lead to a core meltdown are similarly, demonstrably wrong.

Another area of a serious error of judgement has to do with the leakage of tritium into the groundwater around Davis-Besse in the 2007-2010 time period. In Section 2, it states, "1 ERM (2008) provided a plausible explanation regarding tritium release and migration." However, the "explanation" is simply a list of possible tritium sources, "potential inadvertent releases from the power block, including the spent fuel pool, would 3 migrate vertically down through the unsaturated zone to the water table. Potential releases from 4 structures below ground could release tritium directly to the upper or lower dolomite unit." 5 Potential tritium sources in the power block are the reactor containment, auxiliary building, 6 circulating water pump house, turbine building, and borated water storage tank (ERM 2007), 7 (ERM 2008). In addition, several spent fuel pool leaks have been documented 8 (Davis-Besse Undated). " These sources would all produce leaks of varying amounts, degrees of radioactivity, and seriousness in terms of compromising the safety of the plant. Before allowing the plant to be relicensed, the NRC must

require FENOC to demonstrate a causal link between an accidental release of radiation and tritium entering the ground water. As long as the source of tritium and the cause of the leaks are unknown, there is a very real danger that another, more serious release of radiation will occur. As was demonstrated with the NRC's response to the cracks in the containment dome, simply accepting a "plausible explanation" from FENOC is not a high enough standard of oversight to protect the public health and safety.

Section Two: Errors of Omission

The recommendation that the adverse environmental impacts of license renewal for Davis-Besse are not great enough to deny the license renewal is dependent on the omission of essential information from the NRC staff's consideration.

In the initial public comment on the license renewal application, many people pointed out that nuclear power plants release radioactive isotopes which are known to cause cancer. There is a cancer cluster downwind of the power plant. This supports the conclusion is that radiation from Davis-Besse is causing the cancers. However, the NRC staff response to this assertion on page A-24 was that, "In summary, there are no studies to date that are accepted by the nation's leading scientific authorities that indicate a causative relationship between radiation dose from nuclear power facilities and cancer in the general public." To support this, they cite six studies done between 1979 and 2001. However, they have omitted many studies published in respected scientific journals which have been published since then which DO show a link between living near a nuclear power plant and doubling of cancer rates. This is not too surprising, since cancers caused by radiation can take up to 20 years to appear. Therefore, studies done when nuclear plants are only 10 or 15 years old would mask the long term effects of exposure to low level radiation.

Two of the most widely accepted studies that the NRC omitted were done in Europe and have contributed to the decision of the French government to cut back on the use of nuclear power, and the decision by the German government to eliminate nuclear power from its energy mix completely. Leading scientific authorities in those countries are able to make the seemingly common sense connection between the release of radioactive isotopes into the environment and the subsequent development of cancer. The 2008 German study, "Kinderkrebs in der Umgebung Von Kern Kraftweken" describes a 60% increase in solid cancers and a 120% increase in leukemia amongst people living near nuclear power plants. The French study, "Childhood Leukemia Around French Nuclear Power Plants" documents a doubling of leukemia rates. This means that for each child with leukemia near a French nuclear plant, there is a 50/50 chance that their cancer was caused by emissions from that plant.

There have been many other studies, as well. A study entitled, "Childhood Cancer Near Nuclear Installations," by Ian Fairle published in the Journal of Environmental Science and Health on 3/1/10, Volume 21, Issue 2, also shows an increase in cancer. There was a study done for the European Parliament that estimated more than 1,000,000 people have died prematurely from the radiation released by the Chernobyl disaster.

It is important to note that finding a fully "causative" link between nuclear plant emissions and increased cancer rates is not only almost impossible, such a study would be immoral and unethical. To demonstrate true causation, one would have to follow a radioactive particle as it left Davis-Besse, entered the environment, was consumed or absorbed by an individual, emitted ionizing radiation inside that person's tissues, and monitored the subsequent cellular damage and cancer development. If a researcher had the ability to do this, they would

also be morally compelled to step in and prevent the victim from developing cancer in the first place. Instead, studies must rely on inductive reasoning, that is demonstrating that the number of cancers increase in the vicinity of nuclear plants in enough instances to make the conclusion that the nuclear plants are causing the increase a reasonable one. This conclusion can be bolstered by demonstrating an increase in rare cancers which are known to be caused by specific radioactive isotopes that are released by nuclear plants, such as thyroid cancers and radioactive iodine. However, many radioactive isotopes, such as tritium, have unpredictable impacts which can affect many different organs.

Finally, the works of Dr. Joseph Mangano, J.M. Gould and their many collaborators can not simply be dismissed out of hand. One of Dr. Mangno's most recent studies, "Infant Death and Childhood Cancer Reductions after Nuclear Plant Closings in the United States," with J.M. Gould, J.J. Mangano, W. McDonnell, J. D. Sherman and J. Brown , Archives of Environmental Health, 57, 23 - 31, 2002. Comes as close as ethically possible to establishing a causative link between nuclear plants and infant mortality. He found that, when nuclear plants were forced to have prolonged shut downs, infant mortality rates dropped. When the shut downs ended and the plants again began releasing radiation into the environment, the mortality rates again went up. Children and women are more vulnerable to to radiation than men. A fact which the NRC does not seem to take into account in this report. This is explainable because dividing cells are the most sensitive to damage from radiation, and infants have extremely rapidly dividing cells. Older men, in comparison have cells which divide much less frequently. Dr. Mangano has many other studies which are included in these comments as Appendix A.

In addition to impacts on humans, essential information on the impact on the flora and fauna of

the study area has been omitted. There is extensive description an quantification of the birds in the area, for example, and a very brief mention is made of ways that birds could be impacted by Davis-Besse's cooling towers is listed, but a detailed discussion of the severity of that impact is omitted. A 2009 study done by Benjamin K. Sovacool entitled, "Contextualizing avian mortality: A preliminary appraisal of bird and bat fatalities from wind power, fossil-fuel, and nuclear electricity" presented to the Energy Governance Program, Centre on Asia and Globalisation, Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore 259772, Singapore and found online at : http://www.nukefree.org/news/avianmortalityfromwindpower,fossil-fuel,andnuclearelectricity suggests that Davis Besse could be killing 3,000 to 5,000 birds every year. Thus, avian impacts should be reclassified as LARGE.

Also, one of the contentions made by commenters on the original Environmental Impact Statement was that the heating of Lake Erie by Davis Besse's effluent would encourage the growth of cyanobacteria such as Microcystis aeruginosa and Lyngbya wollei. The NRC's response was, "Current operation of Davis-Besse has not been linked to the presence or growth of the cyanobacteria in Lake Erie." However, simply because no researcher has made the link, does not mean that the link does not exist. Several facts are known. Algea grows more quickly in warmer water. I have personally observed large mats of algea that have washed up onshore downstream from Davis-Besse. Probably, DB's discharges are encouraging more algeal growth.

In Section 4.1 LAND USE it was stated, " The review included a data gathering site visit to Davis-Besse. No new and significant information was identified during this review that would change the conclusions presented in the GEIS. " Given the NRC staff's poor judgement in other matters, the report

from this visit should have included ANY new information found, so that the public could make a judgement as to what constituted "significant information." This study is supposed to be addressing the impacts of operation after renewal, but it seems in Section 4.2 they only address air quality during the revisions, not after. Section 4.5.2 discusses releases of radiation into local groundwater. It describes "unknown, uncontrolled, and unmonitored releases" of radioactive substances that have occurred in the past, but claims that such leaks are not expected to occur again. Therefore the impact in listed as "small" but in reality it could be much more significant. If the causes of radioactive releases are "unknown" and "uncontrolled," no accurate estimates of their future impacts can be made. In section 4.11 Environmental Justice the report states, "...During 2010, analyses performed on samples of environmental media showed no significant or measurable radiological impact above background levels from site operations (FENOC 2011)." The NRC omitted what it considers "significant." Section 4.4.1 claims that there will be no significant change in surface water use and water quality. However, if projections by the EPA and other agencies are correct, and Lake Erie will warm and shrink as a result of climate change, then there will almost certainly be altered impacts on issues such as thermal stratification of lakes and eutrophication.

Section Three: Errors of Fact

There are many errors of fact in this document, but the most important is the NRC staff's assertion that the power generated by Davis-Besse cannot be replaced by clean sources of electrical generation such as wind and solar. This is one of the Contentions raised by the Intervenors (The Green Party of Ohio, Beyond Nuclear, the Citizens Environment Alliance of Southwestern Ontario, and Don't Waste Michigan) in opposition to the initial application of FENOC for a license renewal. The

Intervenors presented testimony and research demonstrating that wind and solar power, with or without energy storage technologies could reliably replace the power generated by Davis-Besse. The Atomic Safety Licensing Board (ASLB) reviewed the evidence supplied by the Intervenors and agreed to hear their contentions. The Nuclear Regulatory Commissioners then took the unprecedented step of overruling the ASLB and throwing out the Intervenors' contention. The Commissioners based this action on the "pragmatic" belief that neither wind nor solar nor any storage technology will be sufficiently advanced to replace DB in 2017, when its license expires, almost exactly three years from now.

The Commissioners and the NRC Staff are wrong, and their error is being clearly and decisively demonstrated in Denmark. In 2013, wind power alone provided 33.2% of that country's electricity demand. With an installed capacity of almost 5,000 MW, Denmark has successfully integrated wind power, despite its intermittency, by having wind farms that cover a wide area, and the ability to export power to neighboring countries when it is producing excess. In fact, during a wind storm in December, 2013, the nation of Denmark met more than 100% of its needs from wind power alone, and exported the excess to neighboring countries. Denmark has had to upgrade its grid, in order to shift loads and demands quickly and efficiently. Our country is capable of making the same improvements. There is no technical reason FENOC could not do the same as Denmark.

Germany has followed Denmark's lead and is using wind and solar power to completely phase out its nuclear fleet. That nation is now getting 25% of its power from renewables, with wind power generating more than 47 TWh of power in 2013. Other European countries such as Spain and Portugal are also increasing the percentage of power they receive from renewables. Since the wind power is being installed continent-wide, intermittency is not a problem with

the grid since the wind is always blowing someplace.

Here in the U.S., a recent study by PJM Interconnect and GE concludes that wind and solar can easily satisfy up to 30% of the needs of the PJM Interconnect. The Ohio Power Siting Board has just announced approval of a 300 MW Scioto Ridge wind project. This is in addition to a 305 MW wind farm installed in Van Wert County in 2012. The fact that it is possible to install sufficient wind and solar in Ohio to offset the closure of Davis Besse is being demonstrated by the fact that it is being done without FENOC's cooperation or benefit.
It should also be noted that, with a lifetime generation uptime of only about 60%, Davis-Besse itself has to be considered an intermittent power source. Instead of investing in wind and solar, FENOC has invested $600 million to refurbish steam tube generators at DB. Utility scale wind turbines can be installed in less than a month. Once operational, they are fully automated and require only annual maintenance. Had the response to the Intervenors' contention been to invest in wind and solar, FENOC would be well on the way to replacing nuclear power with wind and solar. It is still possible to replace Davis Besse's output by April 22, 2017, and it may be replaced by other party's whether FENOC chooses to participate or not.

Appendix A.
Studies suggesting a causative link between living near nuclear power plants and adverse health effects such as cancer.

It is important to note that finding a fully "causative" link between nuclear plant emissions and increased cancer rates is not only almost impossible, such a study would be immoral and unethical. To demonstrate true causation, one would have to follow a radioactive particle as it left Davis-Besse,

entered the environment, was consumed or absorbed by an individual, emitted ionizing radiation inside that person's tissues, and monitored the subsequent cellular damage and cancer development. If a researcher had the ability to do this, they would also be morally compelled to step in and prevent the victim from developing cancer in the first place. Instead, studies must rely on inductive reasoning, that is demonstrating that the number of cancers increase in the vicinity of nuclear plants in enough instances to make the conclusion that the nuclear plants are causing the increase a reasonable one. This conclusion can be bolstered by demonstrating an increase in rare cancers which are known to be caused by specific radioactive isotopes that are released by nuclear plants, such as thyroid cancers and radioactive iodine. However, many radioactive isotopes have unpredictable impacts, such as tritium which is diffused throughout the body and can affect many different organs.

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Genesky, Donielle

From:	Kevin Kamps <kevin@beyondnuclear.org>
Sent:	Saturday, January 24, 2015 4:19 PM
To:	Puco Docketing
Subject:	OPPOSITION COMMENT UNDER CASE # 14-1297-EL-SSO: (#16) Defense of Earth Day, 2014 environmental coalition intervention contentions against Davis-Besse Shield Building wall gap, rebar damage, worsening cracking, and re: renewable alternatives
Attachments:	5 23 14 Reply in support of gap rebar contention.pdf

Dear Public Utilities Commission of Ohio,

This is my 16th emailed submission regarding this proceeding.

On May 23, 2014, the environmental coalition (Beyond Nuclear, Citizen Environment Alliance of Southwestern Ontario, Don't Waste Michigan, and Green Party of Ohio) intervening against Davis-Besse's 20-year license extension, represented by Toledo attorney Terry Lodge, defended its Earth Day, 2014 contention filings against opposition from FirstEnergy and NRC staff:

May 23, 2014: Intervenors' Reply in Support of Motion for Admission of Contention No. 6 on Shield Building Concrete Void, Cracking and Broken Rebar Problems.

This reply is posted online at:

https://adamswebsearch2.nrc.gov/webSearch2/view?AccessionNumber=ML14144A000

It is also attached to this email.

Given the already severe, and worsening, cracking of the Shield Building's concrete containment (something FirstEnergy and NRC staff had previously adamantly argued was impossible, until FirstEnergy admitted, in August-September 2013, was actually happening); the Shield Building air gap or wall void (extending 80% of the way through the Shield Building wall) documented in early 2014; the extensive Shield Building structural rebar damage; and the renewable energy (wind and solar PV), energy efficiency, and energy storage (including FirstEnergy's own Norton compressed air energy storage facility, near Akron) alternatives to a 20-year license extension; we urge PUCO to not approve FirstEnergy's requested massive ratepayer bailouts to prop up its uncompetitive, age-degraded, problem-plagued, catastrophically risky Davis-Besse atomic reactor.

Thank you.

Sincerely,

Kevin Kamps, Beyond Nuclear

--
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Beyond Nuclear aims to educate and activate the public about the connections between nuclear power and nuclear weapons and the need to abandon both to safeguard our future. Beyond Nuclear advocates for an energy future that is sustainable, benign and democratic.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	)	Docket No. 50-346-LR
FirstEnergy Nuclear Operating Company Davis-Besse Nuclear Power Station, Unit 1	)	May 23, 2014
	)	
	)	

REPLY IN SUPPORT OF MOTION FOR ADMISSION OF CONTENTION NO. 6 ON SHIELD BUILDING CONCRETE VOID, CRACKING AND BROKEN REBAR PROBLEMS

Now come Beyond Nuclear, Citizens Environment Alliance of Southwestern Ontario (CEA), Don't Waste Michigan, and the Green Party of Ohio (collectively, Intervenors), by and through counsel, and reply in support of their "Motion for Admission of Contention No. 6." Intervenors are replying in opposition to the "NRC Staff's Answer to Motion for Admission of Contention No. 6" ("Staff Answer") and the FirstEnergy Nuclear Operating Company's filing, "FENOC's Answer Opposing Intervenors' Motion for Admission of Contention No. 6" ("FENOC Motion").

Reply to assertion that Intervenors are pursuing a motion for reconsideration of dismissal of Contention No. 5

The Staff goes to extraordinary lengths to argue (Staff Motion pp. 4-26, *inter alia*) that Intervenors are making an "untimely request for reconsideration" of the dismissed proposed Contention 5. This is incorrect on the face of the April 21 Motion. Intervenors properly relied for their Contention 6 filing in part on the growing and disturbing history of cracking, meticulously documented through 2012 by their (6) filings totaling hundreds of pages following the

observation of cracking in the shield building concrete in 2011 during the reactor head replacement project at Davis-Besse. Their documented concerns showed that the proliferation of different types of cracks may have commenced in the 1970's before the plant had opened, and that their spreading and frequency of occurrence may be increasing with the passage of time. To that, Intervenors in their April 2014 motion added the 2013 revelations of new cracking discoveries, followed months later by the NRC's regulatory step sending FENOC a formal Request for Additional Information ("RAI") dated April 15, 2014 (ADAMS No. ML14097A454, Exhibit 7 hereto).

But the NRC Staff pillories Intervenors for making "general claims that the AMPs are inadequate," (Staff Answer at 31, 38/60 of .pdf), pointing out (*id.* fn. 157) that the "last changes to the Shield Building Monitoring and Structures Monitoring AMPs were made in FENOC's responses and LRA amendments dated November 20, 2012 and February 12, 2013, respectively." The February 12, 2013 RAI negotiation with FENOC exemplifies the gross inadequacies of the shield building AMPs. In that letter, also referred to as L-13-037, the Staff executed this climbdown from a somewhat tough regulatory posture:

> Following discussions, NRC Staff stated that, *instead of addressing RAI B.2.43-2a as written, FENOC should respond to the RAI by providing summaries of the laboratory (i.e., university) testing performed and the results of the testing.* The summary should address the Shield Building reinforcing bar-concrete bond strength, the assumptions made in the structural operability calculations regarding bond strength, and how the testing performed supports those assumptions. *A copy of laboratory reports is not needed by the NRC Staff.*

(Emphasis added). In one stunning retrenchment, the Staff eschewed receipt of copies of lab reports on cracking and signaled that it would accept "summaries" from FENOC. *Id.* at p 4/13 of .pdf. The upshot of such self-de-regulation means that the laboratory results remain in the

proprietary control of the utility company and that the NRC Staff is utterly dependent on the interpretations and possible "spin" in the quest to learn the true cause(s) of the cracking phenomena.

The letter contains several additional facts which expose how averse to regulating shield building crack and structural problems the Staff truly is. On the very next page (p. 5/13 of .pdf), the Staff proceeds to recount what FENOC tells the NRC about the laboratory testing the agency doesn't want to have available to the public. Without conducting independent scrutiny of the information, and accepting apparently-oral summaries of testing, the NRC reverts to the classic regulatory stance of "leak before break" - that the shield building can be expected to demonstrate classic deflection and surface cracking indications prior to complete structural failure. This unverified naivete contrasts with the engineering uncertainties of the building which were postulated in 2011 by the NRC's own engineers, and documented in depth forward from the early 1970's by Intervenors, who submitted their FOIA'ed information to the ASLB. This naivete is epitomized in the Staff's statement, also on p. 5/13 of the .pdf: "The robust design and construction of the Shield Building allow the building to retain significant margin against design loads even with laminar cracking." This conclusion derogates the proofs of shield building cracking over decades, caused by weathering and watering of the structure pre-emplacement of the dome, and before the sealing of the Initial Construction Opening on the side wall, from the water flow from the top of the SB wall pre-dome, and notation of cracking as early as 1976, before plant operations.

Then, at p. 7/13 of the .pdf, the NRC Staff retreated even further, assuring FENOC that "instead of addressing RAI B.2.43-3a as written, FENOC should respond to the following re-

quests . . . 1. For Request #1, NRC Staff stated that the discussion is not about aging mechanisms."

And more than a year later, on April 15, 2014, after the revelations of shield building rebar damage, "discovery" of a large concrete void which as discussed *infra* is the product of a deliberate series of acts, and borescope results suggesting new cracking, the NRC Staff is moved to undertake additional regulatory investigation. Coincidentally, the April 15 NRC RAI letter (dated the day before what the NRC and FENOC claim was Intervenors' 60th day to move for Contention 6, on the revelation of the wall gap and rebar damage) asks FENOC what, if any, changes to the AMP must happen, given these latest revelations.

In that letter, the NRC Staff noted that "during a subsequent routine baseline inspection in August/September 2013, FENOC discovered several (about 15) cracks on the Davis-Besse shield building that were not identified previously." And the Staff, though not demanding borescope testing results, and without the 2012-13 laboratory testing, cited the rebar separation problem, notes that FENOC has taken additional core samples of shield building concrete and is performing evaluations and testing to determine the root cause of the cracks and their apparent progression. The anticipated 2014 root cause analysis sought by the NRC will be the historically ***third*** root cause analysis of the seemingly-unstoppable, continuing cracking phenomenon.

Presumably, the NRC Staff does not undertake RAI inquiries as a vain act, but instead, as a deliberate investigatory step aimed at reviewing and revamping the existing regulatory regime - in this case, the Shield Building Monitoring Program and the Structures Monitoring Program Aging Management Plans ("AMPS") credited for the shield building in the Davis-Besse License Renewal Application ("LRA"). While as the Staff argues, "such questioning does not automat-

ically give rise to an admissible contention," some surprising admissions against interest by both FENOC and the NRC Staff in their respective Answers support the conclusion that Intervenors are headed in the right direction.

In their April 21 Motion, Intervenors alleged considerable new, material information which now has been placed beyond debate by the Staff and FENOC. Specifically, Intervenors bring the following concessions of FENOC and the Staff to the notice of the ASLB, because they bolster the case for admitting Contention 6 for adjudication:

A) FENOC's admission (p. 15 of their Answer, p. 17/69 of .pdf) and in the accompanying Hook Affidavit at ¶ 5) that "The [concrete] void was not discovered by visual inspections until February 2014 as it had been *covered by formwork intentionally left in-place following the 2011 concrete fill,* to act as a blast shield during the anticipated 2014 hydrodemolition process." FENOC thus tries to explain away a serious divergence from the continuing licensing basis of Davis-Besse by rationalizing it as a conscious, premeditated, and potentially criminal or civilly-punishable move by FENOC or its contractor. An allowable inference from this admission is that despite the very high media visibility of the cracking discovered in 2011, targeted by Beyond Nuclear's prompt FOIA request, and amplified by ongoing releases of nonpublic cracking-related information directly from a U.S. Congressman, the Nuclear Regulatory Commission not only botched the oversight of the critical re-sealing of the shield building, but neither the NRC nor FENOC were motivated to bestir themselves in the ensuing 2.4 years to ascertain the full dimensions of the concrete void and its implications, and associated rebar compromises.

B) FENOC's admission (at p. 15 of their Answer (17/69 of .pdf), and in the accompanying Hook Affidavit at ¶ 6) that the company

> . . . completed an Apparent Cause Evaluation on April 14, 2014, for the concrete void. The apparent cause of the void was the lack of flowable concrete. *In addition, the apparent cause of not having earlier identified the full extent of the void (notwithstanding identification of voiding on the exterior of the Shield Building) was weakness in the organization's questioning attitude and decisionmaking.*[1]

(Emphasis added).

By this admission, FENOC confirms its long-standing institutional repudiation of tough questioning and dissenting professional opinions, its continuing acceptance of bad management decisions, and a willingness to knowingly depart from CLB specifications and obfuscate its regulatory and legal violations for more than two (2) years. Certainly all post-concrete void assurances that there was no compromise of safety or functioning are now suspect, if they weren't prior to the May 16, 2014 filing of FENOC's Answer.

C) FENOC's October 2013 letter to the Advisory Committee on Reactor Safeguards, attached to this memorandum, requesting that the Advisory Committee on Reactor Safeguards (ACRS) subcommittee meeting scheduled for October 2013 and the ACRS full committee meeting scheduled for December 2013 be rescheduled to "late May 2014" - *after* the spring 2014 steam generator replacement at Davis-Besse and associated cut through the shield building. The stated reason, that "follow-up inspections of core bores in the Shield Building identified the need for an expanded core bore inspection scope" and "the evaluation of the inspection results will not be complete in time to support the current schedule" are of even greater interest in light of the Staff's admissions below.

D) The NRC Staff's admission, referencing the 2013 cracking discovery (Staff Answer p. 17, p. 24/60 of .pdf), that

---

[1]This sheds more light on the malefactor issue *vis-a-vis* the concrete void episode.

> While some of the previously unidentified crack locations can be explained as pre-existing cracks that were not originally identified due to limitations with the borescope originally used, *the remainder of the previously unidentified crack locations cannot be explained at this time. FENOC has contracted with PII to conduct testing and further evaluation to determine the cause and apparent progression of the unexplained cracks, the results of which are expected in June 2014.* FENOC drilled additional new core bores in 2013 that were sent off for laboratory testing to assist in determining the age and cause of these previously unidentified crack indications. The Staff issued an RAI on April 15, 2014 requesting FENOC to describe and justify modifications or enhancements, if any, that may be potentially required to the AMPs credited for the shield building for license renewal, considering this recent plant-specific operating experience.

(Emphasis added).

E) This further Staff assertion (Staff Answer at p. 30 (p. 37/60 of .pdf), fn. 149):

> FENOC's Shield Building Monitoring Program inspects existing core bore holes to manage the effects of aging on the 2011 laminar cracking. Thus, for example, if the laminar micro-cracking were to grow, the Shield Building Monitoring AMP should identify the growth.

This comprises the Staff's acknowledgment that worsening cracking will warrant an enhanced AMP.

Axiomatically, a motion for reconsideration may not include new arguments or evidence unless a party demonstrates that its new material relates to a Board concern that could not reasonably have been anticipated. *Texas Utilities Electric Co.* (Comanche Peak Steam Electric Station, Units 1 & 2), LBP-84-10, 19 NRC 509, 517-18 (1984). It was the judgment of the Intervenors, in light of the Board's December 28, 2012 order (LBP-12-27) denying their enormous efforts to admit Contention 5 that the September 2013 cracking discoveries did not have significance so long as they were presumably encompassed within the Aging Management Plans (AMPs) for the shield building. What altered Intervenors' perception of the importance of the September 2013 cracking announcement, however, was the subsequent evidence of other difficulties with the structural status of the shield building, coupled with the new knowledge (as

the Staff has admitted in its Answer) that a different technological detection method is driving the Staff to reconsider the AMPs for the shield building. The Staff contends a falsehood: that Intervenors' Motion for Admission of Contention 6 attempts merely to relitigate issues already decided as to proposed Contention 5. What Intervenors actually maintain is that there is significant new information which, in light of the previous history of cracking documented from the early 1970's through 2014, requires adjudication.

Reply to argument that DSEIS SAMA must not be supplemented

The Staff further argues (Answer p. 49, p. 56/60 of .pdf) that "even assuming that the shield building cracks identified in August/September 2013, the concrete void, or rebar damage had an age-related feature, Intervenors have failed to tie these issues to any specific environmental impact. The Commission has made clear that complex connections not obvious on their face must be supported by qualified experts." Intervenors contend that the connection between shield building failure on a catastrophic level, and the environment should be obvious on its face. Instead of recognizing the Commission policy as "either-or," the Staff portrays it as a requirement to produce an expert witness, or else nothing. But it is increasingly apparent to Intervenors, even if not to FENOC with its economic self-interest, or the Staff, with its fawning denial, that the shield building cracking, as an ongoing, still-misdiagnosed and misunderstood process, should be treated as a potentially catastrophic flaw. With poorly-understood continuing cracking, there is a point at which a common sense of concrete cracking and rusting rebar in the shield building suggests its failure is approaching, when it structurally can no longer stop objects hurled at enormous velocity, nor withstand a mild earthquake, nor absorb a serious overheating event within the reactor, or not incur compromising damage from a major natural disaster such as the

1998 tornado which blasted across the Davis-Besse compound.

The Staff says (Answer p. 49, p. 56/60 of .pdf) that "Intervenors once again make vague unsupported claims that the SAMA analysis is deficient." Despite ongoing, seemingly inevitable, plant-specific, unique structural damage and deterioration, coupled with FENOC's organizational deafness on the subject of the shield building, the NRC insists (Answer p. 51, p. 58/60 of .pdf) that it can exclude the shield building from SAMA analysis within the Supplement Draft Environmental Impact Statement at its whim: "The shield building is not credited for mitigating a release in a severe accident and the SAMA analysis does not model the shield building."

FENOC omitted to include within its SAMA analyses any information about the Davis-Besse shield building cracking or the corroding steel barrier shell contained within it. There is zero analysis of the changed physical properties of those facilities, nor any discussion of the implications of those changed physical properties on the capacity of the shield building or the steel containment structure to contain radioactive materials in the event of an accident. FENOC made the optimistic, self-serving assumption in its SAMA analysis that the shield building, as well as steel containment vessel, are as good as new.

Although an agency does not need to formally supplement an EIS whenever new information about a project comes to light, it must be reasonable in addressing new information, and consider its environmental significance and likely accuracy. *Warm Springs Dam Task Force v. Gribble*, 621 F.2d 1017,1025 (9th Cir. 1980). NEPA imposes continuing obligations on the NRC, even after completion of an environmental analysis. An agency that receives new and significant information casting doubt upon a previous environmental analysis must re-evaluate

the prior analysis. *Marsh v. Oregon Natural Resources Council*, 490 U.S. 360, 374 (1989). This requirement is codified in NRC regulations at 10 C.F.R. §51.92(a). This obligation extends to new and significant information even when such information pertains to a Category 1 issue. *See Duke Energy Corp.* (McGuire Nuclear Station, Units 1 and 2; Catawba Nuclear Station, Units 1 and 2), CLI-02-14, 55 NRC 278, 290 (2002).

The principal factor an agency should consider in exercising its discretion whether to supplement an existing EIS because of new information is the extent to which the new information presents a picture of the likely environmental consequences associated with the proposed action not envisioned by the original EIS. The issue is whether the subsequent information raises new concerns of sufficient gravity such that another, formal in-depth look at the environmental consequences of the proposed action is necessary. When the new information provides a seriously different picture of the environmental landscape such that another NEPA "hard look" is necessary, supplementation must take place. *State of Wis. v. Weinberger*, 745 F.2d 412, 418 (7th Cir. 1984).

With the shift in knowledge about the shield building from the supposed controllable nature of the cracking damage to a potentially open-ended scenario of further deterioration, and recognition of the realistic prospect that the shield building is hopelessly compromised and incapable of serving its design functions, the SAMA candidate accidents and the physical project improvements necessary for mitigation, while seemingly audacious, are in fact merely obvious. The new information articulated by Intervenors requires EIS supplementation of the SAMA contention.

Reply that the contention filing is untimely

Both the NRC Staff and FENOC maintain that Contention 6 cannot be admitted because Intervenors did not timely bring their motion within 60 days after Toledo Blade newspaper coverage of the concrete void and rebar damage (*viz.*, by April 16, 2014 instead of on April 21 2014, which was within 60 days after formal public notice of the concrete void was published by the NRC).

To decide this issue, Intervenors suggest that the ASLB review its ruling in LBP-12-27, the December 28, 2012 decision dismissing Contention 5, where timeliness was also the object of considerable argument. From pp. 16-19, the ASLB discusses the myriad developments and staggered dates at which various new things were learned about the 2011 cracks in the shield building, from multiple sources. Then on pp. 18-20, the Board analyzed this potpourri of milestones from which the parties launched their positions:

> Clearly, this contention was filed more than 60 days after the cracking was first discovered and reported by FENOC. It is also clear that it was filed more than 60 days after Intervenors first learned that there were cracks discovered in the shield building. It is less clear that the contention was filed more than 60 days after the extent of the cracking was first known or the cause of the cracking was understood by FENOC, the NRC, or Intervenors.
>
> From the myriad of dates bandied about by the parties, it is apparent to this Board that there were fast-emerging developments following the initial discovery of the cracks. The issuance of the FENOC letter to its investors and the wording of the letter clearly were insufficient to alert members of the public as to the significance of the cracking. In fact, the full scope of the nature and severity of the cracks did not become known until the study and testing of those cracks were conducted which was sometime after the initial discovery of the cracking.
>
> It thus is difficult to peg the exact date when Intervenors would have had enough information to prepare their contention.
>
> That being said, we find the analysis advanced by the NRC Staff on the issue of timeliness helpful. Adopting the NRC Staff's pragmatic application of § 2.309(c) standards, the Board concludes that even assuming the contention does not meet the strict 60-day deadline in our ISO, the contention would meet the non-timely requirements of § 2.309(c). The contention was submitted in a reasonable timeframe from when facts solely

in the Applicant's possession became known to the NRC and interested members of the public. Intervenors found themselves in a position in which they had to assemble bits and pieces of information that became publicly available in the weeks following the first discovery of the cracking. Although the cracks were discovered on October 10, 2011, the extent of the cracking, the cause of the cracking and the options for addressing the cracks were not known until weeks later. Because our ISO requires that Intervenors file a new contention within 60 days of when the information on which it is based first becomes known, we certainly cannot fault the Intervenors for their filing on January 10, 2012 that was based on a December 7, 2011 press release by Congressman Dennis Kucinich, the Staff's December 27, 2011 Request for Additional Information, and the January 5, 2011 public meeting. Using any of these dates, the Motion was filed within 60 days of the information becoming available pursuant to § 2.309(f)(2)(iii).

Intervenors also argue that the information in these sources is new and materially different from information previously available; thus, satisfying §§ 2.309(f)(2)(i) and (ii). We agree and therefore find that Intervenors' contention filed on January 10, 2012 is not time-barred for consideration in this proceeding. *It is simply not reasonable to expect an intervenor to craft a contention that meets the high standards in § 2.309(f)(1) on the mere announcement by a licensee that cracks were discovered during a scheduled outage. In this case, the contention was filed promptly after the January 5, 2012 NRC/FENOC public meeting during which it became clear that cracking was not limited to architecturally "decorative" elements of the building, as was originally believed. This is well within the 60 days required by our ISO. The timing of the filing of this contention thus meets the requirement of 10 C.F.R. § 2.309(f)(2).*

Moreover, even if it were to be considered non-timely and putting aside that Intervenors did not seek leave from the presiding officer, they have met the requirements of 10 C.F.R. § 2.309(f)(2)(i) –(iii).

(Emphasis supplied).

Intervenors submit that a very similar circumstance pertains here, where there has been an announcement of new, unexpected structural flaws in the shield building, where the agency is attempting to obtain a nuanced grasp which may or may not include the interplay of concrete void, cracking, aging management and rebar damage. Intervenors moved quickly in a field of changing events and interpretations. They filed within 60 days of several milestone events. Contention 6 is at worst being raised early - before the third root cause analysis becomes public in 6 weeks or more. Intervenors' motion was timely filed.

Response to FENOC's ersatz motion to strike and allegations of insufficient decorum

Intervenors oppose the motion to strike which FENOC deigned not to characterize as a motion to strike. FENOC includes a section at p. 50 of its Answer (p. 52/69 of .pdf) entitled "Intervenors' Baseless Accusations Should Be Stricken," which clearly is a motion for an order. FENOC contends, as precedent for striking, that it filed an actual motion to strike earlier in this case, which was denominated as such. In that motion, FENOC's counsel verified that he had prior to filing of that motion, engaged in a meet-and-confer consultation as required by 10 C.F.R. § 2.323(b).[2] The section of FENOC's Answer before the ASLB closes with a prayer that "FENOC respectfully requests that the Board strike these arguments and take other appropriate action to ensure that such conduct does not degrade this proceeding." Nowhere in the Answer is there any mention of the convening or conclusion of a consultation as required by rule.

Intervenors are conditionally responding to this section of FENOC's Answer and reserve the right to respond more fully if the ASLB determines that it will consider it as a legitimately-filed motion. However, Intervenors submit that it is not. Counsel for FENOC well understands the consultation requirement of the rule. Moreover, the Licensing Board has affirmed the mandatory nature of the consultation requirement, and its expectations that the parties will abide by it for practical reaons, earlier in this case, in LBP-12-27. The Board applied § 2.323(b) to exclude certain of Intervenors' filings in support of proffered Contention 5 from consideration on the substance of their motion to admit the contention:

---

[2]Which states, in part, that "A motion must be rejected if it does not include a certification by the attorney or representative of the moving party that the movant has made a sincere effort to contact other parties in the proceeding and resolve the issue(s) raised in the motion, and that the movant's efforts to resolve the issue(s) have been unsuccessful."

> First, Intervenors did not certify that they consulted with the other parties prior to submitting this motion. NRC regulations make clear that "[a] motion must be rejected if it does not include a certification by the attorney or representative of the moving party that the movant has made a sincere effort to contact other parties in the proceeding and resolve the issue(s) raised in the motion, and that the movant's efforts to resolve the issue(s) have been unsuccessful." In addition, our ISO reiterated this requirement: "[M]otions will be summarily rejected if they do not include the certification specified in 10 C.F.R. § 2.323(b) that a sincere attempt to resolve the issues has been made."
>
> While Intervenors seemed to suggest at oral argument that the consultation and certification requirement is unnecessary, the value of that regulation is not an issue on which -this Board may rule. And even if we could, it should be apparent from our reiteration of this requirement in our ISO that we consider it to have great value and desire that it be followed by the parties.

."Memorandum and Order (Denying Motions to Admit, to Amend, and to Supplement Proposed Contention 5)," LBP-12-27 at 21-22. At footnote 110 related to the cited passage, the ASLB continued, "While counsel may perceive that there is little likelihood that other parties to the proceeding will accede to the relief sought in the motion, that does not excuse him from making a good faith attempt to reach a resolution before bringing the matter to the Board." *Id.*

.Obviously, fairness and consistency of application of the rule is warranted here, and should cause the speedy dispatch of this non-motion motion. It should be denied and dismissed.

If, however, the ASLB is inclined to decide this non-motion motion on its merits, then Intervenors maintain both that the statements they have made in argument are fair commentaries upon the evidence, are legitimate argument and properly zealous advocacy, and uphold the decorum of this licensing proceeding. Intervenors take the cited examples mentioned by FENOC serially:

"FENOC may be incapable of managing Davis-Besse safely and successfully" (Motion at 2). It is ironic that in the very memorandum in which FENOC's expert is quoted as stating that the concrete void was "intentionally" caused by FENOC or presumably, its contractor, and that

"the apparent cause of not having earlier identified the full extent of the void (notwithstanding identification of voiding on the exterior of the Shield Building) was weakness in the organization's questioning attitude and decisionmaking," that the utility would be looking for sanctions for Intervenors' temerity in arguing that FENOC "may be incapable of managing Davis-Besse safely and successfully." *See* FENOC's Hook Affidavit at ¶ ¶ 5, 6. Given an admission of intentional concealment such as FENOC's, coupled with the NRC's very suspect handling of regulatory oversight of the sealing up of the Davis-Besse shield building in 2011, the characterization of the two entities as "malefactors" is justified.

"Malefactors." The context of the use of the term in Intervenors' Motion was in discussing the §2.309(c) factors of "good cause" for a late filing, wherein Intervenors were making the point, respecting the concrete void controversy, that they were the only one of the three parties to this licensing case who could effectively represent Intervenors' interests. Perhaps "alleged malefactors" should have been the choice of terms, and for that, Intervenors' counsel apologizes. But the term is a fair characterization, made the more so by FENOC's judicial admissions in its Answer of intentionally allowing the concrete void to form and then doing nothing to disclose it or characterize it and analyze the realistic dangers or structural implications it might cause, for more than two (2) years.

FENOC and the NRC "placed profits over safety" in 2002 The conclusion comes from a December 2002 NRC Office of Inspector General Report on Davis-Besse's Hole-in-the-Head fiasco, which found that not only did FENOC place profits ahead of safety (earning a record fine from NRC, amounting to $33.5 million altogether), but also that NRC – at the highest levels of the agency – also put FENOC's profits ahead of public safety. A report from the U.S. Nuclear

Regulatory Commission, Office of the Inspector General, "Event Inquiry: NRC's Regulation of Davis-Besse Regarding Damage to the Reactor Vessel Head," Case No. 02-03S, Dec. 30, 2002, found that the NRC's decision to allow the continued operation of Davis-Besse "was driven in large part by a desire to lessen the financial impact on [FirstEnergy Nuclear Operating Company] that would result from an early shutdown." The OIG further concluded that the "NRC appears to have informally established an unreasonably high burden of requiring absolute proof of a safety problem, versus lack of reasonable assurance of maintaining public health and safety, before it will act to shut down a power plant."

The U.S. Government Accountability Office (GAO) — the investigative arm of Congress — also sternly criticized the NRC for its failure to discover the problem at Davis-Besse sooner, finding in a May 2004 report that the NRC's inadequate oversight prevented an earlier shutdown, even though the agency was fully aware of the potential for the problem, which had manifested at other facilities. The GAO further expressed dismay that the NRC lacks formal guidance procedures for deciding whether to shut down a plant. U.S. General Accounting Office, Nuclear Regulation: *NRC Needs to More Aggressively and Comprehensively Resolve Issues Related to the Davis-Besse Nuclear Power Plant's Shutdown*, GAO-04-415, May 2004.

Intervenors engaged in fair comment predicated on facts.

Pejorative reference to "the NRC Staff's and FENOC's 'sheer denial'"

This is yet another example of Intervenors thoughtfully responding with facts, followed by a summary comment in good faith and zealous argument. In an example of use of fair comment, Intervenors ask that "sheer denial" be read in the context meant by Intervenors:

> After Contention 5 was unceremoniously dismissed, FENOC unexpectedly acknowledged in September 2013, as stated in the introductory section of this Motion,

> that there is worsening shield building cracking. And the public now also knows of damage done to rebar in the breach area by hydro-demolition associated with the 2011 re-sealing of that building, and of the 2011 concrete void which may be related in some fashion to causing cracking or other shield building damage. Intervenors submit that it's time to stop accusing them of "mere speculation," and to examine, instead, the repression of public information by the NRC Staff and FENOC. The problem is not so much Intervenors' "mere speculation" as it is the NRC Staff's and FENOC's "sheer denial."

"Repression of information" This statement, too - why isn't the NRC championing its right to be free from a lack of decorum, joining in FENOC's non-motion motion? - is grounded in fact. In fn. 3 at the bottom of page 10 of the Motion, Intervenors point out that "Intervenors' pending 2014 FOIA request filed February 20, 2014 remains thwarted by an unprecedented dispute over Beyond Nuclear being charged for the records, and the public's understanding of the precise current status of the shield building is further confounded by the NRC Staff's opaque verbiage in the RAI of April 15, 2014." These two statements are grounded in facts and are fair comments and zealous advocacy.

Unfounded statement that FENOC ordered the "hasty resealing of the shield building" and "the rushed resealing" . This is a ***founded***, not unfounded, statement. On November 17, 2011, the *Toledo Blade* published an article entitled "Davis-Besse to stay shut until probe ends." [http://www.toledoblade.com/Energy/2011/11/17/Davis-Bessetostay-shut-until-probe-ends.html] The article reports: "Until we have confidence that the cracks in the Shield Building don't have any safety implications, the plant won't go back online," Viktoria Mytling, spokesman at the NRC's regional office in Chicago, said... Ms. Young [FENOC spokeswoman] said Wednesday the reactor head replacement had been completed and that the steel removed to create the access hole had been welded back into place and pressure tested. The shield building hole should be patched by week's end, she said. Ms. Mytling said such patching would not affect

the NRC investigation, and no timetable is in place for restarting the plant..."

On November 19, 2011, the *Toledo Blade* reported that the hole cut for the lid transplant would be sealed shut that day, and that FENOC predicted the reactor would be restarted by the end of November:

> A 12-hour concrete pour is scheduled for Saturday at the Davis-Besse nuclear power plant, closing a hole in the reactor's outer shield building cut last month for access to install a new reactor head, a FirstEnergy spokesman said Friday.
>
> While declining to set a date when the utility plans to restart the plant, spokesman Jennifer Young said it remains on schedule to resume operation by the end of November, as forecast in a recent letter to FirstEnergy stockholders.
>
> By then, Ms. Young said, FirstEnergy also expects to have closed its investigation into hairline cracks discovered in the shield building's reinforced concrete after the access hole was made.
>
> FirstEnergy has submitted to the Nuclear Regulatory Commission its finding that the cracks are not a safety hazard, she said, and now is following up by submitting technical reports to the commission in response to its questions about the matter. "The cracks, as they are, do not impact the structural integrity of the building," Ms. Young said Friday. "There's plenty of margin in the building. It's a very, very robust building." Viktoria Mytling, a spokesman at the NRC's regional office in Chicago, said that as matters stand, FirstEnergy is free to restart Davis-Besse when it considers the plant to be ready, since the regulatory agency has made no finding of any safety hazard there. "If the plant does restart while our review isn't done, and we subsequently identify a safety issue, they are legally required to shut the plant down to resolve the safety issue," Ms. Mytling said. "If we are conducting a review and have a specific safety concern the company needs to address, but they tell us they will restart the plant before providing us with answers we need to make sure the plant will operate safely, we can and would order the plant to cease restart activities until they answer our questions."
>
> The NRC could also order "compensatory actions" -- essentially, special conditions -- for a restart or continued operation if the agency were to declare a safety issue, Ms. Mytling said.
>
> Ms. Young said FirstEnergy expects the "conversation" with the Nuclear Regulatory Commission to be concluded before the restart.

[http://www.toledoblade.com/local/2011/11/19/Nuclear-plant-to-close-hole-made-forrepairs.html]. Again, characterization of this sequence of events as a "hasty" re-sealing of the shield building is fully warranted.

Motions to strike are not available to remedy hurt feelings, but to deal with impertinence.

It is parabolic that FirstEnergy, which has upbraided Intervenors in the past for failing to adhere to the consultation rule, considers itself immune from its applicability. It is hyperbolic that FENOC undertakes to complain about statements and conclusions made by Intervenors that are grounded in fact, logic, good faith argument and which represent fair comments.

FENOC's ersatz motion should be denied before it is assessed on its suspect merits.

WHEREFORE, Petitioners pray the Atomic Safety and Licensing Board admit Contention 6 for full adjudication.

Executed in Accord with 10 C.F.R. § 2.304(d)

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	Docket No. 50-346-LR
FirstEnergy Nuclear Operating Company Davis-Besse Nuclear Power Station, Unit 1	)	May 23, 2014
	)	
	)	

* * * * *

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing "INTERVENORS' REPLY IN SUPPORT OF MOTION FOR ADMISSION OF CONTENTION NO. 6" was deposited in the NRC's Electronic Information Exchange this 23rd day of May, 2014.

Executed in Accord with 10 C.F.R. § 2.304(d)
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Genesky, Donielle

From:	Kevin Kamps <kevin@beyondnuclear.org>
Sent:	Saturday, January 24, 2015 7:01 PM
To:	Puco Docketing
Subject:	OPPOSITION COMMENT UNDER CASE # 14-1297-EL-SSO: (#17) Late 2014 contentions re: worsening Davis-Besse Shield Building cracking and rebar degradation
Attachments:	9 2 14 Final Contn 7 COMPLET FINAL.pdf; 9 8 14 Contn 7 Motn Amd or Supp FINAL-1.pdf; 10 10 14 Reply in Supp Contn 7 COMPLET.pdf; 12 30 14 Davis-Besse Intervenors Motion to Amend No 7 Shield Building - Rebar 12-30-2014.pdf

OPPOSITION COMMENT UNDER CASE # 14-1297-EL-SSO: (#17) Late 2014 contentions re: worsening Davis-Besse Shield Building cracking and rebar degradation

On July 8, 2014, FirstEnergy Nuclear Operating Company (FENOC) revealed that "ice-wedging" was the root cause of the worsening Shield Building cracking it had admitted to in August-September 2013. Prior to that admission, both FENOC and NRC staff had adamantly denied that worsening cracking was even possible.

This FENOC admission is posted online at:

http://pbadupws.nrc.gov/docs/ML1418/ML14189A452.pdf

FENOC's belated admission (it had known about water in the walls of the Shield Building since early 2012, but instead of making that publicly known, instead whitewashed, or weather-sealed -- 40 years too late -- the Shield Building exterior, thereby locking the water in the walls, actually causing the ice-wedging cracking propagation) led to the filing of two contentions by a coalition of environmental intervenors against the Davis-Besse 20-year license extension:

September 2, 2014: Intervenors' Motion for Admission of Contention No. 7 on Worsening Shield Building Cracking and Inadequate AMPs in Shield Building Monitoring Program. 37 pages. (Associated September 3, 2014 coalition press release; September 5, 2014 *Sandusky Register* article)

September 8, 2014: Intervenors' Motion to Amend and Supplement Contention No. 7 on Worsening Shield Building Cracking and Inadequate AMPs in Shield Building Monitoring Program. 27 pages. (Associated September 11, 2014 coalition press release; September 11 *Toledo Blade* article).

The various filings and statements are embedded at the hyper-links immediately above. The motions themselves have also been attached to this email.

Then, on Oct. 10, 2014, the environmental intervenors replied to challenges by FirstEnergy and NRC staff:

October 10, 2014: Intervenors' Reply in Support of Motion to Amend and Supplement Contention No. 7 on Worsening Shield Building Cracking and Inadequate AMPs in Shield Building Monitoring Program. 21 pages.

In addition to this document being embedded at the hyper-link immediately above, it is also attached to this email.

Finally, on Dec. 30, 2014, the environmental intervenors submitted a contention regarding degradation of structural rebar in Davis-Besse's Shield Building walls. This contention is attached to this email.

The intervening environmental coalition includes Beyond Nuclear, Citizen Environment Alliance of Southwestern Ontario, Don't Waste Michigan, and the Green Party of Ohio. Its legal counsel is Terry Lodge of Toledo.

Given the Davis-Besse Shield Building's worsening cracking (remarkably, 0.4 to 0.7 inches, each and every time it freezes), as well as the risks of ever worsening rebar degradation, we urge PUCO to not approve FirstEnergy's requested, massive ratepayer bailouts to prop up its uncompetitive, age-degraded, problem-plagued, catastrophically risky atomic reactor.

Thank you.

Sincerely,

Kevin Kamps, Beyond Nuclear

--
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Beyond Nuclear aims to educate and activate the public about the connections between nuclear power and nuclear weapons and the need to abandon both to safeguard our future. Beyond Nuclear advocates for an energy future that is sustainable, benign and democratic.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	)	Docket No. 50-346-L
FirstEnergy Nuclear Operating Company Davis-Besse Nuclear Power Station, Unit 1	)	September 2, 2014
	)	
	)	

INTERVENORS' MOTION FOR ADMISSION OF CONTENTION NO. 7 ON WORSENING SHIELD BUILDING CRACKING AND INADEQUATE AMPS IN SHIELD BUILDING MONITORING PROGRAM

Now come Beyond Nuclear, Citizens Environment Alliance of Southwestern Ontario (CEA), Don't Waste Michigan, and the Green Party of Ohio (collectively, Intervenors), by and through counsel, and move for the admission of a new Contention No. 7 concerning recent FirstEnergy Nuclear Operating Company ("FENOC") modifications to its Aging Management Plans ("AMPs") within its Shield Building Monitoring Program associated with worsening cracking in the reactor Shield Building at the Davis-Besse Nuclear Power Station, Unit 1 ("Davis-Besse"). Intervenors further move for inclusion of appropriate severe accident mitigation candidates in the Supplemental Environmental Impact Statement being prepared by the NRC Staff for this License Renewal proceeding.

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MEMORANDUM

A. Procedural Background

This Motion addresses the belated emergence and admission by FirstEnergy Nuclear Operating Company ("FENOC"), which owns and operates the Davis-Besse Nuclear Power Station, that there is an uncontained, continuing, and possibly spreading problem of various forms of concrete cracking throughout portions of the walls of the Shield Building which houses the reactor at the plant site.

In February 2014, during hydro-demolition activities for creation of a construction opening in the shield building to support a scheduled steam generator replacement outage, FENOC learned that at least 26 sections of steel reinforcement (rebar) had been broken and/or cracked in the 2011 (and 2014) construction opening area, each break or crack apparently located close to the mechanical splice coupling used to reconnect the rebar during the reactor head replacement outage in 2011. Intervenors argue, in support of their proposed Contention 6 in April 2014, that FENOC may be incapable of managing Davis-Besse safely and successfully through the proposed license extension period of 2017-2037 because of the repeated problems with voids in the concrete, and a seemingly open-ended problem with the spreading of laminar and other cracks throughout the Shield Building. Intervenors sought then, and seek now, to litigate the adequacy of FENOC's anticipated modifications to Davis-Besse's Shield Building Monitoring Program and the Structures Monitoring Program Aging Management Plans ("AMPs") in light of their recent dramatic change of position, wherein the company admits the aging-related nature of the cracking phenomena - a position advocated by Intervenors since the cracks were first publicized by the company in 2011.

B. History of Cracking at Davis-Besse

The Davis-Besse Reactor Shield Building has a troubling history of multiple laminar and other concrete cracks. Intervenors in 2012 proffered multiple filings following the observation of cracking in the shield building concrete in 2011 during a reactor head replacement project at Davis-Besse. Intervenors documented concerns that the proliferation of different types of cracks may have commenced in the 1970's before the plant had even opened, and that their spreading and frequency of occurrence may be increasing with the passage of time. *See, generally,* "Intervenors' Motion for Admission of Contention No. 5 on Shield Building Cracking," and successive amendments and supplements: "Intervenors' Motion to Amend 'Motion for Admission of Contention No. 5'" (Feb. 27, 2012) ([hereinafter First Motion to Amend); "Intervenors' Motion to Amend and Supplement Proposed Contention No. 5 (Shield Building Cracking)" (June 4, 2012) (hereinafter Second Motion to Amend); "Intervenors' Third Motion to Amend and/or Supplement Proposed Contention No. 5 (Shield Building Cracking)" (July 16, 2012) (hereinafter Third Motion to Amend); "Intervenors' Motion to Amend and Supplement Proposed Contention No. 5 (Shield Building Cracking)" (July 23, 2012) (hereinafter Fourth Motion to Amend); "Intervenors' Fifth Motion To Amend and/or Supplement Proposed Contention No. 5 (Shield Building Cracking)" (Aug. 16, 2012) (hereinafter Fifth Motion to Amend). Intervenors incorporate these filings and their accompanying exhibits fully herein as though rewritten.

The ASLB flatly rejected Intervenors' Contention No. 5. "Memorandum and Order (Denying Motions to Admit, to Amend, and to Supplement Proposed Contention 5)," LBP-12-27 (December 28, 2012). But in September 2013, additional concrete cracking which had not

hitherto been identified was discovered in the shield building. On September 20, 2013, a Preliminary Notification of Event appeared in the NRC's ADAMS cache which stated as follows:

> On August 26, 2013, the licensee was performing examinations of core bores in the shield building in accordance with the commitments First Energy Nuclear Operating Company (FENOC) made to the NRC. The commitment is for long term monitoring of the shield building which was documented in the NRC's Confirmatory Action Letter dated December 2, 2011 (ADAMS ML11336A355). The examinations performed in 2011 and 2012 showed no additional cracks. *This year, using new instrumentation with enhanced capabilities, plant workers identified a crack that had not been seen before. To date, the core bore examinations revealed seven previously unidentified cracks.* FENOC has taken steps to reevaluate 43 core bores and will be looking at the remaining 39 going forward.

(Emphasis supplied). PNO, Exhibit 6.

In a formal Request for Additional Information ("RAI") dated April 15, 2014 (ADAMS No. ML14097A454), the NRC Staff said that "during a subsequent routine baseline inspection in August/September 2013, FENOC discovered several (about 15) cracks on the Davis-Besse shield building that were not identified previously." The Staff continued:

> Further, the NRC staff understands that in the ongoing February 2014 refueling outage, during hydro-demolition activities for creation of a construction opening in the Davis-Besse shield building to support the scheduled steam generator replacement, FENOC learned that several (at least 26) sections of steel reinforcement (rebar) had been broken and/or cracked in the construction opening area. Each section was apparently broken very close to the mechanical splice coupling used to splice the rebar during the head replacement outage in 2011.

In this striking understatement, the NRC Staff admitted that when the shield building was sealed shut following reactor head replacement in 2011, a stretch of the shield building wall which was 26-rebar-sections in length was not anchored to the rest of the rebar skeleton. The splices which joined the iron rebar rods together in the area of the shield building where the skeletal structure of the building was patched shut were cracked or broken at the time the concrete was poured to

complete the re-closure. After the 2011 resealing of the shield building, Davis-Besse operated at full power for over two years. While the information on the concrete voids is sparse and a bit unclear so far, it is legitimate to wonder if there is any relationship between the void, which apparently was located along the top of the 2011 construction opening, and the cracked and broken rebar, also located inside the perimeter of the 2011 construction opening.

According to the April 2014 RAI, FENOC has taken additional core samples of shield building concrete and is performing evaluations and testing to determine the root cause of the cracks and their apparent progression. A root cause analysis was performed in February 2012; a second, revised analysis was completed in April 2012. The 2014 analysis is the third root cause analysis.

Intervenors alleged in 2012 when they initially filed Contention 5 over cracking that FENOC must describe how it will manage the shield building cracking during the license renewal term, while the NRC Staff must consider the implications of the shield building cracking in its Draft Supplemental Environmental Impact Statement (DSEIS). Intervenors moved into evidence considerable documentation, such as the internal NRC calculations of two engineers who had determined that a minor earthquake or reactor thermal event could cause the collapse of very significant portions of the shield building walls, up to 90%. But it all came to naught; the contention was summarily rejected.

In 2012, FENOC argued (noted by the ASLB at p. 20, fn 99 of LBP-12-27) that Intervenors' insistence that the shield building cracking must be addressed in the then-anticipated Draft Supplemental Environmental Impact Statement (DSEIS) did not cure the claimed untimeliness of Intervenors' Contention 5 motion. The 2014 DSEIS contains zero mention of the

shield cracking phenomena at all, even as a subject for Severe Accident Mitigation Analysis ("SAMA"). Despite the NRC Staff's DSEIS explanation that the "purpose of [SAMA analysis] is to ensure that plant changes (*i.e.*, hardware, procedures, and training) with the potential for improving severe accident safety performance are identified and evaluated" (DSEIS p. 5-3), there is no mention of the changes in the Davis-Besse shield building, although it is surely a "hardware" structure within the sweep of SAMA review.[1] Given the latest (belated) admissions by FENOC that the cracking phenomena are aging-related, the Final Supplemental Environmental Impact Statement must itself be supplemented to include thorough SAMA recognition and analysis of the cracking damage to the Shield Building. It is ongoing; the stated root cause ("Blizzard of '78" moisture penetration and freezing) no longer holds, well, water. FirstEnergy has enunciated a new theory of "ice wedging" even as it admits that painting the Shield Building in 2012 seems not to have stemmed the presence of water within the concrete of the structure, nor its consequent damaging effects.

In LBP-12-27 (December 28, 2012), the Atomic Safety and Licensing Board refused to consider widespread cracking of the Shield Building as an aging-related problem which would fall within the permissible parameters of this license renewal proceeding:

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[1]The Davis-Besse reactor shield building constitutes a "system [or] structure . . . as delineated in [10 C.F.R.] §54.4. . . subject to an aging management review" because it "perform[s] an intended function . . . without moving parts . . . [and includes] the containment [and] containment liner. . . ." 10 C.F.R. §54.21(a)(1). The shield building and the steel liner within it are among those "[p]lant systems, structures, and components" which are "[s]afety-related systems [and] structures . . . which are . . . relied upon to remain functional during and following design-basis events (as defined in 10 CFR 50.49 (b)(1)) to ensure the following functions - (I) The integrity of the reactor coolant pressure boundary; (ii) The capability to shut down the reactor and maintain it in a safe shutdown condition; or (iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in §50.34(a)(1), §50.67(b) (2), or §100.11 of this chapter, as applicable." 10 C.F.R. §54.4(a)(1).

> . . . Intervenors must point to the specific ways in which the Shield Building Monitoring AMP is wrong or inadequate to raise a genuine dispute with FENOC's LRA. This they have failed to do. ***Intervenors have provided no support for their argument that the cracking (1) is aging-related,*** and (2) prevents safe operation of the plant. These claims amount to bare assertions, which the Commission has made clear "are insufficient to support a contention." We do not intend to imply that Intervenors must prove their case at this stage, as the Commission has made clear that petitioners bear no such burden. However, a petitioner "'must present sufficient information to show a genuine dispute' and reasonably 'indicating that a further inquiry is appropriate.'"

(Emphasis added). *Id.*, LBP-12-27 at 30 (32 of .pdf). The ASLB then castigated Intervenors for "speculating" about the incipient and growing problem of cracking of the Shield Building:

> . . . Contention 5 is based, in large part, on ***pure speculation***. For example, Intervenors state that "there is a likelihood that the risks presented by the current cracks will only increase in the next few years." Intervenors note that Davis-Besse will undergo a steam generator replacement in 2014, and argue that this fact supports their claim regarding increased risk. Intervenors provide no support for their argument that the 2014 steam generator replacement will increase the risk of cracking, and as such, their argument is ***mere speculation***. In addition, Intervenors state that "it is conceivable that FENOC very well may need to replace its steam generators yet again after 2014 . . . risking further contributions to the cracking." Whether FENOC will need to perform another steam generator replacement after 2014 is ***mere speculation, on top of the mere speculation*** that such a procedure might contribute to the cracking.

LBP-12-27 at pp. 34-35 (36-36 of .pdf).

But alas, history has caught up with Davis-Besse. After Contention 5 was unceremoniously dismissed, FENOC acknowledged in September 2013, as stated in the introductory section of this Motion, that there is worsening shield building cracking. And on July 3, 2014, FirstEnergy Nuclear Operating Company formally admitted to the NRC that the cracking problems in Davis-Besse's Shield Building persist, and are worsening. Nearly at the end of this LRA adjudicatory proceeding, FENOC has finally admitted, quietly, what has become quite clear to Intervenors since 2011: the calculations of NRC staff engineers predicting the Shield Building to be permeated by cracking which threatens the continued usefulness and stability of the

structure itself, and the burgeoning evidence of increasing cracking, call into serious question the basis for giving Davis-Besse a new lease on its operating life.

LEGAL STANDARDS

On July 25, 2014, the Atomic Safety and Licensing Board ("ASLB") panel overseeing this proceeding wrote:

> To the extent that Intervenors have proffered Contention 6 in advance of future modifications to the relevant AMPs that they assume will occur as a result of the recently identified structural problems, it is premature. The Board notes that the modifications to Davis-Besse's Shield Building Monitoring Program, anticipated by the Intervenors, were provided on July 3, 2014 in Amendment No. 51 to the Davis-Besse LRA. Specific intervenor concerns regarding specific portions of LRA Amendment No. 51 may be submitted to the Board in a timely manner for its consideration as specified by our Initial Scheduling Order.[2]

The July 3, 2014 "modifications to Davis-Besse's Shield Building Monitoring Program" to which the ASLB referred are contained in FENOC's "Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1, License Renewal Application (TAC No. ME4640) and License Renewal Application Amendment No. 51" sent by FENOC to the attention of the Document Control Desk at the Commission on July 3, 2014 and labeled L-14-224, per 10 C.F.R. Part 54.[3]

Under the ASLB panel's Initial Scheduling Order ("ISO") in this proceeding, a new contention must meet the requirements of the former (that is, pre-August 2012) 10 C.F.R. § 2.309(f)(2)(I) through (iii), which provided that Intervenors may submit a new contention only

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[2]MEMORANDUM AND ORDER (Denying Intervenors' Motion for Admission of Contention No. 6 on Shield Building Concrete Void, Cracking and Broken Rebar Problems), *FirstEnergy Nuclear Operating Company* (Davis-Besse Nuclear Power Station, Unit 1), Docket No. 50-346-LR, ASLBP No. 11-907-01-LR-BD01, July 25, 2014, Page 16, internal citations omitted.

[3]NRC ADAMS Accession No. ML14184B184.

with leave of the presiding officer upon a showing that:

(I) The information upon which the amended or new contention is based was not previously available;

(ii) The information upon which the amended or new contention is based is materially different than information previously available;

(iii) The amended or new contention has been submitted in a timely fashion based on the availability of the subsequent information.[4]

The ISO provides that "a motion and proposed new contention shall be deemed timely under [the pre-August 2012] 10 C.F.R. § 2.309(f)(2)(iii) if it is filed within sixty (60) days of the date when the material information on which it is based first becomes available."[5]

Intervenors address each timeliness requirement in turn.

1) Information not previously available

The information upon which Intervenors' new contention is based was not available before July 3. As the ASLB panel itself pointed out, above, FENOC's "modifications to Davis-Besse's Shield Building Monitoring Program ... were provided on July 3, 2014 in Amendment No. 51 to the Davis-Besse LRA." (*See also* fn. 1, *infra*).

Just as Intervenors could not file cracking contentions by the initial intervention and contention filing deadline of December 27, 2010, since the cracking was not revealed until late 2011, Intervenors could not file this contention regarding "modifications to Davis-Besse's Shield

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[4] Licensing Board Order (Initial Scheduling Order) at 12 (June 15, 2011) (unpublished) [hereinafter ISO].

[5] *Id.*

Building Monitoring Program" until they were published, less than sixty (60) days ago. FENOC made the "modifications" to its Aging Management Programs (AMP) in its Shield Building Monitoring Program based on revelations of previously undetected cracking, and "propagating" - worsening - of the cracking, which was not detected until August-September, 2013.[6]

2) Materially different information

The information upon which this new contention is based is materially different than information previously available. The ASLB panel itself indicated as much in its own July 25, 2014 ruling, as mentioned above, by pointing out this opportunity for Intervenors to file a new contention.

Additionally, with the July 3, 2014 "modifications to Davis-Besse's Shield Building Monitoring Program," FENOC saw it as necessary to modify its monitoring program due to the discovery in August-September, 2013 of previously undetected cracking, and worsening cracking. FENOC's cracking-related AMP modifications to its monitoring program represent significant, new, material information.

3) Timeliness of the amended or new contention

This new contention has been submitted in a timely fashion, within sixty (60) days of the

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[6]See Intervenors' MOTION FOR ADMISSION OF CONTENTION NO. 6 ON SHIELD BUILDING CONCRETE VOID, CRACKING AND BROKEN REBAR PROBLEMS, *FirstEnergy Nuclear Operating Company*, Davis-Besse Nuclear Power Station, Unit 1, Docket No. 50-346-LR, April 21, 2014, Page 6, Exhibits 6 and 7 (ML14112A007). Exhibit 6 is Preliminary Notice of Event or Occurrence, PNO-III-13-007, DAVIS-BESSE SHIELD BUILDING LAMINAR CRACKS, September 20, 2013, ADAMS Accession No. ML13263A410. Exhibit 7 is REQUEST FOR ADDITIONAL INFORMATION FOR THE REVIEW OF THE DAVIS-BESSE NUCLEAR POWER STATION LICENSE RENEWAL APPLICATION (TAC NO. ME4640), Juan Uribe, Project Manager, Projects Branch 1, Division of License Renewal, Office of Nuclear Reactor Regulation, NRC, to Mr. Raymond A. Lieb, Vice-President, Davis-Besse Nuclear Power Station, FirstEnergy Nuclear Operating Company, April 15, 2014 (ML14112A008).

availability of the subsequent information, namely, the July 3, 2014 "modifications to Davis-Besse's Shield Building Monitoring Program."[7] It therefore complies with the ISO's timeliness requirements because it is being submitted in a timely fashion under the pre-August 2012 version of 10 C.F.R. § 2.309(f)(2)(iii).

ADMISSIBILITY CRITERIA

Contentions must meet the admissibility criteria set forth in 10 C.F.R. § 2.309(f)(1), which requires each contention to: (1) provide a specific statement of the issue of law or fact to be raised; (2) provide a brief explanation of the basis for the contention; (3) demonstrate that the issue raised in the contention is within the scope of the proceeding; (4) demonstrate that the issue raised in the contention is material to the findings the NRC must make to support the licensing action; (5) provide a concise statement of the alleged facts or expert opinions in support of the petitioner's position on the issue and on which the petitioner intends to rely at hearing; and (6) provide sufficient information to show that a genuine dispute exists with the applicant/licensee on a material issue of law or fact, with reference to specific disputed portions of the application. A failure to meet any of these criteria renders the contention inadmissible.[8] 10 C.F.R. § 2.309(f)(1)(I)-(vi). These admissibility criteria are addressed in turn below.

1) Specific statement of the issue of law or fact to be raised

FENOC's revisions to the AMPs in its Shield Building Monitoring Program, dated July 3,

[7]Because Monday, September 1, 2014 is Labor Day, Intervenors' filing deadline is Tuesday, September 2, 2014.

[8] Internal citations omitted, referenced by the ASLB panel.

2014,[9] acknowledge not only the risk, but the reality, of aging-related cracking propagation[10] -- that is, worsening – in the already severely cracked Shield Building, an admission which brings the issue within the scope of this License Renewal Application proceeding. FENOC's proposed modifications to its Shield Building Monitoring Program AMPs, regarding the scope (areas of the Shield Building to be examined), sample size (number of tests to be performed), and the frequency of its surveillance activities, are woefully inadequate. Significantly more core bores, as well as a broader diversity of complementary testing methods should be required, and at a much greater frequency than FENOC has proposed. The cracking phenomena must be identified, analyzed and addressed within the Final Supplemental Environmental Impact Statement for the license renewal.

2) Provide a brief explanation of the basis for the contention

In light of the revelation in August-September, 2013 of previously undetected cracks and the conclusion that they were worsening (propagating), Intervenors challenge the adequacy of FENOC's Shield Building Monitoring Program AMPs proposed for the 2017-2037 license extension period. Specifically, FENOC's testing frequency is inadequate, and risks becoming

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[9]See FENOC's "Reply to Request for Additional Information for the Review of the Davis-Besse Nuclear Power Station, Unit No. 1, License Renewal Application (TAC No. ME4640) and License Renewal Application Amendment No. 51," Davis-Besse Nuclear Power Station, Unit No. 1, Docket No. 50-346, License Number NPF-3, sent by FENOC to the attention of the Document Control Desk at the U.S. Nuclear Regulatory Commission on July 3, 2014, per 10 CFR 54, Enclosure: Davis-Besse Nuclear Power Station, Unit No. 1 (Davis-Besse), Letter L-14-224, Amendment No. 51 to the Davis-Besse License Renewal Application (8 pages), p. 1 of 8. ADAMS No. ML14184B184 (hereinafter referenced as "FENOC's RAI Letter July 3, 2014").

[10]Two of numerous examples: "**The cracking propagation** was determined to be a result of ice-wedging (freezing water at a pre-existing crack leading edge)," and "**The rate of cracking propagation** is estimated at 0.4 to 0.7 inches per freezing cycle based on laboratory simulation." *Id.,* Page 7 of 8 (13 of 14 on pdf counter). (emphases added).

less adequate over time (via relaxed, less frequent testing). Annual inspections, at a minimum, should be required, not two- or even four-year inspection cycles, as FENOC has proposed.

In addition, the number of core bores to be examined should be significantly increased over the meager number proposed by FENOC. Vast areas of the Shield Building surface area, and volume, would fall outside of FENOC's Monitoring Program AMPs, as currently construed, and so the scope of the testing should also be significantly expanded.

Given the importance of the Shield Building to radiological containment, such as the proper functioning of the Emergency Ventilation System,[11] as well as a biological shield, and a tornado and missile shield,[12] and thus to public health, safety, and environmental protection, and in consideration of the already severe, and worsening, cracking of the Shield Building, these inadequacies in the Monitoring Program AMPs are unacceptable, and must be rectified.

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[11] Davis-Besse Nuclear Power Station/License Renewal Application/Technical Information, section 2.3.3.13 Emergency Ventilation System. Page 2.3-88 [184/1,810 on pdf counter]. This document, dated August 30, 2010, appears to have not been posted at ADAMS nor assigned an ML number. However, it is posted at the following link on NRC's website: http://www.nrc.gov/reactors/operating/licensing/renewal/applications/davis-besse/davis-besse-lra.pdf.

[12] At section 2.4.1 CONTAINMENT (INCLUDING CONTAINMENT VESSEL, SHIELD BUILDING, AND CONTAINMENT INTERNAL STRUCTURES)–SEISMIC CLASS I, of the Davis-Besse Nuclear Power Station/License Renewal Application/Technical Information, FENOC states: "The Shield Building is a concrete structure surrounding the Containment Vessel. It is designed to provide biological shielding during normal operation and from hypothetical accident conditions. The building provides a means for collection and filtration of fission product leakage from the Containment Vessel following a hypothetical accident through the Emergency Ventilation System, an engineered safety feature designed for that purpose. In addition, the building provides environmental protection for the Containment Vessel from adverse atmospheric conditions and external missiles." Page 2.4-3 [263 of 1,810 on PDF counter] This Davis-Besse NPS/LRA/Tech. Info. document, dated August 2010, is posted at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/davis-besse/davis-besse-lra.pdf.

3) Demonstration that the issue raised in the contention is within the scope of the proceeding

As explained by FENOC:

> The Enclosure identifies the **change to the License Renewal Application (LRA)** by Affected LRA Section, LRA Page No., and Affected Paragraph and Sentence. The count for the affected paragraph, sentence, bullet, etc. starts at the beginning of the affected Section or at the top of the affected page, as appropriate. Below each section the reason for the change is identified, and **the sentence affected is printed in *italics* with deleted text *{lined out}*[13] and added text *underlined.*[14]** [Emphasis added]

Thus, *italicized and underlined text* is "affected," and "added." Intervenors assert that various sections of the *italicized and underlined text*, identified below, contain significant new material information and that FENOC's July 3, 2014 revisions to its Shield Building Monitoring Program AMPs finally acknowledge what should have been evident (and admitted) before now, the aging-related risk of cracking propagation. This issue is within-scope of this LRA proceeding, and worthy of a hearing, as will be shown.

4. Demonstration that the issue raised is material to the findings the NRC must make to support the licensing action

The NRC is mandated by the Atomic Energy Act and National Environmental Policy Act to provide reasonable assurance of public health and safety, and environmental protection, during the proposed 20-year license extension at Davis-Besse, and to take a "hard look" at environmental impacts, as by making predictive safety findings and conducting an environmental analysis regarding the safety and environmental impacts of the 20-year license extension.

The Shield Building at Davis-Besse is critical to radiological containment during reactor

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[13] Intervenors are not able to indicate deleted text by striking it out, or lining it through as it appears in FENOC's original, and so indicate this with {parentheses}.

[14] FENOC's RAI Letter, July 3, 2014, p. 1 of 8.

emergencies, such as meltdowns or other radioactive releases. It can filter radioactivity to a certain extent before it is expelled to the external atmosphere, and it is also essential to defending the Inner Steel Containment Vessel, and Reactor Pressure Vessel against external threats, such as tornadoes or missiles. The Shield Building further provides biological shielding during normal operations. (See fns. 11 and 12 *infra*).

The severe, and finally-admitted "propagation" cracking of the Shield Building threatens to fail the Shield Building from performing its vital design safety and environmental functions. Intervenors challenge the adequacy of FENOC's Shield Building Monitoring Program AMPs to guarantee the Shield Building fulfills its vital safety functions, as required by applicable laws and regulations. Therefore the issues raised by this contention are material to a license extension decision for Davis-Besse.

5. Concise statement of the alleged facts or expert opinions in support of the petitioner's position and on which the petitioner intends to rely at hearing

Intervenors incorporate herein by reference the "Bases for Contention" section below as their listing of the facts showing that FENOC's Shield Building Monitoring Program AMPs are inadequate to provide reasonable assurance that the Shield Building can provide adequate protection to public health and safety and the environment during the 2017 to 2037 license extension period.

6. Showing of a genuine dispute between the licensee on a material issue of law or fact, with reference to specific disputed portions of the application

Intervenors incorporate herein by reference the "Bases for Contention" section below in support of this criterion. Intervenors provide information which demonstrates that a genuine dispute exists with FENOC on a material issue of law and fact regarding the adequacy of