Mason PUD 3’s Guide to
GENERATING YOUR OWN
RENEWABLE ENERGY
Questions to consider when exploring a Solar PV System:

- What are your goals for installing a Solar Power system?
- Are your interests in solar: Environmental? Economics? Social?
- How much energy are you hoping to generate? What are your home’s current energy needs?
- How much do you expect to still rely on the PUD 3 electrical system?
- How much are you looking to spend on a Solar Power system?
- Is Solar right for your location?
- What are you doing to manage expectations?
- Do you know anybody else in Mason County that has a Solar Power system at their home?
This guide is designed to provide Mason PUD 3 customers with information on grid-connected Solar Photovoltaic (PV) and other renewable generation systems. It provides background on system basics, net-metering and connecting to the utility grid.

This guide also includes suggestions on working with a renewable energy contractor, possible rebates and incentives, and other factors to consider when evaluating the purchase and installation of a renewable generation system (like rooftop solar) for your home or business. For questions about generating your own electricity not answered by this guide, please contact the PUD at (360) 426-0777.

Some PUD 3 customers are interested in installing a solar power system for their home or business. Here are several great reasons:

- Solar photovoltaic (PV) systems generate renewable energy from the sun. The energy generated is carbon-free and environmentally friendly.
- Once the system is installed, electricity is generated at no additional cost, leaving the customer with a reduced reliance on the electric grid.
- Solar systems are safe and reliable. Most systems have no moving parts and are easy to install and maintain.
- Solar power system popularity, efficiency, and affordability has greatly increased over the last several years, becoming more available to a wider range of people interested in generating their own electricity.

There are additional factors a customer should consider before purchase and installation:

- A solar or renewable generation system is a large investment. Production incentives and tax credits are not scheduled to last indefinitely.
- Mason County’s climate may not provide ideal generating conditions. Caution should be taken when comparing potential Mason County system performance to a solar system’s performance from another climate (e.g. Eastern Washington, Southwest United States, Germany, etc.).
- Your monthly PUD 3 bill will not disappear. Solar systems need to be connected to the electric grid to provide electricity when it can’t produce enough electricity to keep up with the demand of the home or business. A daily system charge, and any electricity used from the grid above what your renewable generating system is able to produce, will still be billed on a monthly basis.
Components of a Solar PV System

WHAT IS A SOLAR PV SYSTEM?
THE BASICS OF A SOLAR PHOTOVOLTAIC (PV) SYSTEM

Solar Photovoltaic (PV) systems produce electricity using the power of the sun. The term “photovoltaic” can be translated as “light-electricity”.

The process is done through three main components found in every solar PV system that runs in conjunction with the electric grid.

1. **SOLAR CELLS** – Solar cells are the very beginning of a solar PV system. The sun’s light energy hits these cells, made of a semiconductor material. As the light is absorbed, it knocks a number of electrons loose. The flow of these electrons is called electrical current. Solar cells are grouped together in a module that is usually several feet in length and width, and often called a panel. A collection of modules forms an array, which is commonly what goes up on your roof. The equipment used to attach the solar array to your roof is usually called “racking.”

2. **DC/AC INVERTER & PRODUCTION METER** – Solar energy is created as direct current (DC). The electric grid uses alternating current (AC), because it is a more efficient way to move electricity over long distances. The inverter in a solar PV system changes the DC from your solar panels into AC for your house. There is often a revenue-grade, kilowatt-hour “production meter” installed immediately after your inverter so you can measure and track how much electricity your solar PV system is generating. Newer inverters often incorporate an automatic AC/DC disconnect switch, but this is different than the disconnect switch with a lockout function discussed below. The power then flows to your electrical panel.

3. **GRID INTERCONNECT** – You’ll probably want to use electricity at night, when the sun isn’t shining, right? How about in the winter, when it’s rainy and overcast? That’s where the grid interconnection comes in! Generating your own electricity with a solar PV system is a great idea when you have PUD 3’s electric grid to back up your system. This makes sure your energy needs are met when you are using more energy than your solar PV system can produce. The grid interconnect is made up of two main components:

   - A disconnect switch with a lockout function, allowing PUD 3 linemen to disconnect your solar array from the electric grid so that they can work on utility lines without fear of energy back-feeding from your system into the grid.
   - A net meter is a special utility meter that measures energy delivered to, and received from, your home or business. It measures the two-way flow of electricity. This meter will measure the “net difference” of the energy you generate and the energy you use from the grid. Your total energy consumption is the sum of your production meter (see above) and your net meter.
PUD 3 offers a program called “Net Metering” to customers who want to generate some of their own electricity while still connected to the PUD 3 electric grid.

Generating your own electricity is growing in popularity across the country. Customers should educate themselves by doing research and checking the qualifications and experience of a company who will assist them in the installation of a renewable energy generation system. This ensures your satisfaction in the product and that the installation meets local and state standards.

It is important to note that while a contractor may assist you in meeting the utility interconnection standards, it is the customer’s responsibility to maintain the appropriate equipment. A customer will be at risk of disconnection if PUD 3 personnel determines the utility interconnection and net metering agreement is in breach.

Do I qualify to generate my own electricity (become a net-metering customer)?

In Washington State and at PUD 3, residential or small commercial electricity customers in good standing, who generate at least some of their own electricity are eligible for net metering. The program works on a first-come, first-served basis for customers who meet the following requirements:

- The generating system must be 100 kilowatts (kW) or less.
- The generating system is on the customer’s premises.
- Generating resources include solar PV, wind, hydropower, biogas from animal waste, or combined heat and power unit electric generating system.
- The customer must submit completed applications and agree to follow PUD 3’s net metering policies.
- Customers must provide, at their own expense, power conditioning, connection, and safety equipment that meet PUD 3 specifications.

How do I apply for the net metering program?

Start the process by filling out a "Net Metering and Interconnection Application" and a "Net Metering Agreement", or by contacting PUD 3’s conservation department at 360-426-0777. PUD staff will review your application and work with you to make sure it meets all the required safety and technical standards.

It is the customer’s responsibility (not the renewable energy contractor) to ensure that the policies in the net metering agreement are adhered to.
Will I need a new electric meter?
PUD 3 will provide a meter that tracks the difference as you generate excess power or receive electricity from the PUD’s electrical system.

This is a separate meter from the production meter installed after the inverter to measure the amount of generation from your solar PV system. The utility’s net meter is installed at the point the electrical service of the home or business meets the electric grid.

What do I need to install to keep utility workers safe?
A disconnect switch with a lockout function needs to be installed on your side of the net meter. It provides access for PUD 3 personnel to disconnect the generating system at any time, without notice, if, in the PUD’s opinion, a hazardous condition exists and such immediate action is necessary to protect persons; the PUD’s facilities; or property of others from damage or interference caused by the customer’s electric generating facilities; or lack of properly operating protective devices or inability to inspect them. The inverter also needs to have a voltage-sensing automatic disconnect switch.

Is a PUD 3 inspection required before my system goes online?
PUD 3 will inspect your system to ensure that it meets technical specifications and safety requirements. This protects your energy system, the PUD’s electrical distribution system, and utility personnel. You may begin operating your generating system only after PUD 3 gives official written approval to do so.

What happens if I generate more electricity than I use?
It is important to have realistic expectations when researching and planning for a generation system, like a solar PV system. Our homes and businesses use a lot of electricity. Private-scale generation facilities are relatively small and are subject to low capacity factors.

If your system generates more electricity than you use, the excess power delivered to the PUD’s distribution system is credited to your account at the same rate class at which you would buy power from the PUD. Other requirements of the rate schedule apply, including the daily system charge. Unused credits carry over each month until April 30 of each year. If any net metering credits remain, they will be granted to the PUD as described in Washington State Law. (RCW 80.60)

How does my solar generation affect PUD 3’s electricity grid?
PUD 3 will buy less energy from Bonneville Power Administration to serve the electrical load that is being served by your renewable energy system. In the grand scheme of the whole utility, it is a very small amount of energy.
How does net metering work?

Net metering measures the difference between the electricity purchased by a customer from PUD 3 and the electricity produced by a small generation unit. A net meter tracks the difference as a customer generates excess power or receives electricity from the PUD’s electric grid.

PUD 3 reads the net meter as normal. Under the net metering arrangement, if a customer uses more electricity than they produce, they are billed for the consumption at the appropriate rate class. If generation exceeds consumption, and is fed back into the PUD system, the customer receives a billing credit for the excess generation at the same rate class.

Understanding NET METERING with a Solar PV System

1. Solar array converts energy from sunlight into electricity.
2. The inverter converts the electricity from direct current (DC) to alternating current (AC) for use in your home or business and measures the energy produced by the solar array.
3. The energy is used in your home or business.
4. Excess energy not used by your home or business goes back to the electric grid and you receive a credit.

Net metering measures the difference between the electricity purchased by a customer from PUD 3 and the electricity produced by a small generation unit. A net meter tracks the difference as a customer generates excess power or receives electricity from the PUD system.
In Washington State, there are production incentives available that may assist with recovering the cost of installing a solar PV system.

There are many benefits to owning a renewable generation system. The first, and most immediate, is that you are able to use the energy produced by your system first, reducing the amount of electricity purchased from PUD 3. In addition to this benefit, you may also qualify for Washington State Production Incentives and Federal Tax Credits. Many local banks offer low-interest loans to improve the energy efficiency of your home or business, or to install a solar PV system or other renewable generation system.

**Washington State Production Incentives**

Customers who generate their own electricity may be eligible for incentive payments from Washington State. The program is authorized under Washington State Law. The program is run by the Washington State University Energy Program. PUD 3 has chosen to participate, and serves as a “pass-through” agency for the incentive. The program requirements and incentives do not come from PUD 3.

**System Certification (one-time application)**

The types of renewable energy generation that qualify include solar PV systems, wind generators, and anaerobic digesters. Your renewable energy generation system must be certified by the Washington State University Energy Program. This is a one-time certification. The application can be found in the Helpful Documents section at the end of this guide, or online (www.pud3.org/solar). It will require detailed information such as system operation data (e.g. tilt, azimuth, and shading) and supporting documentation, such as an executed interconnection agreement with PUD 3 and documentation of system cost. If you purchase property with a renewable energy generating facility, you must reapply for certification as the new owner.

**Washington State Production Credits (annual application)**

Depending on the fiscal year a renewable energy system was certified with WSU Energy and the source of the equipment, incentives can range between $0.02 and $0.21 per kilowatt-hour (up to $5,000/year and 50% of the total system cost) and are paid by Washington State. Incentives are available for an eight-year period following the year the system is certified. In order to maximize production incentives, PUD 3 encourages customers to select solar modules that were manufactured in Washington State and qualify for the highest incentive payment rate.

Please see the chart below:

<table>
<thead>
<tr>
<th>System Certification (Fiscal Year)</th>
<th>Base Rate ≤ 12kW</th>
<th>Base Rate &gt; 12kW</th>
<th>Made-in-Washington Bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>$0.16</td>
<td>$0.06</td>
<td>$0.05</td>
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<td>$0.14</td>
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</tr>
<tr>
<td>2021</td>
<td>$0.10</td>
<td>$0.02</td>
<td>$0.02</td>
</tr>
</tbody>
</table>

**HOW DO I READ THIS CHART?**

Example: You install a 10kW solar PV system on your home and get it certified in October of 2019. The panels are made in Washington. Your base incentive is $0.14/kWh + a Made in Washington bonus of $0.04/kWh for a total of $0.18/kWh.

Starting in July 2020, you’ll apply to WSU Energy for a Washington State production incentive of $0.18/kWh on all of the energy your system generates each year.

You’ll be able to apply for this incentive for eight years.
To apply for Washington State Production Credits, an application must be submitted to the Washington State University Energy Program by August 1 of each year that shows the energy produced by the renewable generation system from July 1 – June 30 of the previous fiscal year. This measurement comes from the production meter installed after the inverter, not PUD 3’s net meter. PUD 3 must be given access to read the production meter to verify the reported energy generation.

PUD 3 will receive a notification from WSU Energy letting us know who to send a check to, and how much it should be for. PUD 3 will distribute the incentive on WSU’s behalf, and take an equal amount as a deduction on its Washington State Public Utility Tax.

This application can be found in the Helpful Documents section at the end of this guide or online (www.pud3.org/solar) It is the responsibility of the customer to download, fill out, and submit the form to the WSU Energy Program.

Be aware that some contractors say they will take care of this for their customer. It is ultimately the responsibility of the customer to ensure the application is submitted completely and on time. It is not the utility’s responsibility to remind customers of the deadline or to fill out the form.

**Program Requirements**

Customers should work with their renewable energy contractor and ask PUD staff or WSU Energy to ensure they meet all the requirements to receive incentives from this program.

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**PROGRAM REQUIREMENTS INCLUDE:**

- ✔ A customer-installed, revenue-grade production meter.
- ✔ Compliance with program procedures and regulations.
- ✔ Random auditing of generating systems and production meters.
- ✔ Must be certified by Washington State University Energy Program.
- ✔ Must be installed in PUD 3’s service territory.
- ✔ Must be owned by a customer who has a PUD 3 account.
- ✔ Must be owned (not leased) by the customer applying for the incentive.
- ✔ The renewable generating system and interconnection setup must be approved by PUD 3.
- ✔ The customer’s net metering application and agreement must be approved by PUD 3.
- ✔ A signed PUD 3 Incentive Program Agreement.
- ✔ Access for PUD 3 personnel to read the system’s Production Meter.
**Federal Tax Credits**

Federal tax credits may be available for the purchase and installation of a renewable generation system and/or production credits for the output of that system. Discuss these opportunities with your solar contractor or a tax professional.

The Federal Energy Policy Act of 2005, as amended by the Consolidated Appropriations Act of 2015, includes provisions for individuals to claim up to 30% in federal income tax credit for the cost of solar technology installations. Credit applies to the basis remaining after any utility or state incentives have been taken. This tax credit has a gradual step down rate beginning in 2020. See www.ENERGYSTAR.gov/taxcredits for more details. Contact the U.S. Internal Revenue Service, or a tax professional for further information.

*See a tax professional for further information.*

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**Renewable Generation Incentives**

### FEDERAL

**Personal Tax Credit:**

up to 30%

### STATE

**Production Incentives:**

$0.02 to $0.21 per kWh

Up to 50% of Total System Cost
How big of a Solar PV System should I get?

The number one question people ask is, “How big of a system should I get?” This is an important question and will be met with several others, such as:

- How much are you willing to spend?
- How much space do you have?
- What type of roof do you have? (ex: Composition shingles on a low slope, or a steep, slate roof?)
- Is your roof structurally sound to support the weight of a solar array?
- Do you want to maximize potential generation incentives?
- What are your goals?

Work with your solar contractor to determine many of these answers. It’s important to consider them ahead of time. A 1 kW system may take up to 80 ft² of roof area, while a 10 kW system may require as much as 1,000 ft². Many solar modules are about 200-300 watts, and take up about 16 ft² each.

Getting a Quote

Getting several quotes for the equipment and installation of a solar PV system should be the next step in your process. Some contractors offer a free quote, and others charge a small fee to perform an on-site assessment of your location and make a recommendation. PUD 3 recommends getting at least three quotes, or as many as you can until you feel comfortable with the right contractor and system.

When comparing quotes, be sure you’re making an apples-to-apples comparison. Do both bids include the full installation of the equipment? Request that all of your bids specify the system capacity in “AC watts”, or specify the output at the inverter. When considering a warranty, ask yourself if the company will stay in business long enough to assist with any manufacturer or installation warranty issues that may arise.

Solar Washington is a nonprofit organization composed of people, companies, programs and organizations working to advance the solar industry in our state. Through education and networking, they promote the development and effective use of solar and renewable energy with concern for the economic, environmental and social fabric of Washington. www.solarwa.org
It is also important to select a contractor that will assist you with all applicable permits, which will include, but not be limited to a Washington State Labor & Industries (L&I) Electrical Permit and a City of Shelton or Mason County Mechanical/Building Permit, in addition to the PUD 3 Net Metering Application & Agreement. These permits may require engineering to determine if your roof has the strength to support the solar array.

It is important to note that while a contractor may assist you in meeting the utility interconnection standards and Washington State Production Incentives, it is the customer’s sole responsibility to maintain the appropriate equipment and turn in the correct incentive applications.

Questions for your Solar Contractor

Here are a list of other questions that you should ask your contractor:

- Are you licensed, bonded, and insured as an electrician and/or solar installer in the state?
- How many solar PV systems has your team installed? Any in Mason County?
- What different size systems can I actually fit on my roof?
- What brands of solar modules and inverters will you be using on my system? What are their warranties? If the components are manufactured in the State of Washington, does that increase any incentives the State may offer?
- Are your components UL listed? (Required for electrical inspection and utility interconnection)
- Can you show me some systems that you have installed, and/or share some references?
- Do you finance solar projects? If not, what are my upfront costs?
- Who owns the system? Who gets the production credits? Who gets the electricity output of the system?
- How much energy will I generate and what does my return on investment look like?
- What is my Total Solar Resource Fraction (TSRF)? (You’ll want it to be 75% or higher!)
- What is my estimated solar production by month (not just annual production)?
- Is my roof in good enough shape to last for the life of the solar PV system (25-30 years+)? Do I need to re-roof beforehand?
- Will you help me understand and secure any available financial rebates, production credits, or tax incentives, whether local, State, or Federal?
- Will you take care of all of the paperwork that my utility requires to become a net-metered customer, as well as coordinate the job with them?
- Will you also take care of any city, county or state permits that are necessary?
- What are additional expenses over the life of the system? Will I need to replace any components? Do you cover that?
- If there is a problem with the system, who do I contact?
It turns out power rates play an outsized role in valuing solar energy. Hawaii, with high rates, had the highest lifetime revenue potential at $7.93 per watt, according to the study. California was second, at $3.49.

Oregon and Washington, which benefit from some of the lowest power rates in the nation, had the lowest solar values, at $1.04 per watt and 85 cents per watt, respectively, based on potential revenue from net metering.

The national average was $2.35.


The actual value of solar is $0.85/watt in Washington. How much are you planning on paying per watt for your Solar PV system?
MASON COUNTY’S SOLAR CLIMATE

<table>
<thead>
<tr>
<th>Good Solar Conditions</th>
<th>Poor Solar Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abundant Sunshine</td>
<td>Cloudy Days</td>
</tr>
<tr>
<td>Fair Solar Conditions</td>
<td>Poor Solar Conditions</td>
</tr>
<tr>
<td>Partly Cloudy Days</td>
<td>Days with Precipitation</td>
</tr>
</tbody>
</table>

**Solar Power in Mason County’s Climate**

With an average of 174 days of rain and 57 days of cloud cover per year, Mason County residents really enjoy it when the sun is out and shining bright. Take a look at a few charts from [http://www.city-data.com/city/Shelton-Washington.html](http://www.city-data.com/city/Shelton-Washington.html) based on data reported by over 4,000 weather stations. As a word of caution, Mason County residents should have tempered expectations when considering our local climate and its match with solar PV.

**Your Solar Power System in the Winter**

The largest consumer of electricity in a home is electric heat. Most Mason County residents use electricity to heat their home (about 75% or more). Unfortunately, that is also the time of year when a solar PV system produces the least amount of electricity. The electric grid will provide the energy needed during high-use times, when your solar PV system is unable to meet the home or business’ energy demand.

**Expected Average Daily Solar Radiation**

The potential to generate solar energy is measured in Average Daily Solar Radiation, and is displayed as kWh/m²/day. It’s basically how much energy you can expect to generate in a location based upon the size of your solar panels. Of course, there are a lot more things that determine the amount of electricity you can generate, but this gives you a good idea if your general location is suitable for solar generation.

Take a look at two charts to your left comparing January and July’s Average Daily Solar Radiation in the United States.

Here are a few things to consider when evaluating the charts to your left:

- **Electricity doesn’t store very well. What you generate, you have to use right away. Therefore, looking at an annual chart can sometimes be misleading. With that in mind, how do you plan to use your solar generation?**

- **When do you use the most electricity - in the winter (January) or the summer (July)?**

- **If you live in Arizona and your main electricity usage is cooling, this electrical load coincides with the perfect time of the year to generate solar electricity. In Mason County, the time that we use electricity the most (in the winter for heating) is also the time that we get the least amount of production.**

- **What are some other things you notice about these charts?**
Solar Generation vs. Energy Efficiency

If you’re looking to save money on your monthly utility bill, perhaps energy efficiency is the right way to go. PUD 3 has been helping its customers save energy and save money for over 30 years. Our energy conservation department offers a wide variety of rebates to help improve a home’s energy efficiency and eliminate energy waste.

We offer free energy audits for all PUD 3 customers: residential and commercial. There are rebates available for electrically heated homes that can help upgrade a heating system or increase insulation levels. Rebates are also available to improve a business’ lighting.

In almost all cases, increasing a home’s energy efficiency offers a drastically better return on investment when compared to installing a new solar PV system: the capital costs are often much less; the energy efficiency often improves the comfort of your home; and in many cases attacks the root of the problem, rather than the symptoms.

If you’re interested in installing a solar PV system, it is strongly encouraged to take advantage of Mason PUD 3’s energy efficiency rebates before installing the solar system in hopes of eliminating energy waste by upgrading the efficiency of your home. Learn more at www.pud3.org/saveenergy.

Mason PUD 3’s Fuel Mix: 99% Carbon-Free!

PUD 3 is a public power utility, which allows it preferential access to the federal hydropower system. In addition to the low cost of power, hydroelectricity is 100% carbon free! PUD 3’s fuel mix includes hydroelectricity, wind, nuclear, and solar energy. It also contains a small amount of fossil fuels (coal) to be readily available for the grid to back up highly-variable renewable energy sources such as wind.

Take a look at the comparison between PUD 3’s fuel mix and the nation’s fuel mix in the charts to the right.
Low Cost of Electricity

This may sound a little boastful, but did you know PUD 3’s electricity rates are the lowest of all its neighboring utilities? Did you know our rates are almost 50% cheaper than the average cost of power in the United States? Being a public power utility with access to the low-cost and reliable Federal Hydropower System comes with great benefits.

The low cost of electricity here in Mason County is an important factor to consider when contemplating if a solar PV system is right for you. A lower avoided cost (the cost of electricity you don’t have to buy from PUD 3 with a solar power system) makes it harder to recoup your investment in the system. It also reduces the impact a system can have on your monthly utility bill- if your rate is already low, avoiding paying for electricity at a low rate isn’t as impactful as avoiding paying for electricity at a high rate. You’re saving less money per kilowatt hour generated here than you would in a high-cost electricity market like Arizona, Hawaii, or even Seattle.

Even with a solar power system, a PUD 3 customer is expected to pay the daily system charge to be connected to the electric grid, so please don’t expect your monthly utility bill to disappear, even in the best generating scenario!

**DID YOU KNOW:**

PUD 3 power is almost 50% cheaper than the average cost of power in the United States!

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The cost of electricity per kWh, as compared to Mason County PUD 3’s neighboring utilities:

- **MASON PUD 3**: $0.0672
- **Peninsula Light Co.**: $0.0729
- **Grays Harbor PUD**: $0.0850
- **Puget Sound Energy**: $0.1109
- **Seattle City Light**: $0.1189

The cost of electricity per kWh, as of February 1, 2015, assuming 1,000 kWh consumed during the billing period.
Understanding “Capacity Factor”

A solar power system has a “capacity factor”. This is a factor that all electricity generating power plants have. (You did know you were installing a power plant on your roof, right?!) Here’s how you figure out a power plant’s capacity factor, and it may be the single most important number to take into account when considering a solar PV system:

The Formula

The capacity factor of a power plant (solar PV system) is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely. To calculate the capacity factor, take the total amount of energy the plant produced during a period of time and divide by the amount of energy the plant would have produced at full capacity.

Solar Cell Efficiency

Don’t confuse capacity factor with efficiency of a system. The efficiency of a solar cell or an inverter is one of the elements that go into determining the capacity factor.

The technology found in solar cells have come a long way in recent years. Just a few years ago, you could only expect to find a solar cell that was 11% - 15% efficient. Today, you can find solar cells that have a 20% or greater efficiency. This is not the efficiency of the whole system, but rather the measure of the amount of electrical energy you can expect when considering the full amount of light energy that is absorbed by the solar cell.

Inverter Efficiency

Another factor that limits electricity production is the efficiency of the inverter. Changing electricity from direct current (DC) from the solar panels to alternating current (AC) as used by your house and on the electric grid is no easy task. It takes energy to make the conversion, so every kilowatt that you put into the inverter, won’t come out the other side.

Location, Location, Location

A solar PV system’s location will also directly affect how well it performs. If you have tall fir trees, common here in Mason County, blocking your solar exposure for part of the day, the system won’t produce as much energy. Even small objects, like a utility or flag pole, can result in significant shade losses. As little as 10% shade on a module can reduce output by as much as 80%. Obviously, you want to maximize your exposure to full and direct sunlight when determining where to install your solar power system.

To get the most benefit from a system, a well-designed solar PV system has clear and unobstructed access to the sun for most of the day, throughout the year. You can make an initial assessment yourself, and if the site looks promising, your solar contractor has the tools to trace the sun’s path at your site and offer a more complete assessment.
HOW MUCH ENERGY WILL IT PRODUCE?
PUD 3 has found the estimated capacity factor for recent solar PV systems in Mason County to be about 10% - 11%. Using this capacity factor, here is a way to estimate the production of a system you’re considering:

\[ \text{Estimated Annual Production in kWhs} = \text{System Size} \times 8,760 \times 0.10 \]

Other factors aside, the best orientation (direction) for a solar electric system is south, where the sun spends most of its time, and therefore south-facing roof installations are most common. Roofs that face east or west may be acceptable, but generate about 20% less electricity. Solar panels can be mounted flat on a flat roof, but perform best when mounted due south on a 30-45 degree tilt.

Fuel Availability
When it comes to renewable energy like solar PV systems, one of the main variables in determining a system’s capacity factor is fuel. If there is no fuel available (sunlight!), there will be unused capacity. Solar energy seems to be very predictable: we know when it will be day or night. However, in a solar climate like Mason County, generation can be a little more variable than that of Arizona. Seasonal changes and cloud cover greatly impact a solar PV system’s generation output, and therefore, have a tremendous impact on its capacity factor.

A Contractor’s Disclaimer
A local solar contractor published this to their website:

SOME RENEWABLE ENERGY BASICS FOR THE PUGET SOUND AREA – A REALITY CHECK

If your motivation is purely monetary – a quick Return On Investment (ROI) and money in your pocket – then Renewable Energy is probably not for you. Electric Utility rates in Seattle City Light and Puget Sound Energy areas are considerably lower than the rest of the nation, and the system costs are the same. Paying for the system from the savings on your electric bill will take a long time.

- http://westseattlenaturalenergy.com/cost

NOTE:
Mason PUD 3’s electricity rate is about 30% cheaper than the two utilities listed, minimizing the already low ROI opportunities described.
COMMUNITY SOLAR

Investing in a Community Solar project may be an alternative to installing a solar PV system at your home or business. For a fraction of the investment, you can participate in a community solar project to earn energy credits on your PUD bill as well as qualify for available production incentives.

Installing a Solar Power System on Your House isn’t for You?

Maybe you have a poor location for solar - too much shade or other installation challenges? Maybe it’s too expensive to install a full system? Maybe you don’t own your own home? Perhaps you’re planning on moving soon?

All of these can be barriers to installing solar on your home - but it doesn’t have to prevent you from investing in solar energy right here in Mason County! Like a community garden, a community solar system allows a group of people to work together to install, maintain, and benefit from solar energy.

Mason PUD 3 customers who can’t or don’t want to maintain a large solar system can add solar energy to the grid and still receive the benefits that come with owning solar panels, but at a size and cost that works for them.

How does the program work?

Community Solar is a different model for solar energy. Instead of putting solar on your own home (which requires home ownership, the right sunny location, and a fairly large upfront investment), Community Solar lets many people come together to build one larger solar power system. Participants benefit through economies of scale, better siting, and the opportunity to take part at a much lower entry level. Instead of paying thousands of dollars for your own solar electric system, you can get financial benefits and support solar in our community for a much smaller investment.

A customer can participate in the project by purchasing “solar units”.

An annual billing credit of the energy generated by the Community Solar system is credited to the participant’s utility bills according to the level in which they participate.

Each year, up to June 2020, the Washington State Production Incentive will be distributed to program participants (up to $5,000) according to the level they participate in the project.

A Sample Community Solar Project

1. PUD Builds & Maintains One large Solar Power System

2. Mason PUD 3 Delivers Solar Energy to the Participants

3. Cleaner, greener Homes for Participants

Participants Receive Energy Credits on their PUD 3 Bill and are Eligible for Washington State Production Incentives
Justin Holzgrove, Mason PUD 3 Energy Resources Manager, visited with two net metering customers to talk about their solar energy experience. He shared his impressions about both customers’ approach to generating their own electricity.
CASE STUDY - Geoff, Island Lake

Geoff decided to install a solar photovoltaic (PV) system for philosophical reasons, “We can all do our part to develop this technology and contribute to a better society.” I got the impression that Geoff thinks there will be many more solar PV systems coming to Mason County.

He’s not so concerned about getting the maximum amount of energy from the system. His business is “energy intensive.” For him, installing solar on his house was a way to help contribute to renewable, carbon-free energy production. He enjoys the “toy” part of the experience. He’s also happy his PUD 3 bill has gone down since he got it installed!

Geoff chose a solar contractor from the South Puget Sound area and was happy with their level of service. His reasoning was that they would be close at hand if there were any issues.

Working with his contractor was simple. After performing a site visit, taking measurements, and making some calculations, they made a recommendation to take full advantage of his home’s solar exposure and available roof space. The contractor took care of all permits and worked with PUD 3 (in addition to the combining of his home’s two meters). Their setup was clean and professional.
Geoff installed an 8 kW system with Washington-made solar panels and inverter to maximize his production incentive. Through June 30, 2020, he’ll earn $0.54/kWh that he generates. In fact, while we were talking, Geoff exclaimed,

“Look here- in the last ten minutes I generated two kilowatt hours, earning me $1.08!”

Geoff will apply for the Washington State production incentive each year.

Before installing his solar PV system, Geoff installed energy efficient windows, increased his home’s insulation, and installed an attic fan to cool the house in the summer. By eliminating energy waste, he maximized the value of his solar PV system. Geoff also had a new roof installed before the solar panels were installed.

Geoff’s contractor estimates his system should be fully paid for in 15-20 years.

Facts about Geoff’s system:

- 8 kW capacity
- Washington-made Solar Panels and Inverter
- Will earn $0.54/kWh through June 30, 2020
- System payback estimate: 15-20 years
Mike chose to install a solar PV system at his house in hopes of reducing his PUD 3 bill and capitalizing on available production incentives. For this reason, Mike chose to purchase the largest system his roof would accommodate.

His 9.9 kW system qualified for the full sales tax refund (it’s only 75% for systems larger than 10 kW). To maximize his production incentive, he chose Washington-made panels and inverters. He’ll earn $0.54/kWh generated through June 30, 2020.

**Mike’s thrilled about the prospects of selling energy TO the PUD!**

Mike started his process by contacting the PUD, where he learned the steps needed to have his system installed. His contractor (from Seattle) seemed very busy at first, but once the panels were delivered to the house, the project only took about two days. Mike’s contractor says that they’ll take care of the annual Washington State production incentive application. However, Mike understands it’s his responsibility to make sure it gets turned in on time (annually, on June 30).
Mike’s system uses two inverters. A communication module allows the solar contractor to monitor his system’s production level down to each panel. Mike can login with his iPad to view the same system status information. If the contractor notices one panel lagging in production behind the others, they’ll already know – and say they will have a technician dispatched to look into it.

Mike’s home is well-insulated. But it has electric wall heaters. His next purchase will be an energy efficient ductless heat pump. This will allow him to add cooling to his home and maximize his solar power system’s generation.

Mike wasn’t worried about the condition of his roof before the panels were installed. His contractor said it would be about $800 - $900 to remove the panels and reinstall them if he needed a new roof before the life of the system expires.

Mike is estimating his system will pay for itself in 5-10 years.

Facts about Mike’s system:

- 9.9 kW capacity
- Washington-made Panels and Inverter
- Will earn $0.54/kWh through June 30, 2020
- System payback estimate: 5-10 years
How much does a Solar Power system cost to install?

There are many variables that go into the cost of a solar PV system. Like all major purchases, there are many decisions to make. How big of a system do you want? How efficient of a system are you looking for? What is the quality of equipment you’re purchasing and where was it made? Are there special installation considerations?

PUD 3 is finding that you can expect to spend between $3,000 - $8,000 per installed kilowatt (kW) designed capacity ($3 - $8/watt). PUD 3 recommends getting at least three bids and selecting the contractor you feel the most comfortable with that offers the best product available within your price range. Please see the section of this guide entitled “Working with a Solar Contractor”.

How many other Mason County homes have solar and how big are their systems?

Over seventy PUD 3 customers have solar power systems ranging in size from 0.2 kW – 10 kW, with an average system size of about 6 kW. However, larger systems are becoming more affordable and are encouraged to take full advantage of Washington State Production Incentives.
What about other private renewable generating systems in Mason County?
There are two wind generators connected to PUD 3's grid, and they are about 3 kW in design capacity. However, they don’t seem to generate much electricity. Check out the online version of this FAQ (www.pud3.org/solar) to read an article from Home Power magazine, Issue #167 called “Wind Turbine Buyer’s Guide”.

Do I need to do any structural changes to my roof/home?
That depends on your roof and home. Your solar contractor will be able to make that recommendation. Be sure to ask your solar contractor about how your new solar power system will affect your roof warranty, as well as any leaks or damages that occur as a result of the system.
If your roof is older and in need of being replaced in the near future, you may want to defer installation of your solar system until that is completed.
Check your local city or county building department for applicable permit information.

Will my system provide power during an outage?
The short answer is NO. PUD 3’s linemen must have access to an AC disconnect switch to disconnect and lockout your solar power system during an outage. This prevents the system from back-feeding, or sending energy onto the grid, which would endanger the PUD 3 crews working to restore power. Additionally, PUD 3 requires inverters to have an automatic voltage-sensing disconnect switch built into them to prevent backfeeding. This redundancy is for the safety of PUD 3’s linemen and other personnel.

Should I invest in battery backup/storage for my solar system?
Adding a battery backup/storage option to your solar PV system will greatly increase the cost and return on investment. You’ll need to consider the initial cost of the batteries and the maximum projected life (measured in “cycles” – charge and discharge). The high cost and short life of the batteries, when compared to your solar PV system may affect your decision.
If you’d like a backup power source during outages, an efficient generator will likely serve you better than a battery bank. Most of our power outages occur during winter storms when days are short and solar PV systems are producing little power to recharge a battery bank. Battery power is short lived and extremely limited. Please see PUD 3’s web page on Generator Safety for more information: www.pud3.org/gensafety.

Do solar PV systems need maintenance?
Since a solar PV system is compromised of panels that have a sturdy tempered glass surface (naturally sheds water and dust) mounted 4” – 8” above the roof to prevent debris from building up underneath, they're generally maintenance free. However, for maximum efficiency, it is recommended to wash the face of the PV panels at least once a year, usually after pollen season.
A solar PV system that tilts the panels to track the sun in order to optimize energy production has motors that will require regular maintenance.

How much sun is needed to generate electricity with a solar power system? What about all the rain here in Mason County?
Let’s just say, the more sun you put in, the more electricity you’ll get out! To learn more about factors that both enhance and limit production of a solar PV system, take a look at the section in this guide that covers other things to consider when evaluating is solar power is right for you.
Does a solar PV system need direct sunlight, or will ambient light be suitable?

This comes down to the efficiency of the solar cell, which “collects” the light energy, and it’s a simple exercise in scale. If you have a collector that is 20% efficient, which is on the high side for solar cells available on today’s market, it will absorb about 20% of the light that hits it. If you shine a lot of light on it (direct sunlight), the total amount of useful light for the production of energy will be much higher than if you shine a very little bit of light on it (ambient light). So, while “ambient light” may be able to generate a small amount of electricity from a solar PV system, it will greatly reduce the actual capacity factor of that system.

What about other countries of the same latitude or climate (e.g. Germany)?

Comparing solar generation with anywhere except Mason County is a frustrating task. There are so many variables that go into the production (see: Capacity Factor) and financial benefit of a solar power system. A comparable position on the globe certainly isn’t helpful because local climate isn’t a latitude/longitude based system. You also should consider the political climate, which varies greatly from state-to-state, as well as between different countries.

Germany has been a global leader in installed solar capacity and is often put forth as an example of why solar PV is a great idea for Western Washington, because we’re at approximately the same latitude, with a similar solar radiation score. It’s important to also consider the political climate for solar power systems in Germany. The German government has heavily subsidized the installation of renewable energy through many measures over the years. There are also lucrative “feed in tariffs” allowing owners of distributed generation systems to sell power back to the grid at very favorable rates. Permitting for solar PV systems, and the systems themselves are also cheaper in Germany.

It should also be mentioned that there is a price to pay for these “favorable” conditions: the average cost of electricity in Germany is $0.35/kWh, which is among the highest in the world. To compare, USA’s average cost of electricity is about $0.12/kWh and PUD 3 is about $0.07/kWh. Unfortunately, these incentive and pricing structures can mask true evaluation on whether solar power is a good fit for a “comparable climate” such as Germany.
What is “passive solar”?  
Passive solar is a building design principle or strategy that uses the design and placement of windows, walls, and floors to collect, store, and distribute solar energy in the form of heat in the winter, while rejecting solar heat in the summer. Unlike a solar PV system, passive solar doesn’t use mechanical or electrical devices (e.g. solar PV panels).

What is “solar water heating”?  
Solar water heating is more often found in hot, sunny climates such as Arizona or Hawaii than Western Washington, where we have a shorter solar season. A solar water heater is mounted to a home’s roof to take advantage of the sun’s radiation to heat or preheat water before use in the home. A closed loop system of heat transfer liquid is mounted in a collector panel below the tank and is heated by the sun.

The hotter liquid rises in the system, which comes into contact with the domestic water. The heat energy is then transferred to the water in the tank. Once the heat energy is released into the tank, the liquid continues flowing back along the loop, into the collectors, and the cycle continues. If there is inadequate solar heat gain and the water doesn’t reach the desired temperature, a standard electric or gas water heater is used to add heat until the water reaches the desired temperature. Many systems are passive, closed loop systems, but some require a small circulating pump. There are many various technologies used in solar water heating worldwide.
Here is a list of many of the documents you need to begin generating your own renewable energy.

1. PUD 3 Project Checklist for installing a Solar PV System
2. PUD 3 Interconnection & Net Metering Agreement
3. PUD 3 Interconnection & Net Metering Application
4. PUD 3 Incentive Program Agreement
5. Mason County’s Building Permit Checklist and Application for a Rooftop Solar PV System
6. Washington State Renewable Generation System Certification
7. Washington State Production Incentive Application

YOU CAN FIND LINKS TO THESE DOCUMENTS AT: www.pud3.org/solar
PUD 3’s Energy Conservation Department
(360) 426-0777
email: solar@masonpud3.org
www.pud3.org/solar