## Residential Rooftop Solar – Earth Day, Every Day!!

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New Jersey Agricultural Experiment Station

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# Outline

- Basics of Photovoltaics Operation
- Important Aspects of Roof Alignment
- "Net metering" as a Basic Concept
- Assessing Your House
- Considering "Community Solar"
- Other angles:
  - Adding storage??
  - Adding EV??

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## How do Solar Modules Work?

- "Photovoltaic Effect"
- →Photons of Sunlight are absorbed by semiconductors
- → Requires a "PN Junction" to generate electrical output and power.
- →Power Rating is quoted at maximum sunlight.





### **Electrical Characteristics**

STC	STP225-20/Wd	STP220-20/Wd	
Optimum Operating Voltage (Vmp)	29.6 V	29.5 V	
Optimum Operating Current (Imp)	7.61 A	7.46 A	
Open - Circuit Voltage (Voc)	36.7 V	36.6 V	
Short - Circuit Current (lsc)	8.15 A	8.05 A	
Maximum Power at STC (Pmax)	225 W	220 W	
Operating Temperature	-40 °C to +85 °C	-40°C to +85°C	

# Solar Resource by Region



Figure From: US DOE National Renewable Energy Laboratory

# Data for Newark NJ



Data replotted from: <u>http://rredc.nrel.gov/solar/old\_data/nsrdb/1991-2005/tmy3/</u> this database for a "Typical Meteorological Year"

# Department of Energy Typical Meteorological Year (TMY) Data Annual Summary

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Location	Latitude	Average Daily	rage Daily Average Daily		
		Global Diffuse		Direct	
		Horizontal	Horizontal	Horizontal	
		Irradiance	Irradiance	Irradiance	
		(kWh/m²*day)	(kWh/m²*day)	(kWh/m²*day)	
Wantage, NJ	<b>41.25</b> °	3.86	1.45	2.41	
New Brunswick, NJ	<b>40.49°</b>	3.98	1.45	2.53	
Millville, NJ	<b>39.41</b> °	4.15	1.55	2.60	

National Solar Radiation Database: <a href="https://nsrdb.nrel.gov/">https://nsrdb.nrel.gov/</a>





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Image credit: https://curbelolaw.com/how-much-are-solar-panels-in-new-jersey/

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### Google Project Sunroof

Solar API in Ma





## Fixed Tilt PV Array Design: Energy Output Impacts

- > 10 KW system size (arbitrary)
- Zip Code = 08854, Piscataway
- Latitude = 40.57
- Consider Southward Tilting:
  - Tilt = 0
  - Tilt = 15
  - Tilt = 20
  - Tilt = 30
  - "Ideal Tilt" = 37.3
- > Single Axis Tracking:



- 12,789 (12.6% better) <sup>110</sup>
- 13,106 (15.4% better)
- 13,506 (19.0% better)
- 13,590 (19.7% better)
- 14,697 (8.8% better than fixed/ideal)

https://pvwatts.nrel.gov/pvwatts.php

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Piscataway 08854

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- Solar Array
- Inverter
- Battery Storage
- EV Charging
- Storm Resilience

Photo credit Nissan





New Jersey's cleanenergy program		Press Room   Library   FAQs   Cal	endar   Newsletters   Contact Us   Site N	Map ce and Engineeri rw.MSE.Rutgers.edu
номе	RESIDENTIAL	COMMERCIAL, INDUSTRIAL AND LOCAL GOVERNMENT	RENEWABLE ENERGY	
RENEWABLE ENERGY	Renewable Energy		Find a Program	
SUCCESSOR SOLAR INCENTIVE PROGRAM (SUSI)	Important Links		Program Updates	
ADMINISTRATIVELY DETERMINED INCENTIVE PROGRAM (ADI)	<ul> <li>Transition Incentive Program Extension Notice</li> <li>Current Solar Reporting</li> <li>Utility Interconnection Contacts</li> </ul>	<ul> <li>SREC Pricing</li> <li>Solar Ownership and Financing Options</li> <li>Solar Complaint Form</li> </ul>	<ul> <li>Solar Scam Warning</li> <li>Successor Solar Incentive Program Order</li> </ul>	m
COMPETITIVE SOLAR INCENTIVE PROGRAM (CSI)	<ul> <li>Solar Transition</li> <li>The Solar Act</li> <li>SREC Tracking System</li> </ul>	<ul> <li>Metering Requirements</li> <li>Prevailing Wage Questions</li> <li>RPS Background Information</li> </ul>	<ul> <li>CEA Solar Transition Proceeding Other updates posted.</li> </ul>	
TRANSITION INCENTIVE PROGRAM (TI)	Solar Trade Ally  New Jersey Offshore Wind Strategic Plan		NJ Solar Installations Solar Installations	
SREC REGISTRATION PROGRAM (SRP)	In 2020 the New Jersey Board of Public Utilities (NJBPU) approved the final New Jersey Offshore Wind Strategic Plan, the State's comprehensive roadmap for achieving 7,500 megawatt (MW) of offshore wind energy by 2035. The plan was developed by Ramboll U.S. Corporation through an		182,962	
OFFSHORE WIND	extensive public stakeholder process. It presents wind industry that achieves net economic benefit: value, while also protecting the environment, con	recommendations on establishing an offsure s and gives New Jersey residents the best over all nmercial and recreational fishing interests, and	As of July 2023 over	
COMMUNITY SOLAR	mitigating the impacts of climate change. Learn n New Jersey Solar Programs	nore about offshore wind.	businesses nave installed a solar electric system.	
GRID MODERNIZATION	New Jersey is committed to supporting solar ene Program is the current solar program which allow	rgy. The Successor Solar Incentive (SuSI) /s new solar projects to register to earn New	Find a Trade Ally	
ENERGY STORAGE	Jersey Solar Renewable Energy Credits II (SREC New Jersey's former solar programs, the SREC F Incentive (TI) Program, through which they contir	C-II). Older projects may be registered in one of Registration Program (SRP) or the Transition nue to receive SRECs or TRECs. SRECs, TRECs.		
METERING AND INTERCONNECTION	and SREC-IIs represent the clean energy attribut project.	es of electricity generated from a solar energy	TAK I	
SOLAR PROCEEDINGS TOOLS AND RESOURCES	Legacy SREC Registration Program	(SRP)	Find a Select a contracto for an energy	и
SOLAR ACTIVITY REPORTS	Jersey prior to its close on April 30, 2020. Project SREC eligibility for the duration of the project's Q	is currently registered in the SRP may keep their qualification Life. The value of the SRECs available	today!	







### "Scam" Warning

The State of NJ/NJBPU does **not** have a program that offers free solar panel installation for residents of the state. Any claims that such a program exists are **false**. All current NJBPU sponsored Solar incentive programs can be found at <u>www.NJCleanEnergy.com/renewable-energy</u>.

We recommend you visit this link <u>Considering</u> <u>Solar? Understand Your Options | NJ OCE Web Site</u> (njcleanenergy.com) before you make any final decision.

# Presently Require "Net Metering"

- Annual Energy Usage is Baseline
- New Solar Should Only be Expected to Generate that SAME amount of Energy, or less than required by your home/system.
- Winter: → Solar array likely underperforms compared to energy needs.
- Summer: → Solar array generates more than needed and feeds into the distribution network.
  - $\rightarrow$  Meter runs "backward" when solar generates more than needed.

### MyEnergy Report - July > Inbox ×



MyEnergy@pseg.com Unsubscribe to me -





#### Hello

This month, you spent about **\$36 more on electricity** than the average household in your area. Just a few small changes could help increase your savings. Try one of the tips below.

Jun 15, 2023 - Jul 14, 2023

0 0

#### How am I doing?



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#### Who am I being compared to?

Group Size	Square Footage
1,264 Homes	1,500-2,100
🗗 Year Built	<u> </u>
1944-1954	Non-electric

#### Your electric use over time



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You're using **more electricity** this month compared to the same month last year. Over the past year, you've spent **\$1,628 more on electricity** than the most energy efficient households in your area. Find new ways to save in this report.



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RENEWABLE ENERGY		Find a Program
	Home » Renewable Energy	O Current Programs
	Community Solar	
PROGRAM (SUSI)	The Community Solar Energy Pilot Program er toles utility customers to participate in a solar	Program Updates
ADMINISTRATIVELY	energy project that is remotely located from a gir property.	Solar Scam Warning
DETERMINED INCENTIVE	See our community solar broch as to get started.	Successor Solar Incentive Program Order
PROGRAM (ADI)	Learn About Community Solar	CEA Solar Transition Proceeding
COMPETITIVE SOLAR INCENTIVE PROGRAM (CSI)	The Board is pleased to announce that it has launched the <b>Community Solar Project Finder</b> to connect interested customers with community solar projects that serve their area. Developed in	Other updates posted.
TRANSITION INCENTIVE PROGRAM	partnership with Sustainable Jersey, the Project Finder allows residents to search by ZIP code to view projects that are currently seeking subscribers.	NJ Solar Installations
(11)	g	Color Installations
SREC REGISTRATION PROGRAM (SRP)		182,962
OFFSHORE WIND		As of July 2023 over
PREVIOUS PROGRAMS		182,962 New Jersey homes & businesses have installed a
COMMUNITY SOLAR		solar electric system.
GRID MODERNIZATION		Find a Trade Ally
ENERGY STORAGE	The New Jersey Clean Energy Learning Center also has videos for developers and municipalities.	·
METERING AND INTERCONNECTION	Additional information on how community solar works is available on the Office of Energy Efficiency	N N N
	& Renewable Energy website.	and the
	A list of community solar subscriber organizations currently registered with the Board is available	Find a Select a contractor
TOOLS AND RESOURCES	nere.	Trade Ally efficient upgrade
SOLAR ACTIVITY REPORTS	You can view a sample utility bill for a residential community solar subscriber with PSE&G, JCP&L,	and the second se



## New Jersey Community Solar Project Finder



Enter your zip code to see a list of community solar projects that are available to residents in your zip code.

Find Community Solar Projects Near You

Community Solar FAQ and Glossary

#### What is Community Solar?

Community solar is for anyone who wants to benefit from solar energy generation without installing panels directly on their roofs. This is an ideal opportunity for renters, homeowners with shaded roofs, or anyone else that is unable to install their own solar array on their property to participate and benefit from the generation of renewable energy.

A community solar project is a solar array whose energy generation is financially divided among multiple participating subscribers. As a subscriber, you will receive a financial credit on your utility bill for the portion of power generated by the array on your behalf. Separately, you will be responsible for paying a subscription fee to the community solar project. Community solar projects are designed so that your utility bill credit is larger than the subscription fee, meaning that you save money!

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## New Jersey Community Solar Project Finder



## Enter your zip code to see projects serving your community:

Enter a value

Enter your zip code to see a list of community solar projects that are available in your municipality.

Some zip codes may not overlap perfectly with municipal boundaries. Community solar project sign-ups are by municipality, please check the chart to verify your eligibility.

Community solar subscribers can only subscribe to a project located in their electric utility service territory.

Not sure what some of the terms included in the chart below mean? See the glossary of common community solar terms.

### Science and Engineering www.MSE.Rutgers.edu Example for my Zip Code: 17 were offered

. . . .

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Subscriber Organization Developer Address/Project Description	Link to Project Website	Date Project Operational	Eligibility Requirements	Estimated Percent Customer Savings*	Subscription Contract Terms	Electric Utility Service Territory	Municipalities Served by Project
1 Wiley Subscriber Organization: Altus Power, LLC c/o Neighborhood Sun Project Developer: Altus Power, LLC Address/Project Description: 3.09 MW solar array on the rooftop at 1 Wiley Dr Somerset, NJ	<u>Click here for</u> <u>more</u> information and sign up.	11/1/2023	Credit check required? NO Automated payment required (credit/debit card)? YES Is project open to residents who live in master-metered buildings? YES	All customers 20% LMI customers: 20%	Subscription contract length: 20 years - You can cancel at any time Deposit or subscription fee: NO Is there a fee to leave project during contract period? NO Does percentage of savings change over life of contract? NO	Public Service Gas & Electric	Franklin, Piscataway, New Brunswick, North Brunswick, South Brunswick, Princeton, Montgomery, Rocky Hil Borough, Hillsborough, Millstone, Manville, Bridgewater, South Bound Brook Borough
BEMS Community Solar East Subscriber Organization: Perch Community Solar Project Developer:	<u>Click here for</u> <u>more</u> information and sign up.	Projected to be operational 11/04/2023	Credit check required? YES, only for non-LMI customers Automated payment required (credit/debit card)? YES Is project open to residents who live in master-metered	All customers 20.01% LMI customers 20.01%	Subscription contract length: 20 years Deposit or subscription fee: NO Is there a fee to leave project during contract period? NO	Jersey Central Power & Light	All the municipalities in Ocean County, Monmouth County, Mercer County and Burlington County

# Other Things Happening in NJ

- Grid-Scale Solar
- Dual-Use Solar (Ag + Solar) .... Still evolving.....
  - Fixed Tilt
  - Single Axis Trackers
  - Vertical Bifacial Arrays



# Standard Fixed Tilt Array Geometrics

For long rows only really care about vertical placement of shadow line

X<sub>sun</sub> component doesn't influence shadow



### Vineyard in France









North

### Vertically mounted, double rows of bifacial panels

https://www.next2sun.de/



# Conclusion

### **>** Solar is here and READY.

> NJ programs continue to incentivize solar on your home.

> Other programs incentivize EV ownership and other energy conservation measures.

Thank You!!! Dunbar P. Birnie, III Rutgers University dunbar.birnie@gmail.com