

Columbia Water and Light- Utility Services Division's Solar Guidelines

The installation of solar systems is a growing industry in Columbia and throughout the country. The installation of solar is a multi-step process that involves multiple Departments and Divisions of City government. These guidelines are in reference to the review and approval of the Net Metering Agreement, along with Utility Services Division's involvement in the processing of the associated rebates. Other Departments and Divisions of the City that are necessary for the full process may be mentioned, however, these guidelines do not supersede the requirements of other Departments and Divisions.

I. Definitions

- Columbia Building and Site Development (BSD) - The department within the City of Columbia responsible for building permits.
- Columbia Water and Light (CWL) - The electric utility provider for the generating facility.
- Generating Facility (GF) - The solar powered generating equipment owned and operated by the customer.
- Net Metering Agreement (NMA) - The Interconnection and Net Metering Agreement between the Generating Facility and Columbia Water and Light.
- Net Metering and Easy Connection Act (ECA) - The State of Missouri Statute (386.890.RSMo) for the interconnection and net metering of renewable energy systems under 100 kilowatts.
- System Advisor Model (SAM) - The solar modeling program developed by the National Renewable Energy Laboratory.
- Utility Services Division (USD) - The Utility Services Division is within Columbia Water and Light and is responsible for the review and approval of the Interconnection and Net Metering Agreement, along with processing of rebates.

II. Net Metering Process for Generating Facilities

A. Interconnection and Net Metering Agreement

1. Prior to the GF being able to be connected to CWL infrastructure, the NMA is needed between CWL and the property owner or the authorized agent.
 - a. For residential, the customer must be listed on the account in CIS or listed as the recorded property owner by the Boone County Assessor.
 - b. For commercial, the customer will be determined on a case by case basis by the USD.
 - c. The NMA should be done prior to the GF being installed. The installation of a GF does not guarantee connection to the CWL infrastructure, unless all conditions given in Section II, Subsection B are met and the NMA is approved by USD.
2. USD will provide a letter to the customer approving the NMA when conditions in Section II, Subsection B have been met.
3. The customer will need to complete an electrical permit through BSD for the GF.
4. Upon completion of the electrical permit with BSD, USD will review the installed GF for alignment with approved NMA. Any alterations will be handled on a case by case basis at the discretion of USD.

5. Once the installed system has been reviewed and determined by USD to comply with the NMA, a new bidirectional meter will be installed. CWL will not turn on the PV system at the time when the bidirectional meter is installed.
6. After the bidirectional meter is installed, the customer and/or installing contractor will be notified that the GF can be connected to the CWL infrastructure. CWL will not turn on the GF for its initial connection to the CWL Infrastructure.
7. If the planned PV system is 100 kW or greater, refer to Section V.

B. Net Metering Conditions

1. All of the conditions in the NMA will be met.
2. The NMA will be signed by the customer.
3. The System Advisor Model (SAM) is required to be used as part of the NMA for all GF. CWL has a specific template that must be used in SAM for all GF. This template is provided to all approved contractors and will be provided to any other party upon notification of potential GF project that would be connected to CWL infrastructure.
4. Shade analysis is required as a part of the NMA
 - a. The shade analysis must be used in the SAM model of the GF using the CWL SAM template.
 - b. There are two options when performing a shade analysis
 - (1) The Solar Pathfinder tool and Solar Pathfinder Assistant software can be used to create a shade model to be exported and used in SAM.
 - (2) The 3D Shade Calculator built into SAM may be used to create a shade model.
5. GF projected yearly PV generation from the NREL System Advisor Model cannot be greater than 110 percent of previous 3 year average of electric usage. If the property is new or there is not adequate prior usage, discretion on oversizing will be made on a case by case basis by USD.
6. Plans for the PV system are provided to USD must be certified from a professional electrician or professional engineer. Professional electricians and/or engineers must be a Master Electrician that is licensed by the City of Columbia, a licensed Missouri Electrical Contractor from the Missouri Division of Professional Registration, or a Professional Engineer licensed in Missouri to comply with the ECA.
 - a. The plans must be provided directly from, be stamped by, or be accompanied by a signed statement from the professional electrician or engineer.
 - b. If the plans are not stamped, then a copy of the license or other proof of certification must be provided to USD.
7. If a Line-Side Connection is used to connect the GF to the CWL infrastructure, see Attachment 1.
8. The solar modules and inverters for the GF must be new and listed as eligible solar energy equipment by the California's Energy Commission's Solar Equipment Lists. (<https://www.energy.ca.gov/programs-and-topics/topics/renewable-energy/solar-equipment-lists>)
9. CWL may require a meter base upgrade along with any PV installation.
 - a. Refer to Attachment 2 for additional requirements on meter base replacement.

- b. If a meter base upgrade is necessary, the bidirectional meter will not be installed until the upgrade is completed.
 - c. The cost for the meter base upgrade is the responsibility of the customer.
10. The installation of a bi-directional meter is necessary before the GF can be connected to the CWL infrastructure. The bi-directional meter installation cost will be covered by CWL, given no installation limitations from the existing meter base.
11. PV systems with battery backup will be evaluated on a case by case basis by CWL for connection with City infrastructure.
12. Any exceptions to the conditions listed above in this subsection may be reviewed on a case by case basis by CWL upon request.

III. Rebates for Generating Facilities

A. Rebate Requirements

1. Rebate for a GF is based on the total capacity (kW) and the modeled energy production at the utility peak (kWh).
2. CWL will only provide a rebate for the capacity needed to meet up to 110 percent of the customer's annual consumption.
3. GF with arrays that do not qualify for rebates are eligible for interconnection and net metering.

B. Rebate Calculation and Payment

1. For rebate structure and calculation refer to Attachment 3.
2. Once the installation of the GF is completed, an invoice or contractual documentation must be provided to process the rebate. The following information is necessary on the invoice/documentation.
 - Address for GF
 - Customer Name
 - Description of what was installed
 - Final cost of installation
 - Date of installation (if invoice)
 - Signature of client (if contractual documentation)

IV. Change in Ownership

Per the ECA, if there is a change in ownership of GF, the new owner shall be responsible for filing a new NMA with CWL.

V. Generating Facilities Larger than 100 kW

For any GF larger than 100 kW, these will be handled on a case by case basis with USD.

VI. Solar Water Heaters

A. Solar Water Heater Rebate Requirements

1. All Columbia Water & Light electric customers are eligible to participate in this program.
2. Rebates are offered to customers installing solar domestic water heating systems that use electric resistance heating as their back-up energy source.

3. For customers with a pre-existing electric Domestic Hot Water (DHW) system rebate offer is \$400 per system. Monetary value represents the utility benefit derived from renewable energy attributes that are earned over the life of the system (20 yr. life).
4. Customers that have pre-existing natural gas DHW systems are offered an additional \$400 as a rebate (total of \$800). The enhanced utility benefit represents the present value of marginal revenue stream provided by added electric sales over 20-year life of system.
5. Solar systems must be new and OG 300 certified. Testing for OG 300 certification is provided by the Solar Rating and Certification Corporation in Cocoa, Florida. Their testing of solar hot water systems integrates results of collector tests with a performance model for the entire systems and determines whether systems meet minimum standards for system durability, reliability, safety and operation.
6. Equipment must be warranted for a minimum period of five years and customer is required to maintain system in working order for a period of five years (or risk a prorated reimbursement).
7. Rebate must be applied for prior to installation of equipment.
8. Project must meet all applicable City of Columbia codes, including but not limited to plumbing, building and electrical permits.
9. Prior to installation a completed application is required. Application includes SRCC documentation and warranty information
10. Post installation requires a copy of paid plumbing permit and paid receipt.

B. Solar Water Heater Rebate Procedure

1. Customer must file an application with USD prior to the installation of equipment.
2. USD will inspect the existing water heater to determine the fuel source.
3. USD will send a letter to the customer notifying them of the available rebate for the solar water heater.
4. The customer can then complete the installation of the solar water heater. Once the installation is completed, USD is to be notified.
5. USD will inspect the completed project and insures that all need documentation is provided.
6. USD authorizes payment as approved and check is sent to the customer

Line-Side AC Connections for PV Systems

NEC Article 240.21(B)(1) through (B)(5), regulates wire and over-current protection for feeder taps.

NEC Article 690.64(A) allows a Line-Side AC connection to busbars, conductors, or lugs at any point between the customer's side of the utility meter, and the service disconnect.

NEC Article 750.12 specifies how the output of interconnected power sources shall be connected. City of Columbia Utilities does not allow the line side AC connection to be made within the meter base.

A separate junction box must be supplied. See Figure 1.

Contractors must connect to the service entrance conductors, busbars, or lugs at some point between the customer's side of the meter, and the main service disconnect. Busbar connectors often make this easy with ready-made connection points you simply bolt up to, but other devices for conductor attachments are allowed. These are insulation-piercing tap splice connectors, insulated terminal blocks, parallel tap connectors, crimped parallel connectors, and the split bolt.

Meter base sizing must be verified prior to interconnection approval. Water & Light may require a meter base upgrade along with any PV installation.

Contractors are responsible for paying the meter removal/replacement fee for this type of connection.

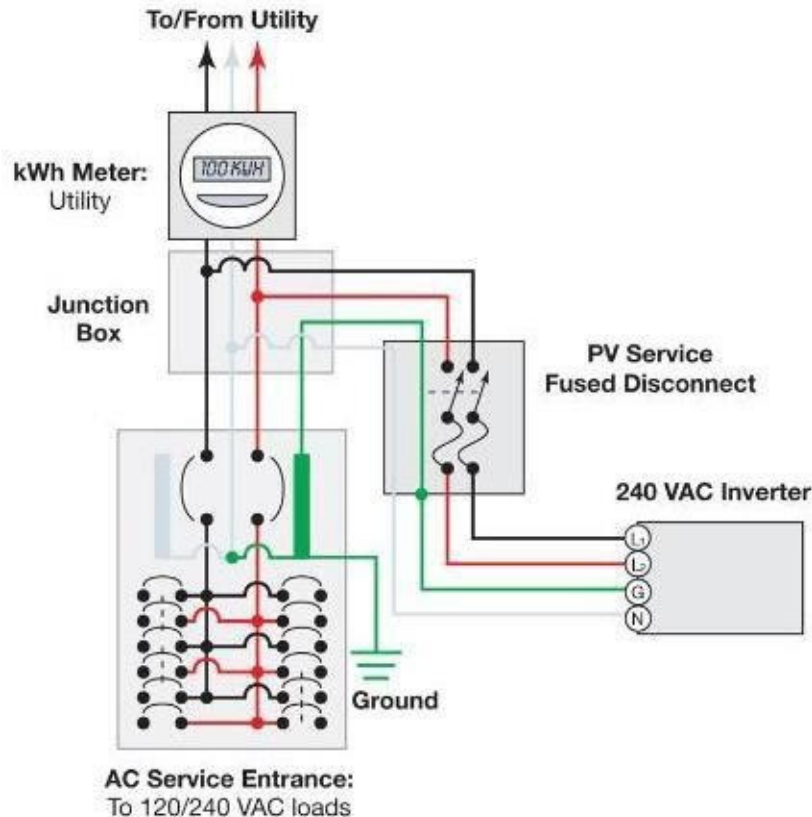


Figure 1. Diagram of allowable Line-Side Connection.

Columbia Water and Light Solar Installation Meter Base Replacement

All meter bases installed in CWL's service territory shall be of a type approved by CWL and meet all requirements in construction and features. It is necessary for the protection of the customer that all electrical work be installed and maintained in a safe manner by a licensed electrician. In addition, meter sockets purchased by the customer shall be:

- UL listed
- Labeled in accordance with National Electrical Code
- Have a lever operated by-pass device
- Be a minimum of 200 amps

Meter bases installed prior to 1980 must be replaced unless it can be verified that they meet the following criteria:

1. Meter base is properly sized for the work to be completed.
 - 60 amp meter bases shall be replaced
 - 100 amp meter bases shall be replaced if the solar system is 15 kW or larger
 - Size/rating of service entrance conductors shall be evaluated for replaced meter bases
2. Meter base is in good condition
 - Meter base is properly secured to building
 - No missing knockouts
 - Minimal signs of rust
 - No evidence of burning or arcing
 - Overhead mast is securely fixed
 - Underground conduit is sealed and securely fixed
3. Meter base is appropriate for a bi-directional meter

**Code Requirements for
Residential and Commercial
Solar Photovoltaic Systems**

Applicable Building Codes:

- IRC 2018 International Residential Code R324.3.1 through R324.7.1
- NEC 2017 National Electric Code (Article 690, NFPA 70 and all other applicable standards)
- IRC 2018 International Residential Code Stationary Storage Battery Systems R327.1 through R327.6

Building Code Questions:

Contact: Columbia Building and Site Development

573-874-2489

<https://www.como.gov/community-development/bsd/building-permits/>

Apply for a Permit:

Online: https://energov.como.gov/energov_prod/selfservice#/home

Over the Phone: 573-874-7474

Solar Rebate Structure and Calculation

The rebate paid for a PV system is based on the total capacity (kW) and modelled energy production at the utility peak (kWh). Water & Light will only provide a rebate for the capacity needed to meet up to 110% of the customer's annual consumption. Annual consumption is an average of the most recent 3 years consumption at the installation location. Systems with a tilt greater than 10 degrees from horizontal and azimuths ranging from 0 – 110 and 320 – 0 **are not eligible for rebates**. However, these systems are eligible for interconnection and net metering.

Step 1. System size: To determine the dollar value of the Baseline Rebate, use the tier corresponding to the rated DC capacity of the system on Chart #1 below.

Step 2. System output at peak: Once the size of the system is determined, the solar vendor/contractor is required to complete and submit modeling of the solar array using the National Renewable Energy Laboratory's System Advisor Model (SAM) software (<https://sam.nrel.gov/>) and/or Solar Pathfinder. This modeling will provide production characteristics specific to the solar array design features. Contractors should contact Columbia Water & Light for the required conditions to model a system's output. System output is expressed in terms of First year kWh/kW (kWh generated per kW of system size) and corresponds to a "Peak Factor" in Table #1. Systems containing arrays with multiple tilt, azimuth and shading conditions must be modeled separately.

Chart #2 below is provided as an indicator of potential rebate based on the system orientation (azimuth and tilt) and does not take into account system shading. Site specific conditions, such as shading, may affect the final rebate amount and must be taken into consideration during the modelling process. Water & Light reserves the right to verify modelled output at any time.

Step 3. Multiply the Baseline Rebate amount by the Peak Factor to arrive at the final rebate amount. Systems containing arrays with multiple tilt, azimuth and shading conditions must be modeled separately. Rebates for these systems are prorated based on the contribution of each array to the total system capacity.

Single Array: **Baseline Rebate × Peak Factor = Rebate Amount**

Multiple Arrays: **% of total DC capacity × Baseline Rebate × Peak Factor = Rebate Amount**

Table #1 - Output at Peak

First Year kWh/kW (From SAM)	Peak Factor	Chart #2 Icon
Greater than 1.97	1.25	●
1.35 to 1.97	1.00	▲
0.41 to 1.35	0.75	○
Less than 0.41	0.00	X

Sample Calculation

Total System Size: 12 kW
 20 degrees tilt
 250 degrees orientation
 No Shading
 Output at Peak: 1.98 kWh/kW (from SAM, <https://sam.nrel.gov>)

Baseline rebate: \$5,800 (from Chart #1)
 Peak Factor: 1.25 (from Table #1)
 Rebate amount: (5,800 x 1.25) = \$7,250

Chart #1 - PV Project Baseline Rebate based on rated kW of the system

Capacity	PV Project Baseline Rebate Tiers			
	0 - 10 kW	10.1 - 50 kW	50.1-100 kW	>100 kW
Rebate	\$500/kW \$5,000 available	\$400/kW \$16,000 available	\$200/kW \$10,000 available	No Rebate Offered
Total Project Size	0 kW	10 kW	50 kW	100 kW
Max Total Rebate	\$0	\$5,000	\$21,000	\$31,000

Chart #2 - Unshaded Production at Peak

For an estimate of unshaded production at Peak, choose the row/column corresponding to the tilt/azimuth of the array. The color of the icon represents the Peak Facotr found in Table #1. Orientations indicated with "X" are not eligible for a rebate.

	350	340	330	320	310	300	290	280	270	260	250	240	230	220	210	200	190	180	170	160	150	140	130	120	110	100	90	80	70	60	50	40	30	20	10	0	
0	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
5	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
10	X	X	X	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
15	X	X	X	▲	▲	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	▲	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
20	X	X	X	▲	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	▲	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
25	X	X	X	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	▲	○	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
30	X	X	X	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	▲	○	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
35	X	X	X	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	○	○	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
40	X	X	X	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	○	○	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X
45	X	X	X	●	●	●	●	●	●	●	●	●	●	●	▲	▲	▲	○	○	○	○	○	○	○	X	X	X	X	X	X	X	X	X	X	X	X	X

This table is provided as a planning tool only. Site specific conditions such as shading of the PV array may greatly reduce its production. Final rebate amounts will be determined using modeled output of the PV system using NREL's SAM and the Solar Pathfinder for eligible tilt/azimuths.