SOLAR 101 MEETING

Sept. 15 | 6:30 pm | PPEC office

Thanks for being an engaged member of your community cooperative

- Meeting Agenda
  - George Carter. President & CEO
    - Welcome
    - General Renewable Philosophy
    - Rate Design
  - Peter Niagu
    - Conservation Pyramid
    - Solar Power potential
    - Solar & Usage Patterns
    - Cost Trends
    - Net Meter vs. Net Billing
    - Rate Changes
    - Net Billing Examples
    - Payback Examples
    - Step-By-Step
  - Steve Kahle
    - Engineering

WELCOME

- Thank you for taking the time to be here.
- We hold these meetings as informational sessions.
- Help you make the best decision for YOU.
- Open and transparent.

Renewable Energy Philosophy

- Paulding Putnam Electric Cooperative supports renewable energy.
- We have wind and solar demonstration units available for members.
- Remember – if you sell back to the grid – you are now a “utility”.
  - Risk
  - Insurance
- Mission Statement supports “sustainable energy solutions”.
- Coal based generation – need to maximize investment, while transition to a renewable future.

Renewable Energy Philosophy

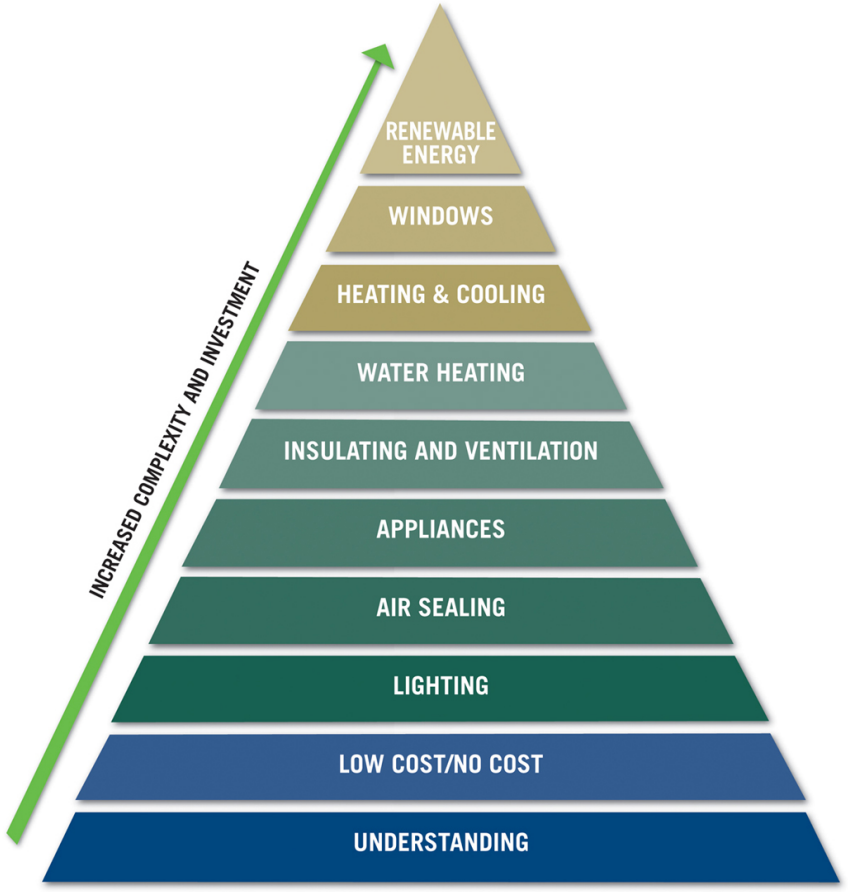
- Buckeye Power impacts:
  - The Ohio Cooperatives own Buckeye Power.
    - Ohio cooperatives members own Buckeye Power – control their generation.
  - Brief history…
  - Long-term, all-requirements power delivery contracts – limits ownership by coops for renewable (or other) generation.
  - As members we own and control our generation supply.

Rate Design

- Consideration for all members.
  - On/Off/Working/Not Working ????
  - Members expect 100% reliable electricity
- Energy Credits directly from Buckeye Power.
- Fair cost recovery?
  - Power Supply as a “pass-through”
  - Members pay for grid access and Distribution Service
- Generation, Transmission and Distribution costs.
- “Net Metering” – PPEC does not support the concept of “net metering”.

CONSERVATION PYRAMID

WHERE DO I BEGIN?



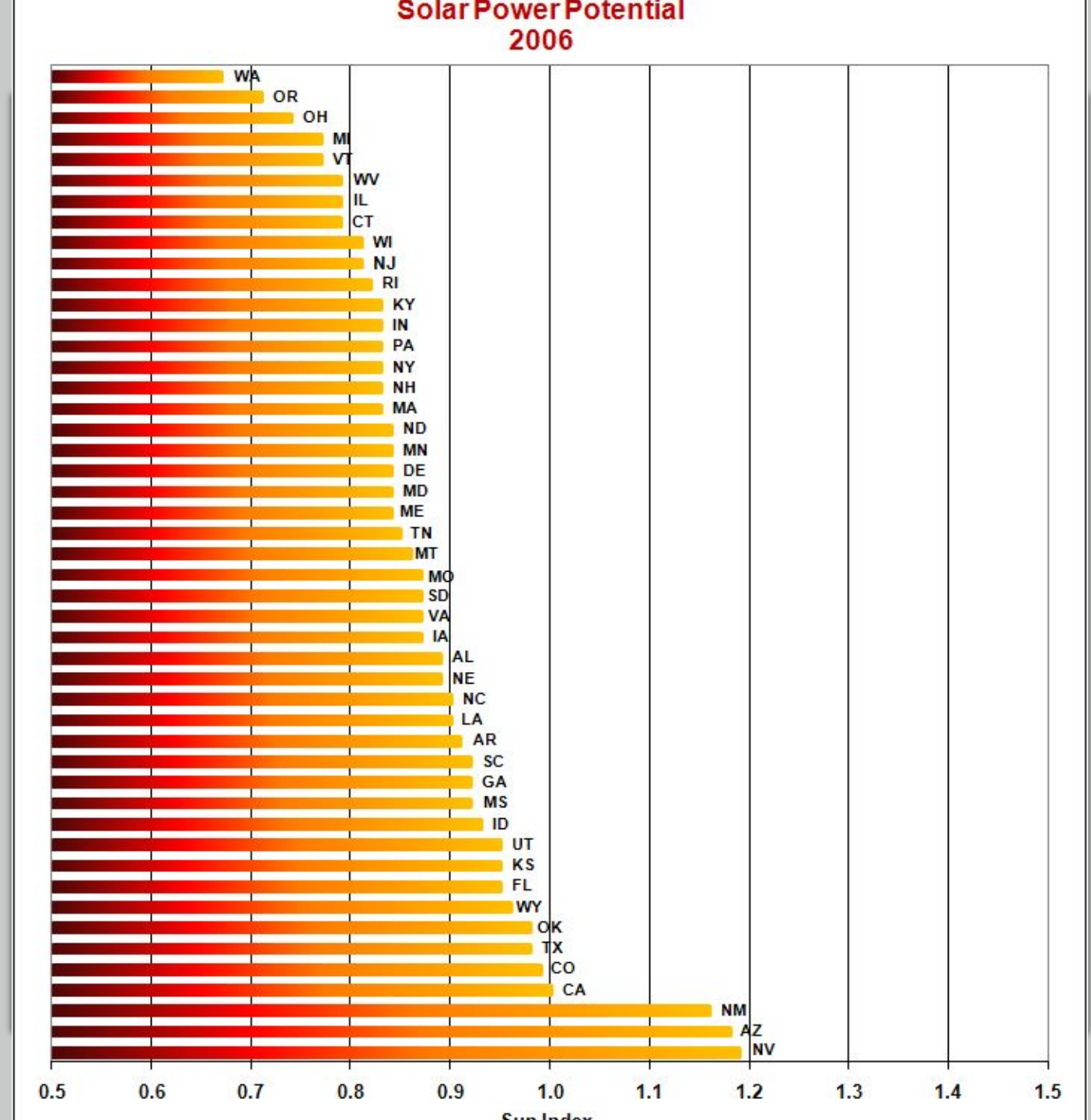
How do solar panels work?

When the sun shines onto a solar panel, energy from the sunlight is absorbed by the Photovoltaic cells in the panel. This energy creates electrical charges that move in response to an internal electrical field in the cell, causing electricity to flow.

Comparison of Solar Power Potential by State

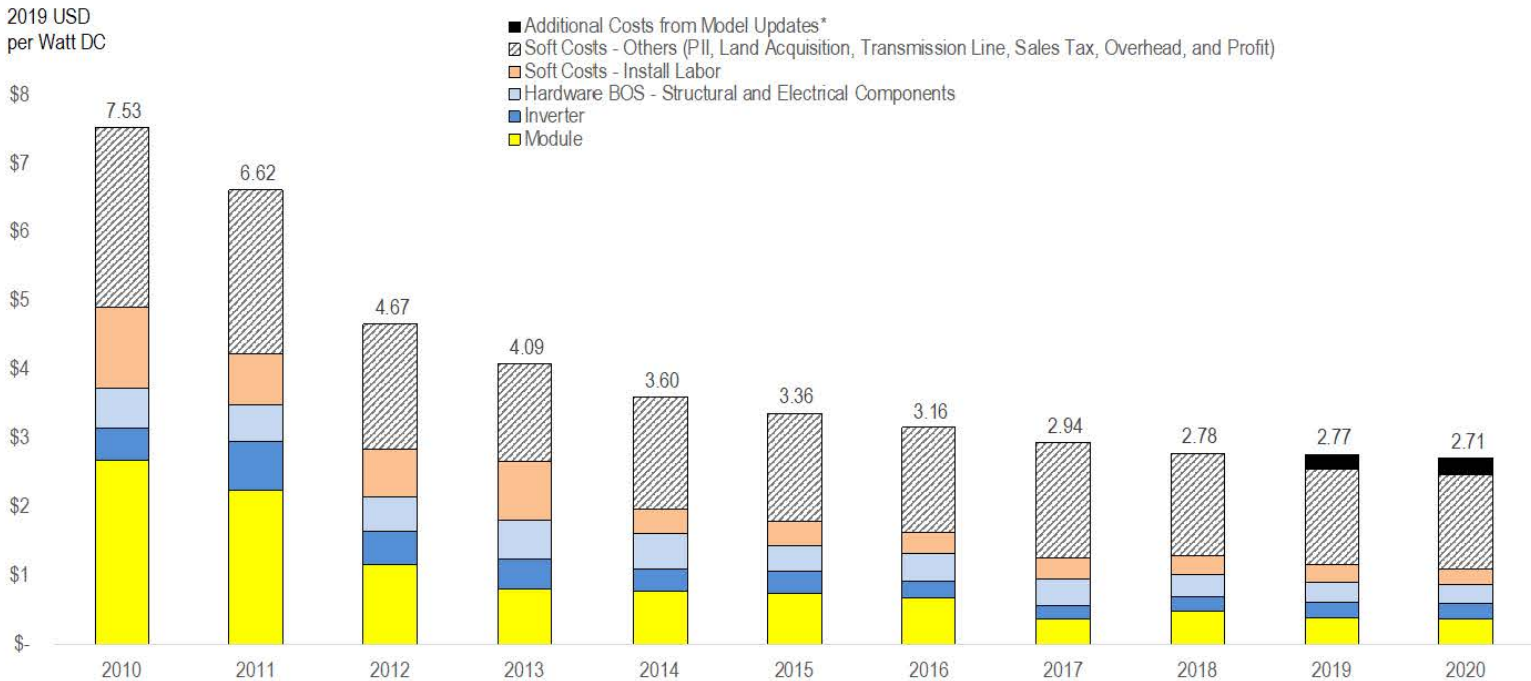
- The sun index is defined as an index of the amount of direct sunlight received in each state and accounts for latitude and cloud cover. The amount of direct sunlight was derived from numbers provided by the National Renewable Energy Laboratory (NREL), Renewable Resource Data Center. The sun index was calculated as the average number of hours of peak direct sunlight hours per year from 1960 to 1990.

https://neo.ne.gov/programs/stats/inf/201.htm



How is solar viable in our area?

Residential PV: Capital Cost Benchmark Historical Trends



From 2010 to 2020, there was a 64% reduction in the residential PV system cost benchmark. Approximately 57% of that reduction can be attributed to total hardware costs (module, inverter, and hardware BOS), as module prices dropped 85% over that period. An additional 20% can be attributed to labor, which dropped 84% over the period, and the final 22% is attributed to other soft costs, including PII, sales tax, overhead, and net profit.

Looking at this past year, from 2019 to 2020, there was a 2% reduction in the residential PV system cost benchmark.

* The current version of our cost model makes a few significant changes from the version used in our Q1 2018 benchmark report (Fu, Feldman, and Margolis 2018), and it incorporates costs that had previously not been benchmarked in as much detail. To better distinguish the historical cost trends from the changes to our cost models, we calculate Q1 2019 and Q1 2020 PV benchmarks using the Q1 2018 version of the residential PV model. The "Additional Costs from Model Updates" category represents the difference between modeled results. Using the previous cost model, the Q1 2019 and Q1 2020 benchmarks are calculated to be \$2.56/W_{DC} and \$2.47/W_{DC} respectively.

https://www.nrel.gov/

Net Metering vs. Net Billing

Under ‘Net Metering’ the solar energy which a Member generates for themselves is metered, so that any access electricity which is generated can be banked (think “rollover data”) to the Member's account for future consumption.

‘Net Billing’, on the other hand, allows solar Member’s to generate electricity for personal use, and sell any access energy to the utility company at wholesale or “avoided cost” prices, while purchasing power at the retail rate.

https://osceolaenergy.com/guide-net-metering-net-billing/

Residential Rate to Net Billing Rate

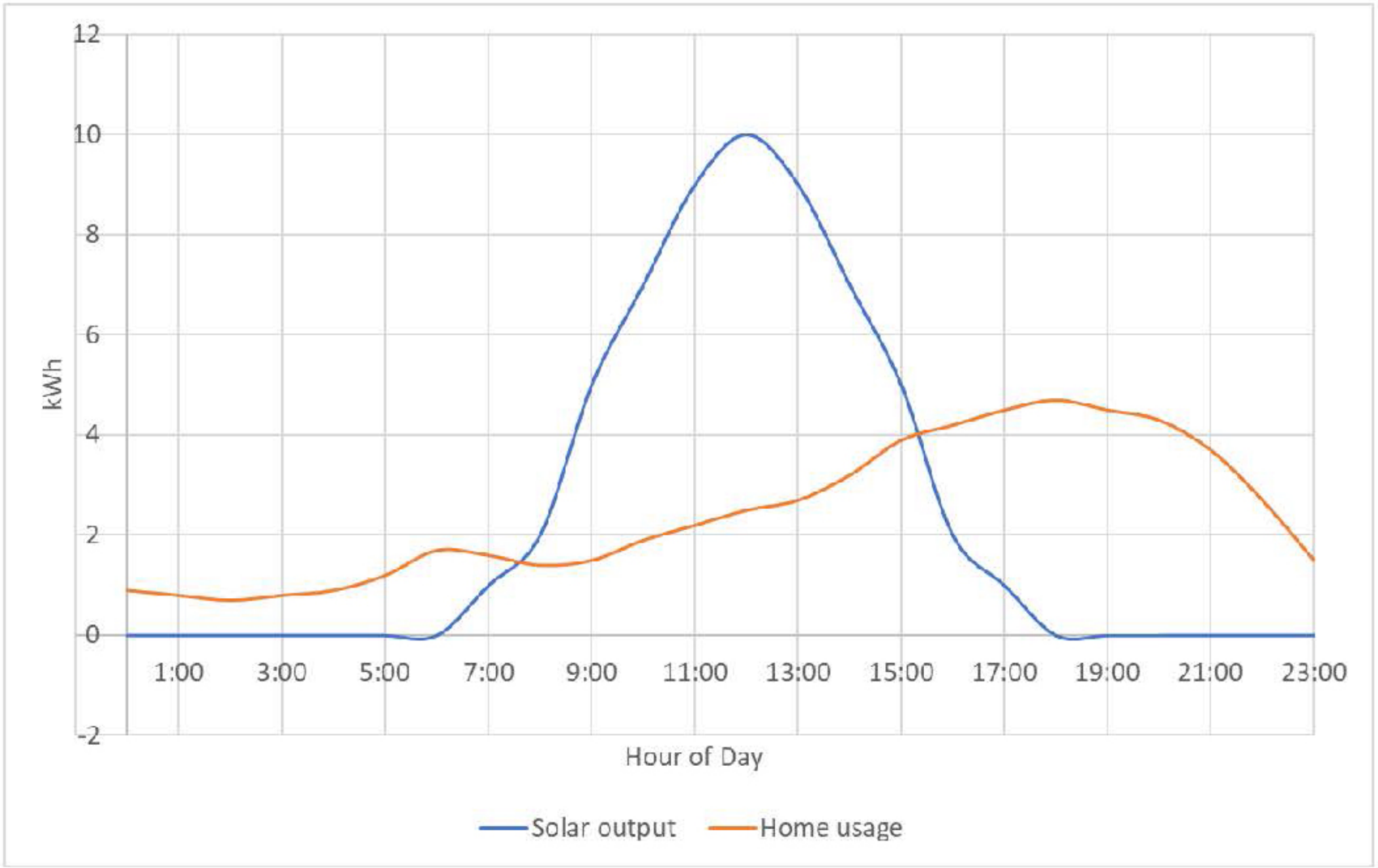
Residential Service- Indiana/Ohio

Service Charge per month:	$32.95
Distribution Energy Charge per kWh:	$0.01913
Generation & Transmission Energy Charge per kWh	$0.08093
Total Energy Charge per kWh	$0.10006

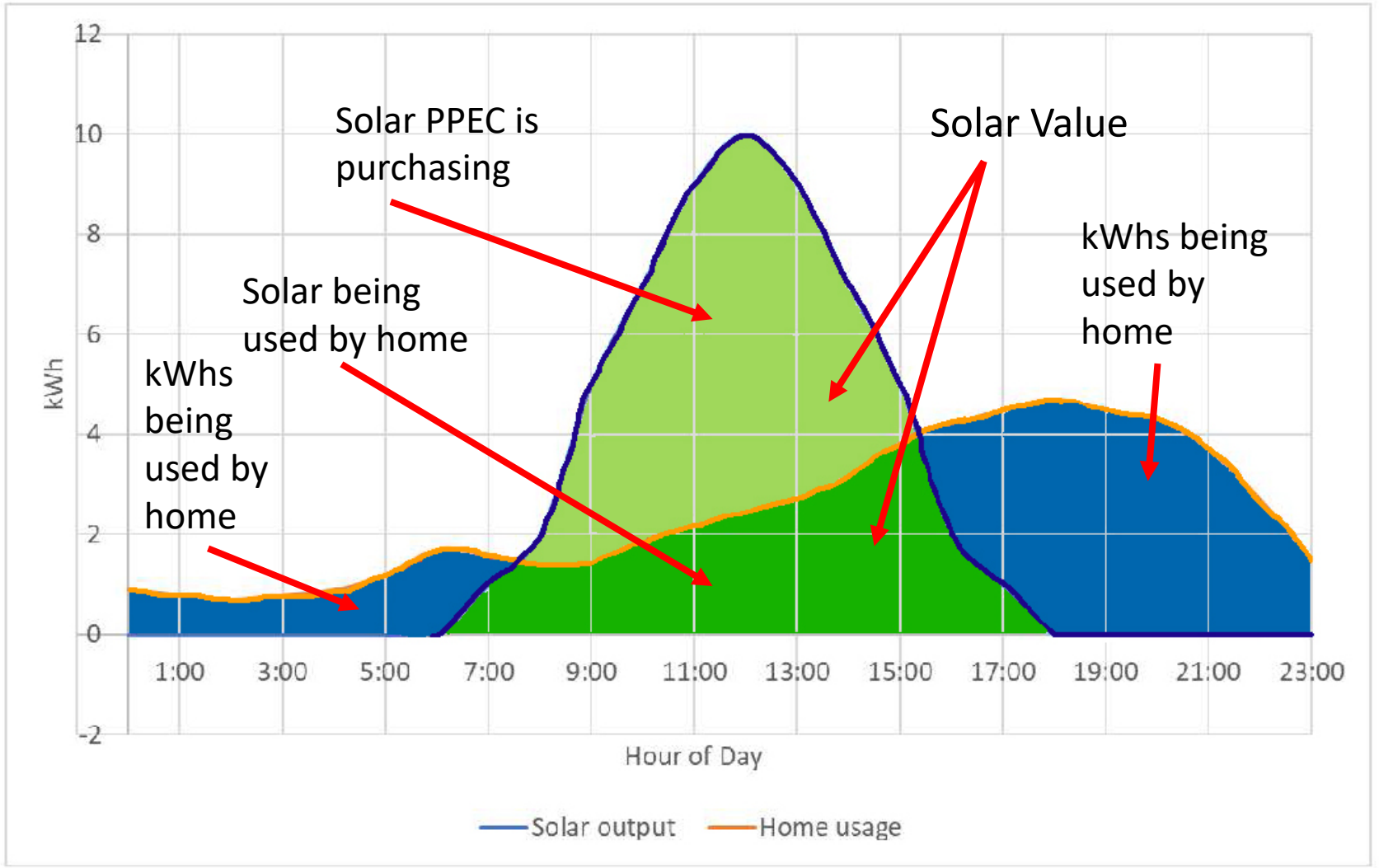
Residential Net Billing Service- Indiana/Ohio

Service Charge per month:	$52.95
Total Energy Charge per kWh	$0.08340
Distribution Generation Credit (excess buy back)	$0.05700

Solar & Usage patterns



Solar & Usage Patterns



Net-Billing Example

12 Month Net Billing Example						
Month	**Solar Array Generation (kWh)**	**Total Member usage (house) (kWh)**	**Total Solar (kWh) PPEC received**	**Total Member usage from PPEC (kWh)**	**Billing ($52.95 Service Charge + $0.083/kWh or -$0.057 / kWh excess)**	**Total Charges**
January	510	1859	0	1349	$52.95 + $111.97	$164.92
February	1028	2467	0	1439	$52.95 + $119.44	$172.39
March	1526	1671	0	145	$52.95 + $138.69	$191.64
April	1402	1262	140	-140	$52.95 + ($7.98)	$44.97
May	1568	1332	236	-236	$52.95 + ($13.46)	$9.49
June	1432	1312	120	-120	$52.95 + ($6.84)	$46.10
July	1542	1252	290	-290	$52.95 + ($16.53)	$36.42
August	1452	1505	0	53	$52.95 + $4.40	$57.35
September	1378	1551	0	173	$52.95 + $14.36	$67.31
October	1020	1075	0	55	$52.95 + $4.57	$57.52
November	982	1310	0	328	$52.95 + $27.22	$80.17
December	602	1504	0	902	$52.95 + $74.87	$127.82
Total	14442	18100				
Sizing	79.80%					

Payback Example

- Assume a home that uses 15,000 kWh
- Install a 10 Kw-dc system
  - will produce about 12,000 kWh/year, or about 80% of the home's usage
  - install cost of $2.50/ W-dc-equal to roughly $25,000. After incentives, roughly $18,500
- Assume:
  - Retail rate of $0.083/kWh
  - Avoided cost rate of $0.057/kWh

Payback Example- Net Billing

- If 7% of solar kWhs are sent back to the grid, then we should expect the following solar values:
  - 7% x 12,000 = 840 kWh credited at $0.057 = $ 47.88
  - 93% x 12,000 = 11,160 kWh valued at $0.083 = $ 926.28
  - Total annual solar value = $ 974.16
  - Simple payback of 18.9 years at $2.50/W-dc install price

Step-By-Step Process

Before choosing a solar system, be sure your home is as energy efficient as possible.

- Investing in energy efficiency provides a faster return on your investment.
- By improving your home's energy efficiency first, you will reduce your overall energy use, and may reduce the size of PV system needed.

Step-By-Step Process

Make sure your roof is in tip-top shape.

a. If yours is older, you may want to repair or replace before installing a roof-top solar PV system.

b. Remember, a PV system may last up to 30 years; be sure your roof will last, too.

Step-By-Step Process

***Research solar and solar contractors thoroughly before investing in a system.**

A. Get at least 3 quotes before choosing a contractor.

B. Work closely with the cooperative for advice and assistance with interconnecting to the grid.

C. The cooperative can provide history of your energy use.

Step-By-Step Process

Call the cooperative before you go forward with the project, so you have a complete understanding of the billing changes.

Step-By-Step Process

When you have decided on a contractor, send in the proper application filled out completely, with the application processing fee.

Step-By-Step Process

After PPEC receives the application and processing fee:

- The cooperative will review your last 3 years of energy use and confirm it falls within our policy of sizing UP TO 80% of your previous 3-year 12-month average.
- Engineering will review the specifications of the proposed system and do a study to be sure our equipment can handle the power. If the system falls within our parameters, you will then get an approval to start construction.

Step-By-Step Process

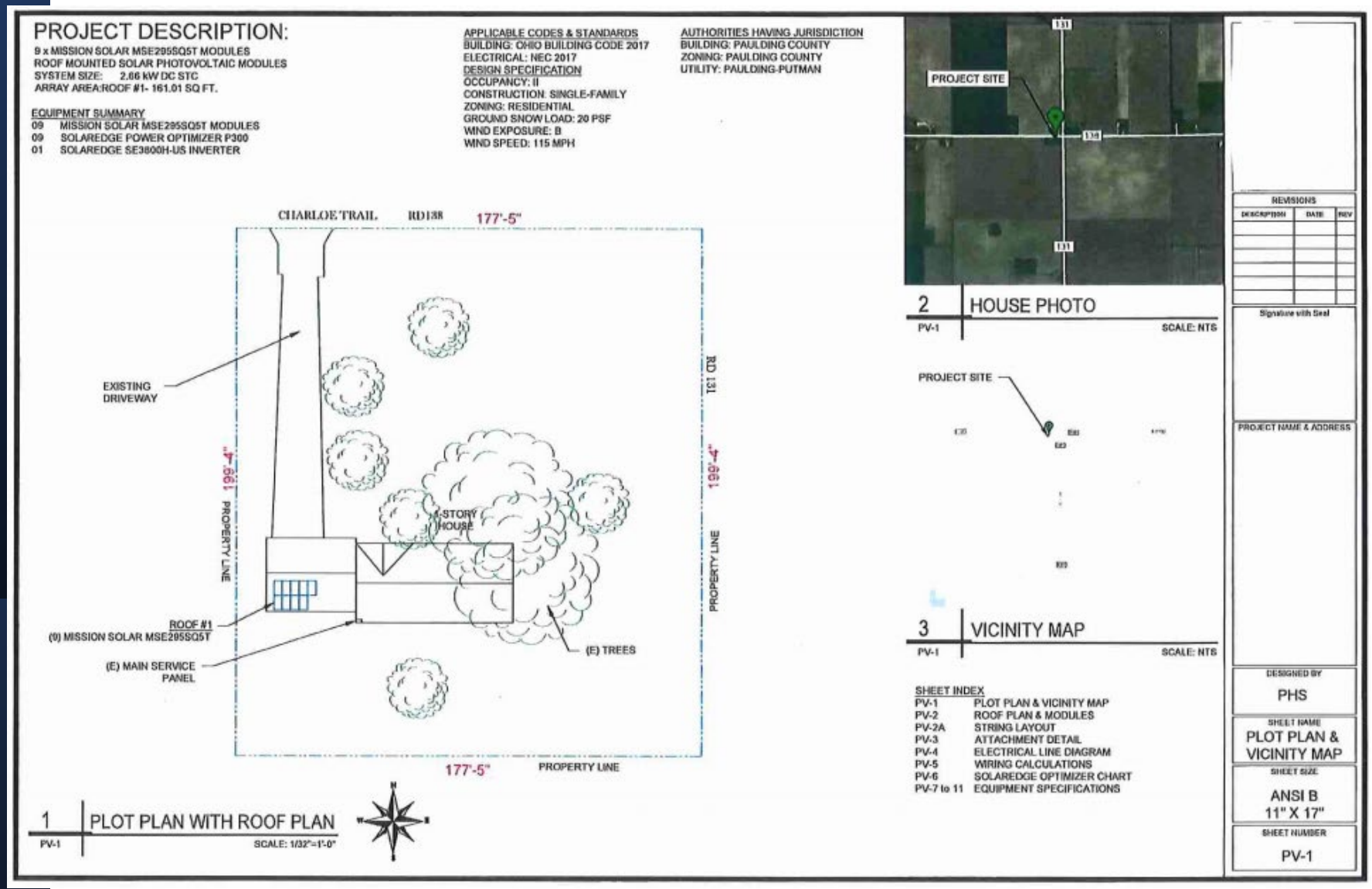
The interconnect agreements must be completed and signed before construction is completed (typically the interconnect agreements are handled by the contractor).

After completion, PPEC will make a site visit to test the disconnect unit and exchange the meter to a bi-directional meter.

Project complete.

Solar Array Installation & Requirements

Site Layout



PROJECT DESCRIPTION:

9 x MISSION SOLAR MSE295SQ5T MODULES
ROOF MOUNTED SOLAR PHOTOVOLTAIC MODULES
SYSTEM SIZE: 2.66 kW DC STC
ARRAY AREA:ROOF #1- 161.01 SQ FT.

EQUIPMENT SUMMARY
09 MISSION SOLAR MSE295SQ5T MODULES
09 SOLAREDGE POWER OPTIMIZER P300
01 SOLAREDGE SE3800H-US INVERTER

APPLICABLE CODES & STANDARDS
BUILDING: OHIO BUILDING CODE 2017
ELECTRICAL: NEC 2017
DESIGN SPECIFICATION
OCCUPANCY: II
CONSTRUCTION: SINGLE-FAMILY
ZONING: RESIDENTIAL
GROUND SNOW LOAD: 20 PSF
WIND EXPOSURE: B
WIND SPEED: 115 MPH

AUTHORITIES HAVING JURISDICTION
BUILDING: PAULDING COUNTY
ZONING: PAULDING COUNTY
UTILITY: PAULDING-PUTMAN

CHARLOE TRAIL RD138 177'-5"
EXISTING DRIVEWAY
199'-4" PROPERTY LINE
RD 131
199'-4" PROPERTY LINE
1-STORY HOUSE
ROOF #1
(9) MISSION SOLAR MSE295SQ5T
(E) MAIN SERVICE PANEL
(E) TREES
177'-5" PROPERTY LINE

1 PV-1 PLOT PLAN WITH ROOF PLAN
SCALE: 1/32"=1'-0"

PROJECT SITE

2 PV-1 HOUSE PHOTO
SCALE: NTS

PROJECT SITE

3 PV-1 VICINITY MAP
SCALE: NTS

SHEET INDEX

PV-1	PLOT PLAN & VICINITY MAP
PV-2	ROOF PLAN & MODULES
PV-2A	STRING LAYOUT
PV-3	ATTACHMENT DETAIL
PV-4	ELECTRICAL LINE DIAGRAM
PV-5	WIRING CALCULATIONS
PV-6	SOLAREDGE OPTIMIZER CHART
PV-7 to 11	EQUIPMENT SPECIFICATIONS

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

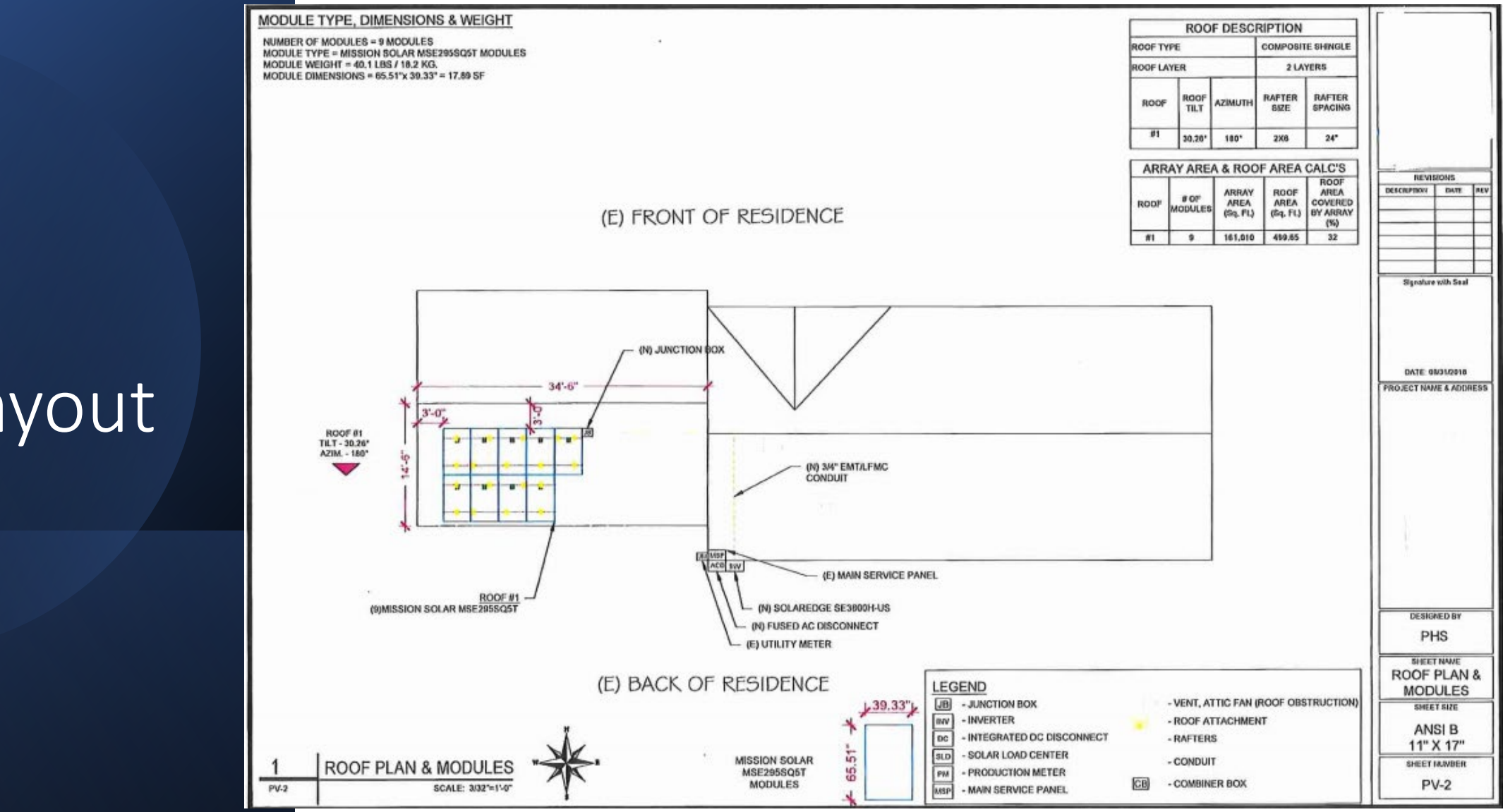
DESIGNED BY
PHS

SHEET NAME
PLOT PLAN & VICINITY MAP

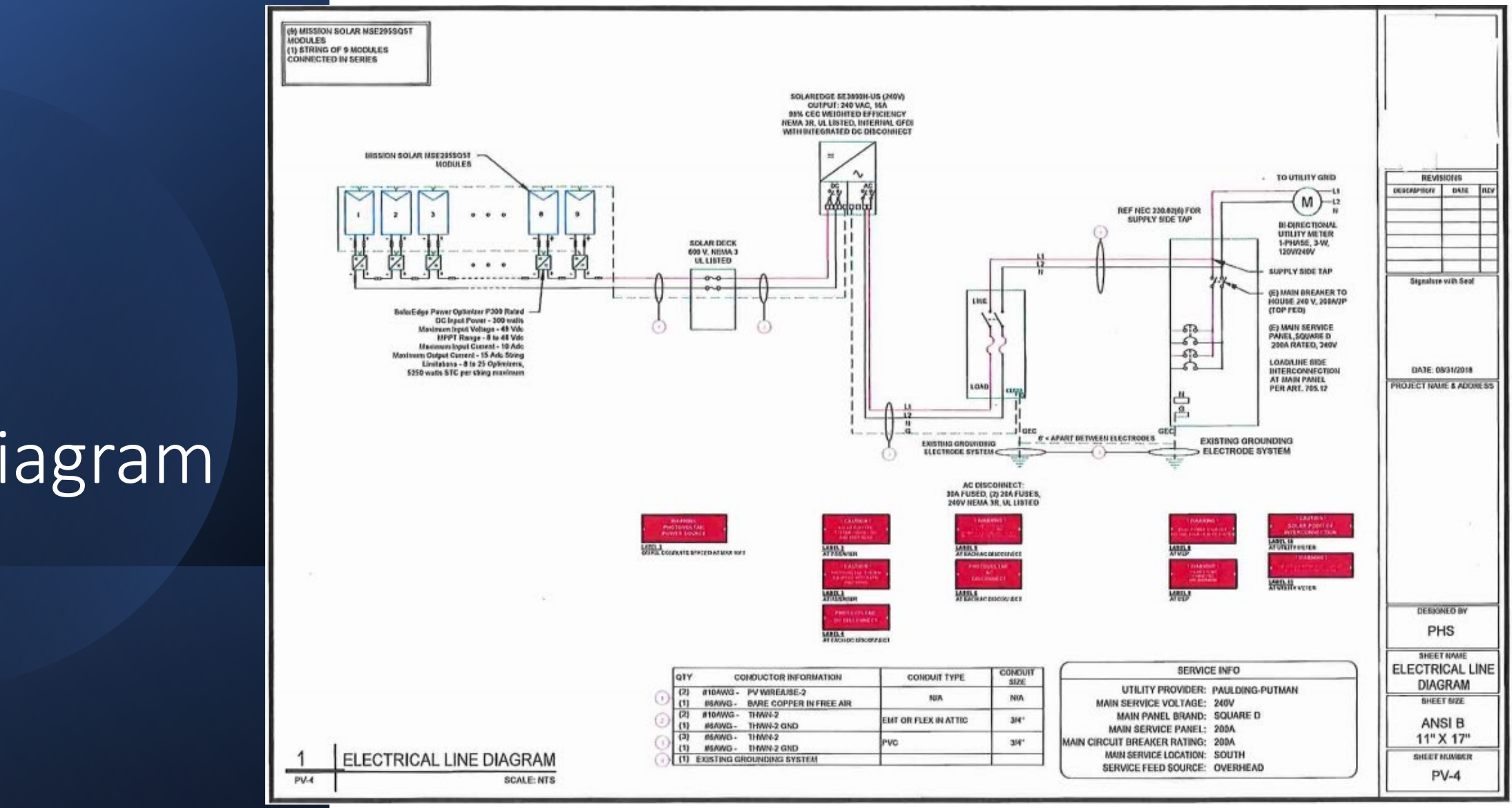
SHEET SIZE
ANSI B
11" X 17"

SHEET NUMBER
PV-1

Site Layout


MODULE TYPE, DIMENSIONS & WEIGHT
NUMBER OF MODULES = 9 MODULES
MODULE TYPE = MISSION SOLAR MSE295SQ5T MODULES
MODULE WEIGHT = 40.1 LBS / 18.2 KG.
MODULE DIMENSIONS = 65.51"x 39.33" = 17.89 SF
ROOF DESCRIPTION
ROOF TYPE
COMPOSITE SHINGLE
ROOF LAYER
2 LAYERS
ROOF
ROOF TILT
AZIMUTH
RAFTER SIZE
RAFTER SPACING
#1
30.26°
180°
2X8
24"
ARRAY AREA & ROOF AREA CALC'S
ROOF
OF MODULES
ARRAY AREA (Sq. Ft.)
ROOF AREA (Sq. Ft.)
ROOF AREA COVERED BY ARRAY (%)
#1
9
161.010
489.65
32
(E) FRONT OF RESIDENCE
(N) JUNCTION BOX
34'-6"
3'-0"
3'-0"
14'-6"
ROOF #1
TILT - 30.26°
AZIM. - 180°
(N) 3/4" EMT/LFMC CONDUIT
(E) MAIN SERVICE PANEL
(N) SOLAREDGE SE3800H-US
(N) FUSED AC DISCONNECT
(E) UTILITY METER
ROOF #1
(9)MISSION SOLAR MSE295SQ5T
(E) BACK OF RESIDENCE
39.33"
65.51"
MISSION SOLAR MSE295SQ5T MODULES
LEGEND
JB - JUNCTION BOX
INV - INVERTER
DC - INTEGRATED DC DISCONNECT
SLD - SOLAR LOAD CENTER
PM - PRODUCTION METER
MSP - MAIN SERVICE PANEL
- VENT, ATTIC FAN (ROOF OBSTRUCTION)
- ROOF ATTACHMENT
- RAFTERS
- CONDUIT
CB - COMBINER BOX
1
PV-2
ROOF PLAN & MODULES
SCALE: 3/32"=1'-0"
REVISIONS
DESCRIPTION
DATE
REV
Signature with Seal
DATE: 08/31/2018
PROJECT NAME & ADDRESS
DESIGNED BY
PHS
SHEET NAME
ROOF PLAN & MODULES
SHEET SIZE
ANSI B
11" X 17"
SHEET NUMBER
PV-2

Line Diagram



MSE PERC 60

gh Power PERC Rooftop Module

MISSION SOLAR ENERGY

Class Leading Output: 300W power

Advanced Technology: PERC and 4 busbars drive >18% module efficiency

Superior Aesthetics: All-black design coupled with outstanding power output

Certified Reliability: 3X IEC, salt mist, ammonia

5600 Pa snow load 175 mph wind rating *New!*

Buy American Act

roudly assembled in the USA

ission Solar Energy is headquartered San Antonio, TX with module cilities onsite. Our hardworking team lls Texas home and is devoted to oducing high quality solar products d services. Our supply chain cludes local and domestic vendors creasing our impact to the U.S. conomy.

Assembled in the USA

CERTIFICATIONS

C 61215/ IEC 61730/ IEC 61701 UL 1703

PowerGuard

e there are different certification requirements in different arkets, please contact your local Mission Solar Energy sales presentative for the specific certificates applicable to the oducts in the region in which the products are to be used.

Superior Aesthetics

MSE PERC 60's slick all-black design coupled with outstanding power output makes it ideal for DG installations including commercial and rooftop systems.

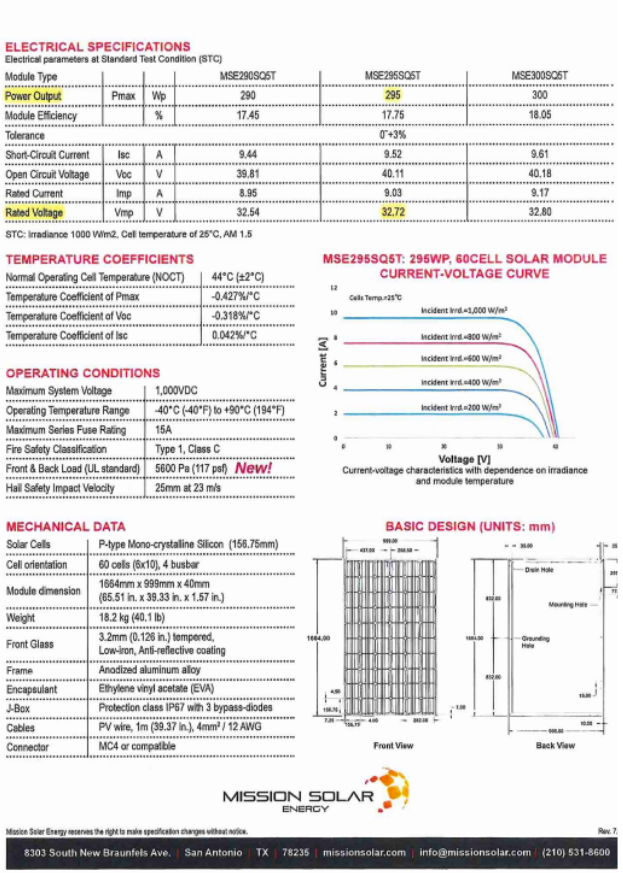
Outstanding performance with PERC

Passivated Emitter Rear Contact (PERC) technology provides excellent power output through advanced cell structure.

Best in class quality

Mission Solar Energy production lines are fully automated and include multiple quality checks throughout the production process.

25-YEAR LINEAR WARRANTY



ELECTRICAL SPECIFICATIONS

Electrical parameters at Standard Test Condition (STC)

Module Type			MSE290SQ5T	MSE295SQ5T	MSE300SQ5T
Power Output	Pmax	Wp	290	295	300
Module Efficiency		%	17.45	17.75	18.05
Tolerance				0~+3%	
Short-Circuit Current	Isc	A	9.44	9.52	9.61
Open Circuit Voltage	Voc	V	39.81	40.11	40.18
Rated Current	Imp	A	8.95	9.03	9.17
Rated Voltage	Vmp	V	32.54	32.72	32.80

STC: Irradiance 1000 W/m2, Cell temperature of 25°C, AM 1.5

TEMPERATURE COEFFICIENTS

Normal Operating Cell Temperature (NOCT)	44°C (±2°C)
Temperature Coefficient of Pmax	-0.427%/°C
Temperature Coefficient of Voc	-0.318%/°C
Temperature Coefficient of Isc	0.042%/°C

OPERATING CONDITIONS

Maximum System Voltage	1,000VDC
Operating Temperature Range	-40°C (-40°F) to +90°C (194°F)
Maximum Series Fuse Rating	15A
Fire Safety Classification	Type 1, Class C
Front & Back Load (UL standard)	5600 Pa (117 psf) *New!*
Hail Safety Impact Velocity	25mm at 23 m/s

MECHANICAL DATA

Solar Cells	P-type Mono-crystalline Silicon (156.75mm)
Cell orientation	60 cells (6x10), 4 busbar
Module dimension	1664mm x 999mm x 40mm (65.51 in. x 39.33 in. x 1.57 in.)
Weight	18.2 kg (40.1 lb)
Front Glass	3.2mm (0.126 in.) tempered, Low-iron, Anti-reflective coating
Frame	Anodized aluminum alloy
Encapsulant	Ethylene vinyl acetate (EVA)
J-Box	Protection class IP67 with 3 bypass-diodes
Cables	PV wire, 1m (39.37 in.), 4mm² / 12 AWG
Connector	MC4 or compatible

MSE295SQ5T: 295WP, 60CELL SOLAR MODULE CURRENT-VOLTAGE CURVE

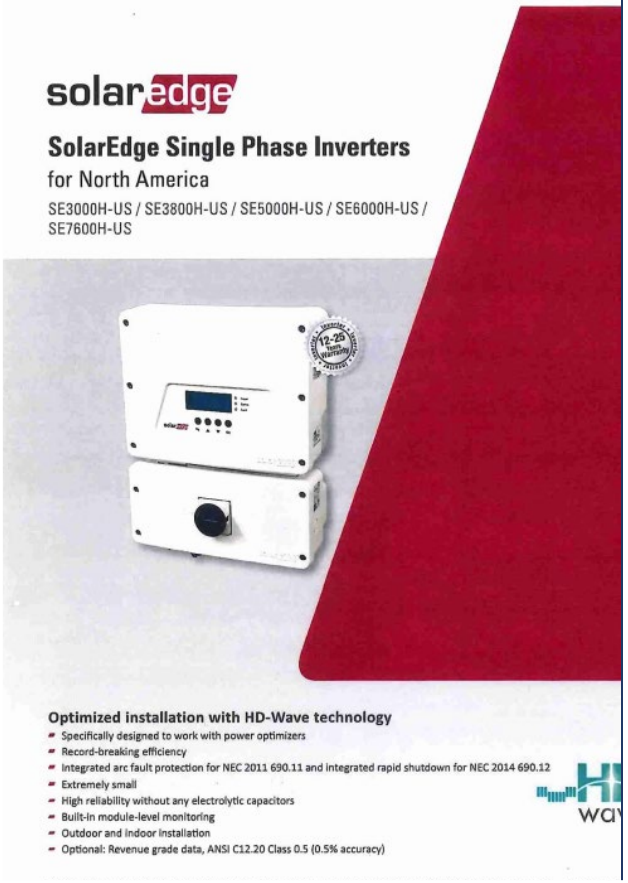
Current-voltage characteristics with dependence on irradiance and module temperature

BASIC DESIGN (UNITS: mm)

MISSION SOLAR ENERGY

Mission Solar Energy reserves the right to make specification changes without notice. Rev.7.

8303 South New Braunfels Ave. | San Antonio | TX | 78235 | missionsolar.com | info@missionsolar.com | (210) 531-8600



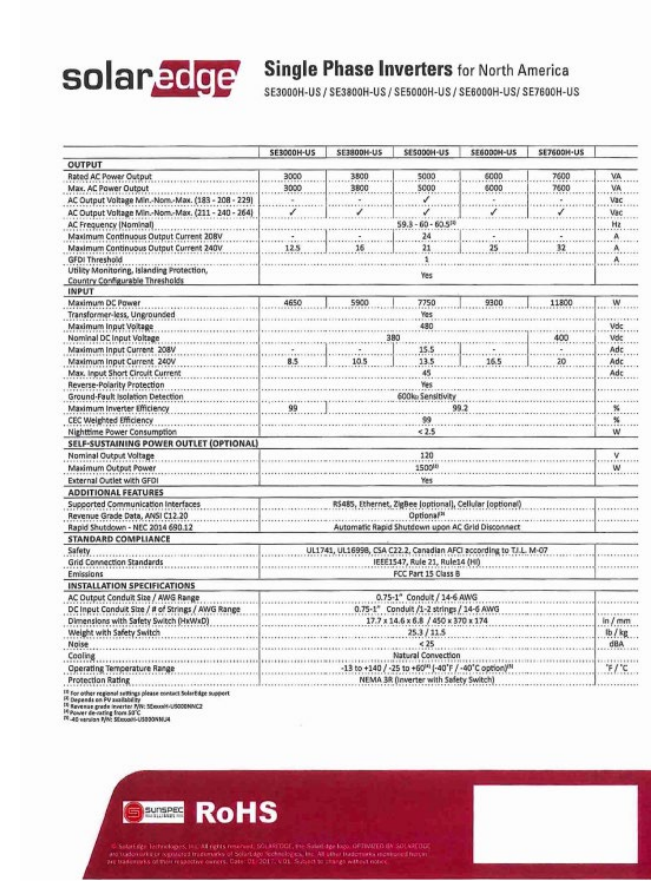
solaredge

SolarEdge Single Phase Inverters for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US / SE7600H-US

Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Integrated arc fault protection for NEC 2011 690.11 and integrated rapid shutdown for NEC 2014 690.12
- Extremely small
- High reliability without any electrolytic capacitors
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)



solaredge Single Phase Inverters for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US/ SE7600H-US

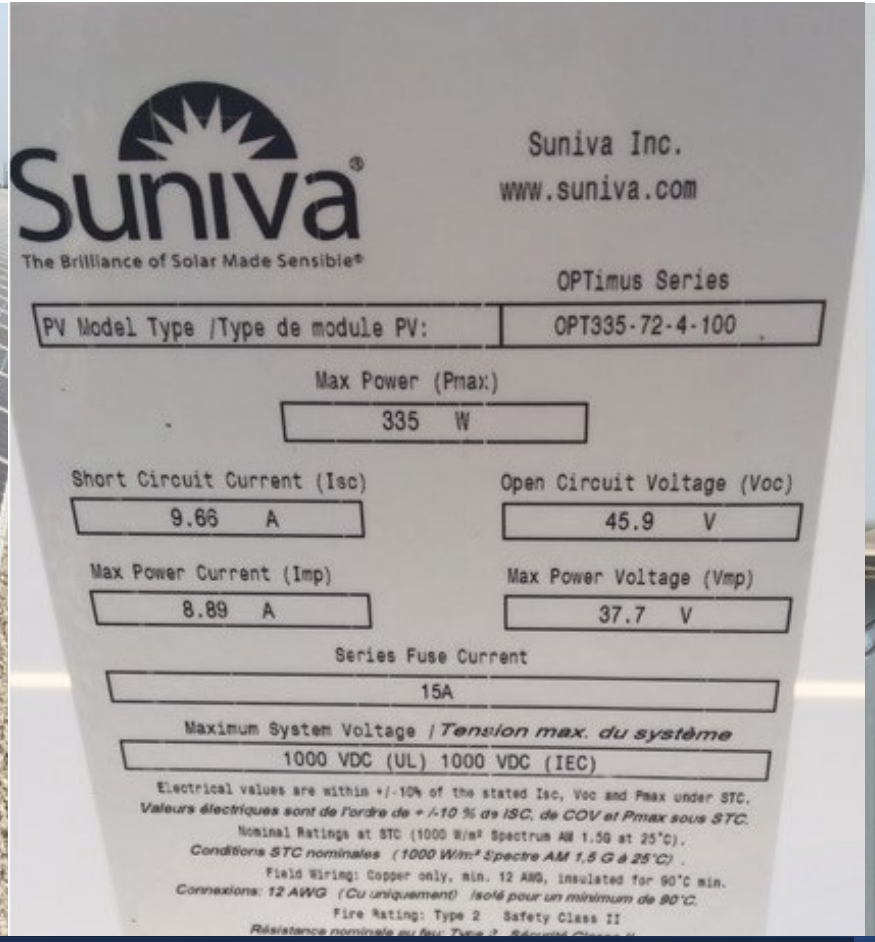
	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	
OUTPUT						
Rated AC Power Output	3000	3800	5000	6000	7600	VA
Max. AC Power Output	3000	3800	5000	6000	7600	VA
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	-	✓	-	-	Vac
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	Vac
AC Frequency (Nominal)			59.3 - 60 - 60.5[1]			Hz
Maximum Continuous Output Current 208V	-	-	24	-	-	A
Maximum Continuous Output Current 240V	12.5	16	21	25	32	A
GFDI Threshold			1			A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds			Yes			
INPUT						
Maximum DC Power	4650	5900	7750	9300	11800	W
Transformer-less, Ungrounded			Yes			
Maximum Input Voltage			480			Vdc
Nominal DC Input Voltage		380			400	Vdc
Maximum Input Current 208V	-	-	13.5	-	-	Adc
Maximum Input Current 240V	8.5	10.5	13.5	16.5	20	Adc
Max. Input Short Circuit Current			45			Adc
Reverse-Polarity Protection			Yes			
Ground-Fault Isolation Detection			600kΩ Sensitivity			
Maximum Inverter Efficiency	99		99.2			%
CEC Weighted Efficiency			99			%
Nighttime Power Consumption			< 2.5			W
SELF-SUSTAINING POWER OUTLET (OPTIONAL)						
Nominal Output Voltage			120			V
Maximum Output Power			1500[2]			W
External Outlet with GFDI			Yes			
ADDITIONAL FEATURES						
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)					
Revenue Grade Data, ANSI C12.20	Optional[3]					
Rapid Shutdown - NEC 2014 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect					
STANDARD COMPLIANCE						
Safety	UL1741, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07					
Grid Connection Standards	IEEE1547, Rule 21, Rule14 (HI)					
Emissions	FCC Part 15 Class B					
INSTALLATION SPECIFICATIONS						
AC Output Conduit Size / AWG Range	0.75-1" Conduit / 14-6 AWG					
DC Input Conduit Size / # of Strings / AWG Range	0.75-1" Conduit /1-2 strings / 14-6 AWG					
Dimensions with Safety Switch (HxWxD)	17.7 x 14.6 x 6.8 / 450 x 370 x 174					in / mm
Weight with Safety Switch	25.3 / 11.5					lb / kg
Noise	< 25					dBA
Cooling	Natural Convection					
Operating Temperature Range	-13 to +140 / -25 to +60[4] (-40°F / -40°C option[5])					°F / °C
Protection Rating	NEMA 3R (Inverter with Safety Switch)					

[1] For other regional settings please contact SolarEdge support
[2] Depends on PV availability
[3] Revenue grade inverter P/N: SExxxxH-US000NNC2
[4] Power de-rating from 50°C
[5] -40 version P/N: SExxxxH-US000NNU4

RoHS

Equipment Specifications

Interconnection Installation & Inspection



Inspection Process

Inspection Process

Net-Billing Meter

YOUR TURN:

QUESTIONS?