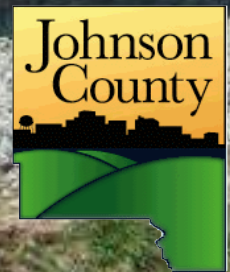


How We Saw the Light and Got Solar



MARCH 2016 SOLAR POWERING IOWA / MREA
Planning, Development and Sustainability Department
Johnson County, Iowa Speaker: Becky Soglin

Why Solar?

- Clean energy
- Reliability
- Local/State Impact
- Savings



Process

1. Energy Efficiency Projects
2. Feasibility + Analysis
3. Request for Proposals (RFPs)
4. Proposal Assessment / Selection
5. Power Purchase Agreement (PPA)
6. Interconnection Agreements+
7. Public Awareness





Johnson County Solar Arrays



Welcome!

Johnson County is proud to be the first county in Iowa to have entered into Power Purchase Agreements for solar arrays. The dashboard links below show you current and past energy generated. Visit anytime!

ARRAYS AT THE SECONDARY ROADS AND SEATS CAMPUS: 4810 Melrose Avenue in Iowa City, operational: October 20

Together, these two solar arrays should generate about 23% of the annual electricity needed at the campus and save taxpayers nearly \$152,000 over the next 25 years. In addition, the renewable energy will annually avoid 86.5 tons of greenhouse gases, which is like taking 16.5 passenger vehicles off the road each year.

**Secondary Roads
Wash Bay and West Garage**

15.2 kW System ↓

**Secondary Roads and
Fleet Maintenance Facility**

70.56 kW System ↓

Big burn prompted changes





4810

New Secondary Roads and Fleet Maintenance Building

Relocated West Garage + Sec Roads Wash Bay

15.12 kW ground-mounted system

70.56 kW ground-mounted system

MELROSE AVE

Building and solar array footprints are approximate.



1. Energy Efficiency

Avoid oversizing solar photovoltaic (PV) system—save money

Audits (usually free)

Projects – insulation, LED, etc.

Utility incentives or rebates (timing is important)



1. Energy Efficiency: Commercial New Construction Secondary Roads New Facility

**100,000+
kWh annual
savings**

**\$34,249 check
\$12,000 annual savings**

- High-efficiency HVAC
- Daylighting + dimming controls
- Insulated doors, windows, roof
- Vent sensors
- In-floor heating

2. Feasibility: People

Consultant (option)

Internal Team

- Leaders
- Staff
 - Physical plant
 - Sustainability (Planning)
 - Finance/accounting
 - Legal
- Solar basic training

2. Feasibility: Factors

Location

- Local building codes
- Shading
- Potential development/change in area
- Security
- Hazards (e.g. flood zones)
- Existing electrical (amp) service
- If existing structure roof, load and lift

2. Feasibility: Factors

Current and Future Energy Use

- Annual kWh and demand
- Rates, riders, fees, etc.
- Rate options and trends
- Solar will likely cover only *part* of need
 - still buy some energy from utility
 - no storage capability (yet)

2. Feasibility: Factors

Timing

- Tax credits will be fairly stable for several more years
- Our Sec Rds project took about a year
 - PPA negotiation
 - Interconnection
- Electrical infrastructure

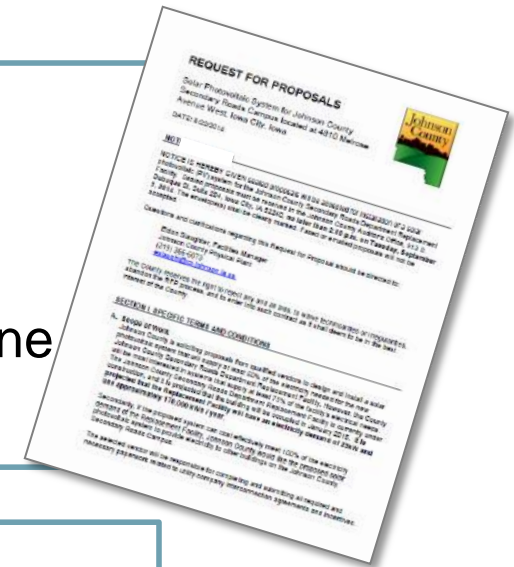
2. Feasibility: Factors

<u>EXAMPLE (not our actual project)</u>	kWh (annual)	Percent
Total need	400,000	100%
Provided by solar panels	100,000	25%
Provided by utility	300,000	75%

3. Request for Proposal (RFP)

RFP Document

- Not a bid
- Design and install
- Short
- Electrical data + building documents online
- Mandatory on-site visit



Process

- RFP public hearings
- PPA public hearings (it's a lease)

Administer RFP

- 30 days to respond
- Created FAQ as vendors asked questions

4. Proposal Assessment: Criteria

“Apples to Apples”

- Cover sheet

Technical

- kW / kWh delivered (verify)
- Cost
- Components
- Warranty

Labor/Service

- Experience
- Customer Service
- Warranty

Buy Local Policy

SERVICE + LOCATION COVER SHEET FOR JOHNSON COUNTY ADMIN OPEN SPACE (SOUTH FIELD)

COMPANY NAME:

DATE:

SERVICE: Figure the specific building's amps and volts accordingly into your calculations.

Administration (Admin) Building 1600 AMP Service at 240 volts	kW (DC)	kW (AC)	Annual Production kWh	Amperage Per Leg	Cost: Outright	10-year PPA starting cost per kWh	Buyout cost at end of 10-year PPA)	Total Cost of the 10-year PPA (include the buyout cost at end of PPA)
25%								
10%								
Other %								



Below, please note any assumptions and briefly describe use of location.

EXAMPLE ONLY

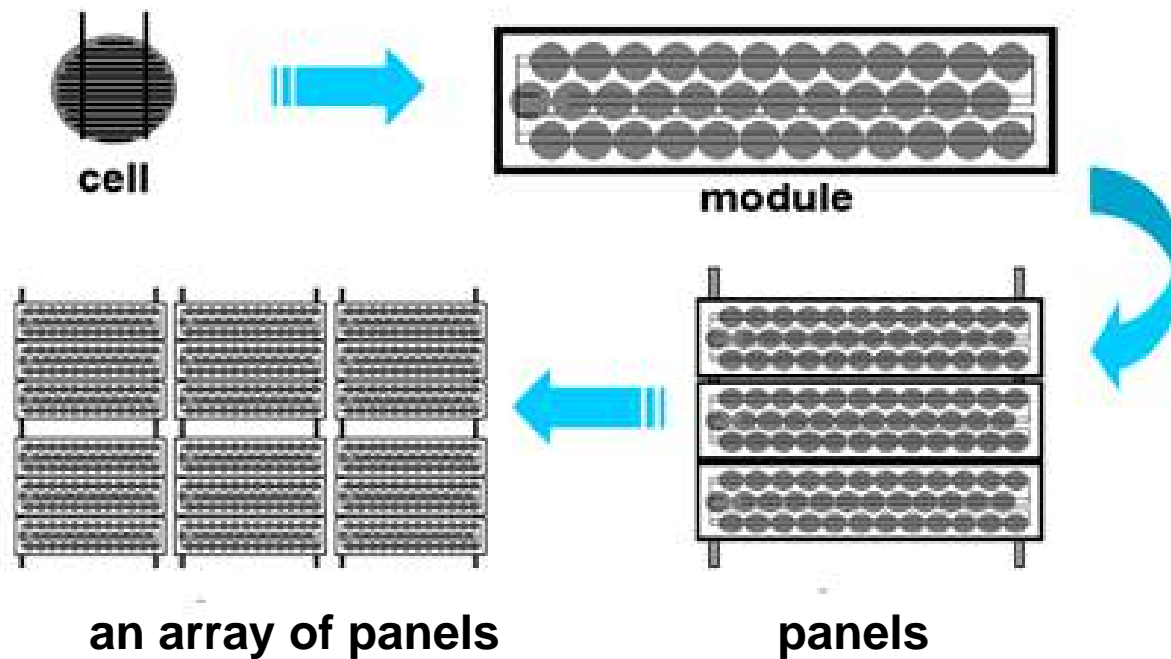


Figure 1. Photovoltaic cells, modules, panels and arrays.

Based on image at Florida Energy Center
http://www.fsec.ucf.edu/en/consumer/solar_electricity/basics/index.htm

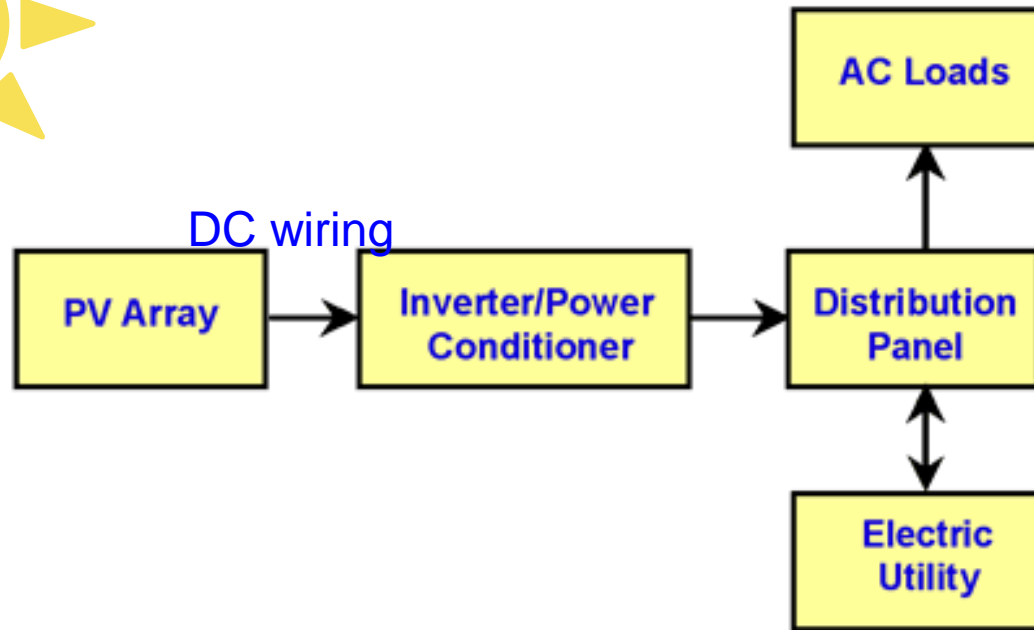
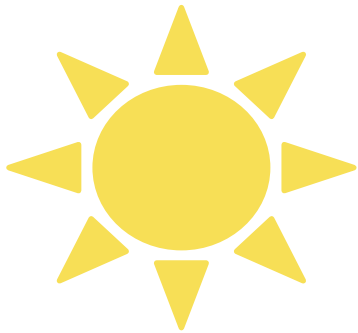


Figure 1. Diagram of grid-connected photovoltaic system.

Adapted from Florida Energy Center

http://www.fsec.ucf.edu/en/consumer/solar_electricity/basics/types_of_pv.htm

4. Proposal Assessment

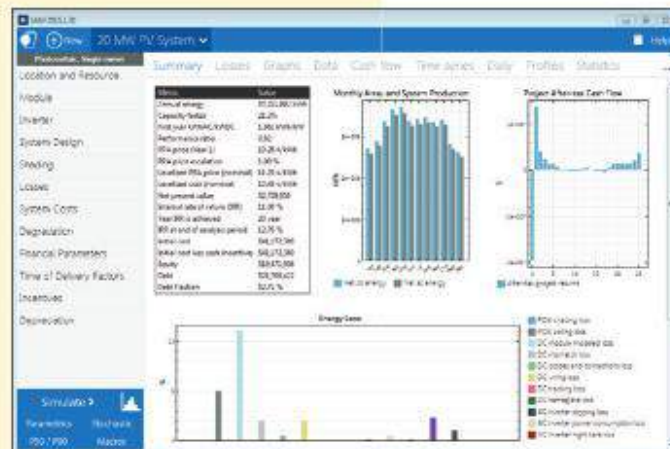
NOTE: This summary was used when we were still planning on a single roof-mounted array. After we selected the vendor, due to net-metering issues, we had to downside to two smaller ground-mounted arrays. However, this helps show proposal assessment.

<i>ELEMENT</i>	COMPANY X	COMPANY Y	MOXIE SOLAR
System size	123.7 kW	140.25 kW	140.25 kW
System cost (outright; labor +equipment)	\$321,776	\$375,870	\$370,322
Vendor estimated annual kWh production	158,100	164,720	175,704
Iowa Energy Center 84%	168,517	190,970	180,838
Company Location	Other County	Other County	North Liberty, Johnson County
Company Experience	X years in solar; X years in electricity	X years in solar	2+ years

Online calculators for array sizing

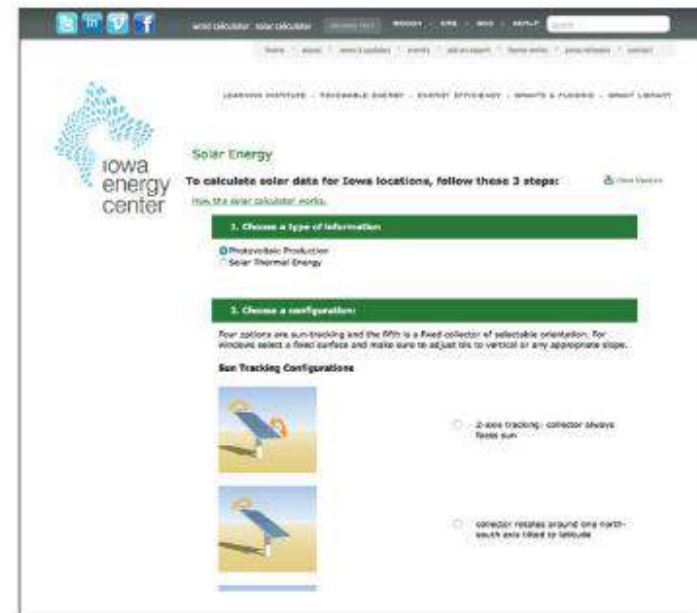
PVWatts uses a trial and error process to narrow the rating of the array to match your desired annual energy output. Care must be exercised in choosing realistic system loss factors as defined by the integral derate factor subcalculator. PVWatts also offers a simplified financial calculator providing the benefit of the solar array based on an assumed fixed value of energy.

pvwatts.nrel.gov



SAM is a downloadable calculator application, which is used as a stand-alone tool. The SAM calculator offers greater flexibility and level of input detail and includes a substantial financial modelling aspect.

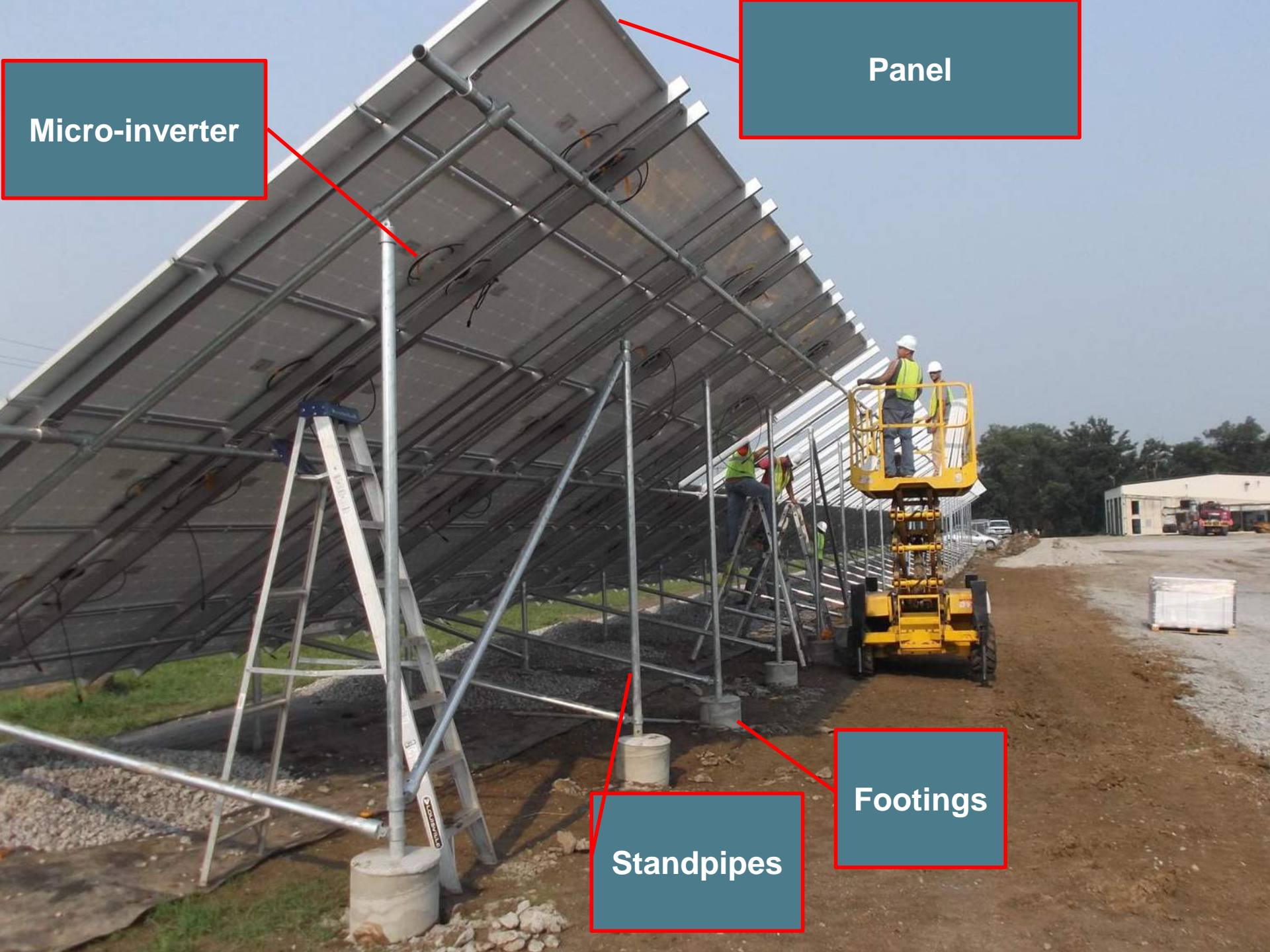
sam.nrel.gov



The **Iowa Energy Center's Solar Calculator** provides the solar resource potential for any location in Iowa but does not have a provision for incorporating the system losses. System losses must be applied externally from the calculator. The calculator does not contain a financial modelling component.

4. Proposal Assessment - Inverters

	<i>COMPANY X SINGLE (CENTRAL) INVERTER</i>	<i>COMPANY X ELEVEN (11) STRING INVERTERS</i>	<i>COMPANY Y SIX (6) STRING INVERTERS</i>	<i>MOXIE SOLAR 510 MICRO - INVERTERS</i>
1. Location	Suggests outside. Mezzanine or floor? (weighs 2,000 lbs)	Above office area or on roof	Mezzanine is likely location (TBD)	Roof
2. Efficiency	96.5%		98%	96.5%
3. Fail impact	If it stops working, all modules stop working. 100% fail	If one stops working, one-eleventh of the modules stop working. 9% fail.	If one stops working, one-sixth of the modules stop working. 17% fail	If one stops working, only one of the 510 modules stops working. 0.2% fail
4. Repair	Complex – need expert	Complex – need expert	Complex – need expert	Relatively easy fix but must go on roof
5. Pros	Single point of maintenance	Seems to be the standard for commercial uses.	Seems to be the standard for commercial uses.	If one breaks down or its module underperforms, 509 still work well
6. Cons	Fail impact is 100%; cannot see function of each module	A higher fail impact than with micros	A higher fail impact than with micros	Roof location is hot and not easily accessible; newer technology
7.Manufact.	Single: Solectrica in business since 2005;	SolarEdge	SMA has been in business 30 yrs	Enphase specializes in micro-inverters. 4th generation product.



Micro-inverter

Panel

Standpipes

Footings

System Details

ELEMENT	Make/Model	Warranty	70.56 kW System	15.12 kW System
Solar modules (array)	Solar World Sun Modules (up to 280 watts each)	25-year performance; 10-year product	252	54
Inverter Type/Number	Enphase Micro M-250	25-year	252	54
Racking for Ground-Mount	SnapNrack	10-year	One	One
Monitoring System for Both	Enphase Enlighten			

5. Power Purchase Agreement

What Is It?

- A contract between a taxable company that installs and operates a solar PV (or other energy) system on a purchaser's premises, and that purchaser buys the power.
- [NREL PPA Checklist](#)

5. Power Purchase Agreement

Renewables Tax Credits

- Federal: 30% of cost (through 2019)
- State: 18% of cost at the time; now 15% (up to \$20,000 commercial)

Problem

- Governments cannot receive credits directly

5. Power Purchase Agreement

Solution

- Vendor providing solar PV system claims tax credits
- Vendor passes savings on to local government
- Government pays solar vendor during PPA (e.g., 11 cents/kWh)
- Vendor responsible for performance during PPA



5. Power Purchase Agreement

PPA typically beats outright purchase for local governments

10-year better than 20-year

Example values

Outright	20-year + buyout	10-year + buyout
\$220,000	\$190,000	\$150,000

5. Power Purchase Agreement – 10yr

Initial comparison based on a single system on roof

<i>ELEMENT</i>	Company X	Company Y	MOXIE SOLAR
System size	123.7 kW	140.25 kW	140.25 kW
Vendor estimated annual kWh production (.5% annual productivity decline assumed)	150,495	164,720	175,704
Iowa Energy Center 84%	168,517	190,970	180,838
<i>Subtotal of estimated payments over 10 yrs</i>	<i>\$118,579</i>	<i>\$216,983</i>	<i>\$191,795</i>
	<i>(2.5% annual escalation)</i>	<i>(3.5% annual escalation)</i>	<i>(3% annual escalation)</i>
<i>Buyout after 10 yrs</i>	<i>\$128,000</i>	<i>\$15,000 – \$20,000</i>	<i>Up to \$10,000</i>
System total cost to County first 10 yrs w/buyout	\$246,579	\$236,983 – \$241,983	\$191,796 – \$201,796
Overall Savings after 25 yrs	\$161,816	210,015	~250,000-\$275,010

5. PPA with Moxie Solar

PPA = 10 years

- Most parts warranted for 25 years (racking = 10 years)

During 10-year PPA

- We pay more for **all** electricity combined (solar + utility) than if purchasing only from utility for 10 years

After PPA ends

- We pay nothing more for another 15 years of solar-generated electricity, aside from basic maintenance/repair

ROI reached in year 13-14 normally

Actual PPA Cost: \$127,628

There will also be a buyout of up to \$10,000 at the end of the PPA.

70.56 kW + 15.12 kW Systems

SYSTEMS COMBINED = 85.68 kW

	Projected Production	Rate +2.5% Inflation/yr.	Projected Annual Payment
Year 1	113775	0.1025	11,661.94
Year 2	113207	0.1051	11,898.06
Year 3	112640	0.1077	12,131.33
Year 4	112077	0.1104	12,373.30
Year 5	111516	0.1131	12,612.46
Year 6	110959	0.116	12,871.24
Year 7	110404	0.1189	13,127.04
Year 8	109852	0.1218	13,379.97
Year 9	109303	0.1249	13,651.94
Year 10	108756	0.128	13,920.77
TOTAL			\$127,628.05

5. PPA with Moxie Solar

Example payments during and after 10-year PPA
(relative to entire campus annual use of 504,749 kWh)

	Our annual solar cost	Our annual utility cost*	TOTAL PAID for the year*	<i>If only using utility, we would pay*</i>	<i>Difference compared to utility only</i>
Year 1	\$11,662 (includes maintenance/repair)	\$31,121	\$42,783	\$40,178	-\$2,605
Year 11	\$0 (plus any maintenance/repair)	\$40,405	\$40,405	\$51,431	\$11,026

*Includes 2.5% annual inflation on utility costs and annual solar cost during PPA. However, we will use 3% in future projects.



**COST/
SAVINGS
DETAIL**
**86 kW
combined**

YEAR	For Comparison-- No Solar: Estimated Utility Bill	Estimated Annual Output (kWh) with .5% annual productivity decline	Solar PPA Annual COST (Values from previous sheet)	With Solar: Estimated Utility Bill	With Solar: Estimated Difference to Johnson County
1	\$40,178.00	113,775	\$11,661.94	\$31,121.51	-\$2,605.45
2	\$41,182.45	113,206	\$11,893.72	\$31,945.96	-\$2,657.23
3	\$42,212.01	112,640	\$12,130.11	\$32,791.95	-\$2,710.04
4	\$43,267.31	112,077	\$12,371.19	\$33,660.02	-\$2,763.91
5	\$44,348.99	111,517	\$12,617.07	\$34,550.76	-\$2,818.84
6	\$45,457.72	110,959	\$12,867.83	\$35,464.75	-\$2,874.86
7	\$46,594.16	110,404	\$13,123.58	\$36,402.58	-\$2,932.00
8	\$47,759.02	109,852	\$13,384.41	\$37,364.88	-\$2,990.27
9	\$48,952.99	109,303	\$13,650.43	\$38,352.27	-\$3,049.71
10	\$50,176.82	108,756	\$13,921.73	\$39,365.40	-\$3,110.32
11	\$51,431.24	108,213	\$0.00	\$40,404.95	\$11,026.29
12	\$52,717.02	107,671	\$0.00	\$41,471.58	\$11,245.44
13	\$54,034.94	107,133	\$0.00	\$42,566.00	\$11,468.94
14	\$55,385.82	106,597	\$0.00	\$43,688.93	\$11,696.88
15	\$56,770.46	106,064	\$0.00	\$44,841.10	\$11,929.36
16	\$58,189.72	105,534	\$0.00	\$46,023.27	\$12,166.46
17	\$59,644.47	105,006	\$0.00	\$47,236.20	\$12,408.26
18	\$61,135.58	104,481	\$0.00	\$48,480.70	\$12,654.88
19	\$62,663.97	103,959	\$0.00	\$49,757.57	\$12,906.39
20	\$64,230.57	103,439	\$0.00	\$51,067.66	\$13,162.91
21	\$65,836.33	102,922	\$0.00	\$52,411.81	\$13,424.52
22	\$67,482.24	102,407	\$0.00	\$53,790.91	\$13,691.33
23	\$69,169.30	101,895	\$0.00	\$55,205.85	\$13,963.45
24	\$70,898.53	101,386	\$0.00	\$56,657.55	\$14,240.97
25	\$72,670.99	100,879	\$0.00	\$58,146.98	\$14,524.01
TOTAL			\$127,622.01		\$161,997.48
buyout max after 10 y			\$10,000.00		-\$10,000.00
\$1,372,390.64			\$137,622.01	\$1,082,771.15	\$151,997.48
Solar+buyout+utility			\$1,220,393.16		

5. Effect of PPA with Moxie Solar

NO SOLAR	ESTIMATED MIDAMER 25 YRS OF ELECTRIC COSTS	\$1,372,390
SOLAR / PPA	10-YEAR MOXIE SOLAR PPA \$127,622 + BUYOUT UP TO \$10,000** + ESTIMATED 25 YRS OF ELECTRIC COSTS PAID TO MID AMER (\$1,082,771)	\$1,220,393
SAVINGS WITH SOLAR / PPA		\$151,997

5. PPA Process

Before signing PPA with preferred company, ensure you receive from company and review

- Detailed equipment list
- Schematics and drawings
- Interconnection data
- PPA draft and details
- Details on ground covers/fencing (if needed/included)
- Statements on
 - Maintenance and security during PPA
 - Amount of electricity to be generated
 - Responsibility for codes, laws, etc.
 - Monitoring portal

A more detailed list of these suggestions is provided in the “Resource” slides at the end of this presentation.



An Important Digression! Net Metering

Net metering

- Ability to send excess energy generated back to the grid and receive a kWh credit on utility account and/or a \$ credit value.
- Affects system size and ROI

Net Metering and PPAs

Your Specific Utility

- Each utility has its own interpretation of the Iowa Utilities Board ruling for solar arrays and net metering tariffs
- Essentially, some pay more, some pay less for excess energy generated

Net Metering and PPAs

Net-metering Rule

- Per MidAmerican Energy, for an entity to be eligible for net metering at a **retail** or net billing (NB) tariff:
*“Generating capacity and associated energy is intended to serve only the electric requirements of the **owner** of the Facility.”*

Utility View

- Because we have a PPA, MidAmerican Energy does not consider us to be the *owner*.

Rock-and-Hard Place

- But without the PPA, we wouldn't have been able to get the tax credits...

Net Metering and Rates

Rates (Tariffs)

- Retail rate would be about 7 cents per kWh
- Instead wholesale (QF) 1 to 2 cents per kWh



Net Metering: Downsize

Since utility doesn't allow us to send energy back to the grid...

	Original 10-year PPA	Actual 10-year PPA
Project	1 array Serve one building with excess to grid	2 arrays Serving different buildings. Nothing sent to grid.
Size	140 kW	86 kW
Type	Roof-mount	Ground-mount
Solar Electricity Generated/ Year	175,704 kWh	113,775 kWh
Solar Electricity <i>relative to total need 504,749</i>	34.8%	22.5%
Cost (includes \$10,000 buyout after 10 years)	\$197,475	\$137,628
Savings after 25 years	\$249,788	\$151,997

Net Metering: Downsize

Since utility doesn't allow us to send energy back to the grid...

	Original 10-year PPA	Actual 10-year PPA
Project	1 array Serve one building with excess to grid	2 arrays Each serves one distinct building. Nothing sent to grid.
Size	140 kW	86 kW
Type	Roof-mount	Ground-mount
Solar Electricity Generated/ Year	175,704 kWh	113,775 kWh
Solar Electricity relative to total need 504,749	34.8%	22.5%
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Size	140 kW	86 kW
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Cost (includes \$10,000 buyout after 10 years)	\$197,475	\$137,628
Savings after 25 years	\$249,788	\$151,997

Net Metering – Action Taken

In spring 2015, Iowa Utilities Board (IUB) solicited comments on regulatory framework for distributed generation.

Johnson County Board of Supervisors asked IUB to ensure that PPAs are eligible for net metering at retail rates.

- [IUB solicitation](#)
- [Johnson County submission](#)
- [Docket NOI-2014-0001](#)

Additional information

<http://energydistrict.org/resources/distributed-generation/>



6. Other Steps After Installation

Inspection

- Iowa City
- MidAmerican

Proof of Insurance

Witness Test

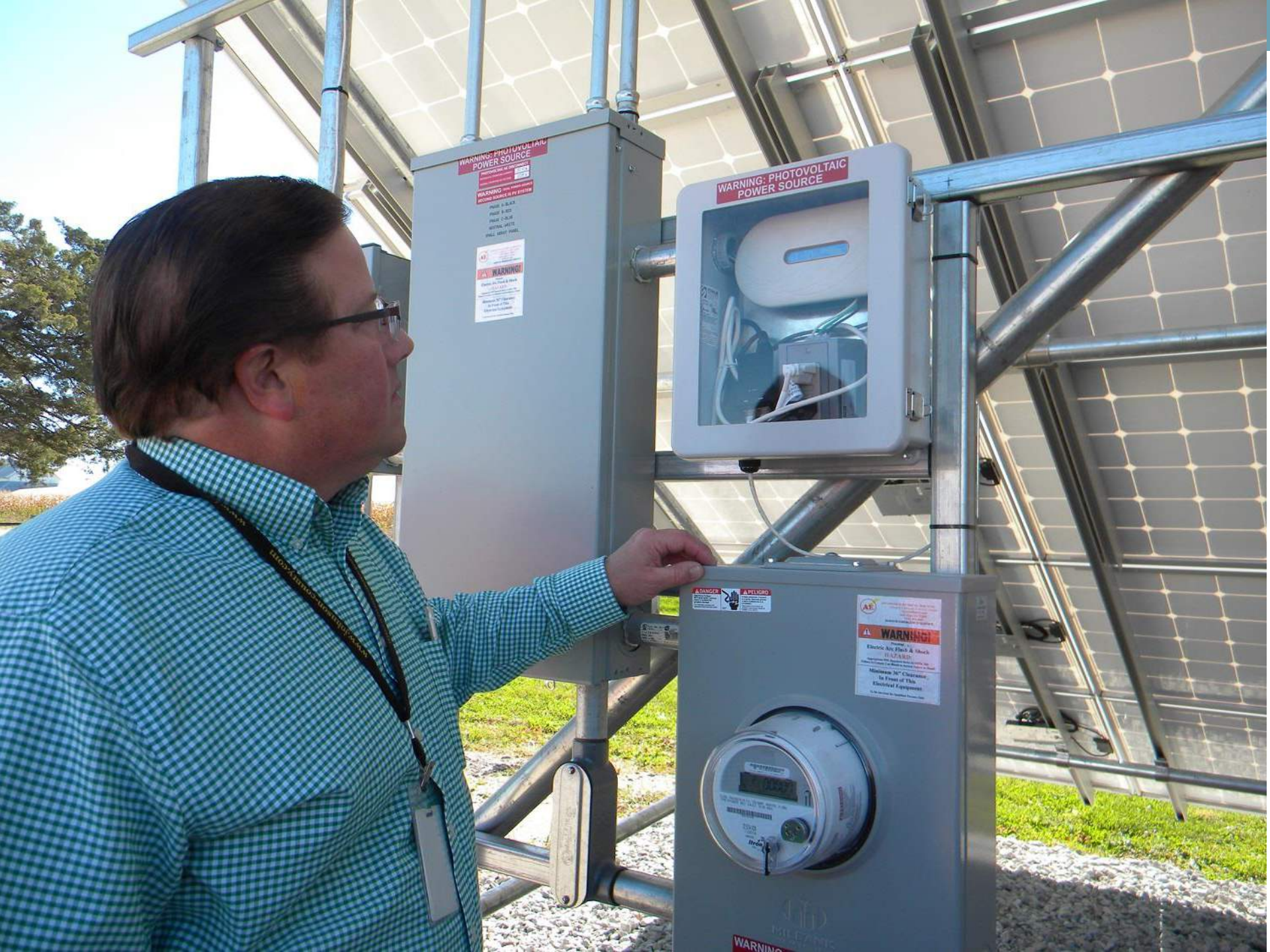
Certificate of Completion

Other documents

One slide – many weeks!

7. Public Awareness





WARNING: PHOTOVOLTAIC POWER SOURCE

PHOTOVOLTAIC EQUIPMENT
WARNING: THIS EQUIPMENT
REQUIRES SERVICE BY PV SYSTEMS

TYPE: 3-2-3
TYPE: 3-2-3
TYPE: 3-2-3
TYPE: 3-2-3
TYPE: 3-2-3

WARNING
Electric Shock & Arc
Flash Hazard
Minimum 10' Clearance
in Front of This
Electrical Equipment

WARNING: PHOTOVOLTAIC POWER SOURCE

DANGER PELIGRO

WARNING
Electric Arc Flash & Shock
HAZARD
Minimum 10' Clearance
in Front of This
Electrical Equipment



WARNING

Expected Results of Solar Array

Offset 86.5 tons annually
Greenhouse Gases of...



Offset CO₂ emissions
of...



Equal carbon
sequestered by...



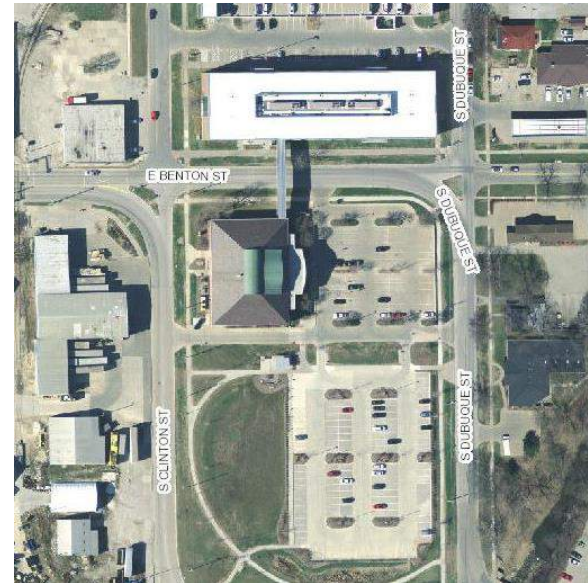
Secondary Roads Solar PV Arrays

3 BENCHMARKING

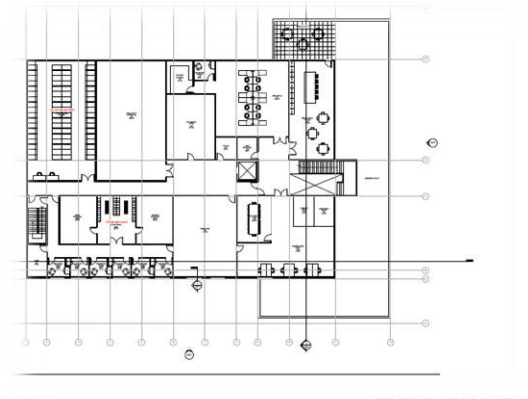
Meter Name	Start Date	End Date	Consumption = Generation	Consumption Units	Dollar Amount	\$ Per Unit
15 kW Solar West Garage and Sec Rds Wash Bay	8/6/2015	8/31/2015	1,873.00	kWh	\$191.91	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	8/31/2015	9/30/2015	2,295.36	kWh	\$235.27	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	9/30/2015	10/31/2015	1,790.20	kWh	\$183.50	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	10/31/2015	11/30/2015	1,363.44	kWh	\$139.75	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	11/30/2015	12/31/2015	780.00	kWh	\$79.98	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	12/31/2015	1/31/2016	1,412.54	kWh	\$144.79	\$0.1025
15 kW Solar West Garage and Sec Rds Wash Bay	1/31/2016	2/29/2016	1,385.01	kWh	\$141.96	\$0.1025
SUBTOTALS 15k kW		7	10,899.55		\$1,117.16	
70.56 kW Solar PV Sec Rds and Fleet Maintenance	10/20/2015	10/31/2015	2,239.00	kWh	\$229.50	\$0.1025
70.56 kW Solar PV Sec Rds and Fleet Maintenance	10/31/2015	11/30/2015	5,844.99	kWh	\$599.11	\$0.1025
70.56 kW Solar PV Sec Rds and Fleet Maintenance	11/30/2015	12/31/2015	3,616.94	kWh	\$370.74	\$0.1025
70.56 kW Solar PV Sec Rds and Fleet Maintenance	12/31/2015	1/31/2016	6,615.10	kWh	\$678.05	\$0.1025
70.56 kW Solar PV Sec Rds and Fleet Maintenance	1/31/2016	2/29/2016	6,452.50	kWh	\$661.38	\$0.1025
SUBTOTALS 71 kW		5	24,768.53		\$2,538.78	
TOTALS			35,668.08		\$3,655.94	0.1025

Next Solar PV Projects

Administration Building and/or
Health and Human Services
Building



New Ambulance Services and
Medical Examiner Building



Resources

OVERALL GUIDANCE

Iowa Energy Center

[Solar PV Energy Guide](#)

NEW!

TAX CREDITS

Iowa Department of Revenue

[Solar Energy System Tax Credits](#)

REQUEST FOR PROPOSAL

The Solar Foundation

[Steps to a Successful Solar Request for Proposal](#)

POWER PURCHASE AGREEMENTS

National Renewable Energy Laboratory

[Power Purchase Agreement Checklist for State and Local Government](#)

U.S. Department of Energy

[Power Purchase Agreements](#)

PROCESS

[PPAs plus Mistakes to Avoid](#)(based on California school districts but helpful overview of issues)

Iowa Utilities Board: [Informational Guide for On-Site Generation](#) (residential and small business use)



Resource

Before signing PPA with preferred vendor, ensure that you receive and review:

- Complete, detailed list of equipment including brands, models, quantities, efficiency ratings, warranties and tilt of panels
- Length, width and height data for array
- Schematics and other drawings or images
- Interconnection data
- PPA draft and details (cost, buyout fees / terms, early termination)
- How vendor will maintain array during PPA including safety, security and protection from vandalism; maintenance protocol (who you call, etc.)
- If applicable, any proposed ground covers or fencing
- Statements
 - that array will generate expected amount of electricity (*e.g., not more than the building demands if you do NOT plan to net meter*)
 - that vendor is responsible for all federal, state, local and utility codes, laws and regs + permits
 - That vendor ensures coordination on public-facing monitoring website and compatibility of entire monitoring system with infrastructure and website.

Contacts



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