Powering Maryland's Future

How Clean Energy Outperforms Nuclear Power in Delivering a Reliable, Safe and Affordable Supply of Electricity

Maryland PIRG Foundation

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Executive Summary

Marylanders count on a safe, secure and reliable supply of electricity, available at a reasonable cost.

Yet, the future of our electricity system is in doubt. Deregulation has stung Marylanders with skyrocketing electricity rates. The Maryland Public Service Commission has warned of rolling blackouts by 2011 if we don't take action to curb power demand or increase supply. And Maryland, like other states, faces the urgent need to reduce its contribution to global warming.

Two paths have been proposed that have the potential to address these challenges. Constellation Energy plans to build a third nuclear reactor at Calvert Cliffs, which the company says could provide a large amount of electricity with little global warming or health-threatening pollution, at less cost than natural gas. Others advocate that Maryland follow a "clean energy" path that uses improvements in energy efficiency and new sources of renewable energy to address the state's electricity challenges.

A comparison of the two pathways shows that by any measure—reliability, cost, safety, environmental impact, or support for a growing Maryland economy—clean energy is likely to outperform a nuclear-based strategy for powering Maryland's future.

Maryland has already begun to adopt clean energy strategies that will make a large difference in addressing the state's future electricity needs.

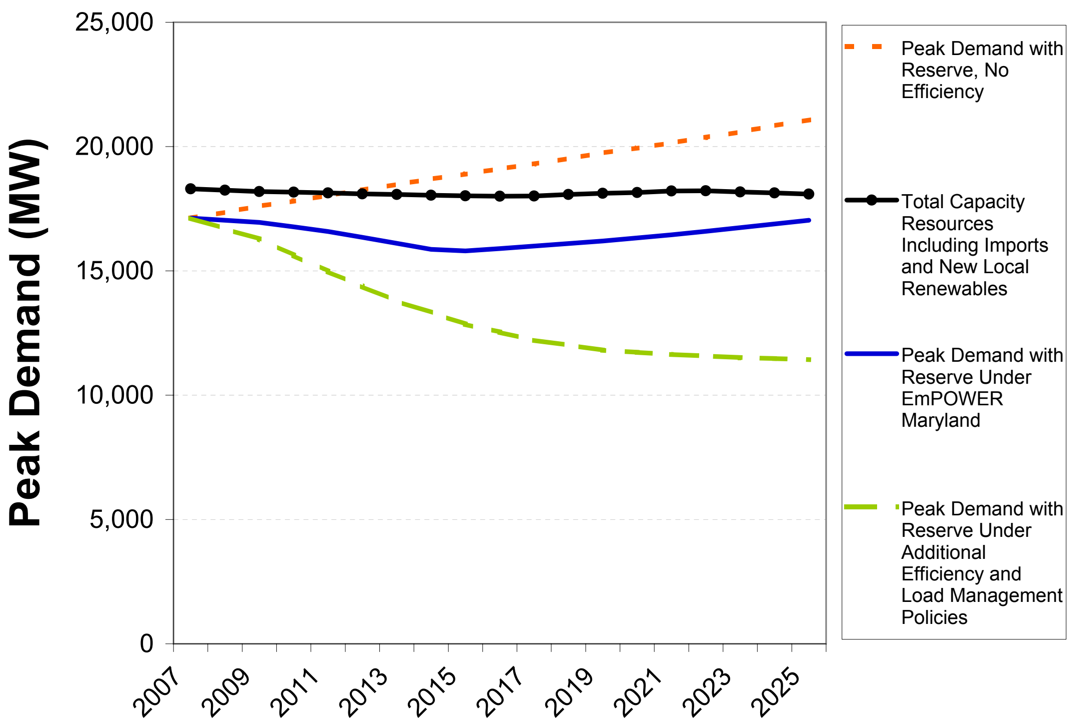
- In spring 2008, lawmakers created or expanded a series of clean energy programs, including the EmPOWER Maryland energy efficiency initiative. These programs will reduce the need for new power plants by reducing demand for electricity, while also creating renewable energy facilities such as rooftop solar panels. These steps should ensure the reliability of the electricity system through 2025. (See Figure ES-1.) Additionally, by 2015, these programs will yield as much energy per year as 1.4 new reactors at Calvert Cliffs.

- However, these efforts will tap just a portion of Maryland's clean energy resources. Additional efficiency and load management could reduce peak electricity demand by as much as 8,500 MW below business-as-usual levels by 2025, ensuring the reliability of Maryland's electricity system for the foreseeable future. Coupled with additional renewable resources—including wind, solar and biomass power—these resources could help enable the state to retire aging power plants. (See Figure ES-1.)

Clean energy resources can deliver a more reliable and efficient supply of electricity for Maryland than the expansion of Calvert Cliffs.

- Nuclear reactors are complex and take a long time to build, while clean energy technologies are quick to deploy. A new reactor at Calvert Cliffs would not be complete until December 2015 at the very earliest, making a nuclear-based strategy ineffective in meeting

Figure ES-1: Forecast Peak Demand and Capacity Resources in Maryland



If demand for electricity were to continue climbing at historical rates, electricity demand would begin to exceed supply after 2011. (In the graph, this is depicted by the upper dashed line crossing above the solid black line with dots.) However, under the EmPOWER Maryland initiative, the state is implementing energy efficiency and load management programs that will significantly reduce peak demand for electricity. In addition, under the state's renewable electricity standard, the state will be installing thousands of solar panels on Maryland rooftops, plus other renewable energy facilities in the region, that will increase the state's capacity to generate electricity. Together, these programs should help maintain reliability through 2025. (In the graph, this is shown by the solid line staying below the solid black line with dots). Maryland has a great deal of additional clean energy potential. For example, an expanded set of energy efficiency and enhanced load management programs could cut peak demand nearly 50 percent below forecast levels by 2025 (shown by the lower dashed line).

the state's near-term challenges. By contrast, energy efficiency and many renewable energy technologies can be implemented quickly, making a significant and rapid contribution to the state's energy needs.

- Clean energy technologies tend to be small and distributed throughout the state in many small units of capacity. While some clean energy sources, such as solar and wind power, generate electricity intermittently, it is unlikely that every unit will fail at the same time. As a result, thoughtful integration of clean energy technologies can provide stable, reliable power to Maryland. While many nuclear reactors also provide stable power, the unplanned shutdown of a nuclear reactor can cause massive disruption to the electric grid. For example, when a power line failure triggered the shutdown of two reactors at Turkey Point in southern Florida in February 2008, more than 3 million customers in the Miami area lost power for up to 5 hours—causing traffic jams, stranding people in elevators, and widely disrupting business. And after the massive northeast blackout in August 2003, nearly two weeks passed before nine affected nuclear reactors were able to return to full power, keeping the grid on the brink of another failure.

- The existing reactors at Calvert Cliffs have suffered from a number of unplanned shutdowns that harmed the reliability of the electricity system. For example, mechanical problems and management failures led to the shutdown of both reactors in May 1989. The outage created a regional electricity shortage and forced Baltimore Gas & Electric to spend more than $450 million to purchase replacement power—most of which was directly passed on to consumers.

Clean energy can deliver a safer and more secure supply of electricity for Maryland compared to expanding Calvert Cliffs.

- A new nuclear reactor at Calvert Cliffs would produce relatively little global warming and health-damaging air pollution, but during its lifetime it would produce about 1,380 tons of highly radioactive spent fuel. This waste remains dangerous for thousands of years, and no nation on earth has developed an acceptable solution for safely disposing of it. Constellation currently stores used fuel on-site at Calvert Cliffs in a cooling pond and in dry storage casks. An accident or direct attack involving spent fuel storage sites could release dangerous radioactive material into the air.

- Energy efficiency, renewable energy and combined heat and power facilities do not produce any radioactive waste, while also producing little air pollution that contributes to global warming and immediate health impacts.

Clean energy can provide electricity for Marlyand consumers at a more reasonable cost than a new nuclear reactor at Calvert Cliffs.

- Recent estimates have placed the lifetime average cost of nuclear power in the range of 12 to 15 cents per kWh—with some as high as 22 cents per kWh (including interconnection and firming costs, but not distribution). In comparison, commercial energy efficiency measures in Maryland are available at an average cost of 2 cents per kWh. Residential efficiency measures cost an average of 3.9 cents per kWh. Industrial combined heat and power can deliver power in Maryland for about 4.5 cents per kWh. And recently signed contracts for wind power in the Mid-Atlantic have come in just above 8 cents per kWh for on-shore facilities and 11.7 cents per kWh for a wind farm to be constructed off the coast of Delaware.

- Since 2005, estimates for the cost of building a new nuclear reactor have skyrocketed, climbing more than twice as fast as other types of generation technologies. Bottlenecks are developing as demand for reactor parts is far exceeding supply. For example, only two metal foundries in the world, one in Japan and one in France, are capable of manufacturing nuclear reactor vessels.

- In mid-2005, Constellation estimated that expanding Calvert Cliffs would have a capital cost of $2.5 to $3 billion. However, in a July 2007 report to the Nuclear Regulatory Commission, Constellation suggested that expanding Calvert Cliffs would have a capital cost of about $6.9 billion. And industry cost estimates to date in 2008 have been more than 50 percent higher still.

- Nuclear reactors can only become financially viable by transferring risk to taxpayers and/or customers. The long-term value of federal taxpayer subsidies for a new reactor at Calvert Cliffs could exceed $13 billion if it is one of the first new plants built in the United States. In addition, taxpayers could be on the hook for up to 98 percent of the damages caused by a worst-case accident at a nuclear facility under a nuclear industry liability cap created by Congress.

Clean energy can create more jobs and expand the local economy more than building a new nuclear reactor at Calvert Cliffs.

- The American Council for an Energy-Efficient Economy (ACEEE) calculates that if Maryland tapped into its energy efficiency potential with six energy efficiency policies and an advanced load-management program, residents would save about $10 a month on electricity by 2015. These policies would return $4 in energy bill savings for every dollar invested.

- ACEEE estimates that this efficient course could create more than 12,000 new jobs in Maryland by 2025, increase net wages paid by $780 million, and grow gross state product by more than $700 million. While no comparable macroeconomic analysis exists for a new reactor at Calvert Cliffs, Constellation reports that it would add 360 full-time jobs to Calvert County.

Powering Maryland's future with clean energy makes more sense than building a new reactor at Calvert Cliffs. Accordingly:

- The state should prioritize successful implementation of the EmPOWER Maryland energy efficiency program and the state's renewable electricity standard. Furthermore, the state should expand the goals of EmPOWER Maryland beyond 2015, expand demand-management programs to capture more of the state's available load-shifting potential, and encourage the development of combined heat and power facilities.

- The Maryland Public Service Commission should deny a certificate of public convenience and necessity for the proposed reactor at Calvert Cliffs, on the grounds that clean energy measures already underway would provide a more stable and reliable electric system and superior economic benefits for the state.

- The state should not offer any subsidies to support building a new nuclear reactor, whether in the form of tax breaks or other approaches that transfer the risk of building a new nuclear reactor onto Maryland citizens.

- To ensure the safety and security of Maryland's energy supply, state leaders should enact a conditional ban on the construction of any new nuclear power plants until a satisfactory national solution for storage of high-level radioactive waste is developed.

- The federal government should redirect subsidies currently on offer to the nuclear industry toward more effective clean energy solutions. An equivalent investment in these technologies can prevent the emission much larger amounts of global warming and health-threatening pollution.

Introduction

What will be the fuel of the future?

In the 1950s and 1960s, the answer was nuclear power, with its promise of virtually limitless energy, "too cheap to meter." However, after a wave of cost overruns and utility bankruptcies, nuclear appeared anything but cheap.

In the 1970s and early 1980s, after the Arab oil embargo, renewable energy entered the picture, offering the promise of tapping virtually limitless reserves of the natural energy all around us. Yet, fitful and limited levels of government support barely lifted wind and solar energy technologies off the ground.

In the 1990s, natural gas was seen as cheap and plentiful, and utilities built hundreds of gas-fired power plants. Now, gas appears neither cheap nor plentiful, and energy costs are going through the roof. As a result, states are increasingly recognizing that saving fuel through energy efficiency improvements can be even more effective than building new power plants and transmission lines.

Today, as Maryland seeks to prepare for the energy challenges of the 21st century, all the options are on the table—except for the status quo.

Maryland's aging power plants are insufficient to keep the lights on if demand for power continues to grow. Even if they were, they would continue to produce unacceptable amounts of pollution linked to global warming and harm to public health. Moreover, Marylanders are still burdened by the rate hikes that followed the state's disastrous experiment with retail competition in the electricity market.

Constellation Energy has proposed one potential solution to the state's electricity challenges: adding a third reactor to its Calvert Cliffs nuclear power plant. The company points to the ability of a new reactor to relieve power shortages in central Maryland while reducing the state's contribution to global warming, and claims it can produce power cheaper than natural gas.[1]

At the same time, Maryland has finally embarked on a series of efforts to promote clean energy, including a massive commitment to energy efficiency and expanded standards for renewable electricity. Under the EmPOWER Maryland energy efficiency initiative, utility companies and the state will begin to develop the state's enormous potential for energy savings and effective use of electricity. And under the state's renewable electricity standard, Maryland will begin to make limitless energy sources such as the wind and the sun a substantial part of the state's electricity supply.

In this report, we compare these two pathways for powering Maryland's future. We evaluate the ability of each option to deliver a reliable and efficient supply of electricity; to keep the state safe and secure; and to meet the electricity needs of Maryland at a reasonable cost.

Placing these two solutions side-by-side, the conclusion is inescapable: clean energy is a more effective and affordable way to address Maryland's energy challenges than building a new nuclear reactor.

Maryland's Electricity Challenges

Marylanders value a clean, safe, secure, efficient and reliable supply of electricity, available at a reasonable cost. However, in many ways, Maryland's electricity system is not living up to our highest expectations.

Concerns about the reliability of the electricity system have been growing. In December 2007, the Public Service Commission warned that rolling electric blackouts could be unavoidable by 2011 without preventative action.[2]

Maryland's electric power system is also a major source of the pollution that causes global warming—as well as health-damaging soot, smog and mercury. The state is implementing policies—such as the Regional Greenhouse Gas Initiative and the Healthy Air Act—that will require existing power plants to curb their emissions and shape future power choices.

Finally, Marylanders are paying more to power their homes and businesses. In the past five years, electricity prices have jumped more than 50 percent, even after adjusting for inflation.[3] Rates paid by Baltimore Gas & Electric customers have climbed 85 percent since deregulation passed in 1999.[4] And millions of dollars are leaving the state to pay for fuel imports, draining our local economy.[5]

Reliability

Access to reliable electricity is a cornerstone of the American economy. Economic losses from the August 14, 2003 blackout that interrupted electric power for 50 million people for as long as two days totaled approximately $6 billion to $10 billion. The damage caused by this single event, triggered by problems in one small part of the electric grid, represented about six-hundredths of a percent of the U.S. gross domestic product in 2002.[6]

In order to maintain reliable electricity service, Maryland needs enough capacity to generate or import electricity to meet the demand for power—and have an adequate reserve margin as a buffer in the event of an unexpected problem.

If demand for power in Maryland were to continue rising at historical rates, available resources would no longer be adequate to ensure reliability after 2011, increasing the likelihood of rolling electric blackouts.[7]

Demand for Electricity and Available Generation Resources

Peak Demand

The key factor that shapes decisions about Maryland's electric infrastructure is the amount of power needed to keep the lights on during periods of peak demand.

The demand for electricity varies widely over the course of the year and the course of any given day. Demand for power on a hot summer day when air conditioners are running can be two to three times as great as in the middle of the night during a time of moderate temperatures. Even though periods of peak demand represent a tiny fraction of the time the electrical system must function, millions of dollars of infrastructure are in place to ensure reliable electric service during those times.

In 2006, weather-normalized demand for power in Maryland peaked at 14,299 megawatts.[8]

Reserve Margin

There is no guarantee that every power plant will be available to supply electricity at any given moment. Generator outages—either for expected maintenance or caused by unanticipated problems—can reduce the amount of power that can be generated within the state at any one time. As a result, planners require that electrical systems have a "reserve margin" of capacity available to handle unanticipated spikes in demand or generator or transmission line failures.

PJM Interconnection, which operates the electric transmission system in Maryland and neighboring states, requires a reserve margin of 15 percent system-wide. In simplified terms, the amount of capacity resources must exceed projected peak demand by 15 percent in order to preserve the reliability of the system. PJM does not enforce a reserve margin in any given state, but it is generally considered good practice for any area to have a surplus of available capacity—provided either through generation within that area or transmission connections with other areas—to ensure that power demands can be met under all possible conditions.

Through this lens, Maryland would need to have more than 16,400 MW of capacity currently available in order to ensure a reliable supply of electricity.

Available Resources

According to the U.S. Energy Information Administration (EIA), 153 individual electric generating units were operating in Maryland in 2006, with a total capacity of 13,382 megawatts (MW).[9] PJM considered approximately 13,101 MW of the generation available in Maryland at the end of 2006 to be available to supply power in order to meet peak demand.[10]

In other words, in-state capacity is nearly 1,200 MW less than that necessary to meet peak demand—and approximately 3,300 MW below levels required to maintain an adequate reserve margin.

Constraints on Maryland's Ability to Import Electricity

Maryland makes up the difference by importing power from nearby states, largely from coal-fired power plants in West Virginia and Pennsylvania. Over the course of a year, Maryland imports about 30 percent of its electricity.[11]

However, Maryland's capacity to import power is inherently limited.[12] As a result, the U.S. Department of Energy has designated both the Baltimore/Washington metropolitan area and the Delmarva Peninsula as "Critical Congestion Areas."[13]

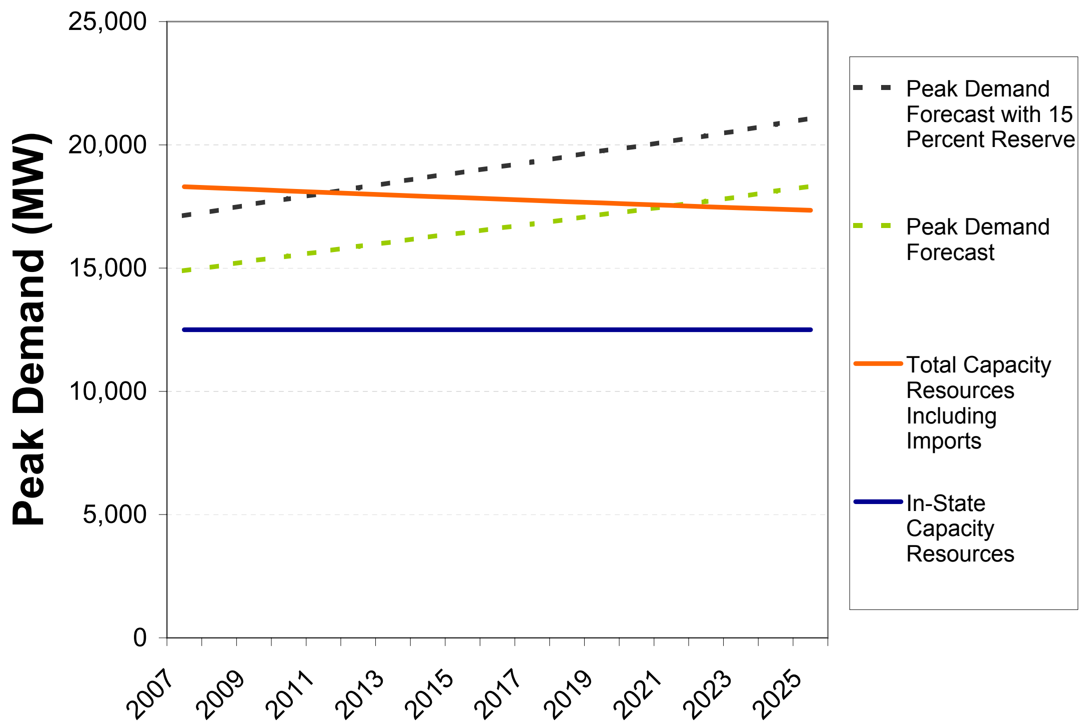
PJM estimates that power reserve margins in the central portion of Maryland and other parts of PJM East will be barely adequate by 2011.[14] In other words, Maryland can count upon no more than about 5,800 MW of power to be available from out of state at any given time.

Future Reliability

In December 2007, the Public Service Commission saw that, if demand for electricity continued to climb at historical rates, given scheduled generator retirements, the state would need about 1,000 megawatts (MW) of additional capacity to generate or import power by 2012 to keep the lights on.[15] (See Figure 1.) As of January 2008, no power plants in Maryland are scheduled to retire by 2012.[16] However, several plants in nearby areas, including Buzzard Point and Benning in Washington D.C., have announced plans to close by that year—reducing capacity in the region by about 900 MW.[17]

If demand for electricity continued to grow, the state could need more than 3,700 MW of additional power resources by 2025—assuming no generation retirements or additions, and assuming Maryland's capacity to import electricity declines by 1 percent per year, as other states in the region increase their demand for power and their electricity imports.[18] (See Figure 1.) This gap could widen if Maryland power plants—65 percent of which are at least 30 years old—shut down.[19] For instance,

Figure 1: Forecast Peak Demand and Capacity Resources in Maryland, if Demand Were to Continue Climbing at Historical Rates[21]



If electricity demand in Maryland were to continue growing at historical rates, the state would no longer have enough resources to meet peak electricity demand and have an adequate reserve margin to ensure reliability after about 2011. (Visually, this fact is represented above by the point were the upper dotted line begins to exceed the upper solid line.) By 2025, the state could need more than 3,700 MW of additional power resources to ensure reliability, even if no currently operating plants retire.

as Maryland implements the Regional Greenhouse Gas Initiative and the Healthy Air Act, it is likely that some of these plants will scale back power production, or retire altogether.[20]

Safety and Environmental Impact

Electricity supply choices all create impacts. For example, electricity generation—especially coal-fired power—is a major source of soot, smog, and mercury. These pollutants interfere with the healthy development of Maryland's children, cause asthma attacks, and kill thousands of citizens each year.[22]

The American Lung Association gives six counties in Maryland an "F" for air quality because of unhealthy levels of smog pollution.[23] Maryland as a whole has the tenth-worst chronic soot pollution problem among U.S. states.[24] And the Baltimore-Washington metropolitan area ranks among the top 10 most polluted cities in the country in terms of short-term soot levels.[25]

Global Warming

In addition, Maryland's overdependence on fossil fuels is contributing to global warming, which threatens to reshape the state through rising sea levels and altered ecosystems.[26] Maryland's electric power system is a major source of the pollution that causes global warming—contributing more than one-third of the state's total carbon dioxide emissions.[27]

If Maryland, the United States and the world continue to emit large amounts of global warming pollution, the state will likely face dramatic impacts. For example, the number of days with temperatures higher than 90°F could quadruple, reaching 100 or more per year.[28] Additionally, sea level could rise by more than 2 feet by the end of this century—or up to 4 feet if portions of the ice sheet on Greenland rapidly disintegrate. As a result, islands and coastal wetlands will disappear, and coastal cities will be at increasing risk of flooding, particularly during storm surges.[29] More than 6 percent of Maryland's land area is vulnerable to sea level rise of this magnitude, making the state the fourth most vulnerable to sea-level rise in the United States.[30]

To limit the severity of these impacts, Maryland is taking steps to reduce its emissions of global warming pollution and set an example for the rest of the United States. For example, the state is participating in the Regional Greenhouse Gas Initiative, a pact between states that limits allowable carbon dioxide emissions from electricity generation. Additionally, the Maryland Commission on Climate Change has issued a set of recommendations aimed at reducing the state's emissions of global warming pollution 25 percent by 2020, and 80 to 95 percent by 2050.[31]

Meeting these goals will require existing power plants to curb their emissions of carbon dioxide. Additionally, Maryland must shift its electricity system toward sources of energy that do not produce carbon dioxide.

Cost

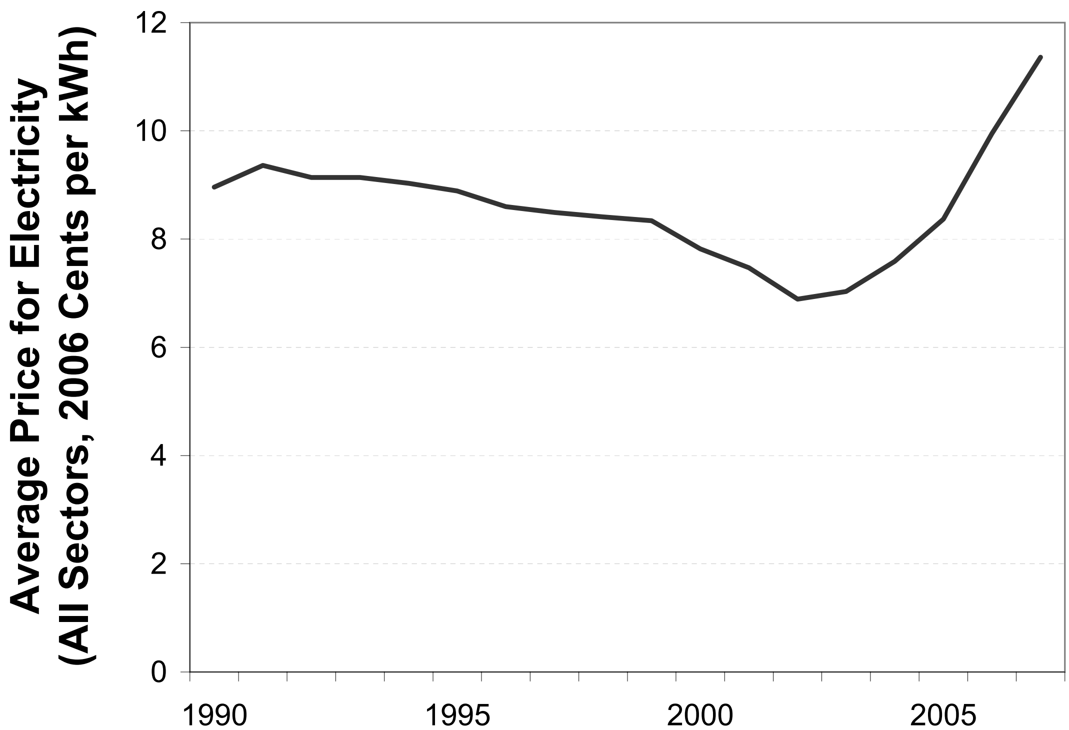
Thanks to rate hikes after deregulation, Marylanders are paying increasing amounts to cover their monthly electricity bills.

When Maryland leaders were debating whether to restructure the electricity market in late 1998, advocates of deregulation promised that increased competition would deliver lower rates. In fact, the opposite has occurred. Following the removal of rate caps in 2006, the price of electricity more than doubled, increasing retail electricity bills by as much as 72 percent, or $743 a year.[32] (See Figure 2.)

Maryland's limited ability to import power contributes to the rising cost of electricity. During periods of peak demand, the state must rely upon higher-priced local sources of power, many of which run on natural gas.[34] Aggravating the situation, prices for natural gas have climbed more than 50 percent since 2002.[35]

Solving all of these problems will require creating a new future for Maryland's electricity system. This future should ensure a reliable supply of electricity, with minimal emissions of health-threatening and global warming pollution, available at a reasonable cost.

Figure 2: Electricity Rates Have Increased Dramatically Since 2002[33]



Electricity rates in Maryland have spiked significantly since 2002, even after adjusting for inflation.

Comparing Two Visions for the Future of Maryland's Electricity System

There are two primary options on the table to power Maryland's future.

One option would increase Maryland's reliance on large, centralized nuclear power plants. In the wake of the 2005 federal Energy Policy Act, which offered more than $13 billion in subsidies for nuclear technology, Constellation Energy announced plans to build a new nuclear reactor in Maryland.[36] The reactor would be built at the Calvert Cliffs nuclear plant in Calvert County, where there are currently two operating reactors.[37] The proposed reactor would be capable of producing 1,600 MW of power. Not only would the reactor double the output of Calvert Cliffs, it would be the largest nuclear reactor in the country, and one of the first built in 30 years.

The other option follows an innovative path, leading to an electricity system based on highly efficient and targeted use of power, generated by a diverse set of small, modular, clean and widely distributed resources. Instead of large power plants, this path would include highly efficient homes, businesses and industry—which can improve the reliability of electricity service while minimizing investment in expensive infrastructure. In addition, this path would build Maryland's capacity to generate electricity from renewable sources of energy—from solar panels spread across the state on rooftops, to wind farms capturing energy in the air blowing over the ocean.

In this section, we take a close look at each of these two paths and evaluate their ability to deliver a reliable and efficient energy supply, keep Maryland communities safe and secure, and provide power at a reasonable cost with strong benefits for the state economy. Comparing both courses side by side, it becomes clear that clean energy provides more advantages for Maryland than building a new nuclear reactor at Calvert Cliffs.

Two Paths: Nuclear Power or Clean Energy

The Nuclear Path

Building a new nuclear reactor at Calvert Cliffs would add 1,600 MW of generation capacity to Maryland's electricity system no earlier than December 2015.

Constellation Energy has said that it plans to break ground on the facility as early as December 2008, if the federal government quickly acts to put loan guarantees in place (as authorized under the Energy Policy Act of 2005).[38] The first phase of construction would consist of non-reactor work, including roads and a visitor center.[39]

Before construction can begin, the company must obtain a "Certificate of Public Convenience and Necessity" from the Maryland Public Service Commission (PSC).[40] Constellation submitted an application for this certificate to the PSC on November 13, 2007.[41] The PSC will hold official hearings on the application from August 11-15, 2008, with evening hearings for public comment on August 4, 11, and 19, 2008.[42]

Constellation will also need a combined construction and operating license for the facility from the U.S. Nuclear Regulatory Commission (NRC). The company submitted an application for this license in July 2007.[43] According to NRC projections, the agency plans to review the application from 2008 through 2010, followed by hearings into 2011.[44]

NRC must also review and certify the design of the new Calvert Cliffs reactor, since none of this type have ever been built in the United States, and only one is under construction anywhere in the world. This process is scheduled to be complete between 2011 and 2012.[45]

Constellation expects construction of the new reactor at Calvert Cliffs to be complete by July 2015, with the reactor in commercial operation by December 2015.[46]

The Clean Energy Path

In contrast, a clean energy path for Maryland would involve using a variety of technologies and programs to meet the state's future energy needs. Maryland has already begun to take some steps toward implementing a clean energy vision.

Maryland's Existing Efforts: EmPOWER Maryland and the Renewable Electricity Standard

In April 2008, the Maryland General Assembly approved the EmPOWER Maryland Act, championed by Gov. Martin O'Malley. Under the program, both electric utilities and the state will have a role in reducing the overall need for electricity. The program aims to reduce per-capita electricity consumption by 15 percent below 2007 levels by 2015 using energy efficiency, and reduce per-capita peak demand by the same amount with efficiency and load management measures.

Maryland can achieve these important goals by looking to successful energy efficiency programs in other states—which have proven effective in saving substantial amounts of electricity and natural gas, saving consumers money, reducing energy prices, preventing the need to build expensive new power plants, creating jobs, and improving local economies.[47] For example, between 2001 and 2005, New Jersey's efficiency programs reduced electricity demand enough to replace a medium-sized power plant (450 megawatts).[48] In 2007 alone, Vermont reduced its electricity consumption by 1.8 percent below forecast levels, at a fifth of the cost of building new power plants and power lines.[49] And in Connecticut, every dollar spent on energy efficiency yields $4 in consumer savings.[50]

During the spring 2008 legislative session, lawmakers also expanded Maryland's renewable electricity standard. Under this policy, 20 percent of Maryland's electricity supply must come from renewable sources of energy—including wind, solar, biomass, geothermal, ocean, and low-impact hydroelectric power—by 2022.[51] The policy also requires that solar energy make up 2 percent of the state's power supply by 2022, which would be roughly equivalent to 1,500 MW of solar power.[52]

Additional Energy Efficiency, Demand Response, and Renewable Energy Potential

EmPOWER Maryland will capture only a fraction of the identified potential for energy efficiency and load shifting in the state. And beyond the state's renewable electricity standard, vast amounts of potential for generating electricity from wind, water and the sun is waiting to be harnessed.

Energy Efficiency and Demand Response

According to an analysis by the American Council for an Energy-Efficient Economy (ACEEE), Maryland has the potential to reduce annual electricity consumption nearly 30 percent by 2025.[53] This resource potential is more than sufficient to meet the goals of the EmPOWER Maryland program—and suggests that the state could cost-effectively reach more aggressive energy savings targets in the future.

Moreover, the ACEEE analysis considers only efficiency measures that are currently available and cost-effective. As future technologies emerge, and as future electricity price increases make a greater range of measures cost-effective, even greater energy savings will become possible.[54]

Maryland also has enormous potential to reduce peak power demands through energy efficiency measures and additional load management programs. According to ACEEE, a suite of efficiency policies plus an enhanced load management program could reduce peak demand in Maryland nearly 50 percent below forecast levels by 2025.[55] In addition to EmPOWER Maryland, the state could achieve these results with:

- Expanded appliance efficiency standards to require new appliances to use less energy,
- Building energy codes to ensure that new and renovated buildings include as many efficient features as possible,
- A state-funded research and development program to identify new opportunities for energy savings,
- Widespread deployment of combined heat and power technology, and
- An enhanced load management program—including "smart grid" technologies, such as load switches capable of remote control by the utility.[56]

Combined Heat and Power

Furthermore, the state could encourage additional distributed energy generation—such as combined heat and power facilities—which would enhance the reliability of the electricity grid by placing generation close to where the electricity will be used.

Combined heat and power (CHP) technology pairs the production of electricity with the production of heat, which can then be used to power industrial processes or to provide space heating or cooling for homes and businesses. CHP has value both as a source of distributed generation and as an energy efficiency improvement. Central station power plants waste vast amounts of energy by failing to capture the energy value of the steam leaving turbines. While the average American power plant operates at a thermal efficiency of about 35 percent, CHP plants can achieve efficiencies of 80 percent or greater, meaning that more of the energy that goes into the plant is available for useful work.[57]

Beyond commercial and industrial CHP applications, which are already common, new forms of distributed generation hold promise for reducing demand for power from large power plants in the future. Small-scale CHP and distributed generation technologies, such as would be suitable for residential or small commercial use, could play an important role in improving the energy efficiency of home and small business energy use in Maryland in the decades to come. Similarly, fuel cells, which use an electrochemical process to convert hydrogen fuel into electricity, could also provide efficiently produced local electricity to customers of all sizes.

Maryland currently has 18 CHP facilities, for a total of 829 MW of capacity.[58] According to the American Council for an Energy-Efficient Economy, Maryland has the technical potential to install as much as 3,200 MW of additional combined heat and power capacity.[59]

Given a series of policies and incentives, including a state CHP resource standard, ACEEE predicts that the state could increase its installed CHP capacity by 224 MW by 2020, out of an economic CHP potential of 780 MW.[60]

Additional Renewable Energy Resources

Maryland has a great deal of renewable energy resources that will not be tapped by the state's renewable electricity standard. For example:

- To install 3,000 MW of solar photovoltaic capacity, Maryland would need to cover just under 6,000 acres with solar panels—less than half of one percent of Maryland's developed land area.[61] This amount of solar capacity could easily fit on the rooftops of commercial buildings and parking lots in Maryland—close to where electricity is consumed.

- The Mid-Atlantic region could support up to 266 GW of offshore wind energy generation capacity.[62] At an average capacity factor of 33 percent, that many turbines could generate more than 750,000 GWh per year—more than 12 times Maryland's current annual electricity consumption. In June 2008, Delmarva Power signed a contract to purchase 200 MW of power from an offshore wind farm to be built off the coast of Delaware by Bluewater Wind Delaware, LLC.[63] The company expects this facility to begin operation around 2012, possibly becoming the first offshore wind farm built in the United States.[64]

- Maryland could potentially access energy resources from the ocean as well. Although ocean power technologies are not yet ready for commercial deployment, they could provide additional renewable energy in future years. Federal officials estimate that capturing power from ocean waves in the Mid-Atlantic could generate as much as 13,000 GWh per year (about 20 percent of Maryland's current annual electricity consumption).[65]

Delivering Reliable and Efficient Service

A reliable electric system includes enough generation resources to meet peak demand for power, plus a reserve to buffer the system against unanticipated failures. A reliable system is also resilient—with resources that help minimize the size of any power outages, and are capable of coming back online quickly after accidental shutdown.

Meeting Power Demand

The Nuclear Path: Long, Uncertain Construction Time

Building a nuclear reactor requires many years of planning and construction. If Constellation decides to build a new reactor, it could be up to a decade before the plant is available to contribute to Maryland's electricity system.

Constellation has said that it anticipates the reactor could be up and running by December 2015.[66] However, no nuclear reactors have been ordered in the United States since the 1970s, and U.S. infrastructure for reactor manufacturing and construction has withered—making the project vulnerable to delay.

In fact, the prototype for the new reactor at Calvert Cliffs—which is currently under construction in Finland—has fallen about two years behind schedule. Contractors have not been able to meet the specifications for reactor components, producing "flawed welds for the reactor's steel liner, unusable water-coolant pipes and suspect concrete in the foundation […]."[67]

Ray Ganther, a senior vice president at Areva (one of Constellation's partners in the proposed new reactor at Calvert Cliffs) said that "Local contractors did not have the breadth of operations expected or needed to carry out such a big project."[68]

Martin Landtman, project manager for TVO, another company involved in the plant, said: "It has taken a lot longer for industry to adapt to this business than we had anticipated."[69]

While Constellation's partners are gaining experience with the reactor in Finland, it is quite possible that delays could occur during the construction of a new reactor Calvert Cliffs, especially considering it would be the first of its kind built in the United States.

Moreover, nuclear plants undergo a lengthy licensing process to allow regulators time to review construction, operational and safety plans. Any delays in this process could push back the date when a new reactor would become available to contribute to Maryland's electricity supply.

In short, a third reactor at Calvert Cliffs will do nothing to address the state's short-term challenges in meeting demand for power. Any delays in the construction of the reactor, such as those that have been common at construction sites around the world, would further delay the plant's contribution to Maryland's peak electricity needs.

The Clean Energy Path: Rapid Impact and Dramatic Results

By contrast, clean energy investments can deliver results quickly and ultimately do a better job of addressing power demand than the new reactor at Calvert Cliffs. Maryland does not need to wait until the middle of the next decade to address its electricity woes. Indeed, Maryland's existing efforts—EmPOWER Maryland and the renewable electricity standard—have the potential to fully address peak demand through 2025.

These clean energy measures focus on reducing electricity demand in thousands of tiny increments, which add up to a big impact over time. Efficiency measures can make a difference in the time it takes to install a lightbulb, build a building, or re-design an industrial process. And load management efforts can help in the time it takes to program a thermostat or install a smart electricity meter.

Moreover, solar panels and wind farms can be manufactured and installed in a matter of months to a few years. (However, many of these technologies are just in their infancy in Maryland, and it may take a few years before the state's renewable electricity standard helps them become more commonplace in and around the state.)

Finally, these small units are much easier to match to individual pieces of electrical demand—making clean energy technologies much more flexible, nimble and scalable than expanding Calvert Cliffs.

Worldwide, energy efficiency and distributed energy sources account for more than half of all new electric service capacity added each year—because of reliability and cost advantages they hold over large central-station generators such as the new nuclear reactor proposed for Calvert Cliffs.[70]

Maryland's Existing Efforts: EmPOWER Maryland and the Renewable Electricity Standard

Clean energy can provide Maryland with enough energy savings and renewable energy to meet the state's peak demand challenges over time.

The EmPOWER Maryland initiative should reduce absolute peak demand by about 8 percent below 2007 levels by 2015—or about 2,700 MW. In other words, the program will provide 1.7 times the effective peak capacity of a new nuclear reactor at Calvert Cliffs, in the same time frame.

Assuming that the goals of EmPOWER Maryland program are not extended, and that per-capita electricity demand remains constant after 2015, peak demand will still be about 1 percent below 2007 levels by 2025. (See Figure 3.) In other words, EmPOWER Maryland will reduce peak demand by about 3,500 MW below levels forecast in the absence of the program.

The contribution of the renewable electricity standard toward addressing peak demand depends on the mix of resources used to achieve the standard. Solar and wind power are "intermittent" resources, meaning that these technologies generate power only when the sun is shining or the wind is blowing.

The good news for Maryland is that the availability of power generated by solar panels matches up very well with times of peak demand. For example, a study of solar power in northern New Jersey found that solar irradiance correlates well with peak electricity demand for utilities where air conditioning drives peak demand.[71] The study found that solar generally has an effective load carrying capacity—or peak capacity value—of 50 to 70 percent, assuming relatively low penetration of solar panels (less than 10 percent of utility peak electricity production).[72] Moreover, solar

Figure 3: Forecast Peak Demand Under the EmPOWER Maryland Energy Efficiency Program

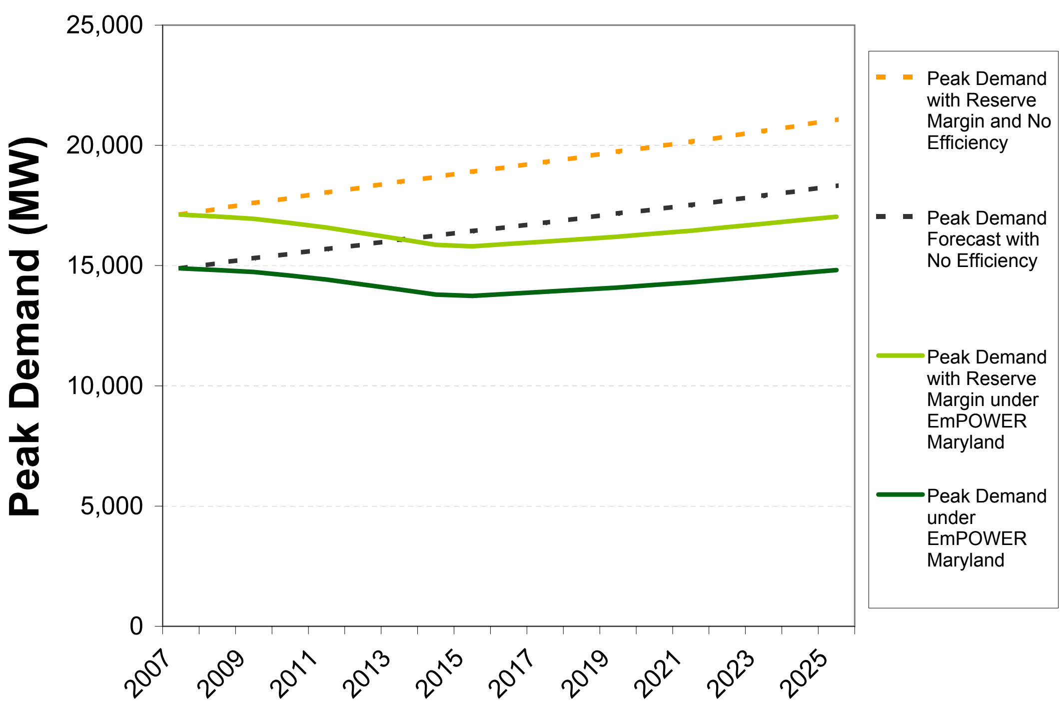
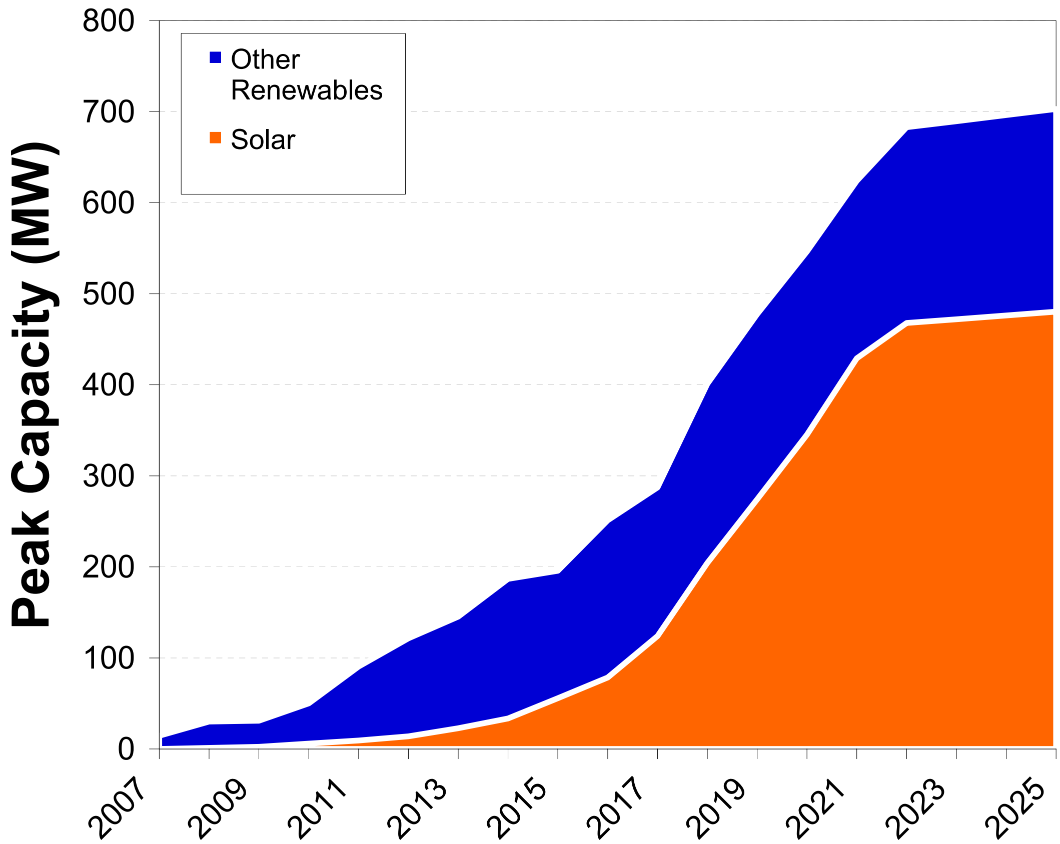


Figure 4: Forecast In-State Peak Capacity due to Maryland's Renewable Electricity Standard



panels are generally sited on rooftops or elsewhere in close proximity to where power is used, thus reducing demand for centrally generated power and transmission infrastructure.

Assuming that solar panels installed under Maryland's RES have a peak capacity value of 50 percent, the state could add about 500 MW of peak solar energy capacity in the state by 2025. (See Figure 4.)

Unlike solar power, which makes its greatest contribution to the grid on hot, sunny days, wind power generation is not well-correlated to periods of peak demand. However, properly sited wind power can make a contribution to meeting Maryland's peak capacity needs. PJM currently assigns new wind projects an initial "capacity credit" of 20 percent, meaning that 10 MW of wind power capacity offsets 2 MW of fossil fuel capacity.[73] For any wind project, detailed studies are needed to determine the effective contribution of the wind farm to the reliability of the grid.

Other renewable resources have capacity credits comparable to traditional power plants. For example, power plants fueled with biomass can operate at an average capacity of 80 percent.[74]

And with a diverse and geographically dispersed portfolio of resources, the need for backup sources of power to maintain reliability declines. According to a study by the Rocky Mountain

Institute, an optimized mix of wind and solar resources can reduce variability in the system by more than half.[75]

For this scenario, we assume that 25 percent of non-solar renewable energy facilities built because of the renewable electricity standard will be installed within Maryland or in offshore areas to the east of the state's transmission bottlenecks. We assume that out-of-state renewable energy facilities will be subject to the same transmission constraints elucidated earlier, and thus do not count them. We assume that a large portion of the renewable capacity built in Maryland will be onshore and offshore wind power, with some biomass capacity—which altogether will have an average capacity credit of 25 percent. Under these conditions, non-solar renewable energy will provide about 220 MW of peak capacity. (See Figure 4.)

Altogether, the clean energy programs created or expanded in spring 2008 will help ensure the reliability of Maryland's electricity system for the near future. Assuming that:

- No generators retire (as none are currently scheduled to retire),
- Maryland's major transmission infrastructure remains unchanged, and
- Maryland's capacity to import electricity declines by 1 percent per year, as other states in the region increase their demand for power and their electricity imports,[76]

These programs should maintain the reliability of the electricity system through 2025, providing resources to meet peak demand plus a 15 percent reserve margin. (See Figure 5.)

Figure 5: Forecast Peak Demand and Capacity Resources in Maryland, with the EmPOWER Maryland Energy Efficiency Program and the State's Renewable Electricity Standard

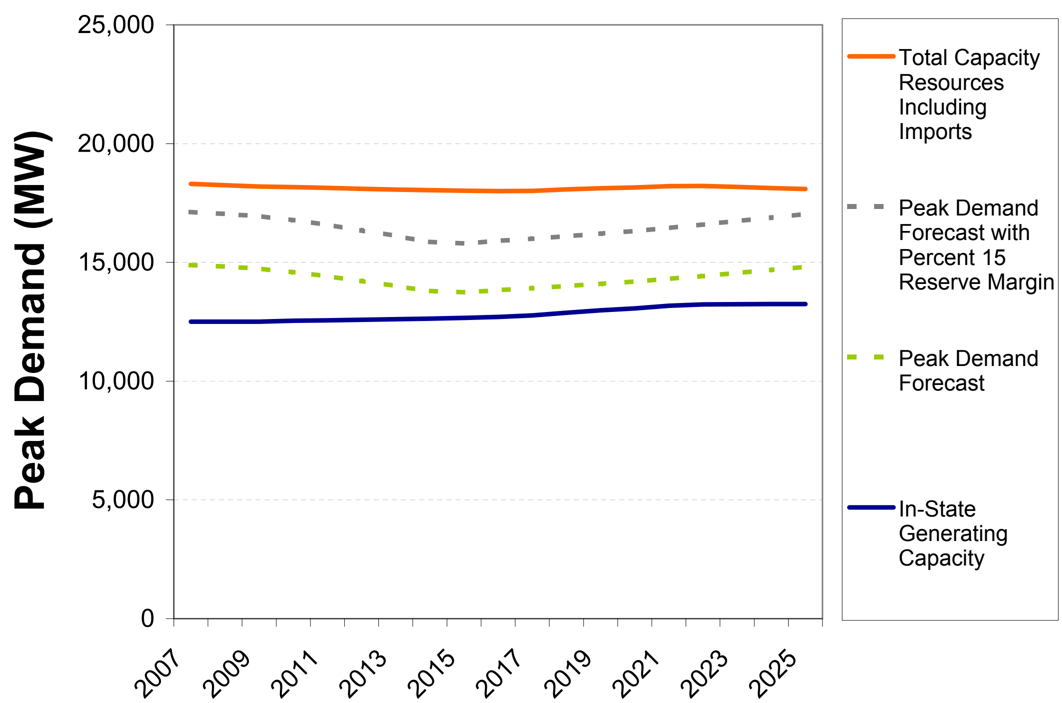
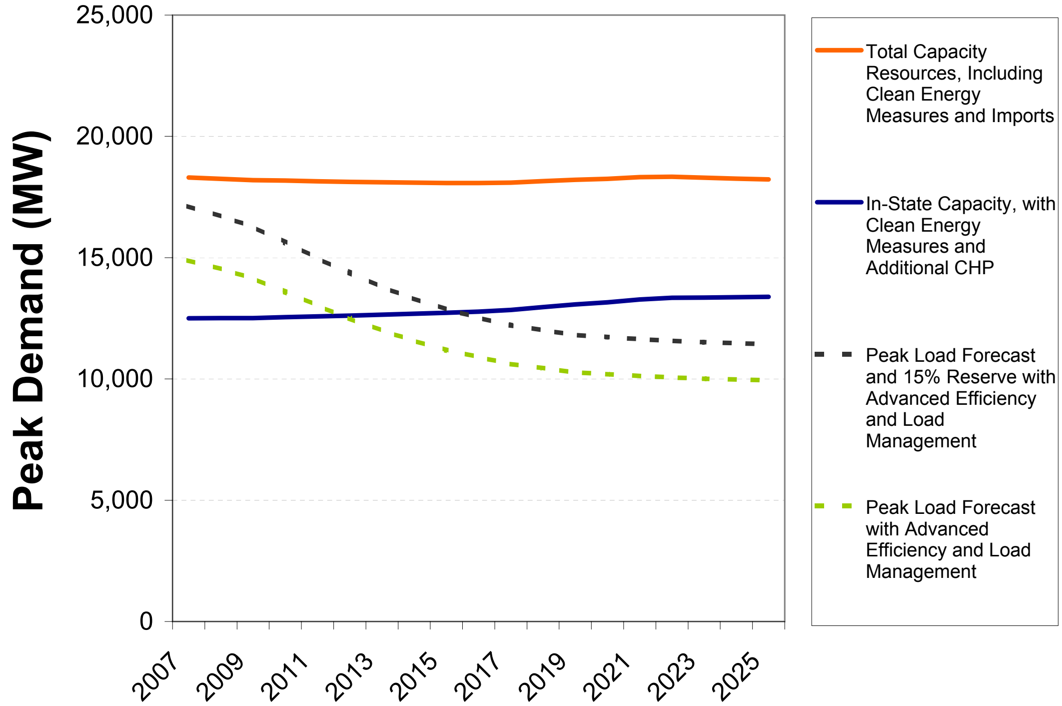


Figure 6: Potential Demand Reductions Possible with Maryland's Clean Energy Resources



Additional Clean Energy Resources

Maryland has a great deal of additional clean energy resources beyond those that will be tapped by EmPOWER Maryland and the state's renewable electricity standard.

For example, with energy efficiency and an aggressive load-shifting program, the state could reduce peak electricity demand by as much as 8,500 MW below business-as-usual levels by 2025.[77] (See Figure 6.) EmPOWER Maryland alone will capture about 40 percent of this available potential by 2025.

Developing these resources could ensure an adequate power supply for the foreseeable future. Indeed, when coupled with greater development of the state's potential for combined heat and power and renewable energy, the state could begin to retire aging power plants while maintaining an adequate reserve of power.

Avoiding Disruption

Electricity grids are complex systems in which the supply of power—and with it, the operation of hundreds of power plants—must be perfectly balanced with demand. Small disruptions—such as the loss of a transmission line or an unexpected mechanical problem at a generator—can have major impacts on the operation of the electricity grid.

Neither nuclear power plants nor clean energy technologies are perfect in terms of providing power when and where it is needed. A thoughtful clean energy strategy, however, has the potential to reduce disruption to the grid.

The Nuclear Path: Large Size Means Any Disruption Is Troublesome

Nuclear power plants are large producers of power. Constellation's proposed third reactor at Calvert Cliffs, for example,

Supplying Maryland's Annual Energy Needs

Power planners often refer to nuclear as a "baseload" resource. By this, they mean that nuclear reactors generate power at relatively consistent levels over long periods of time, supplying power both during peak and non-peak periods.

Constellation predicts that the new reactor at Calvert Cliffs could operate at full output 95.3 percent of the time.[78] Should this aggressive assumption prove correct, the Calvert Cliffs nuclear reactor would generate about 13,360 GWh of electricity per year.[79]

Clean energy resources would be equally effective in supplying this level of power.

Energy efficiency measures reduce demand for electricity both during peak and non-peak hours, and thus can effectively function as a "baseload" resource. The EmPOWER Maryland energy efficiency initiative alone will deliver about 10,000 GWh of electricity savings per year by 2015. And according to the American Council for an Energy Efficient Economy, extending the goals of this program out to 2025 and adding additional measures—including appliance efficiency standards, improved building energy codes, research and development support for efficiency technology, and slightly increased incentives for combined heat and power—could reduce annual electricity consumption by 22,160 GWh by 2025.

In other words, energy efficiency alone will deliver 80 percent of the power output of the new Calvert Cliffs reactor by the earliest date the new reactor could be online. Extending the state's energy efficiency targets to 2025 and adding additional policies would deliver the same energy resource as building nearly two new reactors at Calvert Cliffs.

In addition to energy efficiency, Maryland will also obtain electricity from renewable sources of electricity. Under the state's renewable electricity standard of 20 percent by 2022, renewable resources will yield about 7,600 GWh of renewable electricity in 2015 and more than 12,000 GWh of electricity per year by 2025.[80] Moreover, an optimized portfolio of wind and solar resources can provide significant energy supplies, making it possible to rely less on traditional "baseload" sources of power such as coal and nuclear.[81]

Altogether, energy efficiency and renewable energy resources—already part of Maryland state policy—can effectively meet the state's annual need for electricity.

would have a capacity of 1,600 MW, approximately 12 percent of the current capacity of all of Maryland's existing power plants.

Nuclear power plants, particularly in recent years, have had a decent record of reliability. But when a nuclear reactor does shut down—even if such an event happens relatively infrequently—it can wreak havoc on the electric grid. For example, when two reactors at Turkey Point in southern Florida shut down in February 2008 because of a power line failure, the resulting power outage cut off electricity to more than 3 million customers in the Miami area for up to 5 hours—causing traffic jams, stranding people in elevators, and widely disrupting business.[82]

Nuclear plants have a history of unanticipated failures, which sometimes lead to sustained outages. Of all 132 nuclear reactors ever built in the United States, 28 shut down prematurely because of cost or reliability problems, or in the case of Three Mile Island Unit 2, a near-meltdown.[83] Problems at another 35 reactors resulted in one or more outages of at least one year.[84]

Worldwide, a typical nuclear power plant is available to generate electricity about 83 percent of the time.[94] Constellation has claimed that its new reactor at Calvert Cliffs could be available as much as 95 percent of the time.[95] However, even nuclear plants that function well most of the time have reliability issues. For example:

The Existing Reactors at Calvert Cliffs Have a History of Reliability Problems

"Baltimore Gas & Electric Co.'s generating plant at Calvert Cliffs stands idle these days—mute but powerful testimony to just how costly and uncertain the operation of a nuclear power plant can be, even in the absence of a disaster."

— Rudolph A. Pryatt, Jr., financial reporter for the *Washington Post*, April 19, 1990[85]

Although the existing reactors at Calvert Cliffs have operated with relatively few problems in recent years, the facility has a history of unplanned shutdowns and unreliable operation.

The most serious of these incidents began in May 1989. Baltimore Gas & Electric Co. (then owners of the Calvert Cliffs facility) discovered leaks in the equipment that regulates water pressure, which forced the shutdown of Unit 2.[86] BGE shut down Unit 1 several days later. The reactors remained idle for nearly two years.[87] The company lost $458 million buying replacement power—passing $340 million of the extra costs onto Maryland ratepayers.[88]

The shutdown led to a regional summer power shortage, and utility officials warned of periodic "brownouts"—or voltage reductions—in the Baltimore-Washington area.[89] The shutdown also prompted Wall Street analysts to downgrade the utility's credit rating—an action that likely resulted in increased finance costs, also passed on to Maryland ratepayers.[90]

A legal battle raged at the Public Service Commission over who was responsible for covering BGE's losses. After more than six years and 1 million pages of paperwork, the two sides settled—agreeing to let stand the $340 million charge to ratepayers, but preventing BGE from passing on an additional $118 million, plus interest.[91]

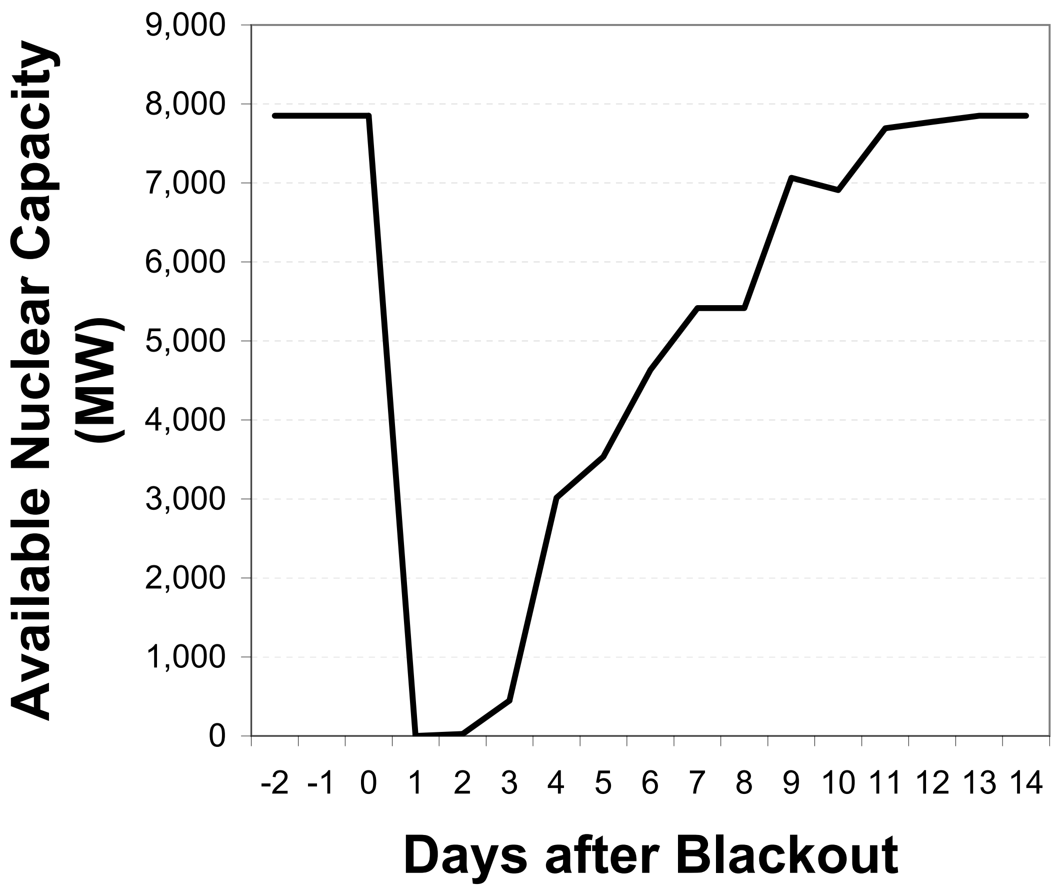
In addition to the prolonged outage that began in 1989, the Calvert Cliffs reactors have suffered a number of other unplanned shutdowns, caused by events as varied as a rag left behind in a cooling system, leaks in steam pipes, malfunctioning of emergency systems, and a lightning strike.[92] During one period when a reactor was shut down for repairs, a cold snap happened, forcing Baltimore Gas & Electric to impose rolling blackouts on its customers.[93]

- Even without a disaster, equipment or management failures can result in extended reactor outages. The existing reactors at Calvert Cliffs have a history of these types of reliability problems. (See Page 23.)

- It can take days or weeks for a nuclear reactor to return to full output after an emergency shutdown. For example, nine nuclear reactors shut down automatically during the wide-ranging Northeast electric blackout that occurred on August 14, 2003. Nearly two weeks elapsed before these reactors regained full generation capacity.[96] (See Figure 7.) Prolonged deactivation of nuclear reactors in Canada threatened to cause another blackout in the days after the event. Government officials asked Ontario citizens to cut their electricity consumption in half to keep the system online.[97] A large amount of backup generation capacity had to be mobilized at high prices to restore electric service in the absence of the nuclear reactors.

Finally, Constellation's proposed third reactor uses a very new design. If built, it will be only the second of its type in the world. New plant designs tend to experience greater problems as engineers work out the "bugs" of a design as they gain practical experience in operating the plant.

Figure 7: Available Capacity of Nine Affected Nuclear Power Plants after the Northeast Electric Blackout in August 2003[98]



The Clean Energy Path: Reliable Distributed Power

"There is no silver bullet that will solve all of Maryland's energy problems. However, this 'silver buckshot' of measures will lower household bills, address Maryland's looming electricity shortage, and promote a cleaner, more sustainable energy supply."

– Malcolm Woolf, Director of the Maryland Energy Administration, April 8, 2008[99]

By producing more power locally and reducing the strain on the centralized electricity grid, a clean energy strategy can help avoid the sort of catastrophic blackouts and supply disruptions that have sometimes accompanied grids that are too reliant on nuclear power. Instead of building one, extremely large power plant, a clean energy path for Maryland would involve thousands of demand and supply changes all across the state—or "silver buckshot"—which should add up to a more reliable grid.

In contrast to a single large power generating station, it is unlikely that all of the pieces of a diverse portfolio of clean energy resources will fail all at the same time. The transient failure of any single small, clean generation unit or even group of units has little to no effect on the overall system.

A properly diversified portfolio of renewable energy resources—across technologies and geography—can provide reliable electricity service. For example, nations such as Denmark have shown that it is possible to obtain as much as 20 percent of their electricity supplies from wind (and even more at certain times and places). And a recent study undertaken in Minnesota found that utilities can obtain up to one-quarter of their electricity from wind while maintaining grid reliability.[100]

Moreover, clean energy technologies—such as energy efficiency, rooftop solar panels and combined heat and power systems—are often located where the energy will be used, reducing the need for power to travel over transmission lines. These resources insulate individual customers from wider electricity disruptions. And since nearly all power failures originate in the transmission and distribution system, energy resources that bypass power lines can reduce the opportunity for grid failures in the first place.[101]

All of this is not to say that a clean energy path will not be without its share of challenges. Grid operators will need to account for the larger number of small generators that will be connected to the grid. And it will take accurate planning to ensure that a temporary reduction in production from any one resource does not disrupt the operation of the grid. Utilities are already employing weather forecasting tools that can make accurate planning possible by providing an accurate picture of demand levels and the availability of wind or hydropower (for example).

Providing Safe and Secure Electricity Service with Minimal Impacts

Marylanders value electricity supply choices with minimal impacts. In this regard, clean energy technologies offer a safer and more secure supply of electricity than expanding the nuclear facility at Calvert Cliffs.

While both clean energy and nuclear power can deliver results with little of the pollution that drives global warming, nuclear power comes with serious risks involving the use and storage of highly radioactive material.

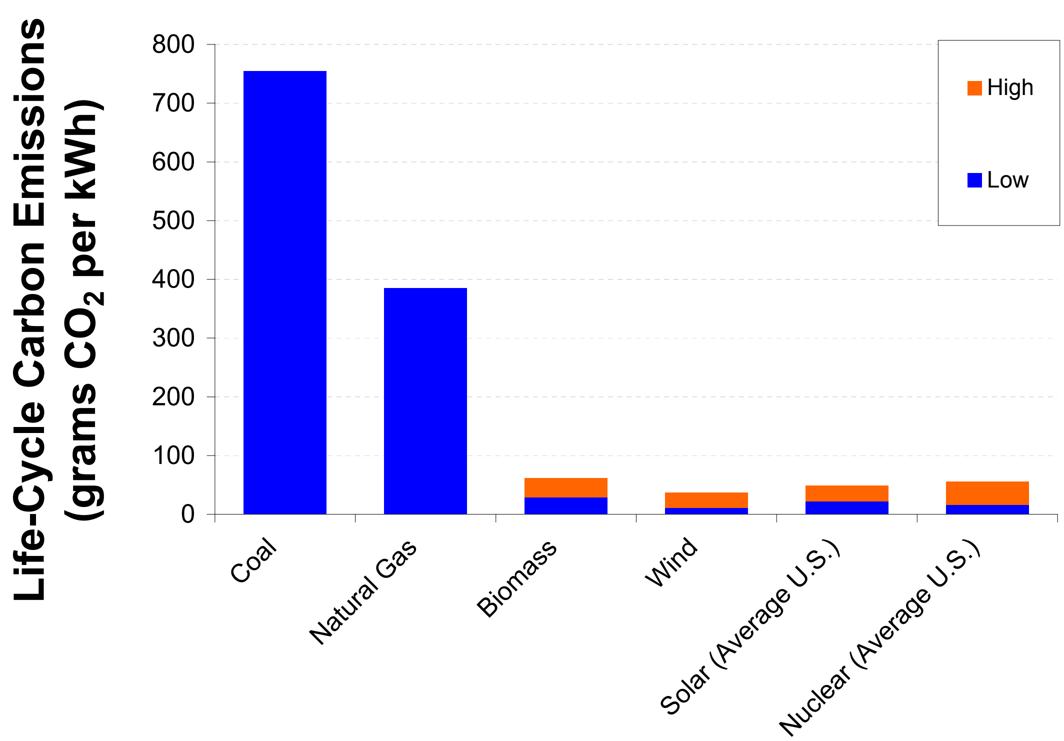
While an accident at a nuclear power plant could conceivably result in airborne radioactive material, an accident involving a solar panel or an efficient appliance could result in little worse than a few customers losing power. And while a terrorist might consider a nuclear power plant a good target—because of the potential to severely disrupt electricity supply or to drive an evacuation—a terrorist would likely find little value in attacking a smart thermostat, an efficient air conditioner, a solar panel or a windmill.

Reducing Maryland's Contribution to Global Warming

Compared to traditional coal-fired power plants and simple natural gas-fired turbines, both nuclear power and clean energy resources emit relatively little of the pollution that causes global warming.

On a life-cycle basis—taking into account the energy used to mine and enrich uranium, build and dismantle the nuclear plant and dispose of radioactive waste—a nuclear reactor in the U.S. emits about 16-55 grams of carbon dioxide per kWh.[102] In comparison, the life-cycle emissions of solar photovoltaic panels installed at an average location in the U.S. fall in the range of 27-49 grams of carbon dioxide per kWh.[103] For further comparison, wind energy emits 11-37 grams of carbon dioxide per kWh and biomass emits 29-62 grams of carbon dioxide per kWh.[104] (Energy efficiency likely approaches zero in its contribution to global warming—since there should be little to no excess energy expenditure in manufacturing an appliance or motor that uses electricity efficiently compared to inefficient models.)

Figure 8: Estimated Life-Cycle Carbon Intensity of Fossil, Renewable and Nuclear Electricity Generation[105]



Phasing Out Coal-Fired Generation

Nuclear power is sometimes viewed as a means of enabling the phase-out of old, coal-fired power plants—the largest source of global warming pollution from electricity generation in Maryland. However, nuclear reactors are not sufficient or required for a transition away from carbon-intensive electricity generation.

Coal-fired power plants will only be shut down as a result of new policy regulating or taxing emissions of carbon dioxide—not through the addition of new generating capacity of any kind.

Moreover, a clean energy strategy coupled with limits on global warming pollution can serve as a more effective strategy to displace old coal-fired power plants. As described in this report, Maryland's energy efficiency and renewable energy resources can produce plentiful energy faster and more nimbly than a nuclear reactor. In addition, a clean energy strategy could displace far more carbon dioxide pollution per dollar of investment than building new nuclear reactors. (See page 36.)

According to this simple comparison, all of these technologies would be relatively effective in preventing global warming emissions if they were used in place of a traditional fossil-fired plant. (See Figure 8.)

However, there are a few caveats to this analysis. Wind and solar energy technologies are becoming more effective and efficient at generating electricity, reducing their potential global warming emissions.

In contrast, the global warming potential of nuclear power depends in part on the quality of uranium fuel used to power the reactor. According to the Oxford Research Group in the United Kingdom, supplies of high-quality uranium ore are limited, and future uranium supplies will have to come from lower-quality ores that require more processing—and thus produce more global warming pollution. If worldwide nuclear generating capacity remained constant, a nuclear plant could have the same lifetime carbon dioxide emissions as a natural gas-fired power plant by 2070.[106]

Minimizing the Risk of Accidents, Terrorism and Weapons Proliferation

While nuclear power and clean energy technologies are similar in their raw performance in terms of emissions of global warming and health-threatening air pollution, clean energy is safer than nuclear power when it comes to the production of nuclear waste; risks associated with accidents, natural disasters or terrorism; and the proliferation of nuclear weapons.

Energy efficiency, renewable energy and combined heat and power facilities do not produce any radioactive waste and have no associated problems with radioactive waste storage or transport. Clean energy technologies are much smaller and more widely distributed, making them far less vulnerable and attractive to terrorist attack. Moreover, clean energy technologies do not facilitate the proliferation of nuclear weapons.

Nuclear Waste

Nuclear reactors produce dangerous high-level radioactive waste. Nuclear waste is one of the most dangerous substances ever created by humans, remaining hazardous for at least a quarter of a million years.[107] No country in the world has developed an effective, safe and permanent way to dispose of this waste.

A new nuclear reactor at Calvert Cliffs would produce about 1,380 tons of high-level radioactive waste during its operational lifetime.[108]

The government has proposed storing nuclear waste for the long term at Yucca Mountain, Nevada, despite the fact that analyses showed it would not be able to meet standards for waste containment. Today, the prospects for the opening of this facility appear dim.

In the absence of a safe, long-term storage solution for nuclear waste, spent fuel is stored on-site at Calvert Cliffs, which is located on the shore of Chesapeake Bay. High-level radioactive spent fuel rods are placed in reactor cooling ponds that were never designed for the long-term storage of nuclear waste.[109] After 10 years or so, the fuel is removed and placed in dry storage casks, also stored on site.

This dry storage approach was initiated in 1992, when the cooling pond reached capacity.[110] Calvert County and plant officials have always considered this a temporary solution, but it has taken on an air of permanence. As of 2004, 1,015 tons of waste was stored at Calvert Cliffs. The two reactors currently operating will produce another 690 tons of highly radioactive waste by the mid 2030s.[111]

However, should a national repository for nuclear waste ever open, more than 118,000 tons of spent nuclear fuel and high-level radioactive waste could be shipped to the site from across the country.[112] The waste would be shipped in casks that would each contain as much as 240 times the amount of radioactive material released by the Hiroshima bomb.[113]

Maryland residents would face risks associated with transport of nuclear waste from Calvert Cliffs. Radioactive material could be shipped by barge across the Chesapeake Bay, or by truck or rail through densely populated areas. If the waste is shipped by truck, the Department of Energy proposes that waste be moved along Route 2, along I-495 around Washington, D.C. and then on I-70 toward Frederick.[114] If waste were shipped by rail, it would travel through Washington, D.C.[115]

A mapping project by the Environmental Working Group found that more than 900,000 Marylanders live within one mile of a proposed nuclear transportation route and 3.1 million live within five miles. The project also found that 163 schools and five hospitals are located within one mile of the routes.[116]

Even if Yucca Mountain ever opens, the problem of nuclear waste will not be solved. The site will not be able to hold all of the waste from existing reactors, much less new waste from an expanded operation at Calvert Cliffs.[117]

Accidents, Natural Disasters and Terrorism

While an accident, natural disaster or terrorist attack at Calvert Cliffs is unlikely to occur, such an event could have severe consequences, and thus must be taken seriously.

Because nuclear plants are critical to the regional electricity supply and the economy—and because a successful attack holds the potential to cause widespread fear—nuclear power plants make attractive potential targets for terrorists. The general security record of nuclear power plants is far from reassuring. In March 2006, for example, the GAO was unable to conclude that all nuclear power plants were capable of defending themselves against a plausible terrorist attack, since only about one-third of the plants had conducted the necessary inspections through simulated attacks.[118]

Should the unthinkable occur—an incident causing a core meltdown at the existing Calvert Cliffs reactors—it could cause 5,600 immediate deaths, 15,000 injuries and 23,000 deaths from cancer.[119] These statistics assume 1970 population levels near the reactors. The impacts would be magnified today, given the wide expansion of residential development across southern Marlyand over the last 40 years.[120]

The cooling pond at Calvert Cliffs poses another hazard. If an accident, disaster or attack ever resulted in water draining from the pool, it could catch fire and release radioactive material.[121]

Were an incident requiring an evacuation to occur at Calvert Cliffs, area residents could find available roads insufficient to remove everyone from harm's way in a timely fashion. The Calvert Cliffs reactors are in the far southern tip of Calvert County where the county tapers to a point between the Chesapeake Bay and the Patuxent River. The only major road serving the area is Route 2, which runs north/south. In case of an evacuation order, people living south of Calvert Cliffs in Calvert County would need to drive south on Route 2 to the Governor Thomas Johnson Bridge over the Patuxent River to St. Mary's County.

In normal traffic conditions, roads leading to the bridge are frequently congested, especially given the rapid population growth of southern Maryland.[122] 40,000 to 55,000 vehicles per day travel the south side of the bridge. The traffic signal there "operates at failing levels in the morning and evening rush hours."[123] During an evacuation, the road could become a bottleneck, preventing residents from escaping radiation released from the plant.

Local officials are investigating the possibility of expanding the bridge, or building a new span over the river. However, such a project is not likely to be completed until 2020 at the earliest.[124]

Nuclear Proliferation

"There are serious problems that have to be solved, and they are not limited to the long-term waste-storage issue and the vulnerability-to-terrorist-attack issue. Let's assume for the sake of argument that both of those problems can be solved.

We still have other issues. For eight years in the White House, every weapons-proliferation problem we dealt with was connected to a civilian reactor program. And if we ever got to the point where we wanted to use nuclear reactors to back out a lot of coal—which is the real issue: coal—then we'd have to put them in so many places we'd run that proliferation risk right off the reasonability scale. And we'd run short of uranium, unless they went to a breeder cycle or something like it, which would increase the risk of weapons-grade material being available."

– Al Gore, 2006[125]

Turning to nuclear power as a solution for the world's power needs in the 21st century would increase the risk of nuclear weapons proliferation. There is not enough sufficiently high-grade uranium available to fuel nuclear power plants beyond the next 40 to 60 years.[126] In order to fuel a new generation of nuclear reactors, the nuclear industry would likely have to begin reprocessing spent reactor fuel, which produces plutonium.

Plutonium is the material of choice for nuclear weapons. All reactors produce it, but it must be separated from highly radioactive irradiated fuel before it can be used in weapons. This separation process is known as "reprocessing." For more than two decades, the United States has had a policy against reprocessing waste from commercial nuclear reactors and not allowing plutonium to be used as fuel in nuclear reactors to prevent the proliferation of weapons-usable material.

Currently, reprocessing only happens in three countries: England, France and Japan.[127] Were the technology to spread in order to provide fuel to civilian reactors, it would increase the availability of plutonium, which is ideal for nuclear weapons construction.

Accounting for all of the plutonium produced by a reprocessing plant would be extremely difficult for plant managers or weapons inspectors. For example, at a reprocessing plant in England, a leak that diverted 160 kg of plutonium into a cement chamber went undetected for eight months.[128] Expanding reprocessing capability would increase the opportunities for states or terrorist organizations to acquire weapons-grade nuclear material undetected.

In short, both a clean energy strategy and nuclear power plants can reduce emissions of global warming pollution. But clean energy technologies create virtually no other risks to the environment or public safety, while the risks created by nuclear power plants are significant and potentially devastating.

Containing the Rising Cost of Electricity

Clean energy can provide electricity for Marlyand consumers at a more reasonable cost than a new nuclear reactor at Calvert Cliffs.

The addition of a third reactor to Calvert Cliffs, on the other hand, does not make economic sense without massive public subsidies—subsidies that far exceed those enjoyed by clean energy alternatives such as renewable energy and energy efficiency.

Nuclear power is far more expensive than many alternative power options. Even the most optimistic estimates for the cost of power from a new nuclear reactor are 300 percent higher than energy efficiency. Nuclear power is more than 200 percent costlier than combined heat and power technologies. And nuclear power is more than 50 percent more expensive than new onshore wind power, and—at best—comparable to new offshore wind power.

Nuclear subsidies could be more profitably directed into more cost-effective energy efficiency and renewable energy programs.

The Nuclear Path: High and Rising Costs

In Maryland's deregulated electricity market, the power plants with the highest operating costs running at a given time set the price for power. In terms of operating costs, nuclear power tends to be one of the cheapest resources available on the market.[129]

However, focusing too closely on operating costs can be misleading. A full evaluation of the price of power from any given technology should account for all costs incurred during the lifetime of the facility. That includes up-front capital costs incurred during planning and construction of a facility, finance costs, plus decommissioning costs—in addition to ongoing operation and maintenance.

Taking into account the full range of expenses, new nuclear reactors look to be the most expensive kind of power plant being built today. And costs estimates have only been rising.

Capital Costs for Nuclear Reactors are Rising Rapidly

Constellation estimated in mid-2005 that designing and building a new nuclear reactor at Calvert Cliffs would cost $2.5 to $3.0 billion (equivalent to $1,660 to $1,990 per kW in 2007 dollars).[130] Due to a variety of factors, however, the plant will likely cost several times that amount.

From 2000 to October 2007, the anticipated cost of building a nuclear power plant nearly tripled, rising by 185 percent.[131] The cost of building a nuclear reactor has risen much more quickly than the cost of building coal, gas or wind generators, which have become 79 percent more costly since 2000.[132] According to Cambridge Energy Research Associates, nuclear costs began to surge at a faster rate than other generation technologies in 2005.[133]Analysts see little chance that costs will ease in 2008, given trends toward rising demand, limited supply, rising fuel prices and the lower value of the dollar.[134]

Nuclear power costs are likely increasing so dramatically because of increased worldwide demand for nuclear reactors, coupled with limited capacity to manufacture reactor parts—in addition to the likelihood that early guesses for the cost of a new nuclear plant were underestimates from the start.[135] No nuclear plants have been built in the United States in 30 years. National capacity to manufacture components has withered, and trained personnel are scarce.[136] For example, only two companies in the world—one in Japan, one in France—are capable of forging some heavy reactor parts.[137]

The costs of concrete, steel, copper, labor, and turbine technology have dramatically increased, driving up the cost of building all power plants—but no other technology has the same component supply bottleneck as nuclear power.[138]

"These costs are beginning to act as a drag on the power industry's ability to expand to meet growing North American demand, and leading to delays and postponements in the building of new power plants."

– Candida Scott, Cambridge Energy Research Associates[139]

Industry Cost Estimates Have Tripled

In June 2007, 11 organizations (nine of which are players in the nuclear industry) brought together a group of experts at the Keystone Center in Colorado to reevaluate the cost of building a new nuclear reactor over the next 10 years.[143] The study group pegged the cost of power from a

Delays and Cost Overruns

Areva, a French government-owned company and Constellation's partner in the proposed third reactor, has fallen about two years behind on the construction of the prototype for the new Calvert Cliffs reactor, located in Finland. Delays have mounted due to "flawed welds for the reactor's steel liner, unusable water-coolant pipes and suspect concrete in the foundation […]."[140] Analysts estimated in September 2007 that the delays added $2.2 billion to the cost of the plant (or 1.5 million Euros)—which is 50 percent above original estimates.[141] The total cost of the reactor could now exceed $6 billion.[142]

It is unlikely that Constellation could avoid these types of problems while building a nuclear reactor in Maryland. Nuclear reactors are extremely complex and have exacting construction specifications. These factors, plus the lack of experienced engineers and contractors, make similar mistakes likely.

nuclear reactor at 8.3 to 11.1 cents per kWh (in 2007 terms, excluding transmission and distribution costs). The group found that capital costs had risen to more than double Constellation's 2005 estimate—reaching $3,600 to $4,000 per kW (2007 dollars).[144] The study group also projected 200 to 300 percent higher costs for uranium fuel.[145]

A mid-2007 estimate for expanding Calvert Cliffs from Constellation itself exceeded the high end of the Keystone figure. In a report to the Nuclear Regulatory Commission filed in July 2007, Constellation suggested that expanding Calvert Cliffs would have a capital cost of about $6.9 billion—equivalent to about $4,300 per kW.[146] (However Constellation redacted the filing, making this figure no longer publicly available).

As 2007 continued, cost estimates increased further. For example, Moody's Investor Service estimated in October that reactors could cost as much as $6,000 per kW of capacity to build; at this price, Constellation's reactor would cost $9.6 billion.[147] Moody's called this estimate "only marginally better than a guess," and an attempt to provide a more conservative perspective to the market. Moody's noted that any company choosing to take on the construction of a new power plant would face the risk of lower credit ratings, given the huge size, complexity, extended construction time, and uncertainties around final cost and ability to recover the investment. Nuclear Engineering International notes that "faced with a lower credit rating, there aren't many company boards that would give the go-ahead to a new nuclear plant."[148]

Cost estimates have continued to climb since then. In early 2008, Moody's high figures began to look like underestimates. In February 2008, FPL Group submitted cost estimates for an expanded reactor system at Turkey Point in Florida, projecting that the effort could cost up to $24 billion.[149] This translates to about $4,200 to $6,100 per kW (in 2007 dollars).[150]

In March 2008, Progress Energy Florida applied to the Florida Public Service commission for a certificate of need for two nuclear reactors in Levy County. The company estimated the project would cost $14 billion—roughly equivalent to $6,300 per kW—plus $3 billion for upgraded transmission lines.[151]

Florida regulators are allowing Progress Energy to start billing customers for construction and development costs

Rising Costs Are Leading to Reactor Cancellations

High costs are driving power companies to cancel plans to build nuclear reactors. For example:

- In January 2008, Mid-American Nuclear Energy Co. dropped plans to build a nuclear reactor in Idaho. Bill Ferhman, president of the company, wrote in a letter: "Consumers expect reasonably priced energy, and … it does not make economic sense to pursue the project at this time. [163]

- In February 2008, the City of Austin withdrew from participation in a planned NRG Energy project to build nuclear reactors in Texas, citing "too much financial risk."[164]

The Cost of Indefinite Storage of High-Level Nuclear Waste

New nuclear plants have an additional, often unacknowledged, cost. The first generation of nuclear operators crafted an agreement with the Department of Energy placing responsibility for long-term disposal of nuclear waste with the federal government. However, new nuclear reactors have no such agreement.[165]

As a result, any waste generated by a new nuclear reactor will be the responsibility of Constellation and its partners. The company will have to ensure the safe storage and isolation of this waste for thousands of years. Such a situation is unprecedented in the history of human civilization, and the cost of indefinite storage of high-level nuclear waste is difficult to predict.

up-front—while in the past, companies typically had to bear the costs themselves until the plant was finished. As a result, Florida customers could begin paying more than $100 per year in higher electricity bills starting in 2009, even though the plant will not begin delivering electricity until 2016 at the earliest. Progress Energy CEO Jeff Lyash estimated that customers' monthly bills could increase 3 to 4 percent a year beyond that, with a potential spike as plant construction intensifies.[152] Residential customers could end up paying as much as $25 more a month to finance the nuclear reactors—equivalent to $300 a year.[153]

In April 2008, Duke Energy in North and South Carolina began to withhold cost estimates for its new nuclear projects, claiming that they were proprietary.[154] News reports suggest that the escalating price figures were becoming a liability for companies with an interest in building new nuclear reactors.[155]

As of May 2008, costs show no sign of declining. The *Wall Street Journal* reports:

> **Estimates released in recent weeks by experienced nuclear operators—NRG Energy Inc., Progress Energy Inc., Exelon Corp., Southern Co. and FPL Group Inc.—"have blown by our highest estimate" of costs computed just eight months ago, said Jim Hempstead, a senior credit officer at Moody's Investors Service credit-rating agency in New York. Moody's worries that continued cost increases, even if partially offset by billions of dollars worth of federal subsidies, could weaken companies and expose consumers to high energy costs.[156]**

Estimates of plant cost have climbed to as high as $12 billon per reactor, well above Moody's pessimistic estimates made in October 2007.[157]

In May 2008, Moody's issued another estimate, placing the capital cost of a new reactor at $7,500 per kW.[158] Analysts calculated that at this price, the reactor would have to sell power into the market at 15 cents per kWh (without transmission and distribution costs) in order to achieve a 10 percent return on its investment.[159]

One estimate, from Puget Sound Energy in Washington, even pegs the cost of a new nuclear reactor at $10,000 per kW. This would translate to a levelized cost of electricity on the order of 22.8 cents per kWh.[160]

The recent underestimates of plant costs are something of a tradition for the nuclear industry, with roots going back to the first round of nuclear power plant construction. Of 75 nuclear power plants operating in the United States in 1986, the U.S. Energy Information Administration found that actual costs exceeded budgets by 209 to 381 percent.[161] Forbes called the nuclear era "the largest managerial disaster in U.S. business history … exceeded in magnitude only by the Vietnam War and the Savings and Loan Crisis."[162]

Constellation Can Expand Calvert Cliffs Only with Massive Federal Subsidies

"We aren't going to build a nuclear plant anytime soon. Standard & Poor's and Moody's would have a heart attack. And my chief financial officer would, too."

– Thomas E. Capps, chairman and chief executive of Dominion, in May 2005, before the passage of the 2005 Energy Policy Act.[166]

"Electricity customers 'spent tens of billions of dollars saving nuclear power plant owners from large losses, even bankruptcy' during the 1990s. 'The loan guarantees arrange the next multibillion-dollar rescue before the fact and charge it to taxpayers instead of customers.'"

– Peter Bradford, former Nuclear Regulatory Commissioner, quoted in the *Washington Post*, 18 December 2007.[167]

Constellation can only expand Calvert Cliffs by shifting risks onto taxpayers and customers through massive government subsidies and possibly long-term power purchase agreements.

Nuclear power has historically received large amounts of financial support from the federal government. From 1950 to 1999, the federal government subsidized nuclear power to the tune of $145 billion. In contrast, solar energy received $4.4 billion, and wind energy received $1.3 billion.[168] And from 1950 to 1993, federal research and development spending for nuclear exceeded that for efficiency by 10 times.[213]

Some types of financial support are difficult to place a value on. For example, taxpayers assume the risk of a major nuclear accident. The Price-Anderson Act limits the liability of the nuclear industry to $10 billion in the event of a catastrophe.[169] By one estimate, power plant operators would be responsible for only 2 percent of the cost of a worst-case accident.[170] With this hugely valuable contribution from taxpayers, nuclear operators do not have to carry the full cost of insurance.

However, even with such generous subsidies, a new generation of nuclear reactors will not be possible without historic levels of additional federal support, including recent multi-billion dollar federal subsidies offered to nuclear power.

These subsidies do not eliminate the high costs and risks of nuclear power. They merely hide those costs and shift risks that private investors are unwilling to shoulder onto customers or taxpayers.

Recent Nuclear Subsidies

"Without loan guarantees, we will not build nuclear plants."

– Michael J. Wallace, Executive Vice President of Constellation Energy, quoted in the *New York Times* on July 31, 2007.[171]

In 2005, Congress passed an energy bill containing numerous additional subsidies for a new generation of nuclear reactors. Some of the largest subsidies are:[172]

- $2 billion to pay companies for any costs incurred in the licensing for six new reactors. Covered delays include those that result from action by the Nuclear

Loan Guarantees Pass Risk onto Taxpayers

A loan guarantee would both allow Constellation to obtain cheaper financing for a new reactor at Calvert Cliffs, and pass costs onto federal taxpayers in the event of a default. And the risk is substantial. For example, when evaluating the Energy Policy Act of 2003, which proposed guaranteeing half the financing for new nuclear reactors, the Congressional Budget Office (CBO) wrote: "CBO considers the risk of default on such a loan guarantee to be very high—well above 50 percent. The key factor accounting for this risk is that we expect that the plant would be uneconomic to operate because of its high construction costs, relative to other electricity generation sources."

Regulatory Commission or litigation, even if the delay helps protect public safety.

- Loan guarantees for up to 80 percent of the cost of a nuclear plant. If loans were extended for six plants and half of the plants defaulted on their loans, as projected by the Congressional Budget Office, the cost would be $6 billion.

- $5.7 billion in operating subsidies, such as liability insurance in case of an accident and a 1.8 cent tax credit for each kilowatt-hour of electricity produced from a new reactor during its first eight years of operation.

- $1.3 billion for decommissioning old plants.

- $2.9 billion for research and development.

Altogether, federal subsidies for nuclear power after passage of the 2005 Energy Policy Act are valued at 60 to 90 percent of the levelized cost of power from a new nuclear reactor—or 4.6 to 8.9 cents per kWh.[173] Applied to a third reactor at Calvert Cliffs, the value of the subsidies could total as much as $13 billion.[174]

Other Subsidies

However, even with a substantial fraction of the risk shifted onto taxpayers, many investors are still hesitant to take on the risk of financing such a massive project.[177] Constellation is seeking other means to reduce risk, including local government assistance, and could seek long-term power contracts with utilities and large electricity customers.

At the local level, Calvert County has already promised $300 million in tax breaks to Constellation if the company builds a new reactor at Calvert Cliffs. This is equal to $4,500 per taxpayer in Calvert County. The new plant will add 450 full-time jobs in the county, but at a cost to taxpayers of approximately $750,000 per job.[178]

And at the state and regional level, Constellation could seek long-term contracts—perhaps as long as the 60-year life of the plant—to deliver electricity at a fixed price, calculated to ensure a return on investment. For example, Constellation's partner Areva secured 60-year electricity supply contracts from a series of local utilities and forestry product companies near its prototype reactor in Finland, who agreed to take on some of the investment and operation risks in exchange for a guaranteed price of power.[179]

The need for such contracts is apparent

Clean Energy Technologies are Still Receiving Less Federal Support

While renewable energy and energy efficiency have received greater levels of attention in recent years—benefiting from a variety of federal tax credits—nuclear power is still taking a large portion of federal energy subsidy dollars. For example, in fiscal year 2007, the federal government subsidized renewable energy technologies to the tune of about $1 billion, primarily through the production tax credit.[175] Nuclear power received $1.3 billion, including nearly nine times as much research and development support as renewable energies—and not including any of the nuclear support measures included in the 2005 Energy Policy Act.[176]

in a November 2007 report prepared by energy consultants for the Maryland Public Service Commission, entitled *Analysis of Options for Maryland's Energy Future*. The authors note, "There is little evidence in PJM or elsewhere in the U.S. that baseload or high intermediate resources will attract commercial investment based on merchant cash flows."[180] They note that, even with the subsidies offered in the 2005 Energy Policy Act, "some form of cost recovery guarantee may be needed as well to attract capital at reasonable rates for future nuclear generation investment."[181] In their cost analysis, the consultants assume that Maryland's utilities will sign contracts to purchase all of the power generated by a new nuclear unit.

Long-term contracts can shift market risks away from Constellation and onto its customers, reducing the cost of capital, but locking customers into what could turn out to be a bad deal. Moreover, credit agencies treat such contracts effectively as debt. Large contracts can lead to a credit rating penalty if it leaves a utility overexposed.[182]

Maryland's regulated utilities would need approval from the Public Service Commission to sign a long-term contract to purchase power from a new nuclear reactor. Before allowing such a deal to occur, the Commission should consider that clean energy technologies cost less than nuclear power and can deliver better returns on the investment, with less risk.

"No nation has chosen a new nuclear plant through an open and transparent competitive procurement process."

– Peter Bradford, former Nuclear Regulatory Commissioner, April 2006[183]

The Clean Energy Path: Low-Cost Solutions

Energy efficiency, load management and combined heat and power technology can provide power at far lower costs than any other resource in Maryland. In addition, these technologies avoid the need to invest in expensive electricity transmission and distribution infrastructure, because they reduce energy demand (and/or generate energy) on-site. Energy from a new nuclear reactor would be—at best—two to five times more expensive. And, according to Moody's Investor Service, "…nuclear generation has a fixed design where construction costs are rising rapidly, while other renewable technologies are still experiencing significant advancements in terms of energy conversion efficiency and cost reductions."[184]

Efficiency measures are much cheaper than generating and delivering electricity. In leading states, energy efficiency supplies most new electricity needs—cutting projected consumption by 1 to 2 percent each year at a cost of less than 3 cents per kWh.[185] In comparison, a typical Baltimore resident pays more than 12 cents per kWh.[186]

In its analysis of Maryland's energy efficiency potential, the American Council for an Energy-Efficient Economy found that the state could economically reduce its electricity consumption by nearly 30 percent by 2025 at average levelized costs of 3.9 cents per kWh for residential measures and 2 cents per kWh for commercial measures.[187] Moreover, the state could economically increase its combined heat and power capacity by nearly 300 MW, with a levelized electricity cost around 4.5 cents per kWh.[188]

Research done for the California Public Utilities Commission (CPUC) at the end of 2007 provides a relatively recent, apples-to-apples comparison of different generation costs. The estimates are specific to western states, but give a useful idea of how nuclear energy stacks up against other generation technologies.

The research for the CPUC puts the levelized cost of new nuclear power at 12.1 to 15.4 cents per kWh in the western United States (2008 dollars, including interconnection and firming costs, but not distribution costs).[189] These values are based on the U.S. Department of Energy's Annual Energy Outlook 2007, with upward adjustments for the declining value of the dollar and for recent commodity price increases. They are still more optimistic than many of the estimates discussed earlier in this report. Nuclear power, because it is generated centrally, would then need to be distributed to customers. In Maryland, residential customers pay about 2.4 cents per kWh for distribution.[190]

Power from a new nuclear reactor would be three to five times more expensive than energy savings from a typical energy efficiency measure in a Maryland home or business. Power from a new reactor would be more than twice as expensive as combined heat and power, and 50 to 80 percent more expensive than the best biogas and small hydropower resources. (See Figure 9.)

Wind energy from recent contracts signed by Delmarva Power also compares favorably against nuclear power. The utility signed purchase agreements with a company building two wind farms in Maryland to purchase wind power at 8.1 cents per kWh, indexed to 50 percent of inflation.[191] In addition, the utility reached an agreement with a company building a wind farm in Pennsylvania to purchase power at 6.8 cents per kWh, plus a 2.5 cent surcharge for Renewable Energy Credits.[192] CPUC's nuclear power estimates are at least 50 percent more costly than these signed contracts. Even if the wind power required 4-5 cents per kWh additional to cover transmission and distribution expenses, it would still come out ahead of nuclear.

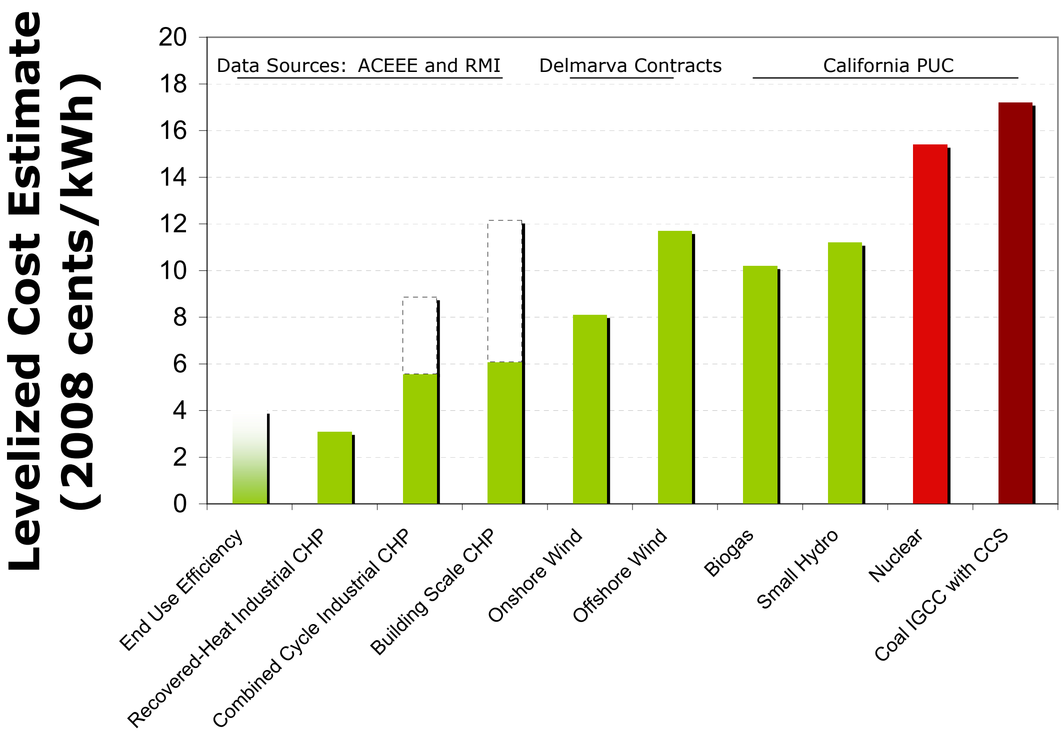
Finally, nuclear—at best—would be comparable in price to power from an offshore wind farm. Delmarva Power signed a contract in June 2008 with a developer planning a wind farm off the coast of Delaware. Under this contract, Delmarva agreed to pay 11.7 cents per kWh for 200 MW worth of power from this facility.[193] However, this is a signed contract—with more cost certainty than a new reactor at Calvert Cliffs.

While solar photovoltaic power can currently only compete with simple-cycle natural gas—a resource normally only used during periods of very high demand—the technology is rapidly advancing, and cost decreases are likely in the future. For example, Nanosolar, a firm backed by Google, has built two manufacturing facilities capable of producing 430 MW of solar capacity per year, using a process analogous to printing newspapers. Nanosolar panels cost under $1,000 per kW to manufacture.[194] At that price, solar photovoltaics begin to approach current nuclear cost estimates.[195] And solar technology is on course for further improvement in the future.

"Costs are coming down, and they're coming down more rapidly than I would have thought."

– Lew Hay, Chief Executive of FPL Group, Inc., June 25, 2008. FPL is planning to build 110 MW of solar photovoltaic and solar thermal power plants in Florida.[197]

Figure 9: Estimated Residential Delivered Cost of Electricity (Levelized) for Low-Carbon Generation Technologies[196]



Efficiency can be as cheap as 2 cents per kWh in Maryland businesses and 3.9 cents per kWh in Maryland homes. Recovering currently wasted heat in industrial applications and using it to make electricity costs around 3 cents per kWh. Industrial and building-scale combined heat and power would have costs comparable to a standard natural gas combined cycle turbine—but added efficiency in using waste heat for industrial process or building needs saves money overall (represented by the white bars surrounded by dotted lines). All of these distributed generation technologies reduce the need to invest in transmission and distribution infrastructure. Many renewable energy resources outperform nuclear as well. For example, Delmarva Power has signed several contracts for wind energy delivered to the PJM transmission network, at 8.1 cents per kWh onshore and 11.7 cents per kWh offshore. In addition, the California Public Utilities Commission (PUC) estimates that both biogas and small hydropower facilities can deliver power for up to 5 cents per kWh cheaper than nuclear. According to the California PUC, the only low-carbon energy source with a higher estimated levelized cost of energy is coal with carbon capture and storage.

Clean Energy Technologies Are a More Cost-Effective Solution to Global Warming

Overall, clean energy technologies are a more cost-effective solution to global warming than nuclear power.

Energy efficiency is at least 300 percent more cost-effective at displacing carbon emissions, and wind power and building-scale cogeneration are on the order of 150 percent more cost-effective than nuclear power.[198] These technologies can help Maryland meet its global warming emission goals for much less cost.

Fueling Maryland's Economy

The Nuclear Path

While no macroeconomic analysis has evaluated the economic consequences of building a new nuclear power plant at Calvert Cliffs—perhaps because much of the underlying financial information is proprietary—Constellation has claimed that the project will have economic benefits for Maryland, including:[201]

- $20 million in annual revenue for Calvert County government,
- 360 new permanent jobs in Calvert County,
- 4,000 jobs during the peak of construction, and
- Ancillary economic benefits from housing and supplying the needs of all of the new workers.

However, to the extent a new nuclear reactor increases the price of energy for Marylanders over what they would pay under a clean energy course, it could end up leading to a net job loss statewide. An authoritative analysis must wait for Constellation to disclose more specific financial details of the plant.

The Clean Energy Path

Clean energy can create more jobs and expand the local economy more than building a new nuclear reactor at Calvert Cliffs.

Energy efficiency saves consumers money on their electricity and gas bills. Energy efficiency programs help consumers use less energy, which directly translates into monetary savings. Investments in efficiency can also make energy cheaper—not just for those who make the investments, but for the entire economy. By reducing demand, energy efficiency programs can put downward pressure on the price of electricity and natural gas—delivering large impacts, rapidly.[202]

The American Council for an Energy-Efficient Economy calculates that if Maryland tapped into its energy efficiency potential with six energy efficiency policies and an advanced load-management program, electricity customers in the state would save $860 million on energy bills in 2015, growing to $2.6 billion in 2025. Residents would be saving about $10 a month on electricity by 2015—$8 directly from efficiency and $2 because the policies would reduce the wholesale price of electricity below business-as-usual levels.[203] These policies would return an astounding $4 in energy bill savings for every dollar invested.[204]

Clean Energy Can Reduce Costs for Residential Electric Consumers

Under Maryland's electricity system, utilities provide "standard offer service" to residential customers at market prices, procuring resources by signing contracts with wholesale electricity suppliers. The goal of this process is to provide consumers with the lowest-cost service over the long term, with the least risk of unexpected cost increases.[199]

According to an analysis carried out for the Maryland Office of People's Counsel, utilities can reduce the overall cost of residential service—and minimize the risk of unexpected cost increases—by incorporating a diverse range of clean energy resources, including energy efficiency and wind power.[200]

Jobs and Economic Growth

In addition to saving money on energy, investments in clean energy will generate jobs for Maryland workers and economic development for Maryland communities. The reason is simple: energy efficiency gives people extra money to spend, which can stimulate Maryland's economy and create jobs. Investments in efficiency and renewable energy also replace expenditures for fuel (much of which is imported from out of state) with expenditures for labor and materials often produced at home.

Renewable energy efficiency investments also create jobs directly. Workers are necessary to improve insulation and sealing of homes; skilled architects and builders are required to perform energy efficient new construction and remodeling; and trained manufacturing workers are needed to build energy-efficient appliances.

The American Council for an Energy-Efficient Economy estimates that Maryland could create more than 12,000 new jobs in the state by 2025 by investing in energy efficiency, combined heat and power, and improved load management.[205] Moreover, workers statewide would earn $780 million in wages more than under a business-as-usual course, and gross state product would grow by more than $700 million.[206]

Renewable energy can contribute to economic growth as well. One 2005 study estimates that a national clean energy strategy, coupled with a shifting of federal energy subsidies to renewables and efficiency, could create as many as 154,000 new jobs in the United States and increase net wages by $6.8 billion.[207]

Policy Recommendations

Marylanders deserve an electricity system that delivers a reliable supply of electricity, helps make our society safe and secure, and offers a strong return for our investment.

To create such a system, Constellation Energy is proposing to build a new nuclear power plant at Calvert Cliffs. Nuclear power produces large amounts of electricity for long periods at a time, while emitting relatively little global warming pollution. And it looks less expensive than building coal-fired power plants that capture and store their carbon emissions.

However, as shown in this report, energy efficiency, load management and new sources of renewable energy are likely to outperform a nuclear-based strategy for powering Maryland's future.

Clean energy technologies can meet Maryland's need for power, while also improving the resilience of the electricity system to disruption. Clean energy technologies are equal to or better than nuclear power in terms of their potential to reduce Maryland's contribution to global warming. Moreover, clean energy technologies—especially energy efficiency—are the most cost-effective power resources Maryland has available. Finally, clean energy technologies offer a safer and more secure future for Maryland. Clean energy technologies do not produce highly radioactive nuclear waste, and are less vulnerable to accidents or attack.

To power Maryland's future:

The state should prioritize successful implementation of the EmPOWER Maryland energy efficiency program and the state's renewable electricity standard.

- The EmPOWER Maryland program is a critical tool for maintaining the reliability of the electric system in Maryland. For instance, BGE has projected that it can cut its projected peak power needs 22 percent by 2011.[208] The Maryland Public Service Commission should ensure that utilities achieve such impressive results statewide, by effectively enforcing interim goals for energy savings and peak demand reduction.[209]

- Furthermore, the state should expand the goals of EmPOWER Maryland beyond 2015, setting visionary long-term targets for energy savings and demand reduction. Additionally, the state should remove obstacles and create incentives in support of expanded development of the state's potential for combined heat and power.

Given the added benefits of clean energy options, the Maryland Public Utility Commission should deny a certificate of public convenience and necessity for the proposed reactor at Calvert Cliffs.

- The Maryland Public Service Commission has the authority to issue or deny a certificate to the builder of a proposed power plant based on consideration of issues including the stability and reliability of the electric system and economics. On these grounds, clean energy measures already underway would provide superior performance.

Maryland should not offer any subsidies to support building a new nuclear reactor.

- Maryland should not authorize the use of state funds to help finance expansion of the Calvert Cliffs nuclear plant, whether through tax breaks or other approaches that transfer the risk of building a new nuclear reactor onto Maryland citizens.

Moreover, to ensure the safety and security of Maryland's energy supply, state leaders should enact a conditional ban on the construction of any new nuclear power plants.

- Such a ban should apply until a satisfactory national solution for storage of high-level radioactive waste is developed. The on-site storage of nuclear waste poses one of the greatest safety threats resulting from the operation of nuclear power plants—and current plans for the transport of nuclear waste in close proximity to populated areas are no more reassuring.

- Illinois, Kentucky, Wisconsin, Montana, Maine and California have adopted moratoriums on the construction of new nuclear power plants unless certain conditions are met. The primary condition is a permanent solution for spent fuel.[210] The Kentucky and Maine laws also require that a high-level nuclear waste storage facility be in operation at the time that disposal of nuclear waste must occur. The Wisconsin law requires that a nuclear power plant be judged to be economically advantageous to ratepayers compared with other feasible alternatives. The Montana law goes several steps further, requiring that there be "no reasonable chance" of the discharge of harmful radioactivity, that the safety systems of the plant be demonstrated as effective, and that nuclear facility owners post a bond equal to 30 percent of the capital cost of the plant to cover decommissioning expenses.[211] Maryland should consider its own version of such a policy.

The federal government should redirect loan guarantees, production tax credits and other financial subsidies currently on offer to the nuclear industry, and instead steer them toward more effective clean energy solutions.

- The federal government has already spent more than $100 billion taxpayer dollars on expanding the nuclear industry in the latter half of the 20th century. Further expenditures on nuclear power represent a significant opportunity cost: investing the same amount of money in clean energy technologies would prevent the emission of much greater amounts of global warming and health-threatening pollution—on the order of 400 to 500 percent more in the case of energy efficiency.[212]

Notes

1. "Relieve power shortages in central Maryland while reducing the state's contribution to global warming:" Constellation Energy, *Power Generation: Calvert Cliffs 3* (factsheet), downloaded from www.constellation.com on 10 June 2008; "Produce power cheaper than natural gas:" Areva, *Press Kit: Areva in the United States*, December 2007.

2. Malcolm Wolfe, Director, Maryland Energy Administration, Letter to Governor Martin O'Malley, *Re: State of Affairs in Maryland Regarding Electricity*, 17 December 2007.

3. Average retail electricity price, all sectors. Data through 2006: U.S. Department of Energy, Energy Information Administration, *Maryland Electricity Profile*, March 2007; Data for 2007: U.S. Department of Energy, Energy Information Administration, *Electric Power Monthly with Data for December 2007*, Table 5.4.B, End-Use Sector, by State, Year-to-Date, May 2008.

4. Paul Adams, "Blackouts Feared for Maryland: Shortages by 2011 a Risk if New Lines Aren't Built, PSC Is Told," *Baltimore Sun*, 22 May 2008.

5. Maryland sends more than $3 billion annually to other states and countries to purchase natural gas and fuels for power plants alone: U.S. Department of Energy, Energy Information Administration, *State Energy Consumption, Price and Expenditure Estimates*, Table 1: Energy Price and Expenditure Estimates by Source, Selected Years 1970-2004, Maryland, 1 June 2007; Additionally, Maryland imports about 30 percent of its electricity from out of state, sending additional money out of the local economy: See note 2.

6. Estimates from Patrick L. Anderson, and Ilhan K. Gekhil, Anderson Economic Group, *Northeast Blackout Likely to Reduce U.S. Earnings by $6 Billion*, 19 August 2003; ICF Consulting, *The Economic Costs of the Blackout*, [undated]. GDP figure from U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2002*, 24 October 2003.

7. See note 2.

8. 14,299 MW: Power Plant Research Program, Maryland Department of Natural Resources, *Forecasted Energy Consumption and Peak Demand in Maryland*, Presentation to the Maryland Public Service Commission, 15 May 2007.

9. Based on U.S. Department of Energy, Energy Information Administration, *Form 860 Database* for year 2006, downloaded from www.eia.doe.gov, 1 May 2008. Estimate of generating capacity excludes generators listed as having retired in the Form 860 database.

10. This estimate is based on EIA Form 860 data for generation capacity in Maryland, adjusted to remove generating units not listed in PJM Interconnection, *2007 PJM Load, Capacity and Transmission Report*, 25 July 2007. The units removed from this estimate are generally small combined-heat-and-power and cogeneration facilities whose existence is noted in Form 860, but which apparently are not considered capacity resources by PJM. Consistent with our treatment of CHP throughout this analysis, we assume that these units contribute to the electric system by reducing peak demand for power and not by providing additional capacity to meet peak demand.

11. Public Service Commission of Maryland, *Electric Supply Adequacy Report of 2007*, January 2007.

12. Ibid.

13. See note 11 and: Philip Rucker, "Proposed High-Voltage Line Would Stretch Across Maryland," *Washington Post*, 26 August 2007.

14. See notes 4 and 11.

15. "December 2007" – see note 2. 1,000 MW is an estimate by the authors – see Figure 1.

16. Public Service Commission of Maryland, *Ten Year Plan (2007-2016) of Electric Companies in Maryland*, 2 June 2008.

17. Ibid.

18. Over the next 25 years, electricity consumption in the Mid-Atlantic region is expected to grow by only 0.5 percent per year, and electricity imports into the region by only 0.3 percent per year. Thus, assuming a decrease in import capacity of 1 percent per year is likely conservative. Consumption and import projections: U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2007*, Table 2, Energy Consumption by Sector and Source, Mid-Atlantic, April 2008.

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