Global Green USA

# Solar City Report

## How Los Angeles Can Gain the Economic and Environmental Competitive Edge

GLOBAL GREEN USA

Analysis Prepared for
Global Green USA
by Barua, Blok & Company

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Global Green USA (GG USA), the United States affiliate of Green Cross International, fosters a global value shift toward a sustainable and secure world through education, advocacy, partnerships, and programs focused on the safe elimination of weapons of mass destruction, stemming climate change, reducing resource use, and preventing conflicts over fresh water. Acting as a catalyst, facilitator, and mediator, GG USA encourages collaborative approaches and crosscutting solutions to environmental challenges.

GG USA's Sustainable Energy Initiative works to build a sustainable energy future by increasing conservation, improving efficiency, and raising the percentage of renewable energy in the nation's overall energy portfolio. The initiative includes public outreach on energy-efficient practices for homes and businesses, promoting green power, working to establish rigorous energy efficiency standards for federal and state agencies, and advocating for increased investment in renewable energy technologies at the state and federal levels.

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# Solar City Report:
## How Los Angeles Can Gain the Economic and Environmental Competitive Edge

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## I. Executive Summary

Global Green USA ("GGUSA") has proposed that the City of Los Angeles and the Los Angeles Department of Water and Power ("LADWP") commit to "carving out" at least 1% [approximately 80 megawatts ("MW")] of LADWP's total electricity generation capacity by 2017 for generation capacity from solar photovoltaic ("PV") technology. This target falls within the City's recently-enacted Renewable Portfolio Standard, which calls for increasing renewable power to 20% of the city's energy mix by 2017.[1] GGUSA has proposed that the City and LADWP install the 80MW of PV capacity on City-owned and City-influenced properties.

The per-watt price of PV is generally higher than the per-watt cost of electricity generated using LADWP's mix of other power resources (e.g., coal, natural gas, nuclear, and hydro), although it may be competitive with the price of electricity from power plants dedicated to meeting peak demand.

An initial analysis of the GGUSA PV proposal suggests the possibility of several benefits to LA:

- *Financial and strategic value.* Adding PV to the mix of resources may offset cost volatility connected with prices for inputs like coal and gas, while reducing exposure to future regulation on greenhouse gas emissions. With regard to homeland security, a PV program can support and visually promote energy independence, while reducing the potential of terrorism-based disruptions. It can also bolster the public perception of LADWP.

- *Air quality improvements.* Because energy production using PV is emission-free, installing PV represents a path for increasing generation capacity without exacerbating air pollution concerns in the LA basin. Indeed, 80MW of PV (alongside limited and targeted energy efficiency initiatives) could potentially offset the need to employ a heavily-polluting 50MW peaking plant currently in place at the Valley Generating Station.

- *Economic development.* PV is a relatively young technology – and a product of a rapidly-growing industry – that involves 2-3 times the labor intensity per watt as the current mix of LADWP resources. A program of the scale proposed by GGUSA can drive local, potentially union-scale job creation. It can also create opportunities for LA to establish competitive advantage as a new "Solar Silicon Valley" that serves not only as a hub for PV innovation, but also for the development and implementation of complementary technologies, such as hydrogen fuel-cells and zero-emission vehicles.

Achieving these benefits depends on successfully structuring and implementing the proposed program. There are three key success factors:

- *Predictability of policy.* Clear objectives and a consensus commitment to a multiyear plan will provide the planning certainty needed by business decision makers – both customers and suppliers – to make significant investments in PV facilities and activities in LA.

- *An open and competitive marketplace.* Ensuring a level "playing field" for suppliers will inspire new entrants to participate in LA, foster competitive pricing, and spur technological innovation.

- *Active efforts to seed demand.* Incentives for purchasing solar will efficiently spark the formation of a functioning local industry that markets and sells PV initially (versus policies that attempt to pick and choose suppliers within and across the value chain). A large and growing market will likely lead to local production and R&D, perhaps as paralleled by the rise of Silicon Valley partly in response to large technology purchases by the State of California.

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[1] "LADWP's Renewable Energy Proposal to Include Existing Hydroelectric Power, Except for Hoover Dam." LADWP press release, 10/7/04.

## II. Background

### A. The Global Green Proposal

In the context of the 20% Renewable Portfolio Standard ("RPS") for 2017 mandated by the LA City Council in October 2004, GGUSA has proposed that at least 1% of LADWP's *total* generation capacity (i.e., 5% of the renewable capacity in place by 2017) be "carved out" for PV. This implies a total of approximately 80MW of installed PV capacity, based on total projected generation capacity of 8,098MW by 2017 (vs. 7,127MW at June 30, 2005).[2]

The GGUSA proposal calls for installing PV on City-owned and City-influenced properties. This focus will enable decision makers at LADWP and in the City government to oversee implementation, while aligning with the City's existing commitment to saving operating costs through adoption of the Leadership in Energy & Environmental Design (LEED) green building standards[3]. It will also provide opportunities for choosing union labor and/or prevailing wage for installation work.

A preliminary estimate by GGUSA of installable capacity on City property, LA Unified School District campus buildings, and currently existing and planned affordable housing stock indicates that installing 80MW in these locations alone is feasible: based on current solar technologies, efficiencies, and performance, an estimated 71.0-82.5MW can be placed at these sites by 2017. This reflects installable capacity of 31.0-32.5MW on City property and existing and planned affordable housing, based on total areas of 4.99 million square feet for City buildings and 5.49 million square feet for affordable housing. In addition, 40-50MW of capacity is installable on the 58 million square feet of school rooftops that will be in place by 2017[4].

GGUSA has also requested that LADWP fund the effort through its capital budget, expected to average $641 million per year over the next five years for investments in generation capacity, transmission infrastructure, and distribution facilities.[5] LADWP has historically funded solar incentives (expected to average $11.8 million over the coming five years[6]) to customers through its Public Benefits program. This program also funds energy efficiency programs, shade tree giveaways, demonstration projects, and subsidies for low-income customers. The LADWP budget, as of June 2004, did "not fully integrate" the needs, solar or otherwise, posed by the RPS.[7] GGUSA proposes that LADWP continue funding solar incentives through Public Benefits in addition to undertaking the contemplated 80MW capital program.

GGUSA asserts that capital budgeting for the proposed installations is appropriate:

- The installations will add to the generation, distribution, and transmission infrastructure, because LADWP would own the installations, as opposed to LADWP's subsidizing residential and commercial customers to purchase and install PV
- For the purpose of the RPS, the 80MW of proposed PV generation capacity will be part of the LADWP total generation resource, which is funded by the capital budget

An 80MW program would represent the second-largest municipal solar commitment in the U.S. to date (after

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[2]Extrapolated from average annual growth of 1.5% forecast from 2005-2014. Numbers for 2005 and 2014 from "Presentation of Draft 2004/05 Power and Water System Budgets," p. 10. LADWP, 6/3/04.
[3]"USGBC-LA Update," p. 1. US Green Building Council, 6/02.
[4]Global Green USA estimates, based on analysis of data from LA City Architect's Office, 2/17/05.
[5]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 24. LADWP, 6/3/04.
[6]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 31. LADWP, 6/3/04.
[7]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 18. LADWP, 6/3/04.

Austin, Texas, which has committed to 15MW by 2007 and 100MW by 2020[8]). This will propel Los Angeles into national visibility on solar energy, which enjoys consistently overwhelming public support in local and national polls. By the nature of the proposal (e.g., placing panels on public rooftops, City properties, and affordable housing projects throughout the LA basin), policymakers will achieve tangible and ongoing awareness of the initiative, over the 13-year course of program implementation, as well as subsequently, over the 25-30 year lives of the installations.

Despite being the second-largest municipal commitment, the initiative represents a relatively low-risk pilot for solar in LA. First, committing to solar is not a groundbreaking move. Eighteen states have established renewable portfolio standards, eight of which target specific amounts of solar capacity[9]. Examples include:

- Arizona (1.1% of generation from renewable resources starting in 2007, 60% of which is solar – representing nearly 100MW by 2007)[10]
- Nevada (15% of generation from renewable resources by 2013, of which at least 5% is solar)[11]
- Colorado (10% of generation from renewable resources by 2015, of which at least 4% is solar)[12]

At the municipal level, cities with commitments to renewable energy and solar include Austin, Texas; San Francisco ($50 million to be spent on solar)[13]; and Washington, D.C. (11% of generation from renewable sources by 2022, at least 0.386% from solar)[14].

Beyond being a move with significant precedent, the initiative represents a very small bet. The commitment represents 1% of the total capacity online by 2017, 5% of the renewable energy portfolio in 2017, and 8% of incremental capacity to come online between 2005 and 2017.

GGUSA has enumerated other potential benefits from adoption of its proposal[15]:

- Affordable housing for low-income families that features utility bills at or near zero, with up to 30,000 new units eligible. Achieving this will likely involve a combination of changes to City policies governing electricity discounts (to add allowances for onsite solar electricity generation), in addition to the benefits from State-level incentives to solar and financing mechanisms likely to be involved for pursuing the overall GGUSA solar proposal.
- Economic development tied to job creation from distribution, manufacturing, and installation. GGUSA credits LADWP's solar program for initially resulting in 366 PV installers doing business in LA, corresponding to roughly 1,000 new jobs in the region. This number has varied over time as the solar incentive offered by LADWP has fluctuated during the past several years. According to GGUSA, "these jobs tend to be created for small businesses with deep roots in local communities."
- Improved LA air quality in the face of record pollution, the LADWP resource mix ("one of the dirtiest among municipal utilities"), Valley Generating Station ("VGS") pollution (1400% growth in smog-causing nitrogen oxides from 1995-2004), and a South Coast Air Quality Management District mandate that VGS cut nitrogen oxide emissions by 50% from 1997 levels by 2010.

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[8] "Austin – Renewables Portfolio Standard." Database of State Incentives for Renewable Energy (dsireusa.org), 12/18/03.
[9] "Renewable Portfolio Standards." Interstate Renewable Energy Council, 1/05.
[10] "Arizona Incentives for Renewable Energy: Environmental Portfolio Standard." Database of State Incentives for Renewable Energy (dsireusa.org), 2/12/04.
[11] "Nevada Incentives for Renewable Energy: Renewable Energy Portfolio Standard." Database of State Incentives for Renewable Energy (dsireusa.org), 1/13/05.
[12] "Colorado Incentives for Renewable Energy: Renewable Energy Requirement." Database of State Incentives for Renewable Energy (dsireusa.org), 11/17/04.
[13] "California Incentives for Renewable Energy: City of San Francisco – Solar Bonds." Database of State Incentives for Renewable Energy (dsireusa.org), 12/3/04.
[14] "District of Columbia Incentives for Renewable Energy: Renewables Portfolio Standard." Database of State Incentives for Renewable Energy (dsireusa.org), 1/25/05.
[15] "Solar and the LA RPS" (unpublished white paper). GGUSA, 7/7/04.

### B. Methodology and Scope of this Survey

GGUSA retained Barua, Blok & Company ("BB&C"), a private-sector advisory firm (please see Section VI, "About Barua, Blok & Company"), to conduct a high-level and preliminary evaluation of prospective impacts of the proposed solar program and of key success factors. The firm's cofounders, Gautam Barua and Michael Blok, executed the project, drawing, in part, on Mr. Barua's recent responsibility for economic development policy as a California Deputy State Controller and Mr. Blok's experience in advising European utility executives.

GGUSA and BB&C agreed that this limited investigation was to inform GGUSA's conversations about its proposed solar program with officials of the City of LA, LADWP, and other stakeholder groups. GGUSA and BB&C also agreed that this survey and report provide *directional, but not exhaustive*, findings.

In managing this survey, BB&C primarily undertook three sets of activities:

- Approximately 25 telephone and in-person interviews with industry executives (producers, marketers, and installers) in the U.S., Europe, and Japan; academics; trade association representatives; elected and appointed officials; activists; and local municipal utility experts
- Secondary research to gather data and compile analyses conducted and/or published by governments, industry, LADWP, nonprofit groups, and trade associations
- Proprietary quantitative and qualitative analysis and synthesis

To elicit "uncensored" opinions and insights, BB&C agreed to maintain confidentiality with most interviewees. Accordingly, this report synthesizes interview findings but does not name or directly quote any interviewees.

While BB&C reviewed the draft content of this report and its analyses with GGUSA management, BB&C made the final decisions about the content herein.

## III. Benefits of Solar to LA

In proposing the solar program, GGUSA names three major categories of potential benefits, as listed above: affordable housing with the potential for near-zero utility bills, job creation, and air quality improvements. The latter two benefits are not as clearly quantifiable as the first. BB&C therefore investigated these in some depth.

This resulting study explored possible benefits: financial and strategic value, air quality improvements, and economic development.

### A. Financial and Strategic Value

Committing to a significant PV program may confer financial and strategic benefits to Los Angeles and LADWP, in terms of managing risks connected to input cost volatility, reducing exposure to potential costs connected with greenhouse gas emissions, and addressing homeland security and other public concerns. At 1% of 2017 capacity, the 80MW of PV envisioned by GGUSA is unlikely to have significant impacts on these issues. However, the program might serve as a "pilot" for implementing and learning from PV, and this might inform more comprehensive and systematic actions to strategically leverage and expand solar power in LA.

> "A PV program may confer strategic benefits, in terms of financial impact, greenhouse gas emission liabilities, and public concerns such as homeland security."

### 1. Managing Cost Risks

On a price-per-MWh basis, PV is significantly more expensive than the cost of electricity generated through the LADWP resource mix. However, the cost differential comes down when considering costs of peaker plants, instead of baseload production. In addition, typical comparisons of PV versus conventional generation mix retail pricing – appropriate to PV, which produces electricity at the place of use – and wholesale pricing for conventional power, which misses costs connected with infrastructure investments and transmission and distribution losses.

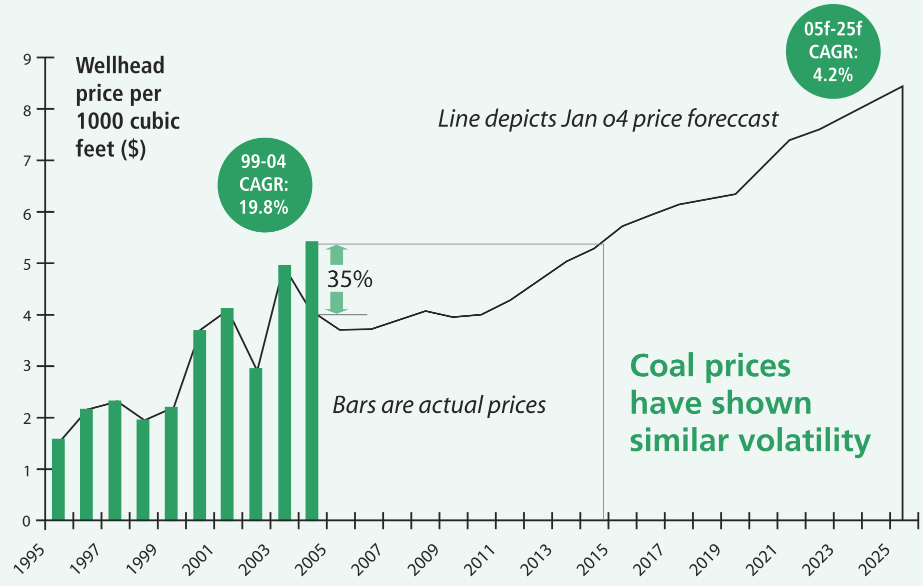
Given the increasing volatility and the likely long-term escalation of fossil fuel prices, as well as ongoing developments in solar technology, PV may be a more economically attractive substitute than it seems at first glance.

Both major fossil fuel inputs for LADWP have demonstrated price volatility and record or near-record high prices. With LADWP's primary resource, coal, spot prices "remain high and unsettled," according to the U.S. Department of Energy[16]. Despite long-term forward contracts held by LADWP to hedge price increases, ongoing price volatility will affect the utility's economics when the contracts expire.

While hedging does not appear to pose a significant financial impact on LADWP today (up to $15 million per year)[17], future hedging costs for natural gas could be substantial at 0.35-0.55¢/kWh (10-20% of the current wholesale cost of gas-fired electricity generation)[18]. With regard to coal, the prospect of climate change regulation may exacerbate rising commodity costs (please see Section III/C/2 below, "Greenhouse Gas Emissions").

LADWP's sharply rising dependence on power generation from natural gas (17% of 2002-03 resource, forecast to be 28% in 2013-14) may create significant financial consequences. Natural gas prices rose by an average of 19.8% per year between 1999 and 2004[19] **(Figure 1)**. Experts claim "prices will track higher than the historical national average," and the "market now sees the same shortages that have governed the oil market[20]." This is especially true in a context where, as

**Figure 1. Natural gas prices have been volatile, having rising rapidly – 2004 actual prices exceed even January forecast by 35%… and already stand at the level forecast for 2015 in January 2004**




Sources: U.S. Department of Energy Energy Information Administration 1/04 and 10/04; BB&C analysis.

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[16] "Coal News and Markets." U.S. Department of Energy, Energy Information Authority, 10/29/04.
[17] "Integrated Resource Plan," p. 20. LADWP, 11/20/03.
[18] "Clean and Affordable Power: How Los Angeles Can Reach 20 Percent Renewables Without Raising Rates." Center for Energy Efficiency and Renewable Technologies, Environment California Research & Policy Center, 3/03.
[19] Energy Information Authority, U.S. Department of Energy, 10/04.
[20] "Natural Gas Prices – Historical and Forecast." Energyshop.com, 11/9/04.

acknowledged by a utility executive, U.S. natural gas supplies have peaked and are now declining.[21]

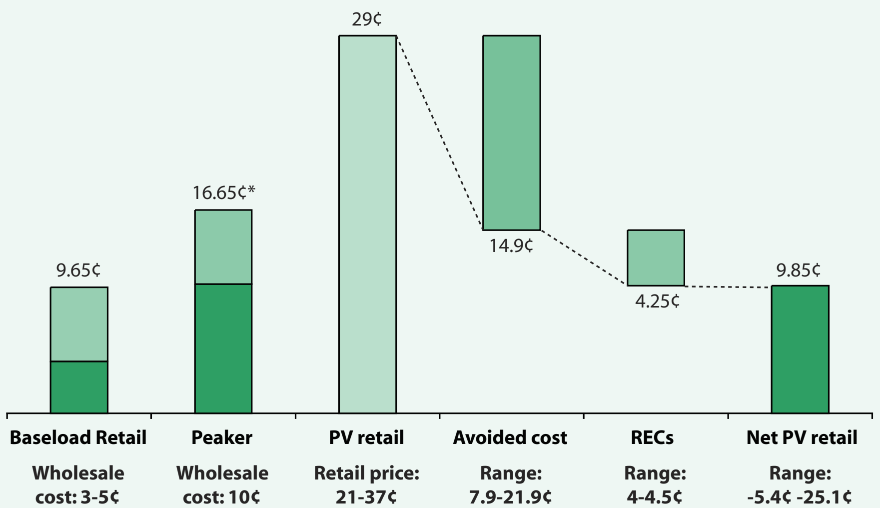
> **"The net retail price of solar can run from 25¢/kWh to even a net financial benefit of 5¢/kWh, after figuring in avoided costs and the value of tradable Renewable Energy Credits. Using midpoints of forecast ranges, the net retail price of solar may be 9.85¢/kWh, which would favorably compare to the current LADWP rate of 9.65¢/kWh."**

Looking forward, price volatility may continue. A January 2004 Department of Energy forecast[22] of 4.2% average annual growth in natural gas prices between 2005 and 2025 falls well within the range of 2-8% yearly increases expected by BB&C interviewees. However, that January forecast underestimated average natural gas prices for the subsequent 10 months by 35%. The November 2004 price of natural gas stood at the level forecast, 11 months before, for 2015. This may call into question the validity of forecasting a mere 4.2% annual growth rate in prices over the next 20 years.

While utilities and policymakers consider Liquified Natural Gas ("LNG") imports to be a potential solution to domestic natural gas constraints, large-scale LNG implementation in California faces concerns over potentially high dollar costs and environmental impacts. In addition, LNG raises foreign policy and supply disruption worries, given that major sources include politically unstable regions like the Middle East and Indonesia. Homeland security is also an issue, given the potential terrorist threat at ports of entry.[23]

One potentially inappropriate concern about solar PV is the higher perceived cost of generating electricity than from conventional (or even non-solar renewable) sources. The unsubsidized retail price of electricity from solar PV is 21¢-37¢/kWh (based on installation and maintenance costs of a solar system, amortized over the life of the system).[24] This is often unfavorably compared to a "guideline" wholesale cost of 3-5¢/kWh (including capital costs and fuel prices) for natural gas-based generation[25], as well as the average LADWP retail price of 9.65¢/kWh[26].

**Figure 2. Illustrative price and cost comparison of conventional and solar electricity generation (assumes midpoint values for ranges)**




* Assuming same absolute markup from wholesale to retail as baseload generation.
Sources: Nuclear Energy Institute 1999; LA Economic Development Corporation 1/01; Solarbuzz.com 2/05; CalSEIA 12/04; *Distributed Energy* 11/04

However, this comparison may be inaccurate for five reasons. An "apples-to-apples" comparison of solar electricity to conventional, fossil fuel-based central power generation suggests that the net retail price of solar can run from 25¢/kWh to even a net financial benefit of 5¢/kWh, after figuring in avoided costs and the value of tradable Renewable Energy Credits. Using midpoints of forecast ranges, the net retail price for solar may be 9.85¢/kWh, which would favorably compare to the current 9.65¢ price for electricity from LADWP **(Figure 2)**.

[21]"A Critical Fuel for California's Energy Future." San Diego Union-Tribune (op/ed), 11/26/04.
[22]Energy Information Authority, U.S. Department of Energy, 1/04.
[23]"Energy Independence: Not When One Company Owns It All." San Diego Union-Tribune (op/ed), 9/15/04.
[24]"Photovoltaic Industry Statistics: Costs." Solarbuzz.com, 1/17/05.
[25]"The Outlook for Nuclear Energy in a Competitive Electricity Business." Nuclear Energy Institute, 1999.
[26]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 16. LADWP, 6/3/04.

"The solar industry asserts that solar may create a benefit of 7.9¢-21.9¢/kWh in avoided costs associated with fossil fuel-base power plants. This could be significant, given an unsubsidized retail price of 21¢-37¢/kWh for solar PV and 'guideline' wholesale costs for fossil fuel-based generation ranging from 3-5¢/kWh to as high as 10¢/kWh at peaker plants, which operate at the times during which solar-based electricity production is likely to be at its highest."

- The solar-versus-gas cost analysis is "apples-to-oranges", because it compares retail (i.e., price to customer at point of use) solar pricing to wholesale (i.e., cost to utility at point of generation) costs of centralized fossil fuel-fired power generation. For the latter, this ignores additional costs associated with delivering electricity from a central power plant to the end user: these costs include transmission, distribution, and infrastructure.

- The wholesale cost of gas-fired electricity averages 3-5¢/kWh, but the solar initiative is likely to offset the cost of "peaker" plants, activated to provide power at times of peak demand (typically during the sunniest time of the day and therefore the period of maximal solar-based electricity production). The wholesale (again, versus retail for solar) cost of peaker plant electricity has been as high as 10¢/kWh in recent years[27]. Based on the markup of average wholesale cost reflected by the LADWP retail price for electricity, this implies a retail price of at least 16¢/kWh – and ignores the higher pollution profile (and attendant public health costs) of operating peaker plants.

- The cited retail cost of solar electricity represents the equipment (and related maintenance and financing) costs amortized over the 20-30 year life of the installation, as opposed to the retail rates (and underlying costs) of centralized fossil fuel generation, which have varied – and generally risen – over time, based on operating and capital costs, as well as policy changes.

- A preliminary solar industry analysis asserts that solar may create a benefit of 7.9¢-21.9¢/kWh in avoided costs associated with fossil fuel-based power plants, such as those for emissions, fuel, transmission & distribution, operation & maintenance, and capacity capital.[28] In light of the aforementioned retail price of solar energy at 21-37¢/kWh, this figure, if accurate, may negate the apparent cost advantage of fossil fuel-fired power generation, especially for peaker plants. This solar industry estimate may reflect biases and warrants further, independent study and confirmation of its assertions, which experts note can be difficult and problematic to calculate.

- Beyond avoided costs, solar electricity may create significant financial benefits by generating Renewable Energy Credits ("RECs") in addition to power. RECs are tradable commodities, separate from the electricity itself, valued for helping utilities meet renewable portfolio standards. The ownership and market for RECs have yet to be defined in California. However, recent experience in Connecticut shows the potential value of RECs, where a REC was worth 4-4.5¢/kWh by late 2004[29].

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[27]"Energizing California's Economic Future. Opportunities & Challenges: A California Energy White Paper and Plan of Action." Los Angeles Economic Development Corporation, 1/11/01.
[28]"Build-Up of PV Value in California." Draft document, California Solar Industry Association, 12/13/04.
[29]"Renewable Energy Credits: Free Money for DE Generators?" *Distributed Energy*, 11/04.

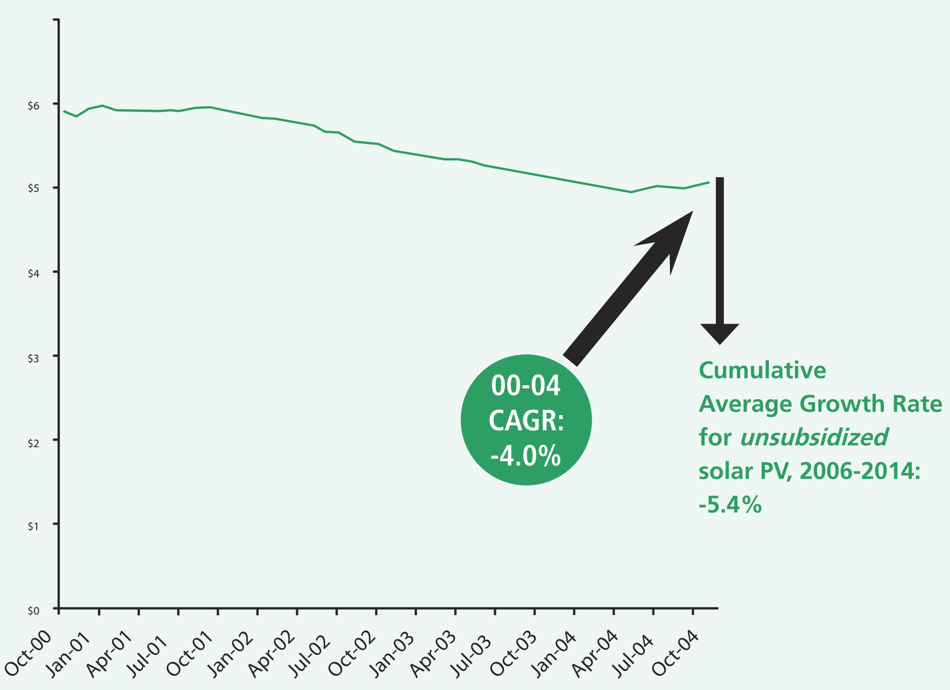
In addition, LADWP may benefit from predictably falling costs, the possibility of disruptive technologies emerging, and the value of the "real option" created with regard to fossil fuel price volatility and the potential for climate change regulation.

As of early 2005, projected costs per installed watt of solar PV are expected to start at $3.50 (ten-year average for 2006-2015, assuming declining state subsidies)[31], leading to a price of $280 million over 13 years ($22 million per year), in current dollars, for the 80MW program proposed by GGUSA. Given the highly predictable output of solar installations, project finance and other, innovative financing models that draw on the capital markets can reduce or even eliminate up-front cash requirements for LADWP.

Recent LADWP solar projects have cost significantly more, at $7-8/watt. However, these costs have included architecture, engineering, and construction not directly connected with the solar installations per se; they also do not reflect the likely savings from a larger-scale program, which will offer learning curve efficiencies.

San Francisco's Moscone Convention Center retrofit, the city's first project under Proposition B (passed in November 2001, by 73% of voters, authorizing $100 million in revenue bonds for renewable energy and energy efficiency in city and county-owned buildings) can provide a sense of costs for a typical unionized municipal project. The retrofit cost $7.4 million for (1) a 675kW PV installation ($4.1 million) and (2) efficiency measures ($3.4 million) to save 4.1 million kWh per year[32]. This provided $614,643 in annual electricity savings per year. The unsubsidized installed cost of solar PV was $6.07/watt; state subsidies lowered the cost of the solar component by $2.1 million, to a net of $2.96/watt. Notably, unionized labor (IBEW Local 6) played "a central role" in the city effort[33]. The Moscone project did incur a substantially higher unsubsidized per-watt cost than the $4-$4.50 paid by the California Construction Authority for placing PV on state fairgrounds[34] – a much simpler project and the lowest-cost public project to date.

**Figure 3. Unsubsidized cost of solar PV panels (per watt)**




Sources: CalSEIA 6/04; Solarbuzz.com 11/04; BB&C interviews and analysis.

Today's estimated costs per installed watt are likely to be the maximum possible. This is because PV is getting cheaper over time. Current technologies, thanks to scale economies with rising production and efficiency improvements, have seen unsubsidized panel prices fall by an average of 4% per year between 2000 and 2004[35]. Experts forecast unsubsidized PV prices to fall by an additional 5.4% per year from 2006 to 2014[36] **(Figure 3)**. Industry executives expect electricity from PV to be directly cost-competitive – even on the aforementioned "apples-to-

[31] California Solar Industry Association, 6/04.
[32] "The Moscone Convention Center: San Francisco Combines Solar & Energy Efficiency." San Francisco Public Utilities Commission, 9/03.
[33] "Solar Power for San Francisco." *Organized Labor*, 12/23/02.
[34] "The Vote Solar Initiative." *Solar Today*, 7/03.
[35] Solarbuzz.com, 11/04.
[36] California Solar Industry Association, 6/04.

oranges" basis – with electricity from conventional fossil fuels within about 10 years[37].

Beyond the predictable cost declines for current technologies, innovative and "disruptive" new technologies promise step reductions (e.g., 50%) in costs. These include such developments as organic/dye PV, thin-film PV, and direct sunshine-to-hydrogen technologies, as well as the participation of startup companies such as Palo Alto, California-based NanoSolar and Energy Innovations in Pasadena, California. Government policy – such as the GGUSA proposal – that stimulates demand and fosters an appealing market might benefit these and other innovators, just as government purchases and other favorable policies cultivated the rise of innovative information technology firms in Silicon Valley.

Once installed, PV offers predictable economics. The input (sunlight) is free, the maintenance schedule is predictable, and manufacturers assume risk through lifetime warranties. In addition, reliability is high: a nationwide study of solar installations demonstrated that actual performance averaged 80%+ of rated capacity[38].

Ultimately, given ongoing fossil fuel price volatility (versus relative stability and predictable declines in PV costs), even a small program, like that proposed by GGUSA, offers a "real option". This option may provide significant financial value in the face of sudden price shocks or regulatory shifts, by enabling LADWP to aggressively shift to solar, based on knowledge and experience gained from implementing the 80MW program. Solar may even reduce fossil fuel price concerns: a preliminary analysis of demand elasticity suggests that every MWh of renewable energy reduces natural gas demand and thereby consumer gas prices; for example, the California Renewable Portfolio Standard may reduce, on a Net Present Value basis over 25 years, gas prices to consumers by $5/MWh of renewable energy generated.[39] It may be appropriate to consider the economics of PV against fossil fuel generation in this light.

## 2. Greenhouse Gas Emissions

The recent international ratification of the Kyoto Protocol to the United Nations Framework on Climate Change has inspired major American businesses to call for domestic action on climate-affecting greenhouse gas emissions. Companies calling for regulation include major utilities American Electric Power (the nation's largest electricity producer and largest emitter of carbon dioxide, a leading greenhouse gas[40]) and Cinergy, a major coal-fired power plant owner.[41] Notably, LADWP, in terms of resource mix, more closely mirrors these primarily Midwest-based utilities – which have faced shareholder, regulatory, and legal pressure over greenhouse gas emissions – than it does other utilities in California.

Should climate change regulation, in the form of carbon dioxide emissions limits or carbon taxes, happen, LADWP is significantly more exposed to costs than utilities across California as a whole. LADWP's strong reliance on combusting coal (48% of 2005 LADWP mix vs. 10% statewide in 2004) creates much more carbon dioxide per watt than natural gas (33% of California's energy mix vs. 17% for LADWP).

The potential impact of regulation, such as carbon taxes, can be examined by considering the December decision, by the California Public Utilities Commission ("CPUC"), requiring investor-owned utilities in the state to explicitly account for the financial risk of greenhouse gas emissions when making new generation investments[42]. Based on the likelihood of carbon taxes or other regulations posing financial impacts to utilities, the CPUC established a present value imputed cost of $8/ton of $CO_2$. This implies a financial risk for LADWP, in present value terms, of

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[37] "Experts See Solar Power Competitive in Next Decade." Planet Ark/Reuters News Service, 10/21/04.
[38] "TEAM-UP Final Report." Solar Electric Power Association, 12/01.
[39] "Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency." Lawrence Berkeley National Laboratory, 1/05.
[40] "Global Warming May Cloud Directors' Liability Coverage." *Wall Street Journal,* 5/7/03.
[41] "Power Giant Endorses Greenhouse Gas Curbs." The Associated Press, 12/2/04.
[42] "Opinion Adopting Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company's Long-term Procurement Plans," Decision 04-12-048. California Public Utilities Commission, 12/16/04.

$10.4 million for the estimated addition of 6,627 GWh between 2005 and 2017[43], assuming the budgeted mix of resources by 2013 (including 48% coal and 28% gas)[44].

LADWP can reduce its exposure to climate change regulations by switching, in part, to PV, which emits no greenhouse gases when producing electricity. While the proposed 1% "carve out" for solar PV is small relative to LADWP's overall generation capacity, even this can have an outsized impact, reducing the present-value financial risk for greenhouse gas emissions from planned capacity additions by as much as 2-3%. The lower figure applies if the new solar capacity offsets both gas and coal in proportion to their roles in the overall generation mix, and the higher figure applies for offsetting coal only.

Lessons from implementing this small solar effort might enable LADWP to cost-effectively deploy additional PV as part of a strategy for coping with climate change regulations and the attendant financial costs.

### 3. Homeland Security and Other Public Concerns

As demonstrated by Congressional concerns[45] over security at nuclear power plants (11% of the LADWP generation mix) and recent attention to terrorism-linked security gaps in LADWP facilities (including a 2002 plan to shore up power and water plant security by spending $132 million over five years),[46] centralized power plants – nuclear and otherwise – present major targets for terrorism. These are appealing targets, because a single strike can cut significant amounts of power and, in the case of nuclear plants, release massive amounts of radiation.

PV installations are decentralized power sources with low output at risk per installation and the absence of combustible or radiation-emitting fuels. This might reduce the vulnerability of LA's power system to terrorism, as well as the associated homeland security costs. A strike on any given PV installation would likely cut power only to an individual property – and that property would be able to restore electricity quickly by accessing grid-based electricity generated by distributed and/or centralized power plants. Security costs in this situation are minimal, since there is such low vulnerability to terrorism.

On a political note, PV installations are visual reminders of the City's commitment to promoting energy independence and spending funds that generate jobs for local citizens over expanding infrastructure for handling imports of oil and natural gas. Given public awareness of American dependence on imported oil and concerns over possibly-related geopolitical dynamics in the Middle East, a PV program might send a message welcomed by voters.

A significant commitment to investing in solar may also boost the public perception of LADWP, because solar energy enjoys such broad support among ratepayers in the community.

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[43]Based on "Presentation of Draft 2004/05 Power and Water System Budgets," p. 11. LADWP, 6/3/04; and "Impact of U.S. Nuclear Generation on Greenhouse Gas Emissions", p.5. International Atomic Energy Commission, 11/6/01; Solarbuzz.com 2/18/05.
[44]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 11. LADWP, 6/3/04.
[45]"Nuclear Plants Said to Face Big Attack Risk." *Los Angeles Times*, 3/26/02.
[46]"DWP to Improve Training for Guards." *Los Angeles Times*, 10/13/04.

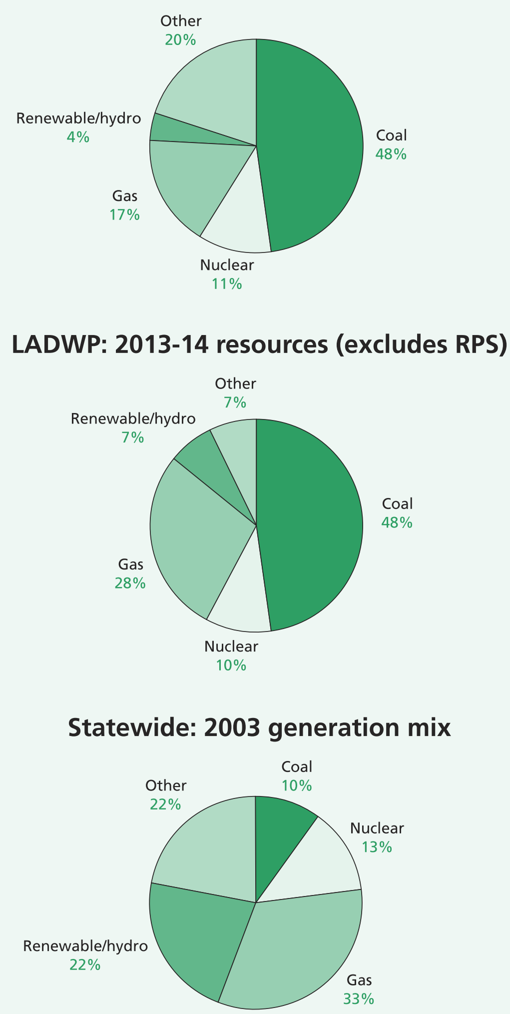
> **"LADWP, compared to other California utilities, may disproportionately contribute to air pollution through its emissions-heavy resource mix."**

### B. Air quality improvements

As a non-emitting power source, PV can help address – even if only in certain parts of the city – significant air pollution issues in Los Angeles. Air pollution has created a $1.8 billion annual public health cost to LA County[47].

Even though point sources like LADWP power plants contribute only 1% of the overall health risk,[48] LADWP, when viewed against other California utilities, may be disproportionately contributing to air pollution – locally and in downwind regions, including other municipalities and states – through its emissions-heavy generation resource mix. Compared to the mix for the state as a whole (33% natural gas, 13% nuclear, 11% large hydro, 10% coal, 10% renewable)[49], LADWP's is arguably "dirtier" due to its vastly greater use of coal (48% coal, 17% gas, 11% nuclear, 4% large hydro and renewable, 20% purchased and pumped storage) (Figure 4). LADWP expects to continue using coal for almost half its generation capacity for at least 10 years[50].

**Figure 4. LADWP generation mix may be more polluting than California's**




Sources: LADWP 2003 Budget Report 6/3/04, California Energy Commission 12/14/04.

The 80MW of PV capacity proposed by GGUSA will offset 8% of capacity that LADWP is projected to add between 2005 and 2017. By reducing the need for additional coal-based generation, PV can reduce the emissions profile of the LADWP generation mix. Since PV can also be deployed throughout the City, it is possible to target certain areas particularly affected by emissions from in-city power plants.

Valley Generating Station ("VGS") is one example of air pollution issue among LADWP's in-city power plants. VGS has seen escalating emissions (1400% growth in smog-causing nitrogen oxides from 1995-2004), and a South Coast Air Quality Management District mandate that VGS cut nitrogen oxide emissions by 50% from 1997 levels by 2010.[51] The "dirtiest" of the plants at this facility is a 50MW peaker plant. The GGUSA proposal for 80MW of PV capacity (which, with expected actual generation at 65% of rated capacity[52], implies 52MW of peak production) could eliminate the need for this plant. This is especially true since, as widely acknowledged, solar PV generally operates at peak generation capacity during the brightest (and hottest) point in the day, when demand tends to peak, as driven by air conditioning and refrigeration power needs.

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[47]"Smog Causing 'Epidemic': Report Says Auto Emissions in Southland Cost Health Care $1.8 Billion." *Los Angeles Daily News*, 8/20/03
[48]Environmental Defense (scorecard.org), 12/14/04.
[49]California Energy Commission (energy.ca.gov), 12/14/04.
[50]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 11. LADWP 6/3/04.
[51]"Solar and the LA RPS" (unpublished white paper). GGUSA, 7/7/04.
[52]Average Equivalent Load Carrying Capability estimated for solar installations across California. Source: California Solar Energy Industry Association (CalSEIA), 10/01.

## C. Economic Development

This survey identified clear potential for a PV program to create jobs immediately within the LA basin, provide an opportunity for building a regional competitive advantage around a solar industry, and support the rise of complementary emergent technologies.

> "The GGUSA proposal could eliminate the need for the Valley Generating Station peaking plant, which has seen 1400% growth in smog-causing air pollutants over 10 years."

### 1. Job Creation

First, the solar program offers the possibility of immediate and lasting job creation, both at higher rates than those available by adding conventional generation capacity and with the real possibility of opportunities for unionization or workers receiving the prevailing wage. Because most of the jobs involve on-site installation and maintenance, they represent a source of employment that cannot move out of LA and for which people can train to participate locally over the long term.

Based on an analysis of nearly a dozen PV job creation models, BB&C estimates that PV sales and marketing, installation, and maintenance alone – the primary activities that would immediately take place with enactment of the GGUSA program – will directly create 2.5 times as many jobs per megawatt of capacity as LADWP has created with its current resource mix. This calculation assumes 2.0 full-time equivalents ("FTEs") per megawatt per year[53], versus approximately 0.8 FTE per megawatt per year of existing LADWP capacity (computed as the ratio of 5,690 FTEs budgeted for 2004-05 in the LADWP Power System[54] to 7,127MW of generation capacity forecast for 2005).

> "The program will directly create at least 2.5 times as many jobs per megawatt as the current LADWP resource mix does"

Because the GGUSA program focuses on installing PV on City-owned and City-influenced properties, LADWP and the City of LA have an opportunity to choose union and/or prevailing wage installation and maintenance services. The local nature of the work, combined with the medium to high skill levels required for many of these jobs, suggests an opportunity for unionization. This raises the possibility of expanding the membership of Local 18 of the International Brotherhood of Electrical Workers (the union representing many LADWP employees) to include workers involved with the program proposed by GGUSA.

Beyond the immediate and direct non-manufacturing union-scale job creation connected with the GGUSA program, the PV industry offers the possibility of additional job creation across the value chain. As the fastest growing segment of the energy industry, PV promises to create jobs, potentially in LA, should rising demand attract not only non-manufacturing activities but also, over time, local manufacturing and R&D efforts. Given both the expectation that current PV technologies will achieve cost competitiveness with conventional power sources by 2014 and LA's sunny climate, solar industry jobs may flourish over the coming 10-20 years. In addition to direct job creation across the value chain, manufacturing activity will accelerate economic development, spurring indirect job creation at twice the rate of non-manufacturing activity.[55]

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[53]This closely ties to an oft-cited figure of approximately 35 "full-time equivalents" (sometimes equated with "jobs") per MW of solar PV capacity [see, for example, "Jobs for Pennsylvania: An Analysis of Employment from RPS Legislation," p. 22. Renewable Energy Policy Project ("REPP"), 5/04]. The higher figure looks at total labor requirements across the entire value chain – from component manufacturing through aftermarket servicing – over 10 years. REPP indicates that their figure of 35.5 "FTEs" represents 69,650 hours of labor required per MW divided by 1,960 hours per person-year. This includes 38,400 hours for one-time manufacturing activities per MW; 26,250 hours for one-time sales, distribution, and installation activities; and 5,000 hours of aftermarket servicing over 10 years. In the absence of significant PV manufacturing in Los Angeles today, Messrs. Barua and Blok have estimated job creation only for sales, distribution, installation, and servicing, using estimates from REPP and other expert sources. Using the REPP numbers, this totals 31,250 hours (26,250 + 5,000) over a 10-year window. Messrs. Barua and Blok have also assumed that a "job," for the purposes of economic development policy, lasts 10 years. They have therefore divided the 31,250 hours by 10 years for an average annual labor demand of 3,125 hours. Assuming 1,960 hours per person-year, this implies 1.59 jobs created per MW. Other expert analyses suggest higher job creation potential (and some suggest lower job creation); hence, the stated estimate of 2.0 jobs/MW.

[54]"Presentation of Draft 2004/05 Power and Water System Budgets," p. 34. LADWP, 6/3/04.

[55]"Study: Accelerating Loss of Manufacturing Jobs Hurts California More Than Previously Thought." *Silicon Valley/San Jose Business Journal,* 2/25/04.

"Similar to today's Silicon Valley, LA can create a 'Solar Silicon Valley' that acts as a nexus for high-value (and tax revenue-producing) activities"

Results of California's demand-side solar policies suggest the economic potential for LA. The California solar incentive program saw the state's solar industry grow to 500 companies (and 4,000 employees) from fewer than 30 companies employing 500 people. At the same time, these companies installed a cumulative total of 26MW of PV statewide by 2003. Existing companies saw significant growth: firms such as Solar Depot and PowerLight grew their workforces by 200% over 4 years (45 employees in 2004 vs. 15 in 2000) and 700% over five years (96 employees in 2004 vs. 12 in 1999), respectively. While little "hard data" on job creation exist, an industry executive estimates that sales and marketing professionals (salaries at $80-150k/year) are 10% of the total solar workforce; installers (project managers, technical experts, and administrative) are 60%; and electricians, installers, and other administrative total 30%.

As California's program has proceeded, purchasers have identified creative models for bringing down prices. For example, in 2003 the California Construction Authority used economies of scale and an innovative RFP process to drive the pre-rebate installed PV cost/watt to $4-4.50, roughly 20% below the then-current market price[56].

### 2. Competitive Advantage

Another economic development opportunity lies in the possibility of using the proposed program as the cornerstone for establishing Los Angeles as the nation's first regional industrial hub for solar technology. This "Solar Silicon Valley" might parallel the creation of the famous information technology corridor in Northern California. Like today's Silicon Valley, the LA solar "hub" could act as a nexus for high-value (and tax revenue-producing) activities by bringing together financial capital sources, technology researchers and innovators, small and large manufacturers, and marketing, sales, distribution, and installation businesses.

Los Angeles is well-positioned to cultivate a regional hub, thanks to the timeliness of the opportunity – and to its possession of the major assets needed to make a Silicon Valley-like technology center succeed. With regard to timing, LA can take advantage of the fact that no U.S. region yet exists as a cluster of activity for the industry. Leading innovators and suppliers are scattered across the country, from the San Francisco Bay Area to Orange County and San Diego in California, as well as Delaware, Massachusetts, and Arizona. In addition, despite commitments from cities ranging from Sacramento and San Francisco to Chicago and Austin to increase local solar capacity, no municipality has articulated a comprehensive industrial strategy around solar.

"No U.S. region yet exists as a cluster of activity for the solar industry. LA uniquely boasts all the assets needed to make a 'hub' really work: latent demand, academia, and financial capital."

In addition to the current lack of a potentially competing solar hub – or even a comprehensive policy anywhere else in the U.S. to create one – LA is uniquely suited to deploying and leveraging the complete set of assets needed to make a hub really work. These include: latent demand, academia, and financial capital.

Latent demand, thanks to the sunny climate and broad support from both the public and the city's elected officials, enables industry to enjoy the benefits of

[56] "The Vote Solar Initiative." *Solar Today*, 7/03.

being close to many customers and a major target market – just as Silicon Valley initially enjoyed connections to the State of California, which was a major purchaser of technology in the 1970s. A pool of world-class academic institutions, including CalTech, UCLA, and USC, can provide a pipeline for innovation and engineering talent, just as Silicon Valley has benefited from the presence of well-trained engineers and research from Stanford, University of California Berkeley, and other Bay Area colleges and universities[57].

Another key asset, capital, may even be a greater strength for LA than Silicon Valley. While Northern California enjoys a greater concentration of venture capital, Los Angeles can appeal to businesses across a broader spectrum of the life cycle, thanks to its large number of wealthy individuals (who might serve as "angel investors") and the presence of major financial institutions, such as commercial and investment banks, which can best serve mature companies.

Los Angeles also offers the foundation to enable quick deployment and use of these assets. Specifically, the City possesses a well-developed infrastructure, diversified and large workforce, and existing commercial and industrial construction. The City might examine avenues for making this platform appealing and useful to solar businesses, perhaps through programs like the Workforce Investment Boards and the Community Redevelopment Agency.

Japan's experience with establishing itself as the world's leading solar production hub demonstrates the prospect of using a demand-oriented program, such as that proposed by GGUSA, for driving regional competitive advantage. Japan committed to the demand-oriented "70,000 Roofs Program" in 1994. The program, which started with incentives that covered half the cost of a residential PV installation, reduced those incentives over time to about 10% by 2003, as costs fell with rising production. By 2002, 144,000 installations were in place[58]. This program catapulted Japan from producing about 60% as much PV as the U.S. in 1996[59] to achieving world production leadership in 1999 and producing about 3.5 times as many PV cells as the U.S.[60] and 49% of world production by 2003. Japan is now also the world's leading consumer of solar power.

### 3. Synergies with Complementary Emerging Technologies

The GGUSA program may also provide a platform for supporting the transition to a "hydrogen economy," as advocated at the state and local levels. PV applications can support emerging technologies, such as hydrogen-consuming fuel cells for buildings and cars. In fact, using PV for converting water to hydrogen may offer significant advantages over alternatives like reforming natural gas and electrolyzing water by using nuclear power.

Directly using PV to electrolyze water into hydrogen and oxygen saves process steps: it avoids DC to AC conversions required for PV-generated electricity to be useful in buildings and the AC to DC conversion required for electrolysis. Moreover, onsite conversion can eliminate the high transportation cost of hydrogen, which might ease transitioning the infrastructure to a hydrogen economy. Looking ahead, PV panels capable of directly converting sunlight to hydrogen might offer the easiest route of all, especially by eliminating efficiency losses involved with electrolysis. However, this technology is in its infancy.

Fuel cells might also improve the utility of PV. To the oft-cited concerns regarding reliability and dispatchability of solar (and wind) power, a PV/fuel cell system could generate stores of hydrogen for power generation as needed. This could improve power system reliability and balance transmission loads for the grid. A variable pricing scheme might provide incentives for PV owners to manage their systems appropriately.

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[57] "Other regions face limitations in replicating Silicon Valley's success, experts say." Stanford Report, 4/11/01.
[58] "World Sales of Solar Cells Jump 32 Percent." Earth Policy Institute, 2004.
[59] "Solar Comes to (Part Of) The Earth." AlterNet, 12/18/03
[60] "Playing Catch-up with US Solar." SolarAccess.com, 9/7/04.

> "Key success factors for fully realizing the potential benefits include predictability, marketplace openness, and demand stimulation."

## IV. Key Success Factors

Stakeholder interviews surfaced several themes regarding key success factors for fully realizing the potential benefits of the GGUSA proposal. These success factors fall into three areas: predictability, marketplace openness, and demand stimulation.

### A. Predictability

As with other areas of public policy, industry leaders seek predictable long-term (10+ year) policy with transparent decision-making, quantitative goals, and clear fiscal plans. This can enable businesses to comfortably plan investments in the market.

Industry views LA's solar programs as problematic. Rising and falling incentive levels have "whipsawed" suppliers and even led to unused incentive funds (when policymakers set incentives too low) and backlogs of customers seeking incentives (when policymakers, as has happened recently, set incentives too high). Changes in policy with administration changes, unclear objectives, and overall lower levels of ambition for PV than in other cities (e.g., Austin, San Jose and Seattle) have left industry apprehensive about making plans for investment connected with PV in LA.

In adopting the GGUSA program, LA would be well-served by setting incentives that decline with the total amount of solar capacity installed, working back from the goal of 80MW installed capacity. This would parallel Japan's successful program, assuring that Government objectives are met, minimizing costs of installed capacity, preventing funds from running out, and further enhancing predictability.

### B. Marketplace Openness

Some LA solar market participants and potential participants have blamed current City policy, which provides a $1.50/watt credit to suppliers that locally manufacture solar systems[61], for creating an uneven competitive playing field. In this view, public policy has led to significant disincentives for new entrants and the potential for the rise of a supplier monopoly or duopoly in the LA solar marketplace. Restructuring incentives to foster an open marketplace will enable LA to maximize the cost effectiveness and economic development value of the program proposed by GGUSA.

A competitive marketplace tends to lead to lower prices, customer satisfaction, and innovation. At the same time, governments are not typically well-positioned to "pick winners," create "champions," or generally favor certain businesses, as existing LA policies may have done. Finally, a competitive marketplace aligns with public policy goals of maximizing the number of people benefiting from said policy: a competitive marketplace ensures that benefits do not accrue to a small number of players.

### C. Demand Stimulation

This survey surfaced an industry consensus that stimulating demand will attract local investments by established suppliers and by innovators, as happened in Japan over the past decade. To maximize the available dollars and overall impact of an incentive program leading to 80MW of PV, LA and LADWP can revamp incentives to maximize the purchasing power of available funds (for example, by creating hybrid financing products that increase available dollars for PV purchases by combining loans and outright grants).

[61] "LADWP Incentives Make Solar Power More Affordable Than Ever and Encourage Local Manufacture of Solar Equipment." Solar Electric Power Association, 12/12/01.

LA and LADWP, in considering PV for City-owned and City-influenced properties, might explore business model innovation, such as the distributed generation sale/leaseback "rooftop rental" model pioneered by companies like RealEnergy. In this approach, LADWP owns a PV installation on another party's property. The property owner or, more commonly, its tenant pays LADWP for the PV-generated electricity at current LADWP electric rates. LADWP then pays the property owner a "rent" calculated as a percentage of the PV-based electricity charge. Under this model, LADWP retains control of generation capacity, can choose the installers, and continues generating revenues from PV. At the same time, the property owner adds a revenue stream (the "rent" from LADWP) that, by adding to the Net Operating Income for the property, increases the value of the property.

Interviewees suggested that the program initially focus on new construction, which will allow for elegant integration of PV. In addition, new buildings offer superior synergies between PV and energy efficiency. On the labor front, Government has greater control, and construction trades are often unionized, maximizing the chances that organized labor will install PV. LA does face a significant amount of new construction, particularly for libraries, police and fire facilities, and schools, funded by recently-passed bond measures.

While Japan's success with using demand-side policy to spur production and R&D shows the possibility for doing so in a high-cost environment like LA, hurdles do exist. While high wage costs are not a decisive factor because of the high degree of automation in the industry, aspiring entrants to LA face high land costs, little greenfield space, and perceived high costs for doing business in California. At the same time, relatively low transportation costs of PV cells (about 3% of total cost) enable suppliers to import finished product from low-cost environments, such as China and Nevada.

**"Being close to customers is important, and a large solar push could attract production and R&D to LA."**

However, if LA becomes the country's hottest PV market, as might happen with a nation-leading commitment to PV capacity under the GGUSA program, at least some production and R&D will follow. In a dynamically evolving market, such as PV, being close to customers is important. Additionally, for a visible product such as PV, local production creates a "license to operate" for major producers, meaning that a large solar push could easily attract production and R&D to LA. This, in turn, can position LA to be the innovation center for solar technology and become the earliest region to adopt solar innovations.

As noted previously, programs like the Community Redevelopment Agency and Workforce Investment Boards might facilitate corporate investments. Given the high fixed cost of establishing a highly-automated solar production facility, as well as the immaturity of the market, LA has incentive to attract big producers now, before they have set up facilities in other regions.

LADWP can play an integral role in making LA the nation's hottest PV market through steps beyond the proposed investment, by the utility, in 80MW by 2017. By continuing its public education and outreach, as well as public benefits solar incentives programs, LADWP will encourage end users in LA to continue adopting solar PV systems at sites other than City-owned and City-influenced facilities. This can result in overall LA demand becoming substantially larger than 80MW, with industry activity (and therefore jobs and tax revenues) attracted to the region accordingly, as noted above.

## V. Turning Obstacles Into Opportunities

This survey provided a preliminary investigation of the potential economic value of the 80MW initiative proposed by GGUSA. To identify the most workable implementation path, a number of key questions need to be addressed.

### A. Labor Concerns

The authors were unable to reach officials of International Brotherhood of Electrical Workers Local 18, the primary union representing LADWP employees. Because the GGUSA proposal affects LADWP directly, decision makers should consult with that Local's leadership to understand and address major concerns about implementing the initiative.

### B. Economics

BB&C derived the cost of the proposed program, as well as the overall estimate of 80MW target capacity, primarily from public sources. An accurate analysis of potential rate impacts – as well as possibilities for mitigating them – has yet to be conducted using LADWP analysis and expertise.

In addition, one interviewee suggested that, based on pilot PV projects in LA (e.g., Staples Convention Center and LADWP headquarters), labor costs added 200% to the cost of installation. This, as well as architectural, engineering, and other construction costs not directly connected to installing the solar system, led to a figure of $13/watt, which is well above the PV market price of approximately $5/watt. Again, LADWP analysis and expertise may help identify opportunities for understanding and managing costs.

Finally, the program will generate Renewable Energy Credits ("RECs"), which are tradable certificates of proof that a kWh of electricity resulted from renewable sources[62]. As separate commodities from the power itself, RECs may have financial value, depending on policy decisions at the local, state, and Federal levels. Any financial analysis of a solar program will need to identify the party to which RECs accrue (e.g., LADWP vs. property owners) and project the dollar value of the credits.

### C. Planning

Given the 80MW target for City-owned and City-influenced properties, what is the best implementation plan over the next 13 years, given the mix of installation sites, ease of installation, expected performance, and costs?

### D. Synergies with State programs

California's political and regulatory authorities have proposed or enacted a number of initiatives that currently or potentially affect the economics of solar systems. Examples include the Governor's "Million Solar Systems Initiative,"[63] state-provided subsidies under the Emerging Renewables Program administered by the California Energy Commission,[64] and the commitment by pension funds CalPERS and CalSTRS to invest up to $950 million in clean technology companies[65].

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[62] "The Renewables Portfolio Standard: How it Works and Why its Needed." American Wind Energy Association, 9/01.
[63] "Governor Schwarzenegger Calls for One Million Solar Energy Systems in California Homes" (press release). State of California Office of the Governor, 8/20/04.
[64] "More Information about the Emerging Renewables Program (formerly the Emerging Renewables Buydown Program)." California Energy Commission (energy.ca.gov), 2/16/05.
[65] "'Green' Startups Draw Investors: State Pension Funds Plan to Put $950 Million in Developing Field." *Sacramento Bee*, 11/29/04.

Implementation plans, financial forecasts, and economic development expectations will need to reflect the impact of such state-level initiatives on issues ranging from solar system availability and pricing to the attractiveness of LA as a location for companies seeking investment capital.

### VI. About Barua, Blok & Company

Barua, Blok & Company Incorporated ("BB&C") is an advisory and investment firm focused on helping to quantify and maximize the financial impacts of private and public sector programs to achieve environmental and social sustainability. Founded by two former McKinsey & Company management consultants and Morgan Stanley investment bankers, BB&C brings together a team of seasoned business managers with extensive working knowledge of sustainability issues. Headquartered in San Francisco, the firm also has offices in Amsterdam, The Netherlands and Washington, D.C. Please see http://www.baruablok.com for more information.

# GLOSSARY

Adapted from "Glossary of Energy Terms." California Energy Commission (energy.ca.gov), 2/20/05.

| | |
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| **Avoided Costs** | The cost the utility would incur but for the existence of an independent generator or other energy service option. Avoided cost rates have been used as the power purchase price utilities offer independent suppliers. |
| **Base Load** | The lowest level of power production needs during a season or year. |
| **Base Load Unit** | A power generating facility intended to run constantly at near capacity levels, as much of the time as possible. |
| **Baseload Capacity** | Generating equipment operated to serve loads 24 hours per day. |
| **Capacity** | The amount of electric power for which a generating unit, generating station, or other electrical apparatus is rated either by the user or manufacturer. |
| **Capacity Factor** | A percentage that tells how much of a power plant's capacity is used over time. For example, typical plant capacity factors range as high as 80 percent for geothermal and 70 percent for cogeneration. |
| **Demand** | The rate at which energy is delivered to loads and scheduling points by generation, transmission or distribution facilities. |
| **Demonstration** | The application and integration of a new product or service into an existing or new system. Most commonly, demonstration involves the construction and operation of a new electric technology interconnected with the electric utility system to demonstrate how it interacts with the system. This includes the impacts the technology may have on the system and the impacts that the larger utility system might have on the functioning of the technology. |
| **Discount Rate** | A factor used to determine the present value of future or past cash flows. The rate accounts for inflation and the potential earning power of money. |
| **Dispatchability** | The ability of a generating unit to increase or decrease generation, or to be brought on line or shut down at the request or a utility's system operator. |

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| **Distributed Generation** | A distributed generation system involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or displacing the need to build additional (or upgrade) local distribution lines. |
| **Distribution** | The delivery of electricity to the retail customer's home or business through low voltage distribution lines. |
| **Electric System** | All the elements needed to distribute electrical power, including overhead and underground lines, poles, transformers, and other equipment. |
| **Fuel Cell** | A device that converts the chemical energy of a fuel, such as hydrogen, and an oxidant, such as oxygen, directly into electricity. The principal components of a fuel cell are catalytically activated electrodes for the fuel (anode) and the oxidant (cathode) and an electrolyte to conduct ions between the two electrodes, thus producing electricity. This converts fuels to power very efficiently and with minimal environmental impact. |
| **Generation** | Process of producing electric energy by transforming other forms of energy. |
| **Gigawatt (GW)** | One thousand megawatts (1,000 MW) or, one million kilowatts (1,000,000 kW) or one billion watts (1,000,000,000 watts) of electricity. One gigawatt is enough to supply the electric demand of about one million average California homes. |
| **Incentive** | A rebate or payment to encourage adoption of a technology. Calculated as the amount of the technology costs that the utility must pay to achieve the benefit/cost ratio desired to drive the market. |
| **Installed capacity** | The total of generating units' capacities in a power plant or an entire utility system. Based on the nameplate rating or the net dependable capacity. |
| **Integrated Resource Plan (IRP)** | A framework within which the costs and benefits of both demand- and supply-side resources are evaluated to develop the least-total-cost mix of utility resource options. In many states, IRP includes a means for considering environmental damages caused by electricity supply/transmission and identifying cost-effective energy efficiency and renewable energy alternatives. IRP has become a formal process prescribed by law in some states and under some provisions of the Clean Air Act amendments of 1992. |

**Investor-Owned Utility (IOU)** — A company, owned by stockholders for profit, that provides utility services. A designation used to differentiate a utility owned and operated for the benefit of shareholders from municipally owned and operated utilities and rural electric cooperatives.

**Kilowatt (kW)** — One thousand (1,000) watts. A unit of measure of the amount of electricity needed to operate given equipment. On a hot summer afternoon a typical home, with central air conditioning and other equipment in use, might have a demand of four kW each hour.

**Kilowatt-Hour (kWh)** — The most commonly-used unit of measure telling the amount of electricity consumed over time. It means one kilowatt of electricity supplied for one hour. In 1989, a typical California household consumed 534 kWh in an average month.

**Load** — The amount of electric power supplied to meet one or more end user's needs.

**Marginal Cost** — The sum that has to be paid the next increment of product of service. The marginal cost of electricity is the price to be paid for kilowatt-hours above and beyond those supplied by presently available generating capacity.

**Megawatt (MW)** — One thousand kilowatts (1,000 kW) or one million (1,000,000) watts. One megawatt is enough energy to power 1,000 average California homes.

**Megawatt-hour (MWh)** — One thousand kilowatt-hours, or an amount of electricity that would supply the monthly power needs of 1,000 typical homes in the Western U.S. (This is a rounding up to 8,760 kWh/year per home based on an average of 8,549 kWh used per household per year [U.S. DOE EIA, 1997 annual per capita electricity consumption figures]).

**Monopoly** — The only seller with control over market sales.

**Municipal Electric Utility** — A power utility system owned and operated by a local jurisdiction.

**Network** — A system of transmission and distribution lines cross-connected and operated to permit multiple power supply to any principal point on it. A network is usually installed in urban areas. It makes it possible to restore power quickly to customers by switching them to another circuit.

**Operation and Maintenance Expenses** — Costs that relate to the normal operating, maintenance and administrative activities of a business.

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| **Peak** | The highest electrical demand within a particular period of time. Daily electric peaks on weekdays occur in late afternoon and early evening. Annual peaks occur on hot summer days. |
| **Peak Demand** | The electric load that corresponds to a maximum level of electric demand in a specified time period. |
| **Peak Load ("Peaker") Power plant** | A power generating station that is normally used to produce extra electricity during peak load times. |
| **Peaking Capacity** | Generating equipment normally operated only during the hours of highest daily, weekly, or seasonal loads; this equipment is usually designed to meet the portion of load that is above base load. |
| **Photovoltaics** | Technology for directly converting light into electricity. The process uses modules usually made up of many cells (thin layers of semiconductors). |
| **Pilot** | A utility program offering a limited group of customers their choice of certified or licensed energy suppliers on a one year minimum trial basis. |
| **Plant** | A central station generating facility that produces energy. |
| **Present Value** | The amount of money required to secure a specified cash flow on a future date at a given rate of return. |
| **Project Financing** | This is the most commonly used method to finance the construction of independent power facilities. Typically, the developer pledges the value of the plant and part or all of its expected revenues as collateral to secure financing from private lenders. |
| **Public Utility** | A utility operated by a non-profit governmental or quasi-governmental entity. Public utilities include municipal utilities, cooperatives, and power marketing authorities. |
| **Public Utility Commissions** | State regulatory agencies that provide oversight, policy guidelines and direction to electric public utilities. |
| **Ratepayer** | This is a retail consumer of the electricity distributed by an electric utility. This includes residential, commercial and industrial users of electricity. |

**Reliability** — Electric system reliability has two components-- adequacy and security. Adequacy is the ability of the electric system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and unscheduled outages of system facilities. Security is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system facilities.

**Renewable Energy** — Resources that constantly renew themselves or that are regarded as practically inexhaustible. These include solar, wind, geothermal, hydro and wood. Although particular geothermal formations can be depleted, the natural heat in the earth is a virtually inexhaustible reserve of potential energy. Renewable resources also include some experimental or less-developed sources such as tidal power, sea currents and ocean thermal gradients.

**Securitization** — The aggregation of contracts for the purchase of the power output from various energy projects into one pool which then offers shares for sale in the investment market. This strategy diversifies project risks from what they would be if each project were financed individually, thereby reducing the cost of financing. Fannie Mae performs such a function in the home mortgage market.

**Solar Thermal Electric** — The process of concentrating sunlight on a relatively small area to create the high temperatures needs to vaporize water or other fluids to drive a turbine for generation of electric power.

**Tax Credits** — Credits established by the federal and state government to assist the development of the alternative energy industry.

**Transmission** — Transporting bulk power over long distances.

**Transmission and Distribution (T&D) Losses** — Losses the result from the friction that energy must overcome as it moves through wires to travel from the generation facility to the customer. Because of losses, the demand produced by the utility is greater than the demand that shows up on the customer bills.

**Watt** — A unit of measure of electric power at a point in time, as capacity or demand. One horsepower is equivalent to approximately 746 watts.

**Watt-Hour** — One watt of power expended for one hour.

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