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Solar Power & NYC Schools: Good Government and Electric Sparkplug

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NOTES

SOLAR POWER & NYC SCHOOLS: GOOD GOVERNMENT AND ELECTRIC SPARKPLUG

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> The role of electricity in contemporary society is increasingly important and supplying it reliably and economically is crucial to the economy.... The State must ensure adequate generating capacity and distribution capacity necessary to avoid constrained areas... while simultaneously protecting the State's environment and reducing global warming. New York needs to maximize the benefits of fuel diversity, energy efficiency, renewable energy, new technologies and energy security, while strengthening the State's economy.[1]

I. INTRODUCTION

By 2030, the New York City Department of City Planning estimates 1.1 million more people will live in New York City.[2] On summer days, when electrical consumption peaks, New York City already consumes more power than Chile and almost as much as Switzerland.[3] Demand, however, continues to grow: New York City Mayor Michael Bloomberg's Plan 2030 ("NYC Plan 2030") estimates that electrical demand will increase by 25% from just over 9

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1. COMM. ON ENERGY, THE ASS'N OF THE BAR OF THE CITY OF NEW YORK, ELECTRIC REGULATION IN THE STATE OF NEW YORK 1, 25-26 (2007), *available at* http://www.nycbar.org/pdf/report/Dereg_report.pdf.

2. DEPARTMENT OF CITY PLANNING, THE CITY OF NEW YORK, NEW YORK CITY POPULATION PROJECTIONS BY AGE/SEX & BOROUGH 1 (2006) (noting population will increase from 8 million to 9.1 million), *available at* http://www.nyc.gov/html/dcp/pdf/census/projections_report.pdf.

3. Associated Press, *Power Line Pits City Energy Needs Against Upstate Opposition*, N.Y. Sun, March 5, 2007.

gigawatts ("GW"), or 9,000 megawatts ("MW"), to over 11.5 GW (11,500 MW),[4] with demand overtaking supply in 2011.[5] Con Edison ("Con Ed"), New York City's main electrical supplier, expects more than one million more room air conditioners in the city in the next five years.[6] City advocates have noted that "as energy demand rises, so does our reliance on dirty, inefficient power plants."[7] NYC Plan 2030 notes that "with limited land available to build new power plants, our challenge is to find a new approach to improve the City's long-term energy outlook."[8] Under current projections, this increased power supply will come mostly in the form of additional natural gas and petroleum with only a small percent increase in overall renewable energy supply.[9] Simple economic theory holds that as demand increases relative to supply, prices will rise.

Further, in addition to the expected rise in petroleum demand caused by the growth of Chinese and Indian economic markets, experts are deeply concerned about the future availability of domestic natural gas.[10] Even without these concerns, natural gas is imported from other states, giving them the benefits of job creation and tax

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4. MAINTAINYC, *available at* http://home2.nyc.gov/html/planyc2030/downloads/pdf/maintainyc_energy.pdf; *See also* PLANYC, *available at* http://home2.nyc.gov/html/planyc2030/ downloads/pdf/full_report.pdf. 1 GW = 1,000 MW; 1 MW produces enough electricity to power roughly 1,000 homes.

5. MAINTAINYC, *supra* note 4 at 4.

6. CON EDISON, ELECTRIC SYSTEM, *available at* http://www.coned.com/newsroom/energysystems_electric.asp (last visited March 10, 2008).

7. ZOILO TORRES, TESTIMONY ON INTRO. 295-IN RELATION TO THE CREATION AND IMPLEMENTATION OF A COMPREHENSIVE ENVIRONMENTAL SUSTAINABILITY ACTION PLAN FOR THE CITY OF NEW YORK, SEPTEMBER 26, 2006 2 (2006), *available at* http://www.urbanagenda.org/pdf06/Intro_395_testimony.pdf.

8. See PLANNYC, available at http://home2.nyc.gov/html/planyc2030/html/about/maintainyc_energy.shtml.

9. PAUL CHERNICK ET AL. ENERGY PLAN FOR THE CITY OF NEW YORK 73 (2003), *available at* http://resourceinsight.com/work/nyc_irp.pdf.

10. John W. Schoen, *Utilities place uncertain CO_2 bets*, MSNBC, April 24, 2007, (noting "for most of the 1990s, natural gas was the fuel of choice for power generation . . . But the popularity of natural gas brought a surge in demand for the fuel that has tightened U.S. supplies and driven up the price"), *available at* http://www.msnbc.msn.com/id/18158460/page/2/; *See also*, NEW YORK ENERGY POLICY TASK FORCE, NEW YORK CITY ENERGY POLICY: AN ELECTRICITY RESOURCE ROADMAP 16 (2004) (noting "given increased reliance on natural gas, there could be reliability and cost impacts from inadequate gas pipeline capacity"), *available at* http://home.nyc.gov/html/om/pdf/energy_task_force.pdf.

revenue.[11] Finally, because of its environmental and health impact – and NYC Plan 2030's goal of making the city's air the cleanest of any big city in the U.S.[12] – the city is unlikely to greatly increase coal consumption.

New York City ("NYC") is, thus, faced with a seemingly impossible set of choices regarding its continued economic growth, environmental sustainability goals, and position as "capital of the world." The approaching energy predicament, however, actually presents NYC with the opportunity to reexamine its energy policy in light of these upcoming problems.[13] The best, and possibly only, solution is to encourage the large-scale use of renewable sources of energy. Although government purchase of renewables can help relieve some of the energy pressure NYC faces, the great majority of electrical demand comes from the private sector. Government investment in renewable energy, however, can help stimulate the market for renewable energies in the private sector.

II. POTENTIAL RENEWABLE ENERGY SOURCES

Wind energy has great potential in New York State;[14] it does not, however, have the same potential in NYC. There are not enough open spaces and the land is low in altitude, both of which disqualify the city for large-scale wind development.[15] Staten Island, for in-

11. NaturalGas.org, Natural Gas Supply, http://www.naturalgas.org/business/analysis.asp (last visited Mar. 13, 2008) (noting "domestic natural gas production comes primarily from 5 states: Louisiana, New Mexico, Oklahoma, Texas, and Wyoming. In fact, according to the Energy Information Administration (EIA) these 5 states were responsible for just under 80 percent of total marketed natural gas production in 2001." Further, the EIA notes that 15% of the U.S.'s natural gas is imported).

12. PLANYC, *supra* note 4, at 121.

13. *See generally*, NYC APOLLO ALLIANCE, LETTER TO THE NEW YORK STATE PUBLIC SERVICE COMMISSION 3 (2006) (noting "the [PSC] should view this summer's energy crisis as a catalyst for future collaboration . . . to think of innovative and sustainable ways to address energy consumption and conservation"), *available at* http://www.urbanagenda.org/pdf/PSCQueensPowerOutage.pdf.

14. AMERICAN WIND ENERGY ASSOCIATION, WIND ENERGY: AN UNTAPPED RESOURCE (2006) (noting New York State is 15th in wind energy potential for U.S. states), *available at* http://www.awea.org/pubs/factsheets/Wind_Energy_An_Untapped_Resource.pdf.

15. *See e.g.*, Defenders of Wildlife, Detailed Recommendations for Wind Energy, http://www.defenders.org/programs_and_policy/policy_and_legislation/energy/renewable_energy/wind_energy/index.php (last visited Mar. 13, 2008)

stance, "is investigating the feasibility of installing at least five windmill towers atop the closed landfill's tallest mound."[16] This could, potentially, provide electricity for 5,000 Staten Island homes.[17] There are not, however, many other spots around NYC that match this potential. Further, while powering 5,000 homes without burning fossil fuels is beneficial, clearly wind could not meet the current or future electrical demands of NYC. Finally, as the recent attempt to install wind turbines in Cape Cod illustrated,[18] many residents do not want wind turbines to potentially impede their views, no matter what the benefits – and they will fight to prevent their installation.

Another renewable energy source for NYC is wave, or tidal, power. In 2006, Verdant Power—a tidal-turbine developer—installed the first series of tidal-turbines in NYC's East River.[19] According to the company, the East River has the potential to create 10 MW of electricity, or enough to power roughly 8,000 homes.[20] Even if the Hudson River had the potential to double the overall impact, it would still be only a fraction of NYC's demand.[21] Further, it is only a fraction of the potential of solar energy in NYC.

Solar power is the only renewable energy with the potential to solve NYC's energy problems.[22] If NYC installs photovoltaic solar panels ("PV") on the roofs of New York City schools—the largest group, in number and size, of publicly-owned buildings in the city—

(noting maximum wind effect is often found at areas of high elevation and open ground); *see also* United Press International, *High Elevation Wind Sources Sited in Ohio*, April 20, 2007 (noting Ohio's wind potential grew from 1% of the state to 12% when research was conducted at high elevations).

16. Sam Williams, *Wind Power in NYC*, Gotham Gazette, March 8, 2006, *available at* http://www.gothamgazette.com/article/environment/20060308/7/1782.

17. *Id.*

18. *Id.*

19. Verdant Power, The RITE Project, http://www.verdantpower.com/what-initiative (last visited Mar. 13, 2008).

20. *Id.*

21. Note: while tidal and wind are not able to meet solar energy's potential, their contribution would certainly be welcome as against conventional energy production, direct government investment probably is not worth the trouble. Because there is little additional potential, the government would not be able to stimulate the market, nor would it be able to invest in either on City-owned land.

22. *See* PLANYC, *supra* note 4, at 112 (noting "of all the renewable energy sources, solar currently has the great potential to generate electricity within the five boroughs").

it could provide approximately 120 MW of electricity, or enough electricity to power 120,000 NYC homes.[23] While the costs of this system appear enormous, the investment could be repaid in approximately a decade; it could also be paid without using any tax revenue. Most importantly, this large-scale investment will also spur private PV installation in the city through the economies of scale, which will lower the costs of parts and installation. This plan could markedly decrease the demand for nonrenewable sources of energy, stabilize electrical prices citywide, lessen the risk of citywide blackouts by decentralizing the electrical grid, provide power during peak-demand times and stimulate job-growth.

III. ELECTRICAL DEMAND IN NYC: PRESENT AND FUTURE

According to a report by New York City Councilman Eric Gioia, "New York City residents are already paying significantly higher utility bills" than residents of other large American cities.[24] In January 2007, NYC residents paid nearly $0.19 per kilowatt-hour ("kWh");[25] the national average for electricity was about $0.10/kWh.[26] In fact, according to Councilman Gioia, San Francisco residents—in the midst of California's energy crisis of the past seven years—were still paying $0.04/kWh less than New York City residents.[27] At the same time, Con Ed has already applied for a rate hike in 2008.[28] According to the company "[t]he city is projecting significant growth in its population, housing stock, and commercial development over the next several years. The growth will create new energy needs, which must be addressed with billions of dollars in investment to enhance and expand our electric delivery system."[29]

It is clear that increased energy supply, competitive electrical prices and environmental and land use concerns cannot be addressed under the current methods of energy production. The current situa-

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23. *See infra* pp. 30-31.

24. Nathan Duke, *City pays double national average for ConEd: Gioia*, Queens Times Ledger, March 15, 2007.

25. One kWh is equal to 1,000 watt-hours, or the "unit of work or energy equal to that expended by one kilowatt in one hour." http://www.merriam-webster.com/dictionary/kilowatt%20hour.

26. *See* Duke, *supra* note 24.

27. *Id.*

28. *Id.*

29. *Id.*

tion highlights the extreme supply and demand pressure NYC is under. The study implicitly shows how San Francisco's (and California's, in general) pro-active planning—as discussed below—in favor of renewable energy and energy efficiency might have begun to reduce demand from power plants. What have New York's state and local governments done to reverse our unsustainable course?

A. New York State Legislation

Executive Order 111 of then-New York State Governor George Pataki notes the responsibility of the State to assume "a leadership role in promoting the efficient use of energy and natural resources in the interest of the long-term protection and enhancement of our environment, our economy, and the health of our children and future generations."[30] The Order demands energy efficiency measures be taken immediately on all new and existing buildings owned by the State.[31] The Order also forces state agencies to increase their purchase, from 10% in 2005 to 20% in 2010, of energy from renewable sources such as PV.[32]

NY Governor Eliot Spitzer has similarly recognized the impending dangers. In a recent speech, Governor Spitzer declared, "we face three seemingly intractable challenges: rising energy bills, rising global temperatures, and a rising tide of young people leaving (NY) for opportunity elsewhere – each of which can be addressed by a long-term clean energy strategy."[33] Although the speech does not mention PV, the governor noted that, "the cheapest and cleanest power plant in the world is the one you never have to build."[34] Governor Spitzer's plan, however, calls exclusively for renewable energy investment in Upstate NY.[35] The plan also focuses almost exclu-

30. N.Y. COMP. CODES R. & REGS. tit. 9 § 5.111 (2001).

31. *Id.*

32. *Id.*

33. Eliot Spitzer, Governor, New York, Address to Crain's Breakfast Business Roundtable (April 28, 2007), *available at* http://www.ny.gov/governor/keydocs/CleanEnergySpeech-final.pdf.

34. *Id.* at 2 (noting the ability of energy efficiency to reduce demand and forestall the need for new power plants). This statement, however, is also applicable to PV's ability to negate the need for power plants.

35. *Id.* at 4 (noting the state government agencies "will announce the approval of 21 contract awards for clean, renewable power plants in New York...all Upstate").

sively on energy efficiency measures, without detailing plans for renewable energy production. The governor misses one of the key findings of NYC Plan 2030: higher population and more reliance on technology, whether efficient or not, will increase demand. Further, Upstate investment in renewables will not sufficiently address energy demand in NYC.

B. New York City Legislation

The government of the City of New York ("the City") has taken even stronger steps, most notably Local Law No. 86/2005 ("LL 86").[36] LL 86 notes "probably no urban activity has greater impact on human health and the environment than building construction and use."[37] In fact, according to NYC Plan 2030, 79% of NYC's CO_2 emissions came from buildings.[38] LL 86 notes that most of NYC's electricity is produced within the city; increased use further harms the local environment.[39] The growth in demand, it states, increases "our reliance on dirty, inefficient power plants."[40] As the first step toward remedying this situation, the law recognizes that green-building techniques reduce the demand for energy;[41] therefore, green methods of building construction and use are a "sound investment of public dollars."[42] Finally, the financial analysis done by the NYC Council demonstrates that avoided costs, besides the additional benefits noted earlier, will "offset debt services."[43] This presumed offset concurs with San Francisco's experience in PV installation at its Mascone Convention Center, discussed below.[44]

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36. New York City Local Law No. 86 (2005) [hereinafter LL 86].

37. *Id.*

38. MICHAEL R. BLOOMBERG, NEW YORK CITY MAYOR'S OFFICE OF OPERATIONS, OFFICE OF LONG-TERM PLANNING AND SUSTAINABILITY, INVENTORY OF NEW YORK CITY GREENHOUSE GAS EMISSIONS, at 25 (April 2007), http://www.nyc.gov/html/om/pdf/ccp_report041007.pdf.

39. LL 86, *supra* note 36 (noting how the pollutants associated with electricity production "contribute to respiratory disease, heart disease, smog, acid rain, and climate change").

40. *Id.*

41. *Id.*

42. *Id.*

43. *Id.*

44. THE VOTE SOLAR INITIATIVE, MASCONE CASE STUDY 1, http://www.votesolar.com/resources/downloads/tools_Moscone_Case_Study.pdf. [hereinafter MASCONE CASE STUDY]. In fact, the offset at the Mascone Convention Center is so high, the 30-year bond will be repaid in 7 ½ years.

In 2005, the New York City Council also produced a report entitled "Working Towards A Sustainable City: Accomplishments & Agenda," which outlined past legislation and future goals of the City regarding sustainability.[45] Although it correctly points out that "New York is already a very environmental city (because of its) incredible density and extensive public transportation system,"[46] the report also notes that "if the City is to maintain its position as a global leader and improve the health and quality of life of those who live and work here, it must further reduce its ecological footprint."[47] The report highlights that "as the cultural, media and financial capital of the world, and with a $50 billion budget, if we lead the way towards environmental sustainability, many others will take notice."[48] Finally, it states, "as the consumer of over 10% of the energy used in this city, the operations of the City of New York have a major impact on local energy availability and air pollution."[49]

In the Climate Protection Act of 2005, the City passed a law requiring the Office of Environmental Coordination to inventory the City's emissions and produce an action plan to reduce its emissions.[50] From a baseline of 1995 emissions, the bill requires the City to reduce emission by 20% by 2010, 25% by 2016 and 30% by 2021.[51] The City, however, has not finalized the data, nor has the City developed or implemented the plan, or monitored progress and reporting results.

Most recently, in an attempt to reduce the energy demand from new NYC buildings, Mayor Bloomberg announced the first major overhaul in the NYC building code since 1968.[52] The new standards emphasize "efficiency and sustainability."[53] For the first time, the city's building code will be tied to the national three-year revision

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45. NEW YORK CITY COUNCIL, WORKING TOWARDS A SUSTAINABLE CITY: ACCOMPLISHMENTS & AGENDA (2005), a*vailable at* www.nyccouncil.info/pdf_files/reports/sustainable.pdf [hereinafter WORKING TOWARDS A SUSTAINABLE CITY].

46. *Id.*

47. *Id.*

48. *Id.*

49. *Id.* at 31.

50. New York City Local Law No. 661, chs..8, §24-801-§24-808 (2005).

51. *Id.*

52. Press Release, The City of New York, Mayor Bloomberg and Buildings Commissioner Lancaster Announce Completion of First Proposed Overhaul to Building Code Since 1968 (May 3, 2007)., *available at* www.nyc.gov.

53. *Id.*

cycle, "enabling the city to take advantages of innovations in new materials and technology."[54] The updated code will provide rebates for "green design" and will require "more efficient heating and cooling systems, white roofs, and (encourage) plumbing systems that conserve water."[55]

The legislation undertaken by New York's state and city governments illustrates their recognition of the economic waste in current energy production and use, the cost-saving potential of green energy production, and other societal costs of the status quo. NYC Plan 2030 similarly illustrates NYC's recognition and concern.[56] NYC is trying to balance population and economic growth with these unavoidable energy concerns: how can NYC grow by one million residents in 25 years without destroying our air and economy? With energy demand sure to grow, how can we hope to improve our air and avoid extreme spikes in energy costs? In a city already almost completely developed, from where will we produce this extra electricity?

IV. CONSEQUENCES OF CURRENT ELECTRICITY PRODUCTION AND USE

Our current production of electricity severely affects all aspects of life in NYC. Individuals, families, and businesses, as well as land, are all affected by the power plants that supply NYC with its electrical demands. Some of the consequences include abnormally high asthma rates and some of the highest electrical prices in the nation.[57]

As NYC Plan 2030 notes, in 2000, asthma hospitalization rates for children in NYC were almost twice the national average.[58] The New York City Economic Development Corporation further estimates electrical demand will increase by 25% by 2030.[59] This will significantly harm our already precarious environmental situation. New York City is already out of compliance with national standards in

54. *Id.*

55. *Id.*

56. PLANYC, *supra* note 4.

57. Residential Electricity Guide, U.S. Department of Energy, Energy Information Administration, *available at* http://www.eia.doe.gov/neic/brochure/electricity/electricity.html (noting in 2003, New York State paid $14.31/kWh, while Vermont paid the second highest at $12.82/kWh).

58. PLANYC, *supra* note 4, at 30.

59. *See id.* at 4..

ozone levels and small particles.[60] Its asthma hospitalization rate is twice the national average; in the Bronx, the rate is almost four times the national average.[61] Currently, in fact, power plant emissions contribute to over 1,000 deaths and 25,000 asthma attacks in the metropolitan area.[62] These emissions cost the city over $6 billion *every year* in public health related expenses.[63] According to the NYC Apollo Alliance,[64] "[t]he poor air quality and high rates of asthma in the city as a whole most severely affect children in low-income communities of color, which are often home to new power plants built to keep up with the city's energy appetite."[65] As NYC Plan 2030 notes, "reducing emissions from local sources alone could dramatically improve air quality."[66] Unfortunately, emissions have actually increased from the City's largest generators: "the Ravenswood plant in Queens increased its NO_x and SO_2 emission by 14%, respectively, between 1995 and 2003 . . . . The Astoria generating plant increased its SO_2 emissions by 65% during the same period."[67] Note that both of these power plants are located in poor, predominantly minority-inhabited sections of Queens.

Beyond environmental consequences, the economic landscape looks even worse. As stated, NYC electrical demand is scheduled to increase 25% by 2030 with demand overtaking supply in 2011.[68]

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60. Air Quality Survey for PLANYC, *available at* http://home2.nyc.gov/html/planyc2030/downloads/pdf/greenyc_air_quality.pdf (noting NYC is already out of compliance with national standards in ozone levels and small particles).

61. *Id.* at 4 (noting that "experts suggest other diseases are also correlated to the presence of significant quantities of air pollution").

62. THE CTR. FOR SUSTAINABLE ENERGY AT BRONX CMTY COLL., NEW YORK CITY'S SOLAR ENERGY FUTURE, PART I: THE MARKET FOR PHOTOVOLTAIC SYSTEMS IN NEW YORK CITY 7 (2006), *available at* http://www.bcc.cuny.edu/InstitutionalDevelopment/CSE/CUNY%20MSR-Market_for_PV_in_NYC.pdf [hereinafter CSE MARKET].

63. *Id.* at 7.

64. The NYC Apollo Alliance is the NYC arm of a national coalition of "labor unions, environmental justice advocates, business leaders, community organizations, and educators... whose aim is to "transform the way New York City is powered in order to create jobs, improve residents' health and productivity, promote equity, and ensure New York maintains its status as the preeminent global city." *See* http://www.urbanagenda.org/projects.htm.

65. NYC APOLLO ALLIANCE, REPOWERING GOTHAM: STATE ACTION TO BUILD NEW YORK CITY'S NEW ENERGY ECONOMY 4 (2006), *available at* http://urbanagenda.org/pdf06/repoweringgotham.pdf.

66. Air Quality Survey, *supra* note 60, at 5.

67. WORKING TOWARDS A SUSTAINABLE CITY, *supra* note 45, at 7.

68. *See* PLANYC, *supra* note 4.

Global warming will spur some of this increased demand. As a result of rising temperatures, the number of days in which the city will need air conditioning will increase by 43% to 135% during the 21st century.[69] The limited supply of land for new power plants, together with increasing demand, will cause prices to skyrocket.[70] NYC's energy infrastructure is "aging and increasingly inefficient."[71] According to combined data from the NYC Economic Development Corporation and the Mayor's Office of Long-term Planning and Sustainability, the percent of energy from power plants over 50 years old will increase from 5% to 70% by 2030.[72] This is especially problematic: plants in operation for more than 30 years require over 10,000 BTUs to produce 1 kWh, whereas plants in operation less than 30 years require only 7,000 BTUs – 53% less.[73] Thus, by 2030, our current power plants will require *much* more fuel simply to reach current levels of production.

Finally, on March 10, 2005, the EPA issued the Clean Air Interstate Rule ("CAIR").[74] According to the EPA, CAIR "will achieve the largest reduction in air pollution in more than a decade... [it] will permanently cap emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in the eastern United States."[75] According to the EPA, this will reduce NO_x and SO_2 in New York City by 47% and 84%, respectively.[76] While this will help improve our air quality, according to The Center for Sustainable Energy at Bronx Community College, implementation will "increase the costs of fossil-fueled elec-

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69. CENTER FOR INTERNATIONAL EARTH SCIENCE INFORMATION NETWORK, PREPARING FOR CLIMATE CHANGE IN THE METRO. E. COST REGION: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND THE CHANGE ENERGY SECTOR 16 (2000) *available at* http://metroeast_climate.ciesin.columbia.edu/reports/energy.pdf. For instance, if NYC residents currently use air conditioning 30 days per summer, as temperatures rise, the number of days they use air conditioning will increase to between 43 and 70 days, respectively.

70. PLANYC, *supra* note 4, at 102. Using simple supply-and-demand, increasing demand without an equal increase in supply will cause prices to increase, unless we can find an equivalent supply of electricity from non-local sources.

71. MAINTAINYC, *supra* note 4, at 3.

72. *Id.*

73. *Id.*

74. U.S. ENVTL. PROT. AGENCY, CLEAN AIR INTERSTATE RULE, *available at* http://www.epa.gov/air/interstateairquality/index.html.

75. *Id.*

76. THE CTR. FOR SUSTAINABLE ENERGY AT BRONX CMTY COLL., *supra* note 62, at 8.

tricity sited within New York City."[77] With demand set to overtake supply in 2011—and costs sure to rise because of it—how will residents or businesses afford to live and work here? What alternative paths can the City take to avoid this economic and environmental meltdown? The best path would include the installation of large-scale PV systems throughout NYC.

V. PHOTOVOLTAIC ENERGY

According to the U.S. Department of Energy, the PV process consists of light shining on a PV cell; then:

> [t]he energy of the absorbed light is transferred to electrons in the atoms of the PV cell . . . . These electrons escape from their normal positions in the atoms of the semiconductor PV material and become part of the electrical flow, or current, in an electrical circuit. A special electrical property of the PV cell—what we call a "built-in electric field" provides the force, or voltage, needed to drive the current through an external "load," such as a light bulb.[78]

Individual PV cells are connected to form modules, which are in turn connected to form arrays.[79] Together with the PV arrays, a system also includes an inverter, which inverts the electricity from DC ("direct current") to AC ("alternating current") power, which is used in most homes.[80] Finally, there is typically a mounting structure to point the arrays towards the sun for maximum exposure.[81]

PV systems are "mobile, silent, durable, virtually maintenance-free, modular . . . and easy to install;"[82] they also typically come

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77. *Id.*

78. U.S. DEP'T OF ENERGY, THE PHOTOELECTRIC EFFECT, *available at* http://www1.eere.energy.gov/solar/photoelectric_effect.html.

79. U.S. DEP'T OF ENERGY, PV SYSTEMS, *available at* http://www1.eere.energy.gov/solar/pv_systems.html.

80. *Id.*

81. *Id.*

82. THE CTR. FOR STUDY OF RESPONSIVE LAW'S GOV'T PURCHASING PROJECT, ENERGY IDEAS 1 (1996), *available at* http://www.gpp.org/energy_ideas/EI.0296/EI.0296.04.html.

with a standard 25-year warranty.[83] PV systems are so reliable, in fact, that they are used on "all space satellites, the Mars Rover, and about 99% of all off-shore Coast Guard buoys."[84] According to Vote Solar, a California non-profit whose goal is to "build the economies of scale necessary to bring down solar's cost,"[85] a system installed in Massachusetts in 1981 is still, as of early 2007, operating at 92% of its peak capacity.[86]

PV can save money in two ways. First, any electricity produced by a PV system is electricity that does not have to be purchased from an electric utility; this decreases the amount of supply demanded, and, thus, lowers the overall price.[87] Second, when the PV is interconnected with the existing grid, a PV owner can sell their excess supply back to their electricity provider,[88] a process known as "net metering."[89] However, according to David Engle, a writer specializing in construction, "[e]lectric utilities—having almost no incentive to make the process easy, and several reasons to thwart it—have typically forced developers to run a gauntlet of expenses and vexing hurdles."[90] Electric utilities profit per watt of electricity they produce; they have an incentive to make interconnection as inefficient as possible to avoid large-scale interconnection, such as citywide investment in PV.[91]

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83. The Vote Solar Initiative, *Solar is Reliable*, http://www.votesolar.org/reliable.html [hereinafter *Solar is Reliable*]

84. *Id.*

85. The Vote Solar Initiative, *About Vote Solar*, http://www.votesolar.org/about/index.html.

86. The Vote Solar Initiative, *supra* note 83.

87. Though, of course, an individual system won't lower the price by an amount one can see. For instance, a 60kW system might produce 40kW; but with NYC's demand at 9 GW, that will not lower demand appreciably. If PV were installed on a large-scale, though, supply demanded would be equally lower. At that point, prices would decline appreciably.

88. Although the New York State Public Service Commission provides the City of NY with electricity, Con Ed controls the power lines and, thus, the delivery of the City's power. Hence, this plan would include selling the excess electricity to Con Ed, who will pay the DOE at a rate to be determined.

89. *See e.g.,* U.S. DEP'T OF ENERGY, NET METERING POLICIES, *available at* http://www.eere.energy.gov/greenpower/markets/netmetering.shtml.

90. David Engle, *Lowering the Interconnection Barrier*, *in* DISTRIBUTED ENERGY: THE JOURNAL OF ONSITE POWER SOLUTIONS, Nov.-Dec. 2005, *available at* http://www.distributedenergy.com/de_0511_lowering.html.

91. *See generally* Illinois Climate Change Advisory Group, *Decoupling of utility rates and profits, available at* http://www.epa.state.il.us/air/climatechange/documents/subgroups/power-energy/decoupling-of-utility-rates-and-profits.pdf.

Recently, however, the New York State Public Service Commission, which is in charge of utilities in the state, made an historic announcement: utilities would be required to "decouple" production from profit-making.[92] As Commission Chairwoman Patricia Acampora noted:

> To the extent current design of utility delivery rates continue to link the recovery of utility fixed costs, including profits, to the volume of actual sales, disincentives exist that limit the utilities' interest in promoting efficient energy use. Creating a mechanism to reduce or eliminate the dependence of utilities' revenues on sales, would thereby increase the utilities' interest in the promotion of customer initiated more efficient energy use.[93]

This change will hopefully encourage utilities to standardize interconnection procedures, while also removing unnecessary rules meant to discourage interconnection.

VI. EXAMPLES OF GOVERNMENT INVESTMENT IN PV

Governments throughout the world have recognized the potential of solar power to meet energy needs. Japan, recognizing future land use and environmental issues similar to NYC's, introduced subsidies for PV installation in 1994.[94] The program paid 50 percent of the cost of every solar installation.[95] By 2005, the government paid only 3 percent. Because of the economics of scale, PV costs have approached market prices for conventional electricity production and the subsidies have been phased out.[96]

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92. New York State Public Service Commission, Press Release, *PSC Seeks More Efficient Energy Use*, April 18, 2007, *available at* http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/ArticlesByCategory/99D1F3C48DDFED1F852572C100713F6B/$File/pr07027.pdf?OpenElement.

93. *Id.*

94. Amanda Griscom Little, *Solar Derby*, October 25, 2005, http://www.grist.org/news/muck/2005/06/23/little-solar/,

95. *Id.*

96. *Id.*

In 2000, Germany passed the Renewable Energies Law.[97] According to Deutsche-Well, a publicly-owned and operated news station similar to the BBC or PBS, "[t]he legislation committed the country to at least doubling the percentage of renewable energy in the overall supply by 2010. It set up generous rates for renewable energy providers who feed into the electricity grid, and created a market for solar energy."[98] In 1999, 16.5 MW of PV were installed;[99] in 2000, 44 MW were installed[100] – more than twice the previous year.

In 2004, Germany introduced a feed-in tariff. Feed-in tariffs are the amount utilities must pay PV owners for the electricity their system produces and sends back to the electrical grid; in other words, excess electricity above the owner's current demand. Over a 20-year period, the tariff "permits customers to receive preferential tariffs for solar generated electricity depending on the nature and size of the installation."[101] The base level of compensation can be up to 45.7-euro cents/kWh.[102] Each year, the tariff will be reduced by 5%.[103] With this additional incentive, in 2005, 845 MW of PV were installed.[104] This growth equates to business expansion for PV companies as well. In April 2007, Goldman Sachs & Co. issued a "buy" recommendation on Centrosolar AG, a German provider of PV systems.[105] The PV market also has brought back economically depressed areas of Germany. "One of the main benefactors of the solar boom is eastern Germany, which has long been under an economic shadow."[106] In fact, according to the Munich-based consulting firm Roland Berger, by 2020, more people in Germany could be employed in solar and related jobs than are in the auto industry and engineering.[107]

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97. Kyle James, *German Solar Boom Shines its Light on Depressed East*, Deutsche-Well, April 13, 2007.

98. *Id.*

99. Solarbuzz.com, Fast Energy Solar Facts: German PV Market http://www.solarbuzz.com/FastFactsGermany.htm (last visited April 10, 2008).

100. *Id.*

101. *Id.*

102. *Id.*

103. *Id.*

104. *Id.*

105. Henrietta Rumberger, *German Stocks Including Telekom Fall; Deutsche Bank, BMW Rise*, Bloomberg News, April 23, 2007.

106. James, *supra* note 97.

107. *Id.*

Domestically, in 2003, "New Mexico passed a $20 million bond for solar and energy efficiency technologies for state-owned buildings."[108] Vote Solar expects the project to net $18 million in savings over the life of the bond period[109] – a 90% return on the initial investment.

In 2001, residents of San Francisco, "after rolling blackouts and soaring energy prices,"[110] voted in favor of a $100 million bond to fund solar generation for public buildings.[111] The first public building to receive funds under the bond was the Moscone Convention Center.[112] According to Vote Solar, "the measure will pay for itself entirely from energy savings at no cost to taxpayers."[113] The 675-kilowatt ("kW") system cost $5.7 million (after $2.4 million in state solar and energy efficiency subsidies).[114] It is projected to produce $750,000 in annual savings, thus recouping the bond money in 7 ½ years.[115] According to Vote Solar, data from the first year of operation showed the system was delivering savings *above* the guaranteed levels,[116] meaning it could be paid off even faster. The project is also guaranteed to save at least 5,000 MW of electricity over the life of the system.[117]

A. California Solar Initiative

Perhaps the world's most ambitious government, however, is the State of California. In August of 2006, Governor Schwarzenegger "signed into law Senate Bill 1, which directs the California Public Utilities Commission ("CPUC") to implement the California Solar

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108. City Successes, The Vote Solar Initiative, at 2, http://www.votesolar.com/city-initiatives/successes.html.

109. *Id.*

110. MASCONE CASE STUDY, *supra* note 44 (Blackouts and soaring energy prices will similarly affect New York City if the city does not increase supply or lower demand).

111. *Id.*

112. *Id.*

113. *Id.*

114. *Id.*

115. *Id.* (The electricity rate was $0.15/kWh. The government of NYC currently receives power from NYPA; the cost is approximately the same, but will likely increase as demand meets supply. Thus, any solar project could potentially save more money relative to the size of the project).

116. *Id.*

117. *Id.* at 2.

Initiative."[118] This program, more commonly known as the "Million Solar Roofs Program," sets a goal of 3,000 MW of new PV capacity in the state by 2017.[119] CPUC will provide $2 billion in incentives from 2007-2017;[120] the California Energy Commission will manage a $350 million program to encourage solar in new home construction.[121]

The California Solar Initiative Handbook ("Handbook") provides the rules and regulations for the plan.[122] The first incentive is the one-time Expected Performance Based Buydown ("EPBB").[123] According to the Handbook, "these EPBB incentives are based on an estimate of the system's future performance. [They] combine the benefits of rewarding performance with the administrative simplicity of a one-time incentive paid at the time of project completion."[124] The EPBB provides a $2.50 per watt subsidy for systems up to 1 MW with a gradually lower subsidy as the system moves higher above 100 MW.[125] The Handbook states "expected production of electricity by the system may not exceed the actual energy consumed during the previous 12 months at the Site."[126] Further, all systems also must have a minimum 10-year warranty from the manufacturer and installer.[127] The system must be interconnected to the electrical distribution grid; therefore, it must comply with applicable codes and utility interconnection requirements.[128] The Handbook states, "these EPBB incentives are based on an estimate of the system's future performance. [They] combine the benefits of rewarding performance with the administrative simplicity of a one-time incentive paid at the

118. Go Solar California, California Public Utilities Commission, http://www.gosolarcalifornia.ca.gov/csi/index.html (last visited April 10, 2008).

119. *Id.*

120. CALIFORNIA PUBLIC UTILITIES COMMISSION, CALIFORNIA SOLAR INITIATIVE HANDBOOK 1-2 (2008), *available at* http://www.cpuc.ca.gov/NR/rdonlyres/A4E6B6BD-0D6E-4C5F-BBA1-F2712B491577/0/CSI_Handbook_1_08.pdf [hereinafter HANDBOOK].

121. *Id.*

122. *Id.*

123. *Id.* at 1-7.

124. *Id.* at 30.

125. *Id.* at 7.

126. *Id.* at 86. This seems to be a stopgap for subsidies for systems meant for profit.

127. *Id.* Although this should not be a problem for the program: as noted earlier, systems generally have 25-year warranties. *See Solar is Reliable*, *supra* note 83.

128. HANDBOOK, *supra* note 120, at 23.

time of project completion."[129] All government buildings that fit within the requirements are eligible for all subsidies and incentives.[130] In fact, government and non-profit PV projects receive $3.25 per watt (compared to $2.50 per watt for commercial projects).[131]

After the EPBB, the state also provides a Performance-Based Incentive ("PBI") to all systems equal to or greater than 100 kW.[132] The PBI is paid per kWh: for residentially- and commercially-owned systems, the rate is $0.39; for government and non-profit systems, the incentive is $0.50.[133] The PBI is paid monthly for five years at a constant rate for the entire term.[134] With both the EPBB and the PBI, the state gives government entities an even stronger incentive to implement solar projects. Finally, the process takes between 12-18 months depending on size and type of project (retrofit or new construction).[135]

As stated, the California Solar Initiative is arguably the world's most ambitious solar development plan. The state recognized the need for reliable, affordable, and environmentally sound energy.[136] To do this, the state put in place "specific and measurable actions throughout California's energy sector."[137] Notable for future government-spurred solar projects, this included strong incentives, both upfront and during the life of the system. As stated, California's goal is to install 3,000 MW of PV systems by 2016. Vote Solar estimates this will result in over 10,000 MW of PV systems installed by 2026.[138]

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129. *Id.* at 30.
130. *Id.* at 34.
131. *Id.* at 35.
132. *Id.* at 1.
133. *Id.* at 7.
134. *Id.* at 35.
135. *Id.* at 42.
136. CALIFORNIA PUBLIC UTILITIES COMMISSION, ENERGY ACTION PLAN II: IMPLEMENTATION ROADMAP FOR ENERGY POLICIES 3 (2005), *available at* http://docs.cpuc.ca.gov/word_pdf/REPORT/51604.pdf.
137. *Id.* at 2.
138. THE VOTE SOLAR INITIATIVE, CALIFORNIA SOLAR INITIATIVE - ECONOMIC BENEFITS OF AVOIDED ELECTRICITY PURCHASES, *available at* http://www.votesolar.com/resources/downloads/CSI_Econ.pdf [hereinafter ECONOMIC BENEFITS]; *see also* THE VOTE SOLAR INITIATIVE, VOTE SOLAR ANALYSIS OF CALIFORNIA SOLAR INITIATIVE BENEFIT, *available at* http://www.votesolar.com/resources/downloads/CSI_Model.pdf [hereinafter ANALYSIS].

The 25-year expected Net Present Value illustrates the incredible cost-saving benefit to California's economy – only one of the various benefits of the initiative. Using Vote Solar's analysis, avoided costs are examined under three cases: low, medium, and high.[139] Under the three cases, benefits of 25 years of electrical production only from solar installed from 2006-2016 are: $1.2 billion, $3.1 billion, and $5.2 billion, respectively.[140] However, when you include solar systems installed from 2017-2031, the avoided costs over the same 25-year period increase to an astounding $7.3 billion, $12.5 billion, and $18.2 billion, respectively.[141]

Under the low scenario, this program is still a 50% return on investment.[142] Under the medium scenario, the return on investment is 129%; under the high scenario, return on investment is 217%. When you include systems installed from 2017-2031, the return on investment is off the charts. Under the low scenario, the return is 304%; under the medium scenario, return is 521%; under the high scenario, return is 758%. Note, too, the low scenario is highly unlikely; the price assumption for the low model is $0.11/kWh for peak power generation and $0.06/kWh for non-peak generation.[143] In 2005, overall residential electricity cost almost $0.13/kWh (with commercial prices at nearly $0.14/kWh).[144] Considering residential electric prices have risen every year since 1980,[145] it is unlikely the price will decrease, and remain there, over the next 25 years. The avoided costs, therefore, likely will be closer to the medium or high scenarios, with return on investment being somewhere between 129% and 217% for 2006-2016 systems and 521% and 758% when you include 2017-2031 systems.

None of these avoided costs include other, positive effects of the plan. Vote Solar estimates approximately 20,000 jobs will be created from the 2006-2016 PV installations alone – those projections

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139. ECONOMIC BENEFITS, *supra* note 139 (All dollar amounts are in 2005 dollars. Real savings will be higher in 2031 (the end of the 25-year period) to reflect inflation).

140. *Id.*

141. *Id.*

142. *Id.* The program costs roughly $2.4 billion. The net avoided costs, then, are 50% of the costs under the *lowest* scenario.

143. ANALYSIS, *supra* note 138.

144. CALIFORNIA ENERGY COMMISSION, CALIFORNIA STATE-WIDE WEIGHTED AVERAGE RETAIL ELECTRICITY PRICES BY SECTOR (2006), *available at* http://www.energy.ca.gov/electricity/statewide_weightavg_sector.html.

145. *Id.*

increase to over 68,000 jobs including PV systems installed between from 2017-2026.[146] The plan avoids 52 million tons of carbon dioxide emissions, which increases to 188 million tons of emissions avoided over the longer period.[147] These numbers do not reflect other benefits, such as lower incidence of asthma, cleaner air, increased grid reliability, or less volatile energy prices. Overall, these avoided costs and related benefits show that other figures besides upfront installation costs should be factored into price comparisons between competing energy choices. Since 1994, for instance, the National Park Service has factored carbon dioxide, nitrous dioxide and sulfur dioxide to all facility life cycle cost calculations.[148]

B. Existing Tax Incentives

Tax incentives are available from the federal and state government. These incentives are meant to encourage solar installation, which will build the PV industry, thus, affecting the economies of scale; ultimately, this is meant to bring the market price to fossil fuel levels.

The federal government offers a 30% incentive for solar installation.[149] For home installations, however, the credit is capped at $2,000,[150] while there is no cap for businesses installing PV.[151] Therefore, any system that costs more than $6,667 would still only receive the $2,000. This credit is not enough to encourage homeowners to install a PV system: in New York State, a 2.5kW system costs approximately $22,000.[152] Capping home installations also does not make sense because many small installations on homes can help families reduce electrical costs and demand, while also helping the market attain the economies of scale faster than businesses can.

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146. ANALYSIS, *supra* note 138.

147. *Id.*

148. Center for Study of Responsive Law, Government Purchasing Project, "Photovoltaics: Striking It Green." *available at* http://www.gpp.org/energy_ideas/EI.0296/EI.0296.04.html.

149. 26 U.S.C. § 25 (2005).

150. *Id.* at (a)(2).

151. Damon Darlin, *Your Money: Financially, Solar Power for the Home Is a Tough Sell*, N.Y. TIMES, April 14, 2007, at C6.

152. *See* NYSERDA Clean Power Estimator, Power Naturally, New York State Energy Research and Development Authority ("NYSERDA"), *available at* http://www.powernaturally.org/default.asp.

Some states have picked up the tax incentive slack from the federal government. New York State's "Energy $mart" program, for instance, provides incentives for systems up to 50kW, that can offset installation costs by 40-70%.[153] The same $22,000 2.5kW PV system would receive a $10,000 incentive from Energy $mart[154] on top of the $2,000 federal tax credit. The price after both of these credits would be approximately $10,000, which, assuming a $100 per month electric bill, would help consumers pay off the PV system in about 13 years.[155] That estimate, however, does not include the higher electrical prices sure to come alongside the increased demand pressures. If the probable increased prices were factored into a 30-year cost analysis, consumers would find their repayment period to be less than the current estimates. The costs of the system noted above, therefore, will most likely be recouped in less than 13 years.[156] Residents in San Francisco have already seen how increased rates lead to higher savings. According to Mike Hall of Borrego Solar, a San Francisco PV installer, "everybody who got solar put in last year is saving 11 percent more this year because of rate increases. And rates are going to keep going up. The energy situation is really bad, so it's only a question of how fast (rates go up)."[157]

Banks also recognize how PV installations are smart investments for homeowners. According to ICF, a global energy consulting firm, every $1 reduction in annual energy costs increases a home's value by $20.73.[158] Further, a "California property, with a $22,412 solar system, would be worth $21,000 to $49,000 more."[159] According to Mr. Hall, "homeowners usually have no problem getting home-equity loans for solar systems. 'Depending on what type of loan you can get, you can make it so that your loan payment is about the same as what you would have paid (your utility company). So when rates go up again you're doing even better.'"[160] PV systems increase the

153. NYSERDA, PV Incentives, Power Naturally, *available at* http://www.powernaturally.org/Programs/Solar/incentives.asp.

154. *See* ECONOMIC BENEFITS, *supra* note 138.

155. *Id.* Note, too, incentives help increase the rate of installation, which will, in the long-run, lower the cost of PV systems.

156. These costs, of course, do not include the other benefits of PV noted above. *See* discussion pp. 13-16.

157. Gregory Dicum, *Green Solar Gets Practical*, S.F. GATE, January 25, 2006.

158. Darlin, *supra* note 151.

159. *Id.*

160. Dicum, *supra* note 157.

worth of homes and buildings on which they sit; they also enable the home- or business-owner to save money beyond the monthly payments, savings that increase as electrical rate increase.

C. PV Success Stories

In May 2007, Hall's Warehouse, in South Plainfield, New Jersey, completed a $9 million PV system with 8,000 solar panels, which will produce 1.4 MW of electricity.[161] Incredibly, this system produces 1/10 of Hall's electricity demand.[162] The system, however, will pay for itself in 5 years because of the $4.6 million in rebates and tax credits offered by New Jersey.[163] After the 5-year repayment period, Hall's will save hundreds of thousands of dollars per year, with avoided costs increasing along with prices. Over the 30-year life span of the system, moreover, the company will save the equivalent of 24,000 tons of carbon dioxide, or two million gallons of gasoline.[164]

Robert Felton, a California homeowner, paid about $2,500 per month for electricity in 2005.[165] After installing a 45-kW system on his home's roof, "he seldom sees an electric bill (and) estimates the system could save (him) almost $2 million over 30 years – far more than the $255,000 the system cost him after a $134,000 rebate."[166] This would be a 780% return on investment – before accounting for interest he could earn by investing the money he saved.

D. School PV Success Stories

Schools around the country are already taking advantage of solar power to decrease operating costs. In 2002, the school district in Carle Place, Long Island spent $200,000 to install five PV systems equaling approximately 50 kW[167] in its three schools.[168] For a dis-

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161. Kirsty Sucato, *A Company Puts Itself on Solid Solar-Power Footing*, N.Y. TIMES, April 1, 2007, at 14NJ7.

162. *Id.*

163. *Id.*

164. *Id.*

165. Gregory Dicum, *Plugging into the Sun*, N.Y. TIMES, January 4, 2007, at F1.

166. *Id.*

167. Interstate Renewable Energy Council, *Schools Going Solar*, January 23, 2007, *available at* http://www.irecusa.org/index.php?id=36.

trict that paid $200,000 per year in electricity for its lighting system alone, "in its first year, the solar panels lowered the district's electric bill by more than $10,000."[169] Like the San Francisco convention center project, this used no taxpayer money. The installer took no money upfront; instead, he will be paid back over 18 years.[170] Over just the 18 years it will take to repay the system, the school district estimates it "will generate a surplus of nearly a half-million dollars."[171] Before taking into account the money it will save after the 18-year repayment period, this will be a 250% return on investment. According to the installer, "representatives from about a dozen Long Island districts had looked at the Carle Place system."[172] Further, three other Long Island districts are already in the beginning stages of installing their own systems.[173] According to the Carle Place superintendent, the system has been beneficial in three ways: "[f]irst, we have drastically reduced our energy bills . . . in addition, we are reducing greenhouse gas emissions . . . and the third part is that this has provided us an opportunity to educate our students about solar energy and alternative energy resources."[174]

In 2006, Monterey Ridge Elementary in Monterey, California installed 20,000 square feet of solar panels on land behind the school.[175] The 200-kW system, which will provide 40 percent to 60 percent of the school's electricity needs, could generate enough power to serve 5,600 local homes.[176] The school district will pay roughly $900,000 of the $1.5 million price tag of the system, with the state rebate covering the other $600,000.[177] The district will recoup the cost of the system in about 15 years.[178]

At Oberlin College in Ohio, the Environmental Studies Department's parking lot added a PV-covered roof. The roof holds a 100-

168. Linda Saslow, *Turning Green, Schools Lead in Solar Energy*, N.Y. TIMES, March 4, 2007, at 14LI5.

169. *Id.* Note, too, that the district saved an additional $60,000 by changing to "more energy-efficient bulbs."

170. *Id.*

171. *Id.*

172. *Id.*

173. *Id.*

174. *Id.*

175. Blanca Gonzalez, *Monterrey Ridge Elementary (CA) Goes With Lots of Solar*, SAN DIEGO UNION TRIBUNE, August 18, 2006, at NC3.

176. *Id.*

177. *Id.*

178. *Id.*

kW PV system; together with an existing 45-kW system, Oberlin's PV now produces enough electricity to power 15 homes.[179] According to Green Energy Ohio, the system will be a "win for the College and for the City of Oberlin, which will benefit from the center's electrical energy when surplus energy is exported into the municipal grid."[180] With peak power production expected to be 30% more than the facility's demand,[181] the College can sell its surplus to the local electrical company to increase its return on investment.[182]

VII. NYC PUBLIC SCHOOLS AND PV

In 2006, the entire state of California installed its highest load of PV: approximately 50 MW, enough to power 135,000 homes.[183] At the end of 2005, the entire nation's PV capacity was 425 MW.[184] As soon as the City takes the initiative, NYC public schools alone could install 120 MW.[185] By creating an enormous-scale market, the City would enable private PV to reach its highest potential, offering all the benefits of PV to the entire city at the most efficient price.

A. NYC's Renewable Energy Potential

In 2003, the NYC Economic Development Corporation issued an "Energy Plan for the City of New York" ("the Energy Plan").[186] Though limited in scope as to PV, the Energy Plan speaks highly of PV potential in a city like NYC: "(PV) panels are well suited to urban areas because they are small and produce no noise or pollution."[187] While the Energy Plan notes the high initial cost as a "primary hurdle,"[188] it writes glowingly about the "considerable benefits" for NYC, including PV being "modular, silent, create(ing) no

179. *Oberlin College Completes Solar Parking Pavilion*, Green Energy Ohio, April 14, 2006, *available at* http://www.greenenergyohio.org/page.cfm?pageID=968 [hereinafter *Oberlin Solar*].
180. *Id.*
181. *Id.*
182. *Id.*
183. Dicum, *supra* note 165.
184. *Id.*
185. *See infra* pp. 30-31.
186. CHERNICK, *supra* note 9.
187. *Id.* at 71.
188. *Id.*

pollution, can be operated unattended and require(s) little maintenance compared to other power plants."[189] Further, it recognizes PV's production occurs at peak demand periods.[190] Most consequential, the Energy Plan observes:

> PV) would be most valuable on heavily-loaded networks and high on tall buildings with heavily-loaded distribution. In both situations, the (PV) capacity would help to avoid the need to upgrade distribution, while achieving (*sic*) maximal reductions in line losses. Rooftop (PV) may also be helpful in shading roofs and reducing heat gain.[191]

The Energy Plan fails, however, to further delve into the possibilities of PV in the City. An 89-page document, it devotes roughly only 1½ pages to PV's potential.[192]

Another New York City-financed study entitled "New York City's Solar Energy Future," (a two-part study: "Part 1" and "Part 2") illustrates the current energy situation, while also showcasing the potential for PV in the City.[193] According to Part 1, "there is enough commercial and residential roof space to host between 8,500 MW and 15,700 MW of PV installations within the New York City area,"[194] or most to all of our electrical demand.[195] In fact, reports suggest that 7,736 MW of PV—or 67% of projected electrical demand—could be installed within the area by 2022.[196] This development is not assured; nor is it even likely, unless the State and the City take major steps to alleviate the major barriers to private entry.

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189. *Id.* at 72.

190. *Id.* (noting PV production occurs when "electricity is needed most (and is most valuable)").

191. *Id.*

192. *Id.* at 71-73.

193. CSE MARKET, *supra* note 62; *see also* THE CTR. FOR SUSTAINABLE ENERGY AT BRONX CMTY COLL., NEW YORK CITY'S SOLAR ENERGY FUTURE, PART II: SOLAR ENERGY POLICIES AND BARRIERS IN NEW YORK CITY, January 2007, *available at* http://www.bcc.cuny.edu/institutionalDevelopment/cse/CUNYPV_%20PolicyAndBarriersStudy.pdf. (Prepared for The City University of New York's "Million Solar Roofs Initiative.")

194. *Id.*

195. *See* MAINTAINYC, *supra* note 4, at 4 (showing that New York City's current electrical demand is 9,000 MW and will increase to 11.5 MW by 2030).

196. *Id.*

The City has the potential to effect *major* changes in city energy use and production by purchasing large-scale PV for government buildings, specifically school buildings.

Two NYC laws intended to move the City toward a brighter renewable energy future already exist. Local Law 564-A ("LL 564") requires the City, by Earth Day 2013 and 2022, to obtain 13% and 19% of its electricity from renewable sources, respectively.[197] The Council's Introduction 381 ("Int. 381") "requires the City to assess the feasibility of incorporating clean, on-site generation (such as PV) at its facilities."[198] This project would help accomplish both of these goals. In fact, as to LL 564, this project alone possibly could represent nearly 13% of the City's electricity.[199] As to Int. 381, this should illustrate the potential of clean, on-site power generation by the City, especially since renewable energy resources besides PV, such as wind and biomass, have little potential for on-site generation in City-owned buildings.[200]

B. NYC Public Schools Demand and Potential

City agencies account for over 10% of energy use in the city.[201] The Department of Education ("DOE") accounts for over 26% of that.[202] In the 2007 NYC Budget, electrical appropriations for the DOE were approximately $204 million.[203] The DOE's overall budget for 2007 is approximately $14.1 billion.[204] Thus, electricity

197. . WORKING TOWARDS A SUSTAINABLE CITY, *supra* note 45, at 41-42.

198. *Id.* at 42.

199. *See Infra* note 202 (noting that the DOE uses 26% of the City government's electricity. The PV system produces electricity during the day, which is when schools are in session and using almost all of their electricity). Therefore, if this system could produce approximately 50% of the schools overall electricity, it would equals 13% of the City' government's electrical demand, or approximately 2.6% of NYC's electrical demand.

200. *Supra* notes 15-21.

201. WORKING TOWARDS A SUSTAINABLE CITY, *supra* note 45, at 31.

202. NYC Department of Citywide Administrative Services, *available at* http://www.nyc.gov. While DCAS handles electricity for DOE, it does not handle heat. Therefore, although the DOE accounts for 26% of DCAS's *energy* purchase and because DCAS purchases gas for other agencies, DOE's percentage of City electrical demand is actually higher than the DCAS chart indicates.

203. *Id.*

204. NYC Department of Education, Department of Budget Operations and Review, http://schools.nyc.gov/offices/d_chanc_oper/budget/dbor/question/questions.html.

accounts for approximately 1.4% of the DOE's budget. With approximately 1,200 public school buildings,[205] the average school building pays more than $170,000 per year, or over $14,000 per month, for electricity. This number is approximately equivalent to the base salary of nearly four first-year elementary-school teachers.[206]

These buildings, however, are mostly the highest and largest buildings in their respective neighborhoods. They are therefore perfect for large-scale PV projects, as they have mostly unimpeded access to sunlight.[207] These buildings are large enough to install 50-kW to 200-kW systems on the roofs.[208] This article will use a 100-kW system as the average, thereby making the potential for a DOE-wide system 120 MW.[209] Note, however, that 120 MW is most likely below the actual potential for school PV. Most schools have roofs large enough to fit systems well over 100-kW and receive unimpeded sunlight.[210] Further, this program could be opened to private schools, many of which are similarly the highest and largest buildings in their respective residential neighborhoods. For the sake of this paper, the conservative figure of 120 MW will suffice; both variables — average size and total number of buildings in the system —however, could mean drastically larger overall potential.

This project would be enormous on all levels, especially price. Energy Initiative 11 of Plan 2030 ("Initiative 11"), entitled "Foster the Market for Renewable Energy," notes, "since City facilities are

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205. NYC Department of Education, School Construction Authority, About the SCA, http://schools.nyc.gov/Offices/SCA/AboutUs/default.htm (last visited Mar. 3, 2008).

206. NYC Department of Education, Division of Human Resources, Salary Step, 2007. http://schools.nyc.gov/Offices/DHR/MostPopularClicks/TeacherSalaryStepDifferential.htm (last visited April 10, 2008).

207. Other buildings might shade some schools, especially schools in Manhattan. However, because many schools could hold over 100kW systems, the system as a whole would still likely average approximately 100kw per school, if not greater.

208. An estimate based on the current capability of PV panels and the size of city schools.

209. 100 kW times 1200 schools equals approximately 120 MW. Although some schools are smaller and, especially in Manhattan, might be shaded by other buildings, the total average of potential is still likely equal or greater than 120 MW. Most public school buildings could hold well over 100 kW of PV. The 120 MW number, therefore, remains a viable, if low-end, potential for NYC public schools.

210. *Id.*

not eligible for NYSERDA incentives or tax credits, the economics for public solar projects are even more difficult than in the private sector."[211] Using the cost of San Francisco's Mascone Convention Center as a baseline,[212] installing 120 MW of PV, and installing energy efficient devices to decrease the school's demand on NYC's public schools would cost roughly $1.4 billion. However, if state incentives similar to California's were included, the cost would fall to just over $1 billion – a $400 million decrease. A federal expenditure on the project (not unreasonable given the project's ability to jumpstart the industry, secure our energy supply, and make natural gas more readily available in other parts of the country) would lower the cost even more. Although the cost looks exorbitant, using the same San Francisco projections, the project's cost would be paid off in 7½ years, or possibly less since electricity costs about 27% more in NYC than San Francisco.[213] Further, the PV systems would produce the most electricity when the schools are not in use – during the summer.[214] This is concurrent to NYC's peak electricity demand. The schools, like Oberlin College and their PV-covered parking lot,[215] will receive even greater net-metering gains than a typical building (due to less demand from the schools during these peak periods). Together, this means the project could be paid off even faster. Finally, according to the EPA, 120 MW of PV saves approximately 344 million pounds of carbon dioxide *per year* – the equivalent of 40,000 acres of trees.[216] In NYC terms, this would be equivalent to planting 47 Central Parks every year for the life of the system.[217]

Under current law, city agencies, including the Department of Education, have absolutely no incentive to reduce their energy use.[218] Since the Department of Citywide Administrative Services

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211. Energy Report for PLANYC, at 15, *available at* http://www.nyc.gov/html/planyc2030/downloads/pdf/report_energy.pdf,

212. MASCONE CASE STUDY, *supra* note 44.

213. *See* Duke, *supra* note 24.

214. *See* Spitzer, *supra* note 33 (noting that "experts say that a 1 percent reduction in demand during peak periods can reduce electricity prices by 10 percent).

215. *See Oberlin Solar*, *supra* note 179.

216. APOLLO ALLIANCE, NEW ENERGY FOR CITIES 4, *available at* http://www.apolloalliance.org/docUploads/new_energy_cities.pdf,

217. The NYC Department of Parks and Recreation, http://www.nycgovparks.org/sub_your_park/park_info_pages/park_info.php?propID=M010 (Central Park is approximately 840 acres).

218. MASCONE CASE STUDY, *supra* note 44, at 33.

pays the electricity bills for all City agencies, the agencies do see any of the savings.[219] In fact, agencies have an incentive to oppose investments; less money will be available to them in their capital funds if they devote money to electricity reduction.[220] While amending the system to facilitate efficiency within various agencies would be an important method of lowering energy costs and demand, and should be done to encourage less energy consumption by the City, this system should be financed at the City level.

Initiative 11 envisions private companies operating public PV systems. The City plans to "release an RFP ('request for proposal') to attract private solar developers to build, own, operate, and maintain the panels on City buildings. The City will enter into a long-term contract with the developer to purchase the solar energy generated by these panels."[221]

The plan, while a well-meaning attempt to jumpstart solar development in NYC, would not be in the best interests of NYC. Like the PV examples touched upon earlier, this project can be undertaken without spending one dollar of taxpayer money, while still allowing the City to own (and reap the full benefits of) the system. The City can finance it through publicly backed bonds, like San Francisco, or by paying back installers over the life of the system, like in Carle Place, Long Island. If studies found the NYC public school PV projected similarly to San Francisco's, the most effective way to finance the project would be to sell 30-year bonds. The system would be paid back faster than 30 years, as every example illustrates. The money saved over the remaining years can be invested in funds earning more than the low-interest bonds pay out, thereby giving the City an even higher return on its investment. Money saved on the project could go to a number of sources including teacher pay, school construction, or a mix of those plus a fund to encourage green energy development and energy efficiency in the private sector.

Further, Initiative 11 states the City will work with the State and Public Services Commission to lower the barriers for PV systems in NYC.[222] Initiative 11 notes two barriers: the maximum amount of grid-connected PV and the amount of power that can be sold back to the grid.[223] If the City is willing to work with the State to lower

219. *Id.*
220. *Id.*
221. PLANYC, *supra* note 4, at 15.
222. *Id.*
223. *Id.*

those barriers, why not work to make State incentives, such as those offered to San Francisco's Mascone Center—available to City-owned buildings? New York State has an interest in lowering demand for fossil fuels; this would be the perfect way to jumpstart the PV industry statewide, while avoiding school costs not directly associated with the teaching of its children.

VIII. OTHER BENEFITS OF PV INSTALLATION

As former NYS Comptroller Alan Hevesi wrote, "conventional energy sources have benefited from sizable tax incentives and subsidies; if similar incentives were directed toward renewable energy technologies, the gap between conventional and renewable energy costs would narrow even further."[224] All levels of our government subsidize or help fund conventional energy production; why should NYC not invest in renewable energy?

In every aspect, renewable energy production is superior to conventional energy production. As Comptroller Hevesi's report notes:

> [B]y generating more renewable energy, the State could spur job growth in a high-skilled, high-wage sector; stimulate in-state investments; increase tax revenue; retain energy expenditures that currently leave New York; cut back on the release of harmful pollutants; reduce public health care costs; reduce State dependence on foreign oil; and provide consumers with energy that is not subject to the volatile fluctuations of petroleum and natural gas prices.[225]

Studies show that renewable energy creates 40% more jobs per dollar invested than more conventional production industries.[226] Re-

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224. ALAN G. HEVESI, NEW YORK STATE, ENERGIZING THE FUTURE: THE BENEFITS OF RENEWABLE ENERGY FOR NEW YORK STATE (2005).

225. *Id.*

226. *Id.* These jobs are in the areas of construction, manufacturing and installation. Jobs from fossil fuels are limited to production locations; for example, petroleum jobs are focused around sites that produce petroleum, such as Saudi Arabia and Iran. *See also* Sam Eaton, *Getting a Slice of the Green Economy*, Marketplace Money, Apr. 2007, *available at* http://marketplacemoney.publicradio.org/display/web/2007/04/13/green_jobs (quoting Kevin Doyle of the Environmental

newable energy jobs are labor-intensive; they generate high-paying jobs in research and development,[227] which could attract students and professors to NYC's own Columbia University and Cooper Union, two of the top scientific research universities in the nation. PV would also create well paying jobs in NYC, due to strong support for labor unions.[228] As "Repowering Gotham" notes, NYC has a large, highly skilled manufacturing workforce.[229] Manufacturing jobs, however, declined by 33% in the 1990s;[230] widespread PV installation could help revitalize the sector in NYC. According to Jeff Rickert, vice president of the Apollo Alliance, "from a labor unions' point of view, these are the kinds of jobs their unions are most prepared for."[231]

Public school rooftop PV would supply only 120 MW at peak production points (sunny early-afternoons); current NYC electrical demand is over 9,000 MW. While it will help eliminate a great deal of the electrical costs for NYC public schools, it will barely dent the electrical needs of NYC as a whole. This plan will spur private installations, however, and, to lower their costs, will encourage PV businesses to manufacture their panels in the city.[232] The high initial cost of PV systems drastically reduces private PV use. According to the United States Department of Energy, however, mass production and installation of PV could greatly reduce the cost,[233] thereby making it more attractive to home- and business-owners. Its study showed that, since 1993, the Sacramento Municipal Utility District had installed 10 MW of PV; since then, every year, PV achieved nearly 11% reductions in cost.[234]

Careers Organization: "[J]obs in (environmental consulting and engineering) are expected to grow 5.5 percent a year through the end of the decade.").

227. HEVESI, *supra* note 224.

228. *See* HEVESI, *supra* note 224 (noting "unions are aware of the job growth potential for highly skilled construction and manufacturing labor"); *see also* Spitzer, *supra* note 33.

229. NYC APOLLO ALLIANCE, *supra* note 65.

230. *Id.*

231. Moises Velasquez-Manoff, *Unions See Greenbacks in 'Green' Future*, The Christian Science Monitor, Jan. 2007.

232. MARK BOLINGER ET AL., U.S. DEPARTMENT OF ENERGY, USING BULK PURCHASE COMMITMENTS TO FOSTER SUSTAINED ORDERLY DEVELOPMENT AND COMMERCIALIZATION OF PV (2002), *available at* http://eetd.lbl.gov/ea/EMS/cases/Bulk_Purchases.pdf.

233. *Id.*

234. *Id.*

The City can leverage its commitment to install 120 MW of PV to entice manufacturers to open a factory in NYC. When Chicago made commitments of only $2 million and $6 million, respectively, it was able to "lure" Spire Corporation to build a factory on a brownfield on the west side of Chicago.[235] Surely, the City can count on luring manufacturers to NYC with a commitment of over $1 billion.

According to the Renewable Energy Policy Project (REPP), a national non-profit organization funded, in part, by the U.S. Environmental Protection Agency, "significantly increasing the U.S. market for renewable energy will require federal, state, and local governments to substantially increase their purchasing of PV."[236] REPP states that there are two main rationales for government to take the lead in PV purchase: it can resolve the "chicken and egg" dilemma associated with new technology and it can help overcome institutional barriers to commercialization.[237] The purchase of a 120 MW PV system will allow the economies of scale to reach a more efficient point, lowering the cost, which, in turn, will lead to private market demand. Increasing private market demand will further increase competition amongst manufacturers and installers, which will lower the prices even further.

A. Potential Problems and Solutions

Con Ed's power system ensures that NYC has the most reliable electrical grid in the nation;[238] at the same time, even the company recognizes that it is "one of the most complex systems in the world."[239] The grid design and state regulations make PV grid interconnection in NYC very difficult to accomplish on a large scale. According to Professor Stephen Hammer, then of the London School of Economics, "renewable sources linked to the Con Ed grid can run into problems if the device produces more power than is used by the customer."[240] Con Ed's specifications limit the size of interconnec-

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235. *Id. at* 5.

236. JOEL STRONGBERG & VIRINDER SINGH, GOVERNMENT PROCUREMENT TO EXPAND PV MARKETS (1998), *available at* http://www.crest.org/repp_pubs/pdf/pv4.pdf.

237. *Id.*

238. CON EDISON, *supra* note 6.

239. *Id.*

240. STEPHEN HAMMER, THE CTR. FOR SUSTAINABLE ENERGY AT BRONX CMTY COLL., POWERING THE BIG APPLE (2004), *available at* http://www.bcc.cuny.edu/InstitutionalDevelopment/CSE/Solar_Power_oct-1.cfm.

tion or require them to install expensive equipment that can disconnect the system from the grid in case of an emergency.[241]

However, as mentioned above, the New York State Public Service Commission ordered New York utilities to decouple profit from use,[242] which will alleviate some of these concerns. Professor Hammer offers several additional ways to circumvent these problems: first, for larger installations, power could be sent directly into Con Ed's high voltage feeder lines, which currently allows the PV owner (in this case, the City) to earn a fee equal to the local marginal electricity price for the power it produces.[243] Another solution is to set up a "micro-grid" between the PV system and the adjacent buildings, on top of Cod Ed's grid, wherein the PV owner could sell its surplus energy to its neighbors.[244] This method, according to Professor Hammer, is currently illegal in NYS: "[t]ariffs detailing the rate to be charged to customers for the surplus power must first be established by State regulators, and permission must also be granted by the City of New York."[245] One possible tariff solution would be to give the PV owner half of the rate at the time of sale back to the grid. If the summer afternoon price is $0.20 per kWh, then the PV owner would receive a $0.10 per kWh credit. If, during a non-peak period, the price is $0.16 per kWh, the PV owner would receive $0.08 kWh. This solution would provide a fair and demand-driven tariff for PV owners, rather than a pre-determined tariff, like in Germany, that might not reflect the price of electricity.[246]

IX. CONCLUSION

New York City's increasing population and electrical demand puts ever-tightening pressure on residents, businesses, land-use, and the

241. *Id.*

242. *See* New York State Public Service Commission, *supra* note 92.

243. HAMMER, *supra* note 241.

244. *Id.*

245. *Id.*

246. *See, e.g.,* Solarbuzz.com, *supra* note 99. This method could lead to less electrical production by utilities if the tariff is too high. For instance, if the demand price is $0.20/kWh and the tariff is $0.15, the utility would make $0.05/kWh minus the cost of production, which could be higher than $0.05/kWh. Thus the utility would lose money for every kWh it produces; it would, therefore, produce less electricity until the lower supply increases the price enough to equal costs.

local and worldwide environment. The only way NYC can continue to be the "capital of the world" without choking itself on fumes or building a power plant in Central Park's Sheep Meadow is to begin a large-scale investment, both publicly and privately, in renewable energy. As a geographically small but tall city, NYC's best investment would be in photovoltaic solar systems. To jumpstart private installation, the City of New York should purchase PV for the New York City public school system. This system will allow NYC to spend less on infrastructure and more on educating students. Through the economies of scale, the system will help lower the cost of private installations, revitalize NYC's manufacturing sector and create high paying, often unionized, jobs. It will help reduce NYC greenhouse gas emissions, public health care costs, and dependence on foreign oil, while providing a barrier for NYC residents against energy price fluctuations. Together with energy efficiency techniques, in the long-term, NYC could produce a great deal of its daytime electricity with PV, drastically reducing its dependence on conventional energy production and ensure only the cleanest, most efficient power plants remain in operation.

All it takes is strong-willed and forward-looking government support. As the many reports cited throughout this paper demonstrate, when planning for future energy needs, many people in, and affiliated with, government recognize the incredibly diverse benefits of solar energy. However, in each report, most of the discussion is dedicated to conventional sources of energy. Change of this magnitude—and the high initial cost—can be dissuasive to politicians and budget-writers. Officials who understand, and take advantage of, the benefits of PV will be at the forefront; they will stop spending taxpayer money on unnecessary expenses and start adding jobs and tax revenue to their locales. More importantly, their investment will spark private PV installation, which will have greater overall benefits to their communities.