Nebraska
Wind & Solar
CONFERENCE & EXHIBITION

Consumer Webinar for Residential / Small Business Solar

Thursday, August 26th
10:00 AM

Featured Presenters:

Ron Rose
Nebraska Public Power District

John Hay
UNL Biosystems Engineering Department

Marc Shkolnick
Lincoln Electric System

Kirk Estee
Omaha Public Power District

David Rich
Nebraska Public Power District

Nebraska Wind and Solar Conference

Consumer Webinar for Residential/Small Business Solar

Thursday, August 26, 2021

Presenters:

- Ron Rose - NPPD
- John Hay - UNL
- Marc Shkolnick - LES
- Kirk Estee – OPPD
- Dave Rich - NPPD

Nebraska
Wind & Solar
CONFERENCE & EXHIBITION

Net Metering

- (2009) LB 436 mandated net metering
  - Encourage customer-owned renewable energy
  - Stimulate the economy
  - Encourage diversification of energy generation
  - Maintain low-cost, reliable electric service

Net Metering, continued

- (2009) LB 436 -
  - Customer must generate electricity on the customer side of the meter
  - Interconnection agreement with their local utility
  - Net Excess Generation is the amount of energy, if any, that exceeds the total consumption during a billing period
  - Credit a customer-generator at the applicable retail rate up to the total requirement

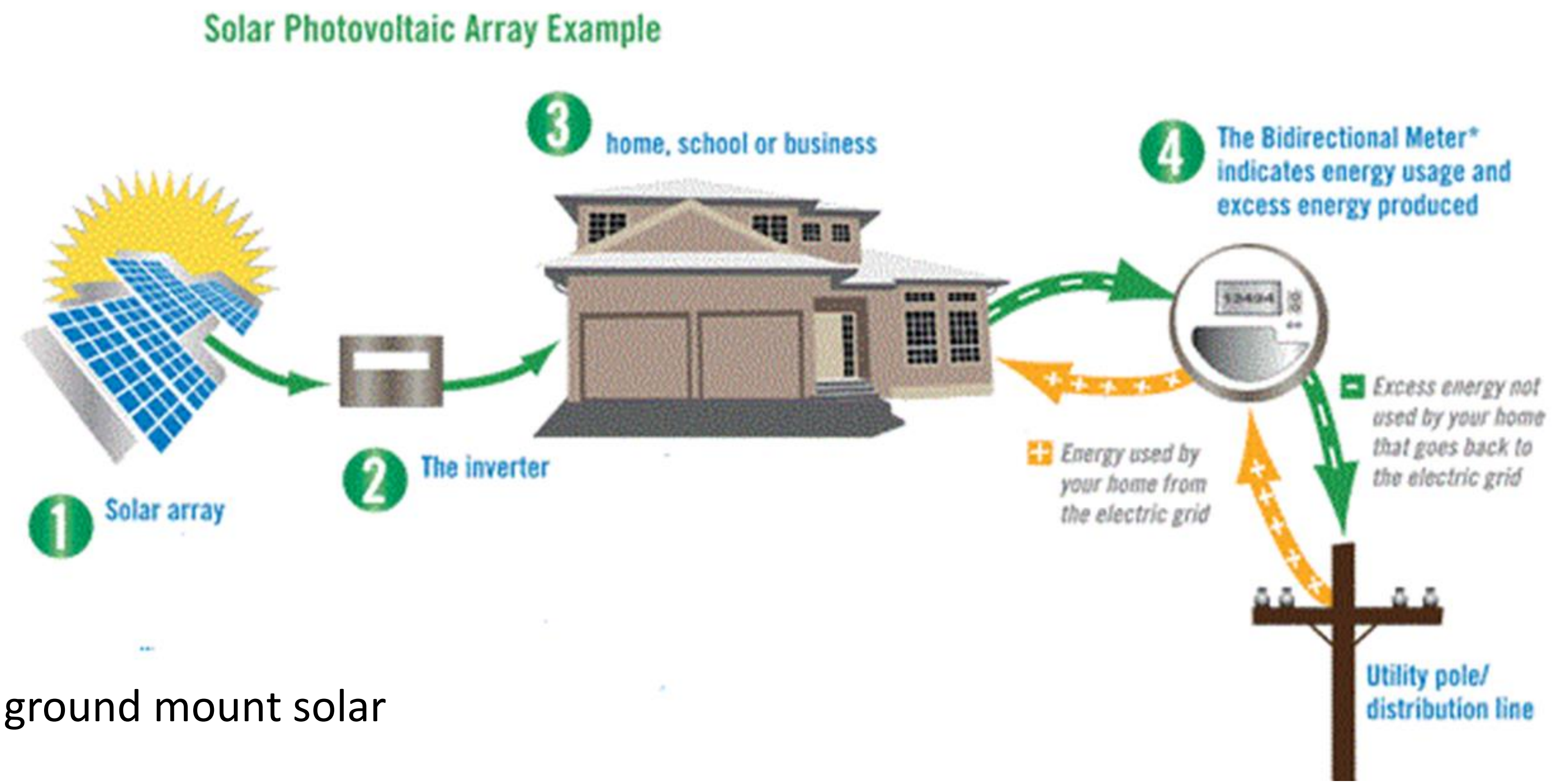
Net Metering, continued

- (2009) LB 436 -
  - Qualified Facility
    - Methane, Wind, Solar, Biomass, hydropower, or geothermal
  - Controlled by the customer-generator and located on their property
  - Does not provide credits to another location
  - Rated capacity of 25kW or less
  - Inspected by City Electrical Inspector or
    - State Electrical Division

Net Metering, continued

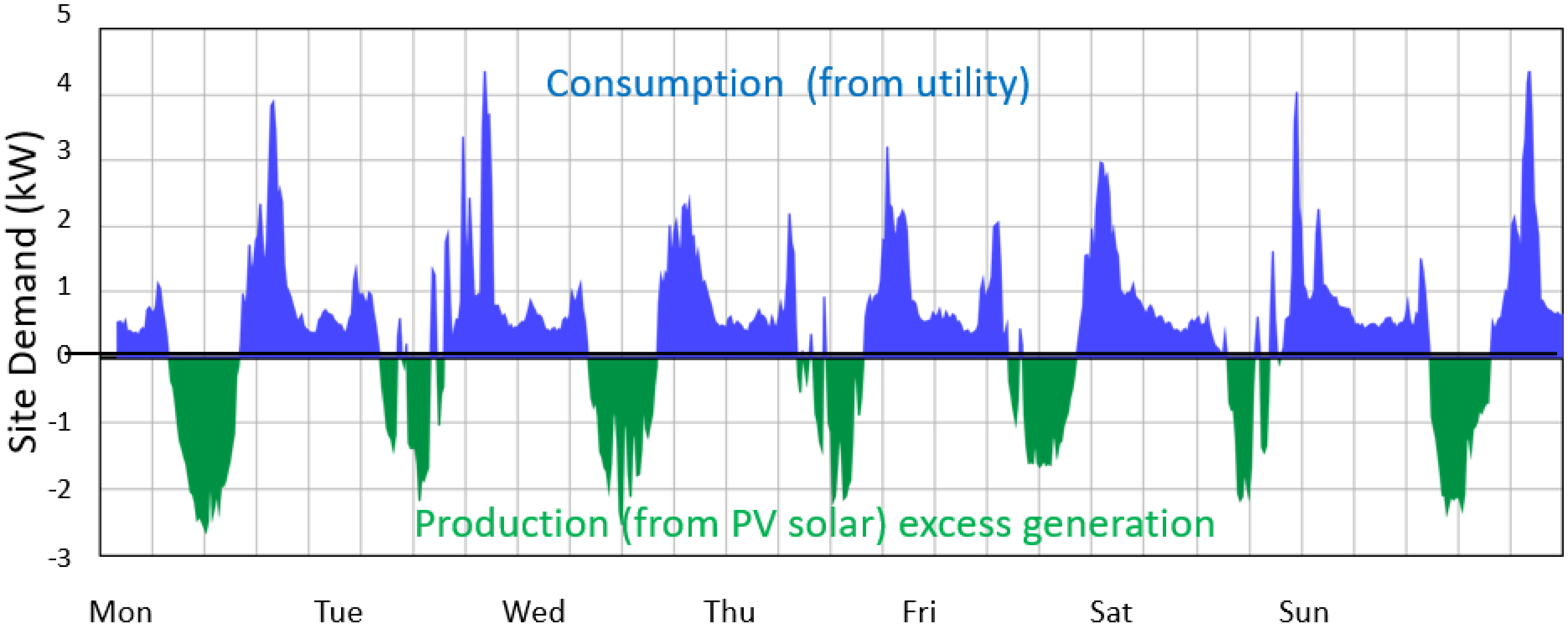
- (2009) LB 436 -
    - Equipment shall meet UL and IEEE standards
    - Equipment is to automatically isolate in a power outage
    - Utility shall provide bi-directional meter
    - No additional costs to the customer using the existing infrastructure
    - Net Excess Generation is paid at utility avoided cost
    - Utility is not required to provide net-metering once the total of capacity of all customer’s qualified generators reaches 1% of avg. monthly peak demand

Net Metering, continued



Roof or ground mount solar

Net Metering, continued



Net Metering Example for York, NE

Calculation to forecast PV Solar offset

~~$/kWh = $281.60/2000 = $0.14/kWh~~

- Billing example (NPPD)
- What we typically see <u>before</u> net metering:
  - Energy received (from your public power utility): 2000 kWh

A. Customer Charge	$ 22.50
B. Energy and Delivery Charges	$ 200.00
C. Production Cost Adjustment	$ 5.82 CR
D. Other Fees and Taxes	<u>$ 64.92</u>
	$ 281.60

$/kWh =
($200-$5.82+58.31) =
$252.49/2000 = $0.1262/kWh (summer)
$180.59/2000 = $0.0903/kWh (winter)

Net Metering Example for York, NE, continued

- Billing example (NPPD)
  - Net Excess generation (NEG) = 0

Energy received (from your public power utility): 2000 kWh
Energy delivered (to your public power utility): -- 500 kWh
Billed Net 1500kWh

Customer Charge	$ 22.50
Energy and Delivery Charges	$ 150.00
Production Cost Adjustment	$ 4.36 CR
Other Fees and Taxes	$ 51.00
	$ 219.14

Net Metering Example for York, NE, continued

- Billing Example (NPPD)
  - Net Excess generation (NEG) = 500 kWh

Energy received (from your public power utility): 1500 kWh
Energy delivered (to your public power utility): -- <u>2000 kWh</u>
Billed Net -500 kWh

Customer Charge	$ 22.50
Net Excess Generation	$ 44.70 CR
Lease Payment	$ 3.25
Gross Revenue Tax	<u>$ 1.36</u>
	$17.59 CR

Credit is applied to customer account to future billing. Any excess credits shall be paid out to coincide with the last bill of an annualized period or within 60 days of customer terminating service.

PV Solar (without storage battery) is not backup generation during an outage

- Large misconception that PV Solar can be used during an outage as backup power
- PV Solar disconnects from the grid during an outage to protect utility lineman
- Safety feature of all UL and CSA approved inverters
- During an outage, the PV Solar inverter must disconnect within 0.1 seconds

Residential Battery Storage

- Net Metering will largely reduce the economic benefit of battery storage
- Net Metering (Battery Storage kW + PV Solar kW ≤ 25kW)

- Pros
  - A few hours of automatic backup to critical loads during a utility outage
  - Offset on-peak energy (kWh) if on a TOU (time of use) rate

- Cons
  - Cost
  - Operation and Maintenance, programming, scheduling

Social & Environmental Benefits of PV Solar

- Positive social impacts from decreased electric bills for low-income individuals
- Job creation
- Reduces Greenhouse Gas Emissions
- Reduces Dependence On Nonrenewable Energy Sources
- Improves Humanity's Health In The Long-run.

Financing options for PV Solar

Residential, Commercial, and Ag Production customers

- 26% Federal ITC (Investment Tax Credit) must have tax liability to claim the credit.
- https://www.energy.gov/eere/solar/downloads/residential-and-commercial-itc-factsheets

- NDEE (Nebraska Dept of Environment and Energy)
  Dollar and Energy Savings loan
  - This is a low interest 10-year loan from your local bank supported by NDEE
- https://neo.ne.gov/programs/loans/loans.html#:~:text=Most%20financial%20institutions%20in%20Nebraska%20offer%20Dollar%20and%20Energy%20Saving%20Loans.&text=The%20lender%20will%20approve%20your,to%20proceed%20with%20your%20project

Financing options for PV Solar

Commercial and Agriculture Production customers only

- Federal & State Tax MACRS (Modified Accelerated Cost Recovery System) depreciation information for Solar
- https://www.energy.gov/sites/prod/files/2020/01/f70/Guide%20to%20Federal%20Tax%20Credit%20for%20Residential%20Solar%20PV.pdf

- USDA Rural Development REAP grant program for energy efficiency and renewable energy.
- https://www.rd.usda.gov/programs-services/rural-energy-america-program-renewable-energy-systems-energy-efficiency/ne

Solar Economic Analysis

- Costs
- Production
    - Shading
    - Tilt/Azimuth
- Incentives
- Assumptions
    - Inflation/escalation
    - Maintenance
    - Insurance
- Process and picking an installer
- Resources

Why Solar?

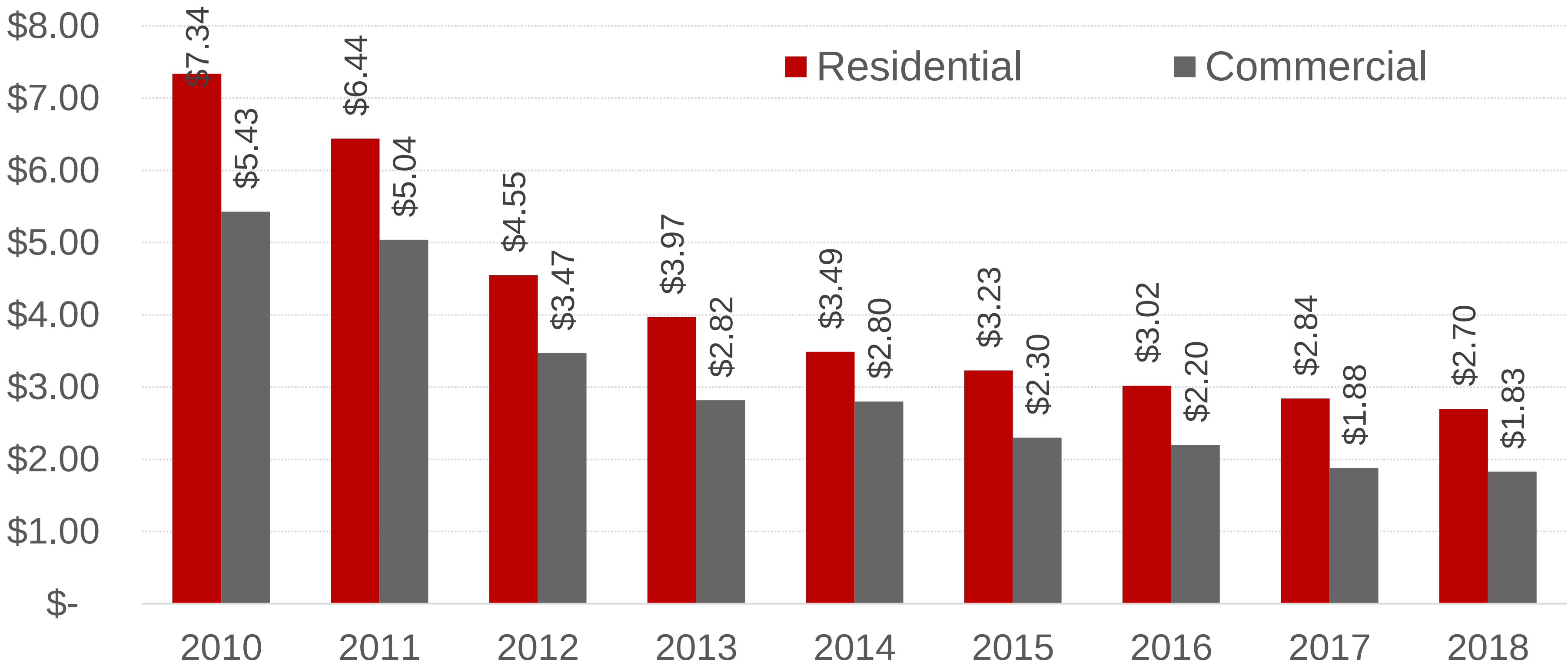
Residential or Business System

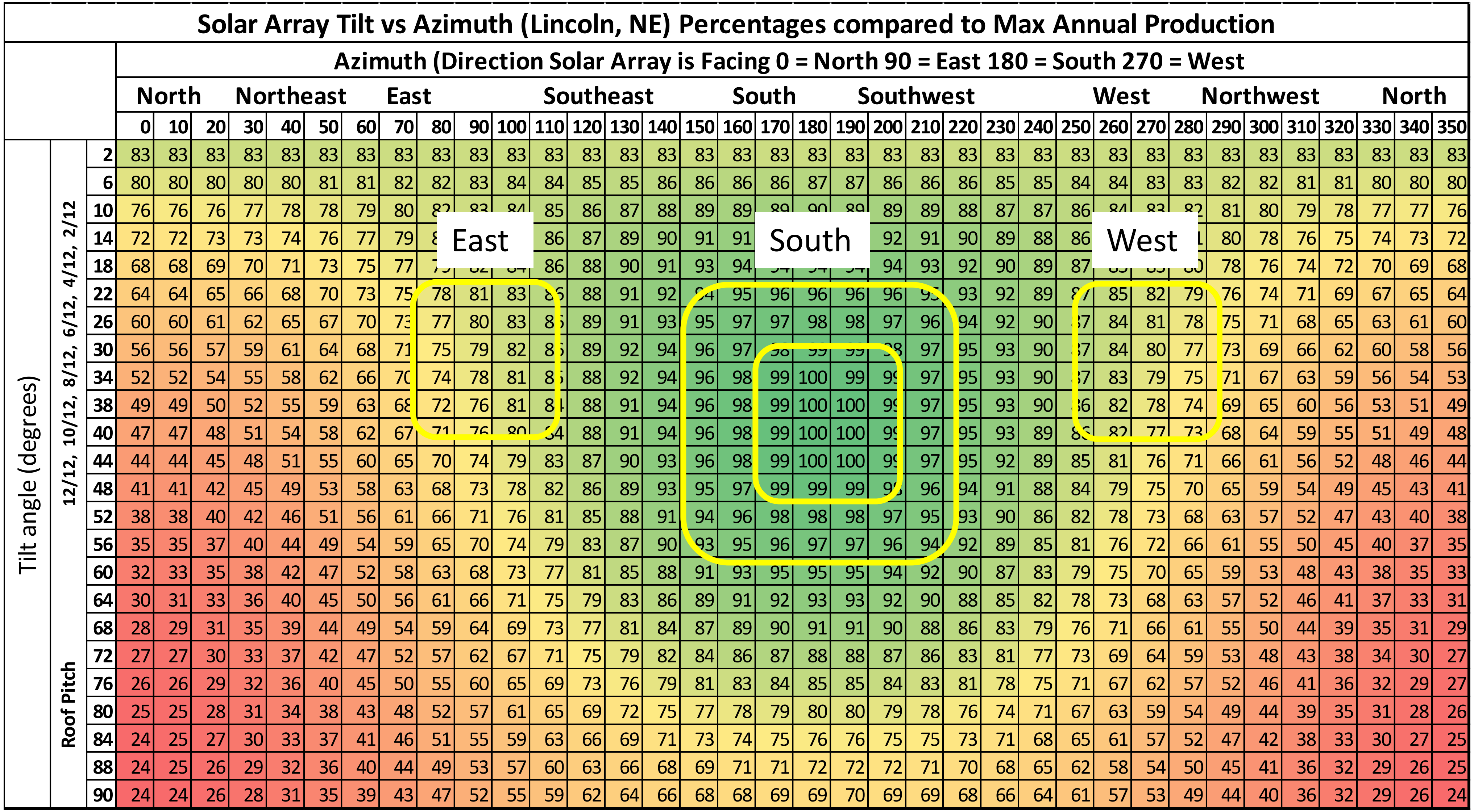
- Pros:
  - Green energy
  - Tax credit
  - Attached to your home or business
  - Depreciation (businesses)
  - Marketing
  - Ongoing savings
- Cons:
  - Initial cost of system
  - O&M
  - May not regain investment if you move

Community Solar Purchase

- Pros:
  - Green energy
  - Can participate even without place to install
  - Sell it back if you move
  - No O&M
  - Little to no risk
- Cons:
  - No tax credit (maybe)
  - No depreciation
  - Not at your location for marketing purposes

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





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

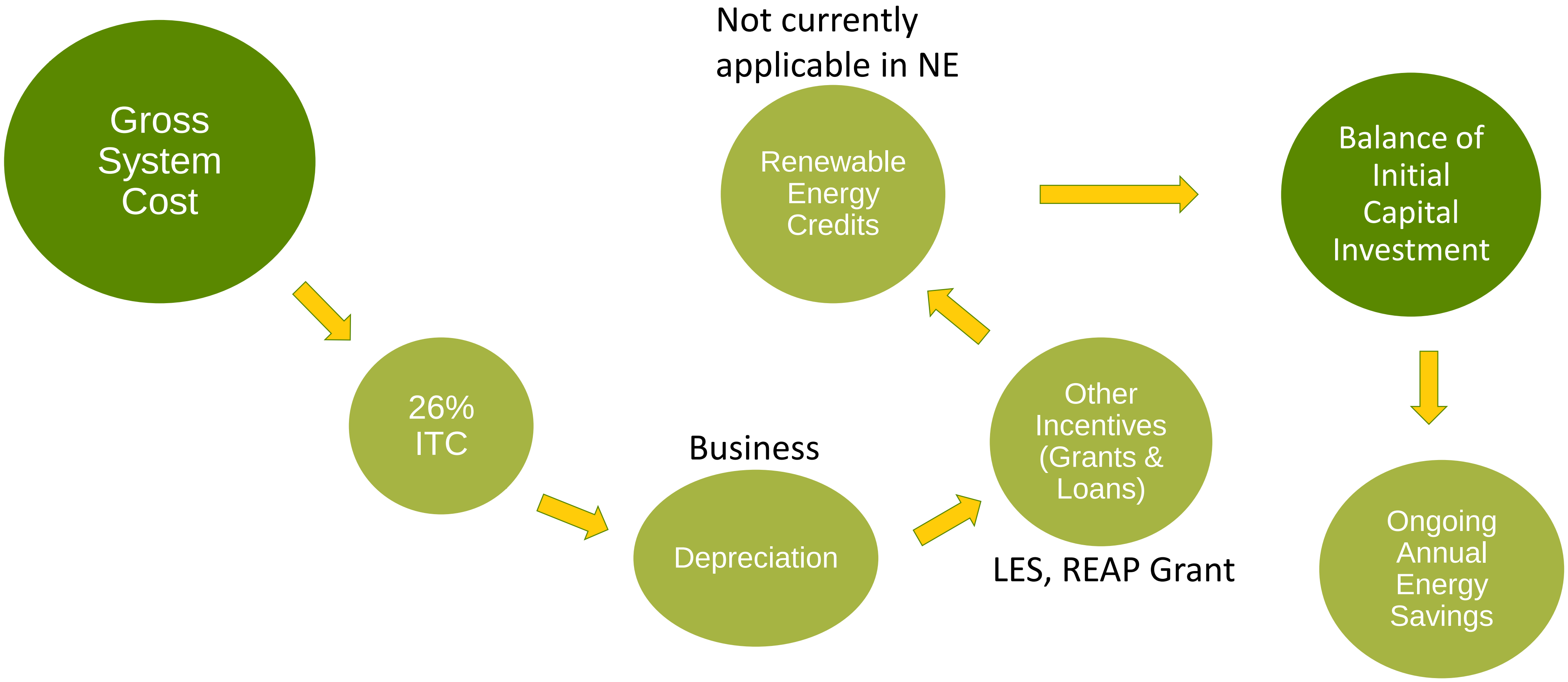
Roof Pitch

		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	89	88	87	87	86	84	83	82	81	80	79	78	77	77	76
14	72	72	73	73	74	76	77	79	[illegible]	[illegible]	[illegible]	86	87	89	90	91	91	[illegible]	[illegible]	[illegible]	92	91	90	89	88	86	[illegible]	[illegible]	[illegible]	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	85	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	85	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	84	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

Nebraska Wind & Solar
CONFERENCE & EXHIBITION

Cash Flow Mechanics of Investing in PV Solar

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



Gross System Cost

26% ITC

Business

Depreciation

Other Incentives (Grants & Loans)

LES, REAP Grant

Not currently applicable in NE

Renewable Energy Credits

Balance of Initial Capital Investment

Ongoing Annual Energy Savings

Incentives: Federal

The Federal Business Energy Investment Tax Credit (ITC) Schedule for Photovoltaic Solar	
12/31/19	30%
12/31/20	26%
12/31/21	26%
12/31/22	26%
12/31/23	22%
12/31/24	10%
Future Years	10%

The Federal Residential Energy Investment Tax Credit (ITC) Schedule for Photovoltaic Solar	
12/31/19	30%
12/31/20	26%
12/31/21	26%
12/31/22	26%
12/31/23	22%
12/31/24	10%
Future Years	0%

USDA Rural Energy for America Program (REAP) Grant

25% of total costs
-Rural or Agricultural to Qualify

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 ← Good
    - Simple
    - Discounted
- Net Present Value ← Best
- 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	No net metering	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	14.6 years	13.5 years	10.5 years
Net Present Value (6% discount Rate) (25 years)	-$1,387	$740		$7,456

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	No net metering	Conservative Assumptions (O&M, Insurance, normal inflation)	All 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

System Price Sensitivity

Residential 6 kW		
System Total Cost ($ /Watt)	Payback (years)	Net Present Value (6% discount rate)
$2.00	12.16	$2,244
$2.25	13.42	$1,492
$2.50	14.64	$740
$2.75	15.82	-$12
$3.00	16.97	-$764
$3.25	18.08	-$1,516
$3.50	19.15	-$2,268
$3.75	20.20	-$3,021
$4.00	21.22	-$3,773

Small Commercial 25 kW		
System Total Cost ($ /Watt)	Payback (years)	Net Present Value (6% discount rate)
$2.00	12.65	$8,851
$2.25	14.03	$6,987
$2.50	15.38	$5,122
$2.75	16.70	$3,258
$3.00	17.99	$1,394
$3.25	19.25	-$470
$3.50	20.49	-$2,334
$3.75	21.70	-$4,198
$4.00	22.88	-$6,062

System Owner
Installer and Electrician
Utility is involved.

Steps in Solar PV Process

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

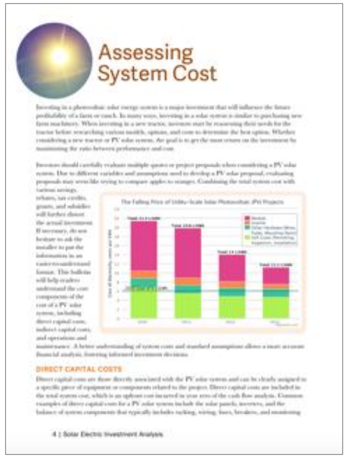
1. Study electric bills, efficiency
2. Solar homework, goals,
3. Get quotes, talk to multiple installers
4. Contact utility (Owner and Installer)
5. Design
6. Order solar modules, inverter, mounting
7. Building permit
8. Structure
9. Solar rail mounting
10. Solar module (panel) installation
11. Electrical 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)

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)
- **Nebraskans for Solar** has list of installers on-line

Solar Electric Investment Analysis – bioenergy.unl.edu


EXTENSION
EC3008
SOLAR ELECTRIC INVESTMENT ANALYSIS
F. John Hay

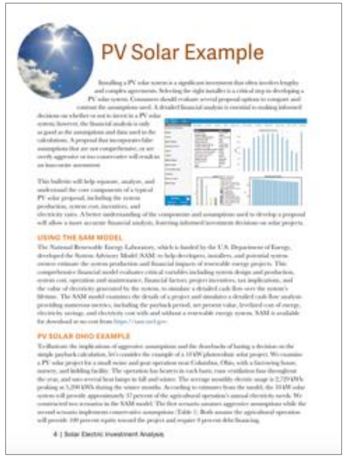

Assessing System Cost


Forecasting the Value of Electricity


Estimating System Production

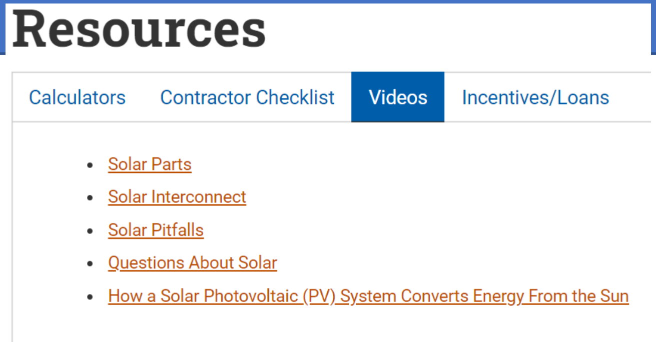

Understanding Incentives


Conducting a Financial Analysis


PV Solar Example

Resources

- NPPD.com



Resources

- Solar Parts
- Solar Interconnect
- Solar Pitfalls
- Questions About Solar
- How a Solar Photovoltaic (PV) System Converts Energy From the Sun

- OPPD.com

CUSTOMER-OWNED GENERATION

Home > Residential > Residential Rates > Customer-Owned Generation

- bioenergy.unl.edu

Solar Electric Investment Analysis Part #1: Estimatin...

PRODUCTION AND PAYBACK

What factors influence the production and value of electricity from your system?

- LES.com

CUSTOMER-OWNED GENERATION

Power in your hands

Interested in harnessing the sun or wind to power your home or business? Planning to install an emergency generator to meet business requirements? Whether you want to supplement the electricity we provide, adopt a greener lifestyle or enhance reliability, LES can help you along the path to generating your own energy

Contact me for Questions

- **F. John Hay**
- Extension Educator - Energy
- **Department of Biological Systems Engineering**
- **University of Nebraska–Lincoln**
- 250 L. W. Chase Hall, P.O. Box 830726, Lincoln, NE 68583-0726
- 402-472-0408
- jhay2@unl.edu http://bioenergy.unl.edu

Nebraska
Wind & Solar
CONFERENCE & EXHIBITION

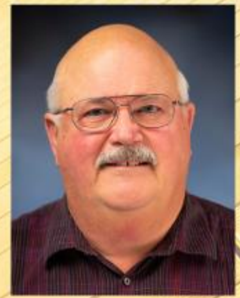
Contractor Webinar for Residential / Small Business Solar

Tuesday, August 31st
10:00 AM

Featured Presenters:

Kirk Estee
Omaha Public Power District

Marc Shkolnick
Lincoln Electric System



David Rich
Nebraska Public Power District

14TH ANNUAL

Nebraska Wind & Solar

CONFERENCE & EXHIBITION

November 8-9, 2021 | Lincoln, NE

www.nebraskawsc.com

Virtual Sessions

Nebraska
Wind & Solar
CONFERENCE & EXHIBITION

Consumer Webinar for Residential / Small Business Solar

Thursday, August 26th
10:00 AM

Featured Presenters:

Ron Rose
Nebraska
Public
Power
District

John Hay
UNL
Biosystems
Engineering
Department

Marc
Shkolnick
Lincoln
Electric
System

Kirk Estee
Omaha
Public
Power
District

David Rich
Nebraska
Public
Power
District