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USING ON-SITE RENEWABLE ENERGY AS THE NEXT STEP TO IMPROVING ENERGY PERFORMANCE AND REDUCING EMISSIONS

As energy costs increase and companies realize the importance of environmental stewardship to mitigate climate change, building owners and managers are looking for ways to reduce their energy consumption and find cleaner energy sources for powering their buildings. jcpenny, a national retailer, has found a successful strategy for achieving these complementary goals.

jcpenny has a corporate energy management strategy that includes using energy efficient technologies in its stores and encouraging energy conservation. As part of this strategy, the company also investigated generating electricity through on-site renewable energy. jcpenny is a partner in the U.S. Environmental Protection Agency (EPA) ENERGY STAR Commercial Buildings Program, and has been tracking building energy use since 2006 using EPA's free benchmarking tool, [Portfolio Manager](#). Portfolio Manager provides a 1-100 energy performance score similar to a "miles-per-gallon" metric for vehicle fuel efficiency. Those buildings that achieve an ENERGY STAR score of a 75 or higher are among the top 25% most efficient buildings in the U.S., and can apply for ENERGY STAR certification. In addition to having more than 270 stores ENERGY STAR certified, jcpenny has earned recognition as an ENERGY STAR Partner of the Year for five years in a row for its comprehensive approach to energy management across its portfolio of buildings.

With the foundation of a successful energy management program, and active efforts underway to reduce energy consumption in its buildings, jcpenny began implementing a renewable energy pilot program by permitting the installation of rooftop solar arrays on nine stores in California and New Jersey starting in the winter of 2008. jcpenny used a Solar Power Purchase Agreement (Solar PPA sometimes referred to as SPPAs) to purchase the energy from the solar photovoltaic (PV) systems installed on jcpenny's rooftops. The SPPAs enabled jcpenny to secure lower-than-utility electricity costs and long-term price stability for nearly 25 percent of the electricity used across the nine stores.

In addition to the direct savings from the lower electricity rates, the use of electricity from on-site solar installations helps improve the stores' ENERGY STAR scores. The increase in a store's score is dependent on a number of factors:

1. The store's operations and energy usage patterns.
2. The percentage of electricity provided by the solar installation relative to the store's total energy (electricity and natural gas) consumption;
3. The store's starting score, since the energy performance scale is based on a regression model that results in a bell-curve of scores (and therefore is not a linear model).

Employing on-site renewable energy can help stores raise their ENERGY STAR scores, thereby meeting corporate goals such as a specified number of ENERGY STAR certified stores. Additionally, retailers may be able to demonstrate better performance to the public, especially in cities or states with laws requiring public disclosure of energy consumption, such as New York City or the State of California.

This case study will highlight two jcpenny stores—in different areas of the country with different sized on-site solar installations—that have seen financial savings and increases in their ENERGY STAR scores as a result of energy intensity reductions associated with on-site solar energy installations and active energy management.



Figure 1. Deptford, NJ 258 kW Solar

CASE STUDY METHODOLOGY

Portfolio Manager is EPA's online benchmarking tool that has become the industry standard for assessing and tracking the energy performance of commercial buildings. In 2009, EPA incorporated the ability to track the financial savings and environmental benefits associated with on-site solar and wind systems. For these reasons, jcpenny chose Portfolio Manager to be one of its energy performance tracking tools.

This case study established an energy performance baseline based on a 12-month period leading up to the time when the solar energy systems were installed on each building in late December 2008.¹ The impact of each solar PV system on the building's energy performance rating was analyzed using data for the two years following the installation of the system.² It is helpful to note that because Portfolio Manager calculates performance scores based on a minimum of 12 months of data, the full impact of the solar PV system could not be determined until December 2009, after the system had been in service for one year.

All of the calculations in Portfolio Manager are based on [source](#) energy intensity³ (kBtu/sq. ft./year), because the source energy value incorporates the complete energy requirement, when taking into account energy used to generate and distribute products such as electricity and steam. Source energy ensures that a building does not receive either a credit or a penalty based on the efficiency of its utility company.

The effect of on-site solar on a building's energy performance score is a result of a difference in site-source conversion factors. EPA assigns a "site-to-source ratio" of 3.34 for grid-purchased electricity to account for typical generation, transmission, and distribution losses. In contrast, the site-to-source ratio for on-site renewable energy is 1.0 because on-site generation does not result in these losses. As such, a building with on-site solar or wind power would receive a higher ENERGY STAR score compared to the same building using grid-purchased electricity.

If an on-site renewable PV system generates more electricity than the building can consume, the excess power is exported to the local electric utility grid under local net-metering policy. Portfolio Manager calculates ENERGY STAR scores using only the coincident use of electricity supplied from the onsite systems, or the electricity consumed by the building at the time of generation by the solar system.⁴ Solar PV systems can be a particularly good fit for retailers or businesses because solar PV system generation tends to align well with store electricity usage and cost patterns, meaning that the majority of solar electricity is consumed by the building.

METHOD TO DETERMINE THE IMPACT ON ENERGY STAR SCORES

A simple exercise in Portfolio Manager—the creation of a "no-solar" scenario—revealed the increase in score attributable to the solar PV system and the increase resulting from other concurrent energy efficiency activities:

1. A building was benchmarked in Portfolio Manager with jcpenny's consumption values of grid-purchased electricity and solar electricity; the baseline score and the most recent score (for December 2010) was recorded.
2. The source of the electricity for the on-site solar meter was changed to "grid-purchased" electricity in Portfolio Manager, but the site energy consumption (kWh) remained unchanged; this step created the "no-solar scenario" and the December 2010 score was recorded.
3. The difference between the baseline score and the "no-solar" scenario score revealed the change in score attributed to energy efficiency improvements, or a decrease in site energy consumption.
4. The difference between the December 2010 "no-solar" score and the actual December 2010 score showed the change in score attributed to the use of electricity generated from on-site solar rather than purchased from the grid.

JCPENNEY'S SOLAR INSTALLATIONS

To complement its ongoing energy management program, jcpenny worked with the solar photovoltaic manufacturer SunPower Corporation as well as a subsidiary of Integrys Energy Services, Inc. to bring solar PV systems to nine jcpenny stores in California and New Jersey, with the installations ranging in size from 259 to 602 kW each (kW-DC). This case study will highlight two of those stores, Deptford, NJ and Palmdale, CA.

¹ Portfolio Manager provides metrics based on a 12-month period to account for seasonal differences in energy usage.

² Find out more about how the ENERGY STAR score is calculated [here](#).

³ Site energy is the amount of heat and electricity consumed by a building as reflected in utility bills (including grid purchased electricity and the energy supplied by the renewable energy system consumed in the building). Source energy is the amount of energy produced at the source of the energy generation to support delivery of energy to the site. [See more](#).

⁴ ENERGY STAR onsite solar and wind energy FAQs can be found [here](#).

DEPTFORD, NJ STORE #2775

In the months prior to the solar photovoltaic (PV) installation, the jcpenny store in Deptford, NJ was performing above-average, achieving an ENERGY STAR score of 62. (See **Table 1** for system details.)

Two years after jcpenny permitted the solar PV installation, in December 2010, the store achieved a score of 81. (See **Figure 2**.) The solar PV system provided about 13 percent of the coincident electricity consumed by the store annually (i.e., 13% of the electricity consumed annually is provided directly from the onsite solar system; this percentage does not include electricity generated by the solar system and exported to the grid).⁵

At first glance, it appears as if the solar installation increased the Deptford store score by 19 points within two years. However, the “no-solar” scenario exercise reveals that the increase is due to both on-site solar and improved energy management. jcpenny launched several energy efficiency and conservation initiatives beginning in 2009, including:

- Participating in the jcpenny Advanced Energy Management (AEM) program designed to maximize energy savings through behavioral changes;
- Installing a smart meter to provide the store manager with 15-minute interval data to better understand the building’s energy usage; and
- Installing building and systems optimization controls.

The decrease in site energy intensity (see the blue line in **Figure 4**) reflects these energy management efforts. The “no-solar” scenario exercise shows that without the addition of on-site solar PV, but maintaining the same amount of electricity use, the store would have achieved a score of 76 in December 2010, which is 14 points higher than the baseline score of 62 from December 2008, and five points lower than the actual score of 81. Therefore, the additional five points is attributed to the addition of a solar installation and decrease in source energy intensity (see the red line in **Figure 4**), for a total increase of 19 points. (See **Figure 3**.)

Deptford Store: 19 Point Increase in ENERGY STAR Score

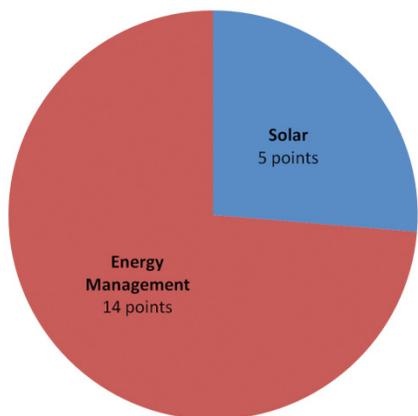


Figure 3. Factors in Deptford Score Improvements: Energy Management vs. Solar Installation.

Table 1. Deptford Building and Solar System Details

Total Capacity	258.64 kW DC
Avg. Annual Solar Electricity Production (2009-2010)	306,423.5 kWh
Avg. Annual Solar Electricity consumed directly by Building	305,564.5 kWh
Building Gross Floor Area	153,049 ft ²
System Installer	SunPower Corporation
Type, Location	Solar PV, Rooftop
Quantity	848 SunPower 305 Watt Panels
Inverter	Xantrex PV225S (225 kW AC rating)
System Area	14,868 ft ²
Installation Date	12/26/2008

Source: SunPower Corporation

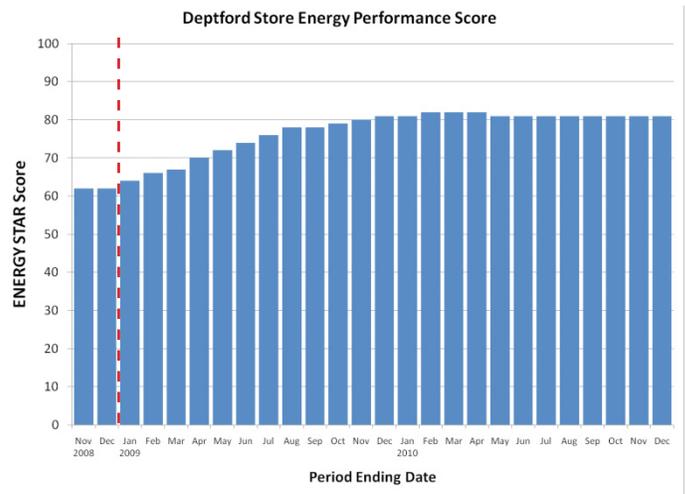


Figure 2. Deptford Energy Performance Score, Nov. 2008–Dec. 2010 (red line = solar installation)

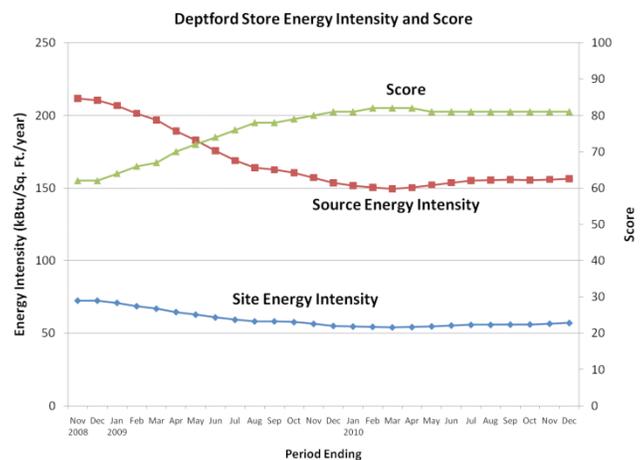


Figure 4. Deptford Store Energy Intensity and Score

⁵ Utilities will establish net-metering agreements with customers that produce excess electricity to compensate them for the electricity being sent to the grid. See Green Power Markets for more information and state rules.

PALMDALE, CA STORE #2388

The Palmdale, CA jcpenny store was recognized by EPA for its superior energy performance, achieving ENERGY STAR certification in 2008 with a score of 79. The store has sufficient roof space and solar resource to provide a significant portion of the store's electricity consumption through solar energy. Realizing the savings potential from the locked-in electricity rate through a SPPA, jcpenny decided to host one of its largest onsite solar installations at the Palmdale store.

The Palmdale store had a baseline score of 79 in December 2008, prior to the installation of the on-site PV system. Within two years of the solar installation providing 55% of the store's electricity use, the store showed a score increase to an average of 98. (See **Figure 5**.)

Like the Deptford store, this 19-point increase between December 2008 and 2010 is attributed to the solar installation and operational improvements. When the "no-solar" scenario exercise is applied to the Palmdale store, this shows that the score in December 2010 would have been 87 without the solar installation. Therefore, of the 19-point improvement, 8 points is attributable to improvements in energy management and 11 is attributable to the addition of on-site solar. (See **Figure 6**.)

During this two-year period, operational improvements led to a decrease in the store's site energy intensity (see blue line in **Figure 7**); however, a significant portion of the decrease in source energy intensity is due to the addition of the solar PV system (see the red line in **Figure 7**).

The Palmdale store's score increase differs from the Deptford store's due to several factors. First, the percent of the total building energy provided by the solar installation was higher for the Palmdale store than for the Deptford store (55% versus 13%). Given this percentage, the source conversion of 1.0 for on-site renewable energy had a more significant impact. In addition, the Palmdale store started with a higher ENERGY STAR score. This means that the Palmdale store had superior management at the outset. The more energy operation and management are optimized prior to the addition of solar panels, the greater the potential impact of those solar panels. Finally, the Palmdale store also offered a slightly different opportunity for the potential of solar because it had greater percentage of total energy supplied by electricity. In most cases, solar panel installations can only be used to replace existing electric loads. Palmdale had a greater potential for solar panels given the high percentage of electricity compared with other fuels.

Table 2. Palmdale Building and Solar System Details

Total Capacity	593.62 kW DC in 3 sub-arrays: 241.23 kW, 245.96 kW, and 106.43 kW
Avg. Annual Solar Electricity Production (2009-2010)	1,010,416 kWh
Avg. Annual Solar Electricity consumed directly by Building	778,081.5 kWh
Building Gross Floor Area	113,847 ft ²
System Installer	SunPower Corporation
Type, Location	Solar PV, Rooftop
Quantity	2,761 SunPower 215 Watt Panels
Inverter	2 Xantrex GT250 (250 kW AC rating) and 1 Xantrex GT100 (100 kW AC rating)
System Area	36,887 ft ²
Installation Date	12/20/2008

Source: SunPower Corporation

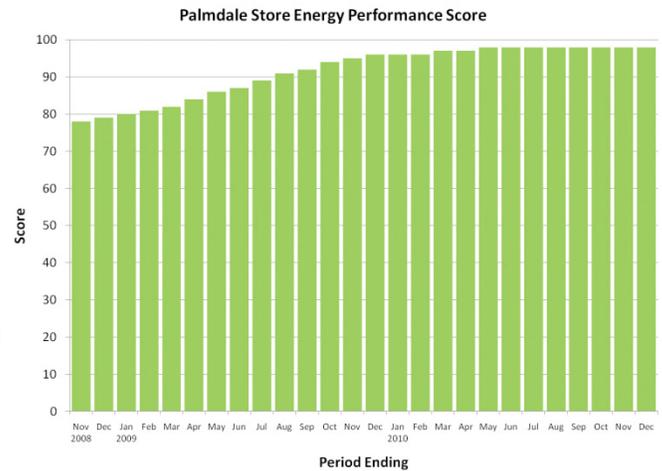


Figure 5. Palmdale Energy Performance Score, Nov. 2008–Dec. 2010 (red line = solar installation)

Palmdale Store: 19 Point Increase in ENERGY STAR Score

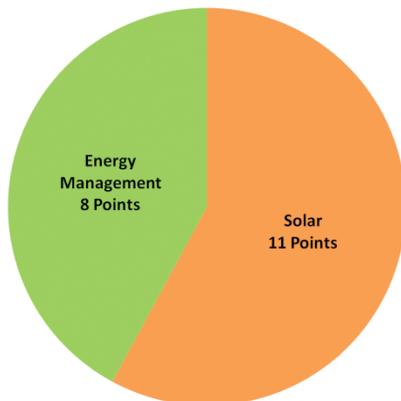


Figure 6. Factors in Palmdale Score Improvements: Energy Management vs. Solar Installation

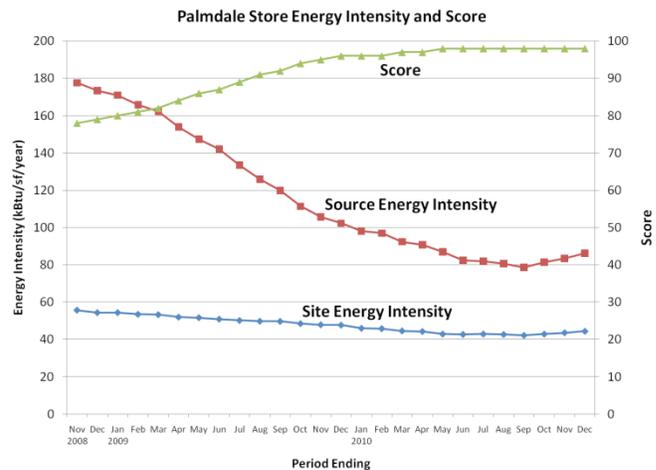


Figure 7. Palmdale Store Energy Intensity and Score

PURCHASING SOLAR ENERGY

JCPenney chose to utilize a SPPA to enable the solar installations to occur at its sites. A SPPA is a long-term agreement to purchase energy from a third party that installs, owns, and operates the solar system on the customer's site. In JCPenney's case, JCPenney purchases the electricity from the system's owner, a subsidiary of Integrys Energy Services, Inc., at rates specified in the SPPA competitively priced against standard utility rates, saving JCPenney money now and providing a financial hedge against rising electricity prices. JCPenney entered into a 10-year SPPA with the subsidiary of Integrys Energy Services, Inc. to purchase the system's electricity. When the agreement expires in 2018, JCPenney has the option to extend the SPPA. The Integrys Energy Services, Inc. subsidiary also owns the renewable energy certificates (RECs) and any other environmental attributes associated with the systems.

SPPAs may be the right choice for many retailers. Some benefits of SPPAs include:

1. The system host is not buying the solar system, only the electricity, so there is no upfront system cost or long-term operations and maintenance responsibilities.
2. System performance risk is shifted to the system owner.
3. A fixed cost of electricity that is less than utility rates provides savings and a hedge against rising and volatile fuel costs.
4. At the end of a SPPA, which is generally a 10- to 20-year contract, the host can buy the system or extend the SPPA.

Direct purchase or leasing-to-own are other solar purchasing options. One benefit of these arrangements is that the retailer owns the system and its associated environmental benefits (e.g., RECs); however, there are sometimes upfront investment costs as well as ongoing operations and maintenance costs.

GREENHOUSE GAS EMISSIONS AND CLAIMING ENVIRONMENTAL BENEFITS

For organizations that are motivated by environmental stewardship and the associated public recognition, one factor in deciding to install a solar PV array in a commercial building is the avoided greenhouse gas (GHG) emissions. To make environmental claims associated with an onsite renewable system, such as avoided air pollution or GHG emissions, the system host or electricity user must retain the associated renewable energy certificates (RECs) produced by the system.

As is common in some SPPA arrangements, JCPenney owns neither the solar systems, nor the associated RECs produced by the renewable energy systems on its roofs. This means that when computing a GHG inventory, the emissions associated with the solar panel installations on their buildings are actually equivalent to the emissions that would be associated with the same amount of energy purchased from the electric grid. This computation is a standard among widely accepted GHG inventory and reporting protocols and calculated within Portfolio Manager.

Portfolio Manager allows users to account for purchases of RECs while claiming their conveyed avoided emissions, as long as the user retains ownership of these claims (e.g. not sold).^{6,7} These REC purchases do not change the GHG inventory; rather Portfolio Manager tracks them separately as reduced emissions through the purchase of RECS.⁸

The revenue generated from the sale of the system's RECs was integral to the financing of the system and helped reduce the delivered cost of electricity to JCPenney. While JCPenney cannot claim to be using green electricity, they are reducing their energy intensity, and therefore moving toward their corporate goal of reducing energy consumption 20 percent per gross square foot by 2015 through energy-efficiency improvements and implementing conservation practices.⁹

CONCLUSIONS

In both the Deptford and Palmdale stores, ENERGY STAR scores increased after the installation of rooftop solar arrays due to the lower site-source conversion factor used in Portfolio Manager for onsite renewable energy. The magnitude of the increase in scores was dependent on the percentage of electricity use in the building supplied by the solar array, and changes in store operations. The percentage of score increase from the pre-solar installation value is dependent on these factors and is therefore not a linear relationship (i.e., the Deptford store saw a 30% increase in performance score from 62 to 81, and the Palmdale store saw a 24% increase in performance score from 79 to 98). These higher ENERGY STAR scores translate into more opportunities for ENERGY STAR recognition.

The SPPA enables JCPenney to achieve long-term savings through lower-than-utility electric rates over the course of the installations' expected 30-year lifespan. Solar energy is a particularly good fit for retailers because it produces the most energy during the day when a store may have the highest operating costs and in the summertime when air conditioning can be a large energy load in some climates.

Overall, JCPenney has found its pilot program for on-site solar arrays successful. In January 2011, JCPenney's tenth solar site went live at Mays Landing, NJ, and JCPenney will continue to explore opportunities in solar technology.

⁶ For more information about RECs and claiming environmental attributes associated with renewable energy, see the [Green Power Partnership](#) site.

⁷ Use the [Green Power Locator](#) from the Green Power Partnership site to find information about green power options.

⁸ The addition of RECs to a Portfolio Manager account will not affect the building's energy performance score.

⁹ See the company's [Corporate Social Responsibility Report](#).