THE
REYNOLDS GROUP
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# THE FUNDAMENTALS OF SOLAR POWER
# AND
# A CHECKLIST FOR PROSPECTIVE BUYERS

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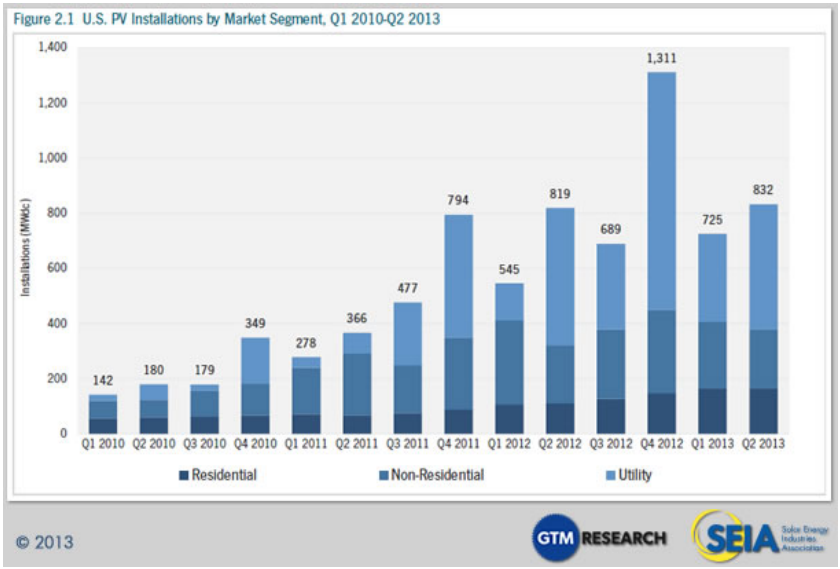
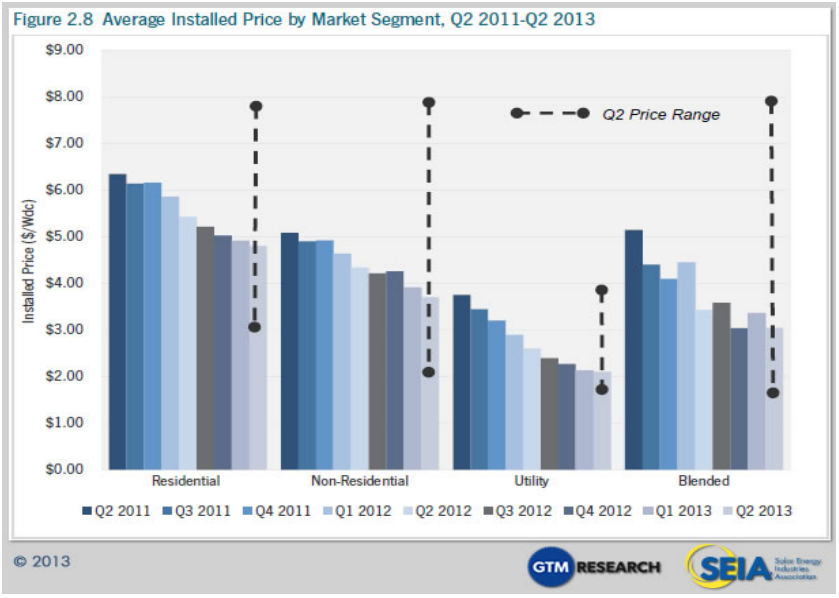
**INTRODUCTION:**

For Parishes considering a Sustainable Energy Investment like solar power, the news is full of discussions about the need for energy security, economic growth, and environmental sustainability. Solar power can be one potential solution. In fact, over the past few years, growth in the solar power industry has exploded in the United States.[i]




Although a fraction of the growth may be attributed to the desire for increased sustainability, or favorable governmental policies, one fact is undeniable: both the price of solar panels and the total cost of solar systems have declined rapidly.[ii]



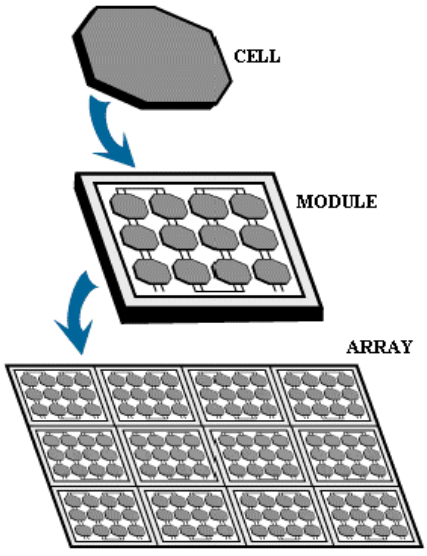
The marked decline in price has led to an ever-increasing installed base of solar power. The influence of solar power is growing. Solar power is now considered to be a mainstream option for utilities, homeowners, business owners, and independent power producing companies. While the ease of deploying solar power has increased, understanding the intricacies of procuring a system can be arduous. This report highlights the fundamentals of solar power by offering a broad overview of the components of a solar system, the rationale behind owning or buying solar power, and potential concerns for stakeholders.

## A BRIEF HISTORY OF SOLAR POWER

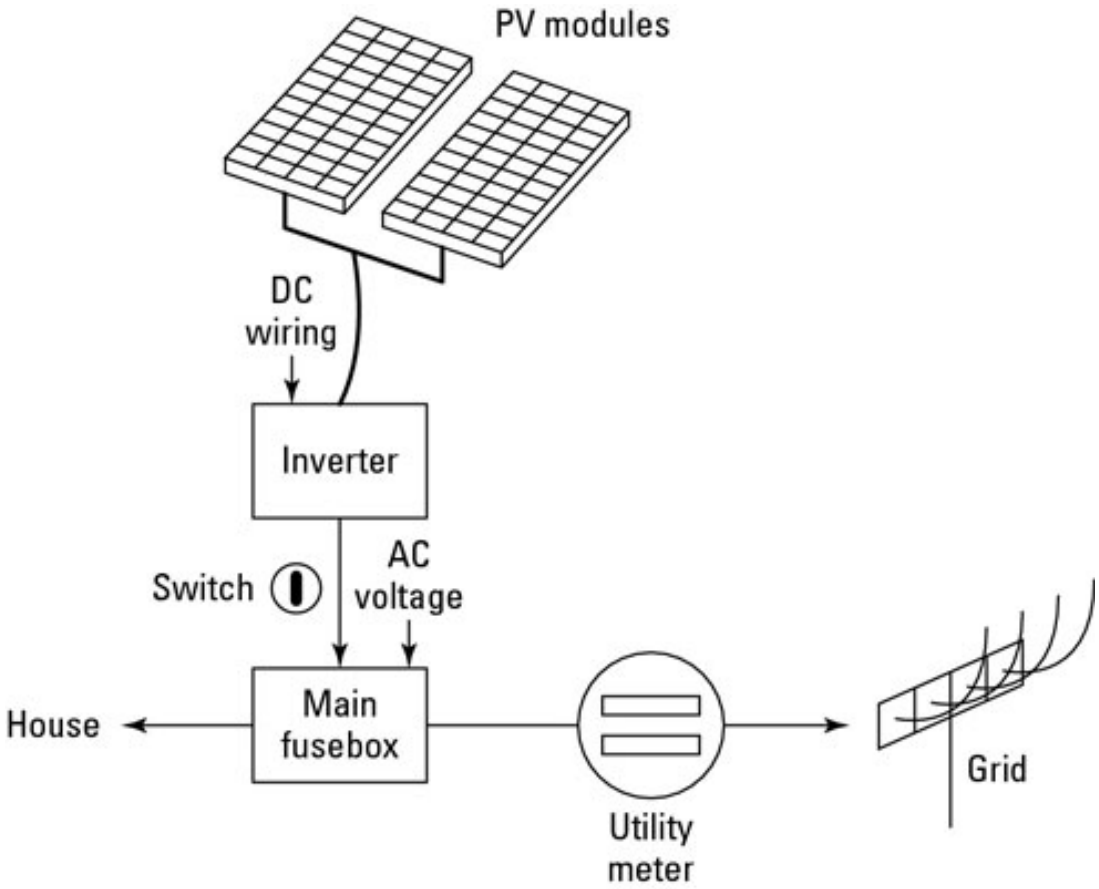
The sun shines more in Southern California than most places in the United States. Capturing the suns energy for useful purposes dates back to the advent of farming. Passive solar systems such as pool covers, insulation, and piping systems have been used for decades. In 1977, solar panels were installed on the White House to demonstrate the potential of solar power to increase energy security. Since the cost of converting the sun's energy into electrical energy has dropped dramatically, society has "jumped on the bandwagon" by providing financial incentives for solar. As with any infant industry, there are not yet any dominant and clear winners. Potential buyers must beware and take care in evaluating Solar Systems for themselves.

## THE COMPONENTS OF A SOLAR SYSTEM

A solar cell harvests light energy from the sun to capture electrons in the form of a direct electric current thereby producing electricity. Multiple solar cells connected to one another electrically form a solar module. Multiple modules wired together form the arrays that have become a common sight on the roofs of building.[iii]



In addition to the solar arrays, commonly known as panels, solar power systems are comprised of many more components. Proper installation and optimized sun exposure assure that solar power systems function for many years. Inverters convert solar energy that strikes the panels from direct current (DC) to alternating current (AC). AC power is directly compatible with the power grid, which is what Americans use to power their major mechanical devices. Quality of wiring, conduit, and connections to the main fuse box are very important. Disconnect switches allow the solar power system to be shut off if any upset conditions occur.[iv] All together, the components of a solar power system are not particularly complex. However, the space required for the panels, their weight, and their visual aesthetics must be factored into any feasibility study. For example, sometimes roofs cannot support additional weight and significant modifications must be undertaken to support a solar power system. Ultimately, the solar power system reduces electricity purchased from the power grid, and in some very limited circumstances, electricity can be sold back to the grid.

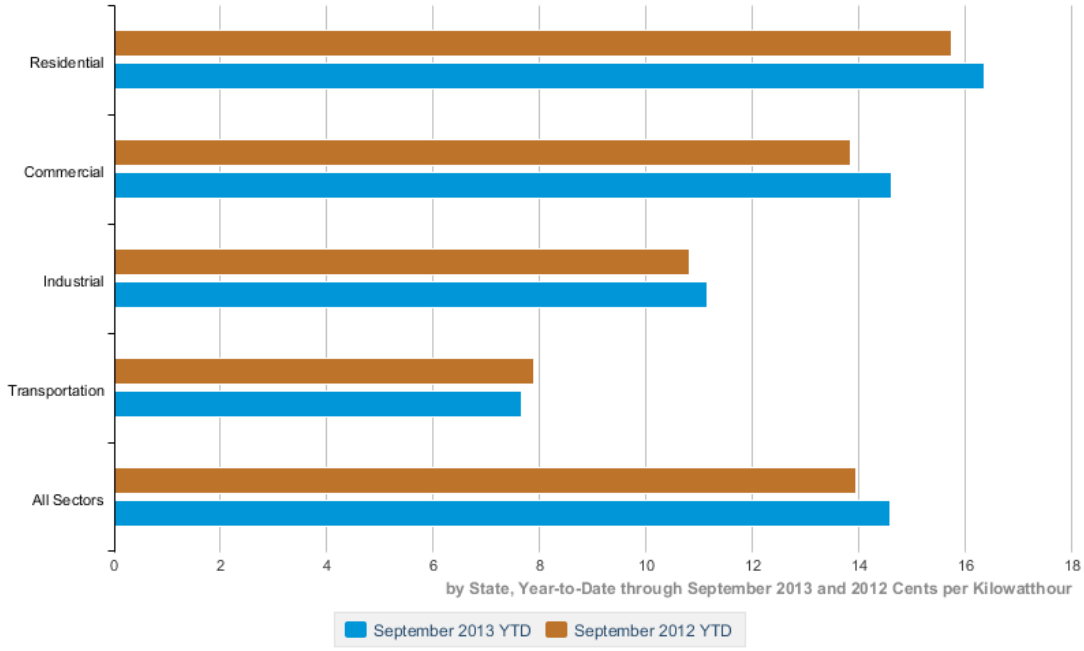


## REASONS TO "GO SOLAR"

The popularity of solar power has risen greatly recently as costs have fallen dramatically and financial incentives have been introduced to encourage adoption. A great number of well-informed consumers have weighed the potential alternatives, benefits, and costs only to realize that solar power makes sense for them.

One potential benefit of installing a solar power system is increased economic security. Because the marginal cost of producing electricity with solar is negligible, there is no increase in cost. Many parishes have large annual electrical expenses that tend to only rise. Solar power can be a hedge against increasing commercial electricity prices. From 2012 to 2013 the year over year change is shown in the graph below. Commercial rates have increased from 13.83 cents/kWh to 14.59 cents/kWh in 2013 for businesses in California.[v] This represents a 5.4% annual increase which is the average increase over the past 20 years as shown in the table below.

**Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector,, California**




eia Source: U.S. Energy Information Administration

Nonetheless, one year does not constitute a trend. Electricity prices have increased historically. Below is a table that shows the year over year increases.[vi] Please note the average annual increase is about 5%, greater than the average rate of inflation.

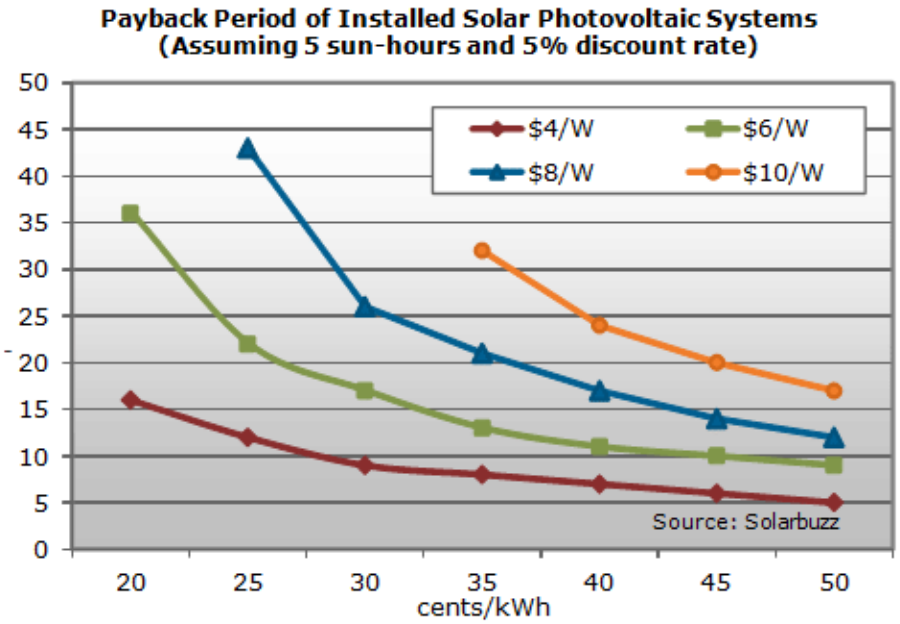
Average Retail Electricity Prices
Investor-Owned/Municipal Utilities
Historical (1982-2010)
Nominal Cents/kWh
Commercial

| Year | IOUs | %Change | Municipal | %Change |
|---|---|---|---|---|
| 1982 | 8.6 | | 5.8 | |
| 1983 | 8.3 | -3% | 5.5 | -5% |
| 1984 | 8.5 | 2% | 5.9 | 7% |
| 1985 | 9.4 | 11% | 6.4 | 9% |
| 1986 | 9.7 | 3% | 7.2 | 12% |
| 1987 | 9.6 | 0% | 7.3 | 2% |
| 1988 | 10.2 | 6% | 8.1 | 10% |
| 1989 | 10.5 | 3% | 8.7 | 8% |
| 1990 | 11.0 | 4% | 9.0 | 4% |
| 1991 | 12.0 | 9% | 9.6 | 7% |
| 1992 | 12.5 | 4% | 10.0 | 4% |
| 1993 | 12.3 | -2% | 10.4 | 4% |
| 1994 | 12.5 | 2% | 10.5 | 1% |
| 1995 | 12.5 | -1% | 10.4 | -1% |
| 1996 | 11.0 | -12% | 10.3 | 0% |
| 1997 | 11.8 | 7% | 10.6 | 3% |
| 1998 | 11.4 | -4% | 10.7 | 1% |
| 1999 | 11.4 | 0% | 10.8 | 0% |
| 2000 | 11.7 | 3% | 10.8 | 0% |
| 2001 | 15.0 | 28% | 11.2 | 4% |
| 2002 | 15.2 | 1% | 13.2 | 18% |
| 2003 | 18.2 | 19% | 14.0 | 6% |
| 2004 | 16.7 | -8% | 11.6 | -17% |
| 2005 | 15.3 | -8% | 11.6 | 0% |
| 2006 | 16.8 | 10% | 11.6 | 0% |
| 2007 | 16.0 | -5% | 11.9 | 3% |
| 2008 | 16.1 | 1% | 12.6 | 7% |
| 2009 | 17.6 | 9% | 13.2 | 4% |
| 2010 | 17.2 | | 13.5 | |

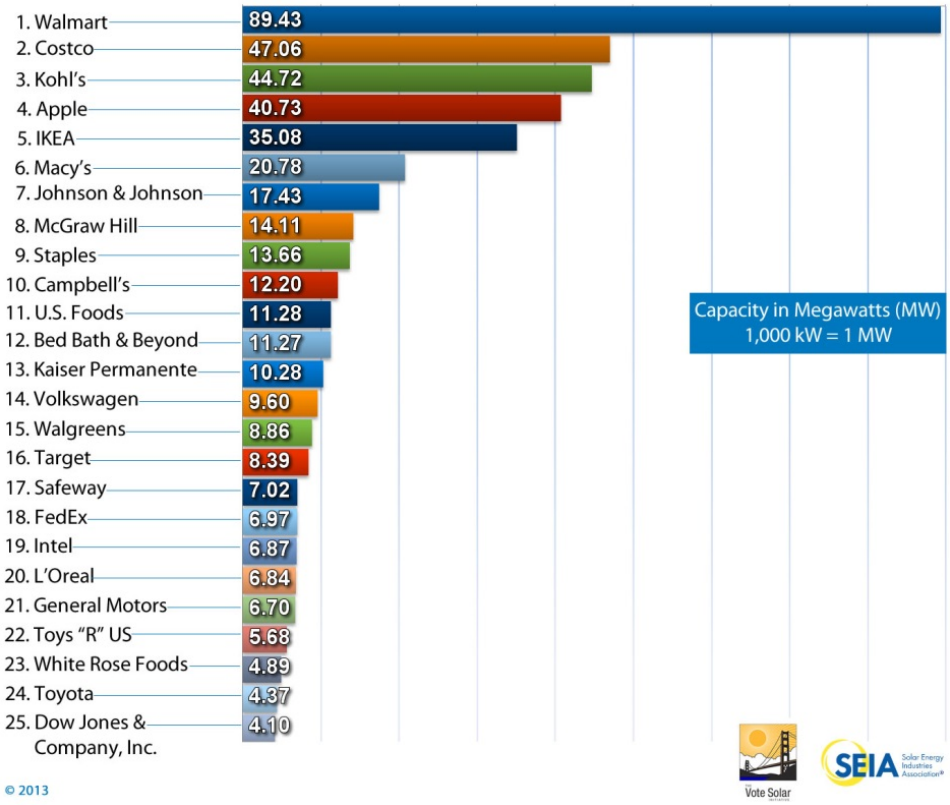
Annual Average Increase 4.2% for IOU's and 5.4% for Municipal

Note: Energy Commission staff used data collected by LADWP to estimate Average Electricity Prices
BGP includes electricity prices for Burbank, Glendale and Pasadena

Furthermore, a variety of financial incentives remain attractive. The Federal Investment Tax Credit (ITC) and the California Solar Initiative are two prominent examples but they are temporary and declining.[vii] These incentives dramatically lower the upfront costs of a Solar System. Unique and "creative" financing options are also available to minimize initial cash outlays but can be very confusing to buyers.[viii] Depending on system costs and electricity rates, Solar Systems may offer reasonable payback periods with financial returns continuing over the life of the system.[ix] Each solar power system installation is unique and must be evaluated as a standalone project.

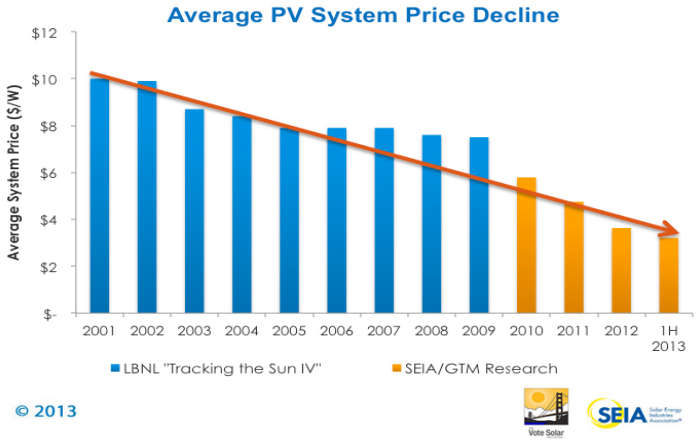



Other considerations make solar power attractive to a number of different stakeholders. For example, many commercial entities support the idea of domestic homegrown clean energy to power their facilities while enhancing local investment. Non-profits highlight the community leadership that their Solar Systems represent. Many solar power system buyers develop media outreach programs to generate positive public relations about their "green practices." Economic benefits coupled with these additional social and moral considerations underscore the main benefits associated with solar power. "Going green" can be good. Below is a list of major companies with solar power generation:




## CAVEAT EMPTOR – POTENTIAL BUYER CONCERNS

Investing in solar power may seem like a "no-brainer" to some. However, as the industry has boomed, cautious buyers have encountered challenges when evaluating their options. The positive aspects of rapidly declining prices are obvious: faster payback, smaller upfront capital investment, overall lower costs. Unfortunately, some vendors choose to compete based on selling price alone, at the expense of quality considerations. Problems occur when zealous solar power system providers over-promise and under-deliver.[x] The following chart shows the decline in photovoltaic (PV) prices over the last decade.



A checklist for buyers is provided to supplement this document. But for the typical parish buyer there are several key considerations:

1. *Design*
2. *Power Consumption and Rate Audit*
3. *Procurement & Construction*
4. *Operations and Maintenance*
5. *Financing*
6. *Turnkey*
7. *Metrics/Marketing*

Manufacturers often offer warranties that last for 20-30 years. The solar industry has been quite volatile and many manufacturers were forced to shutter during the recent economic downturn. For example, the meteoric rise and fall of the now-bankrupt former market leader Suntech Power offers a compelling warning about how these long-term warranties may become worthless. The chart below shows the rise and fall of Suntech. Aside from Suntech, there is a veritable "gold rush" by small time players into the market. ***Buyers must beware***.

Figure: Suntech Power Stock Price: Boom and Bust


Well-informed decision making requires care to research potential designers, installers, manufacturers, contractors, and financiers. Buyers should solicit a number of firms and proposals to find the ideal, best-fit solution. Buyers who make a hasty decision based solely on lowest price and their "rush to do solar" run the risk of investing in a system that may become unreliable and not provide expected economic benefits. Information is the great equalizer for buyers as thorough planning and a "hands-on" approach are often required to guarantee satisfaction.

Finally, key financial incentives are near expiration. Locally, the California Solar Initiative (CSI) is in its last step with no replacement currently imminent.[xi] The Federal ITC is set to be reduced from 30% of cost down to 10%.[xii] These changes may negatively impact individual project economics. Third party "silent" investors, who benefited greatly from tax-advantaged investments, may be much less available for larger commercial projects. In California, regulations are coming into effect mandating the use of solar power generation.

From system reliability and quality concerns to declining incentives and confusing mandates, Parishes must perform thorough research to maximize the potential for successful solar system installation and operation coupled with economic payback.

**CONCLUDING THOUGHTS**

Solar power is not a "one size fits all" solution. Every buyer has unique site and system requirements. Buyers with limited spending ability may achieve higher returns on investment by immediately using passive technologies, such as replacing old windows or insulating to current standards. The well-informed decision maker can avoid negative experiences with designers, contractors, manufacturers, and financiers by taking time to be educated and soliciting multiple bids.

As an industry, solar power is uniquely positioned to offer many facilities a source of clean, reliable domestic power that enhances energy security and invigorates local economies. Business owners and non-profits can combat rising yearly electricity prices and total annual costs with solar power. The social and moral community leadership of investing in clean energy can also pay handsome dividends. Solar power may or may not be an ideal solution for you.

Evaluate solar power carefully.

Figure: Installation at Mater Dei High School

# SOLAR POWER CHECKLIST FOR CONSIDERATION

## Design

- ✓ Does a solar power project fit into the spending priorities/"Master Plan" for the Parish?

- ✓ Has an energy audit been performed to review energy uses and reasons?

- ✓ Are their passive methods the Parish could invest in that would be a "first line" of cost savings without doing solar?
  - o Timers
  - o Motion Detectors
  - o Thermostats
  - o Insulation
  - o Window improvements
  - o Shade coverings
  - o Roof replacements
  - o Mechanical System Upgrades
  - o Conversions from Electric to Gas

- ✓ What is the available space for solar power panels/infrastructure on the roofs or ground?

- ✓ Using basic ratios of space availability and conversion of space to power, does a solar power project make overall sense? There are a number of available tools on the internet such as http://www.nrel.gov/rredc/pvwatts/grid.html to evaluate investment decisions

  - o Space available (square feet) x wattage produced/ square foot = Solar Capacity

  - o Solar Capacity/Year x Price of Electricity = Cost Savings/Year

  - o Solar Capacity x Capital Cost Per Square Foot for Capacity = Capital Cost

  - o Payback Period = Capital Cost/Cost Saving Per Year = Years

- ✓ Are there community design impacts such as "ugliness" or site lines that will have negative impacts on the project consideration?

- ✓ What is the age/durability of roofs or open spaces if involved in the solar project? Can the roofs or open spaces sustain the added weight load, for example?

- ✓ What is the impact of Shade on the usable space for solar on site occupant?

- ✓ What is the impact of site orientation on Solar System efficiency?

    - Most solar systems are installed to be south-facing in order to maximize power production. Individual parishes must also consider whether a solar system on the roof or a ground-mounted system is most desirable. In Orange County, for example, Mater Dei High School chose to employ the use of both system types.
    - In addition to the need for available space on a roof, facilities must also note the age and durability of their roofs they wish to site. The roof must be able to bear the weight of the system. Durability is also important to consider, as some system installers have had problems with roof leaks that require a costly replacement years after a solar installation.

- ✓ Are there available financing options?
    - Cash,
    - Part cash/part loan,
    - Third party investor
    - What does an all cash return look like?
    - If partners enter the project, who profits and how?

- ✓ What are the tax incentives? How do they impact the overall investment and return calculations?

- ✓ Are there non-economic benefits of going solar and being sustainable?
    - Social, moral, “being green”

- ✓ Does the Parish have a qualified design team per Diocesan Construction selection procedures available to evaluate the project?
    - Energy planning
    - Electrical engineer,
    - Civil/structural design,
    - Mechanical,
    - Cost analysis/budget feasibility, and
    - Financial consultant

- ✓ Is there a trustworthy company that can provide reliable conceptual information and eventually detailed design work to assure the solar power system is feasible?

## Power Consumption and Rate Audit

The historical size of the facility's energy bill and current rate structure are two imperative components in determining the feasibility of a prospective Solar System.

- ✓ What is the current total size of the facility power bill?
  - o Installers and contractors use the energy bill to project payback periods, internal rates of return, and the general economic impact of a solar system. Often times monthly power bills for the previous year are requested to make these projections.

- ✓ What is the current rate structure of the utility bill?
  - o For example, many potential customers are in a tiered rate structure and realize most of their savings by going from a higher tier to a lower one. Additionally, many customers move to a Time-of-Use rate structure following installation.

## Procurement and Construction

- ✓ Should a consultant be hired to lead project oversight management?

- ✓ After conceptual Design, does the Parish follow any Diocesan Construction Guidelines?

- ✓ Should a design specification be written that can be put to bid?

- ✓ Who performs bid evaluation and ranking? The Parish committee members who present to the Construction Board?

  Bid evaluation Factors include:
  - o Design competence and cost
  - o Financing terms and feasibility
  - o Cash flow implications
  - o Construction costs
  - o Feasibility costs
  - o Warranties (performance, time and price), bonding, etc.

- ✓ Are the components of the System and the construction fairly priced?

- ✓ Would costing out the delivery components (structural, panels, inverters, etc.) individually save time?
    - o Major electrical
    - o Structure Construction
    - o Solar Panel System Procurement

- ✓ Can the Contractor reliably deliver a completed system?
    - o Experience
    - o Financing capability
    - o Bonding

- ✓ Are the manufacturer's warranties worth the value of the paper they are written on?

- ✓ Can the Project be bid out for competing bids? If a third-party investor is involved, will it allow multiple bids?

- ✓ Will the contractor provide date certain, price certain, and performance certain promises or face liquidated damages?

- ✓ Is the project of large enough size to pass through the Diocesan Construction Committee procedures?

## Operations and Maintenance

- ✓ What are the elements of operating the solar system?

- ✓ Who provides the service; in-house or outsourced?

- ✓ What kind of service contract is required to maintain the functionality of the System?

- ✓ What is the annual cost of operation, fully burdened with staff, materials, and supplies?

- ✓ What is the expected useful life of the System Components?

    - o Is replacement factored into the financial plan?

## Financing

As the solar market has matured, more and more financing options have become available. These options offer the choice to significantly lower the cash outlay required for installation and operation. Facilities should consider whether to use cash up front, part cash and part loan, a third party investor, a power purchase agreement (PPA) or even a tax lien known as Property Assessed Clean Energy (PACE). With so many financial options available, individual Parishes would be wise to compare and contrast so as to optimize the decision for each specific facility.

- ✓ Is the financier willing to be transparent and negotiate a fair investment return? What is fair with respect to risk being taken?
  - o What are the returns to the buyers, and, many times, third party investors who provide the financial package?
  - o How fair and transparent are the financial numbers?
  - o Are returns fair?

- ✓ Can an accurate, normalized, pro forma financial budget be created that shows the major assumptions and the cash flows to the Parish Investor? Can the financial pro forma be tested under different scenarios such as:
  - o Electrical prices
  - o Price increases
  - o Inflation
  - o Interest rates
  - o Cost overruns

- ✓ Are the tax benefits or any other incentive like CSI, utility or local municipality incentives spelled out? Who benefits?

- ✓ What are the returns to the buyers and, many times, third party investors who provide the financial package? How fair and transparent are the financial numbers? Are the returns fair?

- ✓ Is there a minimum Internal Rate of Return or Payback Period that the Parish considers a threshold?

- ✓ What would all cash financing look like?
  - o Does it make sense for the Parish to find the capital and finance the project on its own?

- ✓ If a third party is financing the project, is this third party properly vetted and is it a party who the Diocese wishes to do business with?

## Turnkey

Many times vendors will offer to be the sole source for permitting, design, procurement, and construction operations, and financing.

- ✓ If the Solar System Provider is performing design, construction, financing, and operation as one package, how fair is the financial deal?
- ✓ How willing is the Turnkey Provider to negotiate terms on an open book basis?

## Metrics and Marketing

- ✓ So your Solar System is installed? How will you measure that it lives up to what was promised?

- ✓ How will you incorporate this into a Sustainability Marketing Campaign to highlight the "community leadership" – we are green?

- ✓ Does this project have congruence with the mission and values of the Church?
    - o The Diocese of Orange is well-known for community leadership. Sustainability in general, and solar specifically, may represent an important social/moral commitment for The Diocese. The value of this commitment may not represent a tangible economic benefit, but may further solidify The Diocese's concrete status as a beacon of wider community responsibility, leadership, and environmental stewardship.

# ADDITIONAL RESOURCES

**Basic Information:**

Go Solar California: http://www.gosolarcalifornia.ca.gov/

National Renewable Energy Laboratory: http://www.nrel.gov/

US Energy Information Administration: http://www.eia.gov/

**Financial Incentives:**

DSIRE Database: http://www.dsireusa.org/

**Berkeley Unified School District *Solar Master Plan*:**

http://www.berkeleyschools.net/wp-content/uploads/2011/11/BUSD-Compiled-SMP-Final-11-3.pdf

**Market Research and Analysis:**

Solar Energy Industries Association: http://www.seia.org/

Solarbuzz Analysis: http://www.solarbuzz.com/

# CITATIONS

[i] Solar Energy Industries Association: http://www.seia.org/research-resources/solar-industry-data.
[ii] Ibid.
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[x] Solar Power World: *Just How Reliable is the Solar Industry?* http://www.solarpowerworldonline.com/2013/09/solar-commentary-must-face-reliability-responsibilities/.
[xi] Go Solar California CSI Tracker: http://csi-trigger.com/.
[xii] Energy Matters: http://www.energymatters.com.au/index.php?main_page=news_article&article_id=4049.