



# Behind-the-Meter Projects: Overview

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# Today's Goals

## Behind-the Meter (BTM) Power Projects

- What they are
- Why they are desirable

## Incentives, Net Metering, and other Policies

- How they work

## How to Scope Projects

- Sizing of systems
- Economics

## Solar photovoltaics (PV) business structures

- Solar PPA or lease
- Direct ownership



# What is Behind-the-Meter Power Generation?

Generating power closer to the load avoids transmission and distribution losses and can increase resiliency if designed right



1. Distributed generation (DG) is located on the distribution system
  - a) “Behind-the-meter,” on the customer side of the meter
  - b) Interconnected to the utility distribution system, on the utility side of the meter
2. Utility-scale generation is interconnected to the utility transmission system



## Behind the Meter Projects Provide:

- Energy cost savings,
- Control over project operations and maintenance,
- Self-consumption of distributed generation (usually solar PV),
- Visible commitment to sustainability (with solar PV), and
- Resiliency (with battery storage).

# BTM Project Screening Best Practices

- Identify the relevant load
- Identify the project site
  - Rooftop or ground mount
- Characterize the solar resource
- Evaluate technology options
- Estimate the economics
- Identify financing alternatives
- **Engage your utility early**

NREL Technical Assistance is Available:

<https://www.energy.gov/indianenergy/technical-assistance>



# Incentives, Net Energy Metering (NEM), and Other Policies

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State and utility policies can provide support to all tribal projects.



## Understand Potential Incentives

### Incentive Provider

- Utility
- State
- Federal (tax credits only)

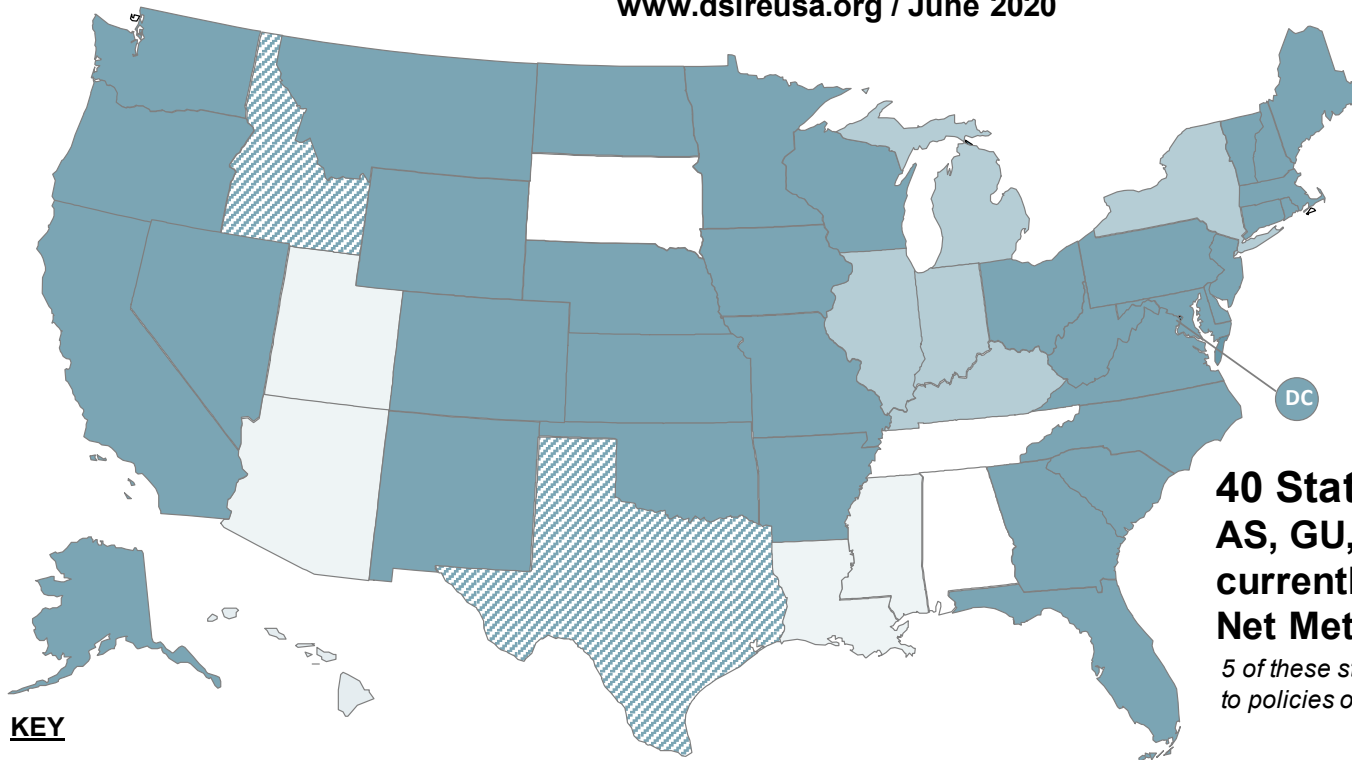
### Type of Financial Incentive

- Upfront amount (\$ or %)
- Performance-based (per kWh)
- Cash or tax credit

<https://www.dsireusa.org/>

# Net Metering

www.dsireusa.org / June 2020



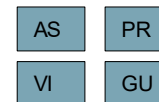
**40 States + DC,  
AS, GU, PR, & USVI  
currently have mandatory  
Net Metering rules**

*5 of these states are in transition  
to policies other than net metering*

## KEY

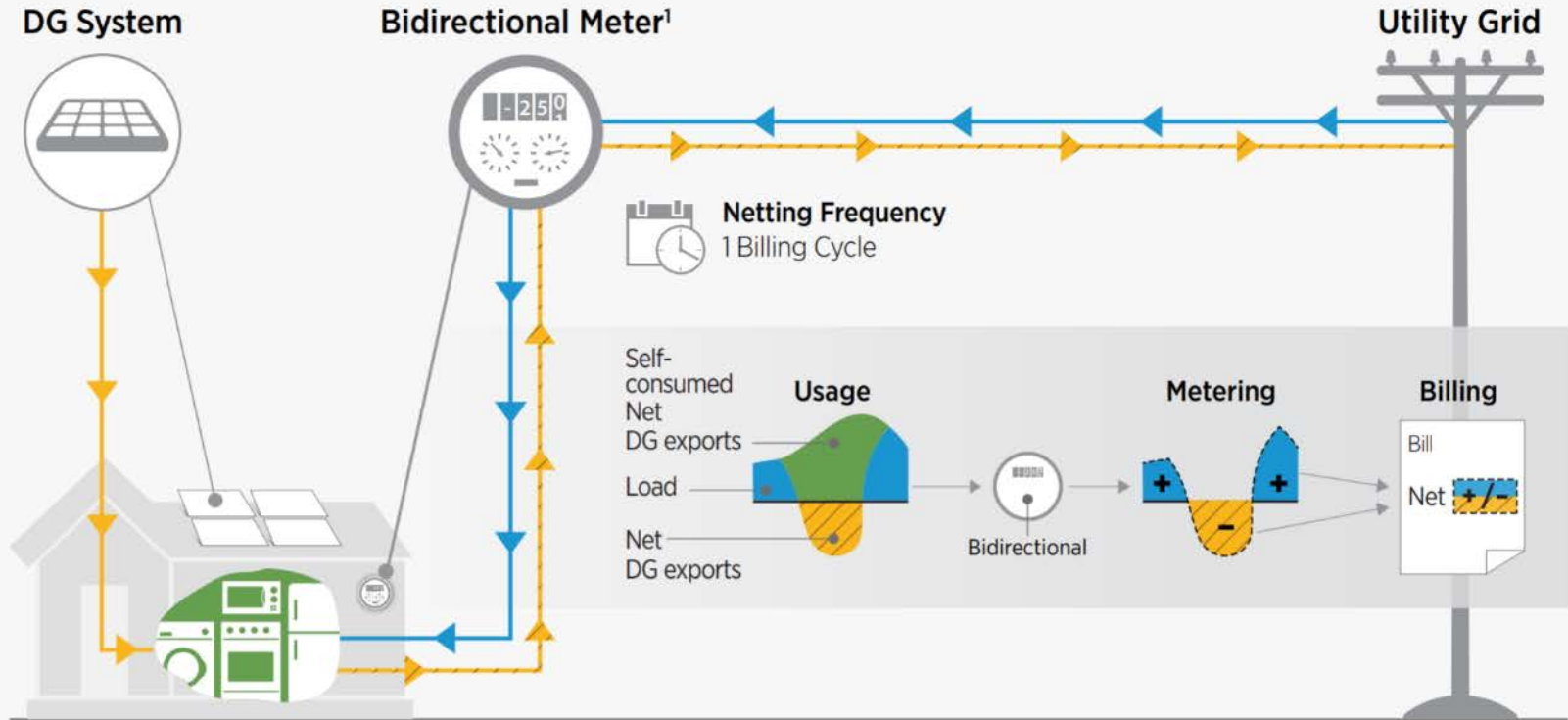
- State-developed mandatory rules for certain utilities (35 states + DC+ 4 territories)
- In transition to statewide distributed generation compensation rules other than net metering (5 states)
- Statewide distributed generation compensation rules other than net metering (5 states)
- No statewide mandatory rules, but some utilities allow net metering (2 states)

## U.S. Territories:





# NET ENERGY METERING



- ← Grid electricity
- ← Gross DG production
- ← Net DG exports

Source: NREL

<https://www.nrel.gov/docs/fy18osti/68469.pdf>

<sup>1</sup> Measures net consumption over one billing cycle.

# NEM

## Excess Generation

BTM PV systems generally meet the average annual load. Some months it will generate more than demand and some months less. Treatment of excess generation is an important NEM design element.



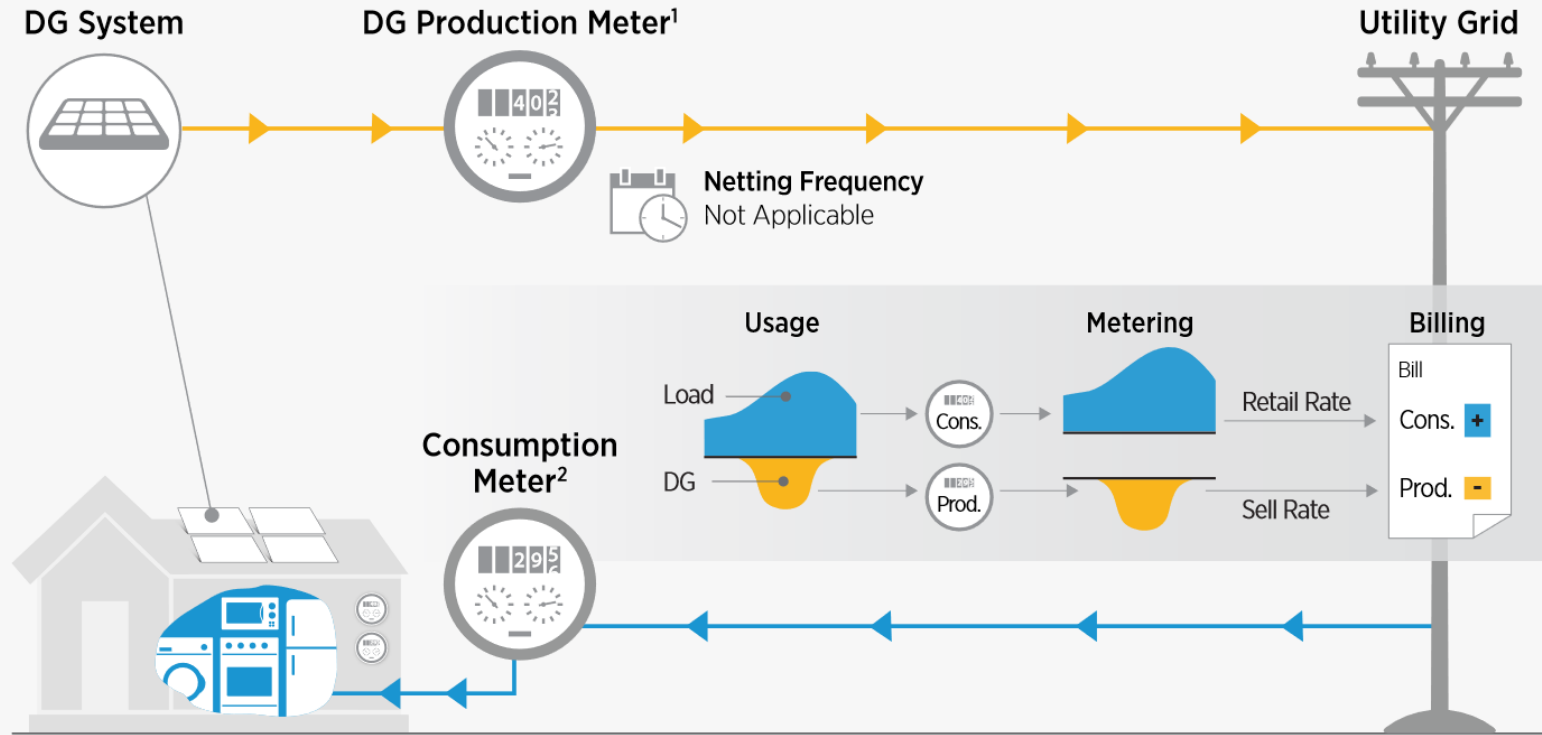
### **Excess generation rolls over**

- Usually within one entire year
- Sometimes within each month/billing period

### **At end of year/month excess generation is either**

- Lost,
- Credited/paid at avoided cost, or
- Credited/paid at the retail rate.

# BUY ALL, SELL ALL



Source: NREL

<https://www.nrel.gov/docs/fy18osti/68469.pdf>

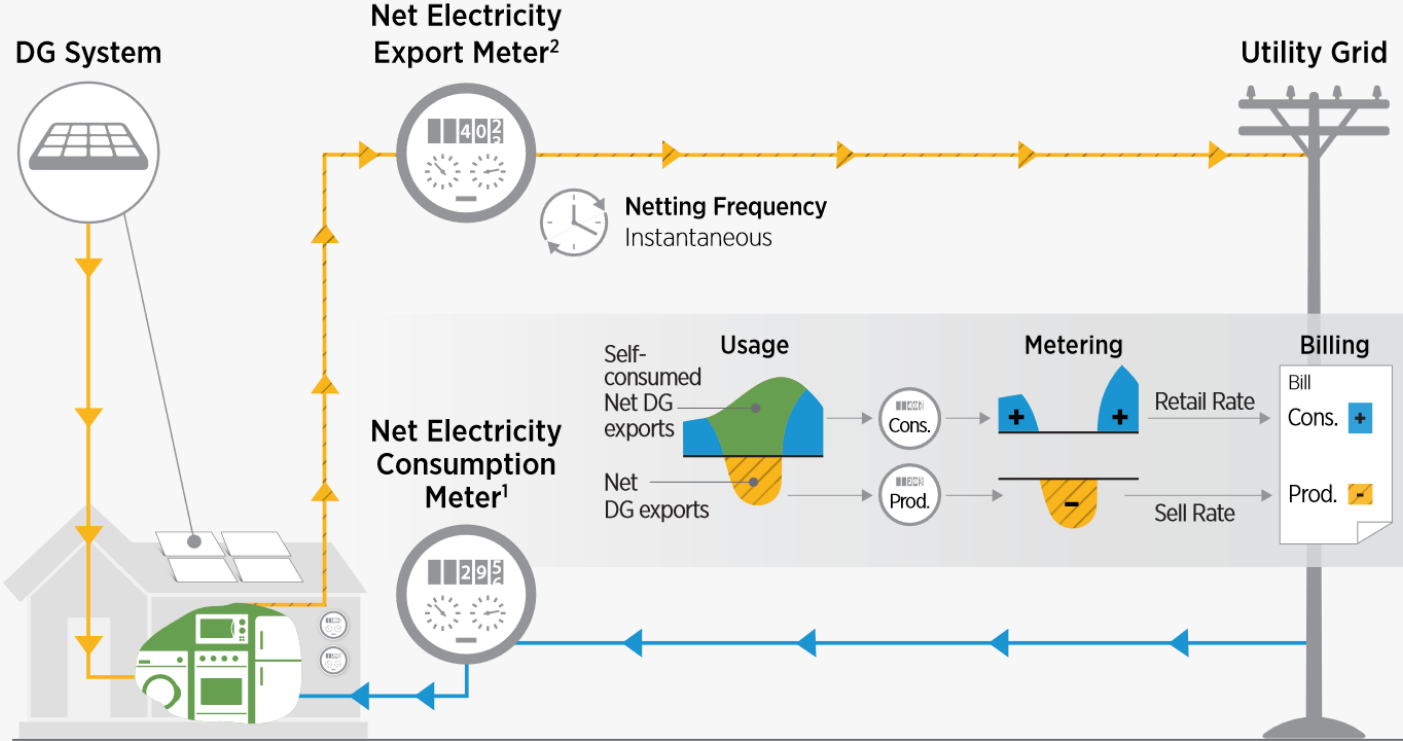
← Grid electricity

← Gross DG production

<sup>1</sup>Measures gross DG production over one billing cycle.

<sup>2</sup>Measures gross electricity consumption over one billing cycle.

# NET BILLING



- Grid electricity
- Gross DG production
- Net DG exports

<sup>1</sup> Measures instantaneous net electricity consumption.  
<sup>2</sup> Measures instantaneous net DG exports.

Source: NREL  
<https://www.nrel.gov/docs/fy18osti/68469.pdf>

# How to Scope Solar PV BTM Projects

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# Project Size Considerations

## Need to work within the NEM law

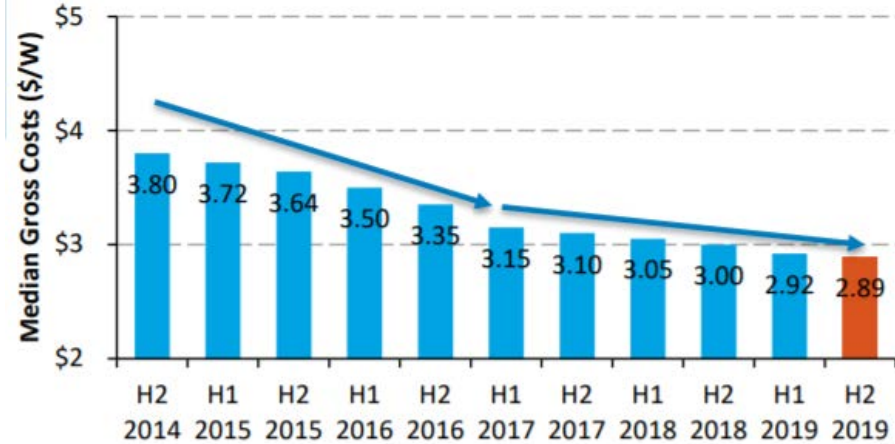
- Available roof space or ground space (slope, geotech)
  - How big the system could be
- Site conditions (roof orientation, azimuth, and shading)
  - How much power it can generate monthly, annually
- Size project at or below total on-site average annual load
  - How much you can use
    - Typically at or below 100% average load (NEM laws)
    - Excess generation is
      - Lost (Aim for project size smaller than 100% load),
      - Paid/credited at avoided cost rate, or sometimes at retail rate (~100% load)



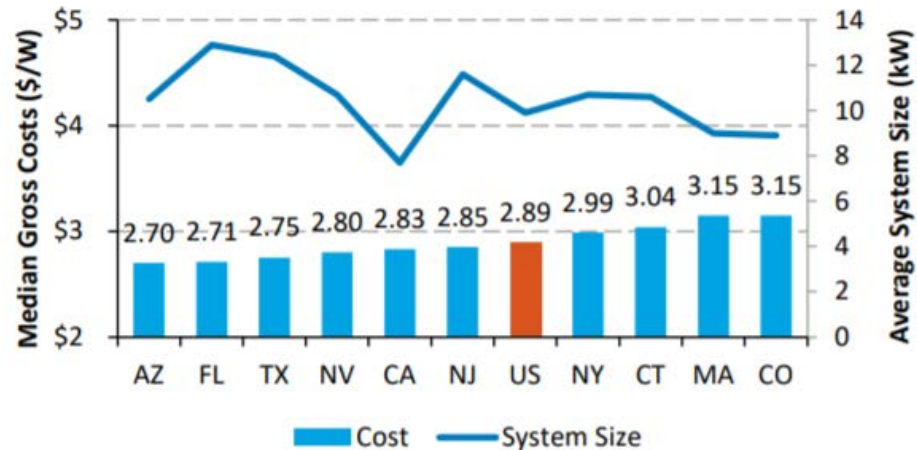
# System Economics

- Cost decreasing over time
- Cost varies by state
  - CA buildings more energy efficient
- Residential systems are generally most expensive
  - Not much economies of scale
  - Bulk purchasing can help
- Community systems are a bit cheaper

## Residential Cost Over Time



## Res. Cost and System Size by State, H2 2019



Solar PV

Business Structures

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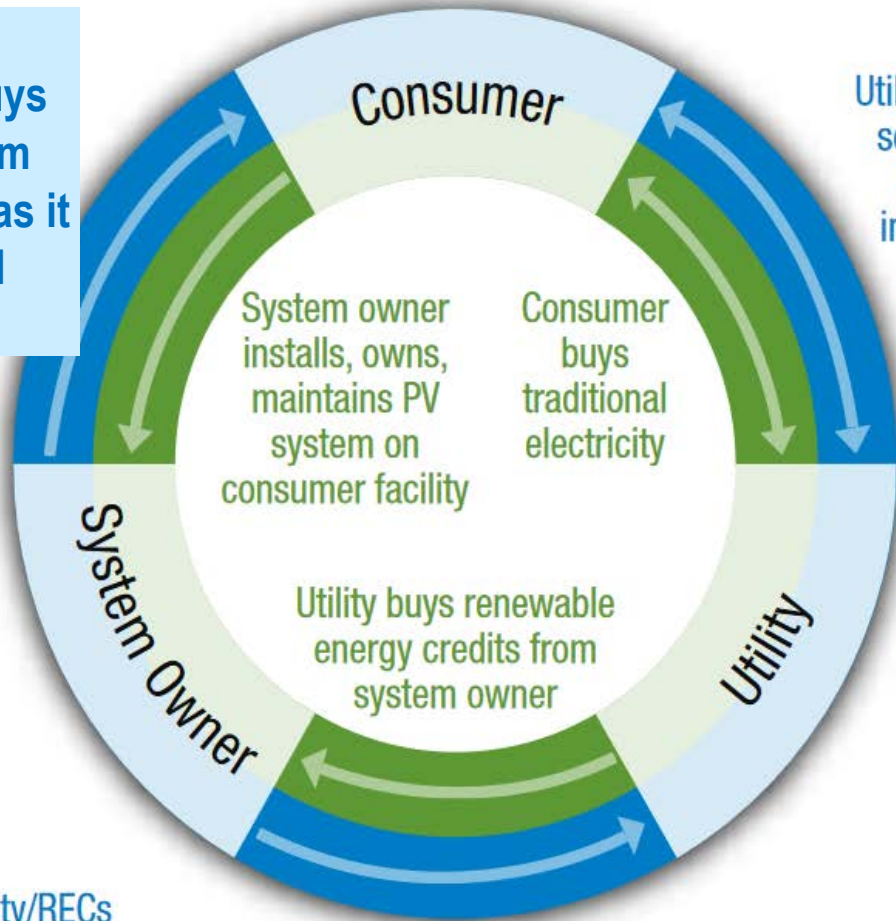


## Direct Ownership

- Immediate ownership and control
- Clear, visible commitment to sustainability
- Can use state/utility incentives
- All operations and maintenance (O&M) responsibilities
- Requires upfront cash/financing
- Higher financing rates than 3<sup>rd</sup> parties, but don't pay 3<sup>rd</sup> parties
- No tax incentives
- Must own the roof/land

# Solar PPA

Customer (consumer) buys electricity from system owner, as it is generated ( $\text{\$/kWh}$ )



Utility buys unused solar electricity; net-metering interconnection agreement



Money



Electricity/RECs

Renewable Energy Certificates (RECs) provided to utility

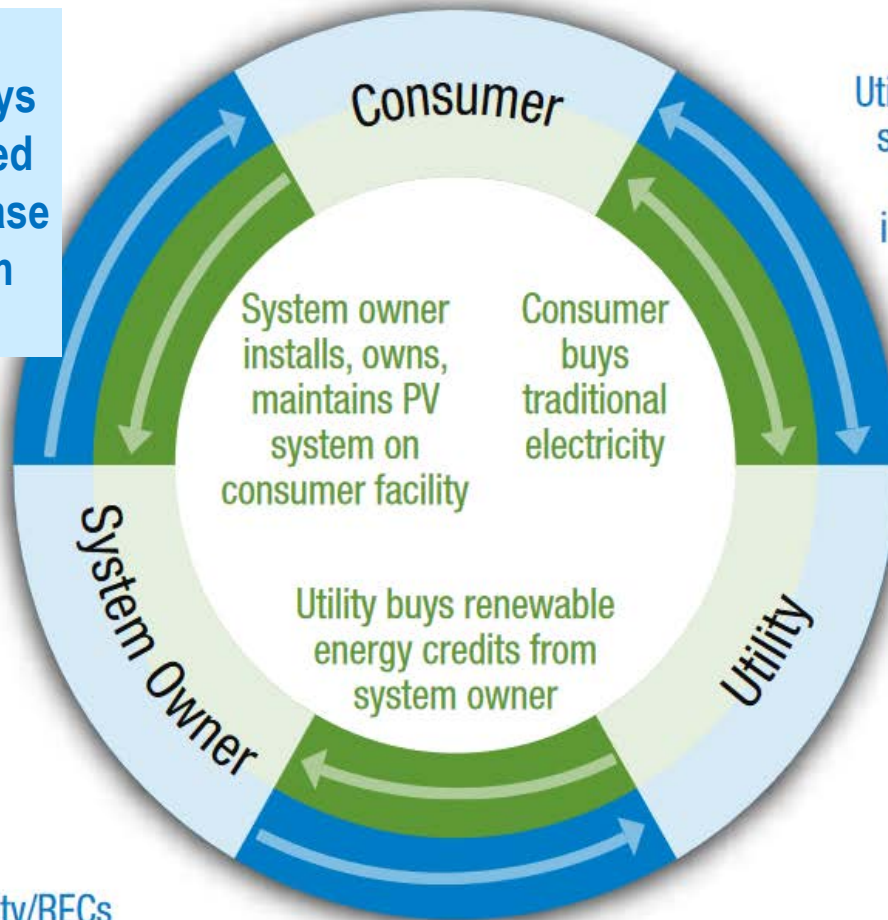
Adapted from:  
<https://www.nrel.gov/docs/fy10osti/46668.pdf>

# Solar Lease

Customer  
(consumer) pays  
fixed, scheduled  
payments to lease  
the PV system  
(\$/month)

Adapted from:  
<https://www.nrel.gov/docs/fy10osti/46668.pdf> and

<https://www.nysed.gov/media/NYSun/files/Homeowners-Guide-Solar-Lease-Loan-Power-Purchase-Agreements.pdf>



Utility buys unused  
solar electricity;  
net-metering  
interconnection  
agreement

System owner  
installs, owns,  
maintains PV  
system on  
consumer facility

Consumer  
buys  
traditional  
electricity

Utility buys renewable  
energy credits from  
system owner

RECs provided to utility

# Comparing the Financing Options

<i>Financing Mechanisms</i>	Self-Financing	Third-Party Ownership PPA	Solar Lease
<u>Incentives</u>			
State Cash Incentive (production-based or upfront)	Yes, if eligible	Yes	Yes
Use of Federal ITC	No	Yes	Yes, except on government or non-profit property
Accelerated Depreciation	No	Yes	Yes, except on government or non-profit property
State Tax Credits	No	Yes**	Yes**
<u>Responsibilities</u>			
Upfront Costs	Yes	No*	No
O&M	Yes	No	Yes, unless contracted to the developer

\* The lower the up-front costs, the higher the price of electricity, therefore up-front costs depend on the contract arrangement between the third-party owner and the customer to meet the goals of both parties.

\*\* Requires a larger tax liability within the state the system is located.

Adapted from:  
<https://www.nrel.gov/docs/fy10osti/46723.pdf>

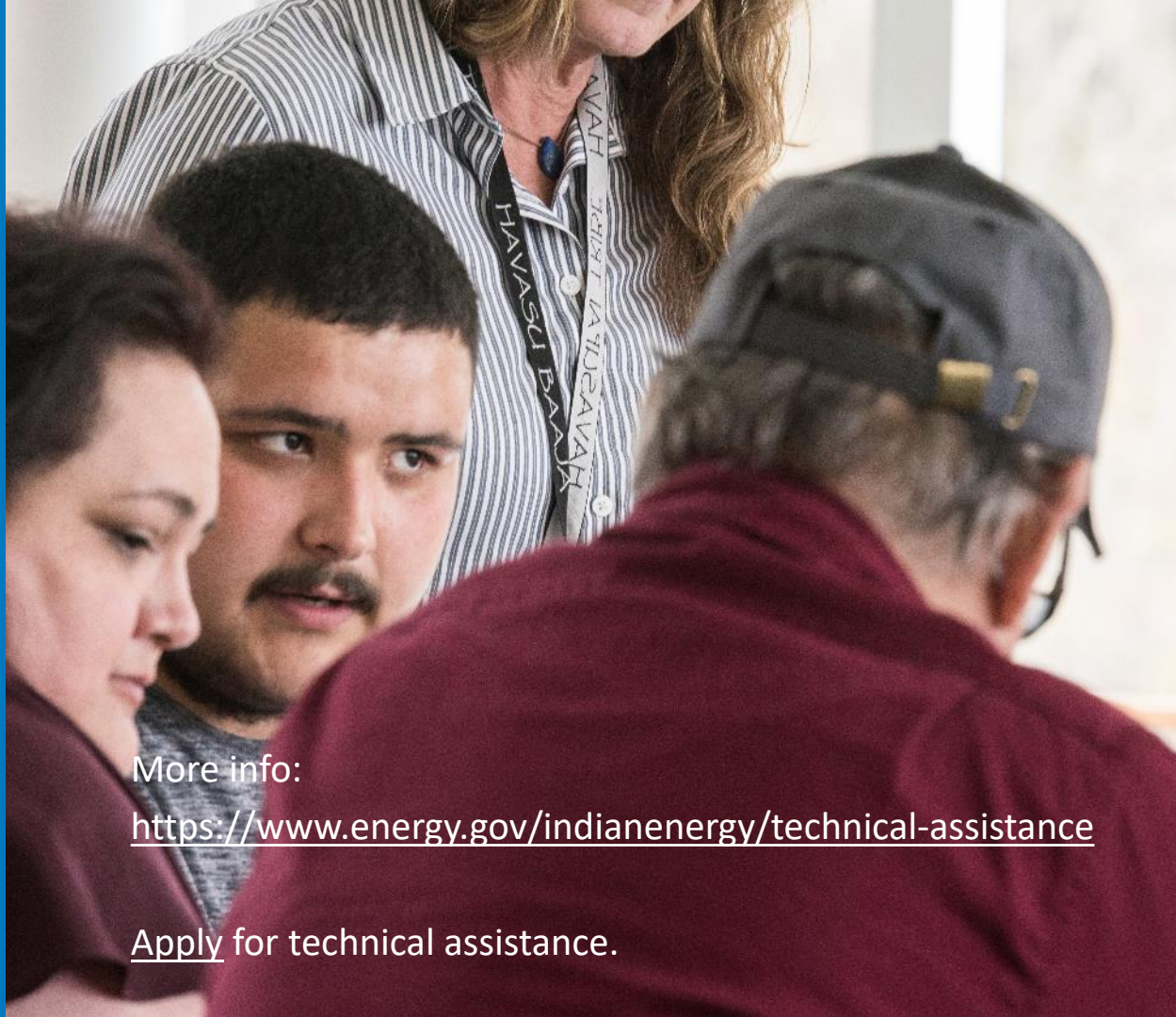
# U.S. DOE Technical Assistance is Available

1. Strategic Energy Planning
2. Technical Analysis
3. Financial Analysis

More info:

<https://www.energy.gov/indianenergy/technical-assistance>

Apply for technical assistance.



# Free NREL Technoeconomic Tools

**REopt Lite:** RE model that examines economic viability, critical load outages, integration, and optimization

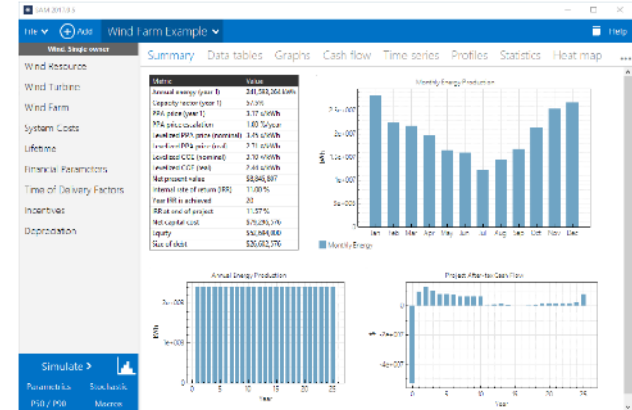
- Includes solar PV, wind, and battery energy systems and will soon include CHP
- The user can enter your own input data

**System Advisor Model (SAM):** software model that facilitates project-level decision-making.

- Includes solar PV, solar thermal/process heat, high concentration PV, wind, geothermal, biomass power generation, marine energy wave and tidal systems, solar water heating, and battery energy storage
- The user can enter your own input data



<https://reopt.nrel.gov/tool>



<https://sam.nrel.gov/>



# Thank you!

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[www.nrel.gov](http://www.nrel.gov)

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Photo sources available upon request

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	Net Energy Metering	Buy All, Sell All	Net Billing
Self-Consumption Allowed	Yes	No	Yes
Netting Frequency	Billing Cycle	Billing Cycle	Instantaneous
Quantities Measured and Billed	<p>1) Net consumption over the billing cycle</p> <p>2) Net excess kWh credits to be compensated or banked</p>	<p>1) Gross consumption over the billing cycle</p> <p>2) Gross DG production over the billing cycle</p>	<p>1) Instantaneous net consumption throughout the billing cycle</p> <p>2) Instantaneous net exports throughout the billing cycle</p>
Sell Rate Applicability	Accrued net excess generation credits that have expired after credit reconciliation period	Gross DG production	Instantaneous DG exports
Value of DG to Customer	<ul style="list-style-type: none"> <li>• Retail rate for self-consumption and exported generation</li> <li>• Sell rate for expired net excess generation credits</li> </ul>	<ul style="list-style-type: none"> <li>• Sell rate for gross DG production</li> </ul>	<ul style="list-style-type: none"> <li>• Retail rate for instantaneous self-consumption</li> <li>• Sell rate for instantaneous net DG exports</li> </ul>
Intra-Billing Cycle Banking of Kilowatt-Hours	Yes	No	No



# Community and Shared Solar



**Like NEM, but expands the market**

- Renters
- Multi-family housing
- Homeowners with unsuitable rooftops

More information: <https://www.energy.gov/eere/solar/community-and-shared-solar>

# Energy Storage Financial Incentives

www.dsireusa.org / April 2020

