THE SOLAR ALLIANCE MEMBER COMPANIES

American Solar Electric

Applied Materials

Borrego Solar

BP Solar

Conergy

Dow-Corning

Energy Innovations

Evergreen Solar

First Solar

Kyocera

Oerlikon Solar

Mitsubishi Electric

MMA Renewable Ventures

PPM Energy

REC Solar

Sanyo

Schott Solar

Sharp Solar

SolarCity

Solaria

Solar Power Partners

SolarWorld

SPG Solar

SunEdison

SunPower

Suntech

Trinity Solar

Uni-Solar

Xantrex

Working with the states to develop cost-effective PV policies and programs.

COMMENTS OF THE SOLAR ALLIANCE

ON

THE DRAFT NEW JERSEY ENERGY MASTER PLAN (APRIL 2008)

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July 25, 2008

SOLAR ALLIANCE COMMENTS
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July 24, 2008

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on
DRAFT NEW JERSEY ENERGY MASTER PLAN (April 2008)

July 24, 2008

1. INTRODUCTION

The Solar Alliance is grateful for this opportunity to comment on the *Draft New Jersey Energy Master Plan – April 2008* (the 'Draft EMP' or 'Plan'). We commend the Governor's Office of Economic Growth, the New Jersey Board of Public Utilities, Department of Environmental Protection, Department of Transportation and others represented on the EMP Committee, as well as the Bloustein School of Planning and Public Policy at Rutgers, for their initiative in developing this Draft Plan. The document clearly represents the dedicated and conscientious efforts of these and many other stakeholders, and provides an important starting point for discussions of New Jersey's energy future that are now taking place.

The Solar Alliance is a group of 29 of the largest solar development and manufacturing companies in the United States, who are working together to advance sensible solar and renewable policies in the states. The Solar Alliance members are:

American Solar Electric	Applied Materials	Borrego Solar
BP Solar	Conergy	Dow-Corning
Energy Innovations	Evergreen Solar	First Solar
Kyocera	Oerlikon Solar	Mitsubishi Electric
MMA Renewable Ventures	PPM Energy	REC Solar
Sanyo	Schott Solar	Sharp Solar
SolarCity	Solaria	Solar Power Partners
SolarWorld	SPG Solar	SunEdison
SunPower	Suntech	Trinity Solar
Uni-Solar		Xantrex

2. SCOPE AND SUMMARY OF SOLAR ALLIANCE'S COMMENTS

We are submitting these comments to urge that renewables in general, and solar in particular, can contribute much more to New Jersey's energy future than the Draft EMP suggests, and that the State plays a critical role in transitioning from today's conventional generation to widespread, low-cost renewable options. We also express our concerns about some of the methodology and assumptions used in the modeling that underlies this version of the Draft EMP, and offer constructive suggestions for improvements as this process goes forward. Finally, we offer a number of broader policy recommendations that we believe will help realize New Jersey's energy efficiency and clean generation goals, while ensuring reliable electricity supplies at reasonable risk and controlled cost to the State's consumers.

Solar and renewables can contribute much more than the Draft EMP assumes, and the State plays a critical role in getting there:

- We showcase an achievable program where solar alone can supply 14 GW of capacity, and provide about 40% of the 54,000 GWh gap in new generation the EMP predicts by 2020. This expansion of New Jersey's solar program builds on the solar RPS, and adds large-scale community and utility solar to deliver competitively-priced electricity over the next ten years and beyond.
- Within 5 years, solar will be among the State's lowest-cost generation resources
- New Jersey needs more carbon-free solar to achieve urgent climate change goals
- Emerging storage technologies will increasingly enable solar to help meet baseload demand
- New Jersey has already put in place key building blocks to realize its solar potential
- Recent analyses strongly favor solar and other renewables over conventional generation for New Jersey's mid- and longer-term needs
- State policy plays a crucial bridging role between yesterday's and tomorrow's energy solutions

Our concerns with the Plan's modeling approach are summarized as follows:

- It treats New Jersey's RPS requirement as a *ceiling* on renewables development, rather than as the *floor* intended by the BPU when it set *minimum* renewables requirements.
- It identifies an urgent need for low-carbon resources, but assumes that carbon-free renewables will not exceed 2006 RPS requirements, and other resources will fill a predicted resource gap of 54,000 GWh.
- Its cost comparisons treat renewables, and especially solar, as separate and apart from conventional resources, instead of as integral components of a diverse electricity supply whose expected costs can compete favorably with conventional options over the EMP's time horizon.
- Its capital cost assumptions have been outpaced by events, and yield inaccurate comparisons: they overstate present and future solar costs, and understate conventional generation costs.
- It apparently assumes *static* capital and operating costs for all generation options, although there is no question that these costs will change over the EMP's time horizon.
- It does not include 'levelized cost of energy' analysis, which accounts for both capital and operating cost changes over the life of these resources, and provides much more meaningful comparisons.
- As a result of these deficiencies, the Draft Plan substantially underestimates the role that solar can and must play in the State's future generation mix in order to achieve New Jersey's policy goals.

Our broader policy recommendations include:

- Build on the progress of New Jersey's Solar Transition by restoring the original goal of achieving 2,120 GWh of solar electricity annually by 2020; eliminating any cap on solar capacity or energy; expanding the solar RPS to attract investment; and retaining the 2% rate impact test.
- Take advantage of emerging cross-market opportunities to leverage energy efficiency and demand response with solar.
- Provide appropriate incentives for utility participation and cooperation in solar development, coupled with assurances of fair competition and a level playing field for nonutility providers.
- Establish a new program to construct large-scale solar plants in addition to the distributed solar that the RPS targets, which will deliver electricity at a lower levelized cost of energy than equivalent nuclear or natural gas capacity.

- Promote emerging regulatory approaches that will advance the adoption of energy efficiency and renewables by New Jersey utilities
- Support development and demonstration of enabling technology and infrastructure to achieve solar goals
- Coordinate solar achievement with complementary policies that –
    - reduce energy demand below today's levels through energy efficiency
    - build a sustainable electricity supply by maximizing the state's renewables potential
    - reduce emissions from the transportation sector
    - begin a transition toward sustainable space heating
    - clean up or retire the state's oldest and dirtiest power plants
    - ensure long-term success through a bold, disciplined approach, and true accountability.

These points are discussed more fully below.

3. What Solar can Deliver, and New Jersey's Critical Enabling Role

3.1. Solar can realistically meet much more of New Jersey's need than the Draft Plan suggests

3.1.1. By 2020, solar alone can supply over 14 GW of capacity, and about 40% of the new generation New Jersey will need by then.

The August 2004 *New Jersey Renewable Energy Market Assessment*,[1] prepared at the BPU's direction and commissioned by CEEEP, examined the technical and market potential for PV in New Jersey. The assessment considered only distributed, customer-sited residential and commercial roof space, not larger ground-mounted systems such as utility or private installations on greenfields or marginal lands, or community-scale installations on public land (now being developed in a number of other states).[2] Even so, the report concluded that by 2020, PV technical potential on residential and commercial rooftops alone would approach *18 GW of capacity*, capable of meeting about *23,000 GWh of annual demand*.

Table 1. PV Technical Potential in New Jersey (*Distributed Resid./Comm. Rooftop Only*) [3]

The technical potential, even after accounting for shading, orientation and other losses, is significant for PV in New Jersey – more than two orders of magnitude larger than the 2008 target of 90 MW.

PV Technical Potential – Residential Buildings	2005	2008	2015	2020
MW Cumulative	8,560	8,940	9,790	10,390
MWh per year	11,154,560	11,647,550	12,754,400	13,532,590

PV Technical Potential – Commercial Buildings	2005	2008	2015	2020
MW Cumulative	6,815	7,000	7,260	7,390
MWh per year	8,879,770	9,120,520	9,455,935	9,630,850

17,780 MW

23,163 GWh

Note: The increase in market potential over time is driven by the increase if roof space. The estimate is conservative in that it considers roof space only, and not other potential applications, such as curtain walls, carports, or other structures.

Source: Navigant, et al.

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[1] *New Jersey Renewable Energy Market Assessment* (NJREMA), Final Report to Rutgers University CEEEP, August 2, 2004; prepared by Navigant Consulting Inc., Sustainable Energy Advantage LLC, and Boreal Renewable Energy Development. Available at http://policy.rutgers.edu/ceeep/publications/ .

[2] The Draft Plan observes that "[f]urther help will come from the availability of community-based solar programs, which would allow residential and small commercial customers to participate in the solar market through participation in larger, lower-cost community-based systems, and by grid supply projects. This would also provide for increased distributed generation, which places less stress on the transmission system, while providing communities with increased control over their local energy portfolio." (p. 64) The Sacramento Municipal Utility District and the City of Ellensburg, Washington offer examples of community-based systems. See, e.g., http://www.green-energy-news.com/nwslnks/clips408/apr08026.html, http://www.smud.org/community-environment/solar/solarshares.html, http://www.b-e-f.org/renewables/ellensburg.shtm.

[3] NJREMA, p. 124. The report explains (at p. 7) that 'technical potential' differs from 'theoretical potential' in that it screens out resources that cannot be used due to non-economic reasons, such as land use or other restrictions.

In stark contrast, the Draft Plan assumes that by 2020, *all renewables combined* will supply only about 16,000 GWh – and of that, solar will contribute *less than 1,500 of the 23,000 GWh that it could* supply.[4] We recognize that technical potential typically exceeds economic or market potential. However, a plan that contemplates using *about 6%* of New Jersey's available, carbon-free solar energy in 2020, or somewhere between 1,250-1,700 MW out of more than 17,000 MW available then for distributed solar alone, needs to be rethought. A starting point for that process is to take a fresh look at the costs of solar relative to other generating resources considered in the Plan.

3.1.2. With New Jersey's current policies and the industry's trajectory, solar will be among the State's lowest-cost generation resources within 5 years

During most of its development history, solar has understandably been viewed as a relatively expensive generation resource. This is partly because until recently, energy markets and regulators have not assigned monetary value to 'externalities', notably including criteria pollutants like NO_X, SO_X and particulates, but also including CO_2 – now recognized as a major contributor to global warming and a key target of New Jersey's EMP. Nor have they historically valued contributions to reducing peak demand, now understood as the primary driver for many utilities' largest capital investments – and growing at an alarming rate in New Jersey.

Beyond that, generating resources have long been valued on a capital cost or $/kW-of-capacity basis. While useful for some purposes, this measure ignores fuel, operating and maintenance expenses over the generator's lifetime. *For fossil-fueled technologies, these ongoing expenses typically exceed capital costs by a factor of ten or more.* For solar, which uses no fuel and costs very little to operate and maintain over a plant's lifetime, they are negligible: what you see is what it costs. Thus capital cost comparisons alone can yield a highly distorted view of relative resource value over the longer planning horizon addressed by New Jersey's EMP.

In any case, Section 4 below first shows that the Draft Plan's preliminary modeling relies on capital cost information that may have been accurate when it was gathered, but has been rendered obsolete by recent market and regulatory developments. As a result, the Plan substantially overstates today's solar costs, and vastly understates conventional generation costs going forward – even *without* considering externalities, peak demand implications, or other system benefits (which, except for CO_2 emissions, we also ignore here to ensure comparability).

Also in Section 4, we urge the adoption of a more meaningful cost measure – levelized life-cycle cost of energy (LCOE) – which accounts for many more of the variables that determine what customers actually pay for their energy (including construction time, financing costs, fuel, O&M, capacity factors, tax benefits, CO_2 emissions costs, etc.) LCOE analysis is widely favored for comparing generation resources with very different and ongoing O&M capital costs. Here it demonstrates that **within 3–5 years, leading PV technologies for residential, commercial and community applications will yield *lower energy costs* than the fossil and nuclear** resources to which the Plan defaults.

Lower costs alone will not ensure the clean and secure energy future that New Jersey seeks. This is because solar market participants still need supportive institutional, market and regulatory structures, and a robust supply chain to take advantage of them. But the very real prospect that solar costs will compete favorably with conventional generation costs quite early in the EMP's planning period, gives policymakers every reason to continue to encourage, support and incentivize solar's transition to these markets over the next few years: the future is bright, but the State needs to continue building bridges to get there.

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[4] See Draft EMP, p. 12. Also p.71, positing a BAU demand in 2020 of 100,000 GWh, less 20% reduction from energy efficiency, less 10,000 GWh from CHP, and all renewables together supplying 22.5% (the RPS minimum) of the remaining 70,000 GWh, or 15,750 GWh.

3.1.3. New Jersey needs more carbon-free solar to achieve urgent climate change goals

Solar Alliance's comments focus largely on updating the cost assumptions underlying the Draft Plan's economic modeling, rather than on greenhouse gas reductions or other environmental benefits that solar and most renewables unquestionably provide. We leave it to other commenters to address those benefits in detail. However, we note here that a central driver for New Jersey's EMP is the urgent need to address climate change through resource choices that not only reduce the rate of increase in carbon emissions, but that halt or reverse it.

The Draft Plan (e.g., p. 71) would consign New Jersey to relying more heavily on new fossil-fueled and nuclear resources to meet 2020 demand. This would bypass a huge and timely opportunity to substitute much more benign resources that are now within technical and economic reach. And, as discussed in Section 4.2.2.3 below, whatever near-term emissions benefits nuclear plants might provide, are vastly outweighed by bourgeoning costs, risks and uncertainties that utilities and the nuclear industry itself have acknowledged repeatedly over the past year.

3.1.4. Solar will contribute not only to peaking and intermediate power demand, but increasingly to baseload requirements over the time horizon of the EMP

Because it generates power in the sunniest parts of the day when demand is often highest, PV has usually been viewed as a peaking resource. In many places it also serves an intermediate resource, generating power in the hours leading up to or immediately following the utility's system peak. When coupled with storage, however, solar, wind and other intermittent resources can serve other parts of the typical load duration or demand curve, potentially including baseload power that might otherwise be provided by coal or nuclear.

Enormous investment is flowing into research and development for new storage technologies that will make solar-generated electricity available even when sunlight is not, and this trend is expected to accelerate.[5] Some of these technologies are being used in commercial applications now, others are in the demonstration stage, and still other more advanced technologies are certain to become commercially available within the EMP's time horizon, probably well before 2020.

Compressed air energy storage is one such technology already used successfully for large-scale storage. CAES uses low-cost, off-peak power to pressurize and store air that can later be expanded to produce power during on-peak periods, consuming less than 40% of the fuel used in conventional gas turbines to produce the same amount of power. The first commercial CAES was a 290 MW unit built in Hundorf, Germany in 1978. A second, 110 MW unit built in 1991 operates in McIntosh, Alabama. The Iowa Stored Energy Park now under development is a 268 MW plant with about 50 hours of storage, and can supply about 20% of the annual energy used by a typical Iowa municipal utility.[6] A 2,700 MW CAES facility is being developed in Ohio.[7]

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[5] A Lux Research study released in May reports that 'Energy storage is poised as the next big energy investment field: Venture capital in the field grew 74% to $709 million in 2007.' The study predicts investment of $64 billion by 2012, noting that bulk energy storage for utilities presents the biggest potential opportunity of all markets studied. See *The $41 Billion Energy Storage Market: The Next Big Energy Investment*, Business Wire, May 29, 2008 at http://findarticles.com/p/articles/mi_m0EIN/is_2008_May_29/ai_n25467170. Also, for each year from 2009-2014, the U.S. Energy Storage Technology Advancement Act of 2007 authorizes $50 million for basic and $80 million for applied research; $100 million for up to four energy storage research centers; $30 million for demonstration projects including vehicle storage; as well as $5 million a year for 10 years for secondary applications of electric drive vehicles. See http://www.renewableenergyworld.com/rea/news/story?id=52716 .

[6] *Solution to high energy costs could lie underground*, Sandia Lab News, June 20, 2008; p. 6.

[7] For more information, see http://www.electricitystorage.org/.

Another technology that has recently entered commercial markets in Japan and the U.S. is the sodium sulphur (or NAS) battery developed by Tokyo Electric Power Company and NGK Insulators, which have installed over 200 MW of this storage so far. American Electric Power recently announced that it will be installing 6 MW of these batteries on its system through this year. According to Michael Morris, AEP's Chairman and CEO,

> "Our near-term goal is to have at least 25 megawatts of NAS battery capacity in place by the end of this decade. But this is just a start. Our longer-term goal is to add another 1,000 megawatts of advanced storage technology to our system in the next decade. . . . In our view, advanced storage technologies, like NAS batteries, and other emerging technologies to increase customers´ ability to benefit from energy efficiency will play equally important roles in delaying or avoiding costly future investments in new energy delivery or generation infrastructure." [8]

AES, another of the world's largest energy companies, announced in July that its subsidiary, Indianapolis Power & Light (IPL), has installed and successfully operated another new storage technology at a substation on its grid, consisting of 2 MW of lithium titanate batteries. Although these could power a typical household for over a week, their purpose on IPL's grid is to smooth out peaks and dips created by other supply sources and loads on the system. AES reports that the project is one of its final steps in deploying grid-scale energy storage, and that these '[f]ast-responding, high-efficiency energy storage systems . . . will create a more resilient grid and allow for increased use of variable generating sources such as wind and solar.' [9]

A fourth storage technology known as a 'flow battery' was recently installed in two locations on Progress Energy's grid in St. Petersburg, Florida. These VRB Power Systems units consist of two 5kW x 4hr systems at the University of South Florida's downtown campus and a city park. Small-scale prototypes for much larger systems to come, their purpose is to demonstrate the capability to store large amounts of solar-generated power for use at night or during peak hours.[10]

These are all new technologies, or new applications for proven technologies. Work remains to be done to reduce their costs, scale up their size, and/or develop higher production capabilities. But these and other storage technologies are entering commercial markets now and certainly will be available during the EMP planning horizon. This will expand the capabilities of solar and other renewables, and position these to contribute a much larger share of New Jersey's energy needs than the Draft Plan envisions.

3.2. THE STATE PLAYS A CRITICAL ROLE IN TRANSITIONING FROM CONVENTIONAL GENERATION TO WIDESPREAD, LOW-COST RENEWABLE GENERATION

3.2.1. New Jersey has already put in place key building blocks to realize its solar potential

New Jersey has long been a U.S. pioneer and leader in solar policy. Its Solar Program has been a tremendous success since its inception in 2002. The BPU has built a strong foundation for the customer economics needed to transform the State's energy markets from fossil fuel to clean, local generation supplying reliable electricity for the State's consumers.

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[8] *AEP to deploy additional large-scale batteries on distribution grid; September 11, 2007, at http://www.aep.com/newsroom/newsreleases/default.asp?dbcommand=displayrelease&ID=1397.*

[9] Quoted in Page, L., *Li-titanate storage balances Indianapolis power grid*, July 10, 2008, at http://www.theregister.co.uk/2008/07/10/altairnano_grid_power_sale/.

[10] For more information, see http://www.vrbpower.com/.

With impressive stakeholder support, the Board is moving from traditional rebates to market-driven SRECs to value solar's contribution to New Jersey ratepayers. As a transitional measure, it has encouraged Electric Distribution Companies to provide part of the market with long-term contracts supported by ratepayer guarantees.

Thus the BPU has established a system to recognize and compensate solar's higher costs in the short term, to ensure that New Jersey citizens and businesses can capture longer-term, persistent benefits of scale, experience, and infrastructure development. As the EMP evolves, it can point the way to policies that will hasten that outcome. It can build on the State's experience and its robust policy framework, and embrace the best and most current information available to chart tomorrow's energy paths.

3.2.2. Recent analyses strongly favor solar and other renewables over conventional generation for New Jersey's mid- and longer-term needs

Much has changed, and changed dramatically, in the energy arena in just the past several years: this is not your mother's solar, or your father's fossil or nuclear.

Conventional wisdom about the relative costs and benefits of emerging renewables compared to fossil and nuclear standbys, is being turned on its head. Section 4 below documents that the costs of solar (and other renewables) are declining rapidly while efficiency and reliability are increasing, and solar's benefits for a carbon-constrained world are coming into clearer focus every day. It is for these reasons that in 2007, solar PV installations reached a record high of 2,826 MW – a 62% growth rate over 2006 – and attracted nearly $10 billion of investment, generating revenues of over $17 billion.[11]

Section 4 explains that much the opposite is happening for the fossil and nuclear resources that the Draft EMP would increasingly rely on for New Jersey's future. An important new study just published for the investment community reports that:

> "Public resistance remains high against nuclear power and increasingly high against coal. Since 2006, some 60 new coal plants in the U.S. have been cancelled, blocked, or delayed, and dozens more are being challenged in 20 states. Some states such as Kansas are considering moratoriums against new coal-fired generation—and this is even before nationwide mandatory carbon caps. California utilities are prohibited from buying new coal-fired power from out of state. In this new world, solar can help deliver the reliability that utilities need." [12]

Large fossil and nuclear plants have both suffered from unprecedented recent increases in the costs of key commodities needed to build them. Information presented just this month from American Electric Power – which owns some 36,000 MW of coal, gas and nuclear plants – confirms this:[13]

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[11] *2007 World PV Industry Report Highlights*, March 17, 2008; from http://www.solarbuzz.com/Marketbuzz2008-intro.htm .

[12] Pernick, Ron and Wilder, Clint, *Utility Solar Assessment Study*; published by CleanEdge and Co-op America, with support from The Energy Foundation, Edwards Mother Earth Foundation, John Merck Fund, and Oak Foundation; June 2008. Available at http://www.cleanedge.com/reports/reports-solarUSA2008.php .

[13] Reported by Jim Harding, former Director of Power Planning and Forecasting at Seattle City Light and Assistant and Acting Director of the Washington State Energy Office, in a presentation for the Solar Electric Power Association entitled *Solar Power for Cheap and Cloudy Seattle?,* July 2008; submitted with these comments as Attachment B.

Table 2. Price Increases for Key Power Plant Commodities

Commodity	Annual Escalation 1986-2003	Annual Escalation 2003-2007	Ratio vs. History
Nickel	3.8%	60.3%	15.9X
Copper	3.3%	69.2%	21X
Cement	2.7%	11.6%	4.3X
Iron/Steel	1.2%	19.6%	16.3X
Heavy construction	**2.2%**	**10.5%**	4.8X

Source: American Electric Power

Additional bottlenecks plague today's nuclear industry. According to a June 2008 report by Joseph Romm, former Acting Assistant Secretary of Energy for energy efficiency and renewables during the Clinton Administration:

> "Twenty years ago the United States had 400 major suppliers for the nuclear industry. Today there are about 80. Only two companies in the whole world can make heavy forgings for pressure vessels, steam generators, and pressurizers that are licensed for use in any OECD country: Japan Steel Works and Creusot Forge. . . .
>
> "According to Mycle Schneider, an independent nuclear industry consultant near Paris, the math just doesn't work given Japan Steel's limited capacity. Japan Steel caters to all nuclear reactor makers except in Russia, which makes its own heavy forgings. 'I find it just amazing that so many people jumped on the bandwagon of this renaissance without ever looking at the industrial side of it,' Schneider said. . . .
>
> "Uranium supply is also an issue. . . . Uranium production . . . has had difficulty keeping up with demand. From 1989 through 2003, the industry average uranium spot price was in the $10 to $15 a pound range. It soared to over $135 a pound in 2007 and now is back down around $60 a pound as of mid-May. . . .
>
> "Finally, we have water consumption. As a 2008 Department of Energy report on wind power noted, 'few realize that electricity generation accounts for nearly half of all water withdrawals in the nation.' At the same time, 'existing nuclear power stations used and consumed significantly more water per megawatt hour than electricity generation powered by fossil fuels,' as a 2002 report by the Electric Power Research Institute found. . . .
>
> "Clearly, future power plants need to be designed to use very little water. Nuclear power can be designed with dry (air) cooling driven by giant fans, but that increases capital costs and lowers the net electrical output of the plant. The 2006 Department of Energy report noted, 'In total, dry-cooled systems impose a cost penalty ranging from 2 to 5 percent to 6 to 16 percent for the cost of energy compared to evaporative closed-loop cooling.' . . .
>
> "So, again, nuclear power can deal with the water issues, but only at a price penalty. As of 2002, 'dry cooling had been installed on only a fraction of 1 percent of U.S. generating capacity, mostly on smaller plants.' " [14]

[14] Romm, J., *The Self-Limiting Future of Nuclear Power*, published by the Center for American Progress Action Fund, June 2008, pp. 9-11; footnotes omitted. Available from http://www.americanprogressaction.org/issues/2008/nuclear_power_report.html . Mr. Romm also holds a Ph.D. in physics from MIT, served as Special Assistant for International Security at the Rockefeller Foundation, and a researcher at the Rocky Mountain Institute. He has authored six books on energy security, the environment, and climate change, and has published articles in *Physics Today, Technology Review, Issues in Science and Technology, Science, Scientific American, Forbes, Foreign Affairs, The New York Times, L.A. Times, Washington Post, Businessweek,* and *U. S. News and World Report*. For more information, see http://en.wikipedia.org/wiki/Joseph_J._Romm#Publications .

These challenges, as well as long-standing and pervasive quality control problems, have consistently caused delays in plant construction – something New Jersey can ill afford if it relies on nuclear to fill much of the 54,000 GWh 2020 energy deficit predicted by the Draft Plan.[15]

> "The first of the advanced reactor designs to be built in the West has been under construction in Finland since mid-2005. It is already 25 percent over budget and two years behind schedule because of 'flawed welds for the reactor's steel liner, unusable water-coolant pipes, and suspect concrete in the foundation.'
>
> *"Bloomberg* notes, 'The June commercial startup of China's Tianwan project came more than two years later than planned. The Chinese regulator halted construction for almost a year on the first of two Russian-designed reactors while it examined welds in the steel liner for the reactor core.... In Taiwan, the Lungmen reactor project has fallen five years behind schedule. Difficulties include welds that failed inspections in 2002 and had to be redone.' "[16]

These are some of the broader concerns that should give New Jersey pause in planning to meet its post-2020 needs with more nuclear or coal. In Section 4, we focus more closely on specific cost concerns raised by the Draft EMP's modeling approach, and offer more current and accurate information to help compare future resource costs.

3.2.3. State policy plays a crucial bridging role between yesterday's and tomorrow's energy solutions

By adopting its current solar policies, New Jersey has singularly positioned itself to take advantage of emerging energy realities foreshadowed by skyrocketing costs for gasoline, natural gas, coal, uranium, and large power plant construction. We believe that the writing is on the wall, as the cost trajectories of conventional and renewable resources cross, environmental imperatives intensify, and global warming accelerates. That said, New Jersey will still need a diversified resource portfolio, with different resources contributing what they can within an overall framework of sustainability, and New Jersey regulators now need to shepherd the State from its current resource mix to one better suited to this century's challenges.

In Section 5 we recommend a number of policy initiatives that can economically expand the role of clean local generation in New Jersey's EMP. While this course will yield profound environmental and security benefits, Section 4 below shows that it is also likely to result in the *lowest cost electricity over time* for New Jersey residents. In saying that, we recognize that the solar industry must deliver on its promises to lower costs in order for the State to continue building policy bridges to encourage solar where it makes sense. The BPU's 2007 Solar Transition Order challenges solar providers by capping solar RPS rate impacts at 2%. Our policy recommendations, listed below and elaborated in Section 5, are consistent with that rate cap and can benchmark the achievement of long-term planning goals. Briefly, they are:

1. **Build on New Jersey's Solar Transition by restoring the goal of 2,120 GWh of solar electricity annually by 2020; eliminating any cap on solar capacity or energy; expanding the solar RPS to attract investment; and retaining the 2% rate impact test.**
2. **Take advantage of emerging cross-market opportunities to leverage energy efficiency and demand response with solar.**

[15] Draft Plan, pp. 71-72.

[16] Romm, J., note 13, at pp. 6-7.

3. **Provide appropriate incentives for utility participation and cooperation in solar development, coupled with assurances of fair competition and a level playing field.**
4. **Establish a new program to construct large-scale solar plants in addition to the distributed solar that the RPS targets, which will deliver electricity at a lower levelized cost of energy than equivalent nuclear or natural gas capacity.**
5. **Promote emerging regulatory approaches that will advance the adoption of energy efficiency and renewables y New Jersey utilities.**
6. **Support development and demonstration of enabling technology and infrastructure to achieve solar goals.**
7. **Support efforts to adapt PJM market rules to accommodate high penetrations of solar and other renewables.**
8. **Coordinate solar achievement with the range of complementary policies outlined in the New Jersey Coalition for a Sustainable Energy Future Comments filed in this proceeding.**

4. CONCERNS OVER MODELING METHODOLOGY AND ASSUMPTIONS

4.1. THE DRAFT USES A FLAWED METHODOLOGY TO COMPARE THE ECONOMIC IMPACTS OF ALL POTENTIAL GENERATION RESOURCES

4.1.1. The Draft Plan treats New Jersey's RPS requirement as a *ceiling* on renewables development rather than as the *floor* intended by the BPU when it set *minimum* requirements for renewables, effectively ceding the future to riskier, more costly, and less desirable resource options.

Goal 3 of the Draft's *Plan for Action* is to meet 22.5% of the State's electricity needs from renewable resources. Goal 4 is to develop new, low-carbon-emitting, efficient power plants to close the predicted 2020 gap between New Jersey's electricity supply and demand.[17]

We wholeheartedly support both goals, but we believe that the Draft's approach to achieving Goal 4 is seriously flawed. According to the Draft,

> "[a]fter achieving a 20% reduction in electricity consumption, generating 10,000 GWh of electricity through CHP, and using renewable resources to produce 22.5% of the remaining demand for electricity, 54,000 GWh of our 2020 demand remains to be met by *other generation sources*." [18]

The 'other generation sources' that the Draft targets to make up the 54,000 GWh energy deficit (about 68% of the Draft's predicted 2020 electricity sales) are coal, natural gas (for peaking), and nuclear – but *not* solar or other renewables.[19] The logic (perhaps based on outdated cost assumptions discussed later) seems to be that renewables will 'top out' at 22.5% of retail sales – i.e., at the *minimum* percentage the BPU's 2006 rules required.[20]

[17] See Draft EMP, pp. 62 and 67, respectively.
[18] Id., p. 71; emphasis added.
[19] Id., pp. 71-72.
[20] N.J.A.C. §14:8-2.3, *Minimum percentage of renewable energy required*, expressly provides that "(a) Each supplier/provider . . . that sells electricity to retail customers in New Jersey, shall ensure that the electricity it sells each reporting year in New Jersey includes *at least* the *minimum percentage* of qualified renewable energy . . . required for that reporting year . . .". (emphasis added)

Treating renewables as separate from conventional supply resources, and arbitrarily capping them for 2020 planning purposes at the minimum level established by policymakers two years ago, simply makes no sense. On the contrary, it flies in the face of the Plan's clear and cogent acknowledgments that:

> "Importing additional conventional coal-based electricity, or developing more high-emitting power plants within New Jersey, will undermine our efforts to fight global warming."
>
> "Significantly reducing carbon dioxide emissions from existing power plants . . . depends on a transition away from the most carbon-intensive power plant technologies, and toward technologies that generate electricity with less carbon dioxide emissions or none at all." [21]

Surely this cannot mean looking to coal or even natural gas generation to supply over two-thirds of New Jersey's 2020 electricity needs. The Draft itself points out that no commercial coal plants now use carbon capture and sequestration (CCS); no known CCS sites exist in or near New Jersey; and new coal plants may not be viable at all.[22] It also observes that natural gas is a less reliable and more volatile source – at about triple coal's price, and rising rapidly[23] – and could require LNG facilities off New Jersey's coast. Such facilities have evoked fervent opposition wherever they have been proposed, and have already been rejected by New York, California, Rhode island and other jurisdictions that have recently considered them.

Without additional renewables, that leaves new nuclear plants to supply up to two-thirds of New Jersey's 2020 electricity demand. The Draft anticipates a careful evaluation of the feasibility of building such plants in the State. But it fails to acknowledge or address the findings of several very recent and well-documented reports that raise major new concerns about a nuclear future, including:

- prohibitively high, and escalating, capital costs
- high electricity prices from new plants
- very long construction times
- concerns about uranium supplies and importation issues
- production bottlenecks in key components needed to build plants
- unresolved problems with the availability and security of waste storage
- large-scale water use amid shortages [24]

The first two concerns alone – rapidly escalating capital costs and high electricity prices from new nuclear plants – raise critical red flags about any plan that would default to nuclear to meet two-thirds of New Jersey's projected 2020 energy demand; we address those issues in section 4.2.2.3 below.

[21] Id., pp. 13 and 20.

[22] Id., p. 71.

[23] "Natural gas, much of which is also supplied by troubled and volatile regions, has also experienced a dramatic increase in prices. After decades of relative stability, natural gas prices more than doubled between 2002 and 2007", and had risen to over $10 MMBtu when the Draft was written. Draft EMP, pp. 18, 43, and 71.

[24] Romm. J., *The Self-Limiting Future of Nuclear Power*, p. 1; Center for American Progress Action Fund, June 2008. See also *Nuclear Power Joint Fact-Finding*, The Keystone Center, June 2007; *North American Power Generation Construction Costs Rise 27 Percent in 12 Months to New High: IHS/CERA Power Capital Costs Index,* February 14, 2008, at http://energy.ihs.com/News/Press-Releases/2008/North-American-Power-Generation-Construction-Costs-Rise-27-Percent-in-12-Months-to-New-High-IHS-CERA.htm.

We recognize that, given the urgent need to develop low-carbon generating sources, it may be prudent for now to preserve all of New Jersey's resource options pending further study. That said, however, it would be *anything but* prudent to count on so expensive, uncertain, and precarious a resource for so large a portion of the State's electricity needs. Yet that is the logical and likely outcome of treating the RPS 22.5% minimum requirement as a ceiling on the renewables contribution to New Jersey's future resource mix.

4.1.2. A more sensible approach is to compare the costs and benefits to the State of all potential generating resources over a range of penetration scenarios; assess which of those yield the highest value for New Jersey citizens; and let those findings inform the Plan's resource priorities and choices.

This approach would not posit a predetermined limit on renewables, or on any other supply or demand resource. Instead, it would develop a bottom-up assessment, based partly on new and better information not available when the Draft was prepared, of the lifecycle costs and benefits of all of the resources reasonably available to New Jersey.[25]

For example, the past 18 months have witnessed dramatic growth in larger-scale solar systems.[26] In Section 4.3.4 below, we present a realistic scenario showing that a community- and utility-scale solar program, combined with the solar RPS program now in place, can deliver *14 GW* of capacity and *over 22,000 GWh* of solar electric energy by 2020, and can be scaled considerably beyond that between 2021-2026. The levelized cost of that energy will be *less than conventional alternatives*, and it can be developed incrementally as energy markets evolve – a vital risk mitigation strategy that coal, nuclear and other massive capital construction projects cannot offer.

Before describing that scenario, however, the following section will show that the Draft Plan's generation cost assumptions are seriously out of date, strikingly incompatible with current information, and likely to result in planning decisions that will be extremely costly and unacceptably risky for New Jersey citizens, businesses and governments.

4.2. THE DRAFT'S COST ASSUMPTIONS ARE OUTDATED, APPARENTLY DO NOT CONSIDER CHANGES OVER TIME, AND YIELD HIGHLY INACCURATE COMPARISONS, NOW AND FOR NEW JERSEY'S FUTURE

4.2.1. Solar capital costs are already far below those assumed in the Draft Plan.

Capital costs are only one component of generation costs,[27] but they are an important one, especially for solar and other capital-intensive resources like coal and nuclear. Table 3 of the Draft Plan, reproduced below from page 32 of the Plan, sets forth its *New Jersey Generation Cost Assumptions,* including *'overnight'* capital costs.[28] The first numbers that concern us are the assumed solar capital costs highlighted in the table below.

[25] Table 3, *NJ Generation Cost Assumptions* (Draft p. 32, and Appendix, p. 55), is presented as 'preliminary and subject to change', and cautions that its numbers are 'estimates and are in the process of being updated'. Solar Alliance fully appreciates the challenge facing the Draft's authors and the difficulty of hitting moving cost targets, and has offered to provide them with the best data now available to us for consideration in the next draft of the Plan.

[26] See Attachment C for examples of recent multi-MW scale PV plants.

[27] In Section 4.3 below, we explain that *levelized cost of energy* (LCOE) is a far more useful measure for comparing generation resources with very different capital requirements. This is because LCOE also accounts for life-cycle costs of operation and maintenance, capacity factors, construction time, financing and, for some resources, fuel, retirement and decommissioning.

[28] 'Overnight cost' is a simplifying convention often used in the nuclear industry to express a capital cost (not LCOE) of construction *as if a plant could be built overnight*: it does not include escalation, interest costs during construction, or overruns. See e.g., Joskow, Paul, *Prospects for Nuclear: A US Perspective*; presentation at the University of Paris, Dauphine, May 2006.

Table 3. Draft EMP Table 3: Preliminary Generation Cost Assumptions – All Resources

NJ Generation Cost Assumptions ($2006)								
	Overnight Installed Cost ($/kW)		Variable Operation & Maintenance Cost ($/MWh)		Fixed Operation & Maintenance Cost ($/kW-yr)		Capacity Factors	
	Min	Max	Min	Max	Min	Max	Min	Max
Conventional Coal	$ 1,900	$ 2,400	$ 2.20	$ 2.70	$ 18.30	$ 22.40	Determined by model	
Integrated Gas Combined Cycle (IGCC)	$ 2,400	$ 3,200	$ 1.00	$ 1.25	$ 32.00	$ 40.00		
Advanced Combined Cycle	$ 700	$ 950	$ 2.00	$ 2.50	$ 11.40	$ 14.00		
Gas Turbine	$ 500	$ 750	$ 5.00	$ 6.20	$ 6.00	$ 7.30		
Nuclear	$ 1,700	$ 3,700	$ 0.50	$ 0.60	$ 70.00	$ 80.00	85%	92%
Combined Heat and Power (CHP) (3-25 MW)**								
w/out Chillers	$ 1,000	$ 1,500	$ 4.00	$ 6.50	$ 30.00	$ 45.00	80%	
w/ Chillers	approx. $2,000						80%	
Wind								
On-shore	$ 1,500	$ 2,200	$ 1.00	$ 2.00	$ 28.00	$ 32.00	25%	35%
Off-shore	$ 2,000	$ 2,800	$ 1.00	$ 2.00	$ 28.00	$ 32.00	25%	35%
Solar	$ 7,500	$ 8,000	$ -	$ 1.00	$ 11.00	$ 12.00	12%	15%
	Min	Max						
Levelized Real Fixed Capital Charge Rate (%)	12%	15%						

Note: Costs in NJ are assumed to be 10% higher than rest of PJM

Improvements in technologies and cost reductions are modeled consistent with those in the Annual Energy Outlook and other References

** - Other cost assumptions related to Energy Efficiency (EE), and the Regional Greenhouse Gas Initiative (RGGI) are being finalized along with fuel price assumptions*

*** - Variable and Fixed O&M costs for CHP decrease with installation size; units of 20+ MW face the min. costs*
Source: Cost Generation Taskforce 2007

Table 3: NJ Generation Cost Assumptions: *These numbers are estimates and are in the process of being updated.*

As the Draft indicates, these are preliminary estimates subject to change, and are being updated. In this section we offer more current and more accurate information than was available to the 2007 Task Force that provided the Draft's generation cost assumptions.

We recognize that cost figures of this kind are subject to wide variation and good faith differences of opinion. However, we believe that independent analysts today will agree that the $7,500-to-$8,000/kW installed costs shown for solar are outdated and seriously overstated. Among many sources we might cite in support of this view is a June 2008 report published by Lazard Freres, a leading New York investment firm, for those considering investments in various conventional and alternative energy generation technologies, including both crystalline and thin-film PV.[29]

As part of its analysis (discussed further in Section 4.3 below), Lazard compared capital costs for each of the technologies considered in the Draft EMP (as well as others less relevant for New Jersey). For each technology, the report presents what Lazard's research confirmed is a reasonable range of costs today, and explains the differences between the low and high estimates. The following chart is reproduced from page 7 of the Lazard report; the highlighting is ours.

[29] A copy of the Lazard report, *Levelized Cost of Energy Analysis – Version 2.0*, accompanies these comments as Attachment A.

Figure 1. Solar Capital Costs (Lazard, June 2008)

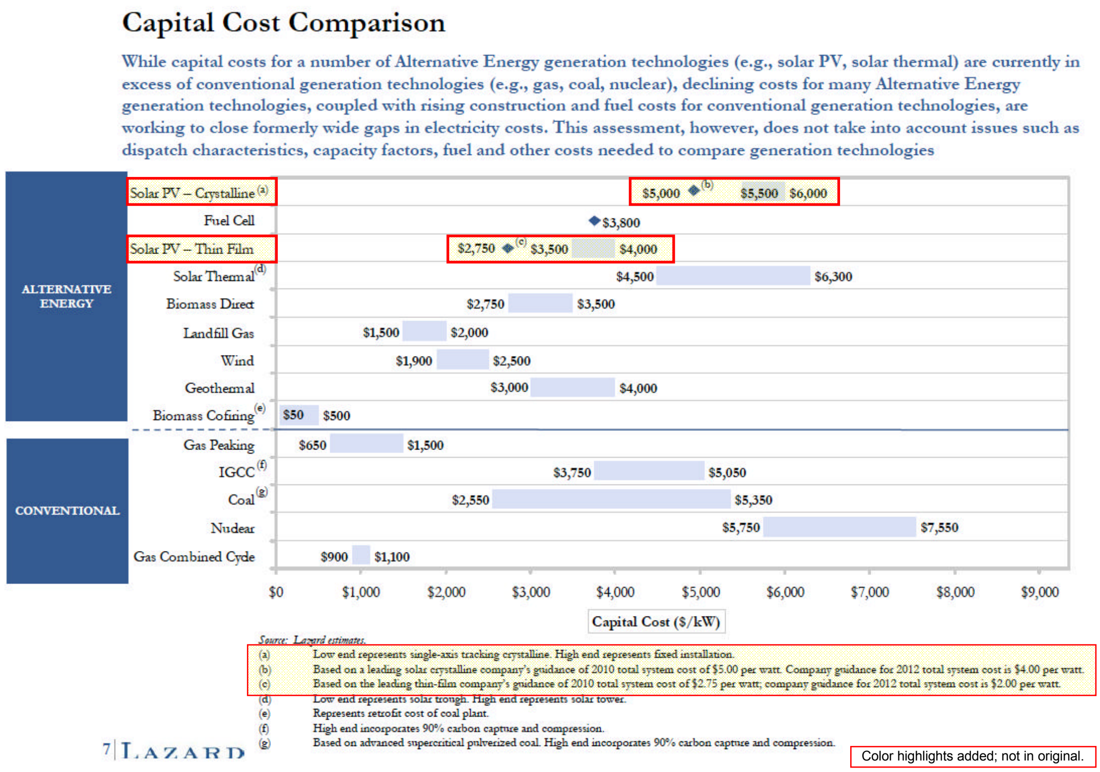


Table 3 of the Draft Plan uses a single range of $7,500 to $8,000 to represent solar 'overnight' capital costs. It is not clear whether it accounts for solar cost reductions universally expected over the life of the Plan, and entirely consistent with solar cost trajectories of recent years. Nor does it distinguish between the two leading forms of PV in use today.

The Lazard analysis does recognize changes over time (albeit only a few years), and does reflect differing costs for different PV technologies. It also includes interest during construction, which the Draft's 'overnight' costs do not. Even so, for crystalline PV, Lazard reports that capital costs today range from a low of $5,500 to a high of $6,000/kW, expected to decline to $5,000 by 2010 and $4,000 by 2012. For thin-film PV technologies, today's capital costs range from $3,500 to $4,000/kW, expected to drop to $2,750 by 2010 and $2,000 by 2012.

In other words: at the low end, today's PV capital costs are already ***less than half*** of those assumed in the Draft plan; at the highest end (for older crystalline technology) they are already 20% below the lowest cost assumed in the Draft (apparently for the duration of the Plan). In two years, Lazard and others expect PV costs to decline even more precipitously, and by 2012, to come in as low as ***one-fourth*** of the capital cost assumed in the Draft.

Lazard's solar capital cost figures are consistent with other recent analyses, notably including the US Department of Energy's. In the following chart reproduced from a June 2008 DOE presentation, DOE shows historical and projected solar capital costs, not by technology but by end-use application (residential and commercial), including indirect and labor costs.

Figure 2. Solar Capital Costs (USDOE, June 2008) [30]

QuickTime™ and a
decompressor
are needed to see this picture.

The industry has already reduced costs substantially below DOE's 2006 figures, as the Lazard figures show. For 2010, DOE's residential solar cost of about $4.60 per installed Watt falls between Lazard's 2010 crystalline ($5.00) and thin-film ($2.75) estimates, as does DOE's commercial estimate of $3.30/Watt for that year. Again, all of these numbers are far below the 'overnight cost' of solar assumed in the Draft Plan, and make solar a much more attractive and realistic option for New Jersey's future than the Draft's dated assumptions might suggest.

4.2.2. Conventional generation costs are already far above those assumed in the Plan, and their cost increases are accelerating.

Because of striking market changes over the past few years, the preliminary cost assumptions used in the Draft EMP for conventional resources are as outdated and unrealistic as those for solar – but in exactly the opposite direction. While solar costs have been *falling*, conventional generation costs have been *rising* even more dramatically, including the costs of conventional resources which solar can supplement or eventually displace.

Intermediate and Peaking Resources. Given their different costs, duty cycles, capacity factors and other technology-specific characteristics, solar and conventional resources sometimes complement one another, and sometimes compete for the same end-uses. PV operates only when sunlight is available, and storage is not yet economic for many applications, so PV today is viewed primarily as an intermediate or peaking resource. For these applications, PV is usually compared with simple or combined cycle gas turbines. Over the EMP's timeframe, global warming concerns will necessitate major advances in those technologies, reducing their emissions but significantly increasing their costs relative to solar, which has no emissions.

[30] *Solar Energy Industry Forecast: Perspectives on U.S. Solar Market Trajectory*; U. S. Department of Energy Solar Energy Technologies Program; June 24, 2008; http://www1.eere.energy.gov/solar/solar_america/pdfs/ solar_market_evolution.pdf

Baseload Resources. Over the same time period, solar is also expected to become a viable source of baseload power, competing favorably with coal and nuclear in New Jersey for that portion of customer demand. As discussed in Section 3.1.4 (page 6), investment has been pouring into advanced energy storage technologies in the past several years, and is expected to accelerate rapidly in the next several. New technologies ranging from a few kilowatts to thousands of megawatts are already being developed and demonstrated by utilities and others around the U.S., and many of these surely will be in commercial use during the life of the EMP.

These will enable PV to serve baseload needs that coal or nuclear might otherwise serve, so it is worth commenting on the Draft's preliminary cost assumptions for those resources as well, highlighted along with natural gas in the portion of the Plan's Table 3 reproduced below.

Table 4. Draft EMP Table 3: Preliminary Generation Cost Assumptions – Coal, Gas, Nuclear

NJ Generation Cost Assumptions ($2006)								
	Overnight Installed Cost ($/kW)		Variable Operation & Maintenance Cost ($/MWh)		Fixed Operation & Maintenance Cost ($/kW-yr)		Capacity Factors	
	Min	Max	Min	Max	Min	Max	Min	Max
Conventional Coal	$ 1,900	$ 2,400	$ 2.20	$ 2.70	$ 18.30	$ 22.40	Determined by model	
Integrated Gas Combined Cycle (IGCC)	$ 2,400	$ 3,200	$ 1.00	$ 1.25	$ 32.00	$ 40.00		
Advanced Combined Cycle	$ 700	$ 950	$ 2.00	$ 2.50	$ 11.40	$ 14.00		
Gas Turbine	$ 500	$ 750	$ 5.00	$ 6.20	$ 6.00	$ 7.30		
Nuclear	$ 1,700	$ 3,700	$ 0.50	$ 0.60	$ 70.00	$ 80.00	85%	92%

4.2.2.1. NATURAL GAS: **Capital costs for gas peakers, combined cycle and IGCC plants far exceed the Draft's assumed costs, and will rise further with carbon controls.**

For simple cycle gas turbines typically used as peakers, the Draft assumes 'overnight' installed costs of $500 to $750/kW. Lazard's June 2008 comparison below shows today's costs ranging from $650 to $1,500/kW – *double* the Draft's costs at the high end.[31]

For an advanced combined cycle plant, the Draft assumes 'overnight' costs of $700–$950/kW. Lazard's more recent figures show a range of $900–$1,100/kW, a *15-30%* increase.

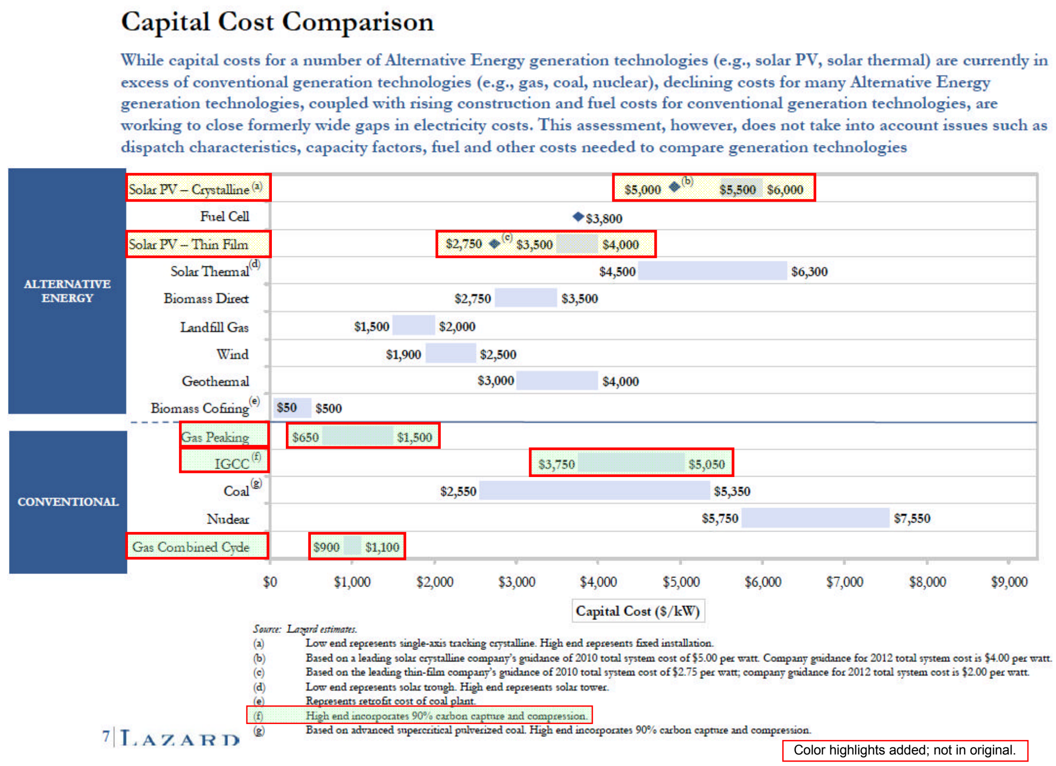
For IGCC plants, the Draft assumes costs of only $2,400–$3,200/kWh, while Lazard's current figures are $3,759–$5,050, about a *57%* cost increase.[32]

It is important to note that here we are dealing *only with capital costs* – not with fuel or other operating or maintenance costs, which typically contribute far more to the cost of energy generated by gas-fired power plants and are also rising rapidly.

[31] Again, the Draft's costs represent the costs of a hypothetical plant built 'overnight', which obviously is never the case. Lazard's figures include interest during construction, averaging 25 months for gas peakers ranging from about 43–168MW.

[32] The high end of Lazard's range incorporates carbon capture and compression, a likely requirement for GHG reduction.

Figure 3. Capital Costs, Solar vs. Gas (Lazard, June 2008)



Certainly there is room for discussion about specific assumptions underlying any set of cost figures. Our point here is not that Lazard's figures are the last word on this subject. It is that they are more current, more realistic, and more credible today than the capital costs assumed in the Draft EMP – and that the rising capital cost of conventional resources is just as clear, consistent, and compelling a trend as the declining capital cost of solar and other renewables.[33]

4.2.2.2. COAL: Recent coal plant costs are also much higher than projected even without IGCC and CCS, and will soar higher with these requirements.

Areas of Agreement. We agree with much of the Draft Plan's analysis concerning the costs and risks of coal-based electricity, and the folly of staking New Jersey's energy future on importing it from other states. In particular, we concur in the following views expressed in the Draft:

> "The prospect of increased greenhouse gas emissions is only one reason to avoid increasing our reliance on imports of out of state dirty electricity. Just as importantly, hopes that these imports would bring us greater reliability and lower prices are likely to be dashed. The prospect of federal limits on power plant emissions of greenhouse gases is creating major uncertainty about what coal-based power will cost. In addition, demand for coal is increasing, as coal is becoming more difficult and expensive to mine and transport, and recent history has featured disruptions in coal supply and spikes in coal prices. All of these factors suggest that it would be irresponsible to stake our energy future on increased imports of out-of-state coal-based electricity." (p. 35)

[33] For another excellent recent discussion of current and projected cost differences between conventional and alternative generating resources, see Jim Harding's presentation referenced in note 13, and Attachment B to these comments.

"**A shift to coal-based generation offers little promise of lower prices.** Although the urgent need to combat global warming precludes such a step, increasing our reliance on coal-based electricity offers no sustained promise of lower electricity prices." (p. 44)

"[Also,] coal delivered over long distances from this region is vulnerable to disruptions in supply and spikes in price due to weather and other natural phenomena, such as earthquakes, fires, and floods. For example, when two coal trains derailed in May 2005, coal shipments were reduced for the rest of the year; the spot price of coal from the region more than doubled in just five months." (p.45)

"With these problems in mind, it is unsurprising that coal prices . . . have increased 45% since January 2002 [through January 2008]. Growing worldwide demand for coal is likely to increase prices further; a doubling of world coal prices in 2008-2009 has been forecasted." (p. 45)

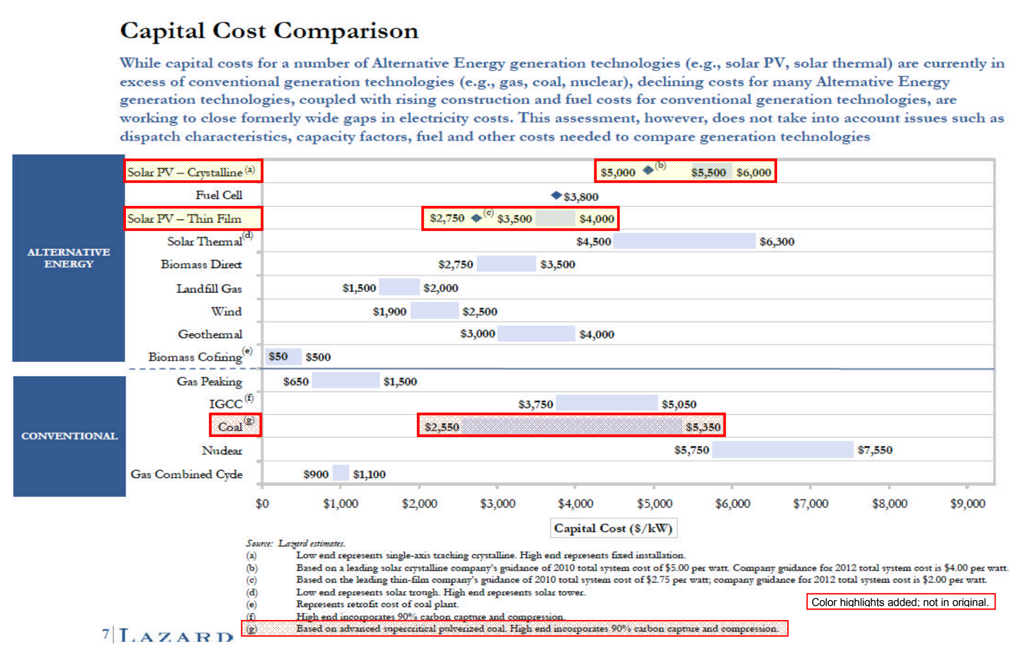
"Also, any meaningful future federal constraint on greenhouse gas emissions from power plants will significantly increase the cost of generating electricity from coal. The prospect of such a constraint is making it more challenging to obtain financing for new coal-based plants." (p.45)

"The fight against global warming makes it imperative that we avoid planning an energy future based on increased imports of coal-based electricity from the Midwest and Southeast. For the reasons discussed above, major investments in infrastructure designed to facilitate those increased imports would be economically unwise as well as environmentally irresponsible." (p. 46)

We support these statements, and would like to update them to demonstrate that if anything, they understate the costs and risks that coal-based electricity – generated in or imported to New Jersey – would visit upon the State. This is important because, notwithstanding the statements just quoted, the Draft Plan appears to leave open the possibility that 'clean coal' should be among the sources considered to fill New Jersey's predicted 2020 generation gap (Draft, p. 71).

Updating the Draft's Coal Assumptions. The Draft assumes an overnight capital cost for a conventional coal plant of *$1,900-$2,400/kW* (Draft *Table 3*, above). Again, Lazard's June 2008 capital cost figures reveal not only what has actually 19transpired since these estimates, but also what is likely to happen as carbon capture and sequestration becomes the law: as shown below, Lazard's coal capital cost figures today are *$2,550-$5,350/kW*.

Figure 4. Capital Costs, Solar vs. Coal (Lazard, June 2008)



Lazard's analysis is consistent with many other recent observations about the state of coal-based electricity today and over the years covered by the Draft Plan. The Plan correctly identifies three critical cost factors that affect coal-fired generation: plant construction costs, GHG carbon controls, and rising coal prices. All of these threaten price stability and ensure long-term carbon liabilities that create risks for the State, and all have been the subject of recent commentary.

4.2.2.2.1. Construction Costs of Coal-Fired Power Plants Are Rising

As recently as 2005, companies reported that capital costs for coal-fired generation ranged between $1,500 to $1,800/kW (lower than the Draft's assumed costs). Building a 600 MW coal plant at those costs would total between $900 million and $1.1 billion.

A study just released by Synapse Energy Economics summarizes the current outlook for coal-fired power plants:

> "Construction cost estimates for new coal-fired power plants are very uncertain and have increased significantly in recent years. The industry is using terms like "soaring", "skyrocketing," and "staggering" to describe the cost increases being experienced by coal plant construction projects. In fact, the estimated costs of building new coal plants have reached *$3,500 kW, without financing costs. This would mean a cost of well over $2 billion for a new 600 MW coal plant* when financing costs are included. These cost increases have been driven by worldwide competition for power plant design and construction resources, commodities, equipment and manufacturing capacity…
>
> "Indeed, there is no reason to expect that the worldwide competition for resources or the existing supply constraints and bottlenecks affecting coal-fired plant construction costs will clear anytime in the foreseeable future….
>
> "The Virginia State Corporation Commission denied the request of Appalachian Power Company to build a coal-fired power plant in West Virginia. The Commission found that the proposal was neither "reasonable" nor "prudent". In its order denying the request to build the new coal-fired power plant, the Virginia Commission also found that the Company's cost estimate for the project was not credible and that the Company had not updated its cost estimate since November 2006. The Commission further noted that the Company ("APCo") will not obtain actual or firm prices for components of the project until after receiving regulatory approval." [34]

A recent Wall Street Journal discussing an industry update on construction costs confirmed this, concluding that:

> "The analysis is of interest because it is difficult to get solid cost data until after plants have been built. Even then, data aren't always available." [35]

4.2.2.2.2. New Federal Rules to Curb Greenhouse Gas Emissions Will Dramatically Increase the Cost of Coal Plants

Leading scientists now agree that carbon emitted to the atmosphere poses extraordinary risk to the environment. Coal-fired power plants emit more GHG than any other energy source. Members of Congress have introduced bills to mitigate GHG emissions, and these have been the subject of studies that project their impact on electricity prices.

The Synapse study referred to above summarizes the current literature, which confirms the Draft Plan's own conclusions:

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[34] Synapse Energy Economics, Inc., *Coal-Fired Power Plant Construction Costs,* July 2008; p. 9; emphasis added.

[35] Smith, Rebecca, *Costs to Build Power Plants Pressure Rates,* Wall Street Journal, May 27, 2008.

"Finally, there is no currently commercially available technology for post-combustion capture of carbon dioxide from coal-fired power plants. Moreover, it is estimated that such technology may not be commercially available until 2020 or 2030, if then. However, it is expected that the addition of carbon capture and sequestration technology will greatly increase the cost of generating power at coal-fired plants." [36]

As quoted above, the Draft Plan observes that federal legislation will 'significantly increase the cost of generating electricity from coal'. The new studies quantify this, estimating that the increase will range from *60% to 80%*, affecting both capital and operating budgets. These increases, and uncertainties over the timing of new legislation, make coal plant cost projections highly speculative.

The Draft Plan reports that financial services and energy industry leaders worked with environmental groups to develop a set of enhanced due diligence principles, known as the Carbon Principles, announced on February 4, 2008 by Citigroup, JP Morgan, and Morgan Stanley. The Principles, designed to cover lending to utilities for new coal-fired plants, embrace a portfolio approach: they ask prospective borrowers to disclose their programs for energy efficiency, renewables, and GHG mitigation as part of any lending review. Citigroup's press release announcing the collaboration states:

"The need for these Principles is driven by the risks faced by the power industry as utilities, independent producers, regulators, lenders and investors deal with the uncertainties around regional and national climate change policy." [37]

The lack of a national consensus on the form of new law and regulation makes the Principles useful, but all participants acknowledge that they are simply a first step. Their ultimate impact on actual emission reductions is not clear. Absent clear rules, prudent planning requires New Jersey to consider a full range of potential cost scenarios.

4.2.2.2.3. The Cost of Coal is Rising

The fundamental justification for building coal-fired power plants has been that coal is cheap, abundant and provides low-cost electricity for consumers.[38] Market developments are changing all that, eroding coal's competitiveness and providing even greater reason to question the soundness of these investments. In some parts of the country, rising coal prices (combined with mounting construction costs and regulatory uncertainty) have made natural gas plants competitive with new coal plants. Table 4 shows why:

Table 5. Increases in Spot Market Coal Prices Per Ton, 2007-2008 [39]

Type	July 2007	June 2008	% Change
Central Appalachian (CAPP)	$45.25	$138.00	195%
Northern Appalachian (NAPP)	$45.60	$134.55	204%
Illinois Basin	$31.50	$ 70.00	122%
Powder River Basin (PRB)	$9.15	$14.00	53%

[36] Op. cit. note 34, p. 10.

[37] Citigroup Press Release, *Leading Wall Street Banks Establish the Carbon Principles,* February 4, 2008.

[38] See *Science Panel Finds Fault With Estimates of Coal Supply*, New York Times, June 21, 2007, referencing National Academy of Sciences, "Research and Development to Support National Energy Policy June 2007. The report concludes that the US might have a 100 year supply of coal at current usage rates. but that by 2030 the rate of coal consumption could be 70 percent higher than it is now. The data suggests that if that higher usage rate occurred, US coal supplies could be exhausted in less than 50 years, with significant price increases, as the supply becomes progressively constrained.

[39] Energy Information Administration, *Weekly Coal Price Reports.*

Coal traders and industry monitors differ as to the permanence of these high prices. But even if CAPP and NAPP prices drop by $30 per ton, the new price floor is dramatically higher than the old one – and price pressures on PRB coal are intensifying as well. In June, Peabody Energy predicted that the demand pressures behind rising coal prices will continue for the next several decades.[40]

Last year's EIA Energy Outlook offers a different picture of long-term coal prices than the coal industry does today. It states that 'Coal prices to the electric power sector remain relatively low, peaking at $1.71 per million BTU in 2010, falling to $1.69 per million BTU in 2018, and remaining at that level through 2030.' [41] However, a 2008 study by Western Resources Advocates offers some insight into EIA forecasting models:

> "Inherent in the risk associated with fuel price changes is the inability to reliably project future fossil fuel prices. The Energy Information Administration conducted a review of its forecasts and found that, for long-term forecasts made from 1982 through 2006, the average absolute error (comparing forecasted prices and actual prices) for coal prices paid by electrical generating plants was about 47% and that natural gas wellhead prices was about 64% – both enormous forecasting errors." [42]

The highest new price floors are actually occurring in regional coal markets that have served New Jersey's coal-fired generation. These include West Virginia (Central and Northern Appalachian) and Pennsylvania[43] – where coal costs are rising fastest, and export demand will exert continued pressure.[44]

New Jersey's energy planners should also assess the litigation and financial risk that comes with reliance on coal. Market impacts from successful litigation to block new mining in the areas where New Jersey power plants purchase their coal creates difficult choices, as reflected in the following 2007 article from the Houston Chronicle:

> "NEW YORK — A Friedman Billings Ramsey analyst upgraded shares of Peabody Energy Corp. on Monday, saying a judge's ruling blocking permits for a rival to mine coal in Central Appalachia will drive coal prices higher.
>
> "Last month, U.S. District Judge Robert Chambers revoked four permits that allowed Massey Energy Co. to mine coal from mountaintops in Central Appalachia. The judge ruled the engineers that studied the sites failed to prove the mines wouldn't harm the environment.
>
> "Last week, the judge blocked two new permits on the same basis.
>
> "Friedman Billings Ramsey analyst David M. Khani said the blocked permits add to a union strike, a mine closure and a severe blizzard that forced a work stoppage last month as factors that will propel coal prices.
>
> "Khani upgraded Peabody Energy to "Outperform" from "Market Perform." He said if there is less coal production in Central Appalachia, buyers will turn to coal from other sources, such as the Powder River Basin.
>
> "He raised his price target on the St. Louis, Mo.-based coal miner's stock to $70 from $68." [45]

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[40] Vic Svec, Senior President for Investor Relations and Corporate Governance, Peabody Energy, *The New BTU,* Basic and Industrial Conference, June 3, 2008.

[41] Energy Information Agency, 2007 Energy Outlook: *Fuel Costs Drop from Recent Highs, then Increase Gradually.*

[42] Western Resources Advocates, *A Clean Electric Strategy for Arizona,* February 7, 2008. The study referred to is Energy Information Administration, *Annual Energy Outlook Retrospective Evaluation of Projection in Past Edition, 1982-2006*, DOE/EIA-0640(2006) 2007, Table 2.

[43] EIA, *Domestic Distribution of U.S. Coal to Origin State, Consumer, Destination, Method of Transportation, 2006.*

[44] Consol Energy, *Merrill Lynch Global Metals, Mining and Steel Conference,* Key Biscayne, Florida, May 14, 2008. Consols export projections rise from 57 million tons in 2007 to 84 million in 2009. The demand pressure positions the company to capitalize on higher prices. See slides: 20 and 22 from the presentation.

[45] *Ahead of the Bell: Peabody Energy,* Houston Chronicle, April 9, 2007.

Litigation impacts coal prices in Virginia, West Virginia. Kentucky and Tennessee in several ways. First, permit denials delay or prevent expansion in the coal supply, raising prices. Second, new environmental mitigation strategies increase mining costs. Third, price increases cause eastern power plants to look to western Powder River Basin coal, in turn increasing its prices and undermining any price advantage from that source.

Arch Coal is the second largest U.S. coal producer, with a large interest in PRB coal. In June its CEO, Steve Leer, summarized the price outlook as follows:

> "We certainly expect it (an increase in PRB prices) to happen. We have tracked pricing in previous run-ups. What we see is that every price increase starts in Central Appalachia moves to Northern Appalachia, moves to the Western bituminous region and then to PRB. Each increase that has occurred since 2001 has seen the spike much higher than the previous one and the valley much higher than the previous one." [46]

4.2.2.2.4. Cumulative Financial Risk

With several cost factors moving in the wrong direction at the same time, many investors and investment analysts are questioning the viability of investments in new coal-fired generation. Moody's reports that 'electric utilities could face a daunting challenge in obtaining timely recovery of these costs through their respective rate-setting authorities.'[47] Standard and Poor's has expressed a similar view:

> "Among the risks are that CO2 compliance costs could spiral out of control, those costs could be up for rate recovery at the same time that other expenses are rising, and the costs could then get 'crowded out' if regulators try to ease customer rate shock. …Clearly, the pursuit of a cooler planet will leave utilities sweating over the risk to their credit quality." [48]

Sponsors of new plants have withdrawn or suspended development plans on 67 plants over the last few years. About 100 more new plants are in various states of development.[49] Bruce Williamson, CEO of LS Dynegy (the corporate sponsor of six new U.S. coal-fired plants), recently told its shareholders,

> "Very few coal plants will break ground in the next several years unless they have already started construction, have an EPC contract or equipment committed to them… New investment for generation has been sidelined." [50]

For over 70 years, the U.S. Department of Agriculture's Rural Utility Services (RUS) has subsidized loans for new power generation in rural America. In February of 2008 it placed a moratorium on new coal-fired power generation. The agency's Administrator denied financing for the Highwood Generation Station proposed by the Southern Montana Electric Cooperative, writing as follows:

> "The inherent risks associated with compounded delays make the situation more problematic as well as increasing the cost of the plant which will be passed on in the form of higher member rates raise concerns about financial feasibility.

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[46] Coal and Energy Report (CER), June 27, 2008, Volume 10, No. 124, p. 1.

[47] Moody's Investor Service, *The Cost of Climate Change,* Corporate Finance—Special Comment, February 2008.

[48] Standard and Poors, *The Credit Cost of Going Green for U.S. Utilities,* Credit Week Special, March 19 2008.

[49] www.sierraclub.org/environmentallaw/coal/plantlist.asp

[50] Reuters News Service, May 14, 2008.

> "Additionally . . . the Agency is precluded from financing base load generation plants in Fiscal Year 2008 and I suspect that will be the situation in Fiscal year 2009. Costs will continue to increase throughout this period.
>
> "With all the facts considered: No base load generation loans probably through 2009; continued cost increases further exacerbated by the added time to reach loan approval; the feasibility of the project with extra time and additional cost; and the uncertainty of the litigation now filed compels me to inform you the Agency will not be able to finance the proposed Highwood Station Plant." [51]

A Washington Post article referring to this letter also wrote that:

> "The RUS administrator, James M. Andrew, said in the letter that it 'is not funding loans for new base load generators until the Agency and the Office of Management and Budget can develop a subsidy rate to reflect the risks associated with the construction of new base load generation plants.' . . .
>
> "The agency also conceded yesterday that it had not considered potential costs that could result from climate-change legislation that most commercial banks, utilities and other businesses consider when considering energy projects. 'Since there is no clear consensus on what emission standards will be enacted and associated costs, attempting to make decisions on loans absent a factual base is speculative at best,' Andrew said.[52]

In short, the cumulative impact of these financial risks makes it very difficult for underwriters and energy planners to provide reliable data for decision makers. Assuming moderate carbon regulation, new coal plants are expected to produce electricity that costs at least 13¢/kWh, and perhaps as high as 16-17¢/kWh, exclusive of any state-specific transmission cost and taxes. At least until new carbon legislation and rules are adopted and markets stabilize, coal-fired power plants will remain not only a costly option, but an extremely high-risk proposition for New Jersey.

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[51] Letter from James M. Andrew, Administrator, Utilities Program, United States Department of Agriculture to Tim Gregori, General Manager, Southern Montana Electric Cooperative, Inc.. February 18, 2008.

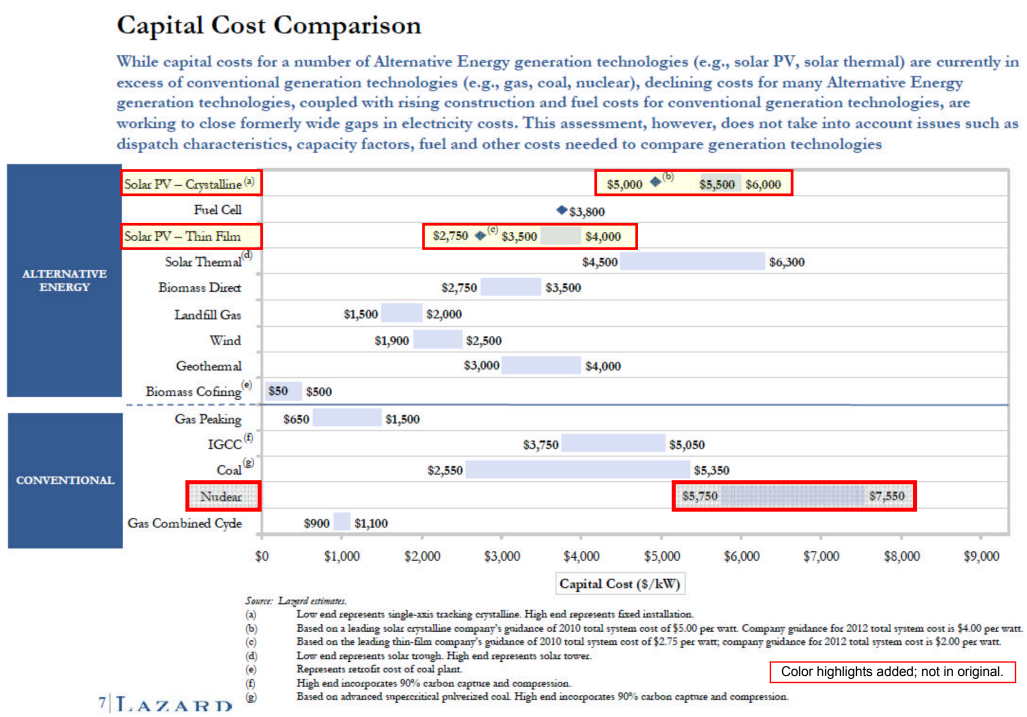
[52] Mufson, Steven, *Government Suspends Lending for Coal Plants: Risks Cited to Economy, Environment,* Washington Post, March 13, 2008. See also Karl Puckett, *Rural Utilities explains funding pullout* and *Coal-fired power plant projects feel heat from rising costs, environmental concerns,* Great Falls Tribune, March 4 and 13, 2008, respectively.

4.2.2.3. NUCLEAR: New data on nuclear plant costs compels New Jersey to consider less costly, more secure low-carbon options.

Per Table 2 on page 14 above (reproducing Table 3 of the Draft), the Draft EMP assumes 'overnight' nuclear costs of $1,700 to $3,700/kW.

Figure 5 below highlights Lazard's more current figures of $5,750 to $7,550/kW – an increase of *nearly 340%* at the low end of the range, and *over 200%* at the high end.

Figure 5. Capital Costs, Solar vs. Nuclear (Lazard, June 2008)



Part of this dramatic increase reflects the fact that Lazard's capital cost figures are not fictional 'overnight' costs, but include interest costs during construction – a very real and very significant cost for nuclear plants that can take anywhere from 6 to 15 years to build.[53] However, a more important and more ominous factor, confirmed by other recent studies, is that *nuclear plant costs have been rising much faster than other power plant costs* over the last several years, perhaps even faster than Lazard's figures reflect.

Cambridge Energy Research Associates (CERA), a widely respected independent advisor to international energy companies, governments and financial institutions, recently developed a new Power Capital Costs Index (PCCI). Introduced in February, the PCCI is similar in concept to the Consumer Price Index, but applies to new power plant construction. It tracks the cost of building new coal, gas, wind and nuclear power plants, and provides a new benchmark for comparing worldwide costs of these plants.

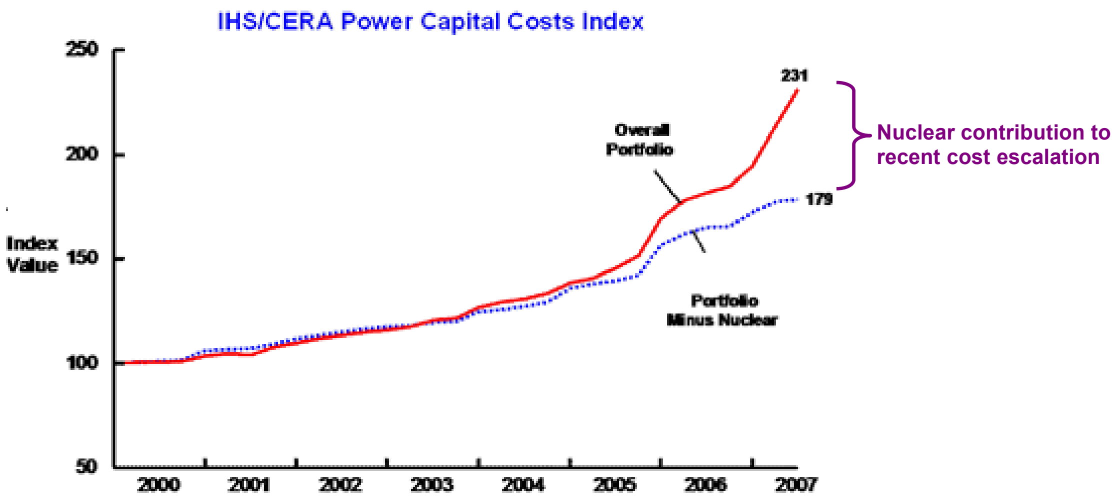
[53] The Lazard study assumed 69 months, near the bottom of that range. See attachment referenced at note 12, *Levelized Cost of Energy Analysis – Version 2.0*; p.12, 'Construction Time' assumption.

CERA's capital cost index for February 2008 showed that

> "the cost of new power plant construction in North America increased 27 percent in 12 months and 19 percent in the most recent six months, reaching a level *130 percent higher than in 2000.*
>
> "The new PCCI . . . registered 231 index points in the third quarter period ending in October, indicating *a power plant that cost $1 billion in 2000 would, on average, cost $2.31 billion today.*" [54]

As sobering as these statistics are, they are even worse for nuclear than for conventional power plants, as shown by CERA's February chart in the same publication:

Figure 6. Cost Escalation: Nuclear vs. Other Power Plants (IHS/CERA Feb. 2008)



According to CERA's lead researcher for this work, Candida Scott:

> " 'Although the PCCI has been on an upward trend since 2000, a surge that began in 2005 has pushed costs up 76 percent in the past three years . . . The latest increases have been driven by continued high activity levels globally, especially for nuclear plants, with continued tightness in the equipment and engineering markets, as well as historically high levels for raw materials.' Excluding nuclear plants, costs have risen 79 percent since 2000, she noted."
>
> " '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 . . . As the cost of construction rises, firms may become reluctant to invest in new plants, or delay and postpone these projects, in turn constraining the growth of capacity.' " [55]

Other recent publications confirm these trends, and also document their rapid acceleration. Current nuclear cost developments may be best summarized in a June 2008 report by author Joseph Romm, former Acting Assistant Secretary of Energy for energy efficiency and renewables during the Clinton Administration, who prefaces the report as follows:

> "The threat of catastrophic global warming means that no carbon-free source of power can be rejected out of hand. The very serious possibilities that sea levels will rise several inches each decade for many centuries, and a third of the planet will undergo desertification are far graver concerns than the very genuine environmental concerns about radiation releases and long-term waste issues."[56]

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[54] See http://energy.ihs.com/News/Press-Releases/2008/North-American-Power-Generation-Construction-Costs-Rise-27-Percent-in-12-Months-to-New-High-IHS-CERA.htm; emphasis added.

[55] Id.

[56] Op. cit. *supra*, note 8. For more information on Mr. Romm's background, see http://en.wikipedia.org/wiki/Joseph_J._Romm .

That said, the author goes on to document recent nuclear cost experience in considerable detail. Excerpts from that report follow: [57]

> "The **U.S. Energy Information Administration projected in 2005** that a nuclear plant's 'overnight capital costs' . . . would total about **$2,000 per kilowatt**. A typical current plant size is 1 gigawatt, or 1 million kW, which would total **$2 billion** under this formula. . . .
>
> "Yet . . . costs are now far beyond $2000/kW. [58] By mid-2007**,** a **Keystone Center** nuclear report funded in part by the nuclear industry and NEI[59] estimated overnight costs at $3000/kW, which equals **$3600 to $4000/kW** with interest. . . .
>
> "At the end of August, 2007 *Tulsa World* reported that **American Electric Power** Co. CEO Michael Morris was not planning to build any new nuclear power plants. He was quoted as saying, 'I'm not convinced we'll see a new nuclear station before probably the 2020 timeline,' citing 'realistic' costs of **about $4,000/kW**. . .
>
> **"Florida Power & Light** presented a detailed cost estimate for new nuclear plants to the Florida Public Service Commission in October of last year. FPL is "a leader in nuclear power generation in the United States" with 'one of the most active and current utility construction programs in the U.S.' FPL concluded that two units totaling 2,200 megawatts would cost **between $5,500 and $8,100 per kW – $12 billion to $18 billion total –** and that two units totaling 3,000 MW would cost $5,400 to $8,000 per kW—$16.5 billion to $24 billion total. (These are the actual costs, not adjusted for inflation.)
>
> "Lew Hay, chairman and CEO of FPL, said, 'If our cost estimates are even close to being right, the cost of a two-unit plant will be on the order of magnitude of **$13 to $14 billion**. That's bigger than the total market capitalization of many companies in the U.S. utility industry and 50 percent or more of the market capitalization of all companies in our industry with the exception of Exelon. … This is a huge bet for any CEO to take to his or her board.'
>
> "An October 2007 **Moody's** Investors Service report, "New Nuclear Generation in the United States," concluded, 'Moody's believes the all-in cost of a nuclear generating facility could come in at between **$5,000–$6,000/kW**.'
>
> "In January 2008, **MidAmerican Nuclear Energy** Co said that prices were so high, it was ending its pursuit of a nuclear power plant in Payette County, Idaho, after spending $13 million researching its economic feasibility. Company President Bill Fehrman said in a letter, 'Consumers expect reasonably priced energy, and the company's due diligence process has led to the conclusion that it does not make economic sense to pursue the project at this time.'
>
> "MidAmerican is a company owned by famed investor Warren Buffet. When Buffet pulls the plug on a potential investment after spending $13 million analyzing the deal, it should give everyone pause.
>
> "In mid-March, **Progress Energy** informed state regulators that the twin 1,100 MW plants it intends to build in Florida would cost **$14 billion, which 'triples estimates the utility offered little more than a year ago.'** That would be **more than $6,400/kW**. The whole cost is even higher; 'The utility said its 200-mile, 10-county transmission project will cost $3-billion more.' It looks like renewables are not the only source of electricity that requires new power lines. Factoring that cost in, the price would be **$7,700/kW**. . . .
>
> "**Georgia Power** said in early May that it planned to spend **$6.4 billion for a 46 percent interest** in two new reactors proposed for the state's Vogtle nuclear plant site. The *Wall Street Journal* noted, 'Utility officials declined to disclose total costs. A typical Georgia Power household could expect to see its power bill go up by $144 annually to pay for the

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[57] The report contains extensive footnotes, omitted here for brevity; emphasis in the excerpted passages is ours.

[58] Citing a November 2007 report by Nuclear Engineering International, the nuclear industry's "leading independent provider of news, features and company data", entitled "*How much?: For some utilities, the capital costs of a new nuclear power plant are prohibitive*,", available at http://www.neimagazine.com/story.asp?storyCode=2047917.

[59] Other funders of the Keystone Center report were American Electric Power, Constellation Energy, Duke Energy, Entergy, Exelon, Florida Power & Light, General Electric, National Commission on Energy Policy, Pew Charitable Trusts and Southern Company; see *Nuclear Power Joint Fact-Finding* report, The Keystone Center, June 2007, available at http://www.keystone.org/spp/energy07_nuclear.html.

plants after 2018,' [and that the] 'existing Vogtle plant, put into service in the late 1980s, cost more than 10 times its original estimate, roughly $4.5 billion for each of two reactors.' . . .

"In March, **Peter Bradford, former Commissioner of the Nuclear Regulatory Commission**, former president of National Association of Utility Regulatory Commissioners, and member of the Keystone Panel, testified to South Carolina Public Service Commission on Duke Power's request to 'Incur Nuclear Generation Pre-Construction Costs,' saying, 'I then explain why Duke cannot establish the prudence of its decision to incur preconstruction costs of $230 million between now and the end of 2009 without providing reliable evidence of the likely cost of the unit and the impact of that cost on the rates to be paid by South Carolina electric customers.'

"Back in February, **Duke Energy** CEO Jim Rogers told state regulators that the plant would cost $6 billion to $ 8 billion, but a mere two months later said the estimate was 'dated and inaccurate.' . . .

"By mid-May, the *Wall Street Journal* was reporting that after 'months of tough negotiations between utility companies and key suppliers … efforts to control costs are proving elusive.' How elusive? According to the *Wall Street Journal*, "**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."

"That is, Moody's is saying actual costs have 'blown past' their earlier $6,000/kW estimate.

"[Finally, in] a 2008 presentation[60] to the Wisconsin Public Utility Institute seminar, [Jim Harding, who was on the Keystone Center panel, was responsible for its economic analysis, and previously served as Director of Power Planning and Forecasting for Seattle City Light] noted that **Puget Sound Energy** had quoted a capital price as high as **$10,000/kW**."[61]

The Romm report clearly identifies a wide range of nuclear capital costs, from $2,000 – $10,000/kW.[62] Just as clearly, every *recent* estimate is much higher than the $1,700 – $3,700 used in the Draft EMP, and estimates from experienced nuclear utilities are climbing consistently, with most now well over $6,000/kW, and one already at $10,000/kW . . . so far.

We noted at the outset that other major concerns about nuclear today include lengthy construction times; concerns about imported uranium supplies; production bottlenecks in critical nuclear plant components; large-scale water use amid shortages; and the availability and security of waste storage. These developments are summarized in the Romm paper, the Keystone Center report referenced in note 24, the Harding presentation (Attachment B), and a 2003 report from the Massachusetts Institute of Technology,[63] among many others.

Here, however, we have focused on nuclear capital costs, because we can compare them relatively easily to assumptions explicitly used in the Draft EMP. We have also observed that capital costs are only one element of generating costs, and that a more encompassing and useful measure is *levelized life-cycle energy costs*, which includes many more of the costs that customers actually pay for their power, and permits more accurate comparisons among different kinds of generation sources. The next section compares New Jersey's generation costs using that measure, and further demonstrates why solar should and will play a much larger role in the State's energy future than the Draft EMP suggests.

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[60] A more recent presentation by Mr. Harding on this topic accompanies these comments as Attachment B.

[61] Op. cit. *supra*, note 8, at pp. 3-7.

[62] Again, some of this variation is attributable to differing economic methodologies (e.g., 'overnight' costs that ignore interest costs and price escalation, nominal vs. real dollars, etc.), but most is not, and the steep upward trend is beyond honest debate.

[63] *The Future of Nuclear Power: An Interdisciplinary MIT Study*, Massachusetts Institute of Technology, 2003; available at http://web.mit.edu/nuclearpower/.

4.3. Levelized Cost of Energy (LCOE) Provides A More Meaningful Comparison Among Generating Resources, Because It Accounts For Many More Of The True Costs Of Generation Over The Resource's Lifetime

4.3.1. Introduction

Both conventional and alternative generating resources exhibit wide variations in capital costs (both 'overnight' and over time); fuel costs; other ongoing operating and maintenance costs; availability and capacity factors (times and percentages of the year when their output is available); construction times; plant lifetimes; and costs of decomissioning.

Some technologies (such as gas peakers) have relatively low capital costs, but potentially very high operating costs, depending on fuel prices. Others (such as nuclear) have very high capital costs, but historically have had relatively low operating costs. Still others (such as solar) have relatively high capital costs today, but negligible operating costs, since they use no fuel or other consumables and require little maintenance over their lifetime.

These technology differences, as well as continuous changes in energy markets, complicate the task of comparing resource costs over time – especially over periods as extended as New Jersey's Energy Master Plan must consider. Comparing any single component, as we have done to this point for capital costs, tells only one part of a much more complex story, but it at least provides a point of departure based on the numbers presented in the Draft Plan's *NJ Generating Cost Assumptions*.

A more complete and meaningful approach is to compare the *levelized or life-cycle cost of energy* (LCOE) resources available to New Jersey over the EMP's planning horizon. LCOE is a more comprehensive measure of energy costs, and the one most often used to compare resources with quite different cost and performance characteristics. It incorporates cost of capital, fuel costs (if any), lifetime O&M expenses, major overhauls and subsystem replacements, and the performance characteristics of different generation technologies.

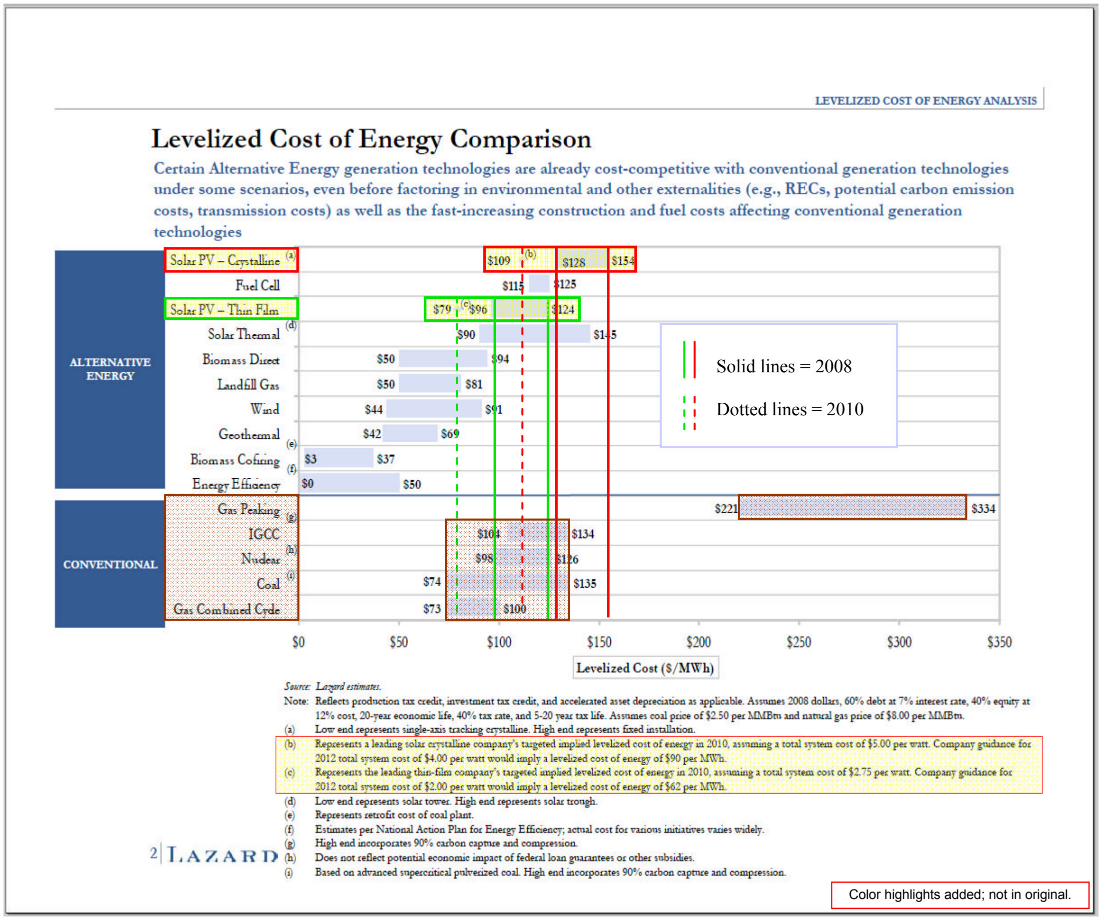
LCOE accounts for annually and less-frequently recurring costs, interest and inflation assumptions, and returns on financial assets. These estimated costs are projected over the installation's lifetime (e.g., 20-30 years). and then levelized to obtain a single cost number representing the multiyear sequence of costs. LCOE approaches may or may not include estimates for the costs of reducing greenhouse gas emissions (such as carbon taxes or emissions trading) associated with particular technologies, because these costs have little actual history and are especially uncertain today.

4.3.2. Solar PV is Already Competitive With Many Conventional Generation Technologies on a Levelized Cost Basis, Even Without Comparing Emission and Externality Costs.

Although as discussed earlier, Lazard's June 2008 report does compare capital costs (in $/kW) for various generation technologies as one component of its analysis, its central purpose is to compare the levelized cost of energy (in $/MWh or ¢/kWh) for these technologies, and to determine how sensitive these costs are to key variables such as fuel prices, emissions control and capital costs.

Lazard presents the results of these analyses in a format similar to its capital cost comparison shown earlier, on page 15. Its base case LCOE results reflect current costs. It confirms that with existing federal tax incentives, LCOE for ***thin-film solar PV today is competitive with all conventional generation except gas combined cycle plants****,* and probably will compete with those by 2012 or sooner. ***Crystalline PV today has a far lower LCOE than gas peakers*** which might serve the same loads, but a higher LCOE than other gas, coal and nuclear options; by 2012 if not sooner, it likely will compete with all of those except combined cycle gas plants.

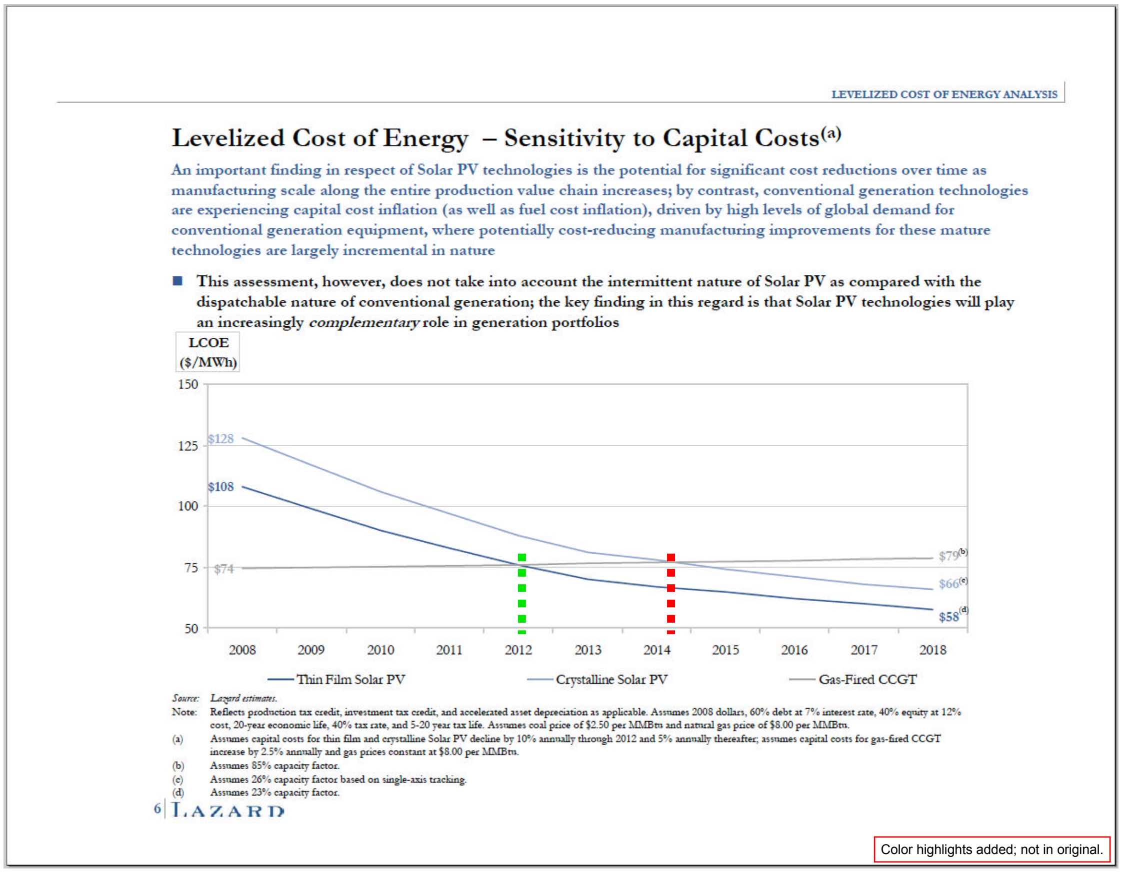
Figure 7. Levelized Cost of Energy, Solar vs. Conventional Resources (Lazard, June 2008)



Although these comments have focused on solar technologies, it is worth emphasizing that ***all* of the other renewable technologies today show LCOE considerably lower than *any* of the conventional generation sources, or at the very least highly competitive across most of their cost range – and energy efficiency remains by far the most cost-effective resource**.

Lazard's analysis presents sensitivity cases which test the impacts of varying fuel prices, carbon emissions costs, federal tax incentives, and plant capital costs on the LCOE results shown above (see Attachment A). That analysis shows that, for now, the costs of solar relative to conventional generation remain especially sensitive to the availability of existing federal solar tax incentives. However, this will be far less important over the next five to ten years as solar capital costs continue on the downward trajectory confidently predicted by US DOE, the financial community, and independent analysts. Indeed, as the following chart shows, capital cost reductions are expected to yield ***PV LCOE below gas combined cycle plants as early as 2012 for thin-film, and 2014 for crystalline PV***.

Figure 8. Levelized Cost of Energy, Capital Cost Sensitivity (Lazard, June 2008)



4.3.3. Solar PV Will Soon be Competitive in New Jersey's Residential Building Markets, and it Already is in the State's Commercial Markets.

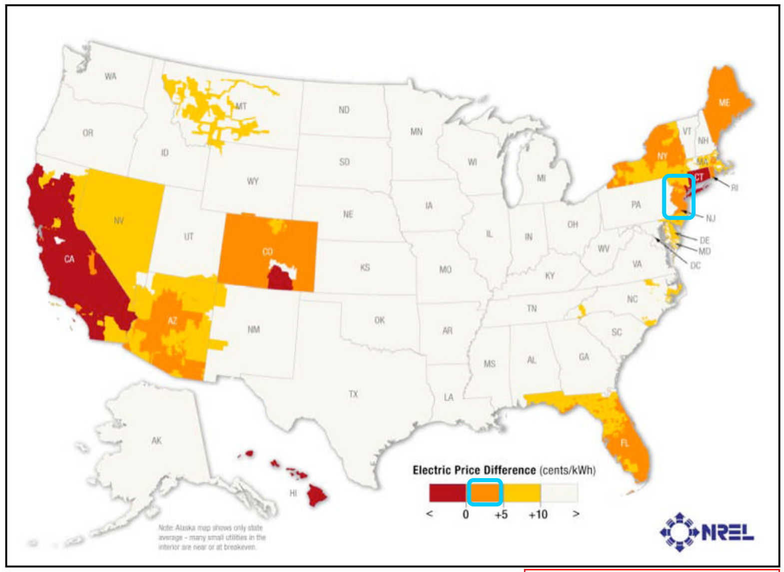
Lazard's analysis confirms that the levelized energy cost of some solar PV is already lower than most conventional generation, and is likely to undercut even combined cycle gas turbine costs by 2012. New Jersey is among the states that will benefit directly from these developments over the next few years, as shown in the following DOE charts presented on June 24, 2008: [64]

[64] *Solar Energy Industry Forecast: Perspectives on U.S. Solar Market Trajectory*; presentation by Thomas P. Kimbis, Acting Program Manager, Solar Energy Technologies Program, U.S. Department of Energy, June 24, 2008.

Figure 9. Solar PV Residential Market Penetration, 2007 and 2015 (USDOE, June 2008)

Market penetration begins - 2007 residential PV and electricity price differences with existing incentives

- Currently PV is financially competitive where there is some combination of high electricity prices, excellent sunshine and/or state/local incentives.



Color highlights added; not in original.

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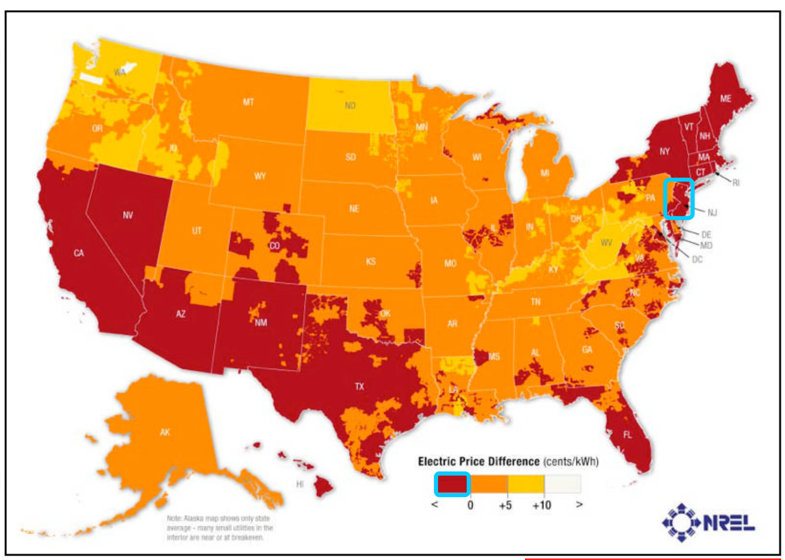
Solar acceleration in a conservative forecast - 2015 residential without incentives and moderate increase in electricity prices

- Attractive in about 250 of 1,000 largest utilities, which provide ~37% of U.S. residential electricity sales.
- 85% of sales (in nearly 870 utilities) are projected to have a price difference of less than 5 ¢/kWh between PV and grid electricity.
- In large areas, PV is cheaper than grid electricity



Color highlights added; not in original.

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To illustrate DOE's conclusions more concretely for New Jersey, Figure 9 below shows the U.S. Energy Information Administration's current (July 2008) retail electricity price report for the State's consumers. Figure 10 overlays these prices (escalated for future years by what DOE states is EIA's 'conservative' 4.7% annual growth factor) on DOE's own solar LCOE curves, with and without current federal solar tax incentives. The result confirms again that based on New Jersey's current retail electricity prices, conservatively escalated over the next few years, *PV can supply electricity at below-grid costs for commercial customers today*, and *is expected to do so for residential customers within 3 years*, even without federal tax incentives.

Figure 10. New Jersey Retail Electricity Prices (EIA, July 2008)

Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State tp://www.eia.doe.gov/cneaf/electricity/epm/table5_6_b

Electric Power Monthly with data for February 2008
Report Released: July 10, 2008
Next Release Date: Mid-August 2008

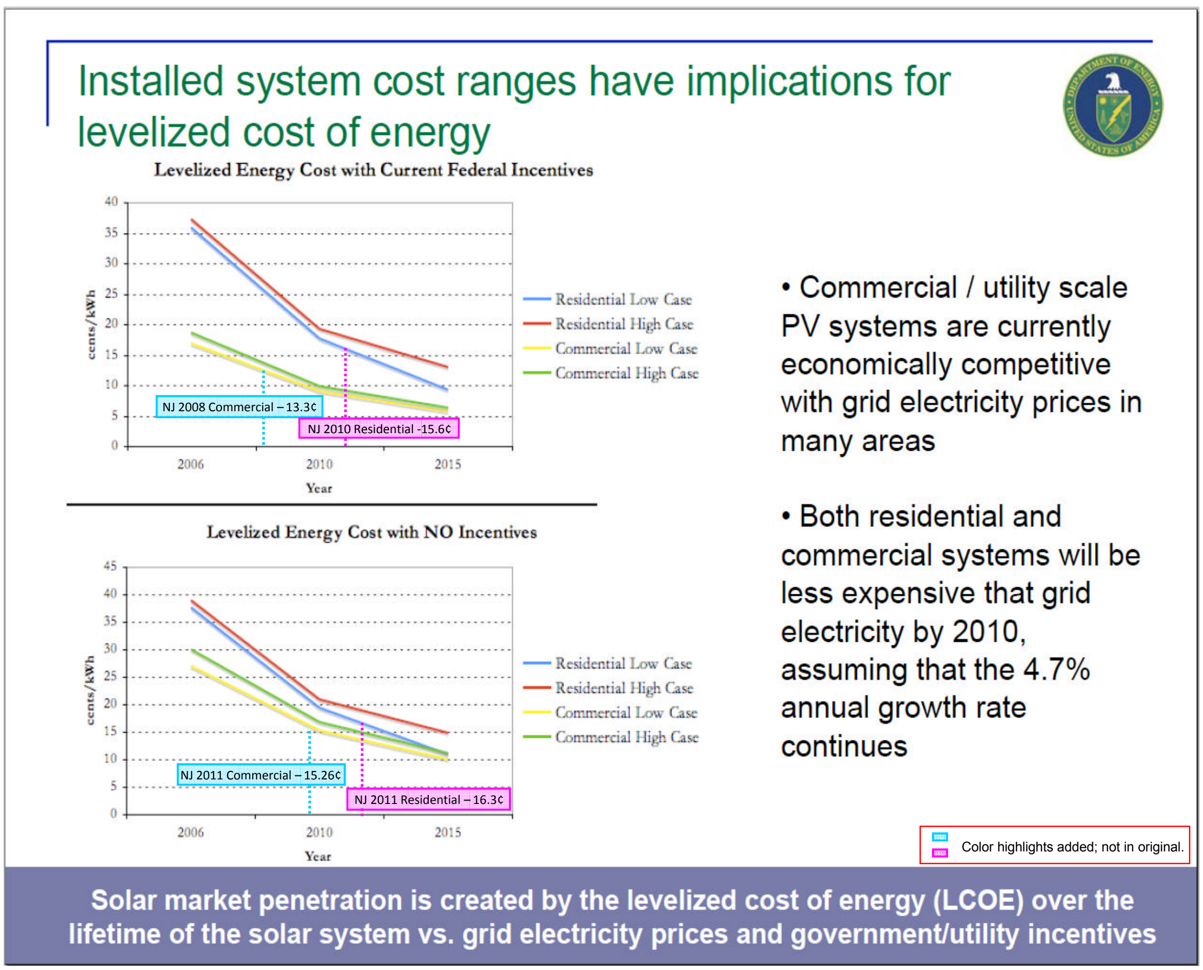
Table 5.6.B. xls format Electric Power Monthly

Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through February 2008 and 2007 (Cents per kilowatthour)

Census Division and State	Residential		Commercial[1]		Industrial[1]		Transportation[1]		All Sectors	
	2008	2007	2008	2007	2008	2007	2008	2007	2008	2007
Middle Atlantic	**13.65**	**12.86**	**12.97**	**12.22**	**7.97**	**7.63**	**11.99**	**11.22**	**12.28**	**11.61**
New Jersey	14.23	12.78	13.3	11.5	11.38	10.18	13.41	11.68	13.42	11.82
New York	17.05	16.01	15.22	14.55	9.19	9.1	13.24	11.78	15.19	14.47
Pennsylvania	10.63	10.27	9.01	8.89	6.92	6.69	7.45	8.56	9.03	8.78

Color highlights added; not in original.

Figure 11. NJ Retail Prices – Intersection with Solar LCOE (USDOE, June 2008 curves)



4.3.4. In the time it would take to build a single nuclear plant, a large-scale solar PV program would yield over 10 times the capacity and almost 3 times the energy, at about 70% of a nuclear plant's LCOE.

In Section 4.2.2.3 (page 25), we looked at the current financial risks, uncertainties and costs of nuclear by itself, without reference to any other resource. While that exercise is sobering enough, comparing nuclear to solar head-on over even the next 10-12 years reveals that nuclear simply cannot compete on an LCOE basis with a sustained large-scale solar PV program. The following comparison shows why.

Table 6. LCOE Comparison: Large-Scale Solar Program vs. Nuclear Power Plant

Comparison of a Photovoltaic vs. Nuclear Capacity Expansion Program

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PV Program - Central, Community & Distributed											
Growth Rate:		300%	250%	200%	175%	165%	150%	140%	130%	110%	100%
Community & Central											
Annual Capacity Installed (MW_{ac})	20	60	150	300	525	866	1,299	1,819	2,365	2,601	2,601
Cumulative Capacity Installed (MW_{ac})	20	80	230	530	1,055	1,921	3,221	5,040	7,405	10,006	12,607
Annual energy delivered (GWh)	33	131	377	869	1,730	3,151	5,282	8,265	12,144	16,410	20,676
Distributed (under RPS)											
Cumulative Capacity Installed (MW_{+B3}, from RPS)	186	260	341	437	554	692	853	1,043	1,262	1,510	1,790
Annual energy delivered (GWh, from RPS)	195	273	358	459	582	727	895	1,095	1,325	1,586	1,880
Total Cumulative Capacity Installed (GW):	206	340	571	967	1,609	2,614	4,073	6,082	8,666	11,516	**14,398**
Total Annual Energy Delivered (GWh):	228	404	735	1,328	2,312	3,878	6,177	9,360	13,468	17,996	**22,556**
LCOE (from PV plants in the year constructed)	$ 0.173	$ 0.160	$ 0.150	$ 0.143	$ 0.135	$ 0.129	$ 0.122	$ 0.116	$ 0.110	$ 0.105	**$ 0.100**
LCOE Weighted (over cumulative PV installed)	$ 0.173	$ 0.163	$ 0.155	$ 0.148	$ 0.142	$ 0.136	$ 0.130	$ 0.125	$ 0.120	$ 0.116	**$ 0.113**
Nuclear Program - Single 1 GW Power Plant											
Annual Capacity Installed (GW_{ac})	-	-	-	-	-	-	-	-	-	-	1
Cumulative Capacity Installed (GW_{ac})	-	-	-	-	-	-	-	-	-	-	1
Annual energy delivered (GWh)	-	-	-	-	-	-	-	-	-	-	7,884
Total Annual Energy Delivered (GWh):	-	-	-	-	-	-	-	-	-	-	**7,884**
LCOE (from plants in the year constructed)	$ 0.126	$ 0.129	$ 0.132	$ 0.136	$ 0.139	$ 0.143	$ 0.146	$ 0.150	$ 0.154	$ 0.157	**$ 0.161**
LCOE Weighted (over cumulative GW installed)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**$ 0.161**

Assumptions

- **Solar**
  - → Annual Capacity Factor: 18.7% (single axis tracking for larger systems)
  - → PV LCOE from USDOE projections, adjusted upward approx. 25%
- **Nuclear**
  - → 1 GW nuclear plant can be permitted, constructed and commissioned in 11 years
  - → Capital cost range for a 1 GW nuclear plant: $5B-$12B (*Wall Street Journal*, May 12, 2008)
  - → Annual Capacity Factor: 90%

Table 11 models a New Jersey solar program that would include enough distributed PV to meet the RPS, coupled with a new commitment to larger, community- and central utility-scale PV installations beyond the RPS requirements (which initially focused on smaller systems). It compares the LCOE of that solar program, with the LCOE of a 1 GW nuclear power plant that might be under design today, begin permitting in 2010, start construction around 2015, and go online in 2020 (a somewhat ambitious schedule given today's uncertainties).

Using what we believe are reasonably conservative assumptions (shown in the table), this exercise shows LCOEs, weighted over a 10-year development period for both resources, of ***11.3¢ for solar and 16.1¢ for nuclear***. Given today's reality of declining solar costs and escalating nuclear costs, these LCOE are consistent with Lazard's estimates, as well as with many others. Other assumptions might be substituted, but as long as they reflect current information, they are not likely to produce very different results.

The table illustrates a critical and under-appreciated advantage of modular technologies – whether the modules are a few kW each, a few hundred kW, tens of MW, or a combination of those (as this integrated solar program would be). The advantage is that modular technologies can begin generating power in year one, and ramp up gradually as the market develops. New Jerseyans need not wait 10 years or more for the first electron to flow, and they need not bear the risk that a single huge plant will fall years behind schedule, or experience the massive cost overruns that many nuclear plants have. In this example, the first solar installations begin delivering electricity in 2010, and others come on line each year through 2020, contributing incremental energy as soon as they are installed. By 2020, when the nuclear plant is assumed to start up, solar generation would already have contributed *nearly 18,000 GWh* of locally produced energy (with no radioactive or other waste to dispose of).

In this illustration, solar generation built up over the 10-year period would provide over 14 GW of peak capacity by 2020, and would continue expanding after that. This compares to 1 GW of capacity that the nuclear plant would only begin to provide in that year, and which likely would not increase over its lifetime.

By combining community- and utility-scale solar with distributed PV in a sustained program, New Jersey can meet at least 40% of its projected 2020 energy need. This is far from wishful thinking: multi-MW PV systems have been installed and are operating in many locations around the world, now including the U.S. Attachment C presents photographs and a list of some of those installations showing that, while these may be relatively new to the U.S., they have been operating successfully in other parts of the world for some time.

*   *   *

The point of the cost comparisons above is not to argue that any particular set of analysts' numbers are the 'right' ones, or the only correct ones. It is to emphasize that energy markets have been changing at light speed over the past several years, with major implications for New Jersey's future resource choices. The placeholder cost assumptions included in the Draft Plan do not reflect those changes, and do not yet provide a sound basis for decisions going forward.

The Plan's preliminary cost assumptions are seriously out of date now. They do not provide a foundation for the state-of-the-art energy analysis that New Jersey needs in this area. And they are almost certain to lead to planning decisions that unnecessarily and unwisely increase risks and costs for the State's residents, businesses, institutions and governments.

*   *   *

5. POLICY RECOMMENDATIONS TO REALIZE NEW JERSEY'S ENERGY EFFICIENCY AND CLEAN GENERATION POTENTIAL

The Draft Plan points out many of the challenges New Jersey faces in controlling our energy destiny. The regional nature of our historic energy market leaves us dependent on PJM rules and processes and its governing structure for generation supply (both conventional and renewable) beyond the State's borders. There are certainly advantages to the balancing function of a large wholesale market, but the Draft Plan clearly highlights disadvantages as well. The difficulties of building new transmission lines to deliver wholesale power from the western PJM region are increasing local congestion charges throughout New Jersey. And we cannot possibly achieve the Governor's GHG Reduction goals if growing amounts of our electricity supply come from the coal fields of Appalachia, or Ohio, or Illinois.

We believe that clean, cost-effective New Jersey-based generation can provide a solution. We have pointed out that the EMP's generation cost assumptions are seriously out of date, and could lead to decisions very much at odds with the State's pressing economic and environmental priorities. Getting the numbers right, or at least reasonable, is not an academic exercise: without scrutinizing today's realities, and without using the best and most current near-term economic forecasts, the State will almost certainly head off in directions that we now know are likely to produce outcomes that could be very costly to New Jersey citizens, from both economic and environmental perspectives.

We have demonstrated that the economic costs of solar, on an LCOE basis, will compare favorably with conventional wholesale generation, probably within the next three to five years and certainly within the next ten – *if New Jersey continues to develop and implement forward-thinking transitional policies*. The remainder of this section respectfully suggests what we believe some of those policies should be.

5.1. BUILD ON THE PROGRESS OF NEW JERSEY'S SOLAR TRANSITION BY ELIMINATING ANY PREDETERMINED CAP ON SOLAR CAPACITY OR ENERGY WHILE RETAINING THE 2% RATE IMPACT TEST, AND EXPAND THE SOLAR RPS TO ATTRACT MORE INVESTMENT IN NEW JERSEY SOLAR CAPABILITIES

5.1.1. **At an absolute minimum, the State should restore its original goal of achieving 2,120 GWh of solar electricity annually by 2020**, rather than the 1,700 GWh assumed in the Draft Plan based on assumed 20% energy efficiency savings.

If solar becomes the lowest-cost generation resource – as independent analysts now predict – there is no reason whatsoever to limit its contribution by tying it to hoped-for energy efficiency savings. If solar were not to achieve its cost targets, the State's goal would be moot in any case. It makes no sense to arbitrarily pit efficiency against cost-effective solar: New Jersey needs both, and the more the better.

5.1.2. **Eliminate any predetermined capacity (MW) or energy (MWh) cap on solar. The 2% limit on solar rate impact is the only cap needed to limit ratepayer exposure.**

Use the 2% rate impact cap as a two-way 'circuit breaker' for the solar RPS. Existing rules delay the annual increase in the RPS percentage if solar costs exceed 2% of retail electricity sales. If solar costs come down as expected, such that total costs to ratepayers remain below the 2% cap, then the BPU should allow the RPS *solar percentage to increase correspondingly*. Our analysis indicates that with a 10% decline in solar RPS costs each year, the existing solar RPS percentage could be increased by 25% between 2013 and 2021 (allowing a 5-year grace period before implementing the 'circuit breaker') without exceeding the 2% rate impact cap.

5.1.3. **For the period 2021-2026, increase the overall RPS percentage to 40%, and the solar portion to 5%.**

This is entirely consistent with the State's GHG goals, and will advance its economic goals for the reasons discussed in Section 4 above.

5.1.4. **Establish a program to build community- and utility-scale solar installations**

The last two years have brought a surge in the U.S. and abroad of large-scale solar technologies and applications. Other states, including California, Nevada, Arizona, Florida and Massachusetts, are already encouraging their utilities to consider these projects, including both community-scale and central systems, as alternatives to other utility generation. New Jersey should similarly explore and encourage this as yet untapped market segment in the State.

Until quite recently, solar PV has not been considered as a competitive wholesale source. But the combination of rising conventional generation costs and the scaling effects of new solar PV technology (as well as solar thermal in parts of the U.S. and Europe) has altered that calculation dramatically over the past twelve months. In New Jersey, the recently passed RGGI legislation embodies a mandate to involve utilities with energy efficiency and renewable energy investments. The State should build on this mandate to encourage its utilities to invest in large-scale solar fields that can achieve economies unavailable to smaller installations and provide cost-effective generation sooner. These should include systems located in areas of the State where congestion issues make local generation even more valuable.

As suggested earlier, one of the challenges is to develop storage technologies to enable this local generation to move toward baseload equivalency, and solar to begin to replace new baseload additions. We have modeled the costs of a solar program versus comparable new natural gas and nuclear plants over reasonable permitting and construction time frames, and have found that the solar program yields a lower LCOE than these conventional alternatives (even without factoring in the transmission costs associated with siting such plants away from populated areas).

This large-scale solar program should be additional to the solar RPS program now in place. The RPS program is considering adding 'grid supply' SRECs, allowing systems larger than 2 MW to participate. A large-systems solar program to supply primary energy to the State as an alternative to central station technologies would need to be carefully integrated with the existing RPS program. New Jersey EDC's might become key players in this large-system market, but the State should consider opening this market to the widest possible set of market participants in order to drive prices down over time. Other states have considered requiring a commission finding that solar capacity has been procured competitively, and consistently with other State goals such as economic development.

The advantages of a utility-based program include the ability to maximize economies of scale and to ratebase investments to provide New Jersey ratepayers with long-term price certainty based on investment timed to the useful life of the asset. Due to falling solar PV prices and escalating construction and fuel costs for conventional generation, an accelerated utility-scale solar program can supply *at least 40% of the 54,000 GWh 2020 shortfall* at an LCOE *as low as 70% that of a new nuclear plant coming online in 2020 (11.3¢/kwh for solar and 16.1¢/kwh for nuclear)*.

5.2. TAKE ADVANTAGE OF EMERGING CROSS-MARKET OPPORTUNITIES TO LEVERAGE ENERGY EFFICIENCY AND DEMAND RESPONSE WITH SOLAR

A variety of new cross-market opportunities for solar, energy efficiency, and demand response are emerging around the country. Building on the foundation New Jersey has already established, we recommend that policy makers consider the following.

5.2.1. Bundling with energy efficiency in new construction

Change the State's building codes to reward or require lower overall energy use at the building's shell and all electrical equipment within the building. Near Zero-energy buildings should also receive code credit for producing their own electricity from clean sources such as solar or fuel cells.

Just this month, California became the first state in the nation to adopt a statewide green building code establishing minimum standards for new construction.[65] The plan, adopted by the California Building Standards Commission, requires that all such construction – commercial residential, schools and hospitals – reduce energy usage by 15 percent. As adopted, the code includes mandatory features with a delayed effective date for housing, and voluntary standards for hospitals and other non-residential buildings.

It also includes, for example, the following provisions for renewable energy:

> **"511 RENEWABLE ENERGY**
>
> **511.1 On-site renewable energy.** Use on-site renewable energy for at least 1% of the electrical service overcurrent protection device rating calculated in accordance with the 2007 California Electrical Code, or 1KW, whichever is greater, in addition to the electrical demand required to meet 1% of natural gas and propane use calculated in accordance with the 2007 California Plumbing Code.
>
> **511.1.1 Documentation.** Calculate renewable on-site system to meet the requirements of Section 511.1. Factor in net metering, if offered by local utility, on an annual basis.
>
> **511.2 Green Power.** Participate in the local utility's renewable energy portfolio program that provides a minimum of 50% electrical power from renewable sources. Maintain documentation through utility billings."

These specific provisions may or may not be appropriate for New Jersey, but the core idea of adopting statewide green building standards that would combine energy efficiency and renewable supply deserves serious attention.

5.2.2. Encouraging the integration and cross-selling of energy efficiency and solar

With or without building code changes, a linked program should educate prospective solar customers on the benefits of efficiency measures to reduce their total electricity use, and energy efficiency customers on the benefits of solar to reduce their costs over time, minimize their

[65] The State's July 17, 2008 announcement appears at http://www.bsc.ca.gov/prpsd_stds/default.htm, which also provides a link to the new code. In California, as in other states, many local jurisdictions have adopted their own green building standards – some stricter than the new state code – and the new code does not prevent cities and counties from taking such actions in the future. An excellent resource for green building initiatives by local jurisdictions across the country can be accessed at http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1779 .

carbon footprint, diversify their supply, and enhance self-reliance. This cross-promotion should be voluntary, and should be integrated into both energy efficiency and solar program delivery.

The industry and the OCE need to analyze which efficiency measures New Jerseyans are implementing and which they are not, as well as what requirements will actually spur participant uptake of energy efficiency. Like California, New Jersey may be able to maximize program returns by focusing on new buildings and/or larger buildings where integrating services may be smoother.

5.2.3. Hybridizing solar with demand response

For New Jersey utilities, a major driver for rising infrastructure and supply costs is providing peak energy for summertime use. The BPU is responding with more aggressive demand response initiatives. Combining solar PV with demand response measures (such as AC controls and thermostat setbacks) can create a more robust dispatchable resource for utilities and demand response providers.

A limiting factor for demand response in New Jersey has been consumer reluctance to limit AC use over the 4-7 days of some recent heat waves. After day three, consumers asked to curtail their AC for 8-hour blocks begin to override their demand controls, undermining demand response as a firm resource. Supplementing other demand response with PV can reduce curtailments to 3-4 hours in the later part of the day: solar carries the load during much of the daily peak period, so fewer hours require the thermostat setback or AC control. This hybrid solution lets utilities maximize comfort and value to the consumer, while ensuring a more robust resource over multi-day heat events likely to become ever more common as our climate changes.

5.2.4. Integrating solar and other renewables into PJM

New Jersey should take steps to open PJM capacity markets to intermittent sources such as solar and wind, as well as demand response. The New England ISO and other regional power pools have incorporated renewables into their forward capacity markets, while PJM's ownership and management structure have inhibited such developments here.

If need be, the BPU should initiate a FERC filing to bypass PJM's cumbersome and conflict-laden Committee structure to fast-track appropriate capacity valuation within PJM markets. The State should also encourage firming technologies such as compressed air and advanced battery storage by funding New Jersey pilot projects to confirm the technical feasibility and economic value of large-scale grid storage within wholesale markets

5.2.5. Promoting other electricity storage applications for distributed renewables

Local electricity storage at the household, building, or utility circuit level provides exciting opportunities to substitute solar for carbon-based transportation fuels. These storage applications can also stretch solar's capability to match load profiles for residential customers and local utility circuits. Below we urge New Jersey to offer financial support for development and demonstration of these technologies.

5.3. PROVIDE APPROPRIATE INCENTIVES FOR UTILITY PARTICIPATION IN SOLAR DEVELOPMENT

Over the past several years, the U.S. Department of Energy, NASEO, California Energy Commission, Massachusetts Technology Collaborative, and a number of utilities have sponsored work by EPRI and the Solar Electric Power Association (SEPA), among others, to explore ways to incentivize utilities to more fully integrate solar and other distributed resources into mainstream utility activities.[66] In addition to some of the activities already underway in New Jersey, this work has identified other options worthy of consideration here. A recent SEPA report[67] discusses these in detail; the following highlights some of them.

5.3.1. Encourage rate base models for utility ownership of community and central solar projects, and for power purchases from non-utilities

Until recently this option has not been widely considered, for several reasons: federal solar tax incentives have not been available to utilities; utilities in some restructured states face restrictions on generation ownership; and utilities, regulators and industry stakeholders have been uncertain about utility participation in potentially competitive markets. However, at least for distributed solar, the SEPA report notes that

> "[a]n important finding of [a recent State Technologies Advancement Collaborative project] was that the distributed generation scenarios most likely to result in a 'win/win/win' outcome for all stakeholders were ones where the utility owned the distributed assets and, although sited on customer premises, the assets were placed on the utility side of the meter, supplying the grid instead of the customer. *Ownership* increased the utility's benefits, because it allowed the utility to earn a return on the distributed asset (as it would on other utility asset investments). Placing generation on the *utility side of the meter* did not decrease the utility's revenue, because its output no longer displaced customer purchases from the grid."[68]

Even without assurances that tax laws will change to extend federal investment credits to utilities, these potential benefits have encouraged some utilities to apply to their commissions for approval of programs where the utility would own solar assets on customer, third party, and/or utility premises.

In New Jersey, PSE&G modified its original Green Towns proposal due to the unavailability of the Investment Tax Credit for such utility owned installations. Their solar loan program was an innovative attempt to bring the 'patient capital' of a utility into the solar generation sphere. If the ITC is extended and passed as drafted, utilities will have the ability in the future to take advantage of the ITC.

We also discuss in Section 5.3.3 a complementary proposal to allow utilities in New Jersey to purchase solar power under a PPA type agreement where the actual ownership and development is done by a private owner. The utility would receive an incentive to enter into such agreements that would provide equivalent returns as in a utility ownership model, and might be able to address nonutility concerns about anti-competitive behavior related to utility asset ownership.

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[66] This work involved a series of collaboratives organized by EPRI's Distributed Resources Public/Private Partnership from 2003-2007, and facilitated by John Nimmons & Associates, Madison Energy Consultants, Energy & Environmental Economics, and the Regulatory Assistance Project. Reports of these activities are available from the California Energy Commission's website, or from the authors.

[67] Nimmons, J. and Taylor, M., *Utility Solar Business Models: Emerging Utility Strategies & Innovation*, Solar Electric Power Association Report #03-08, May-June 2008; available at http://www.solarelectricpower.org/index.php?page=library .

[68] Id., at p. 23; the report discusses the utility programs referenced here that were made public by the time the report was written.

Some examples from around the country follow:

Since 2004, San Diego Gas & Electric has had a small-scale program of this type coupled with energy efficiency and green building in its service territory. On July 11, 2008 the utility sought regulatory approval for a much larger PV program, under which it would build, own, and operate 52 MW of solar at utility facilities, landfills, open space, and parking lots. [69]

This followed a much larger proposal by Southern California Edison in March, which seeks approval to install, own and operate at least 250 MW, and possibly as much as 500 MW, of solar on commercial customer rooftops. [70]

Closer to New Jersey, last Fall Pepco and Delmarva proposed ownership of PV at utility sub-stations and other utility facilities. In June of this year, Duke Energy proposed a $100 million plan to install, own and operate some 20 MW of PV at up to 850 sites including homes, schools, stores and factories in its North Carolina service territory.[71]

These proposals have raised a great deal of interest among utilities, solar proponents and regulators. So far solar proponents and providers have greeted them with cautious praise, recognizing that these proposals could provide the large new markets they need to ramp up production and reduce solar costs, but also that they present important questions of fair competition between monopoly utilities and competitive providers. However regulators resolve these questions, New Jersey should follow these proceedings to find appropriate ways to incentivize utility solar activities, while protecting solar innovators from unfair competition. As discussed elsewhere in this document, a key element of this utility scale program is that it exist in addition to the solar RPS program which the Board has painstakingly nurtured over the last few years.

5.3.2. Buy-outs, 'flips' and other tax-advantaged transactions

The SEPA report also describes arrangements in which utilities, their shareholders and ratepayers might be able to benefit from structured financings for large-scale solar projects, possibly enabling them to capture some of the value of tax benefits that have not otherwise been available to them. Some of these arrangements have already been the subject of utility Requests for Offers under RPS solicitations, and other promising financing strategies are evolving. [72]

5.3.3. Regulatory incentives for renewable power purchases

Another fruitful avenue to align utility interests with the State's interest in developing solar and other renewables, is to revisit the treatment of utility power purchase agreements (PPA) for renewables, under RPS solicitations or otherwise. A proceeding before the Oregon Public Utilities Commission (also discussed in the SEPA report[73]) has been doing just that. It has explored ways to overcome the disincentive faced by utilities when rating agencies impute

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[69] *Application of San Diego Gas & Electric Company (U 902M) for Approval of the SDG&E Solar Energy Project*, filed with the California Public Utilities Commission July 11, 2008.

[70] *Application of Southern California Edison Company (U 338-E) for Authority to Implement and Recover in Rates the Cost of its Proposed Solar Photovoltaic (PV) Program*, filed with the California Public Utilities Commission on March 27, 2008 in A. 08-03-015

[71] *Duke Energy Launches Plan to Own and Operate Solar Power Generation at up to 850 North Carolina Sites*, June 9, 2008, at http://www.duke-energy.com/news/releases/2008060901.asp.

[72] Op. cit. note 67, pp. 32-36.

[73] Id., at pp. 41- 43.

‘debt equivalency’ to utility PPAs, potentially degrading utility credit ratings and raising their cost of capital. It has also explored ways to make utility power purchases (typically treated as pass-throughs) comparable to utility-owned resources (eligible to earn a return for shareholders), by offering some form of earnings potential, such as an ‘adder’ on the utility’s forecasted PPA costs, or at least their capacity component.

We recommend that New Jersey consider this approach or something similar, as another way to encourage the State’s utilities to actively embrace and advance its renewable and climate change goals.

5.4. PROMOTE EMERGING REGULATORY APPROACHES THAT WILL ADVANCE THE ADOPTION OF ENERGY EFFICIENCY AND RENEWABLES

5.4.1. Adopt stronger time-of-use and real-time pricing mechanisms

The BPU should consider expanding consumer choice to include rate options that would allow electric customers to choose time-of-use (TOU) rate plans that encourage non-peak electricity usage. Such rate options are in line with fundamental principles of rate design which dictate that retail prices (rates) should be based on true cost of service causation. The realities of New Jersey electricity use are that peak summer hour usage, mainly driven by ever-increasing use of air conditioning, are forcing distribution utilities to bolster their poles and wires system while purchasing ever more expensive wholesale power. The net result is that all consumers are paying for those customers who are increasing their summer peak hour usage.

Many PJM studies have shown that a minimal reduction in peak usage at the PJM level has a multiplier effect that benefits all consumers – whether or not they have solar on their roofs. By creating rate structures that recognize this differential cost causation, the BPU can provide economic incentives to motivate reductions in peak grid usage by, among other measures, installing local PV technology.

This move to TOU pricing can take many forms. PSE&G is now testing various strategies through its ‘My Power’ program. Its pilot results should help structure TOU rate options.

5.4.2. Establish inverted rate structures

The solar industry is concerned that the evolution of electricity markets be managed in such a way that lower income customers will not be forced to choose between buying electricity and other essentials such as food or shelter.

We believe that rate structures should be established that provide a base level of electricity to consumers at an affordable price, as well as access to programs to help customers reduce the energy intensity of their dwellings and equipment. The costs of expanding the electric infrastructure to accommodate increased individual usage, should be paid by those whose usage drives the need for new investment.

Again, there are many ways to address this issue. Some states use inverted rate structures, which charge those using the most electricity a higher unit price (per kWh). Usage is segregated into price blocks, with each block representing higher usage and a higher price per kWh. This inverted block design also provides a price signal to encourage energy efficiency: those who use the most, pay the most.

5.5. SUPPORT DEVELOPMENT AND DEMONSTRATION OF ENABLING TECHNOLOGY AND INFRASTRUCTURE TO ACHIEVE SOLAR GOALS

5.5.1. Smart grid

New Jersey's electricity distribution system is similar to that in most states. The grid was designed and constructed when the utility model was based on central plant construction and a one-way network delivery mechanism for consumers. Mostly radial, New Jersey's system developed as the State expanded from the Hudson to the Delaware. The system was designed to manage power flows by decreasing voltages close to substations, and increasing voltages at the end of long rural lines where voltage drops made farm motors fail. Real-time operations information did not exist: the most granular information available was often monthly readings at distribution substations.

This system no longer meets the needs of utility operators or consumers. Operators need real-time system information to use expensive distribution assets efficiently. As more customers install on-site generation, more efficient grid operations and more reliable customer supply depend on better information and control capabilities than exist today.

Consumers need more and quicker information about power quality and outage restoration, and want the ability to respond to utility price signals. But 'dumb' equipment and a dearth of communications technology on most grids limits communication with utility control centers. The 'smart grid' refers to redesign and reconstruction of the utility system to provide intelligent nodes and automated meters to transfer actionable information to consumers.

New Jersey utilities have begun pilot programs to test the equipment, perform consumer behavior research, and begin employee training needed to implement the 'smart grid' here. Now, they need to translate that experience from pilots into standard system designs and programs.

Once 'smart grids' are widely implemented, we can realize the true promise of distributed technologies like solar, demand response, and even energy efficiency. Once utilities understand the net power demands of their customers, using capabilities installed at each home or business, they can trim infrastructure expansion and reduce overall capital budgets. 'Smart grids' will also enable New Jersey to minimize construction of new power plants to supply the State, and better utilize existing capacity to lower ratepayer costs.

5.5.2. Electricity Storage

At pages 6-7, we mentioned promising new storage technologies that can begin to firm solar, wind and other intermittent power sources. The same or similar technologies can provide a variety of benefits to the grid, including improved power quality, voltage stability, load shifting, frequency excursion support, etc. Some of these technologies remain in the research, development or demonstration stage, and some are now entering commercialization. Both need policy and financial support from States committed to developing renewable generation and 'smart grid' technologies, and we urge New Jersey to strongly support these efforts.

At least two of the major New Jersey utilities have proposed demonstration programs for electricity storage at the customer and substation level. We support the expansion of these programs and encourage the BPU Clean Energy Office to consider co-funding these and other large scale storage projects in New Jersey.

5.6. Support efforts to adapt PJM market rules to accommodate high penetrations of solar and other renewables

The Draft EMP emphasizes that many of the energy policies that affect New Jersey are beyond its control. In particular, PJM wholesale market decisions are not always seen by New Jersey stakeholders to be in the State's best interest. A current example is the controversy over the new structure of the capacity market.

PJM is now considering its capacity and energy valuation methods to determine if they properly recognize the true value of renewables. It is critical that New Jersey become an active participant in those discussions at the earliest stages. Decisions are being made now about how to calculate wind and solar capacity factors to value renewable contributions to capacity market solutions. Unless it engages at the PJM Committee level, New Jersey will not have the information it needs to ensure that PJM policies are consistent with the directions it chooses in the State's EMP. Since the PJM governance structure presents potential conflict of interest issues, we urge the State to monitor these regional proceedings and decide whether it must intervene at the PJM Executive level, or at FERC.

In the New England ISO forward capacity market proceedings, active participation by the energy efficiency and renewable community succeeded in developing a market structure that enables participation by non-traditional renewable and 'negawatt' providers in regional wholesale markets.

It is also important that PJM operators begin to study the effects of high penetrations of intermittent resources within the power pool. Studies by other ISO's, including California's, have shown that at penetration levels of 20-30%, intermittent resources can be scheduled and controlled. PJM should undertake similar studies if the EMP initiatives, including those recommended here, are adopted. While New Jersey is nowhere near these penetration levels today, PJM operators should be monitoring best practices around the world so they can be incorporated into its operating rules by the time they are needed – hopefully in the not too distant future.

5.7. Coordinate solar achievement with the range of complementary policies outlined in the comments filed in this proceeding by the New Jersey Coalition for a Sustainable Energy future

6. Conclusion

The Draft Plan's analysis represents an excellent beginning. Its authors deserve thanks and commendation for conscientiously addressing a very complex and difficult subject, at a time when all of it is changing dramatically, and on a daily basis.

As challenging as that is, planning assumptions must be based on the best and most current information available if they are to serve New Jersey's policy makers and citizens. These comments have sought to assist the Energy Master Plan's drafters by bringing forth that kind of information and presenting it as systematically as we can. Like their good work over the past year it remains at best a snapshot in time, but we hope that it will strengthen the foundation for the next phase of the planning process. The Draft has already succeeded in engaging a wide range of stakeholders in thoughtful evaluation and more thorough analysis of their own. That is an important step forward, and we appreciate the opportunity to contribute.

* * *

Attachment A

to Comments of The Solar Alliance
on
New Jersey Draft Energy Master Plan

Attachment
A-Lazard-LCOE-6_08

<u>ATTACHMENT B</u>

Solar Power for Cheap and Cloudy Seattle?

Presentation by

Jim Harding, Western Regional Director of the Solar Electric Power Association

July 2008

Mr. Harding served as Director of Power Planning and Forecasting at Seattle City Light for nearly ten years. Before that, he was Assistant and Acting director of the Washington State Energy Office, and Advisor to the Chair of the California Energy Commission.

He has served on expert panels for the Congressional Office of Technology Assessment, National Academy of Sciences, and the Keystone Center, most recently addressing the rapidly rising costs of new large central station power plants, including coal and nuclear power.

Harding-Seattle_7-0
8.ppt

ATTACHMENT C

LARGE-SCALE SOLAR PV PLANTS NOW IN OPERATION

(EXAMPLES)

SunPower Plants


Trujillo Power Plant La Magascona, Trujillo, Spain - 23 MW


Nellis Air Force Base, NV – 15 MW


Serpa Power Plant, Portugal – 11 MW


Bavaria Solarpark, Germany - 10 MW


Isla Mayor Power Plant, Spain – 8.4 MW

Other Examples: Larger-Scale PV Plants Today

http://www.pvresources.com/en/top50pv.php#top50table

Power	Location	Description	Constructed	MWh/GHG
24 MW (40 MW planned)	Germany, Brandis Picture courtesy: juwi GmbH, Mainz	Solarpark "Waldpolenz" GM, GC	juwi GmbH 2007 2008	
23,1 MW	Spain, Abertura (Caceres)	Parque Fotovoltaico Abertura Solar GM, GC, TRAC	Iberdrola 2008	47400 MWh 49800 tons CO_2 emission reduction annually
23 MW	Spain, Hoya de Los Vincentes, Jumilla (Murcia)	Parque Solar Hoya de Los Vincentes, Jumilla GM, GC, TRAC	Luzentia January 2008	41600 MWh 42000 tons CO_2 emission reduction annually
21,2 MW	Spain, Calavéron Picture source: EPURON GmbH, Hamburg	Solarpark Calaveron GM, GC, TRAC 100000 Conergy PowerPlus modules, 18 MW tracking arrays, 3 MW fixed arrays	EPURON GmbH 2008	40000 MWh
20 MW	Spain, Trujillo (Cáceres)	Planta Solar La Magascona GM, GC, TRAC SunPower trackers 120,000 Atersa modules	Elecnor 2008	42,000 tons CO_2 emission reduction annually
20 MW	Spain, Beneixama (Alicante) Picture courtesy/photo: City Solar AG Accener S.L.	Solarpark Beneixama GM, GC 200 x 100 kW Sinvert Master inverters 100000 City Solar PQ 200 modules	City Solar AG Accener S.L. September 2007	30000 MWh 30000 tons CO_2 emission reduction annually
18 MW	Korea, SinAn Picture courtesy: Conergy	SinAn power plant GM, GC, TRAC 108,864 Sharp modules Conergy tracking structures	Conergy Ltd. SunTechnics Ltd. May 2008	27000 MWh 20000 tons CO_2 emission reduction annually
14 MW	USA, Nellis, NV	Nellis Air Force Base GM, GC, TRAC SunPower T20 tracker, SunPower® tracker 70000 modules GT250 Xantrex inverters	SunPower Corp. December 2007	30000 MWh 24000 tons CO_2 emission reduction annually
12,7 MW	Spain, Lobosillo (Murcia) Picture courtesy: Ecostream	Solarpark Lobosillo, Murcia GM, GC 127 x 100 kW SolarMax inverters	Ecostream September 2007	
12 MW	Spain, Villafranca (Navarra)	Parque Solar Fotovoltaico Villafranca GM, GC, TRAC	Parques Solares de Navarra 2008	
12 MW	Germany, Erlasee/Arnstein	Solarpark Gut Erlasee GM, GC, TRAC 1408 SOLON movers used 8 kWp per mover, double axis tracking. 28000 Solon modules	Solon AG 2006	14000 MWh 7700 tons CO_2 emission reduction annually