

The roof of Wilson Reservoir.



A Clean Energy Pathway for South Pasadena

A Report by the City's Renewable Energy Council

6/13/16

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Cover Photo: *The 12,000 square foot roof of South Pasadena's Wilson Reservoir is big enough to install a 140 kV solar system, which would reduce the facility's power bill for pumping water by about \$17,000 annually. The recently rebuilt Wilson Reservoir in San Gabriel is where most of the city's water is pumped from wells. It then is pumped uphill to South Pasadena, some three miles away. Wilson Reservoir accounts for over half the city's electricity usage.*

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A CLEAN ENERGY PATHWAY FOR SOUTH PASADENA:

A Report by the City's Renewable Energy Council

Summary of Recommendations:

The Renewable Energy Council recommends that the City of South Pasadena take these steps in the near-term (completed in 2 years or less), mid-term (completed within 3 to 4 years), and long-term (completed in 5 years or more) to use renewable energy:

- Install solar systems at City Hall parking lots and at Wilson Reservoir as soon as possible. The systems will provide a net cash flow benefit to the city immediately using low-interest financing from the California Energy Commission. (*Near-term*)
- In conjunction with installing a solar system at the City Hall parking lots, the City should consider installing electric vehicle chargers as needed at the parking lot at Hope and Mound to take advantage of economies of scale that could be achieved in installing both systems simultaneously. (*Near-term*)
- Obtain an updated energy efficiency audit. The last one was done in 2009 and technology has evolved rapidly since then. The audit could be obtained from Southern California Edison, but there might be an opportunity to obtain it through Energy Upgrade California, since South Pasadena is a small city. If possible, the audit should cover behavior in driving and other energy uses. The cheapest energy is energy not used. (*Near-term*)
- Include a solar energy emphasis at the City's Clean Air Car Show. Increase the focus on energy efficiency, rooftop solar systems, and renewable energy opportunities in City communications and outreach to the community. (*Near-term*)
- Add an energy storage battery system to the solar system at City Hall, sized sufficient to power any City Emergency Operations Center set up there. Funding for this could come from the City's designated renewable energy fund, as it will not be used for the recommended solar systems at City Hall parking lots or Wilson Reservoir. (*Near-term*)
- The City should plow money from energy savings from these projects into a new revolving Green Fund that would be used to finance additional renewable and clean energy projects. As additional projects are installed, the savings would come back into the fund to pay for more projects on an ongoing basis. (*Near-term*)

- The City should work with local Legislative representatives to pass legislation that eases the California Public Utilities Commission’s current policy regarding exit fees paid to investor-owned utilities for establishing community solar and community choice aggregation programs. The fee is known as the Power Charge Indifference Adjustment. Other changes could be helpful too.
- Make use of biogas primarily by purchasing carbon offsets to make City vehicles run on virtual renewable fuel relatively quickly. (*Near-term*) The City also should monitor opportunities for contracting directly with a biogas supplier if the price comes down sufficiently to make it economical. (*Mid-term*)
- Continue to explore possible sites for more solar installations. Interesting targets are Garfield Reservoir, when its renovation is completed, and the West Side Reservoir, when it is upgraded. The generation capacity of these four projects—Wilson Reservoir, City Hall Parking Lots, Garfield and West Side Reservoir combined—meets more than half the city’s electricity needs. (*Mid-term*)
- Explore creating a Community Solar program in South Pasadena, which would involve installing additional solar systems. City residents and businesses then would be able to use virtual solar energy from the Community Solar system, which would be publicly owned or could be built under a public-private partnership. (*Mid-term*)
- Monitor and evaluate participating in any Los Angeles County Community Choice Aggregation program, which would allow public purchase and production of power for residents and businesses, rather than utility purchase and production, potentially at a lower cost and at a higher level of renewable energy than available from Southern California Edison. (*Mid-term*)
- Explore SCE’s Renewable Energy Self-generation Bill Credit Transfer tariff (RES-BCT) as a way of utilizing virtual net metering to get around current regulatory and financial limitations of installing solar on some sites in South Pasadena. (*Mid-term*)
- Continue to broaden use of electric and alternative-fueled vehicles. (*Ongoing*)
- After gaining experience through these initiatives the City should study and adopt a responsible, decades-long plan to become carbon-neutral. (*Long-term*)

The Renewable Energy Council is available to help the City in further development and implementation of these recommendations.

Introduction:

California is a world leader in the transition from polluting fossil fuel to clean, renewable energy. To facilitate this monumental change, the state has established an extensive set of programs to help residents, businesses, and local governments employ new technologies—like rooftop solar systems—to save money, spur new economic and job opportunities, and reduce their carbon foot prints.

State policies and laws enacted over the past 15 years have continually raised the bar for the clean energy economy transition, with the state now targeting 50 percent renewable electricity by 2030. They follow on the wings of the state’s earlier drive beginning in the late 1940s to rid the air of toxic industrial and automotive smog, particularly in the Los Angeles area. Today, the overriding imperative is the need to stabilize the climate of a planet that’s warming—it seems increasingly rapidly—due largely to fossil fuels, but also due to use of other resources to support a growing population. **To stabilize climate, scientists tell us that greenhouse gas emissions must be reduced 80 percent by 2050, just 34 short years away. This is California’s goal and achieving it will require participation from virtually every resident and institution in the state.**

To help enable participation, the state has created not only mandates, but also a network of opportunities and incentives that residents and cities can seize on to do their part on climate change, which some call the greatest challenge facing today’s young and future generations. These opportunities and incentives combine both market approaches and financial assistance programs, which while complex, increasingly have helped municipal governments and other public institutions up and down the state. Cities have successfully used state policies to employ photovoltaic solar energy systems in an increasing number of settings—from reservoirs to city halls—increase energy efficiency in their operations, and reduce emissions from their vehicle fleets. This not only creates a healthier and more sustainable environment, but also monetary savings.

To investigate how South Pasadena can play its part in the clean energy revolution, the City Council late last year appointed nine South Pasadena residents with expertise in energy to the Renewable Energy Council. Its task was to evaluate opportunities for the City to employ renewable energy at its facilities and to lay out ideas for stimulating a shift toward clean energy throughout the community. The Council began meeting immediately and is pleased to present these recommendations, which outline what it believes is a realistic pathway for the City to increase use of renewable energy and decrease its carbon footprint over the years ahead. The Council, particularly its Technical Subcommittee, evaluated solar systems at Wilson Reservoir and City Hall parking lots on a detailed basis, analyzing the engineering and economic details. Indeed, its recommendation to install solar systems on these two facilities is the Council’s most well formulated and immediately important recommendation. Other recommendations in this report, while also important, were analyzed at the conceptual level.

A Path for South Pasadena:

South Pasadena is a mature, small city with limited staff resources and a limited tax base. In evaluating its recommendations, the Council kept this in mind. Another major constraint for the Council was to develop recommendations that are compatible with tariffs and policies of the two energy utilities that serve the community: Southern California Edison and Southern California Gas Co. Unlike some communities with their own municipal energy utilities that have the ability to set their own rules regarding the terms of interconnecting renewable energy systems to the grid, South Pasadena and its residents are bound by terms set by the California Public Utilities Commission for investor-owned utilities.

After studying options, the Council recommends concentrating on three specific strategies: most importantly photovoltaic solar systems, second, strong efforts to improve underlying energy efficiency, and third, renewable natural gas (also known as biogas). In addition, the Renewable Energy Council recommends that the city continue efforts to transition its vehicle fleet to electric and alternative-fueled vehicles. The Council will remain available to help the City Staff and City Council implement these strategies, including helping to structure any requests for proposals and evaluating resulting proposals.

SOLAR SYSTEM OPPORTUNITIES:

The most **immediate** solar opportunity for the city is to install two systems: a solar rooftop system at Wilson Reservoir in San Gabriel and another at city-owned parking lots near City Hall to provide electrical power for the Police and Fire Departments and also the City administrative building and Council Chamber. The Renewable Energy Council also recommends that the City consider installing electric vehicle charging infrastructure in conjunction with the solar energy system at the Hope and Mound parking lot. This will allow wiring for the charging station to run through the same trench as wiring for the solar system, thereby achieving an economy of scale in the installation cost. In the past, the cost of trenching for a charging station alone has been an obstacle to providing electric vehicle charging infrastructure at the parking lot.

The Council found that with generous 1 percent, 20-year financing available through the California Energy Commission, installing the two recommended solar systems would reduce the City's overall \$1 million a year electricity bill by \$70,000 annually, and provide a positive cash flow effect for the city after making the loan payments, **even in the first year of operation**. The two systems also will reduce greenhouse gas emissions by 260 tons annually, the equivalent of eliminating emissions from 56 cars. (Details of this recommendation to install two solar systems are outlined in Appendix A of this document.)

Time to install these systems using this financing and under the terms of the Southern California Edison tariff is limited. First, financing under the Energy Commission program is limited and offered on a first-come, first-served basis. Second, Southern California Edison caps the amount of solar power that can be installed throughout its sprawling territory under an available renewable tariff. Once the cap is reached this tariff's favorable terms will no longer be available to South Pasadena. These two factors are reason for prompt discussion and action on the part of the city.

Using preliminary bids from two installers, the Renewable Energy Council produced a plot of net savings (electrical bill savings minus loan payments and maintenance) in time. The result is shown in the figure below. Remarkably, the net savings are positive in year 1 and improve each year thereafter.

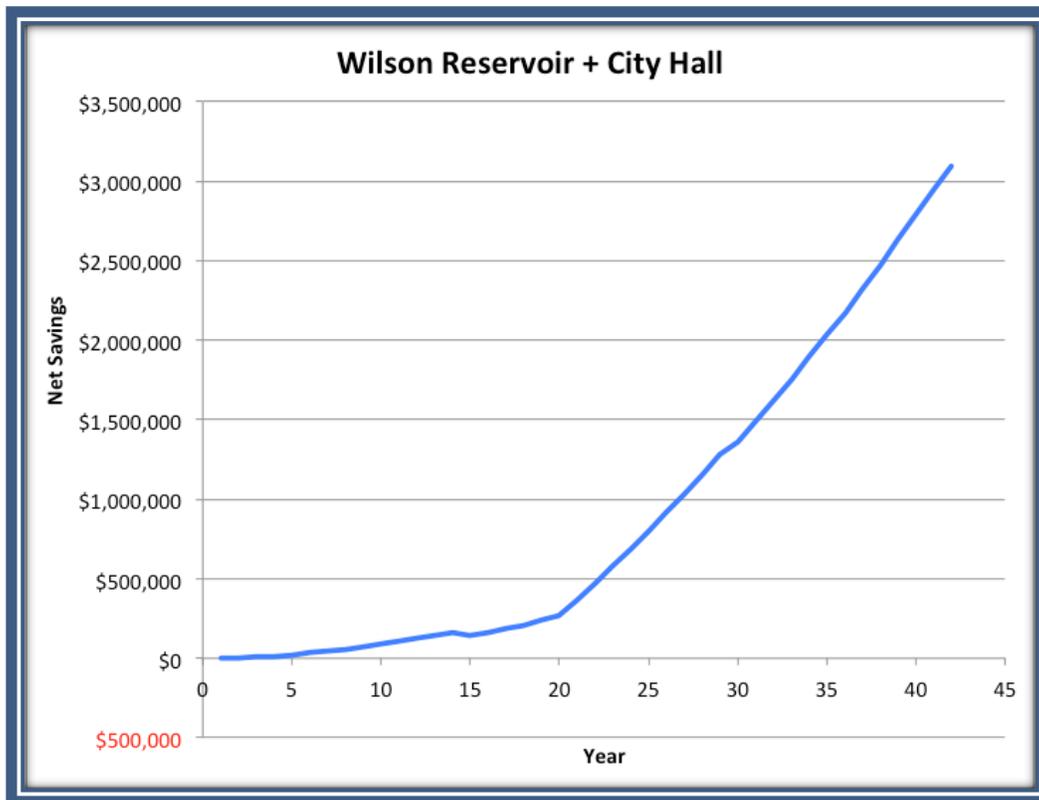


Figure 1: This plot shows the cumulative net monetary effect on the City of installing solar arrays on the Wilson Reservoir and City Hall parking lots under the ECAA financing scheme ([See Table 1, p. 31, for more information](#)).

The Renewable Energy Council also evaluated the West Side Reservoir and Garfield Reservoir. It found that site factors or tariff terms limit solar opportunities at this time. While Garfield Reservoir would be the best location to place solar from a site perspective, tariff limitations make it difficult to do so, though not impossible. The current problem is that Garfield typically uses little electricity compared to the large roof area available for placing solar panels. Covering the roof with panels—which would dramatically reduce the relative cost of a solar system there—would result in more power production than could be consumed onsite at the reservoir, a situation generally not allowed under Southern California Edison tariffs. In short, the tariffs generally require that a rooftop solar system’s output over a year does not exceed the facility’s power demand as measured at the Southern California Edison meter. Fortunately new opportunities are on the horizon, such as the Community Solar program, the Renewable Energy Self-generation Bill Credit Transfer tariff (RES-BCT), and potential community choice aggregation in Los Angeles County, which could provide a justification for installing a solar system on the Garfield Reservoir roof. Further details of these programs are discussed later in this report.

Also on a **near-term** basis, the Council recommends that to help build residents' awareness and support for clean energy, the City should expand what's been commonly known as the South Pasadena Clean Car Show to provide a greater focus on opportunities for households and businesses to install solar systems, beginning with the next event. To do this, the City would enlist solar companies to exhibit and include a presentation to update the community on City renewable energy efforts and opportunities available to the broader community. The Council also recommends that the City highlight renewable energy and energy efficiency, as it does water efficiency, in its communications with residents and businesses, including articles in its newsletter, developing a renewable energy/energy efficiency page on its website, and making use of other opportunities. The Council can offer some assistance in these efforts, at least initially. The Natural Resources & Environmental Commission also could serve as a focal point for providing content for city communications related to renewable energy and energy efficiency.

In the **near-term** too, as the City begins to make plans for an emergency operations center at City Hall, it should take advantage of the City Hall solar system to power the facility. During emergencies, such as the major wind storm in 2011 that left the city in the dark, many for up to five days, power outages are common and often widespread. Yet, solar panels at City Hall could provide clean power for the emergency operations facility 24-7 by adding an energy storage battery system sized to match the center's maximum power load. Nissan, for instance, recently announced a system, known as the xStorage System, which can be installed for \$4,500. (Note: more than one battery pack may be needed, depending upon the emergency center's load requirements.) Tesla is planning to roll out a second version of its Powerwall battery pack later this year. Pricing is uncertain. The company also is offering larger commercial-scale storage energy systems.



Figure 2: The Nissan xStorage device, which can store power from solar panels for use at night and on cloudy days, will retail for around \$4,500. It uses lithium ion batteries, the same as used in its electric car, The Leaf.

Also in the **medium-term**, the Council recommends that the City explore making use of a new tariff that will soon become available from Southern California Edison called the Green Tariff Shared Renewables program. The California Public Utilities Commission closed the proceeding to enable this new tariff—more commonly known as Community Solar or Solar Shares—in early May and the utility is expected to accept offers from

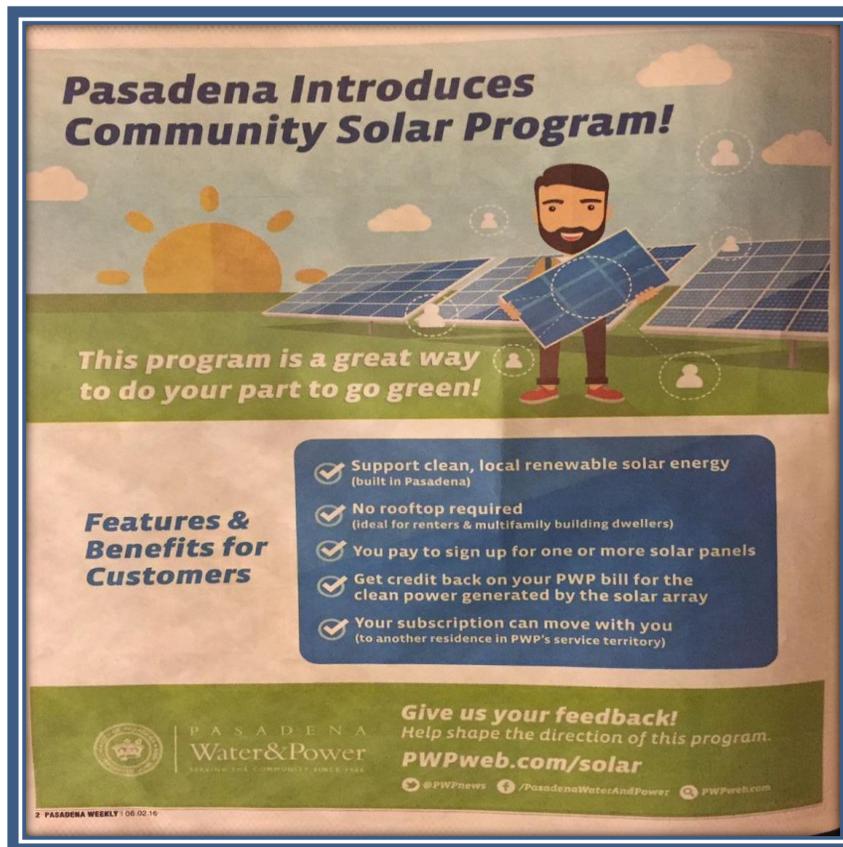


Figure 3: Pasadena Water & Power, a municipal utility, is launching its community solar program, as depicted in this recent ad in the Pasadena Weekly.

program developers through its semi-annual Renewable Auction Mechanism procurement program. Under this option, Southern California Edison would purchase the output from a solar project (which could actually be an amalgamation of several individual installations scattered around at City facilities, schools, and businesses) to virtually serve the power needs of its South Pasadena customers who choose to subscribe to the community solar program under terms offered by Southern California Edison.

Establishing a Community Solar program here would provide opportunities for residents, businesses, schools, and churches who cannot install solar systems—for instance tenants, those with shaded rooftops, condo owners, etc.—with an opportunity to get locally-generated, community-owned renewable power on a virtual basis. To pursue this option, the Renewable Energy Council recommends that the City seek to partner with a developer that could set up the Community Solar program with limited City Staff involvement.



Figure 4: Garfield Reservoir, once reconstructed, will have a rooftop big enough to install a 1 MW solar energy system. It could serve as the anchor location for installing a solar system to provide power for an eventual South Pasadena Community Solar program, that would allow the city and conceivably local schools, businesses, churches, and residents to make use of locally produced solar energy on a virtual basis by agreeing to purchase a share of the program's output.

A potential **mid-term** twist in this strategy—and one that the Renewable Energy Council recommends the City should carefully track and eventually weigh participating in—is the possibility that Los Angeles County may form a **community choice aggregation** program. State law provides municipal governments the right to purchase and produce power in place of the local investor-owned utility by forming a community choice program. Once formed, residents and businesses in community choice areas automatically are enrolled in the program, unless they choose to opt out and keep getting power contracted for or produced by the utility. In community choice program areas, the utility continues to distribute and bill for the power, even though it is purchased or produced by the program manager. To date, Marin County, Sonoma County, and the cities of Lancaster and San Francisco have formed and successfully launched community choice programs. Since Marin Clean Energy was formed in 2008, it has expanded to include unincorporated Napa County and the cities of Benicia, El Cerrito, Richmond and San Pablo. Existing programs typically offer their local residents and businesses options for up to 100 percent renewable energy, and base power rates that are a bit less costly than offered by the local investor-owned utility. Many other jurisdictions—from the state's North Coast counties to the City of San Diego—are in the process of moving to community choice aggregation. Typically, community choice aggregation programs seek to emphasize production of renewable energy at the local level, which could make it easier to develop additional City-owned solar facilities.

Here in the local area, the Los Angeles County feasibility study is due toward the end of 2016 or early in 2017. If it shows that a program could be favorable, the County could choose to move to community choice for unincorporated areas and likely allow cities to opt-in on behalf of their residents and businesses. In other counties with programs, cities that opt in get a seat on the governing board of the new entity established to run the choice program. One of the biggest wildcards in evaluating whether to go forward will be Southern California Edison's calculation of the so-called Power Charge Indifference Adjustment, often called the PCIA. The adjustment is a fee that the Public Utilities Commission allows investor-owned utilities to levy on choice programs to cover the cost of stranded power production contracts entered into by the local utility on behalf of their customers to provide power going forward. The fee and PUC rules for calculating it can be a significant factor in determining whether choice programs can match or beat utility power prices. It also affects Community Solar programs. The situation is dynamic, with choice programs, Community Solar advocates, and utilities arguing at the PUC about how the fee should be applied going forward.

A final option for expanding solar in South Pasadena is to consider SCE's Renewable Energy Self-generation Bill Credit Transfer tariff (RES-BCT). RES-BCT is available through many utilities and is becoming an increasingly popular option for municipalities. At its root, RES-BCT addresses the problem mentioned above at Garfield Reservoir. Under normal net metering, it is not financially advantageous and generally not acceptable to the utility to generate more energy than is used by a single meter. The problem at Garfield is that with its 1 MW capacity potential, yearly energy generation would far exceed the energy used for pumping at the reservoir. RES-BCT addresses this problem by allowing electricity usage at multiple facilities with separate meters to be aggregated into one for accounting purposes. It is quite possible that under RES-BCT it would be financially beneficial to install solar on Garfield. The problem, however, is complex and would need to be studied in detail before committing the City to this path for solar expansion.

ENERGY EFFICIENCY OPPORTUNITIES:

Hand-in-hand with installing solar systems at City Hall and Wilson Reservoir, the Council recommends that the city **immediately** obtain an updated energy efficiency audit for all City properties. Programs are offered by all state energy utilities. The City should implement measures with paybacks in the 3 to 5 year range, or that payback more quickly. It should then plan for those with longer paybacks.

South Pasadena had an energy efficiency audit in 2009 arranged by Southern California Edison. It outlined a series of measures, which the city has largely undertaken. However, years have gone by since that audit and the world has changed. In the interim, the state has updated its building code for efficiency, both the state and federal government have updated efficiency standards for energy-using devices, and the federal government has revamped and reinvigorated its Energy Star program. In addition, recently enacted SB 350 calls for a 50 percent improvement in building energy efficiency by 2030. The new standards and policies reflect rapid advances in technologies, which are eclipsing an earlier array of energy efficient products in the market place. One of the most visible examples is the rise of LEDs in the

lighting market and the effective ban (except for specialty uses) of common incandescent lights. LEDs, which are rapidly falling in price, last longer than compact fluorescent bulbs because they are meant to be turned on and off frequently, and provide high quality illumination properties. From appliances to heating, ventilation, and air conditioning systems, there have been similar advances.

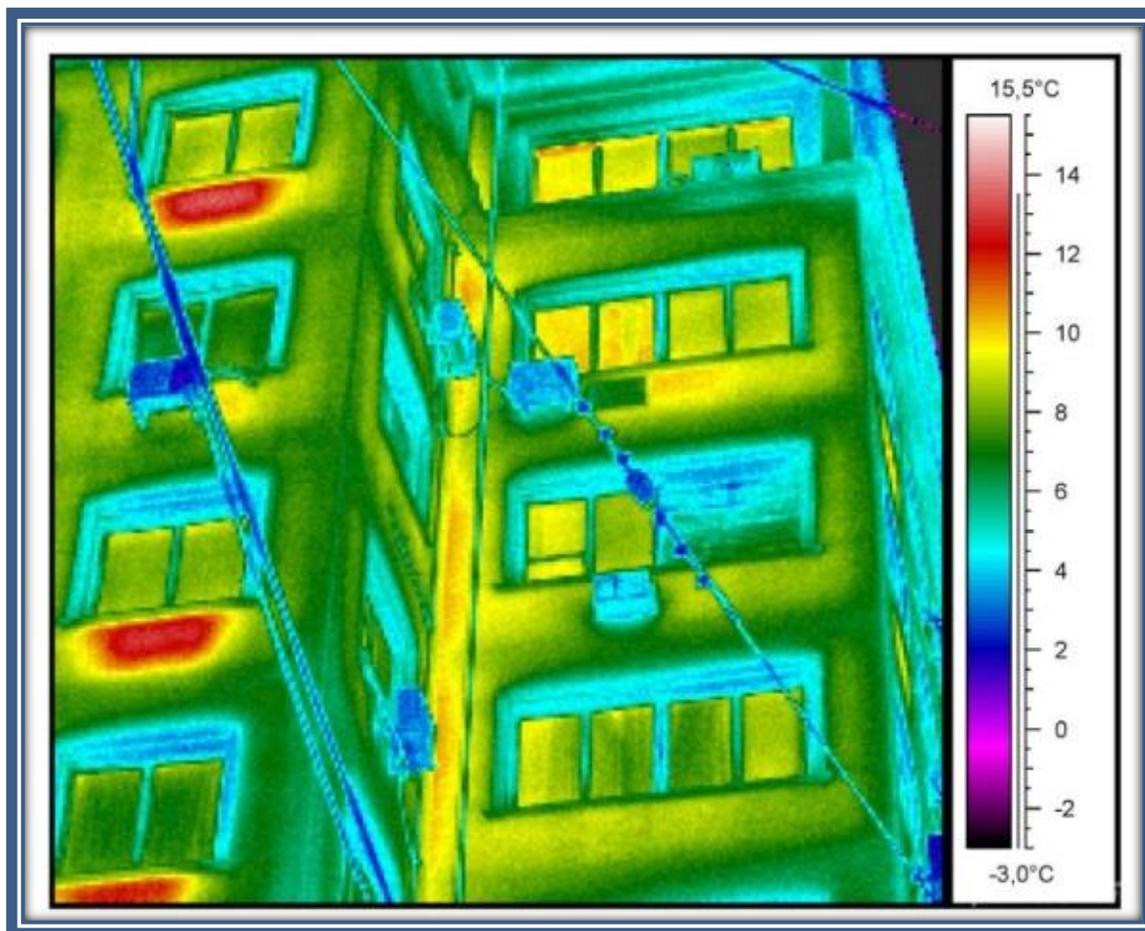


Figure 5: The yellow and red in the picture of the building above show where energy is leaking due to poor seals, lack of insulation, and other factors.

Another energy efficiency strategy the Council recommends the City consider in the **mid-term** is to review its procurement policy to make sure it specifies purchase of energy efficient devices, such as computers, screens, printers, etc., to reduce plug-load in City buildings. This is something that the Natural Resources & Environmental Commission is planning to do under its 2016-17 work plan.

Finally, the city recommends a **continued focus** on water conservation even as the drought eases. Less water use equates to less water pumping from the City's wells uphill to the City, which equals less energy use. In short, water efficiency and energy efficiency are one and the same.

BIOGAS OPPORTUNITIES:

While solar systems can supply electricity for buildings and even electric car charging stations, city buildings also rely on natural gas for hot water heating, heat, and other thermal power needs. In addition, city vehicles burn gasoline and diesel fuel. While electric and natural gas vehicles are available, heavy-duty models generally have proven prohibitively costly for South Pasadena. On the light-duty vehicle side, Police Department needs have made it challenging to purchase and use clean-fueled vehicles, which have limited range. It also should be noted that natural gas, or methane, increasingly produced by hydro-fracturing (commonly called fracking), is fraught with environmental problems. Moreover, well-based methane is not renewable. In addition, natural gas is a powerful greenhouse gas, with a warming potential more than 80 times that of carbon dioxide.



Figure 6: Here at this biogas energy project, methane from livestock waste is captured and burned to produce electricity. The renewable energy attributes and carbon emission reduction values of such projects are packaged and sold to individuals and organizations seeking to offset their carbon emissions and/or meet renewable energy goals at a nominal price equal to about \$12 per ton of carbon dioxide emissions reduced, the going rate in California's carbon cap-and-trade market.

To address the city's use of natural gas and of non-renewable fuels in vehicles, the Renewable Energy Council recommends that the city make use of biogas in the **near- to medium-term**, a renewable form of methane produced by livestock operations, landfills, and sewage treatment plants. Growing populations using more resources (i.e., food, paper, and other organic materials) and growing livestock herds are accelerating production of biogas, a useful energy resource that can be employed as a renewable substitute for conventional natural gas. What makes biogas renewable is that it begins as plant material, is converted to methane by biological processes, and then when it is burned the carbon dioxide emitted to

the air ultimately is taken in by plants as a building block for growth in an endless cycle. By contrast, conventional natural gas use results in the release of carbon to the atmosphere that was once isolated from the ecosphere in deep geological formations, something that creates an imbalance.

To make use of biogas, the city has two opportunities. The most immediate is for the City to purchase the renewable energy attribute or carbon offset values of biogas, which can be sold separately. In this way, the City could offset emissions from a variety of energy uses which it can't do with solar energy. Renewable energy credits or carbon offsets could be used to turn South Pasadena's vehicle fleet, for instance, into one that virtually operates on renewable energy, as well as its buildings. Even travel by City Council Members and Staff, for instance to the California League of Cities conference, could be offset.

The way it works is as follows, when a person or organization purchases a carbon offset or renewable energy credit, it stems from bioenergy or forestry carbon sequestration projects. Bioenergy projects typically involve, for instance, capturing methane produced at a hog, dairy, or other livestock operation and using it to make electricity or injecting it into the gas pipeline system. These uses are renewable and also reduce the need to burn fossil fuel to make power and to drill for natural gas to fill pipelines.

The Council recommends that the City in the **near-term** purchase carbon offsets or renewable energy credits on a menu-based approach, starting for instance with enough to offset emissions from its heavy-duty vehicles and police cars. Offsets generally are available by the year or in increments of a thousand pounds so purchases can be scaled as is needed and affordable. The offsets are fully verified by third-party certification organizations, such as the Climate Action Reserve, a registry approved by the California Air Resources Board for certifying offsets. The number of offsets also could be expanded after gaining experience. Currently, TerraPass, for instance, sells carbon offsets for about \$5.95 per 1,000 pounds of emissions. So to offset emissions from a 2016 model light-duty Ford Police car driven 10,000 miles a year would cost the city \$53.55.

Looking toward the **mid-term**, California is a choice state when it comes to service by its investor-owned natural gas utilities. Choice gives gas utility customers the option of purchasing gas from independent providers rather than relying on gas purchased by the utility on behalf of its customers. While it is more expensive, companies currently supply biogas by dispatching it into the nation's natural gas pipeline system. South Pasadena could arrange to purchase its gas from one of these companies under a biogas purchase agreement to meet all its natural gas needs. The City should periodically monitor market conditions for biogas and make use of this opportunity when contracting for a biogas supply becomes economical.

GREEN FUND:

In the **short-term**, the Council recommends that the City consider forming a Green Fund, which would be used to finance renewable energy projects. This would involve dedicating a portion of the city's reserves to initially capitalize the fund. As savings accumulate from clean energy projects, the money could replenish the fund and be used to fund additional projects. The fund also could be organized in a way that allows local residents, businesses, and organizations to contribute money on a voluntary basis.

EDUCATIONAL OUTREACH:

With some public awareness of climate change and energy conservation present in South Pasadena, there is an opportunity to build community-wide momentum on clean energy and energy efficiency. The City can help do this through a clean energy and energy conservation campaign, which is outlined in Appendix 2 of this report.

CONCLUSION:

The Council has identified what it believes are realistic steps South Pasadena, a small city with limited resources, can undertake to make greater use of renewable energy in the near to mid-term, with the most immediate opportunities being to install solar systems at City Hall parking lots and Wilson Reservoir. As the city evaluates and pursues these recommendations, it also may also want to consider leaving the Renewable Energy Council intact so it can continue to draw on the Council to assist in the implementation phase.

Appendix 1: Technical Subcommittee Report

Solar in South Pasadena: First Steps

EXECUTIVE SUMMARY

The South Pasadena Renewable Energy Council (REC) strongly recommends that City Council direct staff to develop and issue a request for proposals (RFP) for two solar projects on City properties at Wilson Reservoir and City Hall. These projects will produce enough renewable energy to reduce the City's overall electrical use by 10% and reduce the City's electric bill by at least \$70,000 annually. In addition, by taking advantage of available funding through the State of California's Energy Conservation Assistance Act (ECAA) these two projects can provide net positive cash flow to the City in year 1, even after the loan payments. That's because the state financing program offers 20-year loans for municipal renewable energy projects with a 1% interest rate. However, because funding through the ECAA program is limited and SCE caps number of solar projects allowed under the tariff time is of the essence in moving forward. Members of REC are willing to help structure an RFP and evaluate proposals in order to help advance these projects.

INTRODUCTION

The Renewal Energy Council (REC) was established by the City Council in order to explore renewable energy options for City properties as a way of decreasing fossil fuel use and saving energy costs. But in the course of the committee's meetings it became clear that there were some near term opportunities to install solar at several locations in the City as a way to begin the journey. This memo presents a targeted and detailed plan to begin moving the City of South Pasadena towards a renewable energy future.

With the assistance of City staff and SCE, the REC obtained extensive data for energy usage and payments for all 108 City electrical meters. Figure 1 below summarizes both energy and bill information in 11 sites/categories.

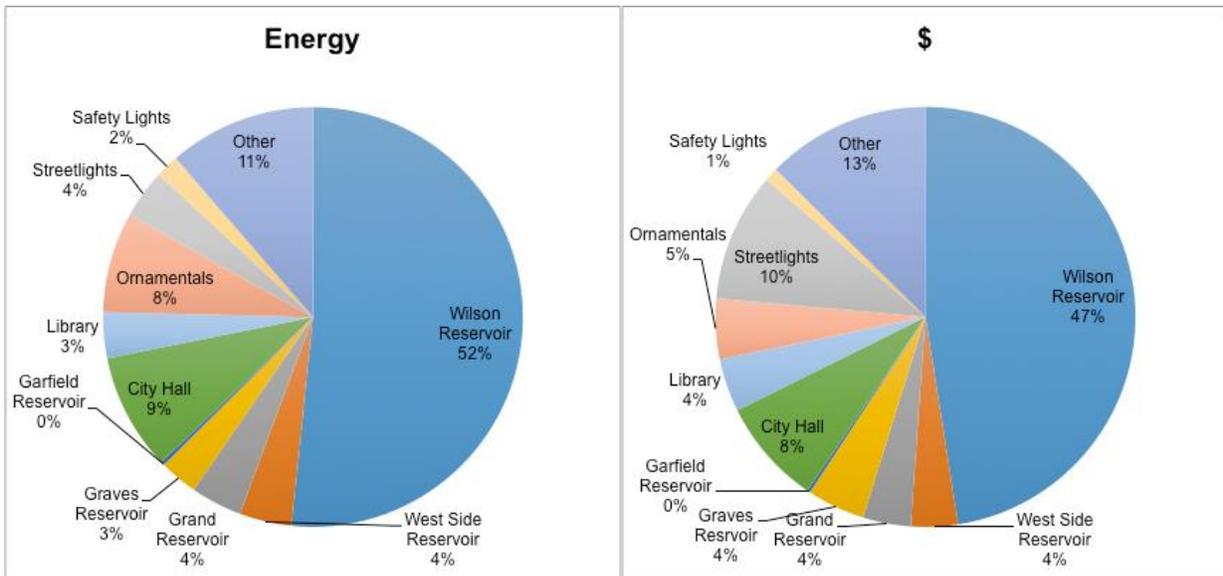


Figure 1: 2105 electrical energy and bill data for the City of South Pasadena. The left chart shows percentage energy usage while the right shows percentage billing information.

It is clear that the water department is the biggest user of electricity with a 63% share of usage and 59% share of bills, and most of that is associated with pumping water from the Wilson Reservoir. The reason for the high electrical usage at Wilson is that the City gets most of its water from groundwater that is pumped from the City's Wilson Reservoir, in San Gabriel, several miles, uphill, to the City's Water Distribution System. Thus, significantly offsetting energy usage and costs in South Pasadena means looking at offsetting energy usage and costs for water pumping, especially at the Wilson Reservoir Pumping site.

At 9% usage and 8% bills City Hall is the 2nd major user of electricity in the City (excluding lighting) and has the additional benefit of being highly visible. Because of the dispersed nature of the lighting it is not possible to provide a solar offset for this energy.

We thus looked at both of these facilities as potential "low-hanging-fruit" to determine if it was cost effective to implement solar installations in South Pasadena. This proposal considers the near term installation of solar on Wilson Reservoir and the public and city parking spaces near City Hall (City Hall Parking).

BENEFITS OF SOUTH PASADENA CITY SOLAR INSTALLATIONS

The City of South Pasadena consumes about 6,200,000 kWh of electricity annually. This is for City operations only and does not include electricity use for private homes and businesses. This electricity costs the City nearly \$1,000,000 annually.

The two solar installations being recommended by the REC, Wilson Reservoir and City Hall Parking, at approximately 370 kW combined power output, will produce about 620,000 kWh annually, lowering the

City's electricity needs by about 10%. This will reduce greenhouse gas emissions by 260 metric tons per year, equivalent to eliminating 56 cars from the road¹. This will also reduce the City's electric bill by at least \$70,000 in the first year of operation, as discussed below.

The development of these two solar projects and potentially additional solar projects in the future will be a visible and significant display of the City's commitment to supporting renewable energy development, reducing carbon emissions and promoting a sustainable environment for future generations, while at the same time paying for themselves, as discussed below.

FINANCING

The financing of any renewable energy project is a crucial consideration. The REC considered multiple options for financing solar in South Pasadena. For these two projects we suggest financing through the State of California's Energy Conservation Assistance Act (ECAA)² as the best short-term option for the City. This program provides 20-year, 1% loans, for cities, counties, colleges and universities and public care institutions/public hospitals to pay for renewable energy projects. Applications are received on a first come/first service basis and funds are limited within each calendar year. Therefore, we recommend city staff submit an application as soon as possible to preserve the City's place in line.

The advantages of obtaining a long-term, low-interest loan are four-fold. First, loan payments are fixed whereas electricity prices are expected to increase between 2% to 4.4% a year in the coming decades³. Second, based on the financial model loan payments are projected to be lower than the City's current electricity cost thus generating a net savings that may be obtained in the first year of the loan. Third, financing provides liquidity and the opportunity cost of avoiding a large capital outlay to the government balance sheet. Lastly, the strategy for utilizing solar is estimated to save two hundred fifty thousand dollars (\$250,000) net present value during the life of the loan. Once the loan has been fully amortized, the savings may reach over three million (\$3,000,000) over the remaining extended life of the solar panels.

There are several questions concerning the ECAA loan that the REC could not determine without the City's input:

Can the City apply for one loan or would it be required to apply for two loans since the projects benefit two different funds (General Fund & Water Fund)?

Could the savings from the water fund be used to offset future water rate increases or used to purchase more energy efficient equipment to further reduce cost?

¹ <https://www.sce.com/wps/portal/home/about-us/environment/energy-conservation/lut/p/b1/pV>

² <http://www.energy.ca.gov/contracts/PON-13-401/>

³ The Future of Electricity Prices in California: Understanding Market Drivers and Forecasting Prices to 2040, Jonathan Cook, Ph.D.

Figure 2 shows the predicted financial picture for the combined projects. Details of these predictions can be found in Addendums A and B at the end of this memo. These details are important and were analyzed thoroughly by the REC.

The financial model for these projects includes:

- 1) Averages of the installed price estimates and energy production from solar energy development companies who visited the sites;
- 2) ECAA financing conditions mentioned above. The impacts of this beneficial financing are shown in Figure 2 with net savings in year 1 and a significantly greater savings at year 20, when the loan is completely repaid;
- 3) Electric rate increases of 4.4% until 2022 followed by 2% thereafter based on current utility research;
- 4) Degradation of the solar panels over time, estimated at 0.5% per year⁴;
- 5) Maintenance, especially inverter replacement based on estimates from the installers;
- 6) Optimization of SCE's electric rate structure, which has a capacity limitation that translates to a need to move forward quickly before the capacity limit is reached;
- 7) Future pumping operations at Wilson Reservoir when Garfield Reservoir comes online in 2017, that significantly affect predicted future savings. The REC deliberately chose the most conservative assumption for future operations;
- 8) Pricing both projects separately. This is also conservative, as doing both projects at the same time would yield additional savings.

For each year out to year 42, the REC estimated the net savings to the City. The net savings is equal to the savings on electric bills less loan payments and maintenance for the solar projects. Figure 2 shows the cumulative net savings for the City.

⁴ From "Best Practices in PV System Operations and Maintenance", NREL, Version 1.0, March 2015. Available at <http://www.nrel.gov/docs/fy15osti/63235.pdf>.

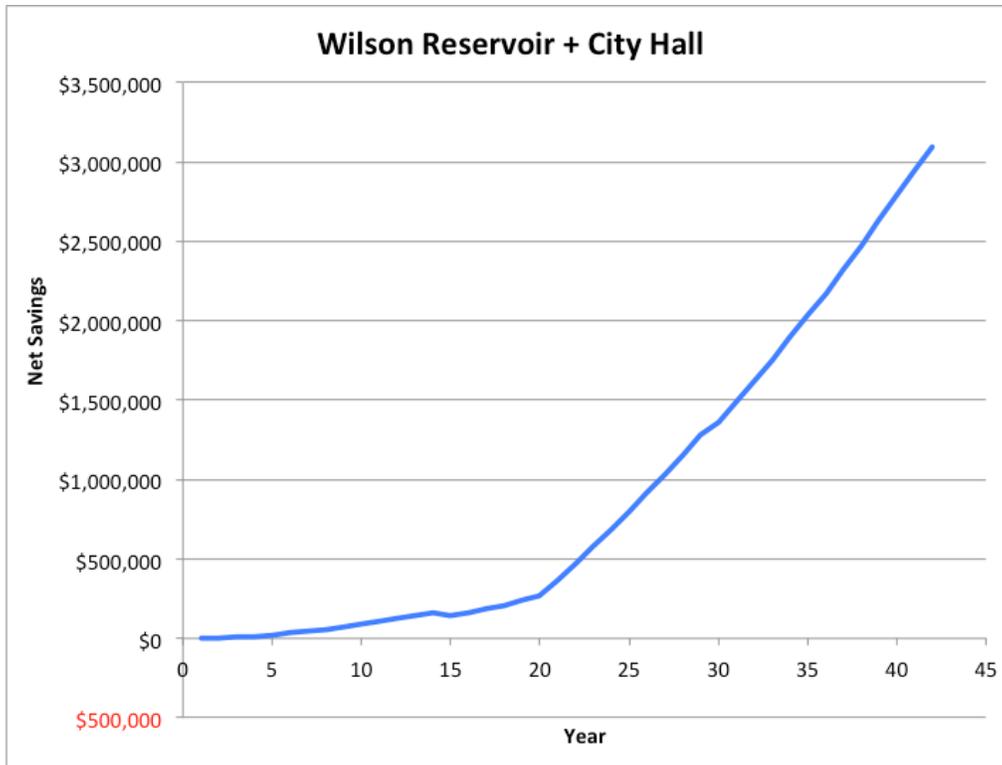


Figure 2: This plot shows the cumulative net monetary effect on the City of installing solar arrays on the Wilson Reservoir and City Hall under the ECAA financing scheme ([See Table 1, p. 31, for more information](#)).

The loan payments are smaller than the savings starting after year 1. However ECAA doesn't require payment for the first year. Remarkably this proposal predicts a net positive cash flow in the first year of operation and thereafter. Furthermore, as detailed above and in the appendixes, we believe this estimate is conservative.

CONCLUSION

In the strongest possible terms the REC recommends moving forward quickly with these two projects. Combined they will provide the City of South Pasadena with a 10% clean energy offset. One of them would be highly visible demonstrating the City's commitment to a sustainable future. Moreover the financial model we have developed suggests that the installations can be completed for minimal costs (staff time only, but members of the REC are willing to help). The larger effect of acting on this proposal, though, is to show the community and beyond, the benefit of the responsible deployment of renewable energy at the City scale.

ADDENDUM A – PROPOSED WILSON RESERVOIR SOLAR PROJECT DETAILS

The South Pasadena REC surveyed numerous City facilities to identify the best sites for solar development. The survey included looking at electricity use as well as space available to install solar panels. The City's water supply system consisting of large covered reservoirs and pumps is ideal for solar energy development. The City's largest electricity use is for water pumping and the largest single site for use of electricity is the City's Wilson Reservoir and groundwater pumping site in the nearby City of San Gabriel. This facility was recently rebuilt with a state of the art covered reservoir over 12,000 square feet in size. Most of this reservoir is also free of shading obstructions. The REC made some preliminary estimates to install solar that made it apparent that this site should be investigated further.



Figure 5: Aerial View of Wilson Reservoir.
Note there is some shading on the right.



Figure 3: Wilson Reservoir Site in the City of San Gabriel



Figure 4: Site Visit to Wilson Reservoir. Note the new concrete roof structure.

Based on the preliminary estimates, the REC decided to pursue preliminary bids from several solar contractors. On March 9, 2016, three solar contractors toured the Wilson Reservoir site, along with the South Pasadena City hall complex and two of the contractors provided informal solar project proposals. These proposals estimated a solar project size of 140 kW DC that would produce over 220,000 kWh annually. The cost of this project would range from about \$350,000 to \$375,000, less than \$2.70/ installed DC watt.

The current pumping operation at Wilson Reservoir utilizes a significant amount of electricity in the high peak electrical demand period between noon and 6 PM on weekdays, to meet the City's water demands. With the way the pumps at Wilson

are operated today, a 140 kW solar project at the site could reduce the electric bill at Wilson by about \$32,000 annually, or about 14 cents/kWh generated. However, most of this benefit would be derived through changing the electric rate to a renewable rate that would virtually eliminate electric demand charges which are a major component of the site's current electric bill.

However, the current pumping operation is required to closely follow water demand as the City's largest water storage facility, Garfield Reservoir, is currently being reconstructed and is out of service. Once Garfield is back in service in 2017, Wilson's pumping operations will likely be modified to significantly reduce high electric demand on weekday afternoons. With this modified operation, the electric bill at Wilson could be reduced by about \$60,000 annually, even before solar is installed. With this modified future pumping operation, the benefits of solar are reduced to about \$17,000 annually, or about 8 cents/kWh generated, which is still beneficial. As can be seen in Figure 6 the net is slightly negative up until year 10. However we wish to emphasize that the model used in this prediction was conservative at every turn. What is shown in Figure 6 is a conservative savings scenario.

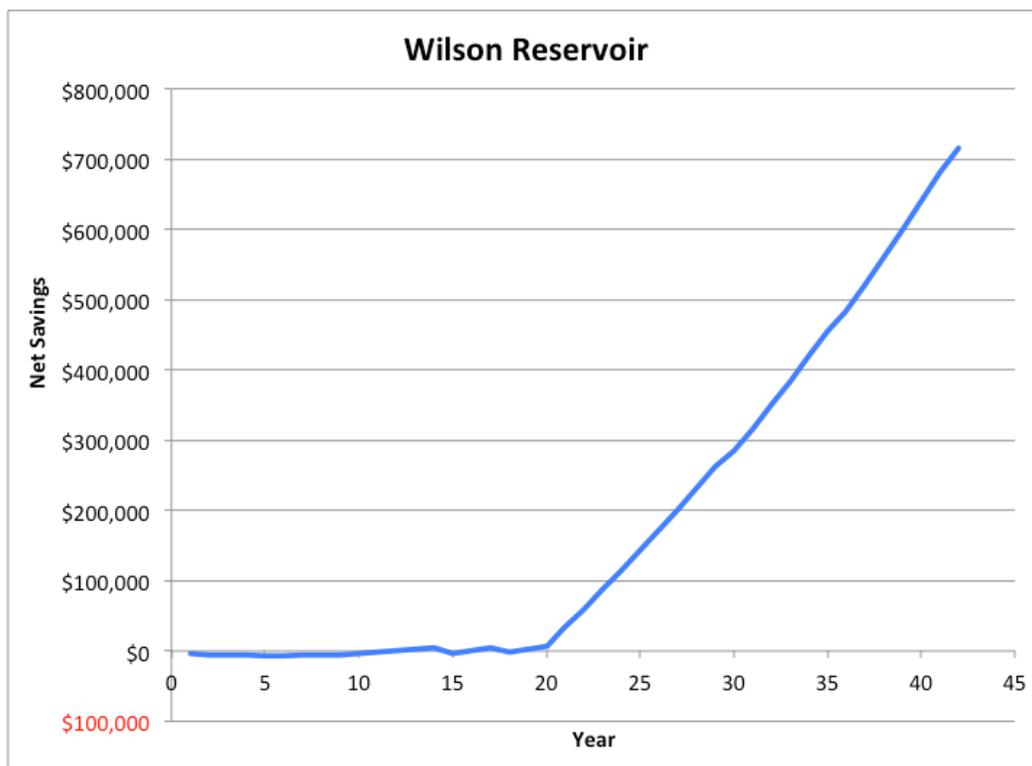


Figure 6: The cumulative net monetary effect on the City based on ECAA financing for the Wilson Reservoir solar installation ([See Table 2, p. 32, for more information](#)).

Finally while it might appear that the net savings are more favorable for City Hall than for Wilson on the basis of Figures 6 and 9, see below, this is an apples-to-oranges comparison as the savings for Wilson were computed under more conservative assumptions.

ADDENDUM B - PROPOSED CITY HALL PARKING LOT SOLAR PROJECT DETAILS
 City Hall is also a major user of energy (9% of City usage overall) and there are parking lots with plenty of unshaded areas both behind and adjacent to City Hall as shown in Figure 7.



Figure 7: City Hall showing parking lots. The northeast parking lot is public parking. The one to the north is parking for City Hall.

In March, 2016 three solar companies performed site visits in order to prepare informal proposals for solar installations on the City Hall parking lots. In addition to potential energy savings, such systems provide shade for vehicles and are easily visible to residents and others. We also asked firms to investigate solar arrays on top of City Hall, but determined that the roof was not conducive to a solar installation.

Informal proposals were received from two of the firms, with cost estimates of \$3.70-\$3.86/watt. The two firms had slightly different sized installations (Figure 8), so overall cost varied from \$780k to \$965k.



Figure 8: Proposed solar installations for City Hall parking lots.

In either case the energy savings are substantial, on the order of \$0.12 - \$0.13/kWh and accounting for a 71% offset of City Hall usage, with a savings of \$45k - \$53k in electricity costs in year 1. Figure 9 shows the potential increase in the general fund over time if solar is installed on the City Hall parking lots. This plot shows positive net impact from year 1 even with conservative assumptions.

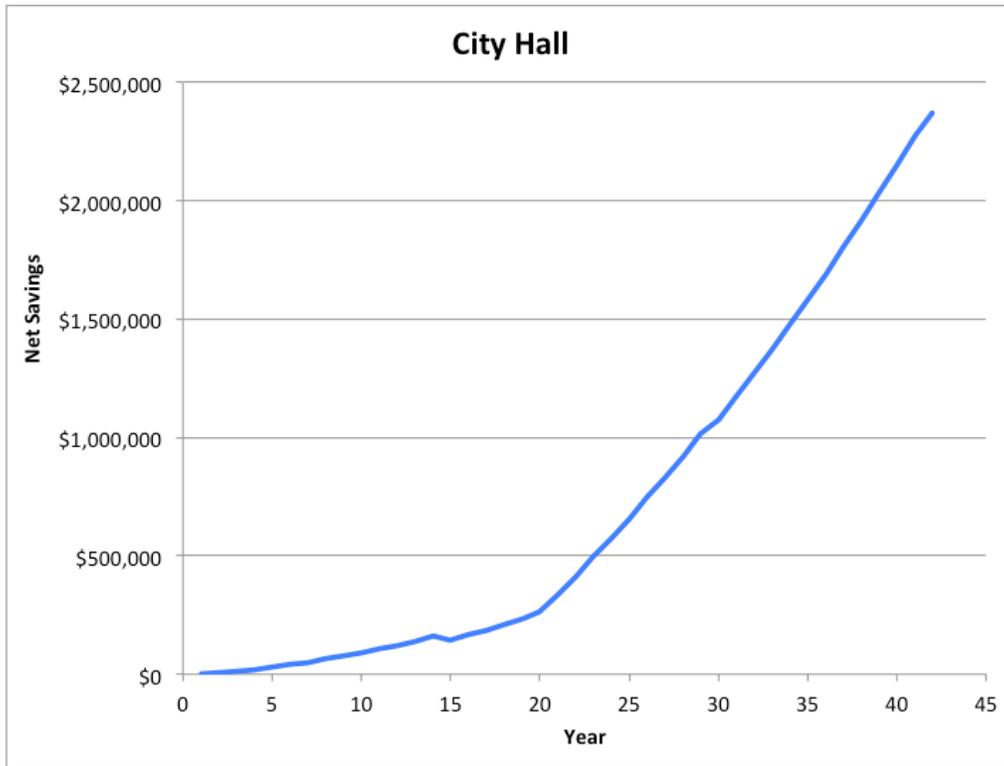


Figure 9: The cumulative net monetary effect on the City based on ECAA financing for the City Hall solar installation ([See Table 3, p. 33, for more information](#)).

Appendix 2: Public Affairs Subcommittee Suggestions Educational Outreach

OBJECTIVES

- Facilitate education of residents on how to conserve energy and promote solar power.
- Target businesses with messaging. Support Southern California Edison's efforts.

ENERGY FIXTURES OPPORTUNITIES

A suggestion is to have the City of South Pasadena lead the way in energy efficiency, by changing out fixtures in various city locations. Efficient fixtures could be installed or changed out in the following locations:

- City Hall Complex
- Recreation and Park Offices
- Orange Grove Park
- Eddy Park
- Soccer Fields
- Arroyo Bathrooms
- Golf Complex
- Tennis Complex
- Library
- Senior Center
- Youth House

The South Pasadena schools should also be encouraged, if possible, to change out their energy fixtures. There are funds from Proposition 39.

AWARENESS CAMPAIGN KICK-OFF

A campaign could be developed to create awareness of energy conservation and renewable energy. There could be a kick-off event that would launch a communication program.

MESSAGING

The campaign messaging will be direct, consistent and easy to understand. Advertising and all campaign collateral materials will be branded with a simple conservation message.

Primary Message: The campaign messaging will target both residential and business customers. The goal of the primary message will be to convey (in one impression) the need to conserve energy.

PROPOSED CAMPAIGN SLOGANS

Energy-Save It

Conserve, It's Simple,

Think About It-How Much Energy Can You Save?

Be Energy Wise

Make Every Watt Count

OUTREACH EFFORTS

Press Releases

Press releases could be sent to media about an energy conservation campaign kick-off media event and efforts. Releases will introduce campaign objectives, stories and include community events scheduled throughout the city in support of campaign. This can also be done to promote the City's solar efforts.

- Newspaper ad in the "South Pasadena Review" announcing the campaign.
- Guest speaker series on energy conservation at the Library or Senior Center.
- Start the telephone messaging on city phones with and energy conservation message.
- Launch special energy conservation web page on city web pages
- Outreach and booths at key events, such as at the Farmer's Market and other events, softball, baseball, soccer, community events, etc.
- See if we can get the grocery stores to assist in outreach, such as customizing the paper bags they sell to have an energy conservation message.
- Rally volunteer groups to distribute energy use surveys
- Stage a kick-off event, perhaps at a solar site.

Funding

Funding could perhaps come from the Water Conservation Fee, as there is a strong connection because saving energy saves water and the reverse. We can also look at grants and contributions

Outreach Strategies

Develop a strategy to educate and communicate with the residents and businesses of the City of South Pasadena.

The focus first is on no-cost or low-cost efforts. These could include:

- Message slide on an on-going rotating basis on Time Warner-Channel 19
- Energy conservation voice message on all City of South Pasadena telephone lines, welcome and when someone is on hold.
- Message on the home page of the City of South Pasadena web site
- Message on the South Pasadena Unified School District web site.
- Message on the City of South Pasadena Chamber of Commerce web site.

Booths and energy conservation literature at all South Pasadena community events:

- Eclectic Music Festival
- Art Fair
- Clean Air Car Show
- Fun Fair
- Parti Gras
- 4th of July events
- Concerts in the Park
- School events, sport events
- Chamber of Commerce events

Social Communication Media

- South Pasadena Facebook message
- Twitter
- See if we can get young people to be our “Green Team” ambassadors and communicate energy conservation messages, a tip of the week. Students could receive community service hours for helping to distribute surveys, energy conservation tips and literature and conducting energy audits.

Energy Conservation and Solar Power Literature

- Develop energy saving tips and flyers
 - Residential version
 - Commercial version
- Distribute the literature at city facilities, library, schools, Chamber, etc.
- Look at the need for the brochures/flyers in a variety of languages if needed.

Fleet Vehicle Signage

- Messaging could be featured on all city fleet vehicles with magnetic signage.

Banners

- Energy conservation banners at fences at key visible locations, such as on the school fences, Orange Grove Park, Arroyo, Rialto Theater, Golf Course, Tennis Club, Garfield Park, City Hall Complex, etc.
- Street banners across the street, light pole banners

South Pasadena Unified School District

- Use the schools to help distribute flyers for the students to take home to their families, along with an energy audit.
- Have the schools run a poster contest on energy conservation. The posters can be displayed like we do with the 4th of July posters.
- Set an energy conservation reduction goal for the schools.

Churches, Organizations and Non-Profits

Explore the opportunities to partner with local groups to get the word out about energy conservation. Targeted groups could include:

- AYSO Soccer
- South Pasadena Little League
- South Pasadena Women's Club
- Churches
- Rotary Club
- Lion's Club

Targeted Advertising

- This could be very limited if needed about the development of solar energy within the city. Ads could be in the "South Pasadena Review."

Appendix 3: Selected Applicable State Laws & Policies On Renewable Energy/Climate Change

AB 32: Known as the California Global Warming Solutions Act of 2006, this landmark law requires the state to cut its greenhouse gas emissions.

SB 43: Enacted in 2013, this statute allows formation of Community Solar programs, through which state businesses and residents can purchase locally-produced solar power on a virtual basis instead of installing solar systems on their own houses and buildings.

SB 350: Enacted in 2015, it requires the state to use 50 percent renewable power by 2030 and to double energy efficiency in existing buildings by then.

Net Energy Metering: A California Public Utilities Commission policy that has advanced solar energy by allowing utility customers with solar rooftops to get paid by utilities at the retail rate for power produced by their systems on sunny days that they do not consume themselves. This power feeds the grid and is used by neighbors.

The Low Carbon Fuel Standard: The California Air Resources Board's low carbon fuel standard requires a 10 percent reduction in the carbon content of transportation fuels by 2020.

Governor's Distributed Energy Goal: Gov. Jerry Brown has set a state goal of seeing that 12,000 MW of distributed energy capacity is developed in California by 2020. Distributed energy systems are solar rooftops, other small-scale solar systems within utility distribution systems, fuel cells, and other systems usually located on utility customer premises.

Governor's Executive Order B-30-15: The Governor has ordered the state to reduce greenhouse gas emissions to 40 percent below 1990 levels by 2030 and to 80 percent below 1990 levels by 2050.

Appendix 4: Selected Financing Programs

There are a variety of renewable energy subsidy programs available from state government agencies. Here is a brief list of programs, with some links for further information and attachments providing details:

CEC 1 Percent Loan Program for Municipalities:

<http://www.energy.ca.gov/contracts/PON-13-401/>

Electric Program Investment Charge Program:

<http://www.energy.ca.gov/contracts/epic.html>

A portion of the money is administered by CEC, while a smaller portion is administered by the utilities, including SCE.

CEC Solicitations, including for the Electric Program Investment Charge:

<http://www.energy.ca.gov/contracts/>

Online Guide to Financing/Funding Programs:

<http://www.coolcalifornia.org/funding-wizard-home> (will be operating in December)

Should the city partner with the school district on a project, the school district could obtain grant funds from the Proposition 39 program:

<http://www.energy.ca.gov/efficiency/proposition39/index.html>

In addition, it remains possible that new money may be included in the upcoming state budget for 2016-17 and into the future from the carbon cap-and-trade program auction revenues. The state's second draft investment plan can be found here:

CARB Investment Plan: <http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/draft-second-investment-plan.pdf>

The California Treasurer's Office through its California Alternative Energy & Advanced Transportation Financing Authority also offers financial programs for city clean energy projects. Details can be found here:

www.treasurer.ca.gov/caeatfa

Regionally, the South Coast Air Quality Management District has funded renewable energy programs. Programs include the district's Technology Advancement Office program and soon to come a program funded by power plant operators to mitigate emissions. The spending plan for this program restricts funding to projects within 10 miles around power plants that have availed themselves of the mitigation fee option to offset their emissions. So far, no plants within 10 miles of South Pasadena have availed themselves of the fee option. However, at least one power plant in Burbank is expected to use the program when it is rebuilt, which would provide money for which South Pasadena could compete.

SCAQMD also administers programs to fund clean transportation (The Carl Moyer Memorial program and the Mobile Source Review Committee program), which conceivably could be drawn on to help fund a project that includes a clean transportation element, such solar electrolysis to produce hydrogen for fuel cell vehicles or a solar charge port, perhaps virtual, to charge electric vehicles.

Appendix 5: Tables

TABLE 1: NET MONETARY EFFECT OF CITY HALL AND WILSON RESERVOIR SOLAR ARRAYS

Year	Savings	Rebate	Loan payment	Maintenance	Net	Cumulative
1	\$68,104	\$0	(\$68,663)	\$0	(\$559)	(\$559)
2	\$70,745	\$0	(\$68,663)	\$0	\$2,082	\$1,516.87
3	\$73,488	\$0	(\$68,663)	\$0	\$4,826	\$6,359.87
4	\$76,338	\$0	(\$68,663)	\$0	\$7,676	\$14,108.16
5	\$77,476	\$0	(\$68,663)	\$0	\$8,813	\$23,082.53
6	\$78,630	\$0	(\$68,663)	\$0	\$9,967	\$33,313.95
7	\$79,802	\$0	(\$68,663)	\$0	\$11,139	\$44,834.01
8	\$80,991	\$0	(\$68,663)	\$0	\$12,328	\$57,674.90
9	\$82,197	\$0	(\$68,663)	\$0	\$13,535	\$71,869.46
10	\$83,422	\$0	(\$68,663)	\$0	\$14,759	\$87,451.14
11	\$84,665	\$0	(\$68,663)	\$0	\$16,002	\$104,454.07
12	\$85,927	\$0	(\$68,663)	\$0	\$17,264	\$122,913.03
13	\$87,207	\$0	(\$68,663)	\$0	\$18,544	\$142,863.46
14	\$88,506	\$0	(\$68,663)	\$0	\$19,844	\$164,341.51
15	\$89,825	\$0	(\$68,663)	(\$46,087)	(\$24,925)	\$141,297.02
16	\$91,164	\$0	(\$68,663)	\$0	\$22,501	\$165,414.29
17	\$92,522	\$0	(\$68,663)	\$0	\$23,859	\$191,165.80
18	\$93,900	\$0	(\$68,663)	(\$9,988)	\$15,250	\$208,602.98
19	\$95,300	\$0	(\$68,663)	\$0	\$26,637	\$237,626.27
20	\$96,720	\$0	(\$68,663)	\$0	\$28,057	\$268,401.54
21	\$98,161	\$0	\$0	\$0	\$98,161	\$369,632.74
22	\$99,623	\$0	\$0	\$0	\$99,623	\$473,484.61
23	\$101,108	\$0	\$0	\$0	\$101,108	\$580,008.94
24	\$102,614	\$0	\$0	\$0	\$102,614	\$689,258.42
25	\$104,143	\$0	\$0	\$0	\$104,143	\$801,286.65
26	\$105,695	\$0	\$0	\$0	\$105,695	\$916,148.22
27	\$107,270	\$0	\$0	\$0	\$107,270	\$1,033,898.67
28	\$108,868	\$0	\$0	\$0	\$108,868	\$1,154,594.49
29	\$110,490	\$0	\$0	\$0	\$110,490	\$1,278,293.21
30	\$112,136	\$0	\$0	(\$46,087)	\$66,049	\$1,358,966.35
31	\$113,807	\$0	\$0	\$0	\$113,807	\$1,488,320.22
32	\$115,503	\$0	\$0	\$0	\$115,503	\$1,620,849.62
33	\$117,224	\$0	\$0	\$0	\$117,224	\$1,756,616.16
34	\$118,971	\$0	\$0	\$0	\$118,971	\$1,895,682.51
35	\$120,743	\$0	\$0	\$0	\$120,743	\$2,038,112.44
36	\$122,542	\$0	\$0	(\$9,988)	\$112,555	\$2,173,983.34
37	\$124,368	\$0	\$0	\$0	\$124,368	\$2,323,221.98
38	\$126,221	\$0	\$0	\$0	\$126,221	\$2,476,021.01
39	\$128,102	\$0	\$0	\$0	\$128,102	\$2,632,448.75
40	\$130,011	\$0	\$0	\$0	\$130,011	\$2,792,574.75
41	\$131,948	\$0	\$0	\$0	\$131,948	\$2,956,469.74
42	\$133,914	\$0	\$0	\$0	\$133,914	\$3,090,383.71

TABLE 2: MONETARY EFFECT OF WILSON RESERVOIR SOLAR ARRAY

Year	Savings	Rebate	Loan payment	Maintenance	Net	Cumulative
1	\$17,675	\$0	(\$20,313)	\$0	(\$2,638)	(\$2,638)
2	\$18,360	\$0	(\$20,313)	\$0	(\$1,953)	(\$4,621.16)
3	\$19,072	\$0	(\$20,313)	\$0	(\$1,241)	(\$5,914.80)
4	\$19,812	\$0	(\$20,313)	\$0	(\$501)	(\$6,483.63)
5	\$20,107	\$0	(\$20,313)	\$0	(\$206)	(\$6,763.76)
6	\$20,407	\$0	(\$20,313)	\$0	\$94	(\$6,747.51)
7	\$20,711	\$0	(\$20,313)	\$0	\$398	(\$6,427.01)
8	\$21,019	\$0	(\$20,313)	\$0	\$706	(\$5,794.27)
9	\$21,332	\$0	(\$20,313)	\$0	\$1,019	(\$4,841.09)
10	\$21,650	\$0	(\$20,313)	\$0	\$1,337	(\$3,559.17)
11	\$21,973	\$0	(\$20,313)	\$0	\$1,660	(\$1,939.98)
12	\$22,300	\$0	(\$20,313)	\$0	\$1,987	\$25.11
13	\$22,632	\$0	(\$20,313)	\$0	\$2,320	\$2,344.97
14	\$22,970	\$0	(\$20,313)	\$0	\$2,657	\$5,028.58
15	\$23,312	\$0	(\$20,313)	(\$10,857)	(\$7,858)	(\$2,771.86)
16	\$23,659	\$0	(\$20,313)	\$0	\$3,346	\$542.82
17	\$24,012	\$0	(\$20,313)	\$0	\$3,699	\$4,247.93
18	\$24,370	\$0	(\$20,313)	(\$9,988)	(\$5,931)	(\$1,634.29)
19	\$24,733	\$0	(\$20,313)	\$0	\$4,420	\$2,766.81
20	\$25,101	\$0	(\$20,313)	\$0	\$4,788	\$7,586.76
21	\$25,475	\$0	\$0	\$0	\$25,475	\$33,148.74
22	\$25,855	\$0	\$0	\$0	\$25,855	\$59,382.73
23	\$26,240	\$0	\$0	\$0	\$26,240	\$86,302.06
24	\$26,631	\$0	\$0	\$0	\$26,631	\$113,920.34
25	\$27,028	\$0	\$0	\$0	\$27,028	\$142,251.36
26	\$27,430	\$0	\$0	\$0	\$27,430	\$171,309.21
27	\$27,839	\$0	\$0	\$0	\$27,839	\$201,108.19
28	\$28,254	\$0	\$0	\$0	\$28,254	\$231,662.88
29	\$28,675	\$0	\$0	\$0	\$28,675	\$262,988.10
30	\$29,102	\$0	\$0	(\$10,857)	\$18,245	\$284,241.94
31	\$29,536	\$0	\$0	\$0	\$29,536	\$317,029.54
32	\$29,976	\$0	\$0	\$0	\$29,976	\$350,632.32
33	\$30,423	\$0	\$0	\$0	\$30,423	\$385,066.15
34	\$30,876	\$0	\$0	\$0	\$30,876	\$420,347.21
35	\$31,336	\$0	\$0	\$0	\$31,336	\$456,491.93
36	\$31,803	\$0	\$0	(\$9,988)	\$21,815	\$483,529.56
37	\$32,277	\$0	\$0	\$0	\$32,277	\$521,337.85
38	\$32,758	\$0	\$0	\$0	\$32,758	\$560,059.60
39	\$33,246	\$0	\$0	\$0	\$33,246	\$599,712.41
40	\$33,741	\$0	\$0	\$0	\$33,741	\$640,314.21
41	\$34,244	\$0	\$0	\$0	\$34,244	\$681,883.24
42	\$34,754	\$0	\$0	\$0	\$34,754	\$716,637.31

TABLE 3: MONETARY EFFECT OF CITY HALL SOLAR ARRAY

Year	Savings	Rebate	Loan payment	Maintenance	Net	Cumulative
1	\$50,429	\$0	(\$48,350)	\$0	\$2,079	\$2,079
2	\$52,385	\$0	(\$48,350)	\$0	\$4,035	\$6,138.03
3	\$54,416	\$0	(\$48,350)	\$0	\$6,066	\$12,274.67
4	\$56,527	\$0	(\$48,350)	\$0	\$8,177	\$20,591.79
5	\$57,369	\$0	(\$48,350)	\$0	\$9,019	\$29,846.29
6	\$58,224	\$0	(\$48,350)	\$0	\$9,874	\$40,061.46
7	\$59,091	\$0	(\$48,350)	\$0	\$10,741	\$51,261.03
8	\$59,972	\$0	(\$48,350)	\$0	\$11,622	\$63,469.17
9	\$60,865	\$0	(\$48,350)	\$0	\$12,515	\$76,710.55
10	\$61,772	\$0	(\$48,350)	\$0	\$13,422	\$91,010.31
11	\$62,692	\$0	(\$48,350)	\$0	\$14,343	\$106,394.06
12	\$63,627	\$0	(\$48,350)	\$0	\$15,277	\$122,887.91
13	\$64,575	\$0	(\$48,350)	\$0	\$16,225	\$140,518.49
14	\$65,537	\$0	(\$48,350)	\$0	\$17,187	\$159,312.93
15	\$66,513	\$0	(\$48,350)	(\$35,230)	(\$17,067)	\$144,068.87
16	\$67,504	\$0	(\$48,350)	\$0	\$19,154	\$164,871.47
17	\$68,510	\$0	(\$48,350)	\$0	\$20,160	\$186,917.86
18	\$69,531	\$0	(\$48,350)	\$0	\$21,181	\$210,237.27
19	\$70,567	\$0	(\$48,350)	\$0	\$22,217	\$234,859.46
20	\$71,618	\$0	(\$48,350)	\$0	\$23,269	\$260,814.78
21	\$72,685	\$0	\$0	\$0	\$72,685	\$336,484.00
22	\$73,769	\$0	\$0	\$0	\$73,769	\$414,101.89
23	\$74,868	\$0	\$0	\$0	\$74,868	\$493,706.88
24	\$75,983	\$0	\$0	\$0	\$75,983	\$575,338.08
25	\$77,115	\$0	\$0	\$0	\$77,115	\$659,035.29
26	\$78,264	\$0	\$0	\$0	\$78,264	\$744,839.01
27	\$79,431	\$0	\$0	\$0	\$79,431	\$832,790.47
28	\$80,614	\$0	\$0	\$0	\$80,614	\$922,931.61
29	\$81,815	\$0	\$0	\$0	\$81,815	\$1,015,305.11
30	\$83,034	\$0	\$0	(\$35,230)	\$47,804	\$1,074,724.41
31	\$84,271	\$0	\$0	\$0	\$84,271	\$1,171,290.68
32	\$85,527	\$0	\$0	\$0	\$85,527	\$1,270,217.31
33	\$86,801	\$0	\$0	\$0	\$86,801	\$1,371,550.01
34	\$88,095	\$0	\$0	\$0	\$88,095	\$1,475,335.30
35	\$89,407	\$0	\$0	\$0	\$89,407	\$1,581,620.50
36	\$90,740	\$0	\$0	\$0	\$90,740	\$1,690,453.78
37	\$92,092	\$0	\$0	\$0	\$92,092	\$1,801,884.13
38	\$93,464	\$0	\$0	\$0	\$93,464	\$1,915,961.41
39	\$94,856	\$0	\$0	\$0	\$94,856	\$2,032,736.34
40	\$96,270	\$0	\$0	\$0	\$96,270	\$2,152,260.53
41	\$97,704	\$0	\$0	\$0	\$97,704	\$2,274,586.50
42	\$99,160	\$0	\$0	\$0	\$99,160	\$2,373,746.40