CYCLONE ENERGY

ELECTRI International Foundation
Green Energy Challenge

Boys & Girls Club of Story County

Prepared by Cyclone Energy:

Dylan Busby • Tristen Girolamo • Jon Hoehne
Shay Hudachek • Heli Nascimento • Conor O'Brien • Julie Penton
Sara Peterson • Marcelious Wyatt

ELECTRI INTERNATIONAL
THE FOUNDATION FOR ELECTRICAL CONSTRUCTION INC.

NECA
NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION

Green Energy CHALLENGE
ELECTRI International NECA

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Executive Summary

The Boys & Girls Club of Story County is a non-profit organization tasked with providing after-school and summer programing for children of all ages, backgrounds, and statuses. Cyclone Energy performed an energy assessment of the 11,200 square-foot Boys & Girls Club facility in Ames, Iowa. The analysis identified improvements that will increase energy performance and occupant comfort. Cyclone Energy determined these potential upgrades:

1. Remove current mechanical equipment and install a new two-pipe Variable Refrigerant Flow (VRF) system;
2. Improve seals around windows and raise perimeter grade to prevent heat loss;
3. Replace existing lighting fixtures with LED equivalents and implement occupancy sensors and dimming controls; and
4. Install a 5 kW roof-mounted photovoltaic system.

The total cost associated with these updates to the Boys & Girls Club is $167,184. The project will be financed through the Iowa Energy Bank Revolving Loan, and will utilize the City of Ames Rebate Program. The total project duration is just under seven months, including five months for design and preconstruction activities, and approximately two months for construction activities. Construction activities will commence on March 19th, 2018. Final completion is expected to take place on May 1st, 2018. The schedule allows Cyclone Energy to work around the Club's hours of operation, and ensures that the construction activities will not interfere with the Boys & Girls Club's youth programs.

Community service was a major factor in this proposal. Cyclone Energy performed over 100 volunteer hours to support the Club's mission. Through our involvement, the team worked with the Boys & Girls Club staff to develop and execute activities to inspire club members to reach their full potential.

Mission Statement

Cyclone Energy, founded in 2011, is dedicated to providing our clients, as well as our community, with the best value in energy savings through cost analysis, feasibility studies, and innovative thinking. Our solutions address both the client's needs and those of the occupants.

Lead Roles of Team Members

- Dylan Busby – Team Captain, Estimate
- Heli Nascimento – Outreach
- Tristen Girolamo – Schedule
- Shay Hudachek – Outreach & Revit Model
- Jon Hoehne – Client Relations
- Marcelious Wyatt – Energy Efficiency Analysis
- Sara Peterson – Lighting Retrofit
- Julie Penton – Finance Plan
- Conor O'Brien – Solar Energy System

Summary of Client

The Boys & Girls Club of Story County is housed in an 11,200 square-foot, one-story building designated to serve young members from ages 6 through 18. Located at 210 South 5th Street, Ames, Iowa, the building was constructed in 1997. The facility serves over 500 children every year. Approximately 140 youth attend the after-school and summer programs on a daily basis at the facility. The after-school programs offer a multitude of fun physical activities, meals, and academic programs. Every activity focuses on the Boys & Girls Club mission statement, "To inspire and enable all young people, especially those who need us most, to reach their full potential as productive, caring, responsible citizens."

Membership is $12 for the school year and $35 for the summer program. This low price is meant to ensure that there are no financial barriers for students to join. The Club raises 95.3% of their annual operating budget through fundraising efforts. They work with the Ames Community School District for after-school transportation so all kids have the opportunity to participate.

Figure 1. Boys & Girls Club of Story County Full-time Staff (L-R: Kaitlin Binnebose, Erika Peterson, Ali Sauer, and Joe Thien)

The staff at the Boys & Girls Club is the backbone of the operation (Figure 1). They are heavily involved in interacting with the children that come into their facility. Each staff member passionately works to ensure that the Club is meeting their goal to inspire, teach, and motivate each individual child that walks through their door. Each staff member has specific roles that contribute to the success of the Club. Erika Peterson, Chief Executive Officer, is in charge of business administration, grant writing, and the facility. Kaitlin Binnebose, Operations Director, is in charge of facility and program operations. Ali Sauer, Development Coordinator, is in charge of marketing, fundraising, event planning, and grant writing. Joe Thien, Program Coordinator, develops the program schedule for the youth. He also trains and coordinates the volunteers. Tatum Causey (not pictured), Teen Coordinator, runs the schedule for the teen program.

The Club's programs and activities focus on academic success, good character and citizenship, and healthy lifestyles. They focus on providing positive youth development and reward-based reinforcement. Due to the support and influence of positive role models and volunteers, club members are more likely to perform community service, abstain from delinquent activities, and to be more physically active than their peers.

The family atmosphere of the Club contributes to a strong sense of belonging, building supportive relationships, and providing opportunities for students to develop themselves. When students arrive each day, they are met at the door with a smile by the staff who acknowledges each of them by name. Once inside, the "Wall of Champs" board encourages students to be supportive of and competitive with one another through their accomplishments. Students can also earn "Be Great Bucks" that can be spent at the Club's store.

With the large number of students that participate in the Club each day, volunteers are needed in many areas, such as helping students with homework, serving food, participating in fun activities with the kids, and cleaning up each night. The Ames Police Department is a strong supporter of the Club, as are many other local businesses, organizations, and individuals that donate their time, money, and other resources.

Figure 2. Boys & Girls Club of Story County Facility

Senior

Construction Engineering

Electrical Emphasis

girolamo@iastate.edu

(563) 203-0789

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Tristen Girolamo

Estimate & Schedule

Qualifications:

National Electrical Contractors Association (NECA) – President
National Association of Home Builders (NAHB) – Member
Associated General Contractors of America (AGC) – Member
Mechanical Contractors Association (MCA) – Member
Associated Schools of Construction (ASC) Competition
Specialty Contracting Team, 1st Place – 2016
Specialty Contracting Team, 2nd Place – 2015
OSHA 10 Hour Certification

Professional Experience:

Interstates – Sioux Center, IA
Intern, Project Coordinator
May 2016 – August 2016

Volunteer Experience:

Boys & Girls Club
School Break Service Trip
- Charleston, SC – Spring 2017

Education:

Iowa State University
Anticipated Graduation: May 2018
Major: Construction Engineering – Electrical Emphasis

Senior

Construction Engineering

Building Emphasis

hudachek@iastate.edu

(319) 330-6899

CYCLONE ENERGY

Shay Hudachek

Outreach & Revit Model

Qualifications:

National Electrical Contractors Association (NECA) – Treasurer
Associated General Contractors of America (AGC) – Member
Green Energy Challenge 2016
OSHA 10 Hour Certification

Professional Experience:

GE Johnson Construction Company – Denver, CO
Intern, Project Engineer
May 2016 – Present

Woodruff Construction – Fairfield, IA
Intern, Field Laborer
May 2015 – August 2015

Volunteer Experience:

Boys & Girls Club
Habitat for Humanity
McFarland Trail Repair
Weather Winterization Program
Adopt-A-Highway – Phi Delta Theta

Education:

Iowa State University
Anticipated Graduation: May 2018
Major: Construction Engineering – Building Emphasis

Senior

Civil Engineering

helifn@iastate.edu

(515) 708-5490

Heli Nascimento

Outreach & Finance Plan

Qualifications:

National Electrical Contractors Association (NECA) – Member
American Society of Civil Engineers (ASCE) – Member, Former Treasurer
OSHA 10 Hour Certification

Professional Experience:

The Walsh Group – Chicago, IL
Intern, Estimator
May 2016 – November 2016

The Walsh Group – Morganton, NC
Intern, Project Engineer
May 2015 – August 2015

Iowa State University – Ames, IA
Peer Mentor
August 2014 – May 2016

Volunteer Experience:

Boys & Girls Club
Captain Midnight's Run For Cystic Fibrosis
Kids Against Hunger

Education:

Iowa State University
Anticipated Graduation: December 2017
Major: Civil Engineering

Senior

Construction Engineering

Electrical Emphasis

ob1722@iastate.edu

(630) 418-2226

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Conor O'Brien

Solar Energy System

Qualifications:

National Electrical Contractors Association (NECA) – Engineering Student Council Representative

Associated General Contractors of America (AGC) – Member

OSHA 10 Hour Certification

Professional Experience:

Clune Construction Company – Chicago, IL

Intern, Project Engineer

May 2016 – August 2016

ARCO National Construction – Kansas City, MO

Intern, Project Engineer

May 2015 – December 2015

Volunteer Experience:

Boys & Girls Club

School Break Service Trips

- Johnson City, TN – Fall 2014
- New Orleans, LA – Fall 2016
- Charleston, SC – Spring 2017

Habitat for Humanity

Education:

Iowa State University

Anticipated Graduation: May 2018

Major: Construction Engineering – Electrical Emphasis

Senior

Construction Engineering

Electrical Emphasis

sarap@iastate.edu

(515) 537-7112

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Sara Peterson

Lighting Retrofit

Qualifications:

National Electrical Contractors Association (NECA) – Secretary

OSHA 10 Hour Certification

Professional Experience:

Baker Electric – Des Moines, IA

Intern, Project Engineer

May 2016 – Present

Edge Commercial – Grimes, IA

Intern, Project Engineer

May 2015 – August 2015

City of Urbandale – Urbandale, IA

Engineering Intern

May 2014 – August 2014

Volunteer Experience:

Boys & Girls Club

School Break Service Trip

- New Orleans, LA – Fall 2016

Urbandale Girls Recreational Association – Youth Coach

Habitat for Humanity

Education:

Iowa State University

Anticipated Graduation: December 2017

Major: Construction Engineering – Electrical Emphasis

Senior

Construction Engineering

Mechanical Emphasis

marwyatt@iastate.edu

(563) 676-7718

CYCLONE ENERGY

Marcelious Wyatt

Energy Efficiency Analysis

Qualifications:

Mechanical Contractors Association (MCA) – President
National Electrical Contractors Association (NECA) – Member
Design-Build Institute of America – Member, Former Treasurer
OSHA 10 Hour Certification

Professional Experience:

The Baker Group – Des Moines, IA
Intern, Project Manager
August 2016 – December 2016

GE Johnson Construction Co. – Denver, CO
Intern, MEP Manager
May 2016 – August 2016

GE Johnson Construction Co. – Denver, CO
Intern, Project Engineer
May 2015 – August 2015

Volunteer Experience:

Boys & Girls Club
School Break Service Trip

- Johnson City, Tennessee – Spring 2015

John Lewis Café (Café on Vine) – Kitchen Help

- Summer 2005 – Summer 2007

Education:

Iowa State University
Anticipated Graduation: December 2017
Major: Construction Engineering – Mechanical Emphasis

Technical Analysis 1: Energy Efficiency Analysis

Assessment

Cyclone Energy performed a detailed energy analysis on the Boys & Girls Club facility. Considerations were made for the lighting and Heating, Ventilation, and Air Conditioning (HVAC) systems. Several useful tools provided by the Department of Energy (DOE) were used in conjunction with Cyclone Energy's established methods to determine the best course of action for upgrading the facility. The existing mechanical equipment is nearing the end of its useful life, and new high efficiency equipment will substantially increase performance. A graph displaying the average electricity consumption by month was created using metering data (Figure 3). Consumption data from 2010 to 2016 was used in calculating monthly averages.

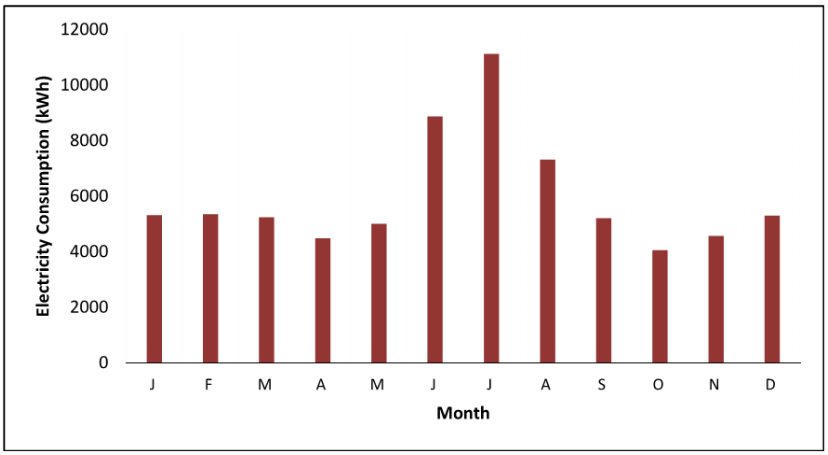


Figure 3. Metering Data Averages for Boys & Girls Club

Lighting & Lighting Controls

The lighting system in the Boys & Girls Club is not the most efficient system available. The majority of the building contains linear T8 fluorescent fixtures while the gymnasium uses 400 W metal halide fixtures. Although the gymnasium fixtures provide appropriate light levels, they also consume large quantities of energy. Indirect 400 W metal halide wall-mounted fixtures line the main corridor. These contribute very little to light levels as they are located underneath windows, consuming energy all day. The lighting controls in place consist of simple on/off switching.

HVAC

Cyclone Energy began the analysis by examining the mechanical system. The facility's current equipment is similar to that found in a common residential air conditioning system. However, there are four 5-ton and one 3-ton nominal roof-mounted condensers to cool the space. Additionally, four 125k BTU furnaces and a single 75k BTU furnace provide heat (Figure 4).

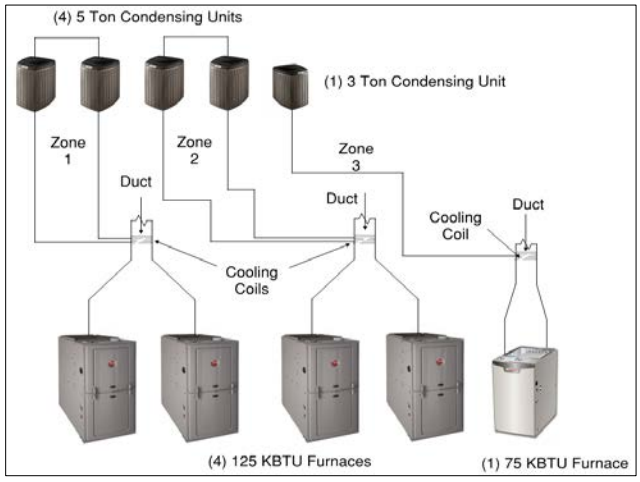


Figure 4. Existing HVAC System

The condensers supply refrigerant to direct expansion coils located just downstream of the furnaces, sharing a common duct. The equipment serves three zones that monitor the building temperature and adjusts accordingly using simple on/off motor controls.

The mechanical room houses the furnaces, ductwork, and other mechanical components. This configuration is atypical for a commercial space. However, to save funds for other activities, the Boys & Girls Club elected to take advantage of discounted equipment costs with ease of serviceability in mind.

The current mechanical system does not condition the building to meet the thermal comfort needs of the building occupants. The staff voiced concerns that during periods of extreme temperatures, the spaces farthest from the mechanical room are uncomfortable. This is because the existing mechanical equipment along with the poor duct routing prevents conditioned air from reaching the edges of the building, causing temperatures to approach the outdoor conditions during peak heating and cooling periods.

Energy Use/Benchmark

Cyclone Energy utilized the Environmental Protection Agency's (EPA) Energy Star Portfolio Manager (ESPM) to further analyze the Boys & Girls Club facility. This program compares facilities of similar size and use to provide information regarding the building's current operating efficiency.

ESPM considers multiple aspects of the building such as occupancy, hours of operation, and metered utility consumption data. Once the necessary inputs are provided, this tool creates a report summarizing the current Energy Use Intensity (EUI) and compares it to the baseline EUI. The baseline EUI is calculated based upon the earliest metering data available; the current EUI is calculated using the most recent metering data. Using this tool, Cyclone Energy determined the Boys & Girls Club consumed a total of 159,704 kWh in 2016, averaging 14.3 kWh/SF. The tool then assigned a percentile score based on energy efficiency and use of the building type that was selected. Our team classified the Club as a "K-12 School." The facility received a score of 90, compared to the average K-12 School building according the ESPM's data. Although the operating conditions assumed by the tool are not a complete match to those of the Boys & Girls Club, the K-12 School classification creates the most useful comparison (Table 1).

Table 1. Energy Star Portfolio Manager Results

Facility	Score	Site EUI (kBTU/ft^2)	Site EUI (kWh/ft^2)	Annual Site Usage (kWh)
Boys & Girls Club	90	48.7	14.3	159,704
Median K-12 School	50	71.5	21.0	234,715

The EUI and Annual Usage, shown in Table 1, reflect site values, and is not inclusive of the power loss from generation and distribution. Although the comparison between the Boys & Girls Club to the National Median shows the facility consumes significantly less energy than similar buildings of this type, the Club staff specifically identified a need for improvements in the lighting and mechanical systems. Upgrading these systems will not only decrease the operation costs, but also deliver a more comfortable working and learning environment, while performing better than the national median in terms of annual usage.

DOE Building Asset Score

Cyclone Energy created a model and input simple descriptions of the mechanical, electrical, and exterior cladding systems (Figure 5). The Building Asset Score (BAS) tool generates a score that ranges from 0 to 10, with 10 being the best. Along with the score, the tool also makes recommendations for areas of upgrade. The Boys & Girls Club received a score of 6.5.

The BAS tool generated recommendations for energy efficiency upgrades. The windows, walls, roof, and interior lighting were high target areas. The following upgrades were considered: (1) replacing the windows; (2) improving wall and roof insulation; (3) caulking the joints around the windows; and (4) performing a lighting retrofit.

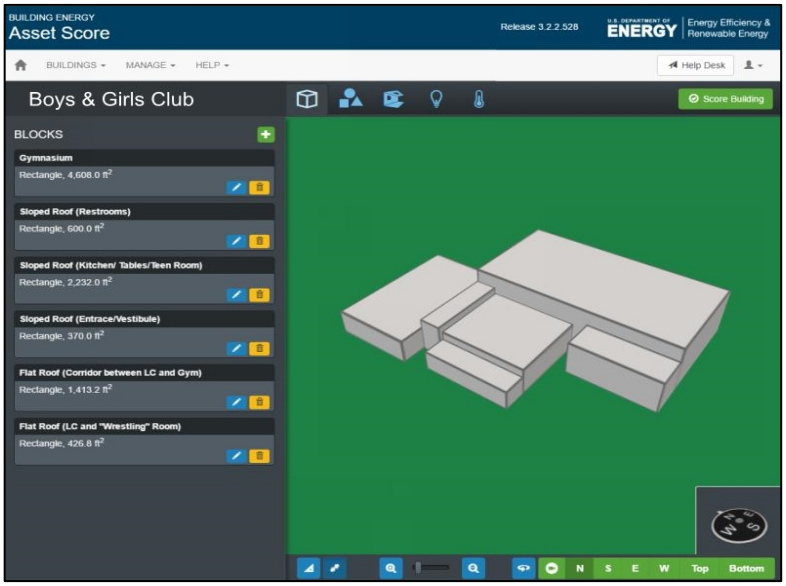


Figure 5. DOE Asset Score Building Model

At this time, Cyclone Energy does not advise proceeding with the first two recommended upgrades due to high installation costs, and a less favorable return on investment. Additionally, the roof has recently been repaired to fix multiple leaks; this would be another reason to consider other upgrade options prior to roof improvements.

Recommendations

Long Term Improvements

Lighting

Some of the areas within the building utilize less efficient fixtures, leaving spaces at lower light levels than desired. Upgrading to LED technology will illuminate the facility more appropriately. Implementing controls such as dimming, will increase the versatility of each space. The building currently has a glazed main corridor that feeds into a heavy traffic area. Utilizing daylight controls in this area will reduce the lighting energy costs, while also exceeding minimum light levels. Lighting retrofit details are provided in the next section of this proposal, Technical Analysis 2: Lighting Retrofit.

Mechanical Upgrades

The age and current status of the Boys & Girls Club provides opportunities for mechanical upgrades. Cyclone Energy considered two options for HVAC improvements. Option 1 is a Variable Refrigerant Flow (VRF) system. Option 2 is a one-for-one replacement of the equipment, with duct rerouting.

Option 1

A two-pipe VRF system will provide proper air distribution while increasing controllability and occupant comfort. The VRF system is comprised of two roof-mounted condensers, a roof-mounted Dedicated Outdoor Air System (DOAS), indoor zoning boxes, and terminal units (Figure 6).

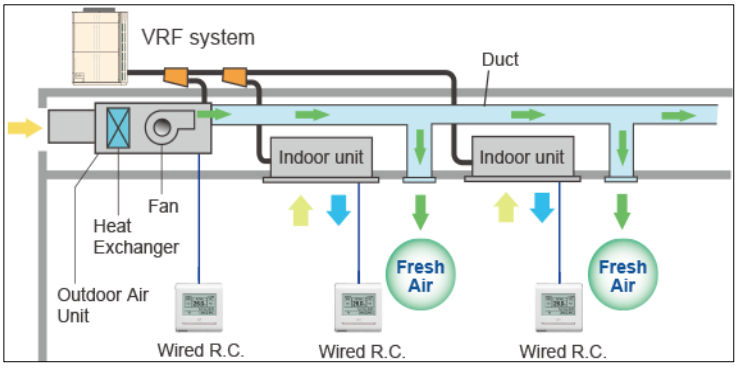


Figure 6. Basic Elements of a Variable Refrigerant Flow System

Although the VRF system requires more technical skill to service, it will increase the comfort level of the building occupants, as well as their overall satisfaction. Furthermore, this option will improve the serviceability of the system due to ease of access.

Option 2

A one-for-one replacement of the existing HVAC equipment with more current counterparts will increase efficiency, but not the quality of comfort for the building occupants. The current system is nearing the end of its useful life, and will require replacement regardless. This option entails removal of the existing furnaces and condensers, installation of the new equipment, and minimal duct reroute.

As demonstrated in Table 2, the estimated net annual savings that will be achieved by proceeding with Option 1 are less than half those seen with Option 2. However, the level of comfort and controllability that is achieved with Option 1 is of importance to the Club. Although Option 2 is viable due to its low initial cost, Cyclone Energy recommends Option 1.

Table 2. Summary of Yearly Cost Savings via Mechanical Upgrade

System	Change in Electricity Costs ($)	Change in Natural Gas Costs ($)	Change in Maintenance Costs ($)	Estimated Net Savings ($)
Current Systems (Baseline)	0	0	0	0
Option 1	+4700	-4900	-200	400
Option 2	-320	-350	-200	870

*Savings were calculated with the provided value of $0.20/kWh and the calculated natural gas rate of $1.40/therm.

Short Term Improvements

Cyclone Energy contacted Baker Group, a local NECA member, to assist with obtaining thermal scans of the building's exterior (Figure 7). The scans revealed that heat was being lost rapidly by the slab beneath the facility, as well as through the joints around the windows. To counteract the heat loss from the slab, additional soil should be backfilled around the building.

Cyclone Energy recommends performing the backfill and carefully sealing any accessible window joints during a future volunteer project to address heat loss. These two options will provide small cost savings, but have a tangible effect on the comfort of the occupants. The volunteer project was not included in the estimate nor the schedule.

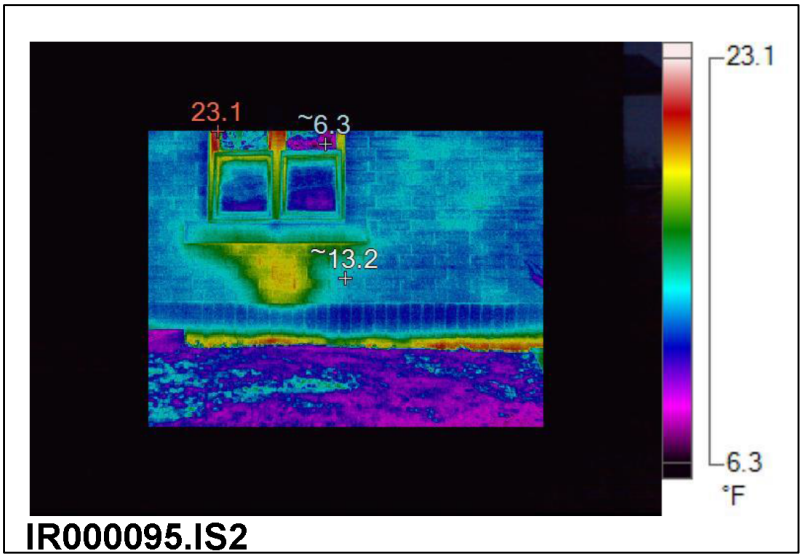


Figure 7. Thermal Image Displaying Slab and Window Assembly Heat Loss

Technical Analysis 2: Lighting Retrofit

Space Assessment

Lighting analysis for the Boys & Girls Club focused on all interior and exterior lighting fixtures, as seen in Figure 8. Cyclone Energy discussed the function and hours of operations for each room with the Club staff. The staff requested that the needs of the building occupants be considered to prioritize convenience over cost. Since the Boys & Girls Club is a non-profit organization, providing an energy efficient system that minimizes upfront costs is necessary. The existing lighting system consists of nine types of interior fixtures, four types of exterior fixtures, and limited lighting controls. Emergency lighting utilizes LED fixtures that have a long life expectancy, hence they do not need to be replaced. Below are some examples of existing fixtures with the largest opportunities for energy savings.

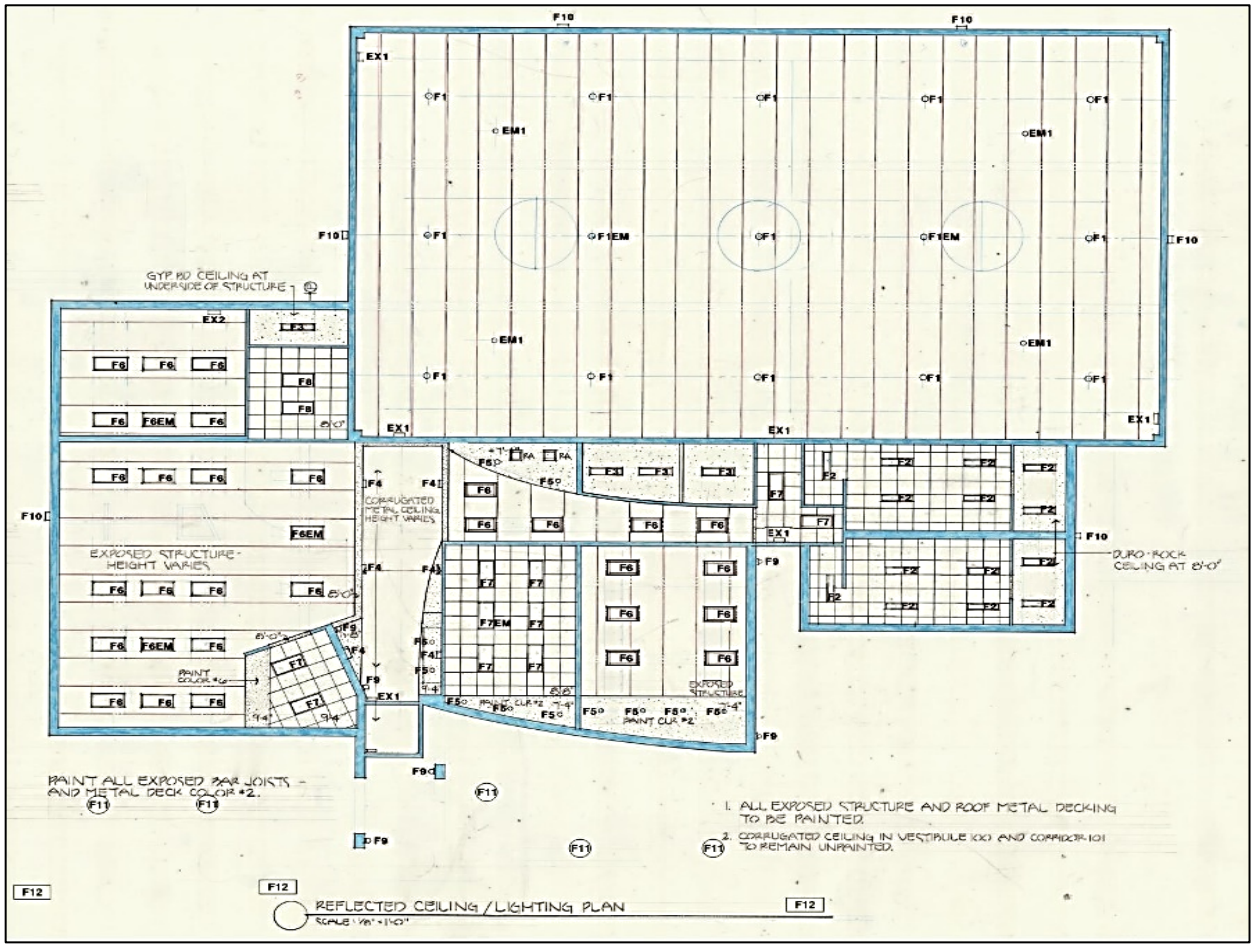


Figure 8. Existing Reflected Ceiling Plan

Figure 9. Gymnasium Fixtures

Fixture F1 (Figure 9), located in the gymnasium, is a 400 W metal halide low-bay luminaire. These fifteen (15) fixtures are estimated to draw 14.7 MWh annually, costing nearly $3,000 to operate (based on $0.20/kWh). Additionally, there is a significant yearly maintenance cost to replace the lamps in the F1 fixtures, mounted at 22'-0" above finished floor (AFF). When lamps burn out, the lighting quality is severely diminished until the yearly replacement occurs.

Fixture F4, located in the main corridor, is a wall-mounted 400 W indirect metal halide. This fixture is mounted at a height of 12'-0" AFF and installed directly under or across from windows (Figure 10). There are no daylighting controls on these fixtures; they remain on during all business hours. Operating costs of these six fixtures alone amount to $1,200 per year.

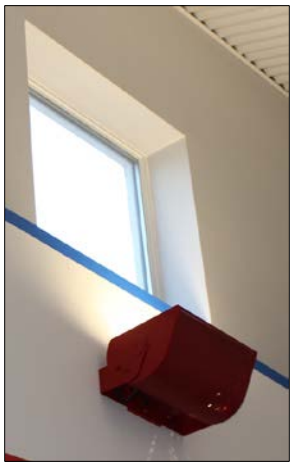


Figure 10. Main Corridor Fixture

Exterior lighting energy usage totals 14.1 MWh per year, based on 4,330 annual hours of darkness. All exterior lighting fixtures are controlled by a building-mounted photocell. Exterior fixtures using the most energy include 175 W metal halide wall-mounted F10 fixtures, 70 W metal halide F11 bollards, and 400 W metal halide pole-mounted F12 fixtures.

New Design Proposal

Cyclone Energy recommends either retrofitting each fixture with an LED alternative or replacing the entire fixture with a newer LED version, as proposed in Table 3. Recommendations were determined by assessing the cost of replacement versus the value of energy savings.

Table 3. Existing and Proposed Fixtures

Fixture Type	Existing Fixtures	New Fixtures/Lamps
F1	Lumark Low-Bay 400W Metal Halide	Litetronics High Bay 125W LED
F2	Failsafe Surface Linear 2-Lamp 32W T8	Philips InstantFit 10T8/48-4000 LED Lamp and Ballast
F3	Metalux Surface Linear 2-Lamp 32W T9	Philips InstantFit 10T8/48-4000 LED Lamp and Ballast
F4	Focal Point Indirect Wall Mount 400W Metal Halide	Eiko Litespan 100W LED Lamp
F5	Halo 7" Compact Fluorescent 32W Tripple	Green Creative 8" LED Commercial Downlight Retrofit
F6 - A	Metalux Surface Wrap 4-Lamp 32W T8	Philips InstantFit 10T8/48-4000 LED Lamp and Ballast
F6 - B	Metalux Surface Wrap 4-Lamp 32W T9	Columbia 2x4 LED Surface Troffer with EcoSystem LED Driver
F7	Metalux 2x4 Recessed Troffer 4-Lamp 32W T8	Metalux 2x4 LED Recessed Troffer
F8	Metalux 2x4 Recessed Parabolic 3-Lamp 32W T8	Philips Daybrite 2x4 Recessed Fluxgrid LED
F9	Phoenix Exterior Vaporproof 26W Tripple	Philips InstantFit 8.5PL-C/T/26H LED Lamp and Ballase
F10	Lumark Exterior Wall Mount 175W Metal Halide	Atlas 43W LED Wall Light
F11	McGraw Exterior Bollard 70W Metal Halide	Eiko Litespan 20W LED Lamp
F12	Lumark Exterior Pole Mounted 400W Metal Halide	Lumark Prevail Exterior LED Area Luminaire

The lighting analysis proves replacing the T8 lamps in all F6 fixtures with LED lamps is the most cost effective option (Figure 11); our team proposes the Philips InstantFit™ lamps. However, due to the client's preference for dimming capabilities in the Learning Center and the Teen Room, twelve (12) F6 fixtures will be replaced with Columbia LED Surface Troffers. The fixture replacements in these two rooms will be paired with a Lutron wireless dimmer switch and a wireless ceiling mount vacancy sensor. This combination of upgrades will provide an energy savings of approximately 5.2 MWh per year.

Figure 11. Rendering of F6 Fixtures in Lounge

The low-bay metal halide F1 fixtures in the gymnasium will be replaced with LED high-bay fixtures from Litetronics (Figure 12). The proposed fixture has multiple benefits: instant-on functionality, high durability, and increased light quality. This fixture has a rated life of 79,000 hours, which provides additional savings on maintenance. With this upgrade, the client will have an energy savings of approximately 10.5 MWh per year, equating to just under $2,100. See the cutsheet for this fixture in the Appendix.

Figure 12. Rendering of New Light Levels in Gym

In the main corridor, the F4 fixtures will be retrofitted using compatible 100 W LED lamps. These will be paired with a Lutron Maestro™ switched daylight sensor to shut them off automatically when daylight is sufficient. The change in lamps will reduce the energy consumption by 4.8 MWh per year, saving the Boys & Girls Club roughly $970 in energy costs.

To maximize energy savings, rooms will be equipped with Lutron Maestro™ lighting control devices. The benefits of these devices are their wireless capabilities, ease of installation, and flexibility for placement. In storage spaces and the office, the current switches will be replaced with vacancy sensor switches. Dual-technology wall switch sensors will be used in the bathrooms to increase accuracy of occupancy detection. All vacancy sensors will be set to manual-on with an adjustable interval of 10-30 minutes, based on the Club's preference. The manual-on setting is recommended because there are many situations in which people are coming in and out of rooms without the need for lights. Energy savings will be maximized if lights are only utilized when needed, rather than every time someone enters a room.

The largest energy savings for the exterior fixtures will be attained by replacing fixtures F10 and F12. The wall-mounted 175 W metal halide fixtures will be replaced with similar style 43 W LED fixtures. The pole-mounted 400 W metal halide fixtures will be replaced with 143 W LED fixtures. The other two types of exterior fixtures (F9 and F11) will have LED lamp replacements. The proposed exterior fixture replacements will result in an annual savings of approximately $2,100, which translates to a reduction in energy consumption of 10.5 MWh.

Impacts and Benefits

The proposed design provides a prioritized list of fixture upgrades in the event full funding is not available. Overall, the new recommended lighting system will result in an estimated 67% decrease in energy consumption from 1.41 W/SF to 0.47 W/SF, which is within today's ASHRAE 90.1 (2016) standard. The installation of lighting controls will further reduce energy consumption. The dimmable fixtures provide versatility, allowing the spaces to be utilized as desired.

Table 4. Lighting Energy and Cost Savings

Fixture	QTY	Existing System (kWh)	New System (kWh)	Energy Savings (kWh)	Energy Savings ($)
F1	15	14,720	4,230	10,490	2,098.00
F2	14	1,789	685	1,104	220.80
F3	4	515	279	236	47.20
F4	6	6,227	1,354	4,873	974.60
F5	11	893	472	421	84.20
F6 - A	20	5,279	2,166	3,113	622.60
F6 - B	12	3,167	1,056	2,111	422.20
F7	10	2,489	1,389	1,100	220.00
F8	2	365	187	178	35.60
F9	6	728	273	455	91.00
F10	6	5,464	1,061	4,403	880.60
F11	5	2,038	434	1,604	320.88
F12	3	5,909	1,860	4,049	809.75
	Totals	**49,583**	**15,446**	**34,137**	**6,827**

The updates to the lighting system will save the Boys & Girls Club an estimated $6,827 in energy savings per year. The total cost for the proposed lighting retrofit is $21,130. With the recommendations provided, the Club qualifies for a $3,980 lighting rebate offered by the City of Ames. With such ample energy savings, the proposed lighting retrofit will allow the Boys & Girls Club to apply more of their operating budget to programs for their members.

Lighting Fixture Schedule			
Fixture	Type	Model Number	Manufacturer
F1	HIGH BAY LED	HB125B440DL	LITETRONIC
F2	LED LAMP & BALLAST	PHIL 468280 - 2 LAMP AND BALLAST	FAILSAFE
F3	LED LAMP & BALLAST	PHIL 468280 - 2 LAMP AND BALLAST	METALUX
F4	LED LAMP	LED100WPT 40KMOG-G6 100W #09348	EIKO
F5	8" LED LENS	27CDLA8/840 #57876	GREEN CREATIVE
F6 - A	LED LAMP	PHIL 468280 - 4 LAMP	PHILIPS
F6 - B	SURFACE 2'X4'	LCAT24-35-ML-SM-U-LUTH	COLUMBIA
F7	LED TROFFER	24GR-LD4-64-F1-UNV-L840-CD1-U 6400 LUMENS 4000K	METALUX
F8	RECESSED LED 2'X4'	2FGG-H-38L-840-4-D-DIM	PHILIPS
F9	LED LAMP ONLY	458398 8.5 PHILIPS LED	HUBBELL
F10	LED WALL LIGHT	WLM43LED	ATLAS
F11	LED LAMP ONLY	LED20WPT50KMED-G6	EIKO
F12	LED POLE MOUNTED	PRV-A40-D-UNV-T3-SA-BZ-PER7	LUMARK
EM1	EMERGENCY LIGHT	CU-1-POLY 6 VOLT POLY CARB EMER-LITE	SURELITE
EX1	EXIT LIGHT LED	X-10 FAIL SAFE POLY LED	FAILSAFE
EX2	EXIT LIGHT LED	CCX-70RWH UNBIVERSAL LED EXIT	SURELITE

1 Proposed Reflected Ceiling Plan
Scale: 1" = 12'-0"

CYCLONE ENERGY

No.	Description	Date

B&GC Facility Upgrades

Boys & Girls Club of Story County
210 S 5th St, Ames, IA 50010

Proposed Reflected Ceiling Plan

Project Number	867-5309
Date	5/1/2017
Drawn By	SJP
Checked By	SCH

E.100

Scale 1" = 12'-0"

Technical Analysis 3: Solar Energy System

Facility Evaluation for PV System

Cyclone Energy evaluated the building, grounds, and roof system to identify the optimal location for a 4-5kW photovoltaic (PV) system. The client requested the system not be placed on the ground due to safety, vandalism, and flooding concerns. Therefore, Cyclone Energy analyzed three design options that would meet the client's location and efficiency needs: awning system, sun tracker system, and roof-ballasted system. Our team worked with representatives from Day & Night Solar, a NECA affiliate from Collinsville, Illinois, to analyze the different options.

Option A: Awning

Cyclone Energy first considered an awning system similar to the one shown in Figure 13. This system would be mounted on brackets located on the south gym wall existing awning structure, adjacent to the playground. However, this design would pose safety risks to members on the ground below. During the winter months, heavy snow or ice buildup could lead to a hazardous situation. Additionally, the system may be prone to damage from outdoor activities, such as basketball. Therefore, it was decided that another mounting system would be more appropriate.

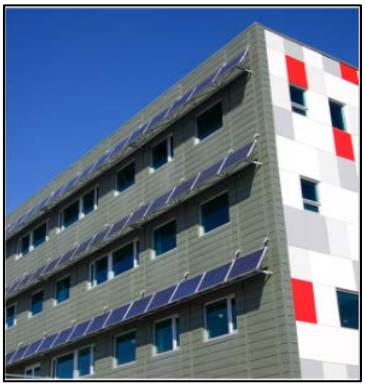


Figure 13. Example of Awning System

Figure 14. Example of Sun Tracker System

Option B: Sun Tracker

A sun tracking system (Figure 14) was also considered. This array would be mounted to the roof of the facility allowing for maximum energy production. Panels are able to follow the movement of the sun at every hour of the day. After the payback analysis was completed, it was evident that the tracking unit did not make fiscal sense when compared to a stationary array. Consequently, Cyclone Energy recommends a stationary, roof-ballasted system.

Option C: Roof-Ballasted System

The roof structure was analyzed and determined to be more than sufficient for the stationary, roof-ballasted system. Day & Night Solar proposed a 5.04 kW system consisting of fourteen (14) 360 W Seraphim panels. This system will generate over 6,600 kWh per year, which is approximately 10% of the Boys & Girls Club's electric utility usage. The panels maximize production during summer months when the Boys & Girls Club is operating at its peak.

Design Details

Shading analyses, shown in Figure 15 and Figure 16, were performed to determine the optimal location for the PV system. Installing the panels on the north end of the gym will maximize sun exposure while minimizing the distance to the electrical room. See Scaled Drawing for panel locations on page 22. The panels will utilize an EcoFoot2+ ballasted mounting system which allows for easier installation and reduces roof penetrations. Per the RFP, this system also contains two (2) Cotek SK1500-148 backup inverters and four (4) 12V 210 AH lithium batteries. Schematic 3-Line Diagram is shown on page 23. See Annual Production Report and shading analysis from Day & Night Solar in the Appendix.

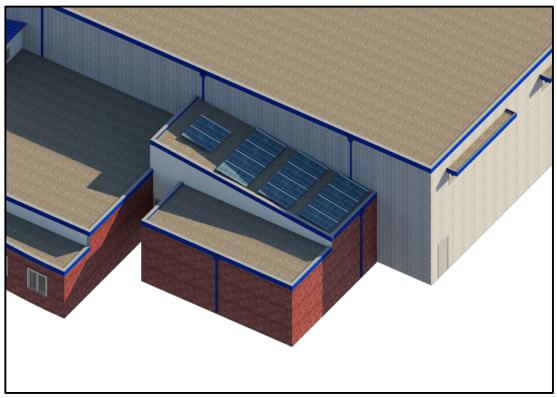


Figure 15. Shading Analysis of Alternative Roof Location

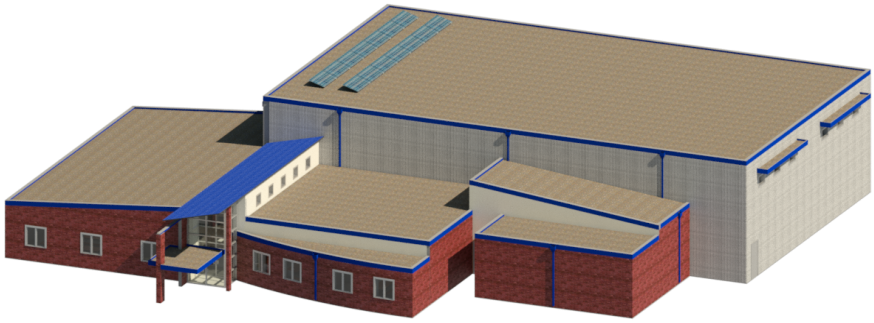


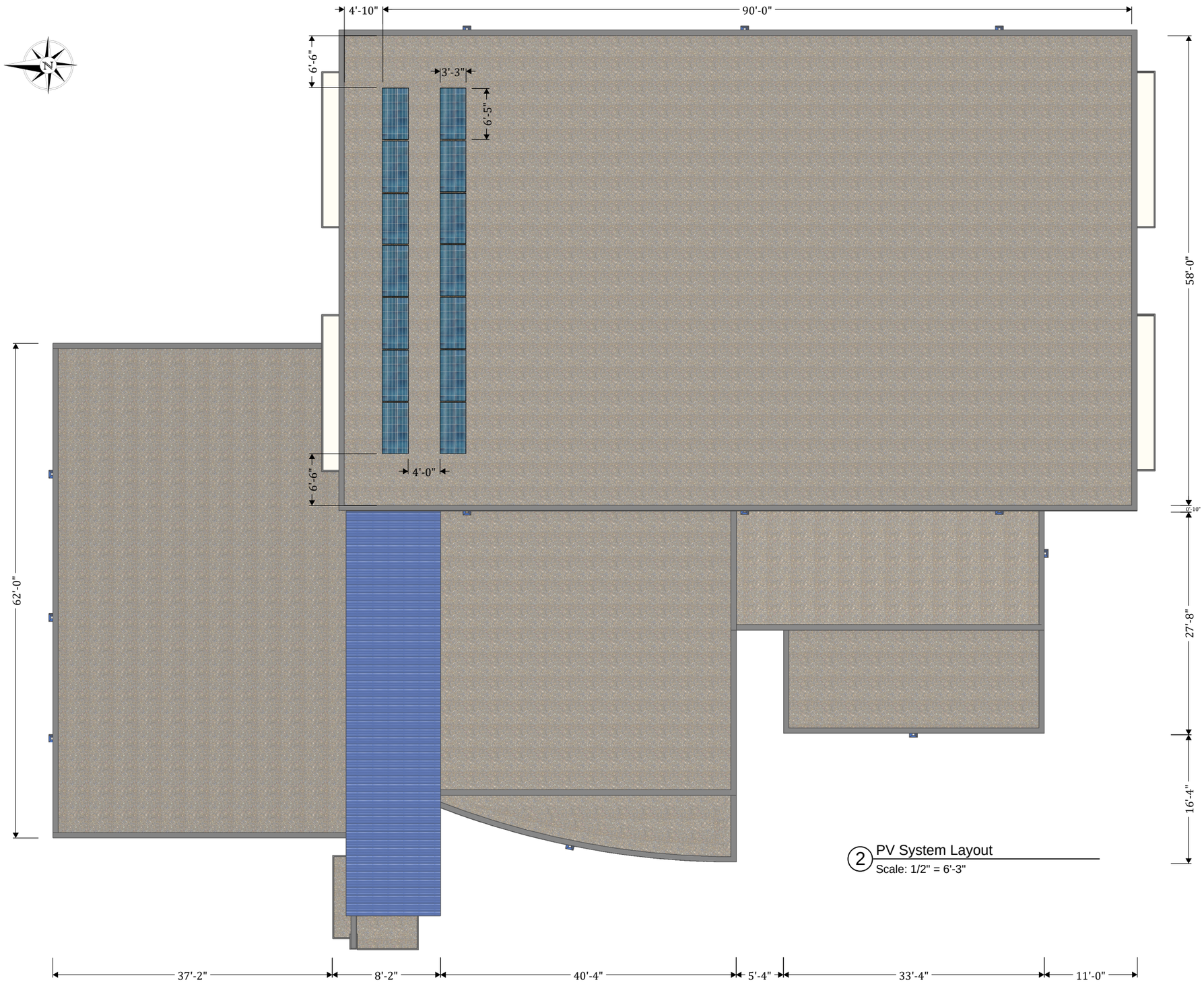
Figure 16. Shading Analysis of Selected Roof Location

Cost Estimate

Cyclone Energy is confident that this design is the best solution for the Boys & Girls Club. Our team will utilize a turn-key subcontract with Day & Night Solar at a cost of $27,670. The system requires basic periodic maintenance, which includes cleaning the panels and checking for corrosion on the battery terminals. The components are anticipated to exceed the requested 20-year lifespan. The batteries include a 10-year warranty, but are expected to last the lifetime of the system. If necessary, the replacement of all four (4) 12V 210 AH lithium batteries would cost $6,000. Day & Night Solar's proposal also includes a web monitoring system.

Key Features

The key features of the proposed system are as follows: (1) the power generated from the system will reduce the annual electric utility cost by approximately $1,320 (based on $0.20/kWh); (2) the batteries allow the facility to power critical loads, such as the security system, computer server, and refrigerator during utility outages; and (3) web monitoring that can be displayed for the children, allowing the staff to integrate energy awareness, carbon offset, and weather effects on the power production into their existing educational programs.



2 PV System Layout
Scale: 1/2" = 6'-3"

CYCLONE ENERGY

No.	Description	Date

B&GC Facility Upgrades

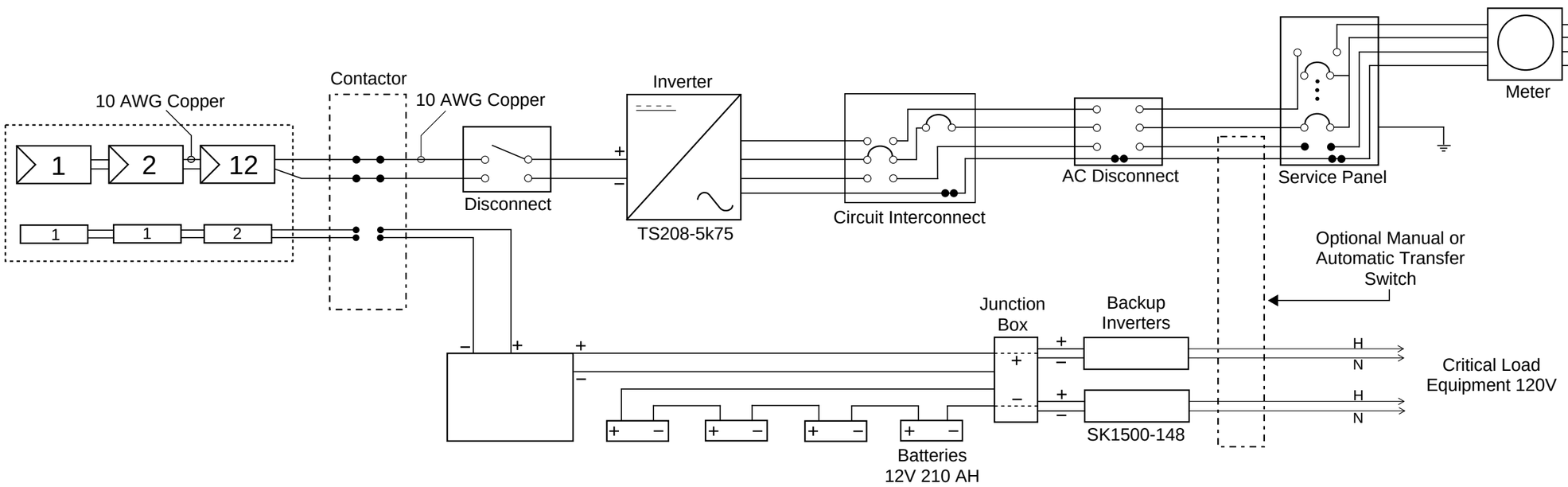
Boys & Girls Club of Story County
210 S 5th St, Ames, IA 50010

PV System Layout

Project Number	867-5309
Date	5/1/2017
Drawn By	SCH
Checked By	BLH

E.200

Scale 1/2" = 6'-3"



Module Specifications	
14 x Seraphim SRP-360-6MA	
STC Rating	360 W
Vmp	37.9 W
Imp	8.98 A
Voc	46.4 V
Isc	9.45 A

Main Inverter Specifications	
1 x HiQ TS208-5k75	
Max AC Power Rating	5.75 kW
Max Input Voltage	1.0 kV
Min AC Power Rating	0 W
Min Input Voltage	200 V

Wire Schedule		
Tier	Wire	Length
String	1 x 10 AWG	83 ft

Charge Controller Specifications	
1 x Morningstar TS-MPPT-60	
Max Batttery Current	60A
Nominal System Voltage	12, 24, 36, or 48 V DC

Back-up Inverter Specifications	
2 x Cotek SK1500-148	
AC Voltage	100/110/120 VAC
Rated Power	1500 W

Day & Night Solar

CYCLONE ENERGY

No.	Description	Date

B&GC Facility Upgrades

Boys & Girls Club of Story County
210 S 5th St, Ames, IA 50010

3-Line Diagram

Project Number	867-5309
Date	5/1/2017
Drawn By	JPP
Checked By	MAW

E.300

Scale: NO SCALE

Schematic Estimate, Schedule, and Finance Plan

Cost Estimate

Cyclone Energy developed a cost estimate for all proposed changes to the facility. This includes costs and savings associated with the HVAC system, lighting fixtures, and solar PV system. Material costs for light fixtures and the lighting controls were obtained from NECA affiliates, Van Meter, Inc. and Graybar, respectively.

Cyclone Energy will subcontract with an Iowa NECA contractor to provide labor for the lighting retrofit. Local union labor rates were obtained from Baker Electric and Commonwealth Electric to create the labor estimate. Cyclone Energy will use one crew of electricians composed of one foreman (F), a fifth-year apprentice (5th App), a first-year apprentice (1st App), and a construction wireman (CW) to install all fixtures and lighting controls. This crew composition takes advantage of the knowledge and leadership of experienced electricians to oversee the installation and development of the apprentices.

Cyclone Energy worked alongside Day & Night Solar to develop a design that will optimize efficiency. A turnkey lump sum price is included in the cost estimate for the solar PV system outlined in Technical Analysis 3: Solar Energy System (see Appendix for the full detailed quote). Day & Night Solar will partner with a local NECA contractor to install the PV system. This crew will consist of one foreman (F), one fourth-year apprentice (4th App), one second-year apprentice (2nd App), and one construction wireman (CW).

The HVAC system estimate was developed using historical cost data. One crew comprised of two journeymen (J), two sixth-year apprentices (6th App), and a crane operator will install all required components. This crew composition optimizes productivity and offers time efficient installation of the required HVAC equipment.

The costs associated with Mechanical Upgrades Option 1 and Option 2 are shown in Table 5. Cyclone Energy has elected to provide the proposed improvements at cost. Additionally, we will donate services for planning and design. Any contingency remaining at the end of the project will be donated back to the Boys & Girls Club.

Table 5. Costs of Lighting Retrofit & HVAC Options

Description	Rate	Option 1	Option 2
Lighting & Controls	-	$ 21,130.39	$ 21,130.39
Solar	-	$ 27,670.00	$ 27,670.00
HVAC	-	$ 97,400.25	$ 41,044.35
Overhead	10%	$ 14,620.06	$ 8,984.47
General Conditons	3%	$ 4,109.32	$ 2,418.64
Contingency	1.5%	$ 2,254.65	$ 1,383.95
Profit	0%	$ -	$ -
Design Fee	0%	$ -	$ -
Total	**14.5%**	**$ 167,184.44**	**$ 102,631.81**

Although the initial cost is higher, Cyclone Energy recommends Option 1 because it will provide a more comfortable learning environment for the occupants. For more details, refer to estimate in the Appendix.

Schedule

Cyclone Energy produced a schedule for the proposed upgrades (see CPM schedule on page 26). The overall schedule will take 145 work days from design to final completion. Design will start on October 10th, 2017; construction will begin on March 19th, 2018. Considerations were made to allow for the Boys & Girls Club to continue regular operation during construction.

The proposed schedule allows for construction activities to take place when students are not at the Club. Construction will be performed from 6:00 AM to 2:30 PM, allowing the staff adequate time to prepare for the arrival of all the students at 3:30 PM. All work will be completed throughout March and April. During these months, the weather is mild with low relative humidity, ensuring occupant comfort while the HVAC system is under construction.

The critical path activities are:

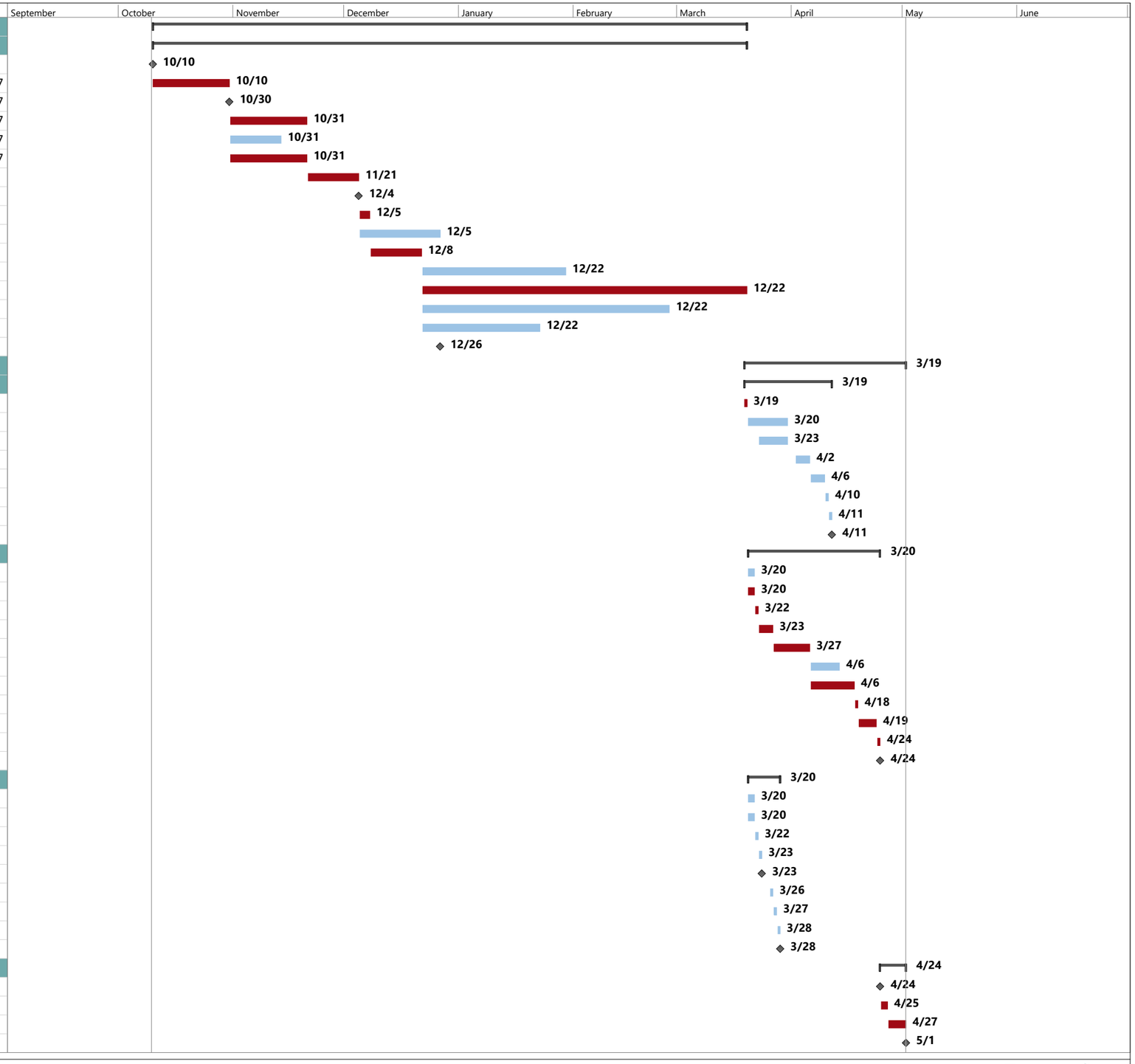
- Mechanical Design
- Lighting Design
- Design Approval
- Submittals
- Procurement of Mechanical Equipment
- Install VRF Condensers
- Install DOAS Units
- Install Zoning Boxes
- Install Terminal Air Units
- HVAC Piping
- HVAC Controls
- Testing and Balancing
- Punch List
- Commissioning

The schedule allows crews for the three major phases of construction (Lighting Retrofit, Mechanical Upgrades, and Photovoltaic System) to work simultaneously. To connect the newly constructed PV array to the building's electrical system, a planned power shutdown will take place the morning of Friday, March 23rd, 2018. The building will be operational before the students arrive after school. By planning the shutdown early, Cyclone Energy will be able to avoid any potential conflicts with other construction activities and Club staff duties. Once the PV array is connected, testing of the system will begin. The solar portion of work will take a total of nine work days, and be completed on March 28th, 2018.

Our plan allots two days for final inspection and project closeout. Final Acceptance & Project Completion will occur on May 1st, 2018. Beginning June 1st, 2018, the Boys & Girls Club will operate under their summer hours, 8:00 AM to 5:30 PM.

As mentioned in the estimate section, this schedule was generated using an electrical crew composition of one foreman (F), one fifth-year apprentice (5th App), one first-year apprentice (1st App), and one construction wireman (CW) for the installation of lighting and controls. Also, there will be a mechanical crew of two journeymen and two apprentices. A third crew provided by Day & Night Solar will be composed of one foreman (F), one fourth-year apprentice (4th App), one second-year apprentice (2nd App), and one construction wireman (CW).

ID	Task ID	Task Name	Duration	Start	Finish
1		**PRECONSTRUCTION**	**113 days**	**Tue 10/10/17**	**Mon 3/19/18**
2		**Design, Submittals & Procurement**	**113 days**	**Tue 10/10/17**	**Mon 3/19/18**
3	PR-0100	Project Initiation	0 days	Tue 10/10/17	Tue 10/10/17
4	PR-0110	Project Approval - B&GC	15 days	Tue 10/10/17	Mon 10/30/17
5	PR-0120	Start Design	0 days	Mon 10/30/17	Mon 10/30/17
6	PR-0130	Lighting Design	15 days	Tue 10/31/17	Mon 11/20/17
7	PR-0140	Solar Design	10 days	Tue 10/31/17	Mon 11/13/17
8	PR-0150	Mechanical Design	15 days	Tue 10/31/17	Mon 11/20/17
9	PR-0160	Design Approval - B&GC	10 days	Tue 11/21/17	Mon 12/4/17
10	PR-0170	Design Approved	0 days	Mon 12/4/17	Mon 12/4/17
11	PR-0180	Submittal Review and Submission - CE	3 days	Tue 12/5/17	Thu 12/7/17
12	PR-0190	Permit Procurement - CoA	15 days	Tue 12/5/17	Tue 12/26/17
13	PR-0200	Submittal Review & Approval - B&GC	10 days	Fri 12/8/17	Thu 12/21/17
14	PR-0210	Lighting Procurement	25 days	Fri 12/22/17	Mon 1/29/18
15	PR-0220	Mechanical Equipment Procurement	60 days	Fri 12/22/17	Mon 3/19/18
16	PR-0230	Solar Procurement	45 days	Fri 12/22/17	Mon 2/26/18
17	PR-0240	Controls Procurement	20 days	Fri 12/22/17	Mon 1/22/18
18	PR-0250	Notice to Proceed - Construction	0 days	Tue 12/26/17	Tue 12/26/17
19		**Construction**	**32 days**	**Mon 3/19/18**	**Tue 5/1/18**
20		**Lighting Retrofit**	**18 days**	**Mon 3/19/18**	**Wed 4/11/18**
21	LR-100	Mobilization	1 day	Mon 3/19/18	Mon 3/19/18
22	LR-110	Light Fixture Demolition	9 days	Tue 3/20/18	Fri 3/30/18
23	LR-120	Lighting Fixture Upgrades	6 days	Fri 3/23/18	Fri 3/30/18
24	LR-130	Lighting Controls Install	4 days	Mon 4/2/18	Thu 4/5/18
25	LR-140	Lighting System Testing	2 days	Fri 4/6/18	Mon 4/9/18
26	LR-150	Final Interior Cleaning	1 day	Tue 4/10/18	Tue 4/10/18
27	LR-160	Lighting Punchlist	1 day	Wed 4/11/18	Wed 4/11/18
28	LR-170	Lighting Retrofit Completion	0 days	Wed 4/11/18	Wed 4/11/18
29		**Mechanical Upgrades**	**26 days**	**Tue 3/20/18**	**Tue 4/24/18**
30	MU-110	HVAC Demo Existing	2 days	Tue 3/20/18	Wed 3/21/18
31	MU-120	Install VRF Condenser	2 days	Tue 3/20/18	Wed 3/21/18
32	MU-130	Install DOAS Unit	1 day	Thu 3/22/18	Thu 3/22/18
33	MU-140	Install Zoning Kits	2 days	Fri 3/23/18	Mon 3/26/18
34	MU-150	Install Indoor Terminal Units	8 days	Tue 3/27/18	Thu 4/5/18
35	MU-160	Install Duct Work	6 days	Fri 4/6/18	Fri 4/13/18
36	MU-170	Install Piping	8 days	Fri 4/6/18	Tue 4/17/18
37	MU-180	Install Controls	1 day	Wed 4/18/18	Wed 4/18/18
38	MU-190	Testing and Balancing	3 days	Thu 4/19/18	Mon 4/23/18
39	MU-200	Energy Punchlist	1 day	Tue 4/24/18	Tue 4/24/18
40	MU-210	Energy Upgrades Completion	0 days	Tue 4/24/18	Tue 4/24/18
41		**Photovoltaic System**	**7 days**	**Tue 3/20/18**	**Wed 3/28/18**
42	PV-110	PV Structure	2 days	Tue 3/20/18	Wed 3/21/18
43	PV-120	Install Conduit/Wire	2 days	Tue 3/20/18	Wed 3/21/18
44	PV-130	Install PV Panels & Inverters	1 day	Thu 3/22/18	Thu 3/22/18
45	PV-140	Terminate PV Panels	1 day	Fri 3/23/18	Fri 3/23/18
46	PV-150	Planned Shutdown for PV System	0 days	Fri 3/23/18	Fri 3/23/18
47	PV-160	Connect to Building Electrical System	1 day	Mon 3/26/18	Mon 3/26/18
48	PV-170	PV Testing	1 day	Tue 3/27/18	Tue 3/27/18
49	PV-180	PV Punchlist	1 day	Wed 3/28/18	Wed 3/28/18
50	PV-190	PV Completion	0 days	Wed 3/28/18	Wed 3/28/18
51		**Project Closeout**	**5 days**	**Tue 4/24/18**	**Tue 5/1/18**
52	PC-100	Project Substantial Completion	0 days	Tue 4/24/18	Tue 4/24/18
53	PC-110	Final Inspections	2 days	Wed 4/25/18	Thu 4/26/18
54	PC-120	Project Closeout	3 days	Fri 4/27/18	Tue 5/1/18
55	PC-130	Final Acceptance & Project Completion	0 days	Tue 5/1/18	Tue 5/1/18



Project: B&GC Facility Upgrades
Subject: Energy Upgrades
Date: Sun 4/30/17

CoA - City of Ames
CE - Cyclone Energy
B&GC - Boys & Girls Club

Task | Milestone | Summary | Critical

CYCLONE ENERGY

Finance Plan

Cyclone Energy researched different loans that the Boys & Girls Club could use to fund the project. Three financing options were considered: Nonprofits Assistance Fund, NECA Energy Conservation and Performance Platform (E-CAP™), and the Iowa Energy Bank Revolving Loan Program. Our team confirmed with Erika Peterson, the Chief Executive Officer, that funds could be acquired through a Capital Improvements Fundraising Campaign to help pay for a portion of the project.

Nonprofits Assistance Fund

The Nonprofits Assistance Fund (NAF) grants loans to nonprofit organizations aiding in expansion and program growth. These loans can also help provide funding for equipment. The NAF offers four different loan types: Working Capital, Lines of Credit, Short-Term Facility Projects, and Long-Term Facility Mortgage. This project qualifies for the Short-Term Facility Project loan, ranging from $50,000 to $1.5 million. These funds can be used for building improvements, repairs, and equipment purchases. Cyclone Energy contacted a loan officer at NAF to investigate the financing terms. A 5-7% annual interest rate was estimated based on the project cost. Relative to other financing options, the interest rate was undesirable; this loan was then removed from our consideration.

NECA E-CAP™

The NECA E-CAP™ screening tool can be used to apply directly for conventional performance-based financing, and generates a finance plan based on the estimated project savings. The plan uses the project savings to determine the monthly cash flow necessary to offset project costs. Due to the short payback period and the high net payments required, Cyclone Energy decided not to use this financing plan. See Appendix for detailed NECA E-CAP™ finance options.

Iowa Energy Bank Revolving Loan Program

The Iowa Energy Bank Revolving Loan Program, sponsored by the Iowa Department of Administrative Services, offers financial support to Iowa's public sector and nonprofit organizations. Eligibility for this loan requires proof that the improvements will save money in energy costs, improve building energy performance, and/or enhance local economies. This loan will cover any remaining project costs.

Conditions for this loan include a 15-year payback period, a 1% annual interest rate, a 2% fee on closing costs, and a 0.25% annual servicing fee. Cyclone Energy anticipated that the Boys & Girls Club will select this loan and created a cash flow diagram based on its terms.

Cash Flow Diagram

A cash flow diagram was developed to determine the payback period of the proposed improvements. The diagram reflects the terms of the Iowa Energy Bank Revolving Loan Program; costs and savings from the HVAC and lighting fixture upgrades; and the addition of the PV system. The Boys & Girls Club expects to raise $75,000 from the Capital Improvement Fundraising Campaign to offset the upfront costs of the total project, thereby reducing the required loan amount to $89,256.

All calculations were based on an electricity rate of $0.20/kWh. According to staff members, the building's average hours of operation are 11 hours per day during the school year and 9 hours per day during the summer. In addition to the energy savings and the fundraising campaign, the Boys & Girls Club will utilize rebate services provided by the City of Ames. A total of $3,988 will be earned for the lighting upgrade and an additional $691 will be received through a PV system rebate.

The accumulated cash flow for the loan diagram (Figure 17) uses the loan amount of $89,256. If the Boys & Girls Club chooses to use the entire estimated energy savings ($710/month), the loan will be paid off in 2031 (Y13). Based on a 20-year analysis, $46,523 will be saved by 2038 (Y20).

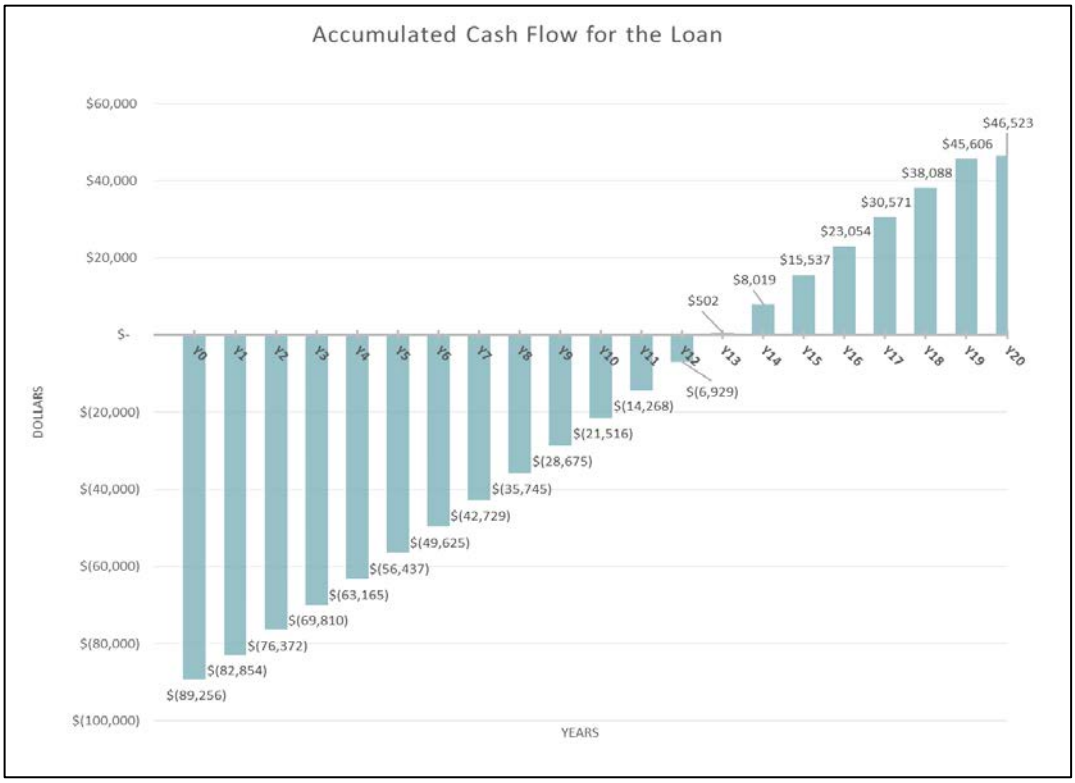


Figure 17. Accumulated Cash Flow for Loan

Energy Awareness and Community Outreach

Existing Programs

The Boys & Girls Club has worked diligently to provide programs that motivate young people to become outstanding citizens. Various activities were developed by the organization to enhance learning skills, induce good citizenship, and promote healthy life choices. For the past three months, Cyclone Energy has been actively involved in existing programs. With over 100 volunteer hours, the team assisted the staff with tasks such as tutoring, preparing/serving dinner (Figure 18), and supervising recreational activities.

Figure 18. Cyclone Energy Cooking Dinner for Club Members

Additionally, Cyclone Energy organized two landscaping events to help the Boys & Girls Club improve their facility. For the first event, the team picked up litter, cleaned sidewalks and parking lots, as well as raked and reseeded the lawn (Figure 19).

Figure 19. Landscaping Event at the Boys & Girls Club Facility

The second event is scheduled to take place on May 5th, 2017, and will focus on replacing infiltration basins for the building's rainwater runoff (Figure 20). For this event, Cyclone Energy will involve other construction engineering students.

The Iowa State University NECA Student Chapter will also work with other construction engineering clubs and the local Lowe's Home Improvement® to build a new storage shed for the Boys & Girls Club in the summer of 2017.

To spread the word about volunteer opportunities with the Club, Cyclone Energy presented to the Cornerstone Learning Community, which is comprised of 100 first-year students in construction engineering. Students were encouraged to become members of the NECA Student Chapter, as well as participate in current and future volunteer events designed by the team.

Figure 20. Infiltration Basin

Innovation in Program Design

After brainstorming innovative ways to contribute to the Boys & Girls Club, Cyclone Energy drafted two different programs to be used as learning opportunities for club members. A Science Day and a Career Night were developed to complement the educational goals of the Club.

Science Day

Inspired by the Boys & Girls Club's mission to provide a rich learning experience for their members, Cyclone Energy organized a Science Day that focused on renewable energy. To fully engage the kids, Cyclone Energy chose to demonstrate alternative energy principles through hands-on activities: operation of a hydraulic catapult, experiments with wind and hydropower turbines, and an explanation of the technology behind solar-powered lamps.

Figure 21. Cyclone Energy and Members at Science Day

The hydraulic catapult will teach kids to work with each other while using water's mechanical energy to do work. The wind and hydropower turbines exhibit power generation in a simple and understandable way. Finally, kids will learn how electrical energy is generated using panels from solar landscaping lights. All stations will include informative posters on the different types of alternative energy. Kid-friendly terms and pictures will be used to increase the effectiveness of this project (Figure 21).

Career Night

Cyclone Energy will coordinate a Career Night to teach the students about pursuing careers in the electrical construction industry, with the goal of preparing the middle and high school members for post-graduation. This will build on the existing Boys & Girls Club's "priority outcome" of academic success.

Testing the Plan and Feedback

Cyclone Energy built a hydraulic catapult that could be operated to launch objects into a bucket. Using water-filled syringes and tubes, the catapult could be positioned, loaded, and fired. With this activity, children can see how to harness the power of water for something useful or fun. In addition, a hydro-powered turbine experiment reinforces the idea of using moving water as a green energy source. When water is poured over the turbine, the shaft spins and lifts a weight. This demonstrates how an actual water turbine does work to produce energy.

To prepare for the Boys & Girls Club Career Night, Cyclone Energy developed a program based on the information provided by Michael Price of Commonwealth Electric. A presentation and two activities will be used for this event. We intend to inspire the pursuit of career opportunities available in the electrical construction industry. This program will also emphasize the current demand for electricians and other trades.

The Boys & Girls Club staff were excited about the proposed events. They looked forward to collaborating with Cyclone Energy on the introduction of these additions to their targeted programs. Dates were selected for both events; Science Day and Career Night will be held on April 19th and April 27th, respectively.

Implementation of Plan

Science Day

For this event, Cyclone Energy guided the children through each station. The team assessed the children's understanding of the specific green energy topic. After a short introduction, the interactive demonstrations began.

The first station introduced two different topics: circuits and wind energy. Cyclone Energy members first explained to the children how circuits work, and allowed them to use a circuit board to power small LEDs. A wind turbine, made of recycled materials, was then presented to the students to simulate an aero-generated power plant. Many of the kids had seen wind turbines before, but were not completely sure how they worked. The children utilized wind power to lift a small weight and visualize the rotation of the turbine blades (Figure 22).

Figure 22. Cyclone Energy Teaching Club Members about Circuits and Wind Energy

Figure 23. Testing the Hydraulic Catapult

At the next station, the kids operated a hydraulic catapult as well as poured water on the hydro-powered turbine. The idea of a hydraulically controlled device was relatively new to some, but all were enthusiastic to see the catapult in action. Kids were asked to effectively use the hydraulic syringes to successfully launch an object into a bucket (Figure 23). The activity involving the water turbine was similar to the previously demonstrated wind turbine. For this experiment, each child was able to take water and pour it over the turbine blades to observe how the amount of energy produced changed with the varying flow of water.

The last station showcased solar power. Here, Cyclone Energy discussed how the sun's rays can be harvested to produce electricity. The team used two solar powered lamps to highlight the conversion from solar energy to light. One of the lamps was used to teach the kids how solar panels work, while another was hidden inside a container, so the kids could look inside and see the performance of each lamp.

Career Night

Prior to beginning Career Night, Cyclone Energy donated and served a taco dinner for over 80 club members and staff. The team then moved to the Teen Room to begin an evening of exciting activities.

Figure 24. Career Presentation to the Teens

Sara Peterson began with a presentation focused on college, trade school, and employment opportunities in the electrical construction industry (Figure 24). There was a lively discussion about career aspirations with club members.

Tristen Girolamo demonstrated how power is distributed from the panel to outlets and fixtures (Figure 25). Finally, club members had the opportunity to wire a circuit board using resistors and batteries to power an LED (Figure 26).

Figure 25. Demonstrating a Panelboard

Figure 26. Circuit Board Team Activity

The event concluded with providing the teens with gift bags filled with promotional materials for Iowa NECA, Baker Electric, and Commonwealth Electric. These items included industry brochures, pens, pencils, sticky notes, engineering paper pads, frisbees, LED flashlights, tape measures, and flash drives.

Our team received positive feedback from many students and staff members about the event. The presentation and activities sparked interest in these young minds to pursue a career in the industry and promote future involvement in NECA.

During our time with the Boys & Girls Club, we have been lucky to witness the happiness and excitement that the children have when they get to the club each day. The Green Energy Challenge has given our group an amazing opportunity to build what we hope will be a long-standing relationship with the Boys & Girls Club and has inspired us to find ways that can continue to participate and help. With the large variety of needs that the club has, our goal is to coordinate community service activities where we can encourage our fellow students at Iowa State to join us.

BOYS & GIRLS CLUB
OF STORY COUNTY
210 South Fifth Street | Ames, Iowa 50010 | 515.233.1872 | www.bgcstorycounty.org | theclub@bgcstorycounty.org

April 21, 2017

Green Energy Challenge Team
Civil, Construction, and Environmental Engineering
813 Bissell Road, Ames, IA 50010

RE: Boys & Girls Club of Story County – Green Energy Assessment

Dear Green Energy Challenge Team:
On behalf of the Boys & Girls Club of Story County staff and board of directors, thank you for the NECA submission regarding the Boys and Girls Club's facility in Ames. The existing building study, the analysis of energy use and lighting, as well as your proposals for improvements to the building, demonstrates a genuine understanding of the overall operation of the building. The proposal provides thorough assessment of the facility, including the impact of recent upgrades, and takes into account the potential impact it has on the youth we serve, our mission, and the Ames community at large.

The lighting retrofit, the installation of a photovoltaic energy system, and the integration of those systems with student learning are all practical for the needs and operation of the Boys & Girls Club Ames clubhouse. The fact that the team has take into consideration the Club's budget, and the neet to work around the schedule of youth development programming, demonstrates your dedication to creating a proposal tailored to our needs. The outreach efforts to provide landscaping service to the club and to provide STEM and career learning opportunities for the youth we serve, also demonstrates your dedication to your field and this project.

We look forward to supporting your team in the Green Energy Challenge and implementing these potential upgrades as the opportunities arise.

Sincerely,

Erika Peterson
Chief Executive Officer

Cyclone Energy gears up for a four-peat

April 20, 2017 Kate Tindall

With new rules and challenges, Iowa State University: National Electrical Contractors Association Student Chapter prepares for competition

It's 2017 and Cyclone Energy is back in action! After taking home a three-peat in the NECA and ELECTRI International Green Energy Challenge (GEC) last year, the Iowa State Green Energy Challenge (ISU GEC) Team is shooting for their fourth consecutive win.

For Cyclone Energy captain Dylan Busby, a senior in construction engineering, this is the third proposal on which he has worked for ISU GEC. He says the group is ready for the hard work, but understands that the stakes are higher.

"The team is facing new challenges this year as the outreach portion of the proposal is bigger than ever before," Busby said.

Members of ISU GEC gather around the Boys and Girls Club of Story County sign (Courtesy Beth Hartmann)

This will be the ninth time the team has competed. For this year's challenge, teams are required to develop an energy audit and analysis to design upgrades for a local community service facility. The client for ISU GEC's proposal is the Boys and Girls Club of Story County. The Boys and Girls Club is a non-profit organization. Its goals are to create a safe environment in which both children and young adults can grow. It also functions to help children succeed academically and develop healthy lifestyles.

As history has shown, being part of this team is a great opportunity for students to enhance their skills in communication and team building, as well as to develop an interest in the electrical construction industry. With new team members and new rules and regulations, the student organization has been working hard to provide the best outcome possible to its client's needs. Members have also been actively involved in volunteering at the Boys and Girls Club and plan to continuing volunteering as opportunities arise.

Members of this year's team are pictured in front of the Boys and Girls Club of Story County sign (above, right). As shown in the photo: (from left) Conor O'Brien (construction engineering, electrical emphasis), Jonathan Hoehne (construction engineering, electrical emphasis), Julie Penton (construction engineering, building emphasis), Shay Hudachek (construction engineering, building emphasis), Heli Nascimento (civil engineering, general emphasis), Dylan Busby (construction engineering, electrical emphasis), Tristen Girolamo (construction engineering, electrical emphasis), Sara Peterson (construction engineering, electrical emphasis). Not pictured: Marcelious Wyatt (construction engineering, mechanical emphasis). This will mark the seventh and fifth year (respectively) that Dr. Beth Hartmann and Jenny Baker, senior lecturers at ISU's Department of Civil, Construction and Environmental Engineering (ISU CCEE), have coached Cyclone Energy.

**Article written by Heli Nascimento and edited by Kate Tindall*

Find out about more exciting opportunities by visiting ISU CCEE on Facebook, Twitter and LinkedIn (Iowa State University Civil, Construction and Environmental Engineering and ISUConE). Or check us out on our website, www.ccee.iastate.edu.

Local NECA Chapter Interaction

Without hesitation, the local **Iowa NECA Chapter** extended endless support to Cyclone Energy in our quest to generate a sustainable proposal for the Boys & Girls Club of Story County.

Baker Electric assisted Cyclone Energy with the lighting retrofit analysis (Figure 27). They helped determine whether to provide a lighting retrofit or lamp replacement throughout the facility.

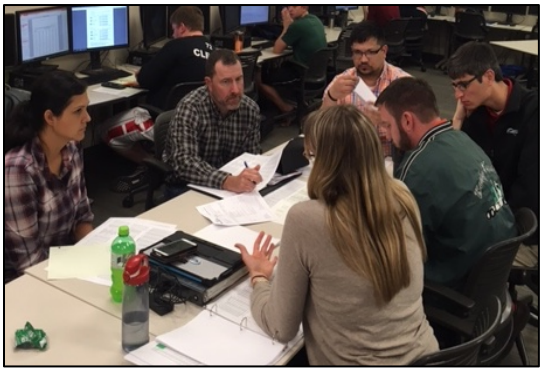


Figure 27. Chad Layland and Lucas Baxter, Baker Electric, Advising Cyclone Energy

For the energy analysis, Cyclone Energy consulted with **Baker Group**. They were able to offer aid in both electrical and mechanical divisions.

Commonwealth Electric provided input regarding wide-range lighting control technologies to help support each space within the building. In addition, they extended knowledge that was passed on to the students for Career Night.

Figure 28. Robert Dandurand, Metro Electric, Assisting Cyclone Energy

Metro Electric met with our team to discuss the proposal. They reviewed the draft document and provided feedback to strengthen each section.

Additionally, representatives from **Nelson Electric**, **Thompson Electric**, and **The Waldinger Corporation** assisted with providing feedback of the overall proposal. Technical revisions were also recommended.

Acknowledgements

- Commonwealth Electric Company of the Midwest, Des Moines, IA:
  - Nate Findlay, Project Manager
  - Michael Price, Senior Vice President
- Cyclone Energy (Former Team Members):
  - Lucas Baxter, Project Manager/Electrical Designer, Baker Electric, Des Moines, IA
  - Caleb Bonderer, Electrical Engineer, M.A. Mortenson, Minneapolis, MN
  - Joe Hahn, Project Engineer, Shive-Hattery, Des Moines, IA
  - Maggie Holt, ME Engineer, JE Dunn Construction, Kansas City, MO
  - Joe Kern, Mechanical Engineer, Baker Group, Des Moines, IA
  - Scott Miller, Project Engineer, The Waldinger Corporation, Des Moines, IA
- Robert Dandurand, Vice President, Metro Electric, Sioux City, IA
- Day & Night Solar, Collinsville, IL:
  - Randy Davis, Project Manager
  - Bob Eaton, Managing Partner
  - Melinda Kershaw, Director of Marketing
- Iowa Chapter NECA, Des Moines, IA:
  - Angela Bowersox, Executive Director
  - Brent Edwards, Assistant Director
- Iowa State University, Ames, IA:
  - Jenny Baker, NECA Faculty Advisor & Senior Lecturer, Construction Engineering
  - Beth Hartmann, NECA Faculty Advisor & Senior Lecturer, Construction Engineering
  - Bradley Perkins, Senior Lecturer, Construction Engineering
  - Kate Tindall, Communications Specialist II, Engineering College Relations
  - Kyle Younkin, Undergraduate Student, Construction Engineering
  - Steven Younkin, Graduate Student, Civil Engineering
- Chad Layland, Vice President, Baker Electric, Des Moines, IA
- TJ Meiners, Vice President of Engineering, Nelson Electric, Cedar Rapids, IA
- NECA E-CAP™:
  - Mir Mustafa, Executive Director, Business Development, NECA
  - Ramsay Stevens, Founder, E-Capital Development
- Jason Odefey, Lighting Sales Representative, JTH Lighting, Des Moines, IA
- Barney Pottebaum, Vice President/General Manager, Thompson Electric Company, Sioux City, IA
- Van Meter, Inc., Urbandale, IA:
  - Aaron Bodenstedt, Lighting Special Projects
  - Dave Hannam, Accounts Manager
  - Dave Papich, Lighting Special Projects

Appendix

ENLIGHTENING

NEWS AND INFORMATION

MADE IN USA AVAILABLE

LED *High Bay*

High Ceiling

Designed Specifically for Quick and Easy Installation.

The Litetronics waterproof LED High Bay makes it easy to improve your lighting in high ceiling environments. Made in the USA available and DLC approved, our standard glass lens product is IP 65 rated and can be used indoors or out for direct and indirect lighting. 5.2" tall, under 16" wide and only 16-18 lbs, it is an easy install compared to most high bays offering up to 29,000 lumens.

Popular Options Include:

- White color
- Shatterproof polycarbonate lens material with an impact rating of over 45 foot-pounds.
- Polyester powder coat designed for cosmetic consistency and strength against highly corrosive materials

Benefits

- 118-120 lumens/watt
- Uniform circular light distribution
- Waterproof IP 65 with glass lens
- Light weight and compact
- Optional PIR sensor for prox sensoring
- 7-year warranty*
- Optional polycarbonate shatterproof lens
- 0-10V low voltage dimming
- Higher Center Beam Candle Power
- Polycarbonate lens with NSF approvals
- DLC approved
- Made in USA available

Markets & Applications

- Retail
- Warehouse
- Industrial
- Gyms
- Transit Facilities

LITETRONICS®

6969 W. 73rd Street
Bedford Park, IL 60638
www.Litetronics.com

5kW roof Iowa State Boys and Girls club, 210 S 5th St Ames IA

Report

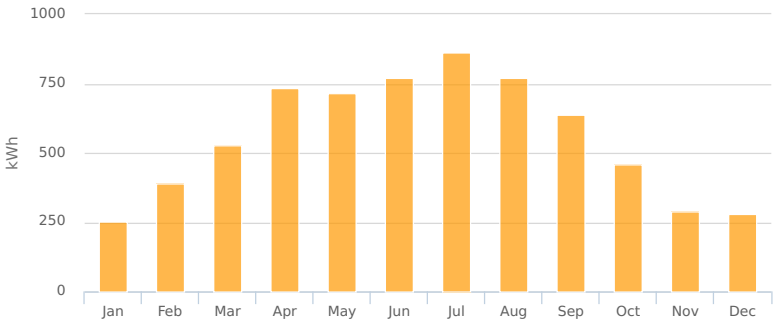
Project Name	Iowa State Boys and Girls club
Project Address	210 S 5th St Ames IA
Prepared By	Engineering Estimating systemdesign@dayandnightsolar.com

System Metrics

Design	5kW roof
Module DC Nameplate	5.04 kW
Inverter AC Nameplate	5.75 kW Load Ratio: 0.88
Annual Production	6.691 MWh
Performance Ratio	82.0%
kWh/kWp	1,327.6
Weather Dataset	TMY, 10km grid (42.05,-93.65), NREL (prospector)
Simulator Version	2dd81a975d-b599770d89-bc40b7c3f5-a296204074

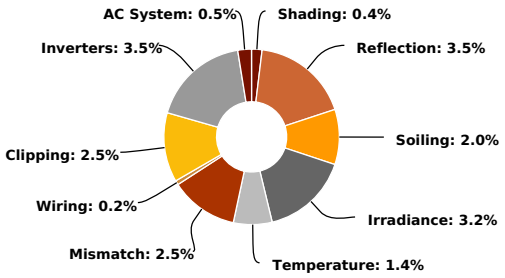
Project Location

Monthly Production



Month	GHI (kWh/m²)	POA (kWh/m²)	Shaded (kWh/m²)	Nameplate (kWh)	Grid (kWh)
January	51.6	62.4	61.8	289.7	253.1
February	78.6	94.1	93.7	441.8	391.4
March	113.4	125.9	125.6	597.4	529.3
April	163.7	174.5	174.0	833.4	734.7
May	168.3	172.7	172.1	823.7	716.1
June	184.1	186.8	186.2	893.6	772.6
July	205.5	210.1	209.5	1,005.6	863.1
August	179.7	189.0	188.4	904.0	769.9
September	140.0	153.5	153.1	731.8	636.7
October	95.8	110.5	110.2	522.7	457.8
November	58.0	70.6	70.3	330.3	288.3
December	53.1	68.9	68.1	317.7	277.8

Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,491.9	
	POA Irradiance	1,619.0	8.5%
	Shaded Irradiance	1,612.9	-0.4%
	Irradiance after Reflection	1,555.7	-3.5%
	Irradiance after Soiling	1,524.6	-2.0%
	Total Collector Irradiance	**1,524.6**	**0.0%**
Energy (kWh)	Nameplate	7,691.6	
	Output at Irradiance Levels	7,447.7	-3.2%
	Output at Cell Temperature Derate	7,343.2	-1.4%
	Output After Mismatch	7,162.5	-2.5%
	Optimal DC Output	7,151.6	-0.2%
	Constrained DC Output	6,971.6	-2.5%
	Inverter Output	6,724.6	-3.5%
	Energy to Grid	**6,691.0**	**-0.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		12.7 °C
	Avg. Operating Cell Temp		19.8 °C
Simulation Metrics			
	Operating Hours		4672
	Solved Hours		4672

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, 10km grid (42.05,-93.65), NREL (prospector)											
Solar Angle Location	Meteo Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Sandia Model											
Temperature Model Parameters	Rack Type	a	b	Temperature Delta								
	Fixed Tilt	-3.56	-0.075	3°C								
	Flush Mount	-2.81	-0.0455	0°C								
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	2	2	2	2	2	2	2	2	2	2	2	2
Irradiation Variance	5%											
Cell Temperature Spread	4° C											
Module Binning Range	-2.5% to 2.5%											
AC System Derate	0.50%											
Module Characterizations	Module	Characterization										
	SRP-360-6MA (Seraphim)	Default Characterization, PAN										
Component Characterizations	Device	Characterization										
	TS208-5k75 (HiQ)	Spec Sheet Efficiency										

Components

Component	Name	Count
Inverters	TS208-5k75 (HiQ)	1 (5.75 kW)
Combiners	1 input Combiner	2
Modules	Seraphim, SRP-360-6MA (360W)	14 (5.04 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	9-14	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Horizontal (Landscape)	10°	180°	2.0 ft	1x1	14	14	5.04 kW

Detailed Layout

Day & Night Solar

1605 Eastport Plaza Drive, Suite 135
Collinsville, IL 62234
P: (618) 344-4001 FAX: (618) 344-4085

Date: April 19, 2017

Prepared for:

Iowa State University
2229 Lincoln Way
Ames, IA 50014

Proposal

This proposal is provided for official quotation purposes for Boys & Girls Club located at 210 S 5th Street, Ames, IA 50010. It also includes shipping costs to customer designation and includes taxes applicable to the project city and state. All orders are insured for 100% of the value of the order to the job site at no additional cost to the Customer.

Our proposal includes the necessary items below on the above referenced project for the sum of twenty-seven thousand six hundred seventy dollars and ninety–three cents ($27,670.93).

Our proposal includes both materials and installation of items listed below to provide a 5.04kW system. Attached systems overview may differ slightly due to software rounding:

1. Fourteen (14) 360-watt panels
2. Inverters
3. Disconnects and required signage per local code
4. Ballast mount system
5. Four (4) Lithium Batteries
6. Two (2) AC 1500 Pure Sine Wave Inverter
7. One (1) Charge controller
8. Web monitoring
9. All conduits, wire and their associated supports, terminations and testing
   (Proposal is based on an EMT, IMC or FMC Conduit installation.)
10. Grounding
11. Shipping
12. Permits and inspections and trash removal
13. All work per applicable codes and the authority having jurisdiction
14. Proposal based on 2011 NEC code requirements

Our quote above excludes the following:

1. Overtime
2. Bond (available upon request at additional cost)
3. Structural warranties of any kind for the building
4. Fire alarms
5. Temporary power
6. Toilet or break room facilities. Proposal is based on utilizing Owner's facilities.
7. Project financing
8. Any upgrades material, labor, switch gear or transformers for existing equipment if modification is needed
9. Any balancing of existing loads
10. Internet connection for web monitoring

Clarifications:

1. Lay down area provide for site storage trailer and materials

Acceptance of proposal indicates a preliminary intent to purchase and secures pricing as quoted for thirty (30) days with delivery schedule, order specifications, and customer requirements to be confirmed subsequently through mutually approved installation schedule.

IMPORTANT - READ CAREFULLY BEFORE SIGNING: READ ALL OF THE TERMS AND CONDITIONS CAREFULLY AS THIS PROPOSAL IS SUBJECT TO ADDITIONAL PROVISIONS ON THE ATTACHED PAGES,

Cyclone Energy: Base Proposal

Project: Boys & Girls Club of Story County
Location: Ames, IA
Architect: Cyclone Energy
Owner: Boys & Girls Club of Story County

Bid Date: 5/1/2017
Revision #: 0
Job #: 867-5309
Area: 11,200 SF

Key Project Personel:
Dylan Busby
Marcelious Wyatt
Sara Peterson
Tristen Girolamo

Division	Description	Material	Labor	Equipment	Sub-Cont	Total	$/SF	Comments
1	General Conditions	$ -	$ -	$ -	$ -	$ 4,109.31	$ 0.37	
2	Exisiting Conditions	$ -	$ -	$ -	$ -	$ -	$ -	
23	HVAC	$ 68,775.40	$ 27,095.10	$ 1,529.55	$ -	$ 97,400.05	$ 8.70	
26	Electric	$ 14,463.08	$ 6,667.31	$ -	$ 27,670.00	$ 48,800.39	$ 4.36	
27	Communication	$ -	$ -	$ -	$ -	$ -	$ -	
28	Saftey and Security	$ -	$ -	$ -	$ -	$ -	$ -	
31	Earhworks	$ -	$ -	$ -	$ -	$ -	$ -	
32	Exterior Improvements	$ -	$ -	$ -	$ -	$ -	$ -	
33	Utilities	$ -	$ -	$ -	$ -	$ -	$ -	

Subtotals		$ 83,238.48	$ 33,762.41	$ 1,529.55	$ 27,670.00	$ 150,309.75	
Sales Tax	Tax exempt					$ -	
Contractor's Fee	0%					$ -	
General Liability	10%					$ 14,620.04	
Bonds & Insurance	0%					$ -	
Contingency	1.5%					$ 2,254.65	
Design Fee	0%					$ -	
TOTAL BID PRICE						**$ 167,184.44**	$ 14.93

NECAECAP
Energy Financing & Gauranteed Performance

dll financial solutions partner

Boys & Girls Club

Use the savings generated from the new system to pay for the financing

	36 Months*	48 Months*	60 Months*
Monthly Payment	$ 2,614.46	$ 2,031.13	$ 1,685.54
Monthly Savings	$ 709.77	$ 709.77	$ 709.77
Monthly Cash Flow	$ (1,904.69)	$ (1,321.36)	$ (975.77)

*Estimated payments are not inclusive of sales tax. Offer subject to credit approval and completion of all required documentation at the sole discretion of DLL.

*Rate is provided as an indication only and is subject to indexation and change prior to documentation and funding.

Required Documents

100% financing

The total investment can be financed and "soft" costs, such as service, maintenance and insurance can also be included in the monthly payments.

Flexibility

You can select a payment plan that best fits your budget. Your finance contact will help you structure the "right" transaction. Structuring option examples include deferred and step payment plans.

Contact

Sean Atwell
Office - 610-386-5435
Mobile - 484-688-4644
satwell@leasedirect.com

This proposal is an expression by the financial solutions provider of its interest in considering a financial transaction on the general terms and conditions outlined above. This proposal is not intended to and does not create any binding legal obligation on the part of either party.

This proposal is for discussion purposes only and is an indication of interest regarding a possible financing transaction on the general terms and conditions outlined herein and should not be construed as a commitment.

This proposal is subject to final approval of the financial solutions provider, which will require your cooperation in furnishing financial information, and the absence of any material, adverse change in your financial condition or business prospects prior to closing.

This proposal expires thirty (30) days from the proposal date.

Cyclone Energy Volunteer Log

Boys & Girls Club

Weekday	Date	Names	Hours	Individual Time (hrs)	Total Daily Time (hrs)
Thursday	3/30/2017	Marcelious Wyatt	3:00 - 5:00 PM	2.00	2.00
Friday	3/31/2017	Heli Nascimento & Julie Penton	3:40 - 6:30 PM	2.83	5.67
Tuesday	4/4/2017	Tristen Girolamo, Shay Hudachek, Heli Nascimento, & Julie Penton	3:00 - 5:30 PM	2.50	10.00
Thursday	4/6/2017	Marcelious Wyatt & Sara Peterson	2:50 - 5:30 PM	2.67	5.33
		Jon Hoehne & Conor O'Brien	3:15 - 5:30 PM	2.25	4.50
Saturday	4/8/2017	**Landscaping Event (12:00 - 3:00 PM)**	-	-	-
		Tristen Girolamo, Jon Hoehne, Shay Hudachek, Heli Nascimento, Conor O'Brien, Julie Penton, Sara Peterson, & Marcelious Wyatt	12:00 - 3:00 PM	3.00	24.00
Tuesday	4/11/2017	Shay Hudachek, Heli Nascimento, & Julie Penton	3:00 - 5:30 PM	2.50	7.50
Thursday	4/13/2017	Conor O'Brien, Sara Peterson & Marcelious Wyatt	3:00 - 5:30 PM	2.50	7.50
Wednesday	4/19/2017	**Science Day (5:30 - 7:30 PM)**	-	-	-
		Jon Hoehne, Heli Nascimento, Julie Penton, & Marcelious Wyatt	5:30 - 7:30 PM	2.00	8.00
Thursday	4/27/2017	**Career Night (7:00 - 8:00 PM)**	-	-	-
		Beth Hartmann, Jon Hoenhe, Shay Hudachek, Heli Nascimento, Conor O'Brien, Julie Penton, & Sara Peterson	4:00 - 8:00 PM	4.00	28.00
				Total Hours	**102.50**