

# Net Zero Energy Warehouse

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## Getting to Net Zero:

- What is Net Zero Energy?
- Building 110 Project Life Cycle
- How Do We Achieve NZE?
- Energy Use and Production Results
- What Can WE do at home to achieve NZE?

## NIH's Research Triangle Park, NC Campus



## Net Zero Energy (NZE)

- A Net Zero Energy Building is one which produces as much energy as it uses over the course of a year (any 12-month period).
- Net Zero Energy Buildings combine:
  - Advanced building design to minimize energy requirements
  - Renewable energy systems to off-set energy demand
- Project Success Requires:
  - Advance Planning
  - Detailed Design Modeling
  - High Attention to Detail During Construction

## Project Life Cycle: NZE Warehouse

### Planning Phase

- 2011 – Preliminary Project Planning and Feasibility Study
- 2012 – Program of Requirements, “The project team has been charged with the goal to design [the] warehouse as a Net-Zero Energy Building.”
- Bridging documents were prepared detailing sustainable features and holistic “path to net zero.”

## Project Life Cycle: NZE Warehouse

### Design Phase

- August 2015 – Award of Design-Build Construction Contract and Independent Commissioning Agent Contract
- November 2015 – 60% Design Documents Complete
- March 2016 – 100% Civil Design Documents Complete
- October 2016 – “Issued For Construction” Building Documents Complete



## Project Life Cycle: NZE Warehouse

Construction Phase: May 2016 – Site clearing and grading began



## Project Life Cycle: NZE Warehouse

Construction Phase: August 2016 – Foundations complete, exterior precast concrete walls in progress





## Project Life Cycle: NZE Warehouse

Construction Phase: July 2017 – Construction Complete!



## How do we achieve Net Zero Energy?

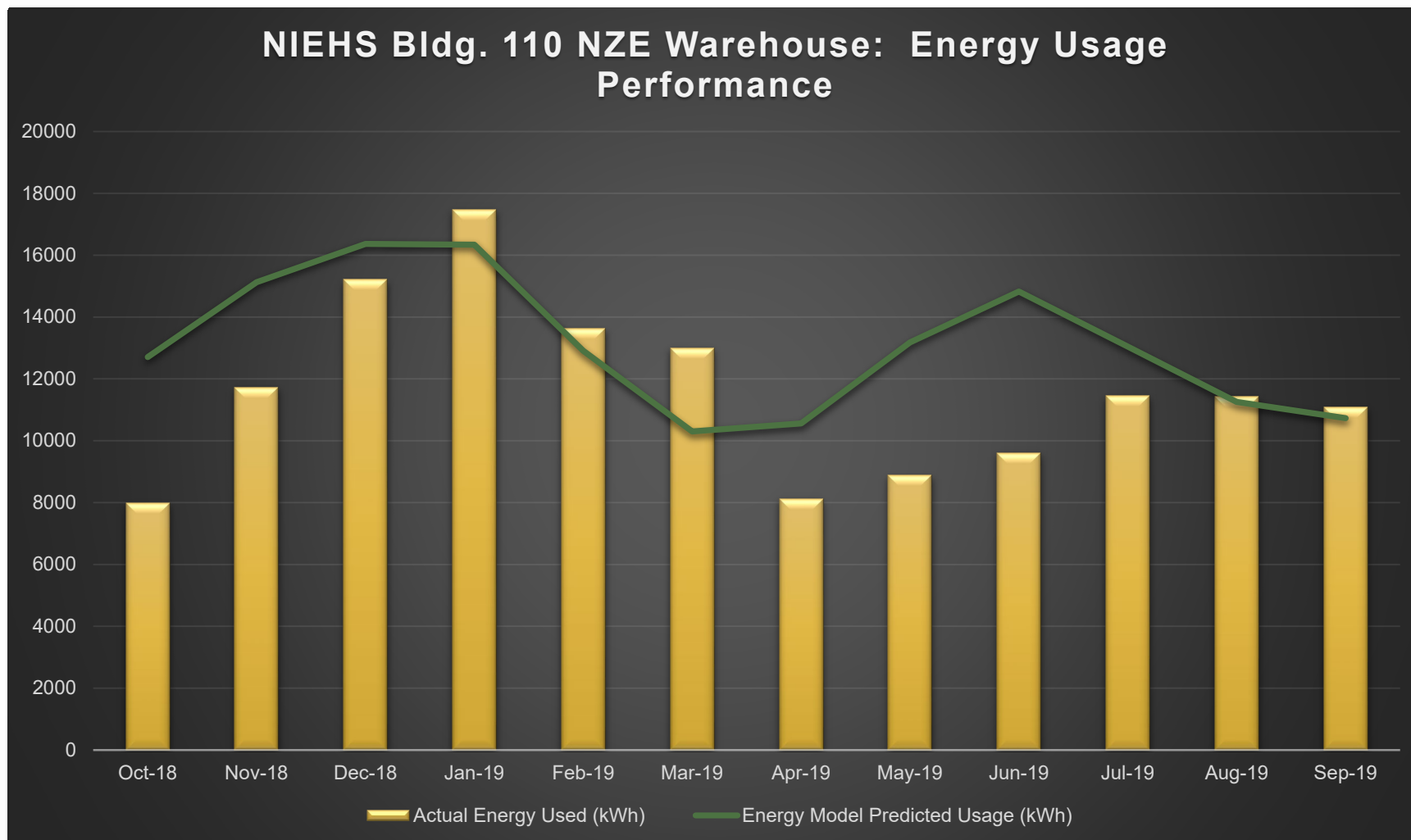
- Modeling, modeling, MODELING
- Optimum Building Orientation
- High Efficient Building Shell
  - Concrete Insulated Walls
  - High Insulation Value (R-30) for Roof System
  - High Efficiency Windows (double pane, tinted glass, Kalwall)
- Window shading and overhangs
- User Training!

# Energy Model Summary

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
<b>Alternative 1</b>					
<b>Primary heating</b>					
Primary heating	13,226	21,121	12.4 %	66,262	165,200
Other Htg Accessories	620		0.4 %	2,118	6,669
Heating Subtotal	13,847	21,121	12.7 %	68,380	171,870
<b>Primary cooling</b>					
Cooling Compressor	10,588		6.7 %	36,136	113,814
Tower/Cond Fans	449		0.3 %	1,532	4,824
Condenser Pump			0.0 %	0	0
Other Clg Accessories	1,154		0.7 %	3,940	12,410
Cooling Subtotal....	12,191		7.8 %	41,608	131,048
<b>Auxiliary</b>					
Supply Fans	43,552		27.7 %	148,641	468,162
Pumps			0.0 %	0	0
Stand-alone Base Utilities	11,247	4,475	8.0 %	42,862	125,780
Aux Subtotal....	54,799	4,475	35.7 %	191,503	593,943
<b>Lighting</b>					
Lighting	30,238		19.2 %	103,202	325,045
<b>Receptacle</b>					
Receptacles	38,670		24.6 %	131,980	415,684
<b>Cogeneration</b>					
Cogeneration			0.0 %	0	0
<b>Totals</b>					
Totals**	149,744	25,596	100.0 %	536,672	1,637,589

Lighting and  
Receptacles account for  
43.8% of planned energy  
usage

## Energy Model Accuracy: Current 12-months











## How do we achieve Net Zero Energy?

- Air conditioning and heating systems are the most efficient in the market
- Natural gas infra-red heaters in receiving areas
- Day light harvesting systems turn on lights to level needed.
- Vaulted skylights and light tubes provide sunshine!
- Building and roof insulation holistically designed with mechanical and electrical systems to ensure low energy usage.
- PV Array “offsets” electricity and NG usage to provide “net zero”

## LEED Design and Construction Submission

- NZE Warehouse is **LEED Platinum Certified.**
- Design Points Targeted = 68
- Construction Points Targeted = 20
- LEED Design Review – 63 of 68 points awarded
- LEED Construction Review – 22 of 22 points awarded
- **85 total points Awarded to achieve LEED Platinum Certification**

## LEED Highlighted Categories

	Category/Feature	Description
	<b>Sustainable Sites (SS)</b>	
	Public Transportation	On-site, on call shuttle services facilitates the use of public transportation.
	Bike Storage & Changing Facilities	Bike racks, lockers & unisex shower encourage alternative transportation.
	Stormwater Wetland & Bioretention Basin	Control rain runoff & improve storm-water quality leaving the site through natural marsh habitats.
	Light pollution reduction	Minimum site lighting was used to eliminate lighting to adjacent property outside the project limits during night time hours.
	<b>Water Efficiency (WE)</b>	
	Water Use Reduction	Low-flow technology on toilets, sinks & urinals in the restrooms & shower
	Instantaneous Gas Hot Water Heaters	No hot water storage tank, instantaneous heaters & recirculated hot water reduces water usage
	<b>Energy and Atmosphere (EA)</b>	
	Building Envelope	Energy efficient windows, roof insulation, Insulated wall panels provide superior insulation & reduces heating & cooling requirements.
	Thermal Comfort VRF Heating & Cooling	Energy efficient Thermal Comfort Variable Refrigerant Flow heating & cooling provides individual temperature control.
	Daylight Harvesting	Photocells adjust interior lights based upon availability of natural light through windows, skylights & solar tubes.
	Infrared Heaters	Natural gas infrared heaters in the receiving area provide warmth & the heat to maintain a comfortable temperature.
	Photovoltaic (PV) Roof Panels	PV roof modules generate renewal energy to off-set building & occupant electrical & natural gas usage.
	<b>Materials and Resources (MR)</b>	
	Storage and collection of recyclables	White paper, mixed paper, aluminum cans, plastic bottles are recycled.
	Recycled Content & Regional Materials	Exposed structural steel columns, concrete panels & other building materials were made locally using recycled content.
	Certified Wood	Wood doors and ceiling were harvested from forests certified to be managed in environmentally responsible ways.
	<b>Indoor Environmental Quality (IEQ)</b>	
	Entrance Mats	Walk-off mats improve indoor air quality by removing dirt & other particles from shoes before they become airborne.
	Environmental Tobacco Smoke Control	NIEHS is a smoke-free campus.
	Low Emitting Materials	Carpet, paint, adhesives, sealants & coatings are low VOC (volatile organic compounds) to improve indoor air quality.
	Lighting Controls	Occupancy sensors facility turn off lights when rooms are empty. Some spaces have dimming capability for occupant comfort.
	Daylight and Views - Daylight	Windows, skylights & solar tubes provide natural light.
	<b>Innovation in Design</b>	
	Educational Awareness	LEED signage, web-site illustrating sustainable building features & virtual tour provide information on building features.



### Sustainable Sites (SS)

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**Water Efficiency (WE)****Water Use Reduction**

Low -flow technology on toilets, sinks &amp; urinals in the restrooms &amp; shower

**Instantaneous Gas Hot Water Heaters**

No hot water storage tank, instantaneous heaters &amp; recirculated hot water reduces water usage



- Hands-free operation
- Low flow fixtures
- Waterless urinal
- 26.6% water savings on Campus using these type fixtures!



## Water Efficiency (WE)

### Water Use Reduction

Low-flow technology on toilets, sinks & urinals in the restrooms & shower

### Instantaneous Gas Hot Water Heaters

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## Water Heater

- Instantaneous gas hot water heaters respond to building demand.
- No hot water storage tank.
- Hot water is recirculated to all fixtures reducing water usage waiting for the water to warm up.

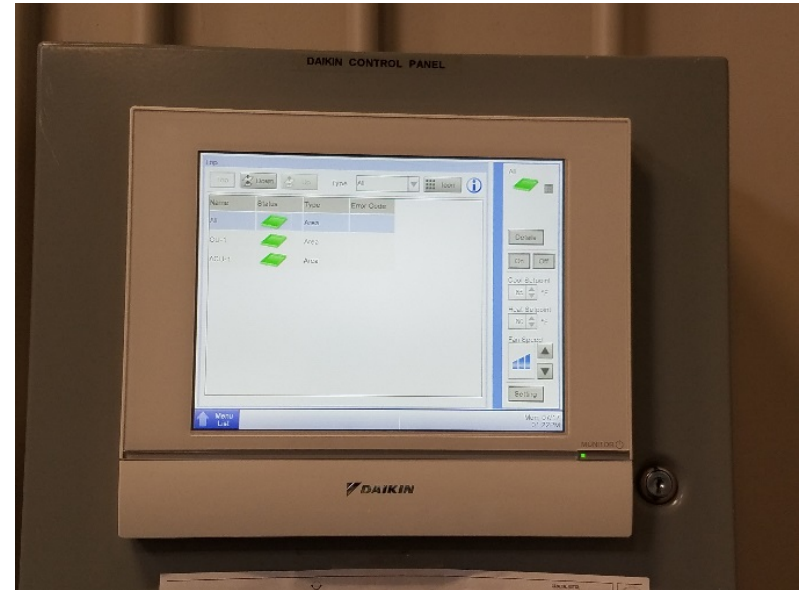




## Energy and Atmosphere (EA)

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<b>Photovoltaic (PV) Roof Panels</b>	PV roof modules generate renewal energy to off-set building & occupant electrical & natural gas usage.

- New Variable Flow Refrigerant (VFR) cooling and heating system



- Skylights, solar tubes and daylight harvesting systems





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## Roof Mounted PV Array





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## Lighting (100% LED)

- Individual lighting level override available in Life Cycle, Offices, Secure Storage, Life Cycle Storage, Conference room, Break room, Copy/mail room.
- Individual controls will reset after period of inactivity
- Occupancy sensors in every space to turn lights off when room is empty.
- Open Office area light levels are pre-set.
- Individual fixtures are controlled independently to maintain pre-set light levels.



# How do we achieve Net Zero Energy?

- NZE Warehouse operations require a CHANGE:
  - Changing employee perspectives and cultures to minimize electrical usage
  - Turn off task lighting
  - Turn off computers and printers
  - Limit Personal refrigerators and microwaves
  - Limit Multiple printers/fax machines/copiers
  - Minimize electrical receptacle usage!

# How do we achieve Net Zero Energy?

- Keeping Loading Dock Doors shut as much as possible when outside temperatures are below 65 degrees F
- Occupancy schedule for A/C and heat
  - 7 am to 5 pm, M-F; 74F summer / 70F winter
- New office thermostats allow fan speed and air direction adjustment





## How do we achieve Net Zero Energy?

- Provide Occupant Training for proper operation of new technologies.
- Promote ownership of project with occupants and emphasize occupants as key members of the team to meet Net-Zero goals.
- Follow-up with maintenance staff and building occupants to confirm systems are performing as expected.

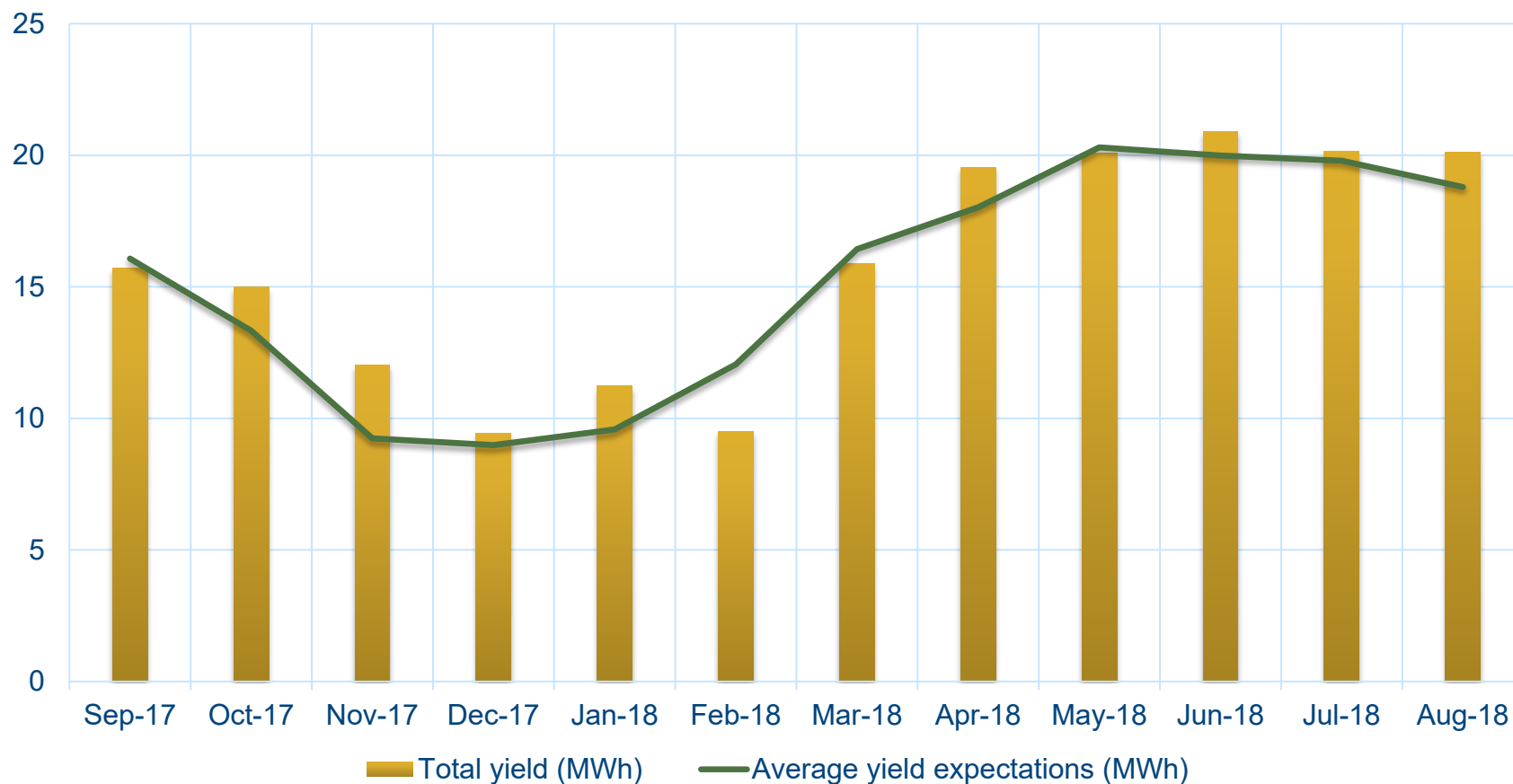
# How Have We Done?



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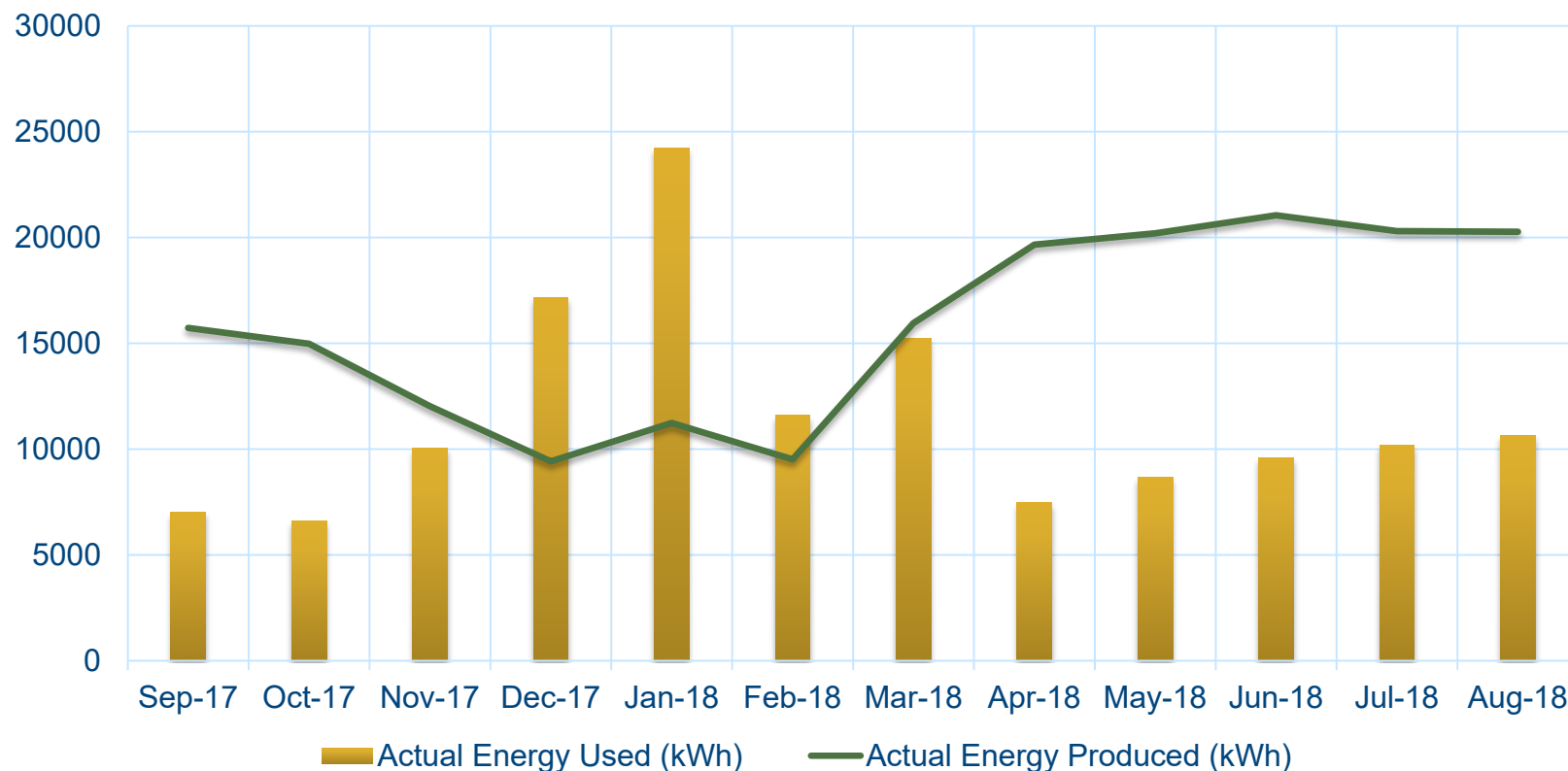
# PV Energy Production Performance: Year One

September 2017 to August 2018

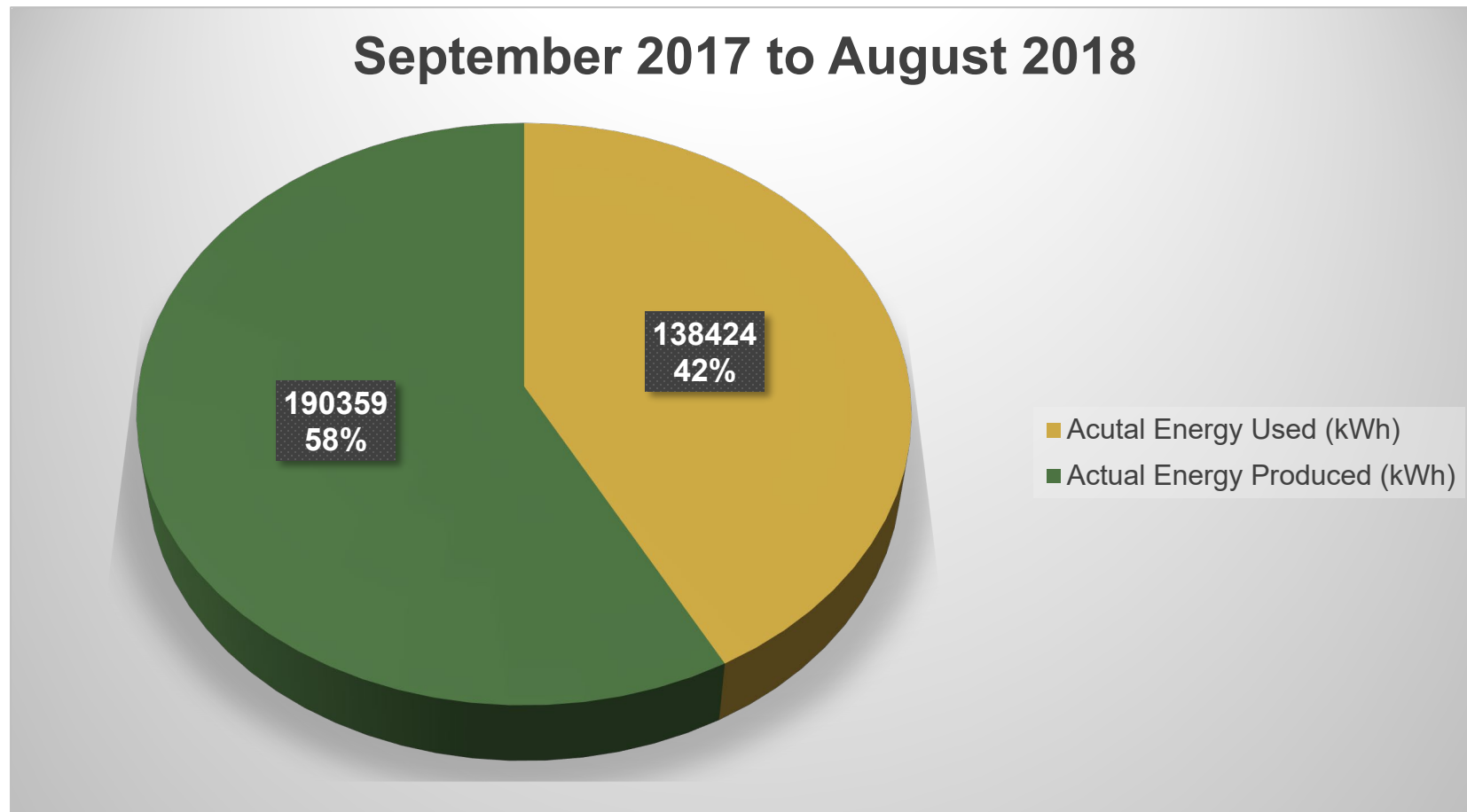


## Actual Energy Results: Year One

September 2017 to August 2018



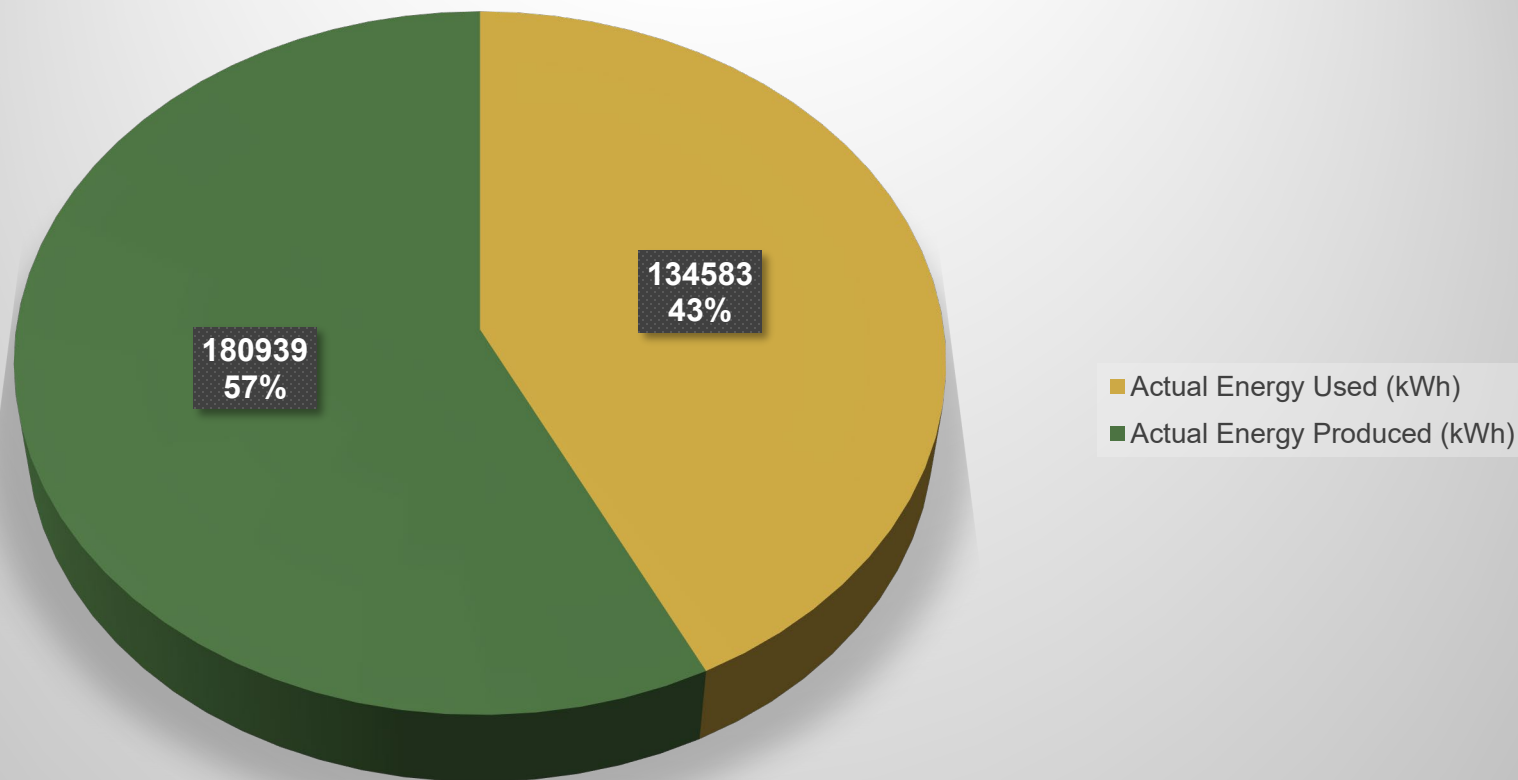
## Actual Energy Results: Year One Total





## Actual Energy Results: Current 12-month Total

October 2018 - September 2019



## What Can WE Do at Home?

- Minimize air leakage from doors, windows, walls.
- Increase the insulation value in your attic, walls, and floor.
- Use LED lighting and turn OFF lights and devices.
- User timers for fans or ventilation.
- Use programmable thermostats.
- Invest in Smart Home Automation.
- Install a solar array!

# Questions?