

# Holy Family Solar Electric System

## Five-Year Report

September 2015 (revised)



## PURPOSE OF THIS REPORT

Holy Family's photovoltaic (aka solar electric) system has been operational for five years (February 9, 2010 – February 8, 2015). In light of this milestone, this report was prepared for the purposes of answering the following questions:

- How much electricity is used at Holy Family?
- Of the electricity used at Holy Family, how much has been generated by the photovoltaic system?
- Has the photovoltaic system reduced the amount Holy Family pays for electricity?

## BACKGROUND

Holy Family is one of six sites that comprise Phase 1 of the Diocese of San Jose's Solar Energy Initiative, which is part of the *Catholic Green Initiative of Santa Clara County*. The other sites in Phase 1 are St. Lucy's, St. Christopher's, Queen of Apostles, Holy Spirit, and Gate of Heaven Cemetery.

Holy Family's photovoltaic system was constructed in 2009 and became operational on February 9, 2010. The system is owned and maintained by Perpetual Energy Systems, LLC, which is a company that partners with entities such as the Diocese to develop renewable solar energy systems. Perpetual paid 100% of the construction cost of Holy Family's system (roughly \$1.5 million) and is responsible for 100% of the maintenance costs. Holy Family and the other parishes function as the "hosts" for the systems. In return for hosting, Perpetual sells electricity to Holy Family at a lower cost than we would otherwise pay to PG&E.

## SOLAR SYSTEM SIZE

Holy Family's system is actually two independent systems comprised of a total of 1,056 solar panels, 420 of which are located on the roof of the Community Center, 96 of which are located in Murphy's Meadow, 276 of which are located in the main parking lot, and 264 of which are located behind the school. All of the panels except those behind the school are linked into one system that is connected to the "Parish" meter. The 264 panels behind the school comprise the second system that is connected to the "Junior High" meter. See discussion, below, for a description of which buildings on the Holy Family campus are served by each meter.

Each solar panel is rated at 175 watts, for a total system size of 185 kilowatts. According to *California Solar Initiative* calculations prior to installation, the system was projected to generate approximately 275,000 kilowatt hours of electricity each year.

## HOLY FAMILY'S ELECTRICAL DISTRIBUTION SYSTEMS

As summarized in Table 1, the "Parish" meter, which receives electricity from Pearl Avenue, feeds the following six buildings: church, community center, parish offices, school building B (grades 1 and 3), school building C (grades K and 2, copy room, bathrooms), and school building D (grades 4 through 6, staff room, main offices). There are no "sub-meters" in place that quantify the amount of electricity that is used by each of the six buildings that are fed by the "Parish" meter. The parish and school split the cost of this electric account, with the school paying 70% and the parish paying 30%.

TABLE 1 HOLY FAMILY ELECTRICAL ACCOUNTS			
Account Name	Buildings Served	Solar System Connection	Payment Responsibility
Parish	Church (1972); community center (1982); parish offices (1972); school buildings B, C, and D (1986)	792 panels	70% school/30%parish
Junior High	School building E/junior high (2004)	264 panels	100% school
Gym	Gym portion of school building A (1994)	None	100% school
Pre-School	Pre-School portion of school building A (1994)	None	100% school
Rectory	845 Kozera Drive (1973)	None	100% parish
(xxxx) = date building was constructed			

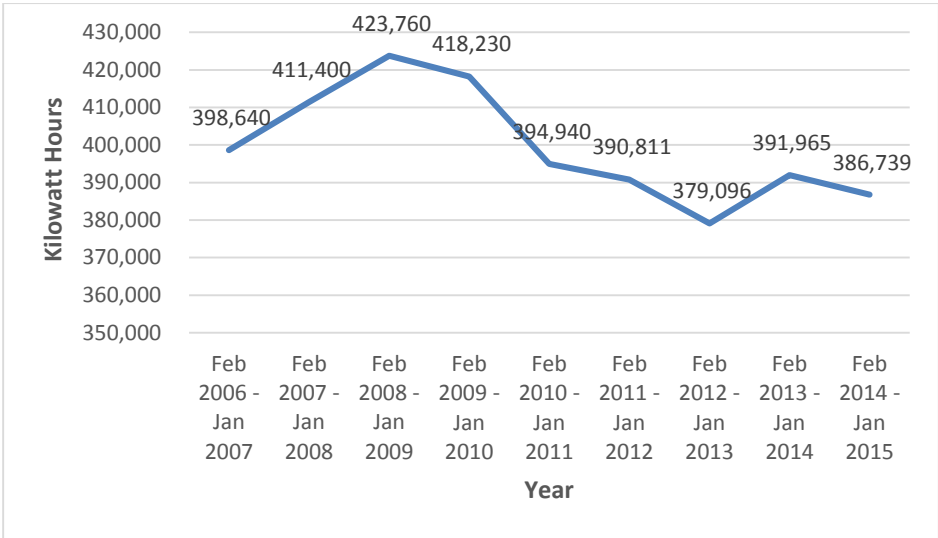
The “Junior High” meter, which receives electricity from Severance Drive, feeds the new Junior High building (grades 7 and 8, science lab, computer lab, and library) that was constructed in 2004. The school pays 100% of the cost of this account.

There are two meters for school building A, one for the gym portion of the building and the other for the Pre-School portion of the building. The school pays 100% of the cost of these accounts. These accounts are not represented in this report as they are not connected to the photovoltaic system.

The rectory, which is located on Kozera Drive, has its own electric meter. The parish pays 100% of the cost of that account. That account is not represented in this report as it is not connected to the photovoltaic system.

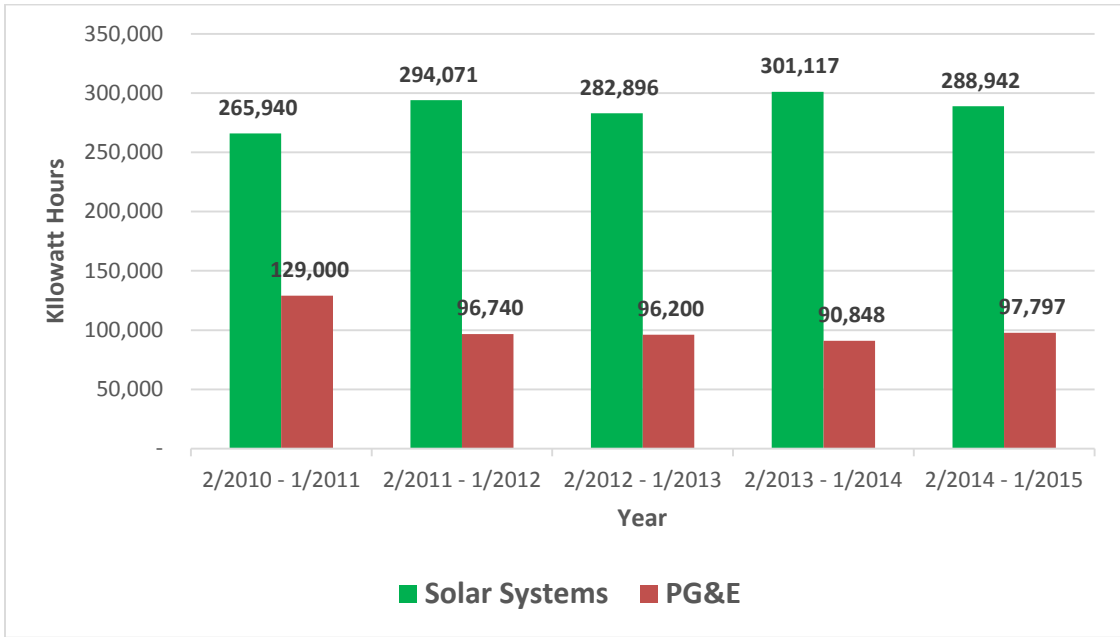
**ELECTRICAL USAGE**

As shown on Figure 1, over the last nine years, electrical consumption on the Holy Family campus, excluding the gym/pre-school building and the rectory, has ranged from a high of 423,760 kilowatt hours (kwh) to a low of 379,096 kwh. The overall trend is toward lower consumption as older lighting and equipment is replaced with that which is more energy-efficient (e.g., LED lighting).



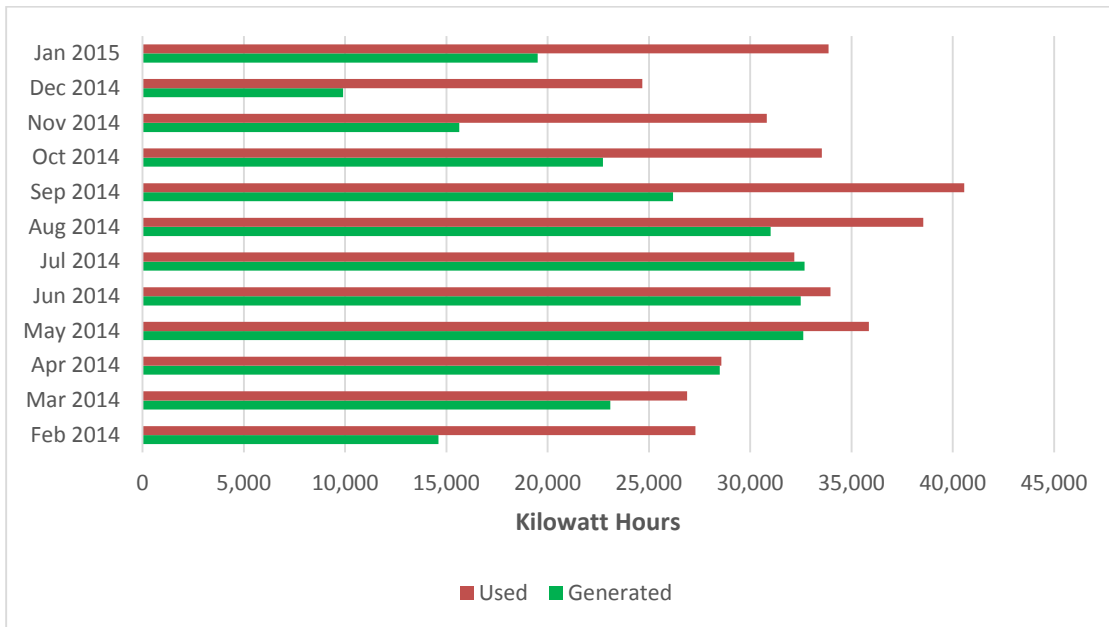
**FIGURE 1: COMPARISON OF HOLY FAMILY ANNUAL ELECTRICAL USAGE**

Of the total amount of electricity used at Holy Family in each of the five years that the solar system has been operational, the amount generated on-site has ranged from a low of 67% in the first year to a high of 75-77% in each of the last four years. See Figure 2.



**FIGURE 2: SOURCES OF ELECTRICITY USED AT HOLY FAMILY**

Using the period February 2014 through January 2015 as an illustration, Figure 3 shows both the amount of electricity generated on-site and the amount of electricity used on-site on a typical month-by-month basis. Note that in July, we generated more electricity than we used, with the excess fed into PG&E’s electrical grid. Figure 3 also demonstrates that solar production is greatest during the non-rainy season and when the sun is at its highest angle above the horizon.



**FIGURE 3: KWH GENERATED AND USED AT HOLY FAMILY ON A MONTH-BY-MONTH BASIS**

## ENVIRONMENTAL BENEFITS

Unlike electricity generated by fossil fuels such as coal and natural gas, electricity generated by photovoltaic systems produces no emissions of carbon dioxide (CO<sub>2</sub>). CO<sub>2</sub> is a greenhouse gas that contributes to the phenomenon known as global warming.

A common way of quantifying the environmental benefit of electricity generated solar systems compared to electricity generated by fossil fuels is to calculate “CO<sub>2</sub> emissions avoided.” According to the EPA, the 1,432,966 kwh of electricity generated in the first five years by the solar system at Holy Family equates to 1,089 tons of CO<sub>2</sub> emissions avoided. This is the equivalent of the annual emissions of 208 passenger vehicles.

## COST OF ELECTRICITY

Excluding the cost of electricity for the gym/pre-school building and the rectory, the annual cost for electricity at Holy Family for each of the last nine years is shown in the chart on Figure 4. Annual costs have ranged from a low of \$54,922 to a high of \$69,479, with an average of \$62,321. Of the total costs, the chart also shows the amounts paid by the school and parish according to the payment-sharing arrangements listed in Table 1.

Of course, the amount paid for electricity depends not only on the amount of electricity used, but also on PG&E’s rates that are in effect at any given time.

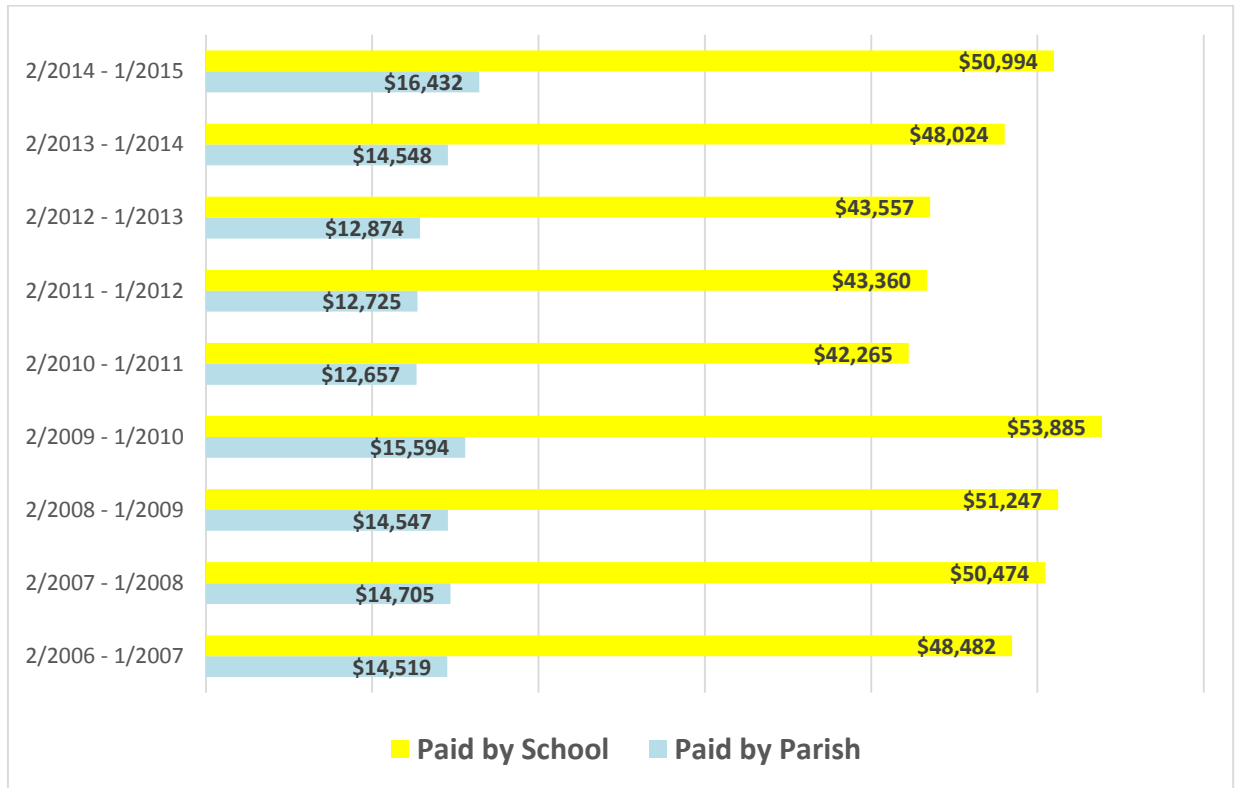


FIGURE 4: COMPARISON OF ANNUAL ELECTRICITY COST

## COST SAVINGS RESULTING FROM SOLAR SYSTEMS

On the surface, it would seem that determining if the solar systems are saving Holy Family any money would be a simple 2-step calculation:

1. calculate how much money we would have paid for the electricity we actually used had we not had the solar systems in operation, and
2. compare that cost to the amount we did pay for the electricity we actually used with the solar systems in operation.

Unfortunately, the world of electrical utility rates is extremely complex. PG&E's rates frequently change and the rates themselves are comprised of multiple components including daily meter charges, demand usage charges, time-of-use charges (e.g., summer peak, summer part-peak, summer off-peak, winter part-peak, and winter off-peak), distribution fees, utility user taxes, and City franchise surcharges. Further complicating the calculations is the fact that the amount we are credited by PG&E for any excess electricity generated by the solar systems is dependent on the time-of-day and the time-of-year the excess is generated. We do not have access to all these data. Therefore, we were not able to calculate the amount of savings to Holy Family between the "with solar" and "without solar" scenarios.

The above notwithstanding, it can be stated with certainty that Holy Family is paying less for electricity with the solar systems in place than we would otherwise be paying without the solar systems in place. This conclusion is based on the data in Tables 2 and 3. Table 2 shows the average cost per kwh paid by Holy Family in each of the past nine years. The data show that over the 6-year period of February 2009 to January 2015, the average cost per kwh increased from 16.6 cents to 17.4 cents, a 5% increase.

<b>TABLE 2</b>			
<b>HOLY FAMILY ELECTRICAL USAGE SUMMARY</b>			
	<b>KWH Used</b>	<b>Total Cost</b>	<b>Average Cost per KWH</b>
<b>Before Solar Installed</b>			
Feb 2006 - Jan 2007	398,640	\$ 63,001.31	\$ 0.158
Feb 2007 - Jan 2008	411,400	\$ 65,178.24	\$ 0.158
Feb 2008 - Jan 2009	423,760	\$ 65,793.86	\$ 0.155
Feb 2009 - Jan 2010	418,230	\$ 69,478.90	\$ 0.166
<b>With Solar Installed</b>			
Feb 2010 - Jan 2011	394,940	\$ 54,922.34	\$ 0.139
Feb 2011 - Jan 2012	390,811	\$ 56,085.21	\$ 0.144
Feb 2012 - Jan 2013	379,096	\$ 56,430.83	\$ 0.149
Feb 2013 - Jan 2014	391,965	\$ 62,572.90	\$ 0.160
Feb 2014 - Jan 2015	386,739	\$ 67,426.04	\$ 0.174
Note: Data are for all parish/school buildings except for the gym/pre-school building and the rectory. Total cost includes that paid to Perpetual Energy and to PG&E.			

<b>TABLE 3</b>			
<b>PG&amp;E RATES PER KWH: 2009 VERSUS 2015</b>			
	<b>2009</b>	<b>2015</b>	<b>% Change</b>
Summer Peak	\$ 0.4149	\$ 0.6117	47 %
Summer Part-Peak	\$ 0.1887	\$ 0.2855	51 %
Summer Off-Peak	\$ 0.1173	\$ 0.1580	35 %
Winter Part-Peak	\$ 0.1420	\$ 0.1808	27 %
Winter Off-Peak	\$ 0.1160	\$ 0.1480	28 %
<b>Average</b>	<b>\$ 0.1958</b>	<b>\$ 0.2768</b>	<b>41 %</b>
Rates shown are A-6 Commercial/Time-of-Use, which are applicable to Holy Family.			

In contrast, the data in Table 3 show that the average cost per kwh charged by PG&E over the same 6-year period of 2009-2015 has increased by 41%. ***Thus, for example, had Holy Family not installed the solar systems, the total paid for electricity for the 12 months ending January 2015 would likely be on the order of 36% more than we paid with the solar systems in place.*** Again, this is a rough, back-of-the-envelope, estimate of savings; actual savings would depend on the numerous variables listed above.

This conclusion is not unexpected because we know that the rate per kilowatt-hour we pay to Perpetual Energy Systems, LLC for the electricity generated by our on-site solar systems is less than the rate we would otherwise have paid to PG&E. As an example, we are presently paying Perpetual Energy 21.5 cents per kwh generated by the solar systems. This compares to PG&E’s current rates of 61.2 and 28.5 cents per kwh during the Summer peak and part-peak periods, respectively. The lower rate we pay to Perpetual was negotiated by the Diocese as part of the master agreement for Phase 1 of the Diocese’s Solar Energy Initiative. The lower rate is, in essence, Holy Family’s compensation for serving as the “host” for the solar systems. Over time, if PG&E continues to increase its rates, Holy Family’s savings will be even greater.

## **RECOMMENDATIONS**

The Diocese is currently proceeding with Phase 2 of its *Solar Energy Initiative*. It is anticipated that the financial and environmental benefits from the Phase 2 systems will be greater than for Phase 1 due to improvements in technology and reductions in system costs. Holy Family should request that the rectory and the gym/pre-school building be evaluated as to their feasibility for inclusion among the Phase 2 installations. As with Phase 1, there would be no capital costs to Holy Family and there would likely be annual cost savings for electricity as well as environmental benefits.

## **FOR MORE INFORMATION**

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