

PARTNERENERGY

Cost Effective Energy Efficiency Measures Study

Six Flags Great Adventure

1 Six Flags Blvd
Jackson, NJ 08527

March 9, 2015
Project No. 150082



Prepared for

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Executive Summary

Partner Energy's team of certified energy professionals performed a full inspection of the property located at 1 Six Flags Blvd in the City of Jackson, NJ (the "Subject Property").

Energy Efficiency Measures

The Subject Property's energy consuming systems were inventoried and evaluated for proper operation. Data collected included equipment nameplate information, building occupancy schedules, equipment-operating times, and utility bills gathered at our on-site visits. From this analysis, we developed a list of potential *Energy Efficiency Measures (EEMs)* and then evaluated for cost effectiveness and impact on building operations.

In Partner Energy's assessment of the overall electric consumption at Six Flags, there are very limited energy efficiency opportunities due to the unique characteristics of Six Flag's energy usage. The primary usage within Six Flags are the rollercoasters, various other rides and associated entertainment facilities. These were not considered for analysis due to the inability to apply appropriate energy efficiency measures without jeopardizing the proper operation and electrical infrastructure for those rides. Therefore the liability of applying energy efficiency measures to the rides and entertainment entities is not something that is in the best interest of the safety of the general public or the park's mission. This being the case, areas focused on more traditional to the energy efficiency market place including surface area lighting (i.e. parking lot) and HVAC unit replacement which is detailed in the study.

It is worth noting that Six Flags has identified and spent nearly one (1) million dollars over the last 5 years on energy efficiency upgrades within the park. These include but are not limited to energy efficient motors, parkwide HVAC unit replacements, and various freezer unit upgrades. The park has likewise committed an additional \$150,000 in 2015 for multiple HVAC unit replacements in various buildings. This report considers additional energy efficient measures for implementation beyond these measures.

The following tables outline the Partner Energy recommended Energy Efficiency Measures for the Subject Property. Information is provided on energy saved, greenhouse gas emission reduction, estimated installation cost, annual cost savings, estimated rebates and simple payback.

Table 1-0: EEM Cost Summary

ECM #	Energy Conservation Measure (ECM)	Savings (kWh)	Savings (kW)	Total Cost Savings	Gross Install Cost	Net Install Cost	Simple Payback Time (Yr)
1	Retrofit Tower parking 1000w MH w/ 300 W LED	62,525	134	\$ 3,751	\$ 122,200	\$ 122,200	32.6
2	Replace 20 ton Admin/Operations Packaged AC	43,680	35	\$ 2,621	\$ 156,000	\$ 156,000	59.5
3	Replaced old split DX heat pumps	19,327	15	\$ 1,160	\$ 36,000	\$ 36,000	31.0
	Total	125,532	184	\$ 7,532	\$ 314,200	\$ 314,200	41.7

SECTION 1 – Energy Audit Description

Introduction

The goal of the energy study is to provide an evaluation of selective building energy consumption in order to help identify modifications and improvements to building equipment and systems that may produce energy savings.

The Energy Review will provide a preliminary look at the energy consumption data associated with specific buildings and systems at the Subject Property. Additionally, the report includes a general evaluation of potential energy measures for energy savings and energy cost avoidance.

1. Replacement of package HVAC units to high efficiency models
2. Changing constant air volume systems to variable air volume
3. Replacement of chillers and boilers in a central plant
4. Rewiring lighting systems for better control
5. Upgrading to ENERGY STAR® rated appliances and computers

Natural gas and electric utility rebates help lower payback periods and are factored into potential Energy Efficiency Measure recommendations.

SECTION 3 – Current Description of Facility

General Description of Facility and Energy

The three (3) buildings audited are located at 1 Six Flags Blvd, Jackson, NJ 08527. The buildings consist of Admin/Operations, Maintenance, and the Wardrobe building.

These buildings were specifically identified as facilities of interest due to their administrative and general office use for year round park operations. All other buildings on the site are primarily related to the entertainment experience and therefore not relevant to this analysis.

Site Visit Summary	
Primary Site Visits	3/1/2015
Lead Engineer	Matt Deedy
Project Engineers - Report	Arun Srinath
Project Engineers - Site Walk	Jason McGuigan
Site Contact(s)	Mike Fatovic
Location, Building Configurations	
Address	1 Six Flags Blvd
City, State & Zip	Jackson, NJ 08527
Number of Buildings	3
Commercial Stories	Mostly 1 story
Year Built	1960
Gross Area [sq ft]	31441
Gross Area [sq ft] Wardrobe Bldg	16786
Gross Area [sq ft] Maintenance	43,010
Area's Inspected	{3} buildings
Utility Providers	
Natural Gas	New Jersey Natural Gas
Electricity	Jersey Central Power & Light
Water	
Average Utility Rates	
Natural Gas Rate (\$/therm)	\$1.00
Electric Rate (\$/kWh)	\$0.10

Meetings were held with Mike Fatovic, one of the facility managers who was present during the site walk. These discussions provided insight into building operations, perceived problems, and previous building modifications and system upgrades.

Jason McGuigan with Partner Energy inspected the site on 03/09/15.

From these discussions, building operations are summarized as follows:

Area	Weekday		Saturday		Sunday		Months	
	From	To	From	To	From	To	From	To
Occupancy Schedules								
Retail - 1st Floor	10:00AM	8:00PM	10:00AM	7:00PM	10:00AM	6:00PM	jan	dec
Office - 2nd Floor	8:00AM	5:00PM	8:00AM	12:00PM			jan	dec

Building Envelope

Three (3) buildings on site are included in this audit. The buildings appear to be concrete stucco wall façade with metal framing and a corrugated metal roof structure. The buildings are low rise non-residential buildings used as administrative buildings for the amusement park.

Lighting

Lighting may have been upgraded on the interior in recent years. The exterior lighting fixtures evaluated were located in the parking area and consisted of 20 light towers. Each tower has (10) fixture heads on the Subject Property and consist of 1000 w metal halide lamps for each fixture head.

Heating, Ventilating, and Air Conditioning (HVAC)

Four rooftop package Gas Electric units provide heating and cooling for the Admin/Operations building. These packaged units are past the end of their useful life and recommended for replacement.

There are a total twenty split DX heat pump units serving the Maintenance and Wardrobe buildings. Some of the units are newer and were installed approximately in 2002 and 2004. Five of the units are more than 20 years old and are recommended for replacement with high efficiency units.

Controls

The buildings do not have an energy management system. HVAC for individual spaces is regulated by programmable thermostats that are programmed for normal cooling and heating set points.

SECTION 4 – Energy Efficiency Measures

Recommended EEMs

A summary the recommended Energy Efficiency Measures in **Table 4-1** is on the next page.

Table 4-1: EEM Summary

ECM #	Energy Conservation Measure (ECM)	Savings (kWh)	Savings (kW)	Total Cost Savings	Gross Install Cost	Net Install Cost	Simple Payback Time (Yr)
1	Retrofit Tower parking 1000w MH w/ 300 W LED	62,525	134	\$ 3,751	\$ 122,200	\$ 122,200	32.6
2	Replace 20 ton Admin/Operations Packaged AC	43,680	35	\$ 2,621	\$ 156,000	\$ 156,000	59.5
3	Replaced old split DX heat pumps	19,327	15	\$ 1,160	\$ 36,000	\$ 36,000	31.0
	Total	125,532	184	\$ 7,532	\$ 314,200	\$ 314,200	41.7

Description of Recommended Measures

The following section discusses the Energy Efficiency Measures identified for the Subject Property.

EEM-1 Replace Exterior Tower Parking Lot Metal Halide lamps with LED

Existing condition: Exterior lamps for the 20 light towers in the parking lots each have (10) fixture heads on the Subject Property and consist of 1000 w metal halide lamps for each fixture head.

Proposed measure: We recommend replacing these lamp fixtures with LEDs. Replacement of these lamps with 300W LED lamps, respectively, is recommended.

Savings: Energy savings will be achieved due to the improved efficiency of the lamps, while maintaining acceptable lighting levels. Savings were estimated by using a spreadsheet calculation.

EEM-2 Replace Old Package Units with High Efficiency Units

Existing condition: The existing packaged gas electric units for the Admin/Operations building are old and inefficient.

Proposed measure: We recommend replacing the existing packaged gas/electric units with new high efficiency units at 12 EER and above.

Savings: Energy savings will be achieved due to increased efficiency of the new packaged AC units with reduced kW/ton energy metric over the existing units. Savings were calculated with a spreadsheet analysis tool. The total cooling demand was somewhat calibrated with measured data.

EEM-3 Replace Old Split DX Units with High Efficiency Units

Existing condition: The existing (6) identified split DX Heat Pump units for the Maintenance and Wardrobe building are old and inefficient.

Proposed measure: We recommend replacing the designated split DX Heat Pump with new high efficiency units at 17 SEER and above.

Savings: Energy savings will be achieved due to increased efficiency of the new split DX Heat Pump with reduced kW/ton energy metric over the existing units. Savings were calculated with a spreadsheet analysis tool.

Energy Efficiency Summary

The purpose of this study was to effectively locate areas for energy improvement within the Great Adventure park non-entertainment areas. Through the study performed by Partner Energy on site and understanding of the operational goals of Six Flags, some areas of improvement were noted, as detailed in the Energy Efficiency Measures. Savings can be found through newer and increased efficiency HVAC units, and upgraded technologies in lighting.

The savings noted in these EEM's totals 125,532 kWh of usage per year, and an estimated \$7,532 in electrical utility cost savings.

One of the purposes of this energy study and report is to explore options for reducing the site electrical load prior to the construction and installation of the photovoltaic electrical generation system. By calculating the reduced kWh and determining the system size required to generate the necessary power to meet that kWh, it can be determined if any reductions in the overall proposed system size are warranted or feasible.

The planned equipment for replacement that comprises the \$150,000 being spent this year represents an approximate 24,000kwh yearly reduction in energy consumption. Put in perspective, the park consumes approximately 27,315,000kwh annually; therefore, if a system size reduction were considered, 24,000kwh translates into approximately 18kW DC, however the overall AC system size remains at 17MW AC.

As demonstrated by their actions over the past five years and the expenditure of more than \$1 million dollars, Six Flags is clearly committed to identifying energy efficiency measures as part of an ongoing corporate program and has successfully implemented many over the last five years. Some of the proposed energy efficiency items noted in this report, due to the long term payback, are not yet committed for upgrade and/or replacement. They will be considered as part of the Six Flags energy efficiency program going forward.

SECTION 5– Qualifications and Limitations

Partner Energy's work was undertaken in a professional manner with the best interests of our client in mind. Our objective was to perform our work with care, exercising the customary skill and competence of consulting professionals in the relevant disciplines. The conclusions presented in this report are professional opinions based solely upon data provided by the Client, their representatives and output provided by ENERGY STAR Portfolio Manager. The opinions and recommendations presented herein apply to existing and reasonably foreseeable site conditions. We cannot act as insurers, and no expressed or implied representation or warrant is included or intended in our report, except that our work was performed, within the limits prescribed by our clients, with the customary thoroughness and competence of our profession at the time and place the services were rendered.

1. The report was prepared in a manner consistent with generally accepted industry practices and standards.
2. All information is true and correct, to the best of the undersigned's knowledge, and reflects the consultant's best professional opinion and judgment.

In addition, the *Simple Payback* is defined as the capital cost divided by the annual savings. Simple paybacks have been calculated before taxes for each measure requiring a capital investment. Since the annual savings and capital costs can vary, these simple paybacks can also vary.

Disclaimer:

Neither the **Partner Energy** nor any person or sub-consultant acting on its behalf: (a) makes any warranty or representation, expressed or implied, with respect to accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, method or process disclosed in this report may not infringe privately owned rights; or (b) assumes any liabilities with respect to use of, or for damage resulting from the use of, any information, method, or process disclosed in this report.

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Energy Audit/Study

The Partner Energy team has extensive experience conducting all levels of energy audits, retro-commissioning studies, commissioning, and demand response studies which require extensive field data collection, energy modeling, and measurement & verification. The asset types we have experience with include multi-family, office, hotel, school, government, hospital, cold-storage, warehouse, and industrial buildings. All of our audits and studies follow the same basic procedure and analyze the same system types, which can include:

- Building Envelope
- HVAC
- Lighting
- Controls
- Industrial/process/plug loads
- Compressed Air

Our approach for this Scope of Work is as follows:

An energy audit and property condition assessment will be conducted on the Subject Property. The energy audit will use a systems approach to examine all the major factors effecting energy consumption. Specific tasks are as follows:

1. Perform a utility bill analysis based on historical data provided by the client:
2. Conduct an on-site survey of the subject property
3. Conduct diagnostic testing, if required
4. Create a baseline whole building energy simulation model of the Subject Property and perform an energy balance.
5. Generate a written report documenting the findings.
 1. Description of measures
 2. Calculated energy savings and demand reduction profile
 3. Analysis of installed and maintenance cost of the systems/technologies being evaluated as compared to the incumbent technologies

Partner draws on our background in commissioning and retro-commissioning to select the appropriate tools, sensors, and tests in order to produce defensible and reasonable calculations and results. The equipment and building operating data collected will be analyzed using industry standard spreadsheet analysis tools.

The Partner Energy team has a diverse and experienced team of mechanical, electrical, building, and civil and energy engineers as well as architects. They keep abreast of the current and up and coming technologies by attending conferences, trade shows, and speaking directly with equipment manufacturers and integrators. Our staff is well versed at understanding new technology through the analysis of specifications and real world testing. Our approach to working with under-utilized and emerging technologies and systems is to work with directly the manufacturer and/or integrator to ensure that the equipment is installed per design and specification.

Appendix A:

Lighting Calcs

ECM #	Space	Annual Hours of Operation	Existing Lamp	Existing Quantity	Watts / Fixture	Input Demand per Unit (kW)	Controls Reduction	Proposed Lamp	Proposed Quantity	Watts / Fixture	Input Demand per Unit (kW)	Electrical Usage Savings (kWh)	Electrical Demand Savings (kW)	Value of Electrical Savings ¹²	Gross Install Cost per Fixture	Gross Install Cost	Simple Payback Time Without Incentive (Yr)
1	Retrol Tower Park 1000w MH w/ 300 W LED	468	(10) 1000w MH	200	1080	216.00	0%	412 w LED	200	412	82.40	62,575	133.60	\$ 3,751	\$ 611	\$ 122,200.00	42.6


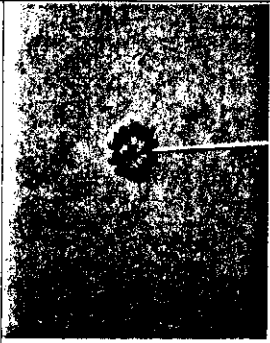

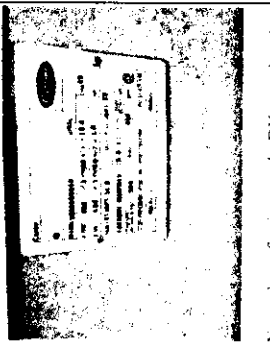

HVAC Calcs

ECM #	Energy Conservation Measure (ECM)	Quantity	Annual Hours of Operation	Tons Each	Base EER	Prop EER	Baseline Input Demand (kW)	Electrical Baseline (kWh)	Baseline Input Demand per Unit (kW)	Electrical Proposed (kWh)	Electrical Usage Savings (kWh)	Electrical Demand Savings (kW)	Value of Electrical Savings ¹²	Gross Install Cost	Simple Payback Time Without Incentive (Yr)
2	Replace 20 ton Admin/Operations Packaged AC	1	4,200	20	9	12	27	33,600	20	25,200	8,400	6.67	\$ 504	\$ 30,000	59.5
2	Replace 27 ton Admin/Operations Packaged AC	2	4,200	27	9	12	72	90,720	54	68,040	22,680	18.00	\$ 1,361	\$ 81,000	59.5
2	Replace 30 ton Admin/Operations Packaged AC	1	4,200	30	9	12	40	50,400	30	37,800	12,600	10.00	\$ 756	\$ 45,000	59.5
3	Replaced old split DX heat pumps	3	4,200	5	8	15.5	23	28,350	12	14,637	13,718	10.84	\$ 873	\$ 27,500	27.3
3	Replaced old split DX heat pumps	1	4,200	2	9	15.5	3	3,360	2	1,951	1,409	1.17	\$ 85	\$ 3,000	35.3
3	Replaced old packaged DX heat pumps	1	4,200	7	9	14	9	11,760	6	7,560	4,200	3.33	\$ 252	\$ 10,500	41.7

Appendix B: Equipment Table

Unitary									
Tag	AC-1	AC-2	AC-3	AC-4	IT Data Room	HP-1	HP-2	HP-3	
Type	Packaged Gas/Electric Admin/Operations	Packaged Gas/Electric Admin/Operations	Packaged Gas/Electric Admin/Operations	Packaged Gas/Electric Admin/Operations	Split DX Cooling Only Admin/Operations	Split DX Heat pump Wardrobe	Split DX Heat pump Wardrobe	Split DX Heat pump Wardrobe	
Area / System served	1989	1989	1989	1983	2009	1	1	1	
Quantity	1	1	1	1	1	1	1	1	
Make	Carrier	Carrier	Carrier	Carrier	Liebert	Carrier	Carrier	Carrier	
Model	50DF024	50DF028	50DF028	50DF034	TCSV601-A	38CK80610	38CK8060	38CK8060	
Serial No.					0950C25187	K969787	3696E17637	3696E17637	
Tons	20	27	27	30	5	5	5	5	
SEER	9.5	9.5	9.5	9.5	11	8	10	10	
Unitary									
Tag	HP-6	HP-7	HP-8	HP-9	HP-10	HP-10	HP-11	HP-12	
Type	Split DX Heat pump Wardrobe	Split DX Heat pump Wardrobe	Split DX Heat pump Wardrobe	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	
Area / System served									
Quantity	1	1	1	1	1	1	1	1	
Age	2006	2004	1981	2009	2009	2009	1976	2001	
Make	Carrier	Carrier	Carrier	United Refrig	United Refrig	United Refrig	Carrier	Carrier	
Model	38AR2008	38TK8036	38CE002310	TZAA-360-DA	TZAA-360-DA	TZAA-360-DA	38CC0600610	38CKC060	
Serial No.	3606G40150	0804E43969	Y110381	7805W500905970	7805W500905976	7805W500905976	A973156	2401E12133	
Tons	7	3	2	3	3	3	5	5	
SEER	13	12.5	8.5	12	12	12	8	12	
Unitary									
Tag	HP-14	HP-15	HP-16	HP-17	HP-4	HP-5			
Type	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Maintenance	Split DX Heat pump Wardrobe	Split DX Heat pump Wardrobe			
Area / System served									
Quantity	1	1	1	1	1	1			
Age	2002	2002	1993	1993	1996	1996			
Make	Carrier	Carrier	Carrier	Carrier	Carrier	Carrier			
Model	38CKC030	24ABR360A660	38B008620	38B008620	38CK8060	38CK8060			
Serial No.	2401E12133	1708E22125	1293G40337	1293G40337	3696E17633	3696E17633			
Tons	2.5	2.5	7	7	5	5			
SEER	12	12	9.5	9.5	9.5	9.5			

Appendix C: Site Photos

	
Existing older packaged AC unit at Admin building to be replaced (Typ of 4)	Existing packaged AC unit top view (typical)
	
Existing 1600 w MH tower Parking lot pole lights	Existing split DX HP to be replaced (Typ)
	
Nameplate of existing split DX to be replaced (Typical)	Equipment yard with split DX HP's