

# FARMINGTON CENTRAL SCHOOL DISTRICT #265

## SOLAR PHOTOVOLTAICS

### EXECUTIVE SUMMARY

Farmington Central School District #265 has a history of being committed to reducing its carbon footprint. The District upgraded lighting fixtures in gymnasiums and parking lots to more efficient fluorescent and LED lights, received the Recycling Recognition Award several times by Peoria County, and the Smarter Building Maintenance Award from the Schools of Illinois Public Cooperative.

With funding from the Illinois Clean Energy Community Foundation (ICECF), Farmington Central School District installed a 756 kW “field” of 2,520 solar photovoltaic (PV) modules. The District now incorporates real-time solar reporting data into science, technology, engineering, and math classes.

### FARMINGTON CENTRAL SCHOOL DISTRICT #265

Farmington Central School District #265 (Farmington Central) is a consolidated school district in Farmington, IL. The school is located about 20 miles west of Peoria and serves 1,450 pre-kindergarten through 12<sup>th</sup> grade students from three counties: Peoria, Fulton, and Knox. The facility is one large, all-electric, building complex and faces significant utility bills. However, with over 900 MWhs expected to be generated by the PV system every year, Farmington Central should save approximately \$80,000 annually in electricity.

As part of its commitment to reducing the community’s carbon footprint, Farmington Central upgraded light fixtures in its gymnasiums and parking lots to more efficient fluorescent and LED lights. Farmington Central also saw the financial benefit of energy efficient lighting upgrades through rebates offered by Ameren Illinois, the local utility. In addition, Farmington Central applied for a grant from the Illinois Clean Energy Community Foundation to install a 756 kW PV system totaling 2,520 panels on the school complex. Following this project, Farmington Central installed a PV-powered car charging station for the vehicles used by the Driver’s Education classes. Teachers use real-time

## SOLAR PV PROJECT OVERVIEW

### Owner:

Farmington Central School  
District #265

### Location:

212 N. Lightfoot Rd.  
Farmington, IL

### Nameplate Capacity:

756 kW DC

### Delivery Method:

Design-Bid-Build

### Total Cost:

\$1,890,213.00

### Funding:

\$1,134,128.000 ICECF Grant  
\$756,085 Farmington Central  
School District #265

### Cost per Watt:

\$2.50

### Project Team:

Clean Energy Design Group, Inc.;  
Farnsworth Group

### Project Contact:

Dr. Zac Chatterton,  
Superintendent

For more information:

Illinois Clean Energy Community  
Foundation

[www.illinoiscleanenergy.org](http://www.illinoiscleanenergy.org)  
(312) 372-5191

Staff Contributors:

Cassie Slattery  
Daniela Herrera  
Gabriela Martin

solar reporting data in the classroom to engage students and to help teach science, technology, engineering, and math.

The total project cost for the PV system was \$1,890,213, of which ICECF covered 60% with a grant of \$1,134,128. The system is expected to generate over 40% of the District's energy consumption.

## SOLAR PHOTOVOLTAIC PROJECT

Farmington Central School District #265 had four goals when they applied for a grant from ICECF: to increase energy efficiency, reduce their carbon footprint, save on utility costs, and give their students the opportunity to learn about energy efficiency and renewable energy. According to District Superintendent Dr. Chatterton, the school board was very open-minded and progressive when it came to renewable energy. Farmington Central hopes the decisions they have made to install solar PV systems inspires other school districts, and even their own students and staff, to pursue renewable energy outside of the school. Students can see many of the roof panels from the school's grounds. The 756 kW roof-mounted PV system will mitigate approximately 17,600 tons of carbon dioxide over its lifetime. Once the nearby Hanna City Rail-Trail is completed, the PV system panels will be completely visible to all trail visitors.

## PRE-DESIGN

The original idea for this project came from Dr. John Asplund, the Superintendent at Farmington Central at the time of the project's conception. As the first of its kind in this area, the project aimed to set an example. Once the project was approved by the District's Board of Education, Farmington Central applied for a grant from the Foundation that would cover 60% of the project cost of installing a 756 kW PV system. The District self-financed the remaining cost of the installation through school bonds and fundraising.

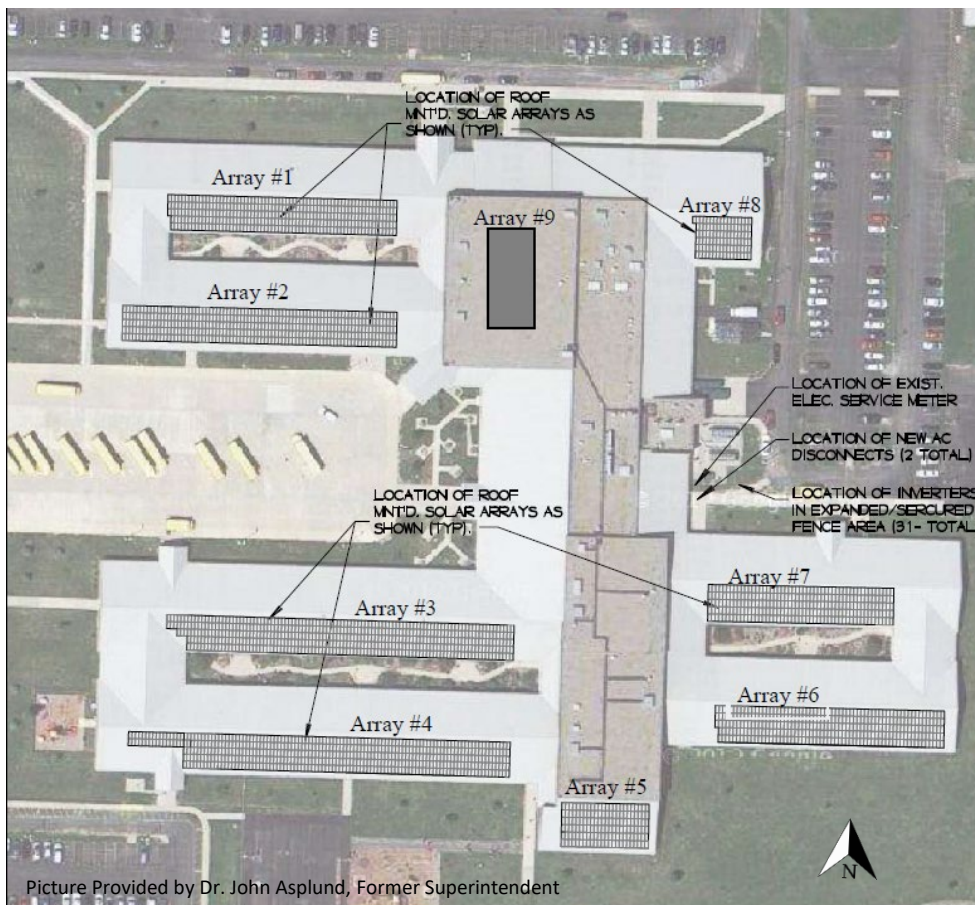
The school complex has east-west oriented wings that provide excellent southern exposure to the sun. The slanted metal vertical ribbed roofing systems with south facing slopes allowed for the attachment of non-corrosive metal fasteners for the solar panels. No structural reinforcement was needed as the metal roofing and outer walls were able to accommodate the extra weight of the panels.

Before proceeding with the project, the District completed an EcoCAT (Ecological Compliance Assessment Tool) test to ensure compliance with the necessary guidelines set by the Illinois Department of Natural Resources Endangered Species Protection Act and Natural Areas Preservation Act.

In order to prepare the students for this project, Farmington staff held assemblies promoting the project and including students in the planning process. Citizens living in the surrounding areas were welcomed to public forums held at the school, to ask questions about the project.

## DESIGN

The installing electrical contractor determined that 122 of the 2,520 modules would be best installed on a ballasted racking system using a flat roof adjacent to the gymnasium. At this location all 122 modules (see Array #9) have clear and open access to the southern sky for the longest period of annual insolation possible.



As shown on the map above, the inverters tied to the roofing system are located in one accessible location adjacent to the east parking lot. This location allows for easy access for maintenance workers and students studying the system. There is a protective fence around the inverters and a metal overhang to keep the inverters out of the weather. See the photo below for a close up view of the inverters.



## PRODUCT SPECIFICATIONS

### Product Specifications

Solar Panels	
Manufacturer	ReneSola
Make/Model	#JC300m_24/ABH
Individual Capacity	300 Watt
Number	2520 PV Modules
Total Capacity	756 kW
Warranty	20 years
Fixed Rack Tilt Angle (Deg.)	15 Degrees Due South
Inverters	
Manufacturer	SolarEdge
Individual Capacity	24.3kW
Number	31
Total Capacity	753.3 kW
Warranty	10 years
Racking System	
Manufacturer	S:FLEX Inc
Make/Model	S:FLEX standing seam
Monitoring System	
Manufacturer	SolarEdge
Make/Model	SE20



Picture Provided by Doug Lentz, Director of Maintenance



## CONSTRUCTION

Farmington Central installed 2,520 PV modules with a 756 kW nameplate capacity. 7,000 S:FLEX Brand clamps were installed within the fixed rack mounting system and torqued to match engineering specification for the ReneSola PV modules.

The initial plan called for all inverters to be installed within separate mechanical rooms throughout the campus. The District maintenance superintendent and the electric contractor decided to instead locate all inverters in a secure outside location, as shown before. The new inverter shed is adjacent to the existing mechanical service area. This change allowed for easier installation, minimized interior finish issues, class disturbances, and exterior wall and roof penetrations. The inverter shed houses all 31 SolarEdge inverters, 2 main Ameren Illinois disconnects, and 2 new electrical breaker switches.

The panels and inverters were installed between December 2014 and February 2015. One of the science classes took part in the installation process as part of their curriculum on sustainable energy. There were no significant interruptions to learning during the construction process. The school's maintenance team was trained before the panels were installed. After the installation, the Farmington team took over.

## OPERATIONS AND MAINTENANCE

Farmington Central's maintenance team was awarded a Smarter Building Maintenance Certification by the Schools of Illinois Public Cooperative (SIPC). This award represents a PLATINUM level of certification for implementing the "green" sustainable building mandates and guidelines set by SIPC. Farmington Central included training for system maintenance and operation into the project cost over 25 years. School maintenance workers do seasonal cleaning of the panels and check to make sure all panels are functioning using the SolarEdge web-based monitoring. The school allots a sum of \$6,500 for its annual operations and maintenance fees. Any small PV related repairs would be funded under these savings. However, larger PV projects and repairs would have to be planned for outside of these annual spending allowances.

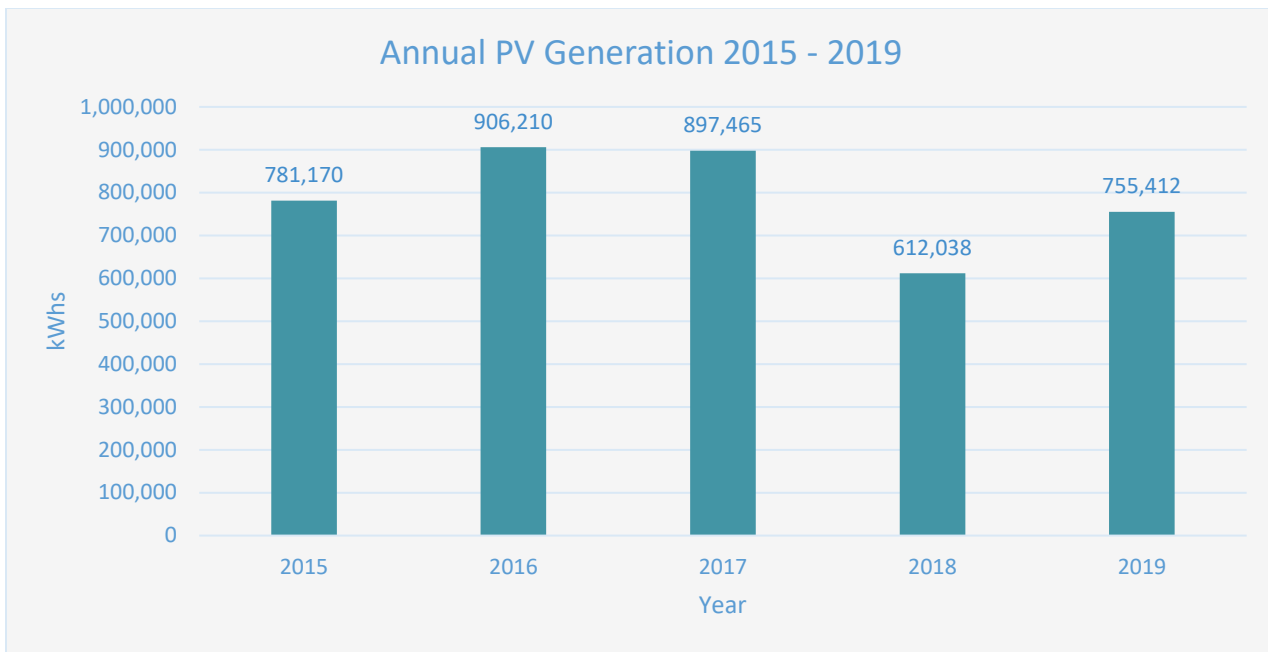
In 2021, Farmington Central plans to install a new transformer to aid the roof-mounted system, thus allowing it to stand alone from the newly installed ground-mounted system. Both systems will receive an overhaul of new inverters with the potential for an entirely new data monitoring platform. These adjustments are being undertaken due to existing issues. During this construction process, interconnection between the panels and the electricity grid has been disrupted.

Picture Provided by Andrew Bach, Farmington Central Teacher



## POST INSTALLATION EVALUATION

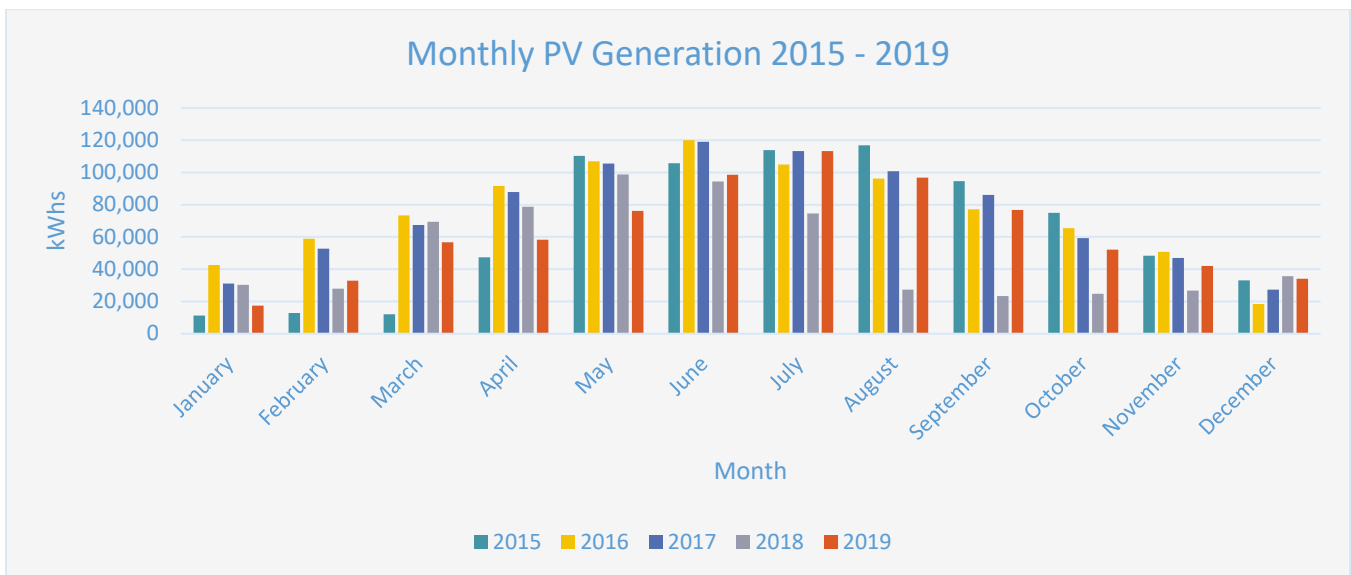
Farmington Central's PV system is tracked online with Solar Edge monitoring software. Both Farmington Central and ICECF have access to this information. The data is used to monitor the amount of electricity generated by the solar system. Below is an analysis of the Farmington Central system, based on this online data.



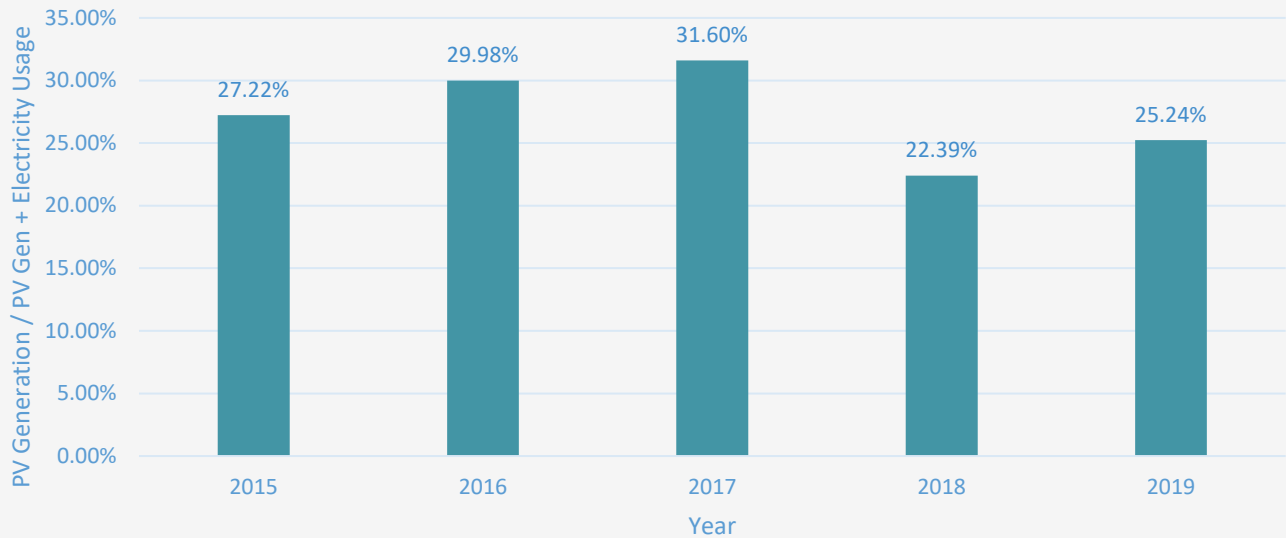
## ENERGY GENERATION ANALYSIS

Farmington Centrals' PV panels started producing at the beginning of 2015, but online generation data was only visible starting on April 23<sup>rd</sup>, 2015. Since we were able to gather the first few months' generation data before the system went online in April, all of the above years are full years of data. Though these data sets represent full years, they do not accurately represent the data as a whole. Due to the ongoing construction of the ground-mounted system as well as some data monitoring issues regarding the roof-mounted system, the data shown above appears considerably below what you'd expect from a system its size. These problems are being addressed by Farmington's staff.

Data is continuously updated on Solar Edge's page. The real-time generation can be found [here](#).



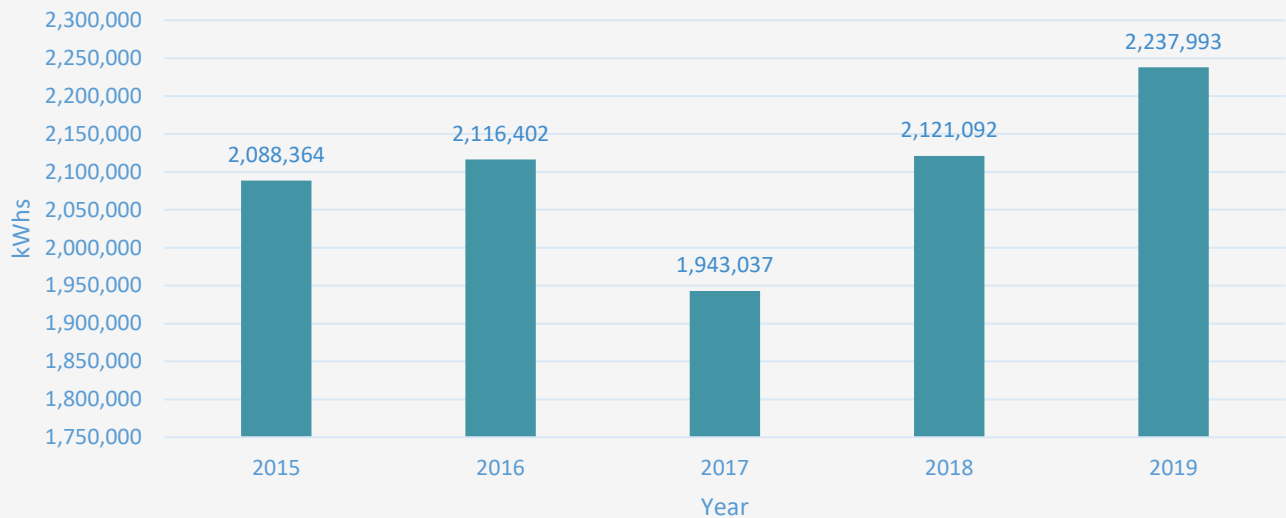
The Percent that PV covers of Total Energy Usage Annually



Total energy use is the electricity purchased to power the building as well as the energy generated to power the building. Based on the data presented through Solar Edge, Farmington generates an average of 27.29% of that energy need annually. In reality, this percentage is likely higher considering the data that is not represented here.

## ENERGY CONSUMPTION ANALYSIS

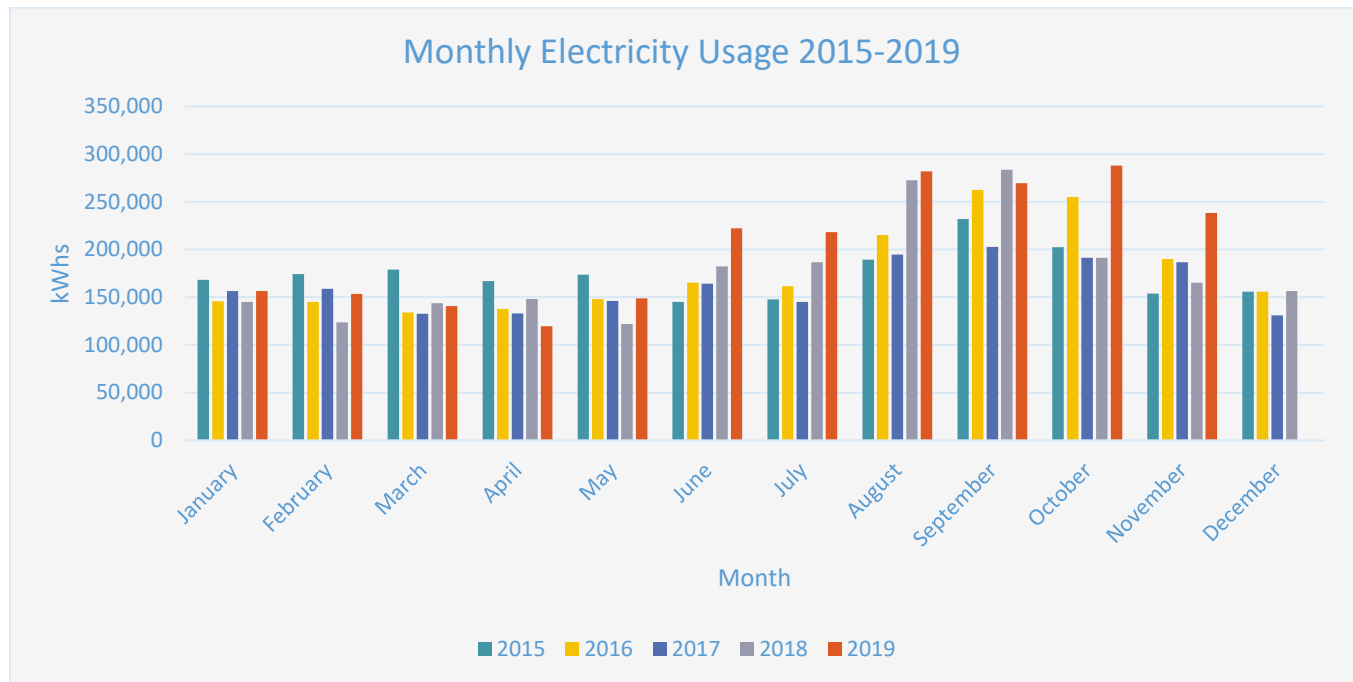
Annual Electricity Usage 2015-2019



Starting in 2018, Farmington Central took on a larger role as a community center. Outside of operating as a school for the surrounding area, the building is rented out during non-school hours for sporting events and community gatherings, resulting in increased electricity consumption.



The chart above shows Farmington Central's annual electricity usage. This represents the electricity purchased and does not include their generated electricity. All years are full data years. From 2015 to 2019, Farmington Central spent an average of \$2,101,377.60 on electricity annually.



During colder months, lower PV generation and increased heating requires more electricity to be purchased.

## PROJECT RESULTS

A 756kW PV system, like the one on Farmington's roof, will generate approximately 907,000 kWhs annually in Illinois. The online monitoring system shows that Farmington's panels were only able to reach this expected level of generation in 2016. Since the panels began showing online generation in 2015, sections of inverters began to disconnect from Farmington's Solar Edge online data. This means that the PV panels were generating electricity that is not reflected in the online data. Farmington has determined that this is an issue with the inverters and potentially the online monitoring system as well. The panels themselves remain fully functional and do not need replacing.

Farmington is taking steps to solve this issue and complete all additional renewable energy projects on their campus by the end of 2021. As of August 2020, the Farmington campus underwent the installation of a 5-acre ground-mounted 975kW solar system. These panels began the interconnection process in October 2020. The roof-mounted system has been shut off as of October 2020 and will remain shut off until the ground-mounted panels are fully connected. This is necessary for the safety of the installers and electricians. As of right now, both PV systems are connected to the same transformer. However, from March 2021 to June 2021, Farmington installed a new, separate transformer strictly for the roof-mounted system. This will allow Farmington to switch to a 3-metered system in which the school, the roof PV system, and the ground PV system can all function independently. Additionally, all of the roof-mounted system's inverters will be replaced due to their ongoing online data issues. Farmington's team has yet to decide whether or not they will be switching from Solar Edge to a new online monitoring platform. The decision will likely be made after the new inverters are installed and

running. When the project is complete, Farmington will have both PV systems' data uploading to the same online platform, allowing students and maintenance staff to stay up to date on both systems.

It is easy to see that the on-site generation provides a financial benefit to the Farmington Central School complex. Outside of financials and building operation, the school also benefits from the panels providing a unique educational tool to their students. Teachers like Andrew Bach use the solar panels in his ecology class to teach about alternative forms of energy, the carbon cycle, and traditional fossil fuels and their role in the carbon cycle and the atmosphere at large. Now, with the two separate PV systems, students can analyze the effects of different installation choices when it comes to renewable energy. Other classes vary in their use of the solar system as a resource, but all have access to the online data.

Picture Provided by Doug Lentz, Director of Maintenance



Newly installed ground-mounted PV system.

It is yet to be determined if Farmington will sell Renewable Energy Certificates (RECs) for the ground-mounted PV array; no RECs will be sold for the roof-mounted system.

## CONCLUSION

ICECF is looking forward to seeing the 756kW solar system come back online by the end of the 2021 year, along with the start of operation for Farmington's new 975kW solar system.

Farmington Central continues to be a role model for schools throughout the state with their willingness to take on larger and more advanced renewable energy projects. Their dedication to creating an environmentally friendly building extends from their board to their staff and students. The incorporation of these panels, in addition to generating significant financial benefits for the school, also function as a tool for students to learn

and will continue to be an asset at the school. Even more, the Farmington Central building will rely less and less on harmful fossil fuels.

Picture Provided by the Farnsworth Group



This northwest facing aerial shot illustrates the extent of the 756 kW roof-mounted system.