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DOCKETED
USNRC

January 13, 2012 (10:15 am)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Atomic Safety and Licensing Board Limited Appearance Hearing for Levy County Nuclear Project
Comments by Mandy Hancock, High Risk Energy Organizer, Southern Alliance for Clean Energy
January 12, 2012 - Crystal River, Florida

My name is Mandy Hancock and I am the high risk energy organizer with the Southern Alliance for Clean Energy (SACE). We are a regional non-profit organization with members here in Florida, in Progress Energy's service region, and across the Southeast concerned about the impacts energy choices have on our health, economy and environment. Thank you for this opportunity to comment.

I am also a resident of Gainesville, Florida, living within 50 miles of the proposed Levy reactors. SACE disagrees with Progress Energy and the Nuclear Regulatory Commission's characterization in the draft environmental impact statement that the impacts of the Levy Nuclear Project on the water systems in the area will be small.

A recent report by the Energy & Water in a Warming World initiative outlines the current threats that the existing electricity infrastructure poses on our nation's water resources. It mentions, for instance, that nuclear reactors are the most water intensive, both in terms of water withdrawal and consumption, in comparison to other energy options and that the reliability of existing nuclear reactors during times of droughts has already demonstrated failures.[1] This report also discusses the Southeast's unique challenges when it comes to protecting water resources in a region plagued by drought. A copy of the executive summary is included with our comments.

It is easy to illustrate the real impacts that nuclear energy has on water use by looking at the two new AP1000 reactors proposed for Turkey Point. Florida Power and Light's projected increase for water demand in Miami-Dade County by 2025 includes a 35% increase for public and commercial needs, and a whopping 3224% increase for thermoelectric power.[2] Just as this doesn't make sense for Miami-Dade, neither does it make sense to commit 1.5 million gallons of fresh groundwater per day[3] for cooling purposes at the Levy Co. site.

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[1] Energy and Water in a Warming World Initiative, *Freshwater Use by U.S. Power Plants: Electricity's Thirst for a Precious Resource*, November 2011. At http://www.ucsusa.org/clean_energy/technology_and_impacts/impacts/freshwater-use-by-us-power-plants.html

[2] Florida Power and Light, Turkey Point COL Application, Rev. 0, p. 2.5-34, June 30, 2009.

[3] Progress Energy, Draft Environmental Impact Statement for Levy 1 and 2 COL, Section 2.3.2, page 9-52, lines 17-24. Available at: http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1941/v2/sr1941v2-chp9-chp10.pdf

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In South Carolina, Duke Energy, which aims to merge with Progress, has also proposed two new AP1000 reactors for their Lee project. In their licensing application, Duke states that the two reactors will withdraw during normal use 50-86 million gallons of water per day (mgd) from the Broad River.[4] Overall consumptive loss will be approximately 50-70%, or 35-41 mgd.[5] Duke's application also mentions that average surface water use (public and industrial) in Cherokee County was 8.4 million gallons per day.[6] This means that on a daily basis the Lee plant could use six to ten times the amount of surface water used by *all other users in the county combined*. Just as we objected commented to the NRC on the Lee reactors, we believe the Levy project will also have large impacts on surrounding water resources.

Instead, we propose alternatives such as energy efficiency and renewable energy that will have little to no impact nearby water sources. A recent report by

Synapse Energy Economics[7] discusses energy choices that would not only protect water resources, but also be more economically viable solutions for Florida's energy future. I've included a fact sheet for your review. It is important that decision makers make the right decisions now to protect our scarce water resources today and into the future.

Thank you,

Mandy Hancock
High Risk Energy Organizer
Southern Alliance for Clean Energy

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[4] Duke Energy, Lee COL Application, Supplement to Rev. 1, Table 2.3-14, p. 2-20. At http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2111/v1/sr2111v1-cover-chp2.pdf
[5] Lee COL application, Rev. 0, Enviro. Rpt. Ch. 2, TABLE 2.3-14 ESTIMATED SURFACE WATER WITHDRAWAL AND CONSUMPTION FOR STATION OPERATIONS, http://www.nrc.gov/reactors/new-licensing/col/lee.html#appDocuments
[6] Lee COL application, Rev. 0, p. 2.3-23
[7] Synapse Energy Economics, Big Risks, Better Alternatives An Examination of Two Nuclear Energy Projects in the U.S., October 2011. At http://www.synapse-energy.com/Downloads/SynapseReport.2011-10.UCS.Big-Risks-Better-Alternatives.10-037.pdf

Union of Concerned Scientists
Citizens and Scientists for Environmental Solutions

The Levy Nuclear Power Plant:
Big Risks and Even Bigger Costs for Florida Residents

FACT SHEET

DECEMBER 2011

Expert analysis concludes that a plan by Progress Energy Florida to build two new nuclear reactors near Gainesville and Ocala carries major risks of cost overruns and delays, while ignoring safer, cheaper, cleaner, and less risky alternatives.

It has been nearly three decades since a new nuclear power plant has been built in the United States. In the early 1980s, an industry that was once hailed as the solution to ever-diminishing reserves of fossil fuels lost momentum under the weight of huge construction delays and cost overruns, combined with mounting safety concerns. But in recent years, nuclear plant developers have begun pushing for approval to build a new generation of reactors. Eighteen applications for new or expanded plants are now before the U.S. Nuclear Regulatory Commission (NRC).

But is nuclear power any more economically viable today than it was 30 years ago? Will the industry be able to build and run safe nuclear plants without calling on taxpayers and ratepayers to cover billions of dollars in cost overruns, as it has in the past?

A new study conducted for the Union of Concerned Scientists (UCS) by Synapse Energy Economics, Inc. (a research and consulting firm that specializes in energy, economic, and environmental topics), takes a close look at proposed nuclear plant construction projects in two states, Florida and Georgia, and compares them with several alternatives available to meet energy demand in those states.[1] In Florida, Synapse researchers focus on the proposed construction of a two-reactor, 2,200-megawatt (MW) nuclear power plant in Levy County near Gainesville and Ocala (see the map), where Progress Energy Florida, a state utility, is planning to begin major construction when and if the NRC grants approval.

The Levy nuclear power plant is not the best way to meet Florida's energy needs:

- It is more expensive than virtually any other energy source in the state, including renewable energy and even coal.
- If built, the plant would raise the average Progress Energy customer's electric bill by $718 per year by 2021.
- Energy efficiency, combined with a greater reliance on natural gas and renewable energy, could provide cheaper electricity to Florida residents at much less risk, while also reducing global warming pollution.

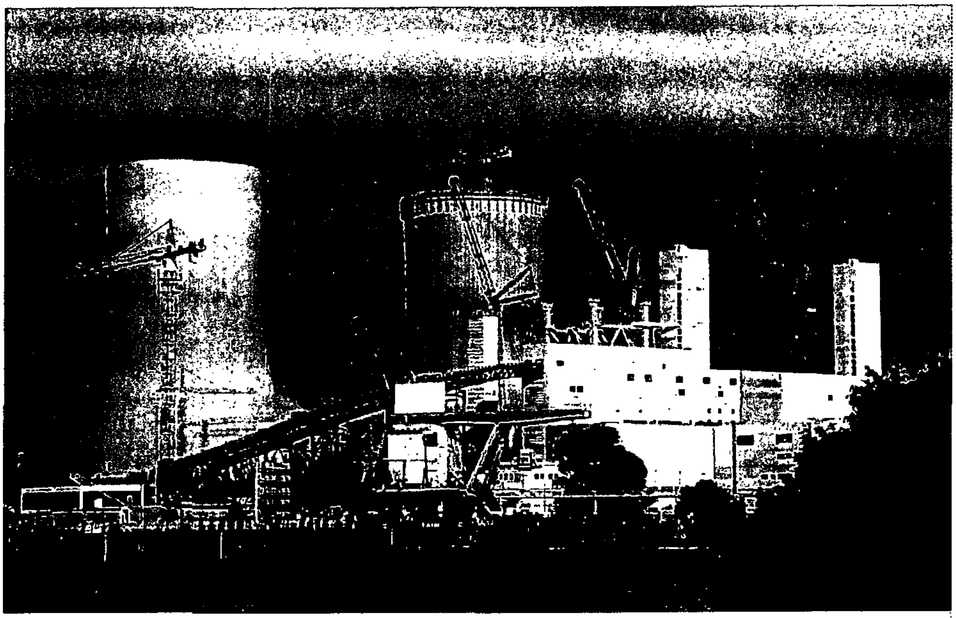
© Wikimedia Commons/Ebyabe

Ratepayers in Ocala (above) and nearby communities are already having to pay for the Levy nuclear plant (marked on the inset map), and will face much higher electricity costs if it is completed.

A RISKY INVESTMENT

Synapse's analysis identifies major problems associated with the construction of the two Levy reactors, including:

Unproven reactor technology. The reactors chosen for the Levy plant are of a new design—AP1000s by Westinghouse—that has never been built in the United States (not surprising, given that the most recently used design was deployed in the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The nuclear industry has a long history of cost overruns and abandoned construction projects, leaving ratepayers and taxpayers to foot the bill.

1970s), or completed anywhere else in the world. That means they have never been tested under actual working conditions. Nuclear power construction has always been, and remains to this day, a very complicated and exceedingly high-stakes process that has often led to major cost increases and construction and regulatory delays. Indeed, the NRC has not yet approved the AP1000 design, which was modified as recently as May 2011, although the agency is expected to approve the design by the end of 2011.[2]

Escalating cost projections. In 2006, Progress Energy Florida projected a maximum construction cost of $3.5 billion for the project—at that time, a one-reactor plant. In 2008, when the company revised its plan to reflect expansion to a two-reactor plant, the projected cost rose nearly fivefold, to $17 billion. Since then, as delays have mounted and the completion deadline has been pushed back, the projected construction cost has increased to $22.5 billion.

The Levy plant will likely cost between $22.5 billion and $29.3 billion, depending on when the plant actually gets built.

Given Levy's history, and indeed, given the history of the entire nuclear industry, even the latest estimates likely understate the final cost. According to Synapse's analysis, the Levy plant will likely cost between $22.5 billion (the total projected by Progress Energy Florida) and $29.3 billion, depending on when the plant actually gets built.

Much higher electricity rates. Skyrocketing nuclear plant construction costs translate into higher electricity costs for ratepayers. Synapse estimates that by 2021, the Levy project will add at least $718 per year to the bill of a Progress Energy Florida residential customer using 1,100 kilowatt-hours (kWh) per month.[3] This cost is much higher than the cost of implementing other low-carbon energy solutions, as described below.

RATEPAYERS ARE ALREADY STUCK WITH THE BILL

The U.S. nuclear industry has been able to promote nuclear power as a cost-effective solution to the nation's energy needs by obscuring the real costs of planning, construction, operation, and waste disposal. In addition to masking the true costs of nuclear power, the industry does all it can to minimize its own financial responsibility by passing these costs onto ratepayers and taxpayers. For example, Progress Energy Florida's customers are already forced to pay for the Levy plant long before the reactors generate a single kilowatt of electricity—*and even if they never get built at all.*

Florida's Nuclear Construction Cost Recovery (NCCR) rule allows Progress Energy Florida (and other utilities) to pass on to current customers certain construction and pre-construction costs associated with building nuclear power plants.[4] Already, Progress Energy Florida customers must pay a per-kWh surcharge to cover Levy's costs: in 2010 the average residential customer using 1,100 kWh a month paid approximately $89.52 (or $7.46 per month). In early 2011, as the company announced that construction would be further delayed, that figure went down slightly to $72.99 (or $6.08 per month); the company further reduced the charge in October (to the equivalent of $2.93 per month), leading some to question whether this plant will ever get built at all. But regardless of when the plant is actually built—or whether it is built at all—ratepayers are being forced to provide a for-profit

company with an interest-free loan. In short, the NCCR rule shifts the project's financial risks from Progress Energy Florida's stockholders to its customers.

The NCCR rule also allows utilities to recover costs from consumers even if they elect not to complete, or are precluded from completing, construction of a nuclear power project. Thus, if Progress Energy Florida eventually decides to abandon its plans to build the Levy plant, ratepayers should expect no refunds on the construction surcharges they have already paid. Such an outcome would be no surprise given the nuclear industry's history of planning and then abandoning projects over the years.

If the Levy plant *does* get built, Floridians will pay top dollar for its electricity. Synapse calculated the "levelized cost" of the project, accounting both for construction and operating costs. Taking into account a number of variables (e.g., delays in construction), Synapse developed a low-, mid-, and high-range cost estimate for the Levy project as well as for other energy sources. The study found that the mid-range levelized cost estimate for the Levy reactors, $164 per megawatt-hour (MWh), was higher than that of most other energy solutions, including improved energy efficiency to reduce consumption, natural gas, biomass, land-based wind, solar photovoltaic, and even coal (see the chart below). The only energy source in the analysis that proved more expensive than the Levy nuclear plant was offshore wind, the cost of which is expected to fall significantly over time.

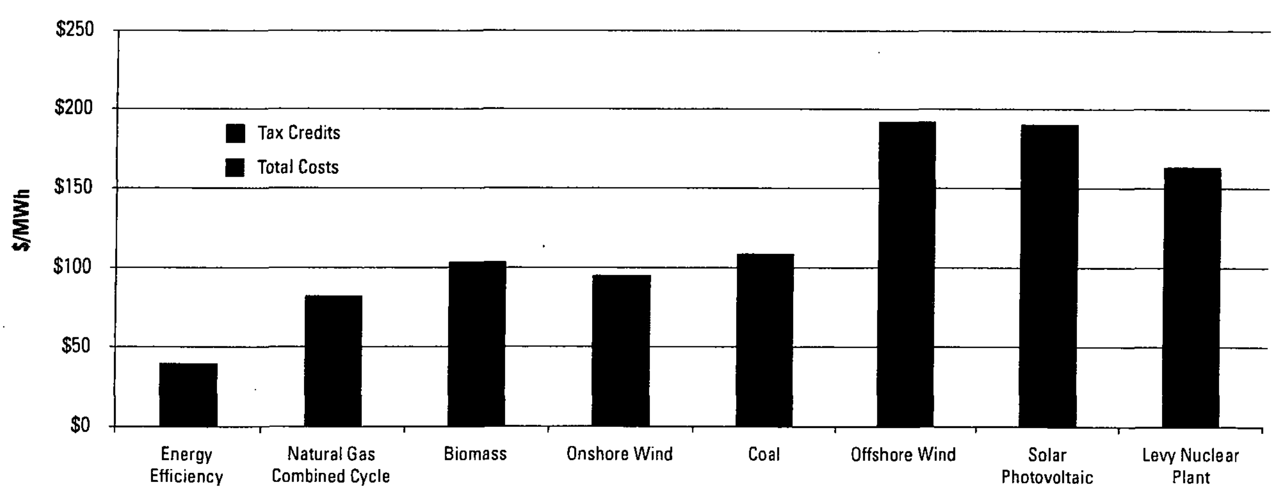
Progress Energy Florida's customers are forced to pay for the Levy plant long before the reactors generate a single kilowatt of electricity—*and even if they never get built at all.*

BETTER ENERGY CHOICES ARE AVAILABLE IN FLORIDA

The nuclear power industry works hard to portray its product as inexpensive. But as the Synapse analysis demonstrates, nuclear power is among the most expensive ways to generate electricity, and investing in the Levy plant would lock residents into higher electricity costs for years. Florida has energy solutions that are clearly superior to the Levy nuclear power plant—solutions that are proven to work, have more predictable costs, and involve far fewer safety considerations.

The most cost-effective way to meet Florida's energy demands now and in the future is to improve energy efficiency. At $40 per MWh (according to the Synapse study), that approach would amount to less than one-quarter of the levelized

Levelized Costs for Levy Plant Compared with Other Energy Resources



Note: Total costs are based on mid-range estimates for all technologies and include capital costs; operation, maintenance, and fuel costs; and costs associated with the projected regulation of carbon dioxide and toxic air emissions. The impact of available tax credits for each technology is also shown.

Data source: Synapse Energy Economics, Inc.

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Energy efficiency initiatives can help consumers save money and reduce the need for new generating capacity. Unfortunately, Florida spends only $6.60 per person on these programs, less than half the national average.

When combined with energy efficiency, renewable energy could significantly reduce—or even eliminate—the need to build large, high-risk generation projects like the Levy plant.

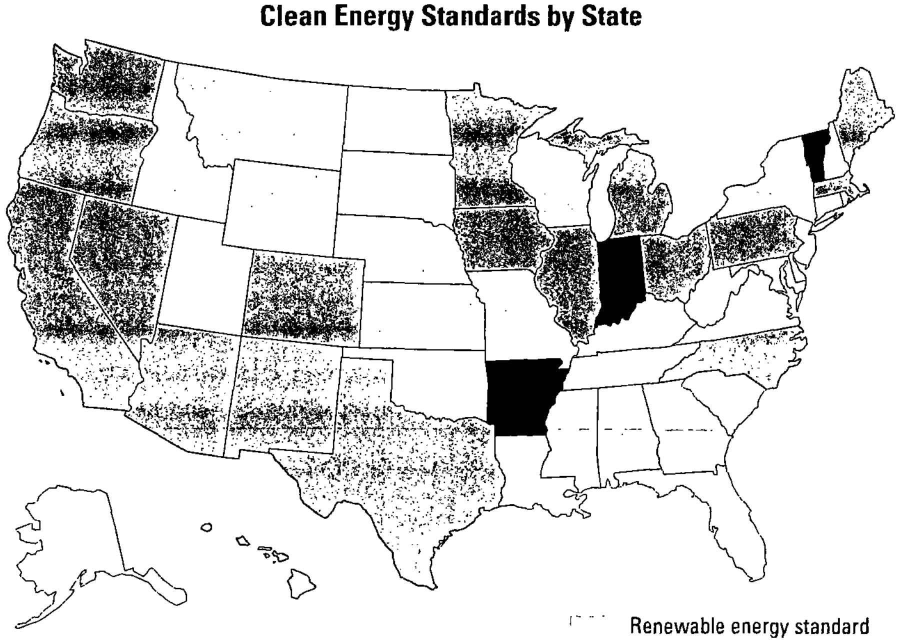
cost of the Levy plant. Increasing the state's reliance on wind, natural gas, and biomass as sources for electricity would also be less expensive than building the Levy plant, with levelized costs (per MWh) of $82, $83, and $90, respectively. These energy alternatives are described in more detail below.

Energy Efficiency. Florida has done little to invest in energy efficiency and has established no statewide energy efficiency targets, a step that 22 other states have taken (see the map at right). Many states require utilities to achieve incremental reductions in their customers' energy consumption through a variety of measures including rebates for energy-efficient appliances, energy audits to identify wasteful energy practices in homes and businesses, and other programs. These energy savings ultimately lead to lower electricity bills for customers and reduce the utility's need to build expensive new generating capacity.

A 2007 study by the American Council for an Energy-Efficient Economy (ACEEE) found that Florida could reduce its projected future electricity use by almost 20 percent through energy-efficiency programs.[5] Yet the Florida Public Service Commission recently approved an energy efficiency program proposal from Progress Energy in which the company projected a maximum energy savings of only 2 percent from demand-side reductions over the next 10 years. This was a significant watering down of the company's 2009 plan, which called for a maximum savings of 3.5 percent.

Overall, Florida ranks twenty-seventh in the nation for energy efficiency, according to ACEEE's 2011 State Energy Efficiency Scorecard.[6] ACEEE also calculated

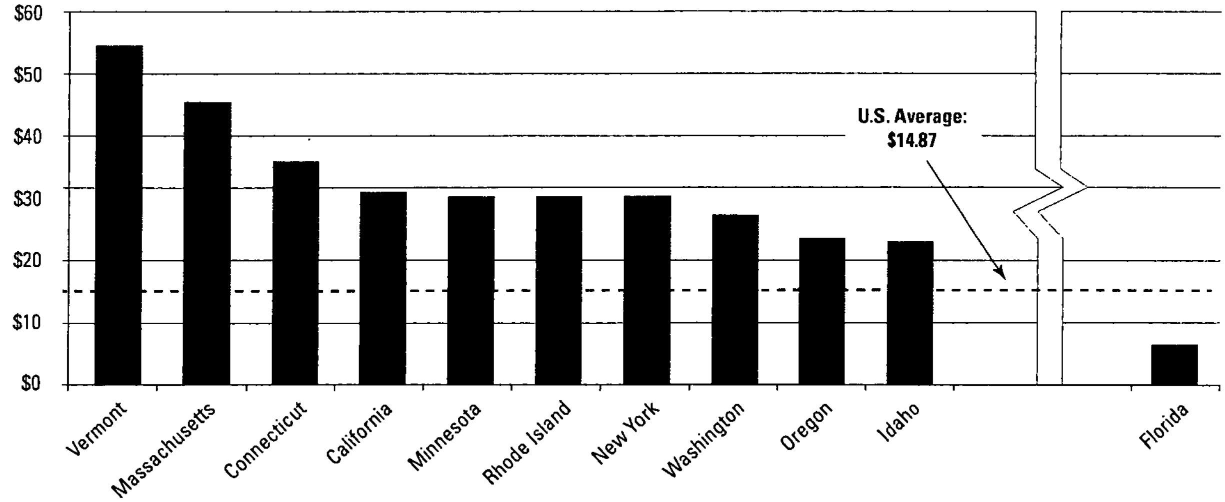
Clean Energy Standards by State



Thirty-two states have policies in place to support energy efficiency and/or renewable energy. Florida has neither.

Adapted from UCS and ACEEE data

Per Capita Spending on Energy Efficiency Programs by State, 2010



Florida lags far behind most other states (and Washington, DC) in energy efficiency; the state ranks 27th for overall progress on energy efficiency programs, and 34th on per capita efficiency spending.

Source: ACEEE 2011

that Florida spent only $6.60 per person on energy efficiency programs, well below the national average of $14.87. The five top-ranking states invested between $30.28 and $54.62 per person (see the chart above).

Renewable Energy. Another area where Florida is not leading, and indeed is barely following, is the development of renewable energy sources. As of November 2011, 29 states and the District of Columbia have passed or implemented policies that now require utilities to tap renewable sources for a minimum percentage of the electricity they provide to customers (see the map). Several other states have established nonbinding goals. Florida has taken neither step.

A suite of energy options are available to help Florida meet its electricity needs and address global warming pollution in a cost-effective way.

This is a lost opportunity for the state. A 2008 study prepared for the Florida Public Service Commission by Navigant Consulting showed that Florida currently has about 1,500 MW of renewable energy capacity, mostly biomass.[7] However, the study found that the state has the technical potential to develop more than 136,000 MW of renewable electricity capacity by 2020, or slightly double Florida's electric generating capacity. Even if only a fraction of this capacity is developed, it would vastly outweigh the electricity that would be generated by the two Levy reactors (see the table next page). Navigant found that Florida could generate between 11,400 and 52,700 GWh of renewable energy by 2020, or between 5 and 24 percent of projected retail electricity sales. When combined with energy efficiency, renewable energy could completely eliminate the need to build large, high-risk generation projects like the Levy plant.

CHEAPER, SAFER CLIMATE SOLUTIONS

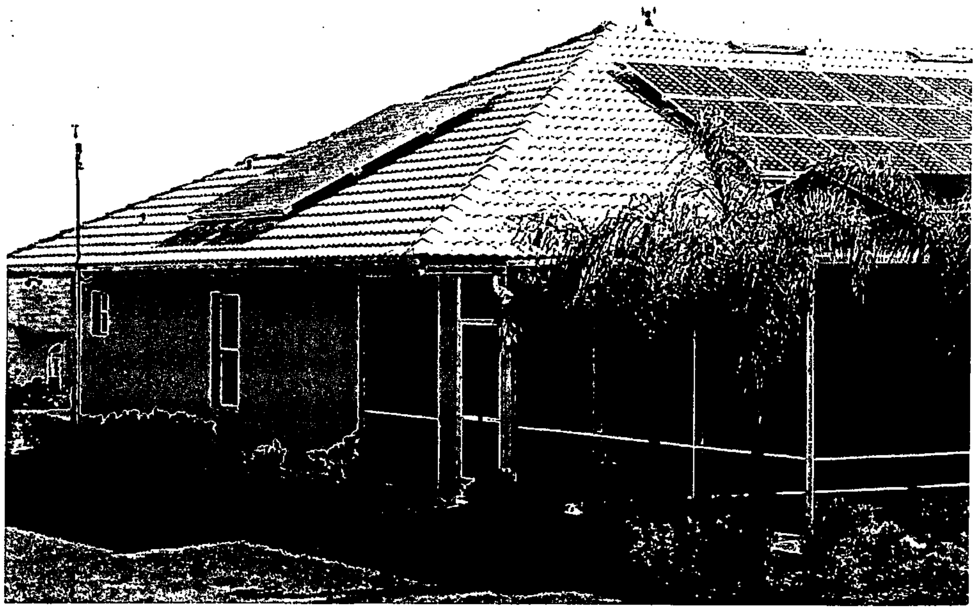
Renewed interest in nuclear power in recent years has been largely driven by the need to reduce the energy industry's global warming emissions. However, Florida has much better ways to accomplish that goal than adding nuclear reactors.

A suite of energy options are available to help Florida meet its electricity needs and address global warming pollution in a cost-effective way. The Synapse study concluded that a combination of lower-carbon strategies—investing in energy efficiency, increasing reliance on natural gas, and deploying renewable energy technologies—would be less expensive, and much less risky, than expanding the state's reliance on nuclear energy.

Technical Potential for Renewable Electricity Generation in Florida by 2020

Resource	MW
Photovoltaic on rooftops	52,000
Photovoltaic in ground arrays	37,000
Concentrated solar power	380
Solar water heating	1,136
Onshore wind	186
Offshore wind	40,311
Biomass (available but not collected)	400–1,359
Biomass (potentially available)	3,945–9,555
Landfill gas (new sites)	110
Anaerobic digester gas	35
Waste heat (sulfuric acid conversion)	140
Ocean current	750
Total potential (renewable energy)	136,393–142,862
Total potential (Levy reactors)	2,200

Data Source (renewable energy): Navigant Consulting 2008



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Rooftop solar panels are one way in which Florida can tap into renewable resources (see chart at left) for clean, low-carbon electricity at a lower cost than building new nuclear plants.

Several states have adopted policies that set targets for reducing heat-trapping emissions. Florida has not established such a goal. Setting strong emissions reduction targets would provide needed support for, and investment in, these smart energy options and put Florida on a lower-carbon pathway at a much lower cost than investing in new nuclear reactors.

THE LEVY PLANT: NO RETURN ON INVESTMENT FOR CONSUMERS

Florida does not need the Levy nuclear power plant to meet the state's electricity needs, and Progress Energy Florida's ratepayers should not be unfairly burdened with the financial risks that the project will impose. Instead, Florida should increase its energy efficiency targets

Florida does not need the Levy nuclear power plant to meet the state's electricity needs, and Progress Energy Florida's ratepayers should not be unfairly burdened with the financial risks that the project will impose.

for Progress Energy and other utilities to levels more consistent with the leading states, and more aggressively pursue renewable sources of energy. Doing so would not only eliminate the need for the Levy plant, but also allow Florida to retire some of its older, dirtier, and more expensive generating plants—a win-win for consumers and the environment.

Endnotes

[1] Chang, M., D. White, E. Hausman, N. Hughes, and B. Biewald. 2011. *Big risks, better alternatives.* Prepared for the Union of Concerned Scientists. Cambridge, MA: Synapse Energy Economics, Inc. October 6. Online at *http://www.synapse-energy.com/Downloads/SynapseReport.2011-10.UCS.Big-Risks-Better-Alternatives.10-037.pdf.*

[2] The NRC issued its final Safety Evaluation Report on August 5, 2011. This report was subsequently published as Supplement 2 to NUREG-1793 in September 2011. See *http://pbadupws.nrc.gov/docs/ML1120/ML112061231.pdf.*

[3] The average Florida residential customer used 1,133 kWh per month, according to the U.S. Department of Energy.

[4] A copy of the NCCR rule is available at: *http://www.leg.state.fl.us/Statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0366/Sections/0366.93.html.*

[5] Elliott, R.N., M. Eldridge, A. Shipley, J. Laitner, S. Nadel, P. Fairey, R. Vieira, J. Sonne, A. Silverstein, B. Hedman, and K. Darrow. 2007. *Potential for energy efficiency and renewable energy to meeting Florida's growing energy demands.* Research Report E072. Washington, DC: American Council for an Energy-Efficient Economy. February.

[6] Sciortino, M., M. Neubauer, S. Vaidyanathan, A. Chittum, S. Hayes, S. Nowak, and M. Molina. 2011. *The 2011 state energy efficiency scorecard.* Research Report E115. Washington, DC: American Council for an Energy-Efficient Economy. October.

[7] Navigant Consulting. 2008. *Florida renewable energy potential assessment.* Burlington, MA. December 30.

This fact sheet is also available on the UCS website at www.ucsusa.org/nuclear_power

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EXECUTIVE SUMMARY

Freshwater Use by U.S. Power Plants

ELECTRICITY'S THIRST FOR A PRECIOUS RESOURCE

A Report of the Energy and Water in a Warming World Initiative

In 2005, the nation's thermoelectric power plants—which boil water to create steam, which in turn drives turbines to produce electricity—withdrew as much water as farms did, and more than four times as much as all U.S. residents. That means lighting rooms, powering computers and TVs, and running appliances requires more water, on average, than the total amount we use in our homes—washing dishes and clothes, showering, flushing toilets, and watering lawns and gardens.

This tremendous volume of water has to come from somewhere.

Across the country, water demand from power plants is combining with pressure from growing populations and other needs and straining water resources—especially during droughts and heat waves:

- The 2011 drought in Texas created tension among farmers, cities, and power plants across the state. At least one plant had to cut its output, and some plants had to pipe in water from new sources. The state power authority warned that several thousand megawatts of electrical capacity might go offline if the drought persists into 2012.
- As drought hit the Southeast in 2007, water providers from Atlanta to Raleigh urged residents to cut their water use. Power plants felt the heat as well. In North Carolina, customers faced blackouts as water woes forced Duke Energy to cut output at its G.G. Allen and Riverbend coal plants on the Catawba River. Meanwhile the utility was scrambling to keep the water intake system for its McGuire nuclear plant underwater. In Alabama, the Browns Ferry nuclear plant had to drastically cut its output (as it has in three of the last five years) to avoid exceeding the temperature limit on discharge water and killing fish in the Tennessee River.
- A 2006 heat wave forced nuclear plants in the Midwest to reduce their output when customers needed power most. At the Prairie Island plant in Minnesota, for example, the high temperature of the Mississippi River forced the plant to cut electricity generation by more than half.
- In the arid Southwest, power plants have been contributing to the depletion of aquifers, in some cases without even reporting their water use.
- On New York's Hudson River, the cooling water intakes of the Indian Point nuclear plant kill millions of fish annually, including endangered shortnose sturgeon. This hazard to aquatic life now threatens the plant as well. Because operators have not built a new cooling system to protect fish, state regulators have not yet approved the licenses the operators need to keep the plant's two reactors running past 2013 and 2015.
- Proposed power plants have also taken hits over water needs. Local concerns about water use have scuttled planned facilities in Arizona, Idaho, Virginia, and elsewhere. Developers of proposed water-cooled concentrating solar plants in California and Nevada have run into opposition, driving them toward dry cooling instead.

Take the average amount of water flowing over Niagara Falls in a minute. Now triple it. That's *almost* how much water power plants in the United States take in for cooling each minute, on average.

Flickr/Williams Jt

This report—the first on power plant water use and related water stress from the Energy and Water in a Warming World initiative—is the first systematic assessment of both the effects of power plant cooling on water resources across the United States and the quality of information available to help public- and private-sector decision makers make water-smart energy choices.

Our analysis starts by profiling the water use characteristics of virtually every electricity generator in the United States. Then, applying new analytical approaches, we conservatively estimate the water use of those generators in 2008, looking across the range of fuels, power plant

Choices about the mix of plants used to generate electricity can ease the tension between energy and water, or exacerbate it.

Longview News Journal/Kevin Green

Drought, heat, and high power demand make for an energy-water collision: Amid the Texas drought of 2011, the shores of Martin Creek Lake—the primary source of cooling water for the Luminant plant pictured here—receded to precariously low levels. To keep the plant operating, Luminant had to import water from the Sabine River. If the drought persists into 2012, operators of the electricity grid have warned that power cuts on the scale of thousands of megawatts are possible.

technologies, and cooling systems. We then use those results to assess the stress that power plant water use placed on water systems across the country. We also compare our results with those reported by power plant operators to the U.S. Energy Information Administration (EIA) for 2008.

We examine both the *withdrawal* and *consumption* of freshwater. Withdrawal is the total amount of water a power plant takes in from a source such as a river, lake, or aquifer, some of which is returned. Consumption is the amount lost to evaporation during the cooling process.

Withdrawal is important for several reasons. Water intake systems can trap fish and other aquatic wildlife. Water withdrawn for cooling but not consumed returns to the environment at a higher temperature, potentially harming fish and other wildlife. And when power plants tap groundwater for cooling, they can deplete aquifers critical for meeting many different needs. Consumption is important because it too reduces the amount of water available for other uses, including sustaining ecosystems.

While our analysis focuses on the effects of water use by power plants today, we also consider how conditions are likely to change in the future. In the short run, our choices for what kind of power plants we build can contribute to freshwater-supply stress (by consigning an imbalanced share of the available water to power plant use) and can affect water quality (by increasing water temperatures to levels that harm local ecosystems, for example). Over a longer time frame, those choices can fuel climate change, which in turn may also affect water quantity (through drought and other extreme weather events) and quality (by raising the temperature of lakes, streams, and rivers). Population growth and rising demand for water also promise to worsen water stress in many regions of the country already under stress from power plant use and other uses.

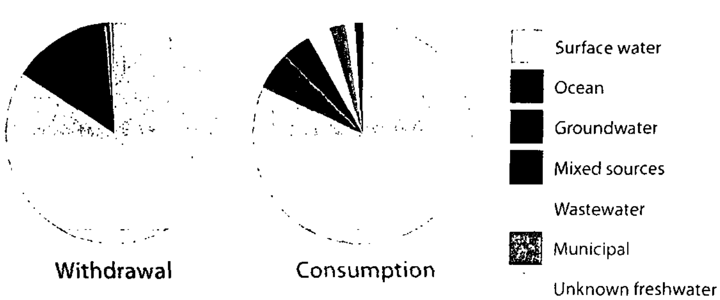


FIGURE 1. Sources of Water Used by Power Plants

In 2008, power plants withdrew 84 percent of their cooling water from rivers and lakes. The balance came mainly from the ocean in coastal regions. Most water that power plants consumed similarly came from surface sources. However, in some regions—notably the arid Southwest—cooling water came from a broader array of sources, including groundwater and wastewater.

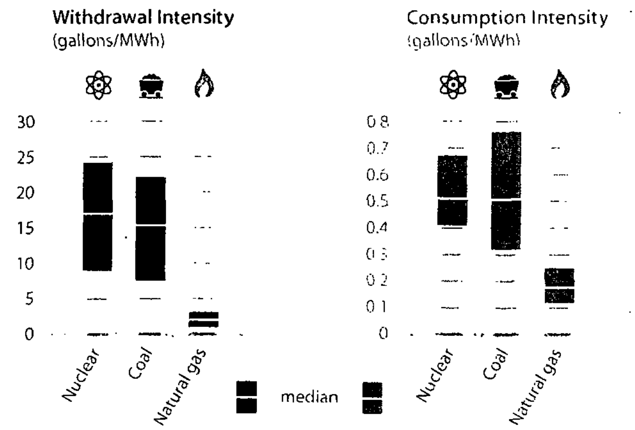


FIGURE 2. Variations in Water-Use Intensity across the Power Plant Fleet

Among power plants using freshwater for cooling in 2008, nuclear power plants used more water per unit of electricity produced. The average nuclear plant withdrew nearly eight times as much freshwater as the average natural gas plant, and 11 percent more than the average coal plant. Nuclear plants also consumed three times as much freshwater as natural gas per unit of electricity produced, and about 4 percent more freshwater than coal plants.

Note: Boxes show the range of water-use values for various technologies from the National Renewable Energy Laboratory (NREL). Comparisons are based on median water-use values.

Electricity's Water Profile

Our findings on the **water profile of power plants** in 2008 show that:

- **Power plants are thirsty.** Every day in 2008, on average, water-cooled thermoelectric power plants in the United States withdrew 60 billion to 170 billion gallons (180,000 to 530,000 acre-feet) of freshwater from rivers, lakes, streams, and aquifers, and consumed 2.8 billion to 5.9 billion gallons (8,600 to 18,100 acre-feet) of that water. Our nation's large coal fleet alone was responsible for 67 percent of those withdrawals, and 65 percent of that consumption.
- **Where that water comes from is important.** In the Southwest, where surface water is relatively scarce, power plants withdrew an average of 125 million to 190 million gallons (380 to 590 acre-feet) of groundwater daily, tapping many aquifers already suffering from overdraft. By contrast, power plants east of the Mississippi relied overwhelmingly on surface water.
- **East is not west: water intensity varies regionally.** Power plant owners can reduce their water intensity—the amount of water plants use per unit of electricity generated. Plants in the East generally withdrew more water for each unit of electricity produced than plants in the West, because most have not been fitted

with recirculating, dry cooling, or hybrid cooling technologies. Freshwater withdrawal intensity was 41 to 55 times greater in Virginia, North Carolina, Michigan, and Missouri than in Utah, Nevada, and California. Freshwater consumption intensity was similar in those sets of states.

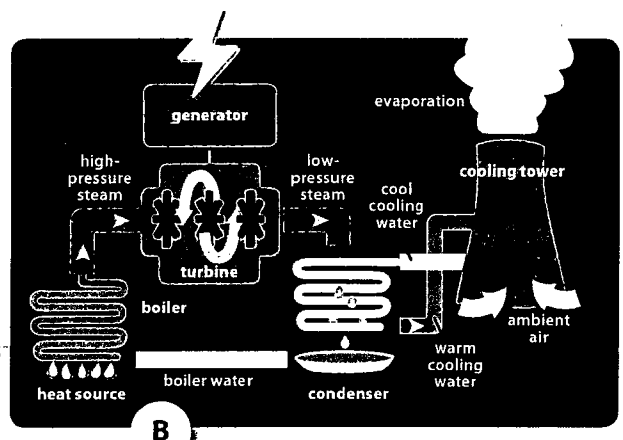
- **Low-carbon electricity technologies are not necessarily low-water.** On average in 2008, plants in the U.S. nuclear fleet withdrew nearly eight times more freshwater than natural gas plants per unit of electricity generated, and 11 percent more than coal plants. The water intensity of renewable energy technologies varies. Some concentrating solar power plants consume more water per unit of electricity than the average coal plant, while wind farms use essentially no water.

Under Pressure: Stress on Water Systems

Water supply is said to be stressed in watersheds when demand for water—by power plants, agriculture, and municipalities, for example—exceeds a critical threshold of the available supply provided by local sources, typically surface and groundwater. Water quality can be similarly stressed when, for example, water users raise temperatures or discharge pollutants. Our findings on the **impact of power plant cooling on water stress** in 2008 show that:

- **Power plants across the country contribute to water-supply stress.** Based on our analysis, in 2008, 400 out of 2,106 watersheds across the country were experiencing water-supply stress. Power plants, by tapping this overstretched resource for cooling purposes, contributed to water-supply stress in one-fifth of those. We focused on 25 watersheds in 17 states in which power plants were the primary driver of water-supply stress based on our analysis. Several states including North Carolina, South Carolina, Missouri, and Michigan had more than one of those watersheds, including the Catawba and Seneca Rivers.

- **High-temperature water discharges are common.** Peak summer temperatures for return flows from more than 350 power plants across the country exceeded 90°F. Some 14 states prohibit such discharges, which can harm fish and other wildlife.



Inset adapted from GAO 2009.

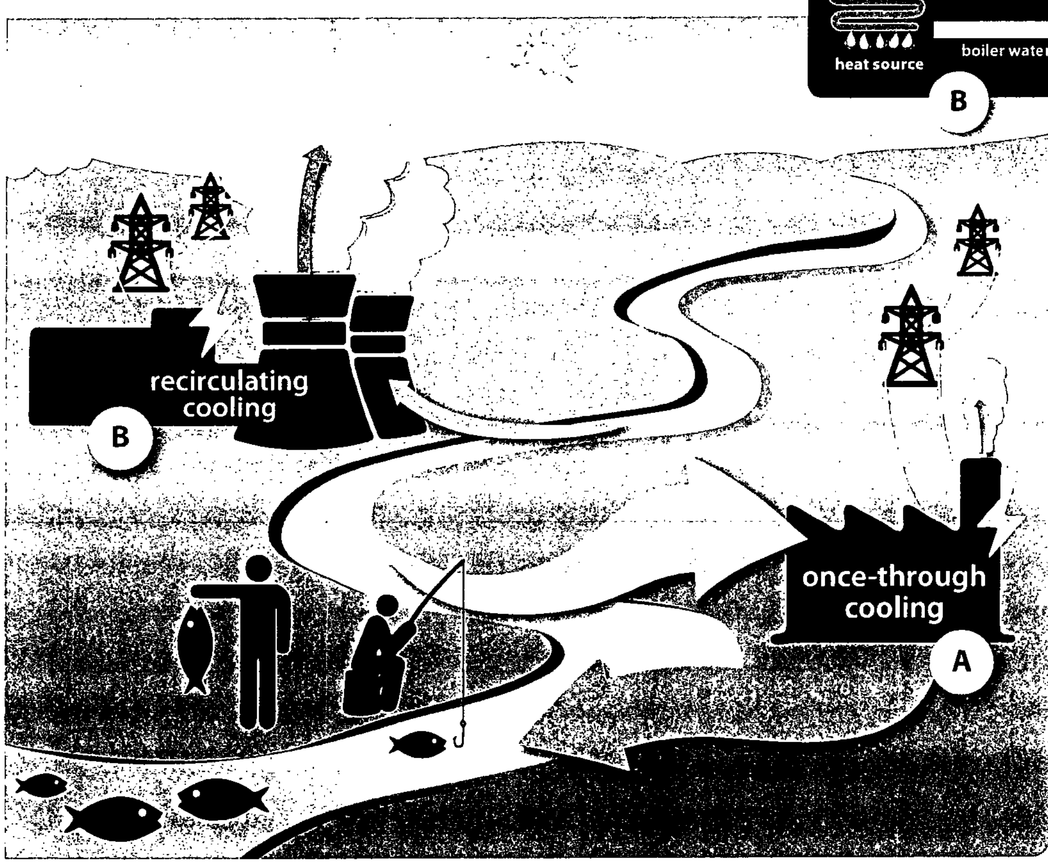


FIGURE 3. How Power Plants Use Water

Most U.S. power plants create steam to drive the turbines that generate electricity. After the steam passes through a turbine, it is cooled, condensed, and reused. Steam cooling accounts for virtually all the water that most power plants use, which they often draw from rivers, lakes, or aquifers. How much water a power plant uses depends on which cooling technology it uses. Once-through cooling systems (A) withdraw large amounts of water, but return most of it—at a higher temperature—to the source. Recirculating systems (B) take in much less water, but can consume twice as much of it or more, because they evaporate much of the water to condense the steam.

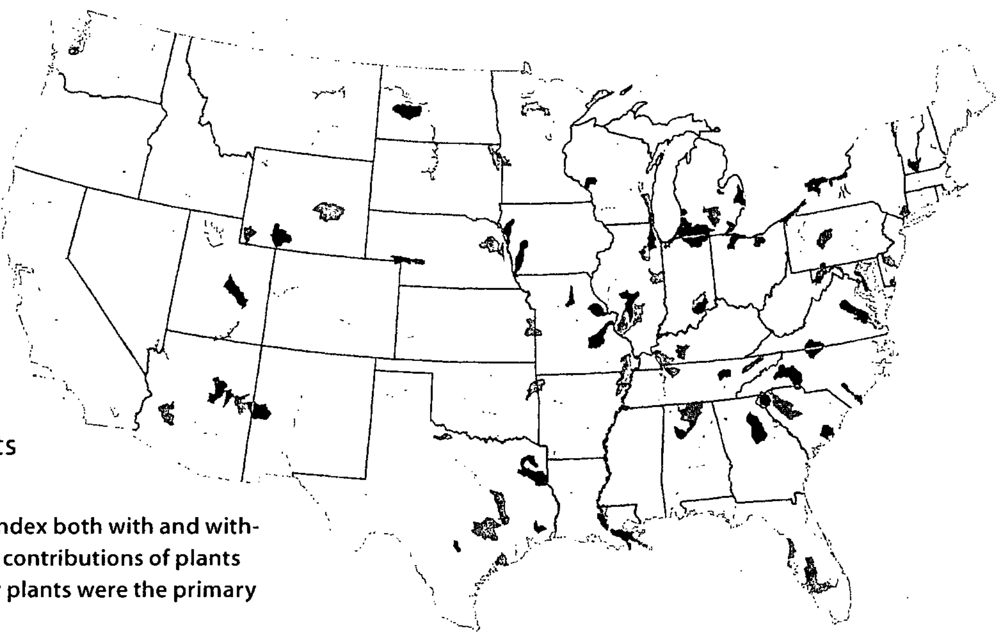


FIGURE 4. Where Power Plants Drive Water-Supply Stress

Calculating the Water Supply Stress Index both with and without power plant water use shows the contributions of plants in each basin, including where power plants were the primary driver of water-supply stress.

- **The mix of power plants in the nation's fleet matters.** The power plant portfolios of U.S. companies have widely varying water-use and carbon emissions profiles. Utilities with lower-water plants place less stress on local water sources. Utilities with carbon-intensive power plants contribute to long-term water stress by exacerbating climate change.

Gaps and Errors in Information on Power Plant Water Use

Collisions and near-misses between energy and water needs point to the importance of accurate, up-to-date information on power plant water demand. Our analysis reveals, however, a number of **gaps and apparent inaccuracies in federal data** reported for 2008. As a result, analyses based on that information would have overlooked regions facing water stress. We found:

- **Gaps add up.** Power plants that did not report their water use to the EIA accounted for 28 to 30 percent of freshwater withdrawals by the electricity sector, and at least 24 to 31 percent of freshwater consumption by the sector, according to our calculations. Gaps in the 2008 information included all water use by nuclear power plants.
- **Discrepancies are widespread.** Reported freshwater use by power plants across the country fell outside the bounds suggested by our analysis, including plants in 22 states for withdrawal, and 38 states for consumption. The discrepancies were especially large in the Lower Colorado River and Southeast-Gulf regions, where plant operators reported consumption five times greater—and withdrawals 30 percent less—than median water-use values would suggest.
- **Discrepancies stemmed from a range of causes.** Some power plant operators are exempt from reporting their water use based on plant size or technology. Many operators appeared to report peak rates of water use rather than the requested annual average rate, leading to overestimates. Other operators reported zero water use.

Flickr/Andy Shapiro

Habitat and hot water: **Rivers and lakes used for power plant cooling can also be prime habitat for prized sportfishing species, including cold-water species such as trout. Yet in 2008 power plant operators reported discharging water to rivers at peak temperatures above 110°F. Those temperatures can be lethal to wildlife, and are far in excess of limits set by many states.**

In the Southwest, power plants withdrew an average of 125 million to 190 million gallons of groundwater daily in 2008, tapping many aquifers already suffering from overdraft.

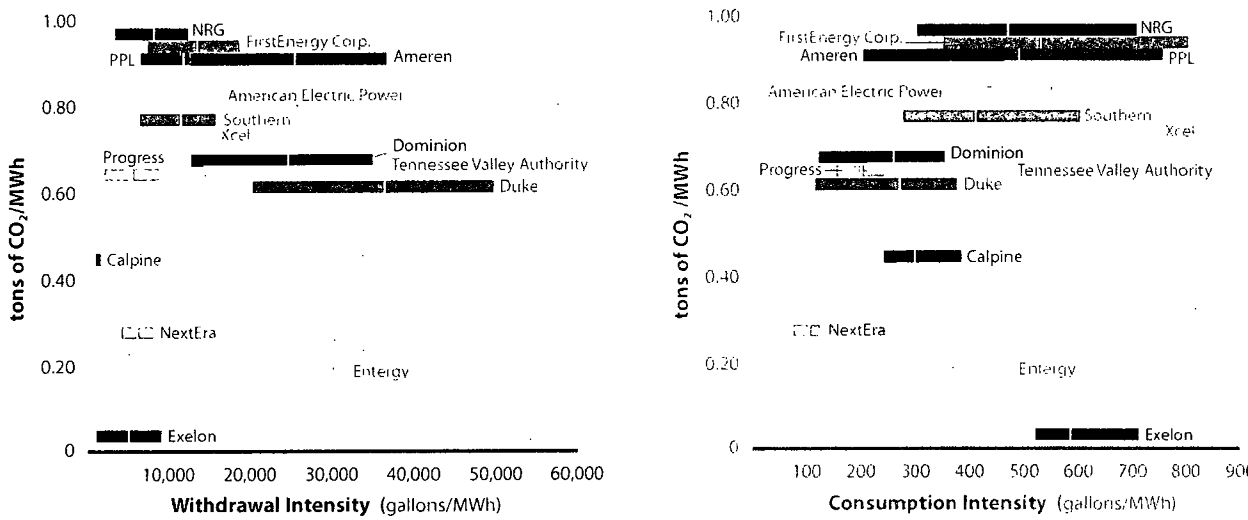


FIGURE 5. Power Companies, Freshwater, and Carbon

The nation's 15 largest electricity producers—which accounted for 50 percent of all U.S. power generated in 2008—varied widely in their water use and carbon emissions. Producers with a large proportion of nuclear plants that used freshwater for once-through cooling had high freshwater withdrawal intensities but low carbon intensities. Producers using seawater to cool nuclear facilities had low freshwater and carbon intensities. Producers with a large proportion of wind or solar photovoltaic plants had low water and carbon intensities.

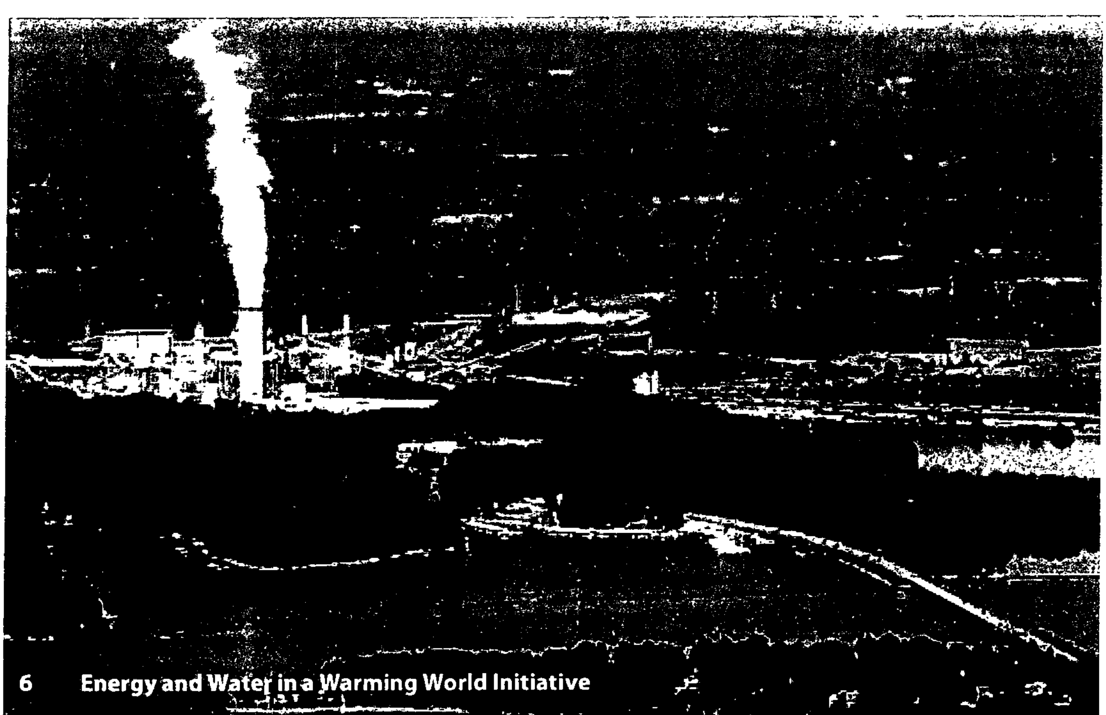
Note: Based on minimum, median, and maximum water-use values from NREL.

- **Good analysis requires good information.** Using the available data masks existing water stress. Several of the 25 watersheds identified did not show up when we analyzed EIA-compiled information.

Toward a Water-Smart Energy Future

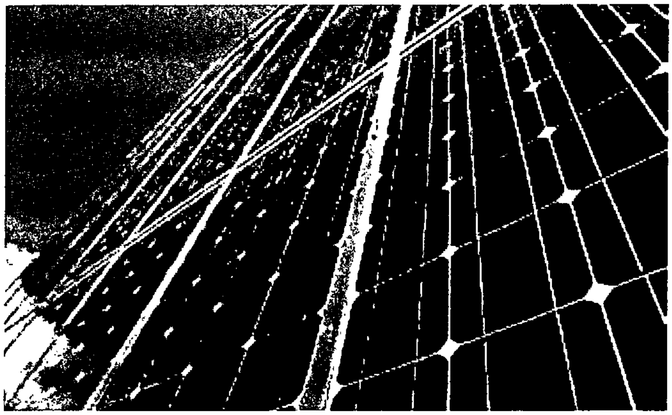
Averting energy-water collisions requires that power plant operators regularly report accurate information on their water use to the EIA and state agencies. The EIA has been working to improve such reporting, to better meet the needs of public- and private-sector decision makers. The agency may therefore remedy many of the problems we identified with the 2008 data shortly.

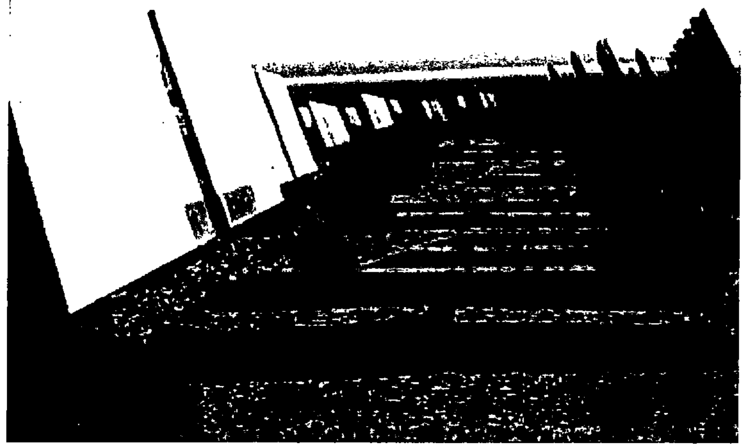
However, providing better information is only the first critical step. Decision makers must then put that information—coupled with sound analyses of water stress—to work in curbing electricity's thirst, especially in water-stressed regions. Our analysis provides a strong initial basis for **making water-smart energy choices**. Here are some ways to do so:



Catawba Riverkeepers

Power plant underreporting of water use: **Drought and rising demand for water have stressed the Catawba River, the source of cooling water for Duke Energy's Marshall Steam Station and several other plants. These power plants underreported the amount of river water they used in 2008, according to our analysis. In its 2009 report on energy and water, the U.S. Government Accountability Office explicitly recognized the importance of providing better information on power plant water use, to improve planning and management.**





Water-smart renewables: **Some developers and utilities are reducing risk by choosing technologies that use essentially no water, such as wind and solar photovoltaics (left), and by investing in energy efficiency. Other developers are choosing low-water approaches for plants that need cooling. For example, the 370-megawatt Ivanpah concentrating solar power (CSP) project under construction in California's Mojave Desert (right) will rely on dry cooling—and consume 90 percent less water per unit of electricity than typical wet-cooled CSP plants.**

- **Get it right the first time.** Developing new resources for meeting electricity demand provides a critical opportunity for reducing water risks for both power plant operators and other users. Utilities and other power plant developers would be well advised to prioritize low-water or no-water cooling options, particularly in regions of current and projected high water stress.

  Some developers are already making such choices. For example, the project developer's choice of dry cooling for the 370-megawatt Ivanpah concentrating solar power (CSP) project under construction in California's Mojave Desert means that the facility will consume 90 percent less water per unit of electricity than typical wet-cooled CSP plants. Other developers and utilities are reducing the risk of energy-water collisions by choosing technologies that use essentially no water, such as wind and solar photovoltaics, and by investing in energy efficiency.

- **Retool existing plants.** Owners and operators of existing power plants with substantial effects on the supply or quality of water in water-stressed regions could consider retrofitting to low-water cooling. When the 1,250-megawatt Plant Yates near Newnan, GA, added cooling towers in 2007, it cut water withdrawals by 93 percent.

  Even greater reductions in freshwater use are sometimes essential. In much of the Southwest, even low water withdrawals can spell trouble, particularly when they come from diminishing aquifers. Water consumption, too, can pose problems. Power producers in highly water-constrained settings can make water-smart choices—as Xcel Energy, which operates the 1,080-megawatt Harrington Station in Amarillo, TX, did in 2006, when it switched to treated wastewater to meet the plant's cooling needs.

- **Set strong guidelines for power plant water use.** Public officials can draw on good information on electricity's thirst to help owners of existing and proposed power plants avert energy-water collisions. Public utility commissions, which oversee the plans of utilities and specific plant proposals, can encourage or require investments that curb adverse effects on water supply or quality, particularly in areas of current or projected water stress.

  Legislators also have a stake in averting energy-water collisions. The Colorado legislature's 2010 decision to retire more than 900 megawatts of coal plants in favor of natural gas, energy efficiency, and renewable energy will reduce water consumption by a volume roughly equivalent to that used by 50,000 people.

- **Engage diverse stakeholders.** Mayors securing water supplies for their cities, anglers concerned with sport and commercial fishing, water resource managers at all levels, and others all have a stake in averting energy-water collisions. Full public access to information on water

Since power plants are designed to last for decades, averting energy-water collisions means taking the long view.

use by existing and proposed power plants will enable these and other local stakeholders to become informed about the benefits of water-smart energy choices.

- **Reduce power plant carbon emissions.** Because human-caused climate change is worsening water stress across much of the United States, water-smart energy choices should include investing in resources that are also low-carbon. The new cooling towers for the coal-burning Plant Yates reduce its impact on water stress but not its carbon emissions.

  The coal-burning generators at Harrington Station in Amarillo, although relying on treated wastewater, still emit prodigious quantities of carbon. Of course, not all low-carbon options are water-smart. Some, such as wind power and energy efficiency, are inherently low-water. Others, such as the proposed carbon capture and storage for coal plants, are not, and could worsen energy-water collisions if used in regions with water stress.

Averting energy-water collisions means taking a long view. Power plants are designed to last for decades, and much of our existing infrastructure will continue operating for years. Our nation's precious freshwater resources will face ever more stress from growing populations, a changing climate, and other trends over the next several decades.

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Texas Parks and Wildlife

Everyone is an energy-water stakeholder: **Local officials, water resource managers, recreation and conservation groups, and others all have a stake in averting energy-water collisions. Full public access to information on water use by existing and proposed power plants will enable stakeholders to become informed about the benefits of water-smart energy choices.**

The typically high cost of retrofitting power plants means that decisions on the water impact of today's plants should consider the risks they pose to freshwater resources and energy reliability throughout their expected lifetime.

The next report from the Energy and Water in a Warming World initiative will take up this challenge by exploring how energy choices affect the resilience of our energy sector in the face of both periodic drought and long-term changes in water availability. Zooming in on key regions of the country will yield a more robust understanding of how the energy technologies we choose to power tomorrow's world would affect water resources.

Decisions made today about which power plants to build, which to retire, and which energy or cooling technologies to deploy and develop matter greatly. Understanding how these choices affect water use and water stress will help ensure that the dependence of power plants on water does not compromise that resource, the plants themselves, or the energy we rely on them to provide.

Energy choices that phase out the power sector's decades-old water dependence can help ensure reliable electricity while protecting our freshwater resources.

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The full text of this report is available online at *www.ucsusa.org/electricity-water-use.*

Energy and Water in a Warming World (EW3) is a collaborative effort between the Union of Concerned Scientists and a team of independent experts to build and synthesize policy-relevant research on the water demands of energy production in the context of climate variability and change. The initiative includes core research collaborations intended to raise the national profile of the water demands of energy, along with policy-relevant energy development scenarios and regional perspectives. The material presented in this report is based on the research of the EW3 Baseline Assessment Team. The work discussed here will also be presented in more technical detail in forthcoming scientific papers and a Web-accessible database. For supporting materials (including glossary, methodology appendix, and graphical appendix) go to *www.ucsusa.org/electricity-water-use.*

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