Distributed Solar for Home Farm and Business (Dec 2022)

F. John Hay (Extension Educator – Energy)

IN OUR GRIT, OUR GLORY™

Outline

- **Introduction and Solar Motivations**
- **How Solar Works**
- **Equipment and Design Considerations**
- **Production**
  - Tilt
  - Azimuth
- **Economics**
  - Incentives
    - Federal Tax Credits
    - Utility
    - USDA Rural Development
  - Savings, ongoing costs
  - Payback
  - Net present value
- **Picking an Installer**
  - Trade Ally Programs
- **Questions**

Introduction and Solar Motivations

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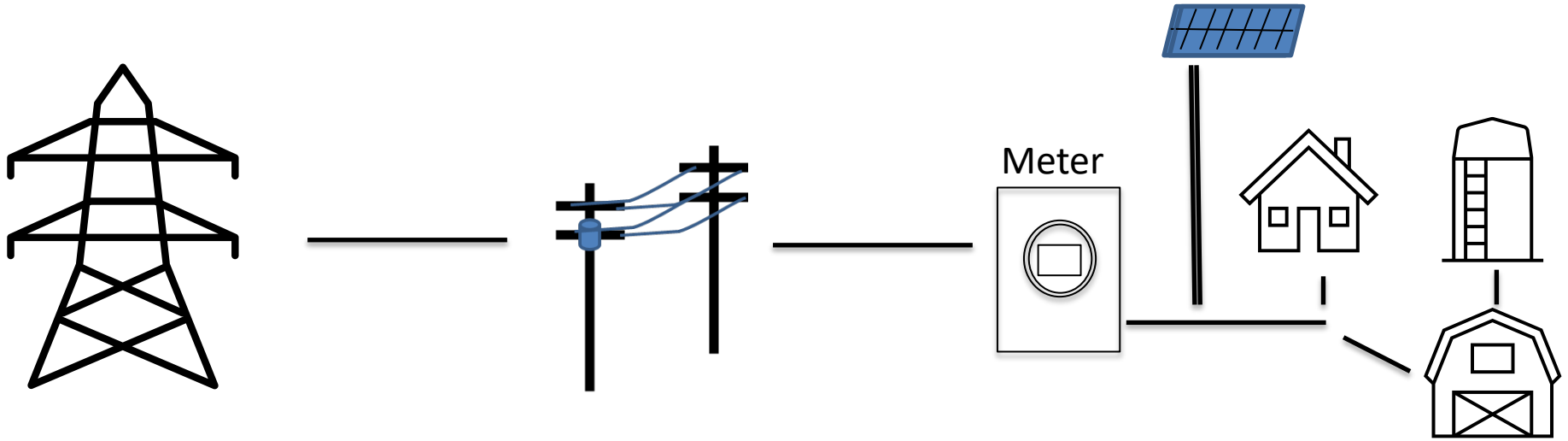
Distributed Generation vs Utility Scale

- **Distributed**
  - Small scale
  - Grid connected
    - Usually behind the meter
  - Customer owned
  - Energy used by customer first
- **Utility**
  - Large Scale
  - Utility or Investor Owned
  - Grid connected
  - Electricity flowing to the grid

Metering



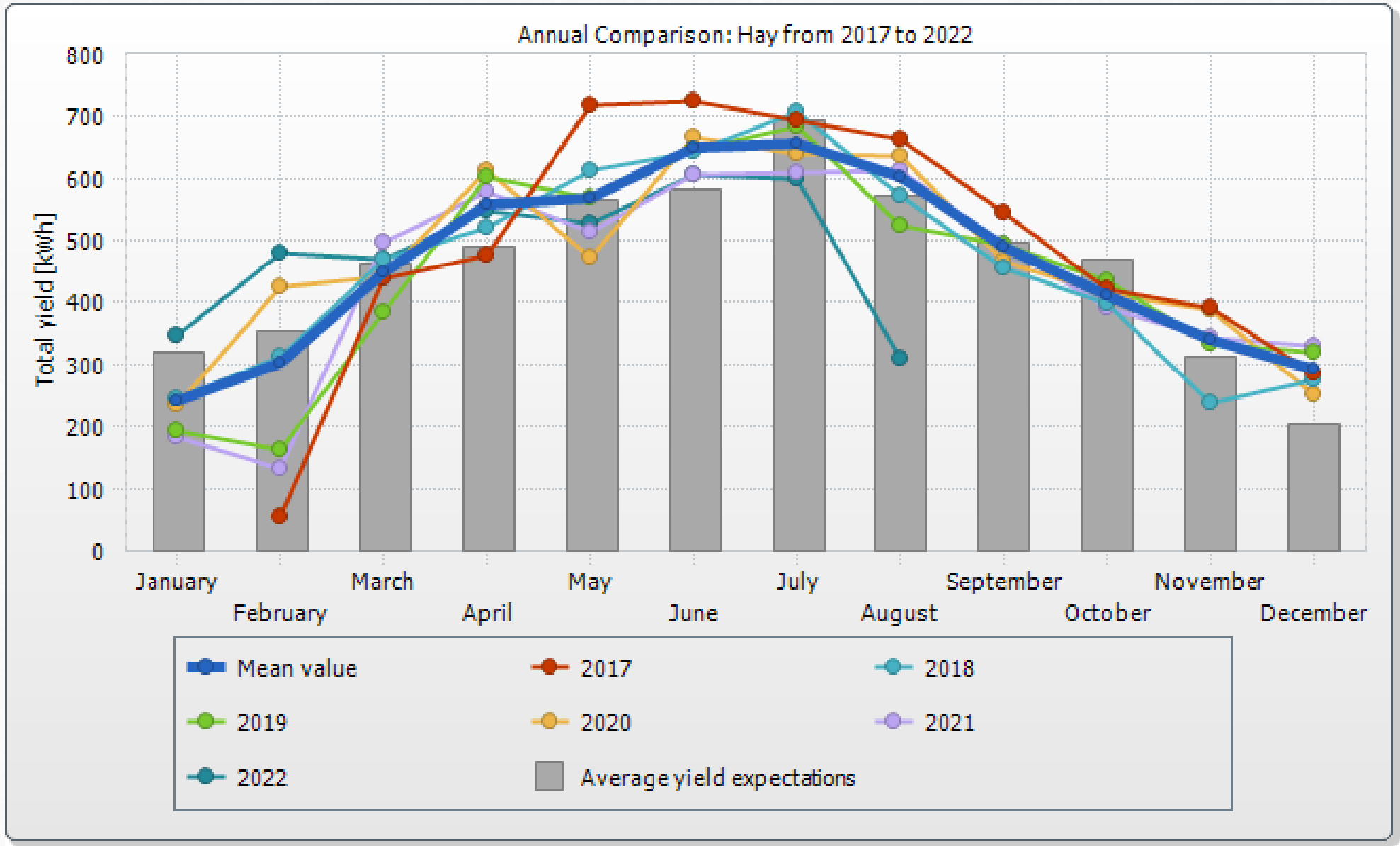
Modern meters don't just count kWh, they can do more (Advanced Meter Infrastructure (AMI)

- Record the time of day each kWh is used
- Record the peak power use (demand)
- Record the loads impact on power quality (power factor)
- Measure in two directions (behind the meter solar or other renewables)


MENARDS
CONCRETE FORMING TUBE


MADE IN U.S.A.
ON
I
WARNING
ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS
TERMINALS ON BOTH THE LINE AND
LOAD SIDES MAY BE ENERGIZED
IN THE OPEN POSITION
OFF
O
PHOTOVOLTAIC SYSTEM
AC DISCONNECT
OPERATING CURRENT 18.7 AMPS
OPERATING VOLTAGE 240 VOLTS


PHOTOVOLTAIC SYSTEM
DC DISCONNECT
OPERATING VOLTAGE 257 VDC
OPERATING CURRENT 17.5 A
MAX SYSTEM VOLTAGE 376 VDC
SHORT CIRCUIT CURRENT 19.1 A


Annual Comparison: Hay from 2017 to 2022
Total yield [kWh]
800
700
600
500
400
300
200
100
0
January
February
March
April
May
June
July
August
September
October
November
December
Mean value
2017
2018
2019
2020
2021
2022
Average yield expectations

Steps in Solar PV Process
(Process for a Customer Owned Grid Connect Solar Electric System)

System Owner
Installer and Electrician
Utility is involved.

1. Study electric bills, efficiency
2. Solar homework, goals,
3. Get quotes, talk to multiple installers
4. Contact utility (Owner and Installer)
5. Design
6. Order solar modules, inverter, mounting
7. Building permit
8. Structure
9. Solar rail mounting
10. Solar module (panel) installation
11. Electrical permit
12. DC wiring and grounding
13. Inverter installation
14. AC wiring
15. Electrical inspection
16. Install safety labeling
17. Utility agreement
18. New meter (Utility site inspection)
19. Turn it on! (owner and installer)
20. Monitoring (owner and installer)

Residential or Business System	Community Solar Purchase
Pros: Green energy Tax credit Attached to your home or business Depreciation (businesses) Marketing Ongoing savings	**Pros:** Green energy Can participate even without place to install Sell it back if you move No O&M Little to no risk
Cons: Initial cost of system O&M May not regain investment if you move	**Cons:** No tax credit (maybe) No depreciation Not at your location for marketing purposes

How Solar Works

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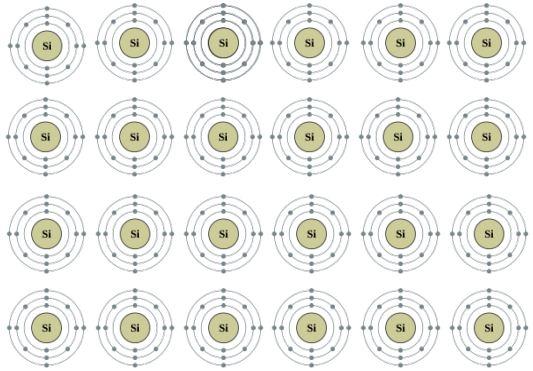
Solar Photovoltaic Array

Solar Photovoltaic Module

Silicon

- 4 valence electrons

Solar Photovoltaic Cell



Inside the Silicon Crystal

EXTENSION

Table 1. Emissions by Type of Electrical Generation	
Carbon Dioxide Emissions of Electrical Generation Systems	
Generation Type	Emission Rate (g CO_2/kWh)
Coal, Steam generator	940[a] - 960.6[b]
Natural Gas, Combustion Turbine	604.2[b]
Natural Gas, Combined Cycle	406.6[b]
Nebraska's Generation Mix 2017	628[c]
Solar PV – utility scale	6- 14[dg]
Utility Scale Wind	4 - 9.11[efg]
Nuclear	4[g]
Hydro	97[g]

Note: Emission rates from electricity generation. Rates noted with "a" from Hong and Slatick, "b" from US DOE Environmental Baseline Report, "c" from EIA.gov State electricity profiles, "d" from Louwen et al. "e" from Gamaa et al. 2019, and Guezuraga et al., 2012. "g" from Pehl et al., 2017

Equipment and Design Considerations

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Photovoltaic Solar System

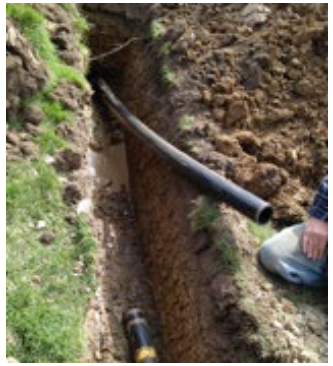
Module

Racking

PV Wire

Combiner Box

Wire Covers



Trenching

Inverter(s)

Disconnect

Meter

Placards

Grounding

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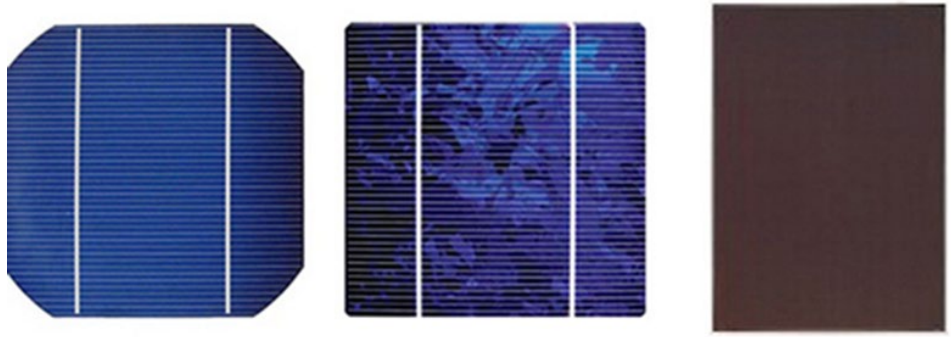
Silicon Solar Cells

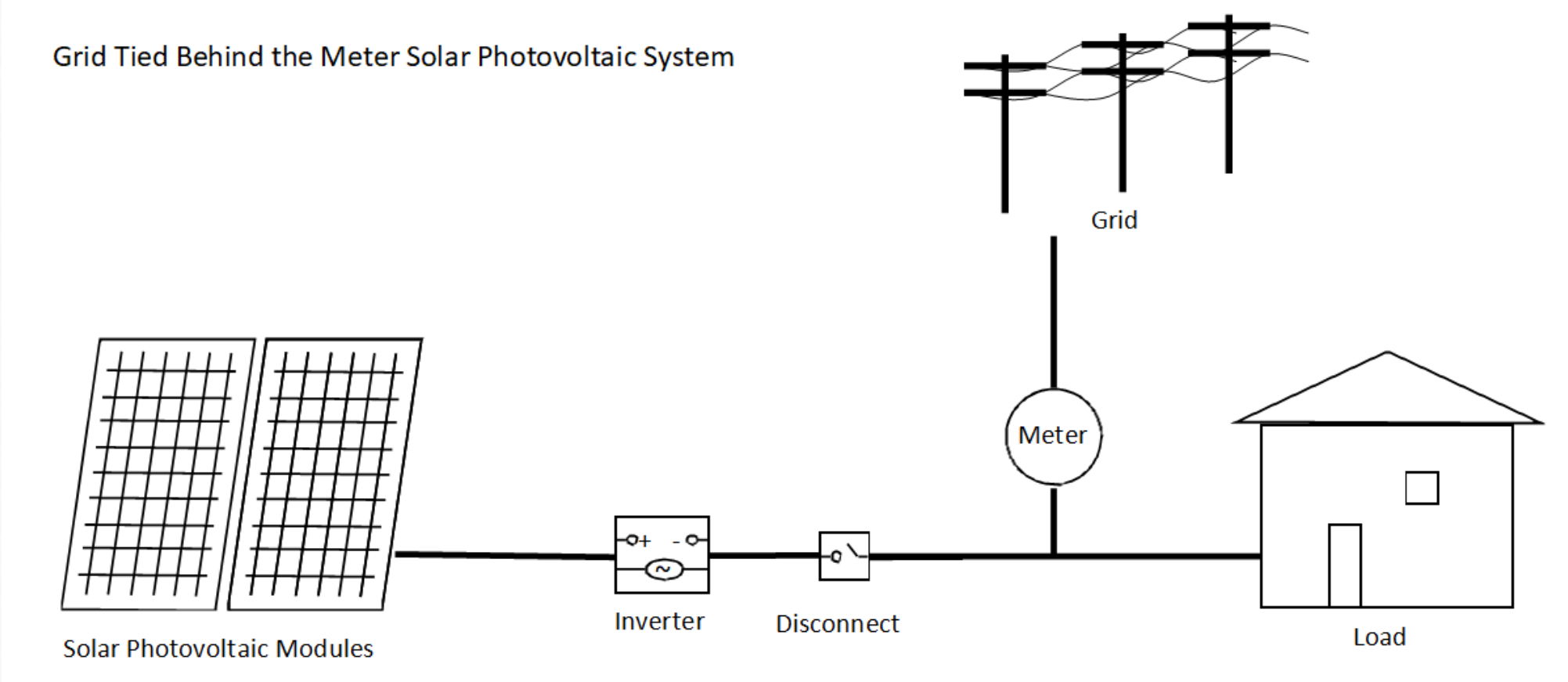


Other Chemistries

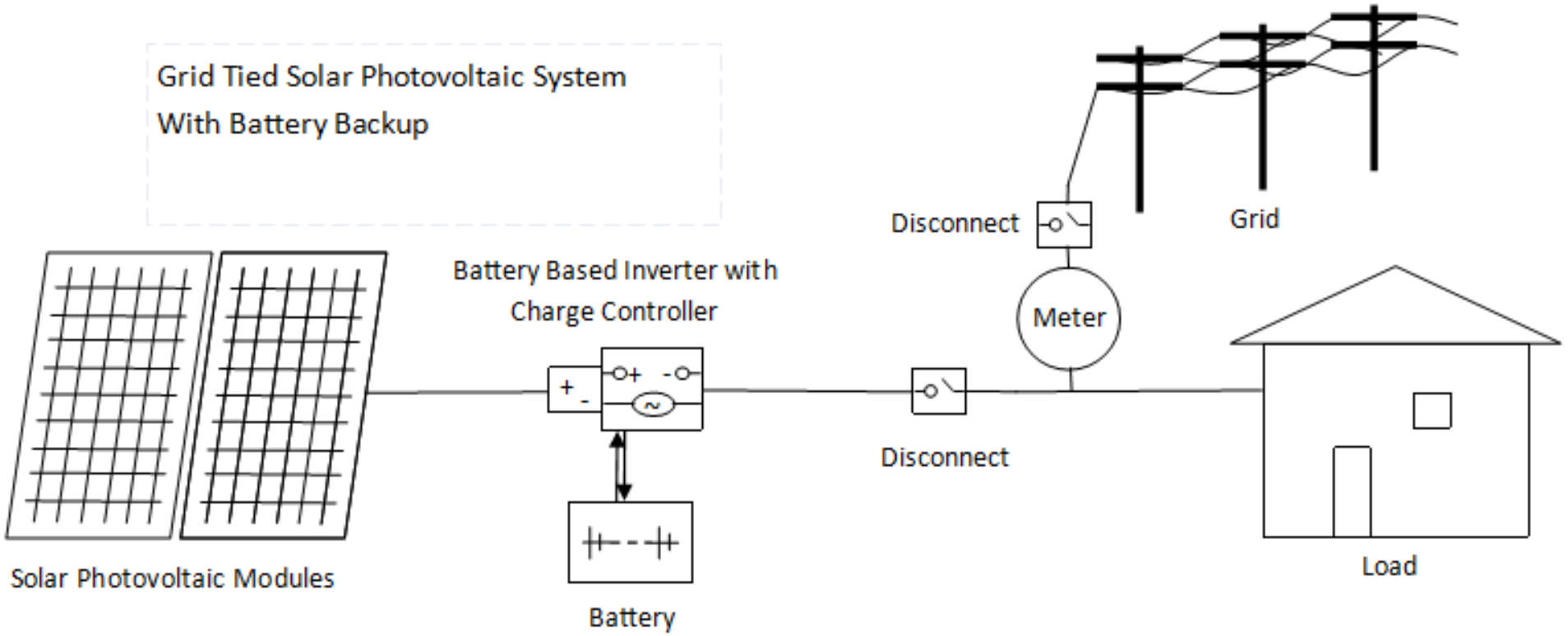
- Cadmium telluride (CdTe)
- Amorphous silicon (a-Si)
- Copper indium gallium selenide (CIGS)

	Mono	Poly	Thin Film
Efficiency	Up to 20+ %	~16%	Up to 12%
Life span (years to reach 80% capacity)	25-30 years	25-30 years	<20 years
Manufacturing costs	High	Moderately High	Low

Distributed Solar



Distributed Solar with Battery Backup



String Inverter (many panels in a string into one inverter)


Microinverters (one small inverter under each panel)

Early Design Choices

Micro Inverters

String Inverter with Optimizers

String Inverter

Early Design Choices

Size: Square Feet or KW

Space Limited

- Small roof
- Small yard
- Trees

Electric Use

-100% of load –green

- 50% of load – Economics

Initial Cost

- As big as your budget
- Based on tax savings
- May consider planning for possible expansion

National Electric Code: NEC 2014/2017: Article 690.12 Rapid PV Shutdown

The National Electric Code, requires rapid shutdown of PV systems on buildings.

DC voltage in circuits running more than 10 feet (NEC 2014) or 1 foot (NEC 2017) to the inverter has to be lower than 30VDC within 30 seconds of rapid shutdown initiation.

NEC 2017 also requires that the voltage on the conductors within the array be lower than 80VDC within 30 seconds.

Most microinverters and DC Power Optimizers comply with these requirements.

Data Source: National Renewable Energy Laboratory. 2017. U.S. Solar Photovoltaic System Cost Benchmark: Q1 2017. Technical Report NREL/TP- 6A20-68925.

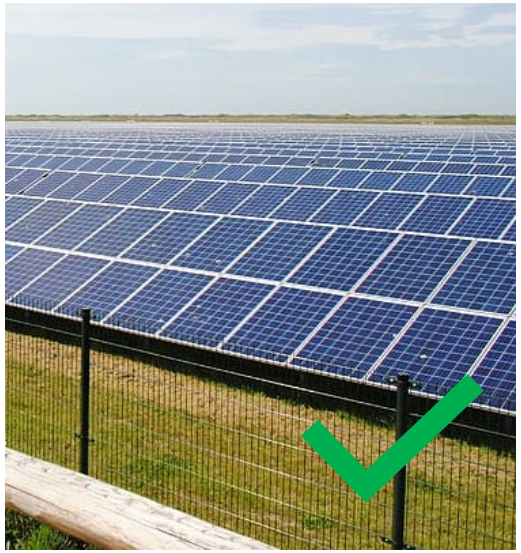
NATIONAL ELECTRIC CODE: NEC 2014/2017: Article 690.31 Restricted Accessibility of Conductors

The National Electric Code, requires Restricted Accessibility of Conductors over 30 Volts .

This is important for **ground mount** system where wires are exposed at back of solar array.

Photo CC BY-SA 2

solarscrim



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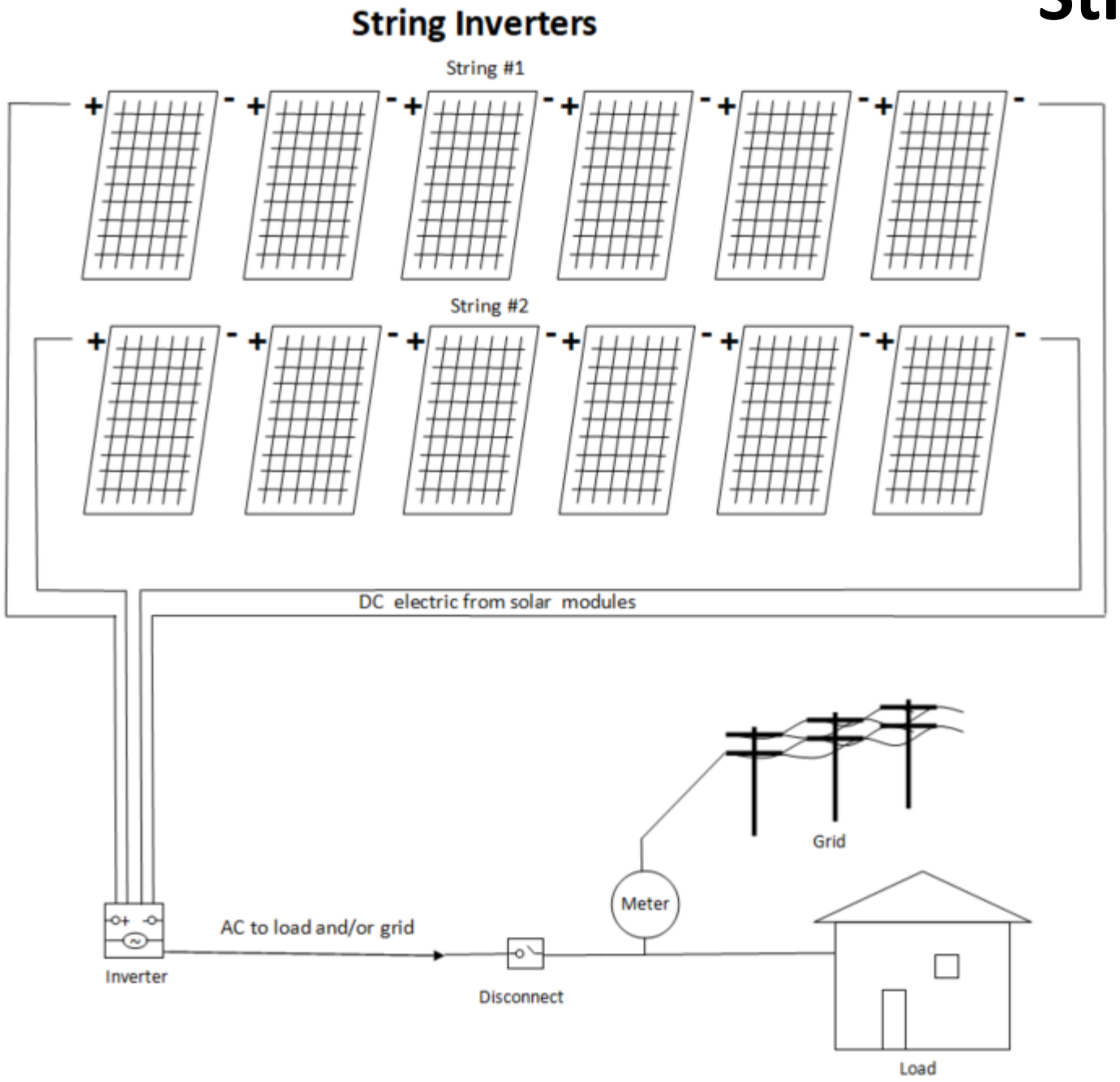
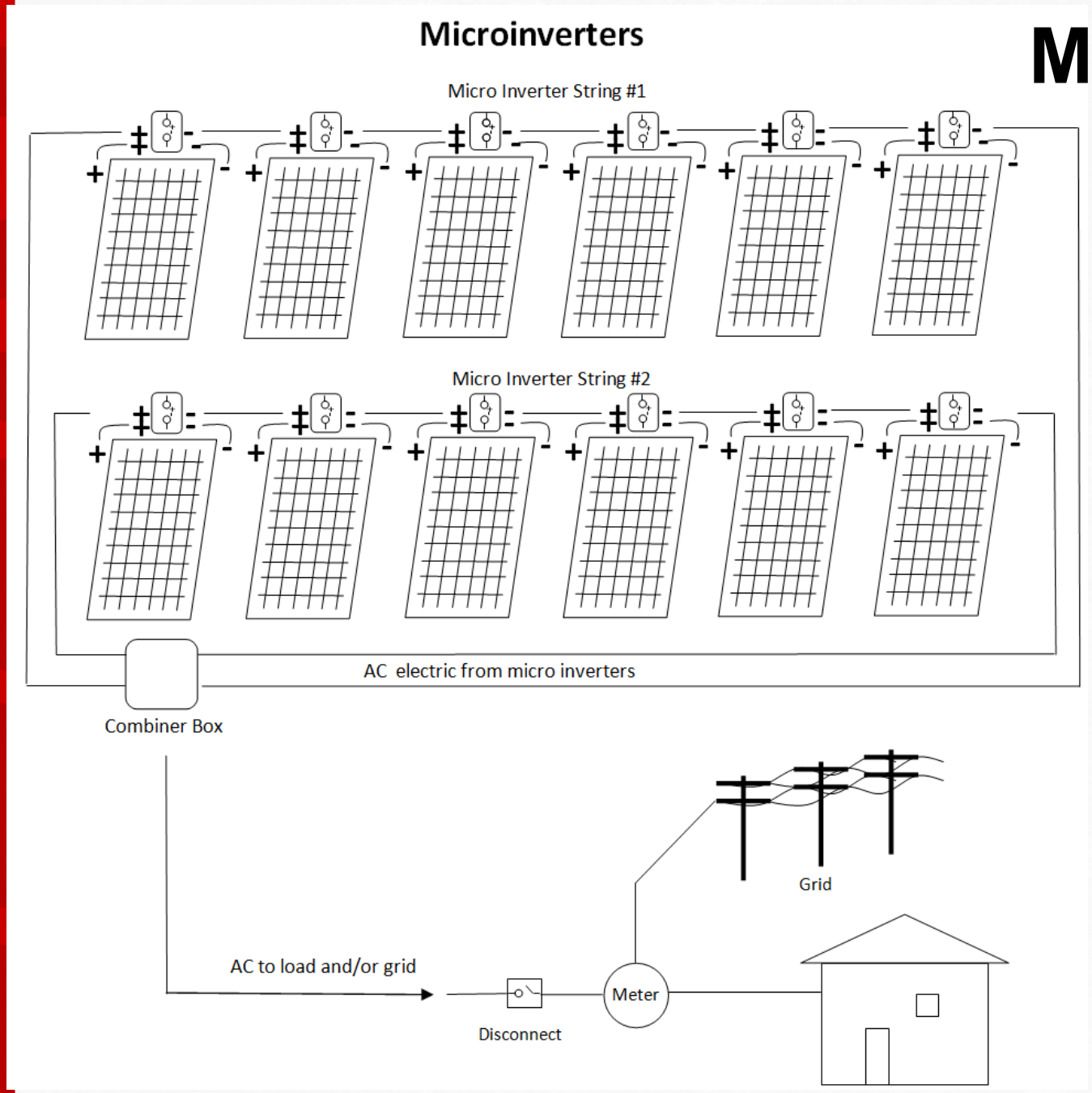
String Inverters



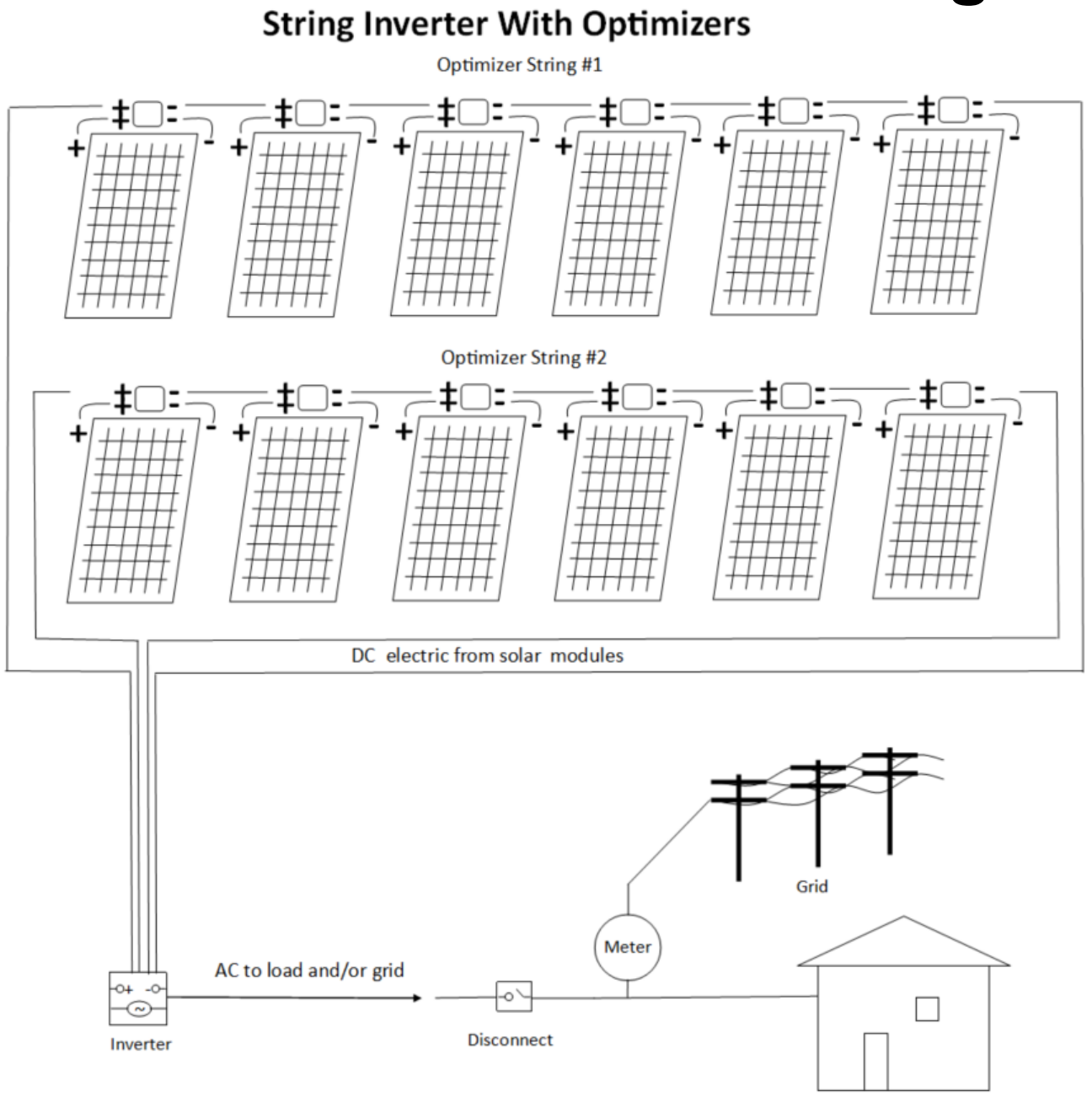
- Lowest Cost
- System Level Monitoring
- Poor Shade Performance
- Requires Additional Equipment for Rapid Shutdown

Micro Inverters



- Highest Cost
- Panel Level Monitoring
- Good Shade Performance
- Rapid Shutdown Ready
- Ease of Installation

String Inverter with Optimizers



DC Optimizer

- Low Equipment / High Installation Cost
- Panel Level Monitoring
- Good Shade Performance
- Rapid Shutdown Ready

Production

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Impact of Azimuth and Tilt on Solar Production

Solar Array Tilt vs Azimuth (Lincoln, NE) Percentages compared to Max Annual Production

Azimuth (Direction Solar Array is Facing 0 = North 90 = East 180 = South 270 = West

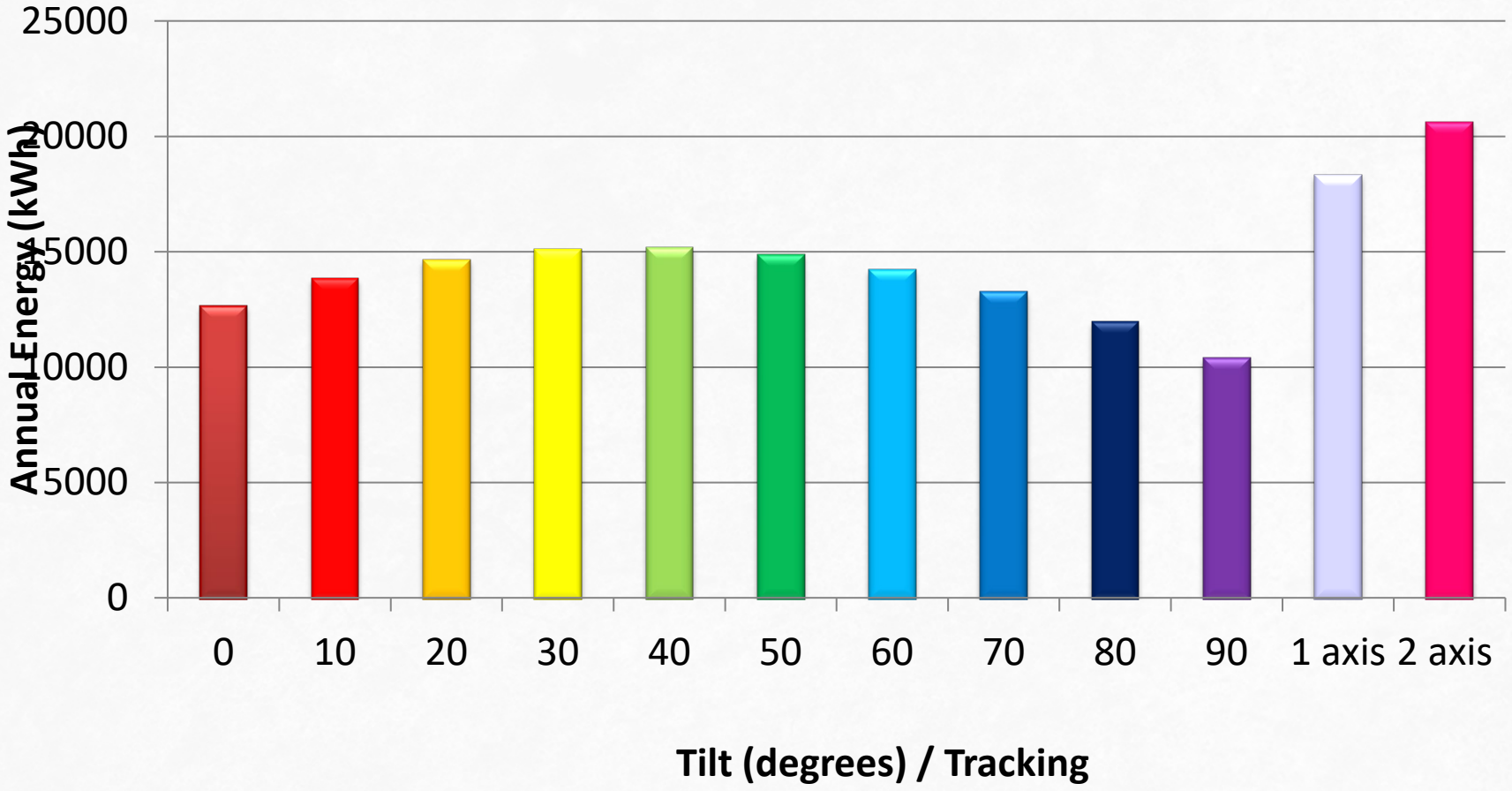
Tilt angle (degrees) 12/12, 10/12, 8/12, 6/12, 4/12, 2/12 Roof Pitch	North									Northeast				East				Southeast				South				Southwest				West				Northwest				North			
	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350
2	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83	83
6	80	80	80	80	80	81	81	82	82	83	84	84	85	85	86	86	86	86	87	87	86	86	86	85	85	84	84	83	83	82	82	81	81	80	80	80
10	76	76	76	77	78	78	79	80	82	83	84	85	86	87	88	89	89	89	90	89	89	88	87	87	86	84	83	82	81	80	79	78	77	77	76	
14	72	72	73	73	74	76	77	79	8			86	87	89	90	91	91				92	91	90	89	88	86				80	78	76	75	74	73	72	
18	68	68	69	70	71	73	75	77	79	82	84	86	88	90	91	93	94	94	94	94	94	93	92	90	89	87	85	83	80	78	76	74	72	70	69	68
22	64	64	65	66	68	70	73	75	78	81	83	86	88	91	92	94	95	96	96	96	96	95	93	92	89	87	85	82	79	76	74	71	69	67	65	64
26	60	60	61	62	65	67	70	73	77	80	83	86	89	91	93	95	97	97	98	98	97	96	94	92	90	87	84	81	78	75	71	68	65	63	61	60
30	56	56	57	59	61	64	68	71	75	79	82	86	89	92	94	96	97	98	99	99	98	97	95	93	90	87	84	80	77	73	69	66	62	60	58	56
34	52	52	54	55	58	62	66	70	74	78	81	86	88	92	94	96	98	99	100	99	99	97	95	93	90	87	83	79	75	71	67	63	59	56	54	53
38	49	49	50	52	55	59	63	68	72	76	81	86	88	91	94	96	98	99	100	100	99	97	95	93	90	86	82	78	74	69	65	60	56	53	51	49
40	47	47	48	51	54	58	62	67	71	76	80	84	88	91	94	96	98	99	100	100	99	97	95	93	89	86	82	77	73	68	64	59	55	51	49	48
44	44	44	45	48	51	55	60	65	70	74	79	83	87	90	93	96	98	99	100	100	99	97	95	92	89	85	81	76	71	66	61	56	52	48	46	44
48	41	41	42	45	49	53	58	63	68	73	78	82	86	89	93	95	97	99	99	99	98	96	94	91	88	84	79	75	70	65	59	54	49	45	43	41
52	38	38	40	42	46	51	56	61	66	71	76	81	85	88	91	94	96	98	98	98	97	95	93	90	86	82	78	73	68	63	57	52	47	43	40	38
56	35	35	37	40	44	49	54	59	65	70	74	79	83	87	90	93	95	96	97	97	96	94	92	89	85	81	76	72	66	61	55	50	45	40	37	35
60	32	33	35	38	42	47	52	58	63	68	73	77	81	85	88	91	93	95	95	95	94	92	90	87	83	79	75	70	65	59	53	48	43	38	35	33
64	30	31	33	36	40	45	50	56	61	66	71	75	79	83	86	89	91	92	93	93	92	90	88	85	82	78	73	68	63	57	52	46	41	37	33	31
68	28	29	31	35	39	44	49	54	59	64	69	73	77	81	84	87	89	90	91	91	90	88	86	83	79	76	71	66	61	55	50	44	39	35	31	29
72	27	27	30	33	37	42	47	52	57	62	67	71	75	79	82	84	86	87	88	88	87	86	83	81	77	73	69	64	59	53	48	43	38	34	30	27
76	26	26	29	32	36	40	45	50	55	60	65	69	73	76	79	81	83	84	85	85	84	83	81	78	75	71	67	62	57	52	46	41	36	32	29	27
80	25	25	28	31	34	38	43	48	52	57	61	65	69	72	75	77	78	79	80	80	79	78	76	74	71	67	63	59	54	49	44	39	35	31	28	26
84	24	25	27	30	33	37	41	46	51	55	59	63	66	69	71	73	74	75	76	76	75	75	73	71	68	65	61	57	52	47	42	38	33	30	27	25
88	24	25	26	29	32	36	40	44	49	53	57	60	63	66	68	69	71	71	72	72	72	71	70	68	65	62	58	54	50	45	41	36	32	29	26	25
90	24	24	26	28	31	35	39	43	47	52	55	59	62	64	66	68	68	69	69	70	69	69	68	66	64	61	57	53	49	44	40	36	32	29	26	24

East

South

West

Impact of Tilt and Tracking on Solar PV Production (10 kW Solar PV Array, Grand Island Nebraska)

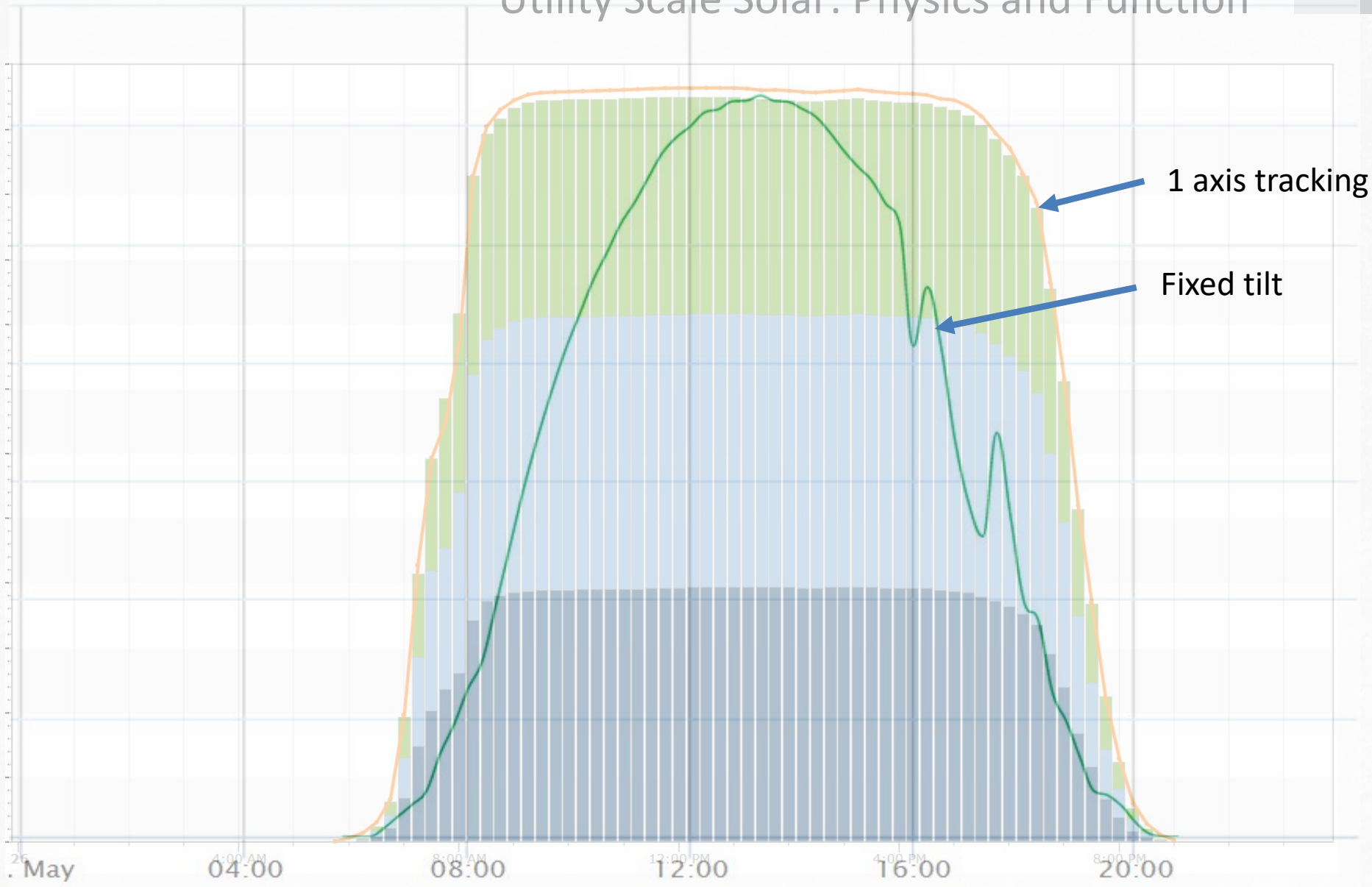


Utility Scale Solar: Physics and Function

One Axis Tracking:

Facing East in the morning,
Following the sun across the sky and facing West in the evening. Increase production by ~15% over stationary array

Utility Scale Solar: Physics and Function



Two Axis Tracking:

Follows the sun across the sky. Increase production by 20%+ over stationary array


PVWatts® Calculator
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
Get Started:
Enter a Home or Business Address
GO »
English
Español
HELP
FEEDBACK
NREL's PVWatts® Calculator
Estimates the energy production of grid-connected photovoltaic (PV) energy systems throughout the world. It allows homeowners, small building owners, installers and manufacturers to easily develop estimates of the performance of potential PV installations.
Notice
PVWatts® V8 adds several new features, including a bifacial module option, a new input for monthly irradiance losses that can be used to represent soiling or snow losses, and updated models for the photovoltaic module, inverter, and thermal effects that use more detailed algorithms than older versions. Version 8 uses new weather data from the NREL National Solar Radiation Database (NSRDB) PSM V3 TMY 2020 dataset. PVWatts® V8 provides production estimates based on the latest, state-of-the art and industry-accepted models from NREL that may differ from the previous version's estimates, depending on the location and inputs.
Follow @PVWatts
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Economics

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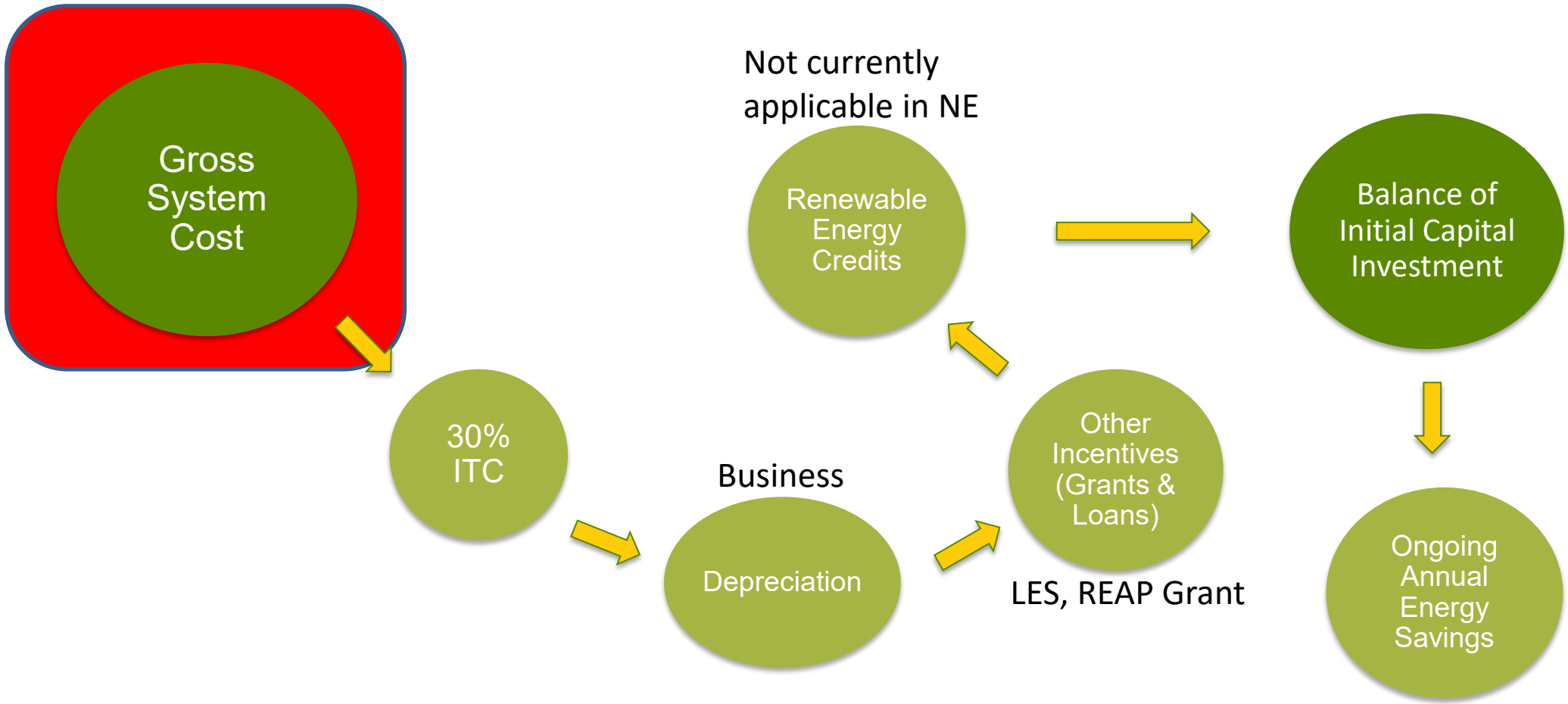
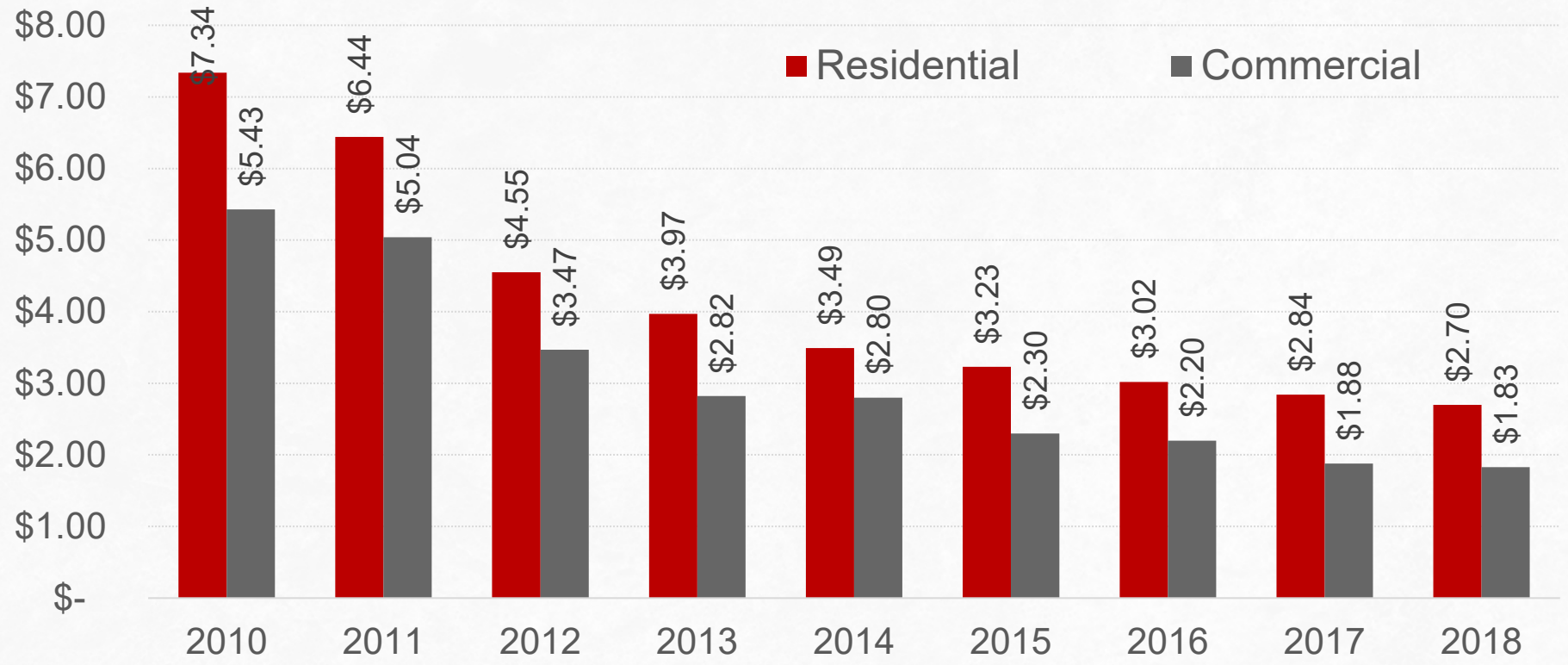
Cash Flow Mechanics of Investing in PV Solar

How will you get your money back and what are the assumptions?



NREL Solar System Installation Cost $ Per DC/Watt (Inflation Adjusted), Q4 2010–Q1 2018



https://www.nrel.gov/docs/fy22osti/82854.pdf

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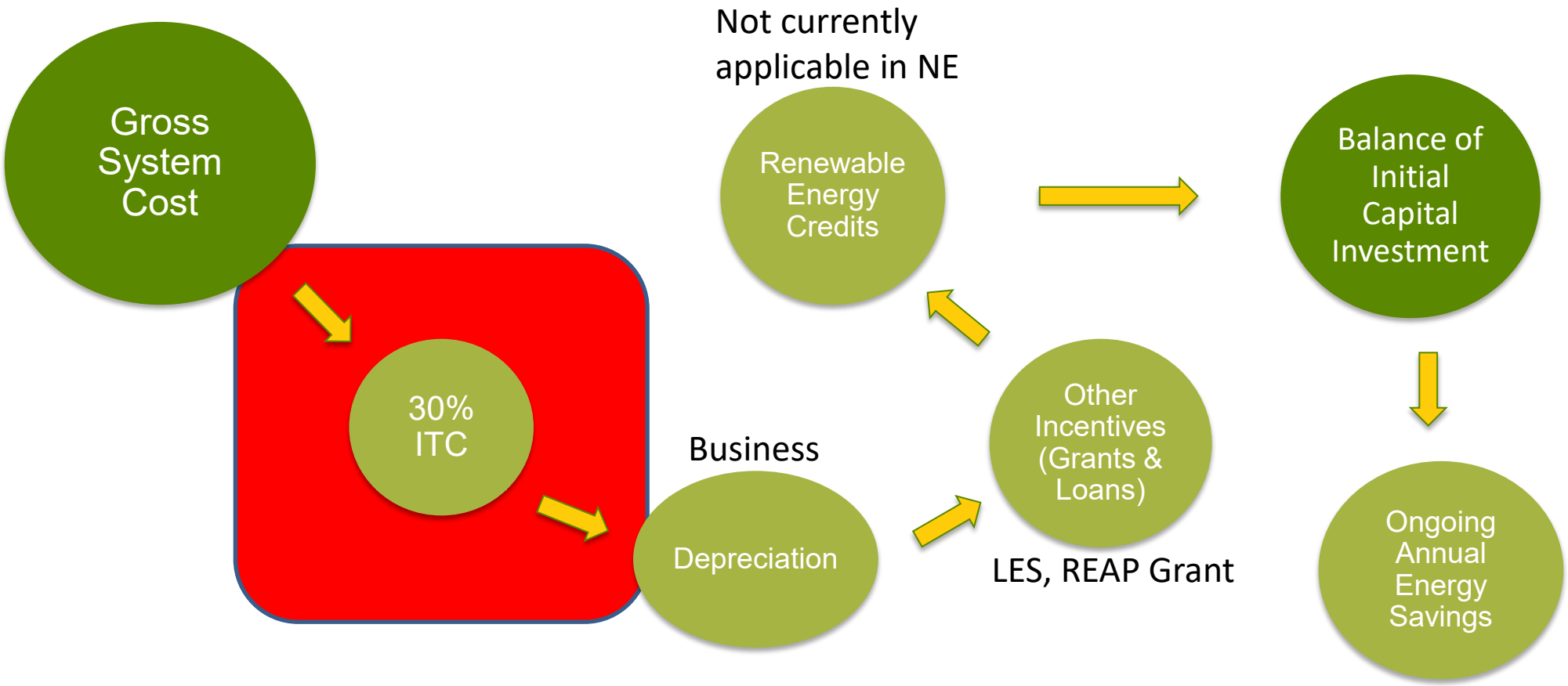


- **Investment Tax Credits (ITC)**
  - Credit for investment
  - Get all credit in year one or spread across a couple of years
- **Production Tax Credits (PTC)**
  - Credit for production
  - Paid per kWh of energy for first 10 years

Investment Tax Credits (ITC)

Residential:

- **30% ITC through 2032**

Commercial (1 MW or above)

- **ITC or Production Tax Credit (PTC) through 2025 – after 2025 switching to new tax credit rules**

Commercial Renewable Tax Credits
Production tax credit (1 MW or above)

- Solar is again eligible
- Through end of 2024, after, changes to new PTC rules
- Base amount 0.3 cents per kWh
  - 5x increase for developers that pay a prevailing wage. (or are less than 1 MW)
  - Adjusted for inflation makes rate ~2.6 cents per kWh

Commercial Renewable Tax Credits
Investment tax credit (1 MW or above)

- Base of 6 percent of a project's cost
  - 30 percent for developers that pay a prevailing wage.
- Additional 10 percent bonuses are available
  - domestically made materials
  - in low-income or fossil fuel-reliant communities.
  - 10% for selling the electricity via community solar to low-income families – the tax credit could potentially reach 60%.

New Clean Electricity Production Tax Credit Beginning 2025

- Any electricity source that does not emit carbon dioxide (CO_2) will be able to choose between the Production Tax Credit (PTC) and the Investment Tax Credit (ITC).

Additional Qualifying Projects

- **Interconnection costs** can be included in the tax credit for projects less than 5 MW AC
- **Energy Storage projects** will also receive the same 30% ITC, even if standalone facilities.
  - Energy storage projects connected to renewable energy no longer have to be charged by renewable energy.

New Ways to Use Tax Credit

- **Transferability**
  - A taxable entity without enough tax liability can transfer the credit to a third party that can use it.
- **Direct Pay**
  - A tax-exempt entity (nonprofit, state gov, public utility, native nation)
  - Take payment equal to allowable tax credit

Farm and Rural Businesses – Energy Efficiency and Renewable Energy

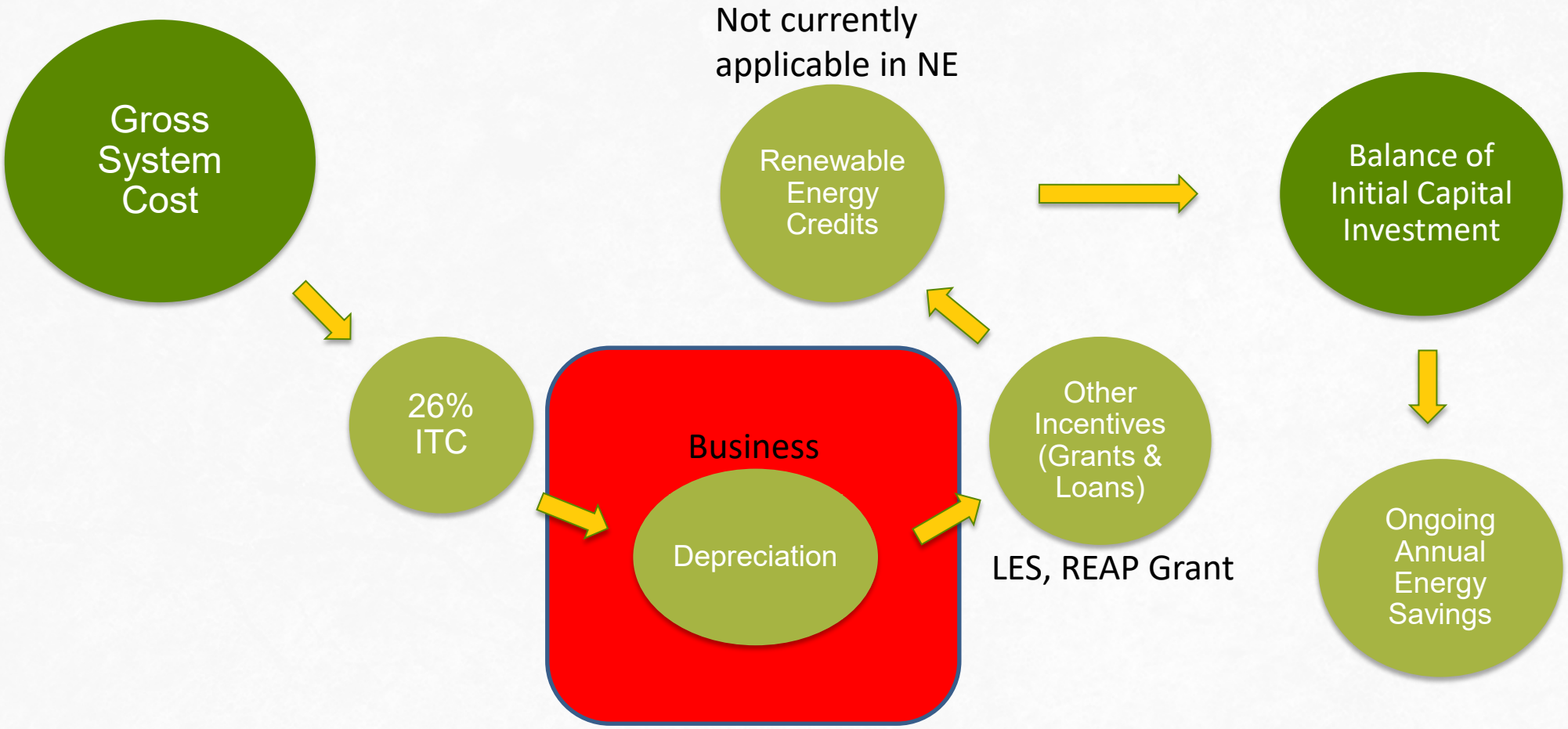
- Provides financial assistance for adoption of clean energy technologies in rural communities.
- $2 billion for the USDA REAP program until 2031 to provide competitive grants and loan guarantees to farmers, ranchers, and rural small businesses for renewable energy systems or energy efficiency improvements.
- More than $300 million is set aside to provide grants and loans to provide financial & technical assistance for “underutilized renewable energy technologies” that are not as widely adopted.
- Federal cost share for grants is raised from 25% to a maximum of 50%.

Energy Efficiency Credits in the IRA

- **Starting in 2023, 30% credit**
- **Max credit $1200 annually**
  - Energy Audits
  - Exterior Doors
  - Exterior Windows
  - AC
  - Electric Panels
  - Some qualifying furnace equipment
  - Heat pumps
  - Biomass stoves and boilers

Cash Flow Mechanics of Investing in PV Solar

How will you get your money back and what are the assumptions?



Depreciation

Depreciation is the systematic reduction of the recorded cost of a fixed asset to match a portion of the cost of a fixed asset to the revenue that it generates.

Under federal Modified Accelerated Cost-Recovery System (MACRS), businesses may recover investments in certain property through depreciation deductions. Most renewable energy technologies are classified as five-year property.

Tax Cuts and Jobs Act - A 100% first-year deduction for the adjusted basis is allowed for qualified property acquired and placed in service after Sept. 27, 2017, and before Jan. 1, 2023

100% placed in service before Jan. 1, 2023
80% placed in service before Jan. 1, 2024
60% placed in service before Jan. 1, 2025
40% placed in service before Jan. 1, 2026
20% placed in service before Jan. 1, 2027

Source: U.S. Department of Energy. https://energy.gov/savings/modified-accelerated-cost-recovery-system-macrs

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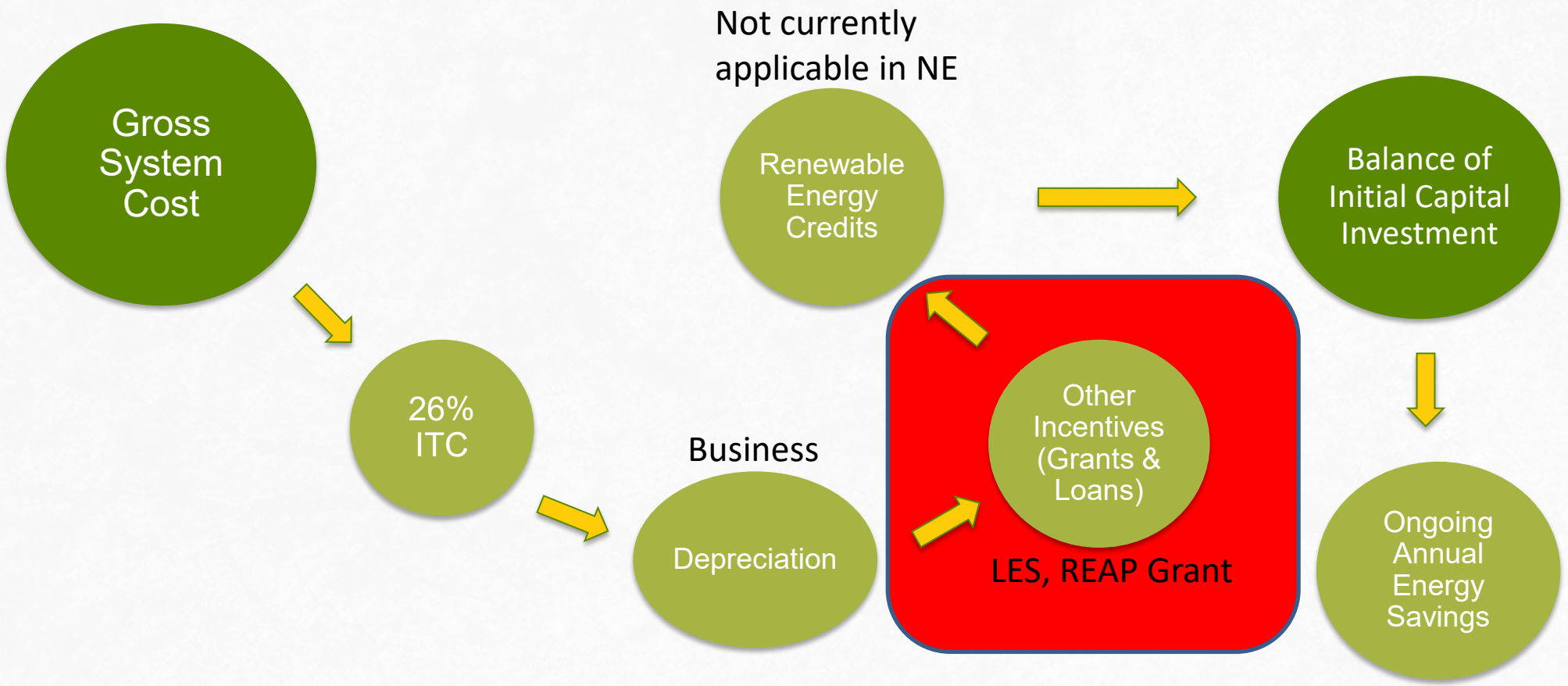
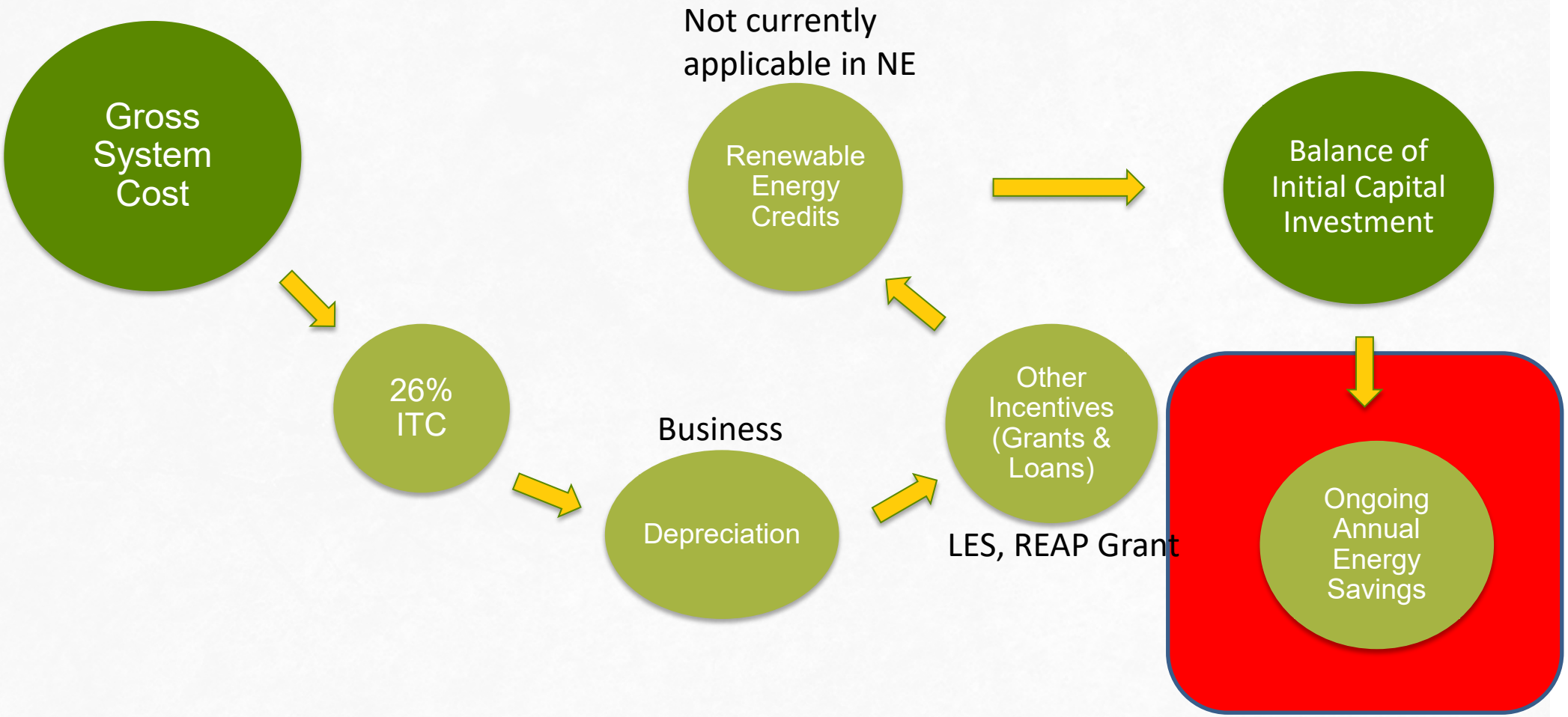


- **Incentives come from four primary sources**
  - federal
  - state
  - local government
  - utility companies
- **Incentives typically target specific sectors, so different incentives exist for residences, businesses, and agricultural producers.**
- **In most cases, grant funding is……**
  - TAXABLE INCOME
  - NOT GUARANTEED

- **Farms**
- **Rural Businesses**
- **Grants up to 50%**
  - Reimbursement
  - Taxable Income
- **Loan Guarantees**
- **NOT Guaranteed Money (there is only so much money available and this grant is competitive)**

Cash Flow Mechanics of Investing in PV Solar

How will you get your money back and what are the assumptions?



How Are You Charged for Electricity?

Customer (fixed) Charge

This fee covers a portion of infrastructure costs.

Energy Charge

This charge covers the cost of producing energy (kWh).

Demand Charge

Covering peak demand (both daily and seasonal) requires that power plants be available to provide energy for relatively short durations.

Transmission , Distribution Charges

Distribution would cover the costs of the local utility to get the electricity to your home or business, may be part of your energy charge or fixed charge if your supplier and distribution utility are the same entity.

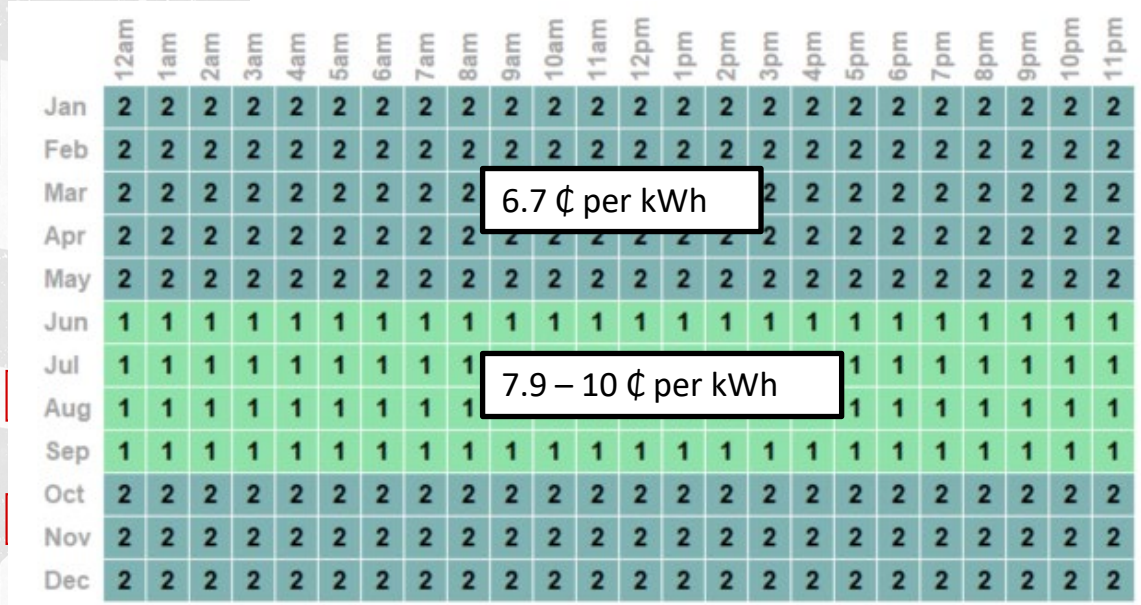
Cost Recovery Charges (other charges and fees)

Additional charges and riders added to the bill

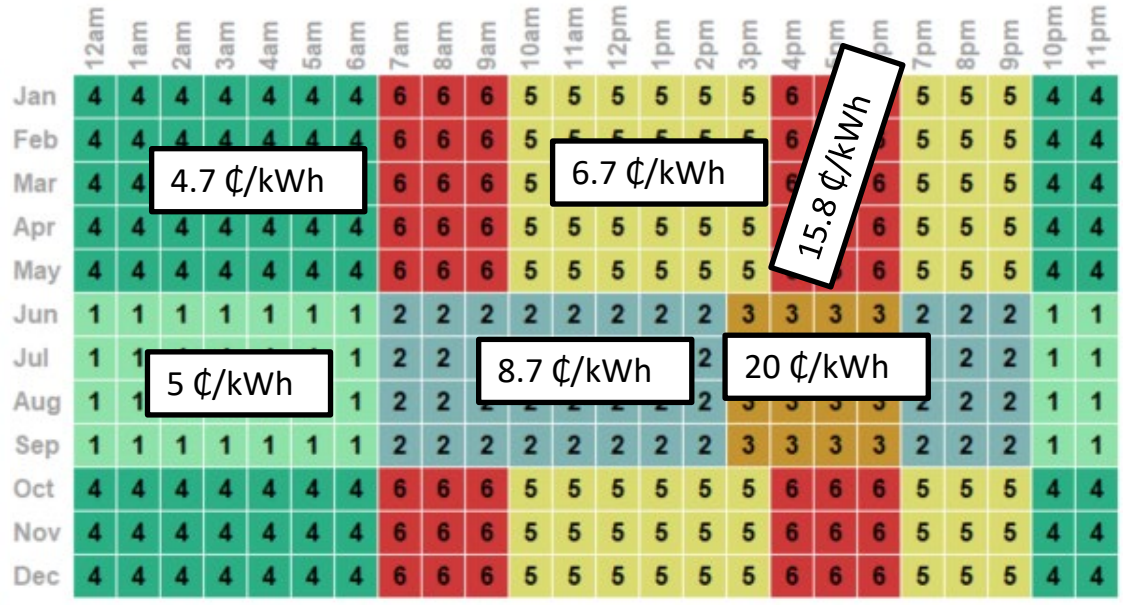
- **Your future electricity rates will likely change to include**
  - **Time of Use rates (residential)**
    - Different costs of electricity at different times of day
  - **Demand Charges (residential and commercial)**
    - A monthly charge based on your peak use
  - **Increase in Customer Charge or Base Cost (residential and commercial)**
    - (maybe with reduction or slower grown for per kWh energy charges)
  - **Power Factor Charges (mostly farm or commercial rates)**
    - For big motor loads,
      - Irrigators, Grain bins, Confined animal operations

Time of Use (TOU)

Seasonal TOU



Daily TOU



House	Seasonal	Daily
Small House	$789	$788
Large House	$1,293	$1,315

LES Electricity Changes

	2014	2018	2022	2023 proposed
Customer Charge	$11.15	$22.25	$5.00	$5.00
Facilities Charge			$20-$46	$22.50-$52.25
Summer energy / kWh	9.95 cents /kWh	8.58 cents /kWh	7.10 cents /kWh	7.28 cents /kWh
Winter energy / kWh	5.73 - 7.30 cents /kWh	5.86 cents /kWh	5.47 cents /kWh	5.50 cents /kWh
Demand / kW	0	0	0	0

Federal Law

Public Utility Regulatory Policies Act (PURPA)

Federal law passed in 1978, forced public utilities to connect renewable energy systems to their grid

Facilities must be Qualifying Facility under Federal Energy Regulatory Commission

Must pay at least 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 ~8-12 cents per kWh

State Law

Net metering

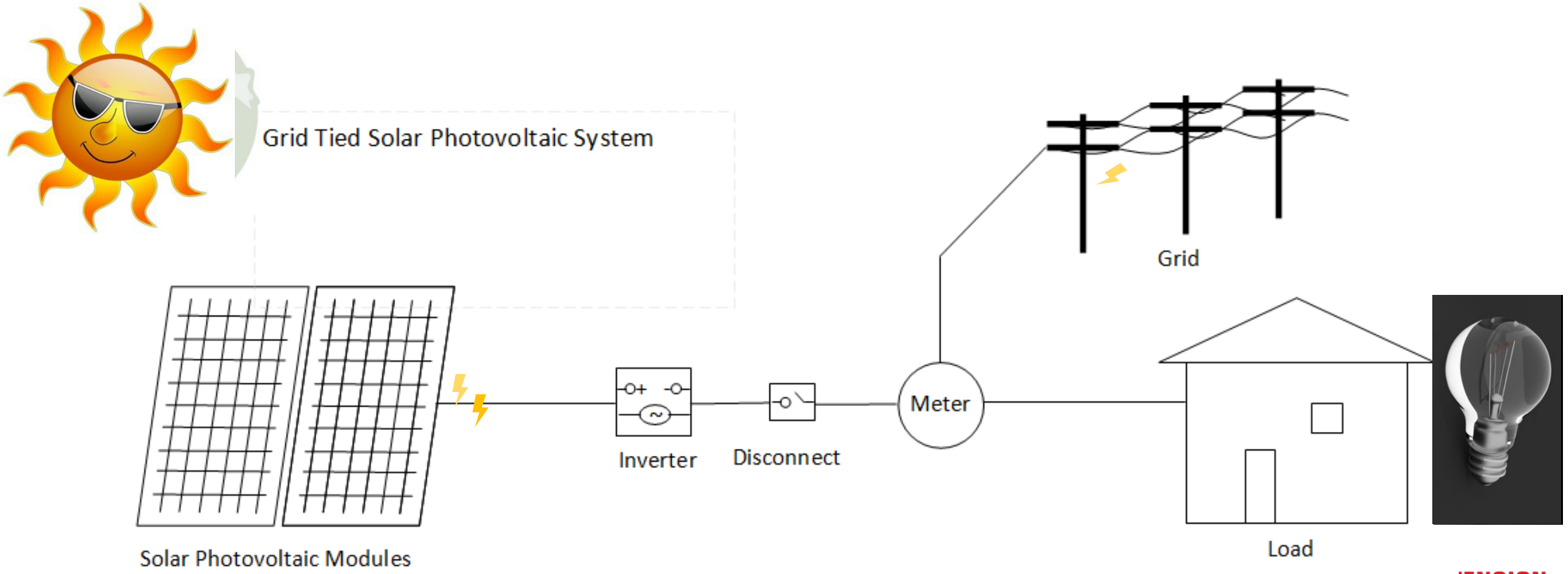
A Net metering policy is an agreement between a utility provider and electric consumer who own generates their own electricity with an onsite renewable energy facility.

"Net", in this context, refers to what kWh's remain after deductions of any energy outflows from metered energy inflows during the billing period.

Under net metering, a system owner receives retail credit for **at least a portion** of the electricity they generate

In Nebraska: Utilities must net meter customers until net metered customer generation reaches 1% of their demand. After which they do not have to net meter additional customers

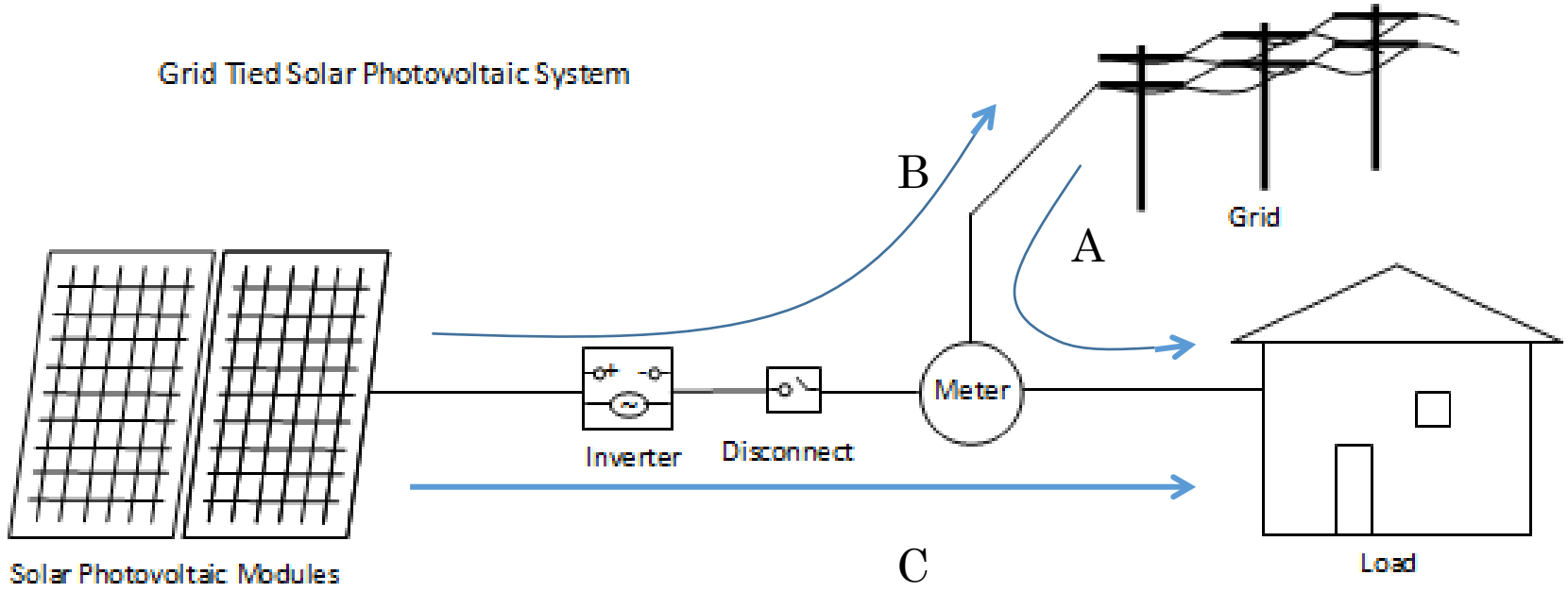
EXAMPLE OF GRID TIED PHOTOVOLTAIC SOLAR SYSTEM



EXTENSION

NET METERING

GRID TIED PHOTOVOLTAIC SOLAR SYSTEM



Net Metered Electric Bill:

Base Fee: $

Demand: $/kW if applicable

Energy: $/kWh x (A-B) kWh

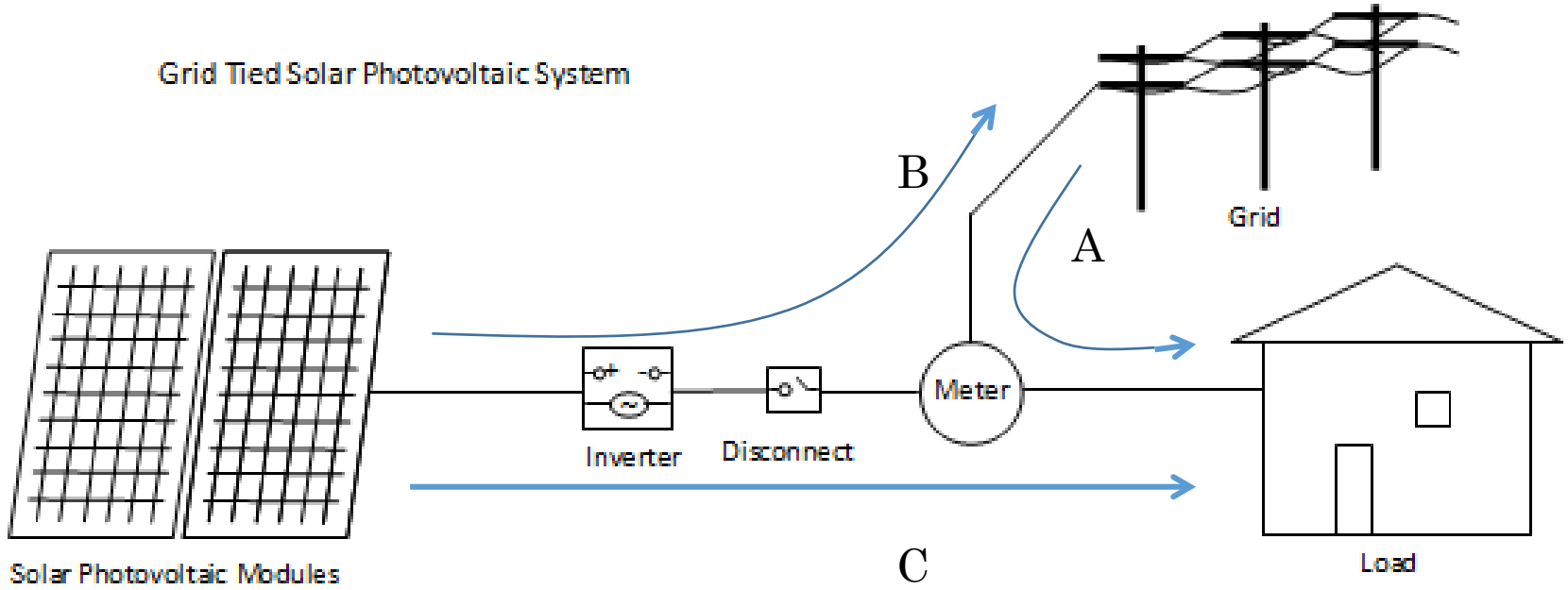
C is used instantaneously by you load and offsets A

(if A-B is negative (net excess generation) then avoided cost is paid to customer for net excess generation)

EXTENSION

NET BILLING

GRID TIED PHOTOVOLTAIC SOLAR SYSTEM

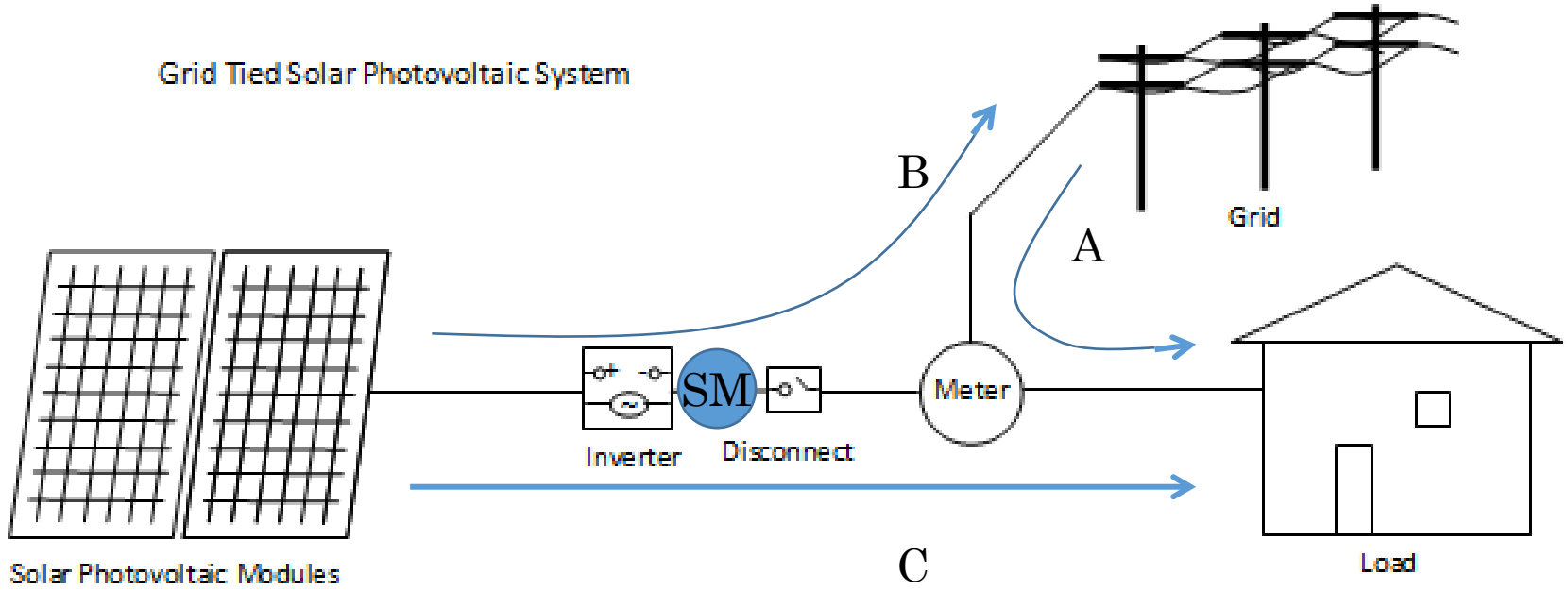


Net Billing Electric Bill:
Base Fee: $
Demand: $/kW if applicable
Energy:
A kWh x $Retail/kWh is paid by customer
B kWh x $Avoided Cost/kWh is credited to customer
C is used instantaneously by you load and offsets A
(A is valued at energy rate for your rate schedule B is valued at avoided cost)

EXTENSION

BUY ALL SELL ALL

GRID TIED PHOTOVOLTAIC SOLAR SYSTEM



Buy All Sell All Electric Bill:
Base Fee: $
Solar Fee if applicable
Demand: $/kW if applicable
Energy:
A kWh x $Retail/kWh Charged to customer
B kWh x $Avoided Cost/kWh Credited to customer
Solar Meter (SM) – B = C
C kWh x $Avoided Cost is paid to customer
C kWh x $ Retail is charged to the custmer

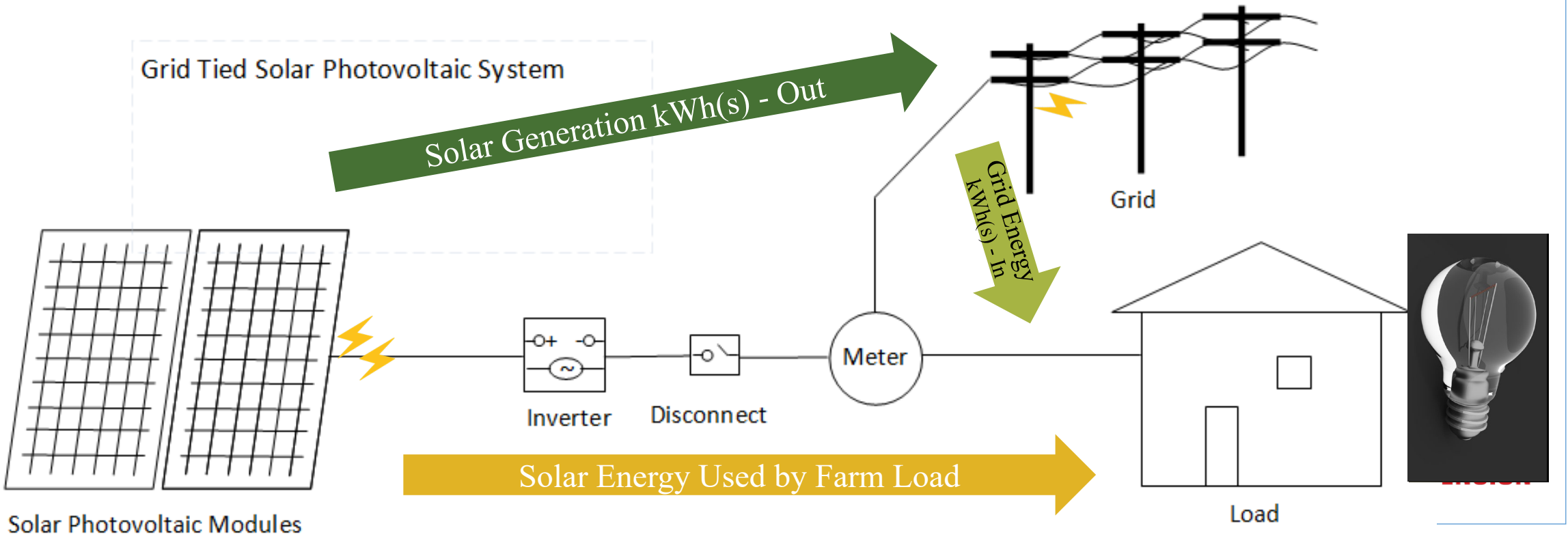
EXTENSION

GRID TIED PHOTOVOLTAIC SOLAR SYSTEM

kWh(s) - In − kWh(s) - Out = Net kWh(s)

(+) Positive Value
Represents
Net Usage

(-) Negative Value
Represents
Net Excess Generation



Considerations for Good Financial Analysis

Assumptions:

- **Solar electricity generation**
  - Degradation
  - Shading
- **Value of the electricity generated**
  - Net excess generation
- **Inflation**
- **Discount rate**
- **Tax implications of incentives**
  - Tax Credit
  - Depreciation
  - Utility incentives
- **Insurance**
- **O&M**

Financial Metrics

- Payback
  - Simple
  - Discounted
- Net Present Value
- Levelized cost of electricity
- Electricity bill with and without system

Payback (Nebraska 2021)

- Using conservative assumptions
  - Residential 12-16 years
  - Commercial/Agricultural 9-14 years

NOTE: system economics are unique the numbers here are only estimates

Residential Example – Eastern NE – Using System Advisor Model – National Renewable Energy Lab					
6 kW solar (roof mount) • House load: 10,500 kWh per year • $2.50 per Watt (total cost) • Finance: 100% at 2.5% • Insurance and O&M • 1.5% energy cost escalation	Net Billing	Buy All Sell All with $35 per month fee	Conservative Assumptions (O&M, Insurance, normal inflation)	Back of the envelope calculations (no other ongoing costs)	6% escalation of electrical prices (no other ongoing costs)
Payback	18.6 years	50+ years	14.6 years	13.5 years	10.5 years
Net Present Value (6% discount Rate) (25 years)	-$1,387	-$12,600	$740		$7,456

Over 25 kW
Utility has met 1%

Small Commercial Example – Eastern NE – Using System Advisor Model – National Renewable Energy Lab				
25 kW solar (ground mount) • Business load: 55,000 kWh per year • Non demand rate schedule • $2.20 per Watt (total cost) • Finance: 100% at 2.5% • Insurance and O&M • 1.5% energy cost escalation • 100% bonus depreciation	Net Billing	Conservative Assumptions (O&M, Insurance, normal inflation)	Back of the envelope calculations (no other ongoing costs)	6% escalation of electrical prices (no other ongoing costs)
Payback	16.5	13.8 years	10.2 years	9.5 years
Net Present Value (6% discount Rate) (25 year)	$2,945	$7,359		$28,036

Picking an Installer

IN OUR GRIT, OUR GLORY™

- **Quality Installation**
  - Long lasting few problems
- **Cost of Installation**
  - Reasonable within the market range
- **Data presented to customer is honest and correct**


• Quality Installation


• Poor Installation

Data presented to the customer

- **Clearly list make and model of all major equipment**
- **Clearly mark total price**
  - Not just the net price after tax credits
- **Energy Production Estimate**
  - Includes tilt and azimuth
  - Includes **shade** if any
  - Is in the ballpark of what PV Watts says
  - Solar panels
  - Inverter(s)
  - Racking
- **Economic analysis if there is one**
  - **Having a false or bad economic analysis is worse than not having one**
  - Should include
    - Includes reasonable inflation factor 1-3%
    - Uses actual rate schedule for your utility and not just a single value for all electricity
    - Correct calculation of incentives
  - May include
    - Panel degradation
    - Depreciation can’t depreciate all of tax credit value
    - Insurance

Picking an Installer

-Trade Ally Programs

IN OUR GRIT, OUR GLORY™

Picking an installer

- **How many systems have you installed?**
  - Where? How many years? Have you worked with my utility?
  - Can I see one? (straight lines, no hanging wires, good dirt work and good concrete work)
- **What is estimated production of a system at my location?**
  - Compare to PV Watts (pvwatts.nrel.gov)
  - Or your Utility's Solar Calculator
- **Does my system need rapid shutdown?**
  - (A good installer should know about this and explain it in a way you can understand)
- **Do you set up internet monitoring?**
  - Internet monitoring is important for all systems but is required to initiate warranty for some inverters
- **Check with your utility for their experiences?**
- **Trade Ally Programs**
  - List of installers who have been trained by the utility

Why the utilities started Trade Ally programs

- **Misleading advertising**
  - Unrealistic paybacks (exaggerated cost inflation)
  - Exaggerated production (not accounting for shade)
  - List of incentives that don’t exist (raise price and reduce by rebate)
- **Poor installations**
  - Over promise under deliver

What is a Trade Ally Program?

- Training offered to installers by utility
- Participating installers promise to represent utility information accurately (rates, incentives, etc)
- Customers utilizing a participating installer may access utility incentive programs

What a Trade Ally Program is NOT

- Not an endorsement or guarantee
- Does not ensure quality installation

Prospective solar owners need to do their homework when picking an installer

Goals

1. **Increase quality of economic analysis**
2. **Increase likelihood of quality installations**

Trade Allies must

- **Attend Training**
- **Complete acknowledgment**
  - Promise to represent rate schedules and other LES incentives accurately

Customers

- **Customers who use Trade Ally installers can access the value-of-capacity incentive**

SUSTAINABILITY

- Sustainability Series
- Decarbonization goal
- Sustainable Energy Program
- LES Peak Rewards
- Solar power

SOLAR TRADE ALLY NETWORK

Solar installers listed below have been educated about and have formally acknowledged that they will represent LES rates, incentives and other utility-related information in a consistent and accurate manner. Only projects installed by a network participant are eligible for LES' value-of-capacity incentive.

Inclusion on the Solar Trade Ally Network participant list does **NOT** constitute an endorsement or guarantee of service by LES.

If you have any questions, contact LES at 402.475.4211 or energyservices@les.com.

Goals

1. **Customers will understand how their bill will be affected**
2. **Increase likelihood of quality installations**

Trade Allies must

- **Attend Training**
- **Use Solar Checklist**
  - Provided to customer prior to agreement signature
- **Use correct rate schedule for calculations**
- **Display inflation rate of electricity used in calculations**

Solar Trade Ally Network

Investing in solar is a big decision as the investment is significant for a long-term project. NPPD is here to assist customers and vendors who are helping them when installing solar.

Want to be an NPPD Solar Trade Ally? | Looking for a Solar Installer?

Are you a solar vendor interested in participating in NPPD's Solar Trade Ally Network? Participants must view NPPD's Solar Trade Ally Network training video and review the Guidelines and Acknowledgement Agreement. By submitting the agreement, participants verify they have been educated about NPPD rates, the inspection process, and will follow the guidelines outlined.

Steps to Become a Solar Trade Ally

1. View the training video below in its entirety.

Goals

Omaha Public Power District Solar Trade Ally Network

1. **Increase quality of economic analysis**
2. **Increase likelihood of quality installations**
    1. Knowledgeable installers
    2. Customer satisfaction and faster start up times
3. **Support local businesses**

Trade Allies must

- **Attend Training**
- **Complete acknowledgment**

Customers

- **Customers who use Trade Ally installers can access OPPD rebate incentive**

TRADE ALLY Program | Your Energy Partner OPPD Omaha Public Power District

Rebates | HVAC Rebate Calculator | Training | Resources

Trade A

A Compreh

We've gathered every
estimate rebates, requ

How to Become a Tra

Find a Trade Ally

Click the type of project icon below to display our most active Trade Allies that can help save on energy and costs.

Lighting

HVAC

Solar

Current Business R

$65

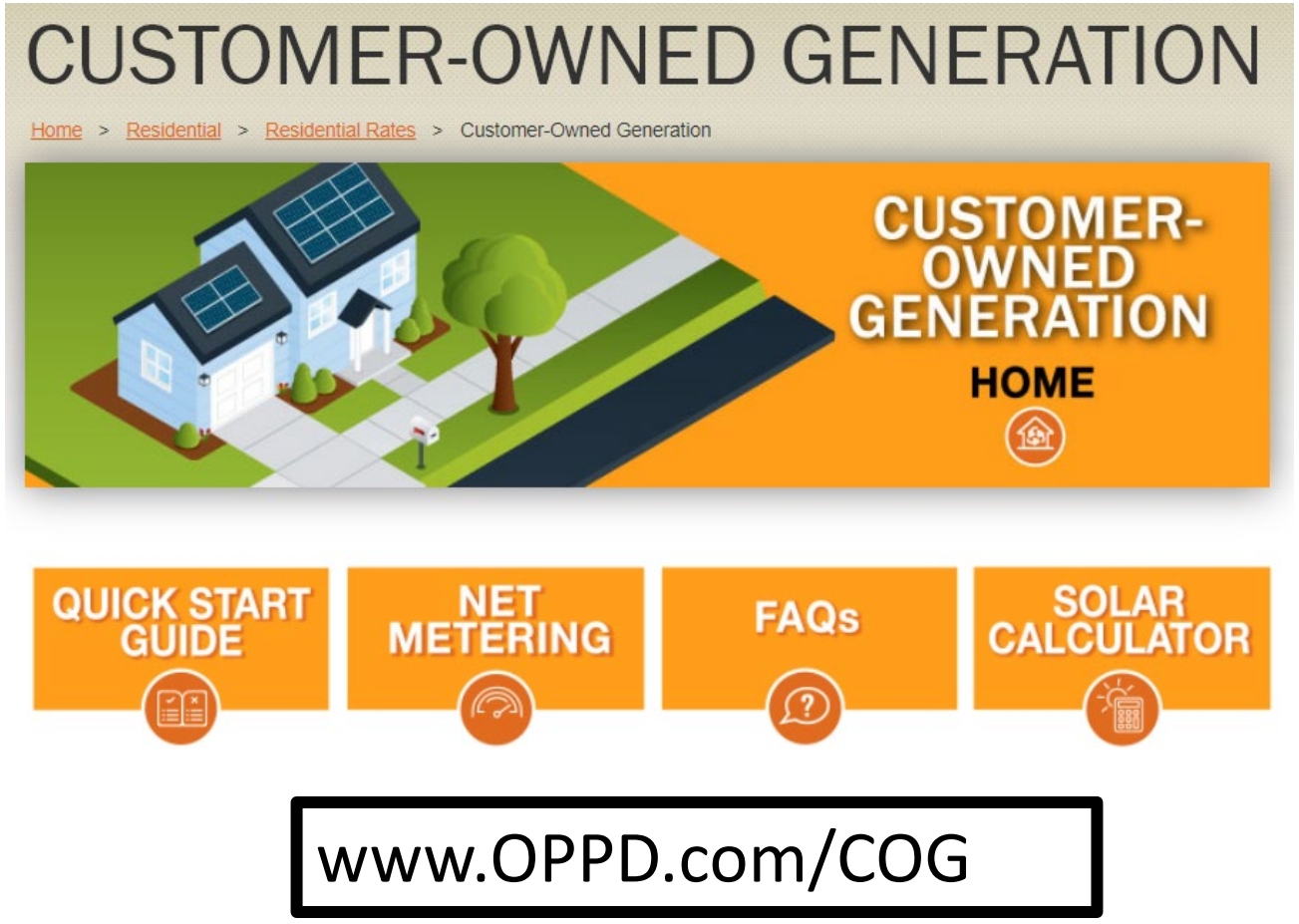
29%

Begin Presc Application

Ally News Update

OPPD Resources to Help Customer-Owners

- Quick Start Guide with Video
- How Net Metering Works
- Solar Calculator (Try it!!!)
- FAQ’s
- Online Application System
- Trade Ally Program to Protect Consumers



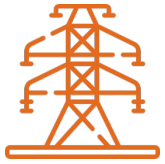
www.OPPD.com/COG

Periodic utility-led training sessions for solar contractors and developers, electricians, City/State electrical inspectors and stakeholders

Benefits of the new program:

- Ability to offer utility solar rebates (when available)
- Referral source - Listing on OPPD website

- More knowledgeable contractors
- Improved satisfaction from proper expectations and faster startups

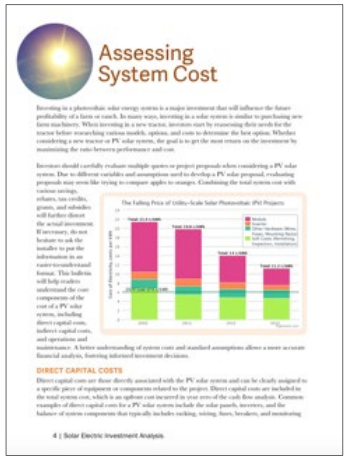


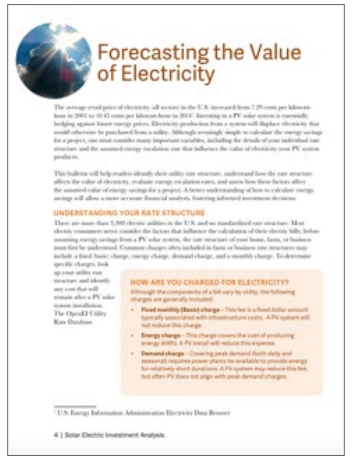
- Higher application approval rates
- Higher witness test pass rates
- Higher overall customer satisfaction

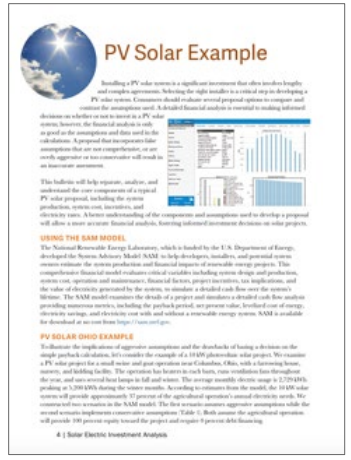
Contractor Requirements (partial):

- Attend training at least once every 3 years
- Accurately represent utility programs, energy costs and escalation rates
- Agree to code of conduct
- Maintain NABCEP certification
- Physical address in OPPD territory
- Been in business at least 12 months under current name
- Installed at least two systems in OPPD footprint in previous 12 months

Solar Electric Investment Analysis – bioenergy.unl.edu







Contact me for Questions

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ON
OFF
solaredge
HD wave

EXTENSION


Fronius

Wyandot County Solar (12 MW / 83 Acres / 159,200 panels)


ICON
CAT