SOLAR ELECTRIC INVESTMENT ANALYSIS SERIES

Value of Electricity

Agricultural Energy Efficiency Initiative of
Virginia Cooperative Extension / Virginia Tech
December, 2017

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Program Overview

- Electricity value varies based on location and timing. Rate structures can be very simple to very complex
- Net metering and some of the many forms it can take
- Types of Solar PV grid interconnection
- How policy impacts the value of electricity

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DISCLAMER:

This presentation and/or the information provided is not meant and should not serve as financial or legal advice and should only be used as an educational resource. Be sure and consult with your financial advisor, tax accountant, and/or attorney before signing an agreement.

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How Are You Charged for Electricity?

- Energy Charge – This charge covers the cost of producing energy (kWh). A photovoltaic solar install will reduce this expense.
- Fixed (Basic) Charge – This fee covers a portion of infrastructure costs. A photovoltaic solar system will not reduce this charge.
- Demand Charge – Covering peak demand (both daily and seasonal) requires that power plants be available to provide energy for relatively short durations. A photovoltaic solar system may reduce this fee, but often PV does not align with peak demand charges.

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How Do You Estimate Energy Savings?

Option 1: Add and Divide

Customer Charge	$7.00
Distribution Related Charges (Demand)	$548.29
Cost Recovery Charges	$84.92
Energy Charge (consumption)	$761.14
Total Bill Amount Due	**$1,401.35**
Total kWh Usage	10,022
Assumed value applied to every kWh to calculate energy Savings	$0.140

or

Option 2: Subtract and Divide

Total Bill Amount Due	$1,401.35
Distribution Related Charges (Demand)	$548.29
Cost Recovery Charges	$84.92
Customer Charge	$7.00
Energy Charge (consumption)	**$761.14**
Total kWh Usage	10,022
Assumed value applied to every kWh to calculate energy Savings	$0.076

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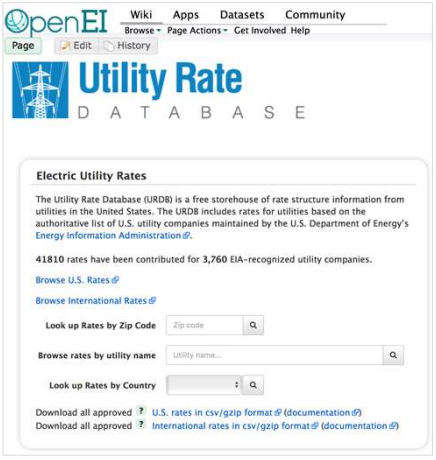
What is Your Rate?

Utility Rate Database provides rate structure information for over 3,700 U.S. utilities. Rates are updated annually by NREL under funding from the U.S. Department of Energy, in partnership with Illinois State University's Institute for Regulatory Policy Studies.



http://en.openei.org/wiki/Utility_Rate_Database

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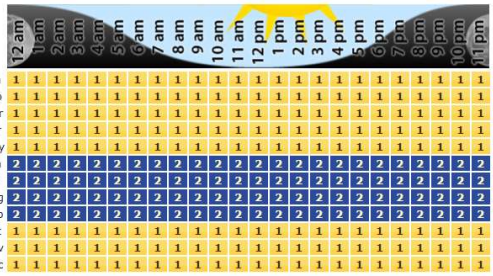
Tiered Energy Usage Charge Structure

Period	Tier	Max Usage	Max Usage Units	Rate $/kWh	Adjustments $/kWh	Sell $/kWh
1	1		kWh	0.09557	-0.00685	
2	1		kWh	0.11049	-0.00685	

Fuel Adjustments Monthly ($/kWh)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Weekday Schedule



Source: OpenEI Utility Rate database: https://openei.org/wiki/Main_Page

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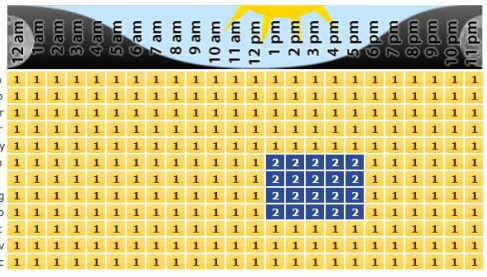
Tiered Energy Usage Charge Structure

Period	Tier	Max Usage	Max Usage Units	Rate $/kWh	Adjustments $/kWh	Sell $/kWh
1	1		kWh	0.09883		
2	1		kWh	0.28135		

Fuel Adjustments Monthly ($/kWh)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Weekday Schedule



Source: OpenEI Utility Rate database: https://openei.org/wiki/Main_Page

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Before Net Metering

PURPA

Public Utility Regulatory Policies Act

- Federal law passed in 1978. Forced public utilities to connect renewable energy systems to their grid
  - Facilities have to be Qualifying Facility under FERC (Federal Energy Regulatory Commission)
  - Didn't have to pay more than avoided cost
  - Avoided cost – what it costs the utility to generate the electricity or purchase it elsewhere (usually a fraction of the retail cost)
  - Retail costs include all transmission infrastructure, personnel and O&M.
  - In Nebraska
    - Avoided cost ~3-4 cents per kWh
    - Retail cost ~8-10 cents per kWh

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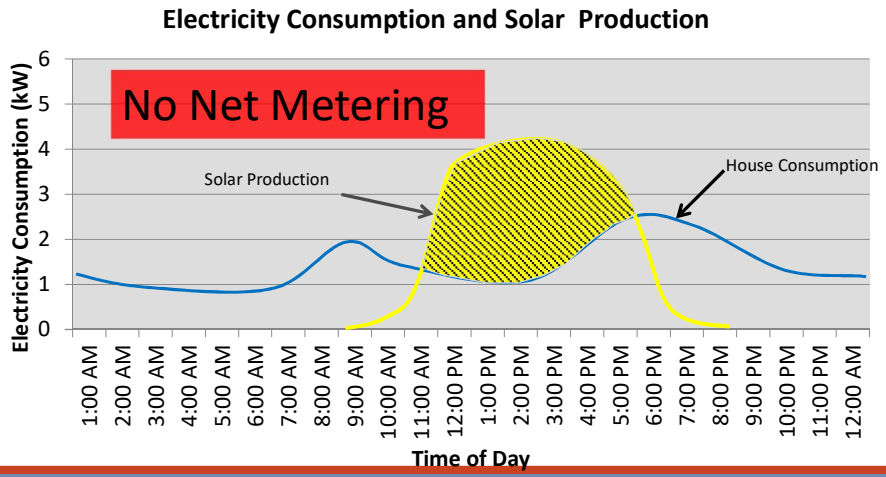
Net Metering



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Net Metering

Net metering is an electricity policy for consumers who own (generally small) renewable energy facilities (such as wind, solar power etc). "Net", in this context, is used in the sense of meaning "what remains after deductions" — in this case, the deduction of any energy outflows from metered energy inflows. Under net metering, a system owner receives retail credit for **at least a portion** of the electricity they generate.

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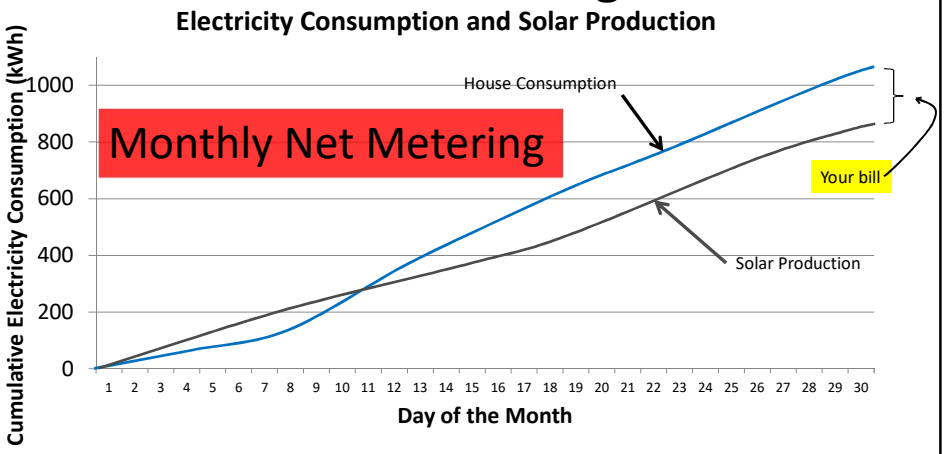
Net Metering



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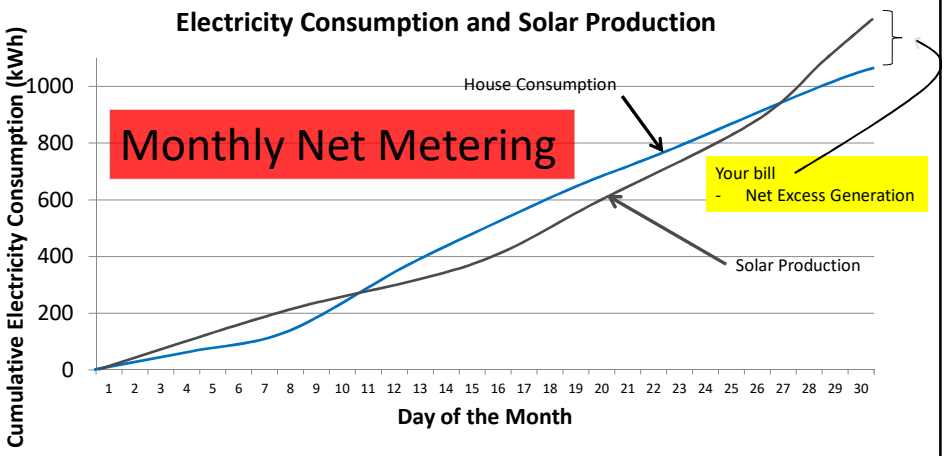
Net Metering



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Net Metering – What's the Value of Energy Savings

Net metering is a billing arrangement where customers who produce their own electricity can receive a credit on their electric utility bills for any extra electricity produced. In Ohio:

- The net metering credit is limited to kilowatt-hour (kWh) charges only, customers are not reimbursed for distribution or transmission services.
- Demand (kilowatt) meter charges will not be reimbursed.
- Compensation for Net Excess Generation varies based on the utility.

Source: PUCO Net Metering FAQ, 2016.
Retrieved from: www.puco.ohio.gov

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Net Metering – What's the Value of Energy Savings

Net metering is a billing arrangement where customers who produce their own electricity can receive a credit on their electric utility bills for any extra electricity produced. In Nebraska:

- The net metering credit is totaled at the end of each billing period many utilities don't separate demand charge so credit applies at full retail rate.
- Compensation for Net Excess Generation varies based on the utility but policy says it is paid at the "avoided cost" rate.

Source: Nebraska Net Metering Law

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Net Metering – What's the Value of Energy Savings

Net metering is a billing arrangement where customers who produce their own electricity can receive a credit on their electric utility bills for any extra electricity produced. In Virginia:

- Net metering credit is for full retail rate.
- Credit for Net Excess Generation is rolled over to the next month. At the end of the year customer generator can decide to roll over or take payout at "avoided cost" or higher rate.
- Systems less than 10 kW are not charged standby fee. Systems greater than 10 kW (AC) are charged Standby fee. (example for Dominion Virginia Power $2.79 per kW monthly distribution standby charge and $1.40 per kW monthly transmission standby)
  - This would add $62.85 per month to a 15 kW system.

Source: http://dsireusa.org

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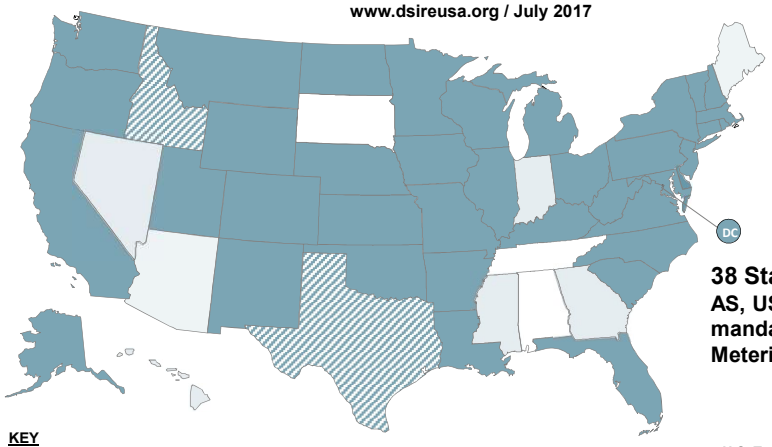
Net Metering

www.dsireusa.org / July 2017



38 States + DC, AS, USVI, & PR have mandatory Net Metering rules

KEY

- State-developed mandatory rules for certain utilities (38 states + DC+ 3 territories)
- No statewide mandatory rules, but some utilities allow net metering (2 states)
- Statewide distributed generation compensation rules other than net metering (7 states + 1 territory)

U.S. Territories:

AS | PR | VI | GU

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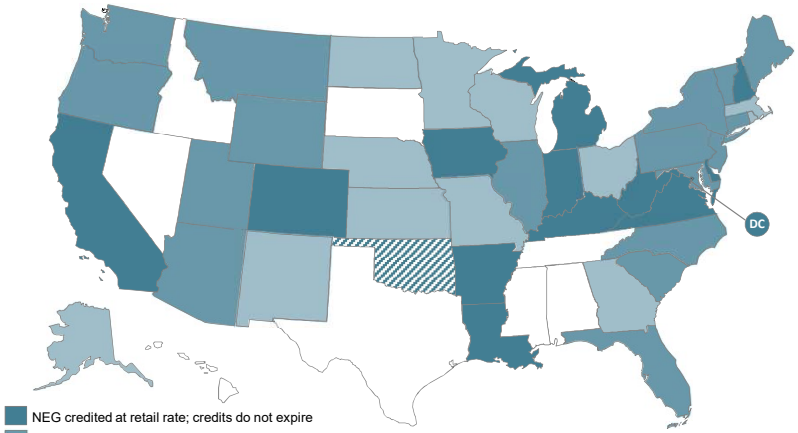
Customer Credits for Monthly Net Excess Generation (NEG) Under Net Metering

www.dsireusa.org / July 2016



- NEG credited at retail rate; credits do not expire
- NEG credited at retail rate at first, then credits expire or are reduced (e.g., to the avoided cost rate at the end of year)
- NEG credited at less than retail rate (e.g., avoided cost rate)
- NEG is not compensated
- No statewide mandatory net metering rules

NOTE: *The map shows NEG credits under statewide policies for investor-owned utilities (IOUs); other utilities may offer different NEG credit amounts. IOUs in HI, NV, MS, and GA have other policies for compensating self-generators. Some IOUs in TX and ID offer net metering, but there is no statewide policy. IOUs in WI differ in their treatment of NEG.*

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Net Metering – Comparison <10 kW

-50 -100

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Consumption	600	700	700	700	700	950	1000	1100	1000	800	750	600
Production	300	350	450	750	750	750	800	700	600	550	400	300
Bill (kWh)	300	350	250	-50	-50	100	200	400	400	250	350	300
VA	$27	$31.50	$22.50	$0	$0	$11	$22	$44	$36	$22.50	$31.50	$27
NE	$27	$31.50	$22.50	-$1.50	$-1.50	$22	$22	$44	$36	$22.50	$31.50	$27
No NM	~$40	~$47	~$43	~$29	~$38	~$63	~$66	~$82	~$63	~$47	~$50	~$40

Virginia – end of year you paid $275 plus base fees, taxes, etc.
Nebraska – end of year you paid $287 plus base fees, taxes, etc.
No Net Metereing – you paid $608 plus base fees, taxes, etc.
No Solar - $934 plus base fees, taxes, etc.

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Net Metering – Comparison >10 kW

	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	Annual
Consumption	1800	2100	2100	2100	2400	2850	3000	3300	3000	2400	2250	1800	29,100
Production	1000	1000	1200	1700	1800	1900	2100	2000	1700	1400	1200	1000	18,000
Bill (kWh)	800	1100	900	400	600	950	900	1300	1300	1000	1050	800	
VA*	$135	$162	$144	$99	$117	$167	$162	$206	$206	$153	$157	$135	$1,842
NE	$72	$99	$81	$36	$54	$105	$99	$143	$143	$90	$95	$72	$1,088
No NM	$117	$144	$135	$113	$135	$209	$215	$253	$237	$153	$149	$117	$1,975
No Solar	$162	$189	$189	$189	$216	$314	$330	$363	$330	$216	$203	$162	$2,862

*Standby Fee of $62 per month in VA

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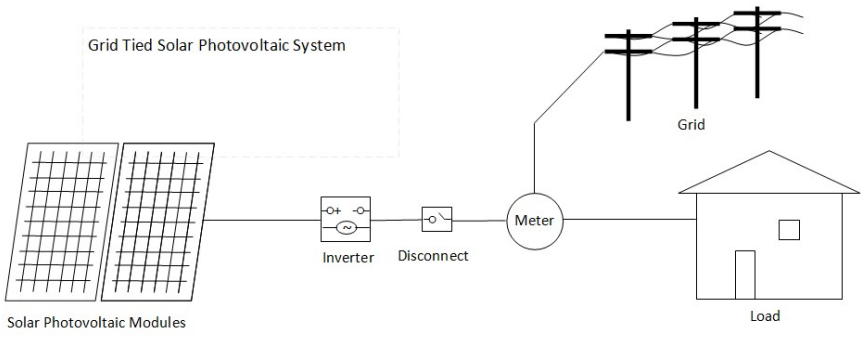

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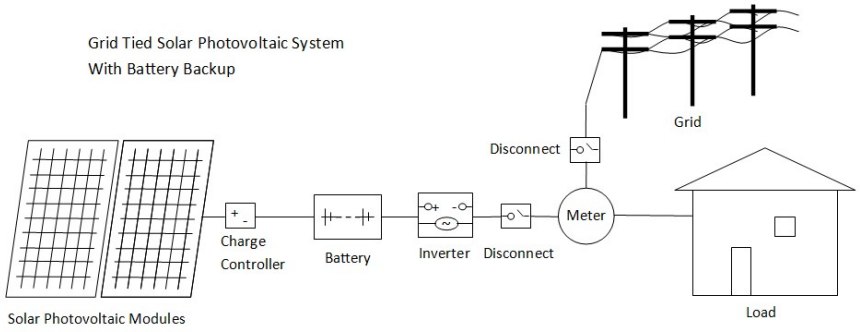

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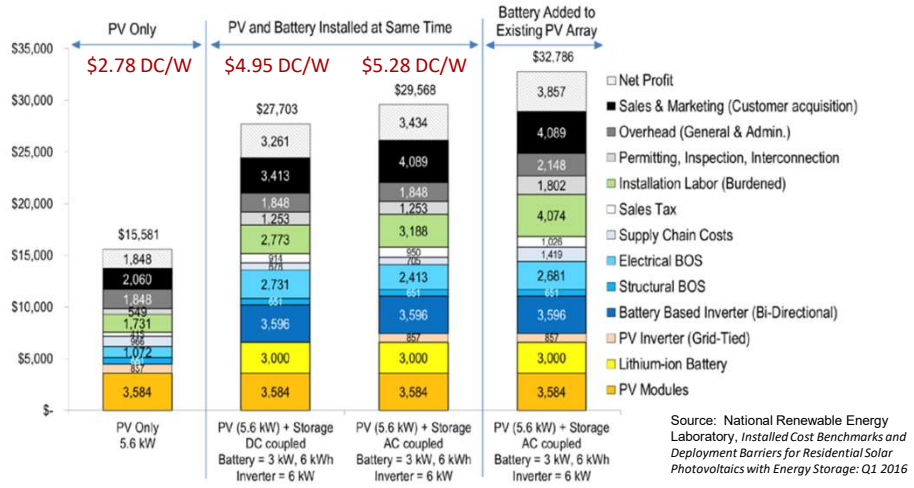

Source: National Renewable Energy Laboratory, *Installed Cost Benchmarks and Deployment Barriers for Residential Solar Photovoltaics with Energy Storage: Q1 2016*

Figure ES-1. Modeled total installed cost and price components for residential PV-plus-storage systems, small-battery case (2016 U.S. dollars)

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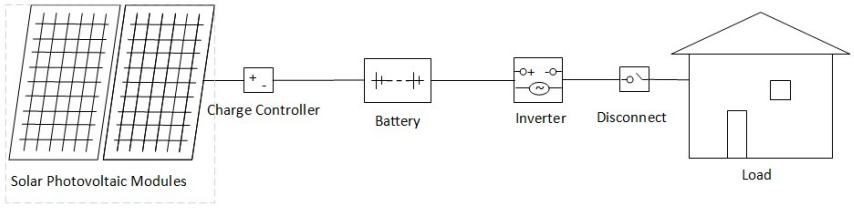
Off Grid Solar Photovoltaic System



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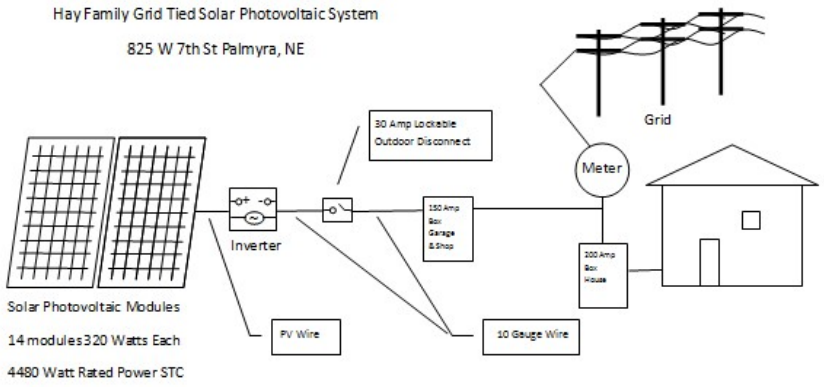

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Net Metering in Michigan: Summary & Resources

Applies only to rate-regulated utilities and alternative electric suppliers. The designation "rate-regulated utility" presently includes investor-owned utilities and rural electric distribution cooperatives that have not opted for member regulation.

- Net metering System Capacity Limit: 150 kW
- Net Excess Generation (NEG):
  - Systems of 20 kW or less – NEG may be carried forward to the next billing period at the retail rate.
  - Systems up to 150 kW - allows NEG carry over at the power supply component of the retail rate (i.e., energy avoided cost)
- http://programs.dsireusa.org/system/program/detail/5773
- http://www.michigan.gov/netmetering

Source: programs.dsireusa.org/system/program/detail/5773

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Net Metering: Read Before You Sign!

If the Electric Generating Facility annually generates 120% or more of the consumers annual electric energy requirements, determined as set forth above, the Electric Generating Facility's output will be presumed to be reasonably anticipated to exceed the annual electric energy requirements of the consumers electric consuming facilities located on the premises, and the power company may, in its sole discretion, elect to cease providing electric service to the consumer pursuant to the power company's net metering rate schedule, and instead elect to provide electric service to the consumer at the rate and upon the terms and conditions set forth in the power company backup in supplementary electric service rate schedule, and require the consumer to sell the output of the electric generating facility to POWER Co Xyz on an hourly basis at the avoided cost rate as determined by POWER Co Xyz in its sole discretion.

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Net Metering: Read Before You Sign!

The consumer shall pay the power company for service hereunder at the rate and upon the terms and conditions set forth in the power companies net metering rate schedule, which is attached hereto and made a part of this agreement as fully restated herein. The power company's net metering reschedule will be superseded by any new or amended net metering rate schedule or any successor rate schedule as approved from time to time by the Board of Trustees of the power company.

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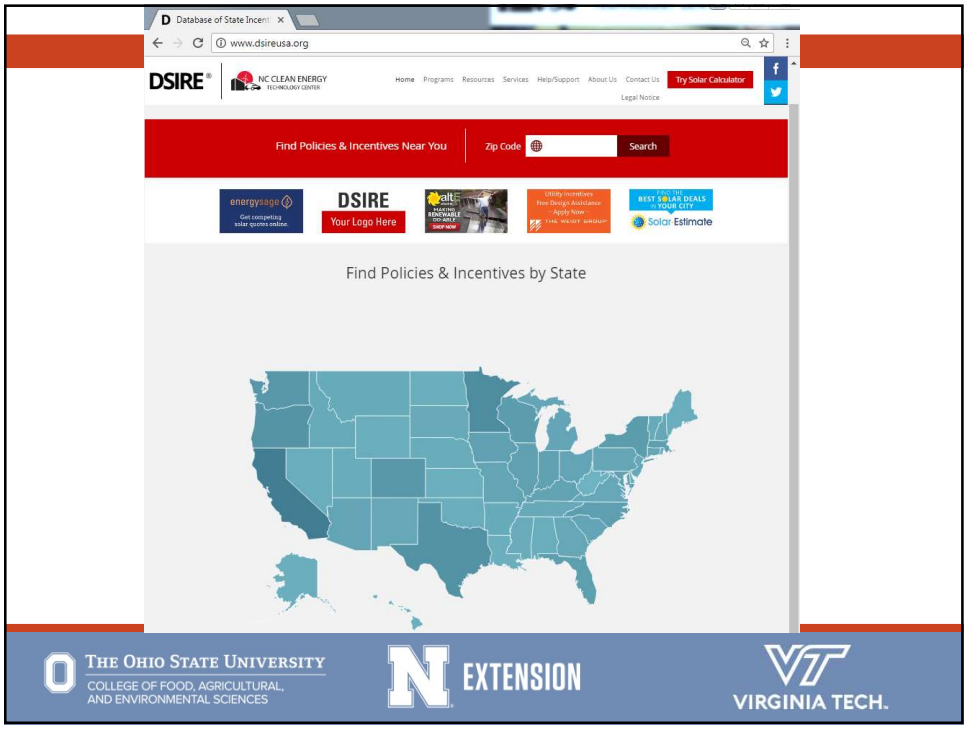

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To maximize the value of a unit of energy (kWh) your solar system generates, you must use it!

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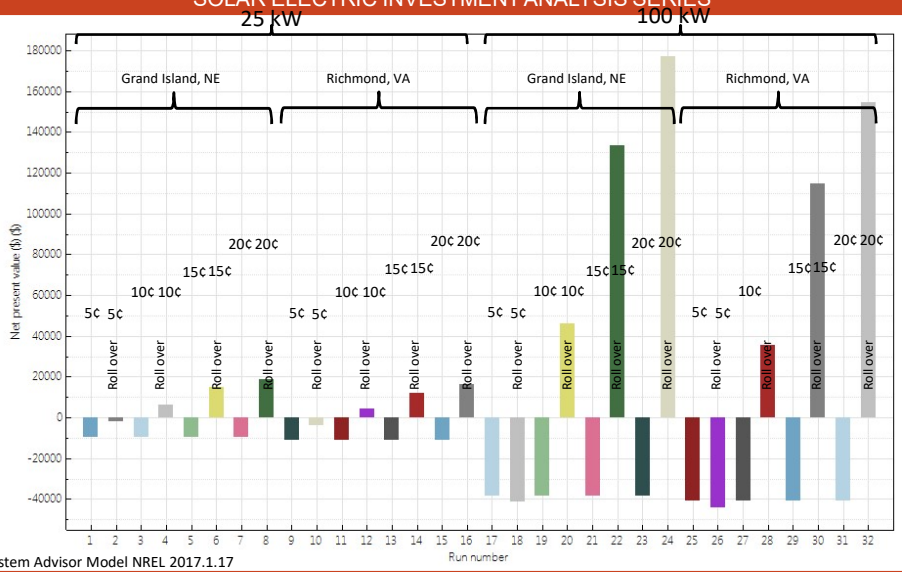

System Advisor Model NREL 2017.1.17

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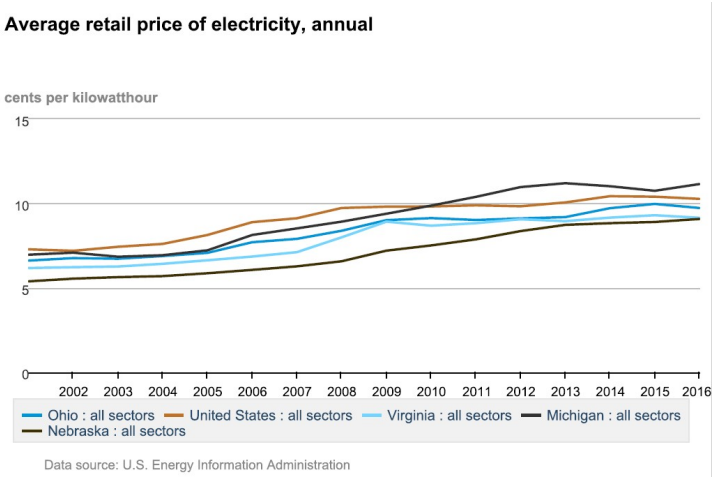
Energy Escalation Rates



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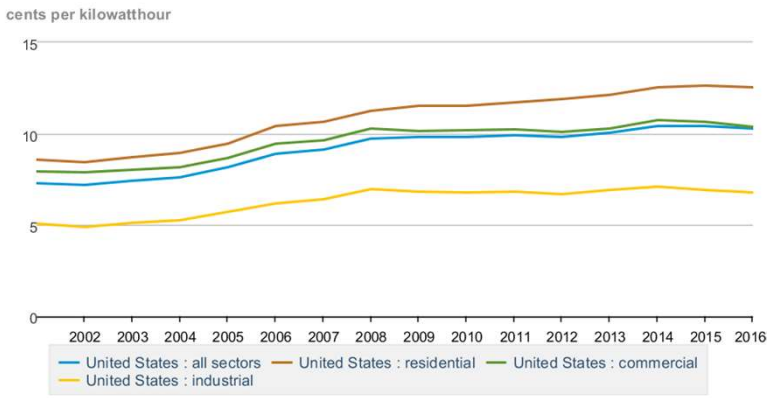
Average retail price of electricity, annual



Data source: U.S. Energy Information Administration

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Energy Escalation Rates

- Nominal energy escalation rate estimates the annual rate energy prices will increase including overall inflation.
- Real energy escalation rate is the rate of change in energy prices with the overall inflation rate subtracted.

2001 - 2015	U.S	Ohio	Michigan
Nominal energy escalation rate	2.9%	3.4%	3.6%
Average annual inflation rate (U.S.)	2.31%	2.31%	2.31%
Real energy escalation rate	0.59%	1.09%	1.29%

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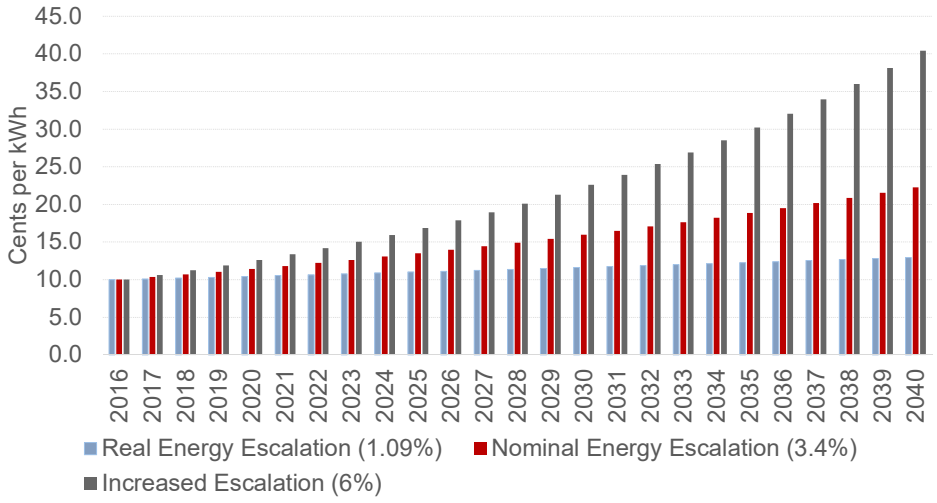
Comparison of Future Energy Rates Based on Escalation Assumptions

Benchmarked at Ohio 2015 rate of 9.98 cents/kWh (all sectors)



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Additional Resources

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Thank You!

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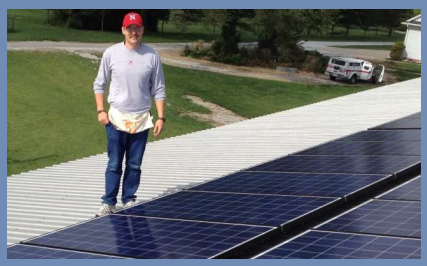

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