

1. Resources

1.1 Solar 101

1.1.1 Pros and Cons of Solar Energy

Considering a solar system for your home? It's essential to understand the advantages and disadvantages before making your decision. Solar energy offers a sustainable way to generate electricity, cut carbon footprints, and help countries reach their net zero goals. Key benefits include affordability, low maintenance, increased property value, and energy independence.

There are not many cons of solar energy, but one criticism is that solar panels don't produce energy at night and are less efficient in areas with limited sunlight. Pairing solar systems with home battery storage can address this issue, storing excess energy for nighttime use. Another drawback is the significant land requirement, but community solar projects are becoming more popular, allowing people to benefit from solar energy even in space-constrained areas.

Advantages of Solar Energy

Solar energy has long been recognized for its numerous benefits. As more solar systems are installed globally, reliance on fossil fuels decreases, benefiting both the environment and individual users. Here are the main advantages:

Renewable Energy

Solar power is a key player in renewable energy. Over the years, solar technology has improved significantly and is now the most popular form of renewable energy. It attracts substantial global investment and can be harnessed worldwide. The manufacturing process of solar panels is also becoming more sustainable, making solar energy the cleanest renewable energy source.

Cost-Effective

Solar energy is more affordable than ever. Since 2015, the cost of solar systems has dropped by about 22%. In many regions, solar energy is the cheapest source of power. Various financial incentives, such as tax credits and rebates, along with attractive financing options like no-money-down leases and solar loans, make solar energy accessible to more people.

Lower Electricity Bills

Investing in solar panels can significantly reduce your electricity bills. The electricity generated by solar panels can cover most or all of your energy needs, depending on the system size and your consumption. Any excess energy can be fed back into the grid for credits or payments, or stored in batteries for later use.

Long-Term Savings

Although the initial cost can vary, the long-term savings from solar energy are substantial. Typically, solar systems pay for themselves within six to ten years, and they can last well beyond 25 years. Solar energy also provides stability against fluctuating electricity prices, offering a reliable and cost-effective energy source.

All-Weather Operation

Solar panels generate electricity in any climate, not just sunny conditions. While they are more efficient in areas with high solar exposure, modern panels perform well even in low-light conditions, benefiting regions with cooler and cloudier weather.

Environmentally Friendly

Solar energy is environmentally friendly, producing no pollutants or emissions. The technology's source is infinite, and its performance requires minimal maintenance. Solar panels also have a long lifespan, significantly reducing their long-term carbon footprint.

Remote Monitoring

Modern solar systems offer remote monitoring, allowing you to track performance via smart devices. Energy Monitoring Systems (EMS) provide analytical and control capabilities, helping you manage consumption and storage effectively.

Low Maintenance

Solar energy systems require minimal maintenance. Keeping solar panels clean and free of debris ensures optimal efficiency for many years. Regular cleaning is straightforward and maintains performance despite environmental factors.

Energy Independence

Solar panels, especially when paired with storage systems, offer energy independence. They can function off-grid, protecting you from power outages and price fluctuations. Remote monitoring adds further control and reliability.

Job Creation

Solar energy is a significant driver of job creation, supporting millions of jobs globally. In the USA, solar industry jobs grew by 3.5% in 2022, highlighting the sector's dynamic employment opportunities.

Disadvantages of Solar Energy

While solar energy has many benefits, there are some drawbacks to consider:

No Energy at Night

Solar panels don't produce energy at night. However, energy storage solutions like batteries can store power generated during the day for nighttime use.

Daylight Dependency

Solar panels need daylight to function, although they can still generate electricity in shaded areas with reduced efficiency. Microinverters and power optimizers can help maximize output even in partly shaded conditions.

Land and Space Requirements

Large-scale solar projects require significant land, sometimes causing opposition. Modern installation techniques and community solar projects help address these concerns by utilizing low-quality land and involving local residents.

High Initial Costs

The initial cost of solar systems can be high, deterring potential users. However, various financing options and decreasing costs make solar energy increasingly accessible.

Relocation Challenges

Relocating solar panels is complex and costly, making it an investment that adds value to the property rather than a portable asset.

Manufacturing Impact

The manufacturing process of solar panels involves energy-intensive processes, although efforts are being made to reduce the carbon footprint. Companies like Qcells are committed to cleaner supply chains and recycling end-of-life panels.

Is Solar Energy Worth the Investment?

The benefits of solar energy far outweigh the disadvantages. Solar energy's affordability, reliability, sustainability, and performance make it an attractive and beneficial investment.

Contact Us

Interested in installing AMPS solar panels or have questions about solar energy? Our team is here to help. We provide high-quality solar panels, outstanding solar solutions, and exceptional customer service. Explore our complete solar energy solutions, including solar panels, home energy storage, and energy management. Contact AMPS to discuss designing and installing a customized home solar panel system or for any solar-related inquiries.

1.1.2 A Beginner's Guide to Home Solar Systems

As solar energy gains popularity, more homeowners are switching to home solar systems. These systems offer numerous benefits, such as energy independence, lower electricity bills, and increased home value. However, many newcomers to solar may not be aware of these advantages.

In this beginner's guide, we cover the basics of home solar systems, their overall benefits, different types, the installation process, and more. Read on to discover everything you need to know about going solar.

What Is a Home Solar System?

A home solar system, also known as residential solar, converts sunlight into usable energy for homes. It consists of solar panels, inverter(s), and an optional battery, and connects to the main power grid.

Solar panels are the core of a home solar system, absorbing sunlight through photovoltaic (PV) cells and converting it into direct current (DC) electricity. This DC electricity then passes through the inverter, which converts it to alternating current (AC) electricity needed to power homes and appliances.

Benefits of Home Solar Systems

Home solar systems have become more affordable in recent years, making them more accessible to homeowners. Here are some key benefits of switching to solar energy:

1. Affordable Solar Panels

Advances in solar technology and increased production have significantly reduced the cost of manufacturing and installing solar panels. Additionally, various financial programs help offset the cost of solar installation.

2. Save Money

One of the main attractions of home solar systems is the potential for long-term savings. By generating their own energy, homeowners reduce their reliance on grid electricity, leading to lower utility bills. Over time, these savings can add up significantly.

3. Backup Power During Outages

Power outages can occur due to extreme weather, emergencies, or high demand. A home solar system with a backup battery can provide power during these outages. Excess energy generated by solar panels is stored in the battery for later use, keeping the lights and appliances on even when the grid is down.

4. Increased Home Value

Homes with solar systems tend to sell faster and at higher prices. Prospective buyers appreciate the environmental and financial benefits of solar energy, making homes with solar panels more attractive in the real estate market.

5. Effective in Various Climates

Solar panels can generate energy in a range of weather conditions, including cloudy, rainy, or snowy days. While they are most efficient in sunny climates, modern solar panels are designed to capture and convert sunlight effectively, making them suitable for various climates.

Types of Home Solar Systems

Homeowners can choose from three types of home solar systems: grid-tied, off-grid, and hybrid. Here's how each one works:

Grid-Tied

Grid-tied systems are the most common, connecting to the local power grid. Homeowners can use solar energy they produce and rely on grid electricity as needed. These systems also allow for net metering, where excess energy is sold back to the grid for credits on utility bills.

Off-Grid

Off-grid systems operate independently from the utility grid, ideal for remote areas. They require a solar battery to store excess energy for use during low sunlight periods.

Hybrid

Hybrid systems combine features of both grid-tied and off-grid systems. They connect to the grid and use a backup battery, offering flexibility and energy independence.

Solar Incentives and Tax Credits

Various rebates, incentives, and tax credits are available to reduce the cost of installing home solar systems. Here are two popular programs:

- **Federal Solar Tax Credit:** Allows homeowners to claim 30% of their solar installation costs on federal income taxes.
- **Net Metering:** Some state and local governments offer programs that let homeowners sell unused energy back to the grid for credits on their electricity bills.

Homeowners should research available programs in their area, as some have strict end dates.

Choosing Solar Panels

When selecting solar panels, consider these factors:

Cost

Installation costs vary based on location, number of panels, and the solar company. Get several quotes to find a balance between cost and quality.

Warranty

Look for warranties covering performance issues and manufacturing defects, typically lasting 20-25 years.

Efficiency

Higher-efficiency panels convert more sunlight into usable electricity. Consult with a solar installation company to choose the best panels for your home.

Determining the Number of Solar Panels

The number of solar panels needed depends on energy consumption, roof space, and panel efficiency. Here are rough estimates based on average home size:

1,500 sq. ft.: 18-24 panels

2,000 sq. ft.: 24-32 panels

2,500 sq. ft.: 30-40 panels

These numbers are general estimates; consult a professional solar company for a detailed design quote.

Home Solar Installation Process

Home solar installation involves several steps:

Assessment

The installation team assesses the property's solar potential, including roof orientation, shading, and structural integrity.

Spacing

Proper spacing ensures optimal sunlight exposure. The ideal layout is planned for maximum efficiency and compliance with building codes.

Drilling

Holes are drilled into the roof to secure the mounting system, with care taken to prevent damage and maintain roof integrity.

Mounting

The mounting system is installed to provide a sturdy foundation for the panels.

Fastening

Solar panels are securely fastened to the mounts, ensuring they withstand various weather

conditions.

Connecting

Panels are connected to the inverter(s) and the home electrical system, enabling the use of solar energy alongside grid electricity.

Maintaining a Home Solar System

Solar panels require minimal maintenance, but regular inspections and basic upkeep can maximize performance and longevity. Here are some maintenance tips:

Clean Panels

Clean panels every few months to remove debris. Use lukewarm water and a soft cloth, or hire a professional for safe cleaning.

Professional Inspections

Schedule annual inspections to identify maintenance or repair issues and ensure optimal system performance.

Monitor System Status

Use a monitoring app like Q.HOME Energy Management System to track energy usage and system performance in real-time.

Contact Us

Investing in a home solar system offers numerous benefits. If you have questions about solar installation or our top-performing solar panels, contact us. At AMPS, we are committed to providing high-quality products and exceptional customer service to help homeowners embrace solar energy and maximize their investment.

Contact us today to learn more.

1.1.3 Do Solar Panels Boost Home Values?

The adoption of home solar panels is growing nationwide, with more homeowners making the switch. Many often wonder if solar panels increase home value and, if so, by how much.

Let's delve into how solar panels affect property values, the factors that influence this increase, and the benefits of having solar panels on a home.

How Much Can Solar Panels Increase a Home's Value?

The added value from solar panels depends on several factors, including the size of the solar system and the local real estate market. Typically, solar panels can increase a home's value by an average of 3% to 4%. For instance, a home valued at \$450,000 could see an increase of \$13,500 to \$18,000 with solar panels.

How Do Solar Panels Enhance Home Value?

Solar panels can boost home values in multiple ways. Firstly, they reduce energy costs, making them an attractive feature for buyers due to the long-term savings on utility bills. Secondly, as a relatively new technology, solar panels help homes stand out in the market. Lastly, with more people seeking sustainable and eco-friendly living, homes with solar panels appeal to those willing to pay more for an environmentally friendly property.

Factors That Influence the Added Value of Solar Homes

While solar panels generally add value, several factors determine how much they increase home values. Homeowners should consider these factors to understand the potential impact of solar installations on their property value.

Local Electricity Rates

Electricity costs vary by location and can be higher in densely populated areas. High and fluctuating electricity rates make solar panels more valuable due to their locked-in rates and ability to lower utility costs, reducing reliance on the grid. Some local utilities also offer net metering programs, allowing homeowners to send excess solar electricity back to the grid for credits on their electric bill.

Home Location

Solar panels add more value in sunny areas with strong solar infrastructure. Generous solar incentives and robust net metering policies also attract buyers, enhancing home value.

Solar Battery

A solar battery stores excess energy generated by the solar system, which can be used at night or during high electricity prices or power outages. A solar panel system with a battery can enhance home value by ensuring continuous power, appealing to buyers who want reliable energy.

Condition of Home Energy System

Well-maintained solar systems add more value than outdated or poorly functioning ones. Solar panels require minimal maintenance, so keeping the system in good condition can enhance its value when selling.

Owned vs. Leased Panels

Homes with purchased solar panels add more value than those with leased panels, as homeowners are not liable for monthly payments. Leased panels reduce the financial benefits of lower utility bills, impacting the overall value added by solar panels.

Current Solar Market

As solar energy gains popularity, states offer incentives, rebates, and tax credits for solar panel installations. This growing market can lead to higher home values for properties with solar panels.

Do Solar Homes Sell Faster?

Solar panels not only increase home value but also speed up the selling process. A study by the National Renewable Energy Laboratory found that solar homes sell 20% faster and spend less time on the market than comparable properties. Homes with solar panels are more attractive to buyers due to reduced energy costs, environmental sustainability, and long-term energy savings.

Benefits of Solar Panels on Homes

Besides increasing home values and selling faster, solar panels offer several other benefits.

Environmental Sustainability

Solar energy is clean and renewable, producing no greenhouse gas emissions or air pollution. Installing solar panels reduces a homeowner's carbon footprint and contributes to a greener

future.

Energy Independence

Solar panels allow homeowners to generate their own energy, reducing reliance on more expensive, polluting sources. Paired with a battery, this independence provides security during power outages or grid disruptions.

Government Incentives and Tax Credits

Many local, state, and federal incentives and tax credits are available for switching to solar energy. The Federal Solar Tax Credit, for example, allows homeowners to claim 30% of the installation cost on their taxes.

Charging for Electric Vehicles

With the rise of electric vehicles (EVs), solar panels can provide the necessary power to charge EVs at home. A sufficiently large solar system can simultaneously power both the home and EVs.

Attracting Eco-Conscious Buyers

Homes with solar panels are especially attractive to eco-conscious buyers who prioritize sustainability. These individuals are committed to reducing their carbon footprint and supporting renewable energy. They value the opportunity to live more sustainably by purchasing a home with solar panels, contributing to a greener future.

Contact Us

Solar panels can increase home values and provide numerous benefits to homeowners. For more information on home solar systems, reach out to the AMPS team today. We're here to answer your questions, address concerns, and provide insights into our top-performing solar and storage solutions.

1.1.4 Choosing Efficient Solar Panels | Solar Panel Efficiency Guide

Solar panel efficiencies have been steadily improving for over a decade. Today, most solar panels on the market have a conversion efficiency rate of over 22%, and typically come with warranties of 10-25 years, ensuring high power output and reliability. When installing a solar system, it is important to understand what determines a solar panel's efficiency, how higher efficiencies generate more solar energy, and how they provide greater savings on your utility bill.

What is Solar Panel Efficiency?

Simply put, solar panel efficiency measures how much sunlight hitting a solar panel is converted into usable electricity. Currently, most popular solar panels have a conversion efficiency of around 22-24%, meaning that 22-24% of the sunlight is converted into solar electricity. While this may seem low, it represents the upper limit of current technology.

Solar panel efficiency is determined by the type of solar cell used, the cell layout, the configuration of the cells, and the overall size of the panel. Many factors interact within the solar panel when capturing sunlight, which we will examine below.

Which Type of Solar Panel is Efficient?

A solar panel's efficiency is primarily determined by its solar cells, which are either made from polycrystalline (multicrystalline) or monocrystalline silicon. Monocrystalline silicon cells – used by AMPS – offer higher efficiencies because they are made from pure silicon, with fewer impurities and a more uniform black color than multicrystalline cells. They also provide more power per square foot, and as the market has adopted this technology, prices have fallen to near parity with multicrystalline. The widespread adoption of monocrystalline solar panels in recent years has helped push solar panel efficiencies higher.

Another type of solar panel is the thin-film solar panel, which uses a different composition to achieve the photovoltaic effect. However, these panels are not widely used in rooftop solar installations.

Why Solar Panel Efficiency Matters

If you have limited roof space, maximizing solar power generation is crucial. This is why solar panel efficiency matters. The more efficient a solar panel, the better it is at converting sunlight into electricity, leading to higher electricity generation and a better return on investment.

A solar system with lower efficiency panels can produce as much power as a system with higher efficiency panels, but it will require more panels, increasing costs and space requirements.

Factors Affecting Solar Panel Efficiency

Several factors affect solar panel efficiency. Research and development teams worldwide work for years to develop higher-efficiency solar cells. This process is highly technical, but for the end customer, it pays to know how the cells work and how they affect a solar panel's overall efficiency.

The type of solar cell used is the biggest determinant of a solar panel's efficiency. AMPS uses monocrystalline cells to achieve efficiencies of 22% or more. These cells offer a sleek, uniform black aesthetic that enhances the conversion process, increasing the amount of sunlight converted into electricity.

Other techniques that boost solar panel efficiency include using half cells, which are simply solar cells cut in half, reducing the current flowing through the cell and lowering resistive losses, thereby increasing efficiency. Solar panels with half-cells also perform better under shaded conditions.

Solar panels with small gaps between the cells can also boast higher efficiencies, especially when paired with round interconnection wires that reflect less sunlight away from the cell compared to flat ribbon-style wires.

Other factors affecting solar panel efficiency include the type of inverter used, solar cell temperature (cells that are too hot exhibit reduced efficiency), and the layout of the system.

Solar Panel Design

The design of a solar panel can influence its efficiency. Panels using half cells are more efficient than those using full cells due to lower currents in the cells, leading to lower resistive losses and higher conversion efficiency.

The color of the backsheet, the protective layer on the back of a solar panel, also affects efficiency. Black backsheets, used primarily for aesthetics, reduce efficiency slightly because black absorbs more sunlight and heat than white or other colors, making the panel warmer and slightly less efficient.

Temperature

Solar panels perform optimally in direct sunlight within an ideal temperature range. A solar panel that is too hot will lose efficiency. The optimum temperature range for peak

performance is 25 °C or 77 °F. For every degree Celsius above this, a solar panel loses about 0.3% to 0.5% efficiency because high temperatures cause electrons inside the solar cell to behave erratically, reducing voltage. Other electrical components in the panel are also affected by high temperatures.

Solar panels are more efficient in cold weather. A cold, bright day is ideal for solar panels. However, colder days are usually shorter and less sunny, so solar panels are more effective in warmer climates where the days are longer and sunnier.

Positioning and Angle

Solar panels perform better when positioned and angled to optimize access to uninterrupted sunlight. However, environmental factors can influence the most optimal position and angle.

In the United States, it is best to have solar panels facing true south for peak sun exposure. True south differs from magnetic south, which is indicated by a compass. True south for solar panels means facing the geographic south, directed toward the South Pole.

If true south isn't possible, having panels face east or west (or both) is also acceptable, though there is a slight decrease in efficiency. We don't recommend facing your solar panels to the north, as this significantly reduces efficiency.

Shade

Shaded solar panels produce less electricity. They work on cloudy days but are most efficient on clear, sunny days. Shadows from neighboring objects can also affect output, so installers should consider potential shadow falls when planning your rooftop solar system.

Solar panels with half cells perform better in shaded conditions because the way the cells are interconnected means a shadow only affects one half of the panel, not the other.

Special inverter technology called Module Level Power Electronics (MLPE) can also boost performance in shaded conditions. This includes microinverters and power optimizers. MLPE ensures each solar panel operates at optimal capacity without affecting the rest of the system. If one panel is shaded, the others remain unaffected.

How to Check Solar Panel Efficiency

Calculate Theoretical Efficiency

The theoretical efficiency of a solar panel is higher than the actual efficiency, reaching around 33%. Current panels cannot achieve this rate, but the calculation is useful for installers planning a solar system. To calculate theoretical efficiency, divide maximum power output (up to 500

W) by rated power (listed in watts on the panel's datasheet) and multiply by 100.

Calculate Actual Efficiency

The actual efficiency of most solar panels today is usually between 22-25%. This is calculated by dividing measured power output (voltage x current) by rated power, then multiplying by 100.

Compare Theoretical and Actual Efficiency

Comparing theoretical and actual efficiency helps determine the overall output of your solar system. A panel with higher actual efficiency is less likely to be negatively impacted by shading, soiling, high temperatures, or other external factors that reduce performance.

Why Aren't Solar Panels 100% Efficient?

To reach 100% efficiency, solar panels would need to convert all sunlight into electricity. This is impossible because sunlight disperses in various ways. Modern panels can harvest up to 25% of the solar spectrum into electricity, with next-generation panels pushing efficiencies to 30% and beyond.

Contact Us

If you are interested in installing AMPS solar panels on your home or have questions about solar energy, our team is here to help. We are dedicated to developing high-quality solar panels, providing outstanding solar solutions, and delivering exceptional customer service because we understand the importance of switching to clean energy and its positive environmental impact.

Browse our complete solar energy solutions, including solar panels, home energy storage, and energy management, or contact us to discuss designing and installing a customized home solar panel system. Feel free to reach out to AMPS for any solar-related questions you may have.

1.1.5 Solar Energy Insights: Top 30 Facts & Trends

Solar Power Generation

- Solar energy is the most abundant source on earth and the fastest-growing new energy generation form.
- Currently, solar PV (photovoltaic) generates around 4% of the world's electricity by converting sunlight directly into electricity using semiconductor materials like silicon.
- Concentrated Solar Power (CSP), a less common form of solar energy, uses mirrors or lenses to concentrate sunlight onto a small area to generate heat and drive turbines, making up less than 1% of global solar power generation.

Solar Energy Storage

- The most common battery storage system for solar energy is lithium-ion batteries, comprising over 95% of global battery production capacity.
- Pairing a solar system with battery storage allows owners to store solar energy generated during sunny periods for use at night or on cloudy days.
- Battery warranties typically last 10 years, shorter than the 20-25 years standard for solar panels, though some providers offer extended warranties.

Environmental Impact of Solar Energy

- Despite the carbon-intensive production process, a typical solar panel offsets its carbon footprint within three years and operates as a carbon-free electricity source for over 20 years.
- Most solar panels are made with polysilicon, with more manufacturers adopting lower-carbon production methods like hydro-powered facilities.
- Over 90% of solar panel components are recyclable, with various government and industry-backed recycling programs available, reducing reliance on fossil fuels.

Solar Energy History

- As early as the 7th century B.C., ancient Greeks and Romans harnessed the sun's rays for heating and warmth.
- The first photovoltaic (PV) cell was developed by 19-year-old French physicist Edmond Becquerel in 1839.
- Solar panels gained public attention in 1969, powering the Apollo 11 moon landings.

Solar Energy Efficiency

- The average solar panel efficiency is around 20%, meaning it converts 20% of sunlight into usable electricity.
- Scientists believe new materials like perovskite can increase efficiency up to 30% in the coming years.

- Multijunction solar cells, which contain multiple photoactive layers, can reach efficiencies up to 50% in labs, though real-world application is still decades away.

Global Solar Energy Potential

- The sun continuously provides 173,000 terawatts of energy to the earth, over 10,000 times our total energy use.
- Covering an area of 191,000 square miles (about the size of Spain) with solar panels could power the entire planet.
- By 2050, solar energy could comprise 70% of a 100% renewable energy world, combined with wind, hydro, and storage.
- Las Vegas operates on 100% renewable energy from solar panels, powering its famous neon lights.

Solar Energy and Economics

- In 1977, a solar panel cost \$76.67 per watt; today, it's around \$0.16 per watt, a significant price decrease. Modern solar panels also offer higher efficiency and power output, allowing homeowners to meet their energy needs for over 20 years with a modest investment.
- Homeowners save between \$20,000 and \$97,000 over the lifespan of a residential solar system.
- The National Renewable Energy Laboratory (NREL) calculates that a home's value increases by about \$20 for every \$1 saved on energy bills, so a \$700 annual saving can boost property value by \$14,000.

Solar Jobs and Sustainable Development

- The solar industry is generating sustainable job growth in many countries, including the US, Europe, Australia, and East Asia.
- In the US, solar jobs grew by 3.5% in 2022, and the EU currently employs over 400,000 people in the industry, with projections to reach over 750,000 by 2030.
- Solar energy, powered by the sun, is immune to the price shocks that affect other energy sectors, ensuring job stability and political support.
- Solar-powered microgrids have transformed off-grid regions in Africa and Asia, providing affordable, reliable, non-polluting electricity, boosting education, opportunity, and entrepreneurship.

Solar Energy Challenges

- Solar power does not work at night, making energy storage essential for continuous growth. Interconnecting countries can help share solar resources.
- Grid connection constraints are a bottleneck for solar deployment in some countries, as outdated grids cannot handle the increased solar power.
- The number of trained installers is too low worldwide to keep pace with the growing

demand for solar energy, requiring thousands, if not millions, more trained installers.

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1.1.6 Understanding Solar Panel Size and Its Importance

When selecting solar panels for your installation, the size of the solar panel is an important factor to consider. Solar panels come in various sizes, and their dimensions can significantly impact the overall energy output of your solar system.

Larger solar panels generally produce more power, but the cell technology they contain is also crucial. Solar panel size can be measured in terms of power rating, with some panels having higher power density despite being smaller in size. The key is to determine which panels offer the most efficient use of space and cost-effectiveness for your rooftop. This might mean using more small panels or fewer large panels, depending on your building.

Solar Panel Dimensions

The options for your rooftop solar system can be seen in the dimensions of solar panels. Leading solar module providers such as AMPS offer various solar panel sizes, and not all will be suitable for every household. The goal is to maximize power output within the available rooftop space.

A typical residential solar system in the US is 6-8 kW, with a home rooftop array optimally having 15-20 solar panels. For example, AMPS offers residential solar panels with a power output of 370Wp to 430Wp. The highest power class of solar modules can often be smaller than lower power modules due to advanced cell technology. Your installation partner will explain these details during the consultation process.

Common Residential Solar Panel Sizes

Residential solar panels are typically determined by the number, size, and type of solar cells. The most common solar cell size is 152-by-152mm (6-by-6 inches). New technologies have led to larger cell sizes, resulting in higher power and potentially larger panel sizes.

Most solar panels contain either 60 or 72 solar cells (usually cut in half and labeled as 120-half cell and 144-half cell). Panels with 60 cells are smaller and have a power rating of up to 300 Wp, while panels with 72 cells can produce over 400 Wp.

Solar modules with PERC technology and 400 Wp output typically measure around 1.9 meters (74 inches) in height and 1 meter (39 inches) in width. Standard residential panels generally have fewer cells and are shorter in length, usually around 1.65 meters (65 inches).

Commercial and Utility-Scale Solar Panel Sizes

Commercial and utility-scale solar panels are larger than residential panels to meet the higher energy needs of businesses. These panels have higher wattage, often reaching 500-600 Wp, and contain more solar cells, up to 96 cells (or 192-half cells). These panels are heavier and require at least two installers for handling.

Factors Affecting Solar Panel Size Selection

Choosing the right solar panel size involves several considerations:

Solar Panel Structure

Consider the dimensions, cell technology, and cell composition of the solar panels. For example, bifacial panels can generate electricity on both sides.

Available Roof Space

Evaluate your rooftop space with a trained installer. Assess areas for shading, irregular shapes, and orientation (south-facing is ideal).

Energy Demands

Determine your energy consumption and whether you need to cover the entire roof or use fewer, larger panels. Review previous energy bills for accurate planning.

Efficiency and Technology

Not all panels with the same dimensions offer the same power output. Consider cell types, interconnection methods, and power optimization technology.

Geographic Location and Sunlight Availability

Factor in your location and sunlight availability. Optimal sizing balances performance and cost. Excess energy can be stored in a battery system or fed into the grid for credits.

How Many Solar Panels Do I Need for My Home?

To determine the number of solar panels needed for your home, arrange a free consultation with AMPS. Record your annual energy consumption in kilowatt hours (kWh) and divide it by the average electricity produced per solar panel. Consider the solar irradiation your rooftop receives per year.

Conclusion

There is a wide range of solar panel sizes on the market. Various factors determine the optimal size for your rooftop. An experienced solar installer can guide you through this process, and AMPS can recommend trusted partners to ensure your solar solution is efficient and cost-

effective.

Contact Us

If you're interested in installing AMPS solar panels or have questions about solar energy, our team is here to help. We are dedicated to developing high-quality solar panels, providing outstanding solar solutions, and delivering exceptional customer service. Browse our complete solar energy solutions, including solar panels, home energy storage, and energy management, or contact us to discuss designing and installing a customized home solar panel system. Feel free to reach out to AMPS for any solar-related inquiries.

1.1.7 How Does a Solar Panel Work: Step by Step

Despite a growing global interest in solar energy, many homeowners do not fully understand how solar panels work. Thanks to the sun's abundant energy, solar panels will continue to generate power for years, making home solar systems increasingly popular.

Let's explore what makes a solar panel work and the step-by-step process that turns sunlight into usable energy to power homes.

What Is Solar Energy?

Solar energy is the radiant light and heat generated by the sun and converted into usable power through technologies like solar panels. Unlike finite fossil fuels, solar energy is a clean, renewable, and environmentally friendly resource for powering our world.

Solar energy has many advantages, which is why many people are switching to it. It doesn't produce greenhouse gases during generation, helping to combat air pollution and climate change. Additionally, solar panels work nationwide, reducing reliance on foreign energy sources and enhancing local energy independence.

How Is Solar Energy Used?

Beyond home use, solar panels have several other applications:

Rental properties

Homeowners can install solar panels to increase property value and offset energy bills.

Commercial and industrial buildings

Solar panels can reduce operating costs and enhance sustainability in commercial spaces.

Utility-scale applications

Solar farms and power plants can generate vast amounts of energy.

Off-grid and remote properties

Solar energy is ideal for areas with limited access to traditional grid electricity, like isolated communities, cabins, or campsites.

Agricultural applications

Solar panels can power irrigation systems, barns, and other farm equipment.

Community solar

Shared energy projects allow city or town residents to invest in and benefit from a single solar

energy system, usually a solar panel farm.

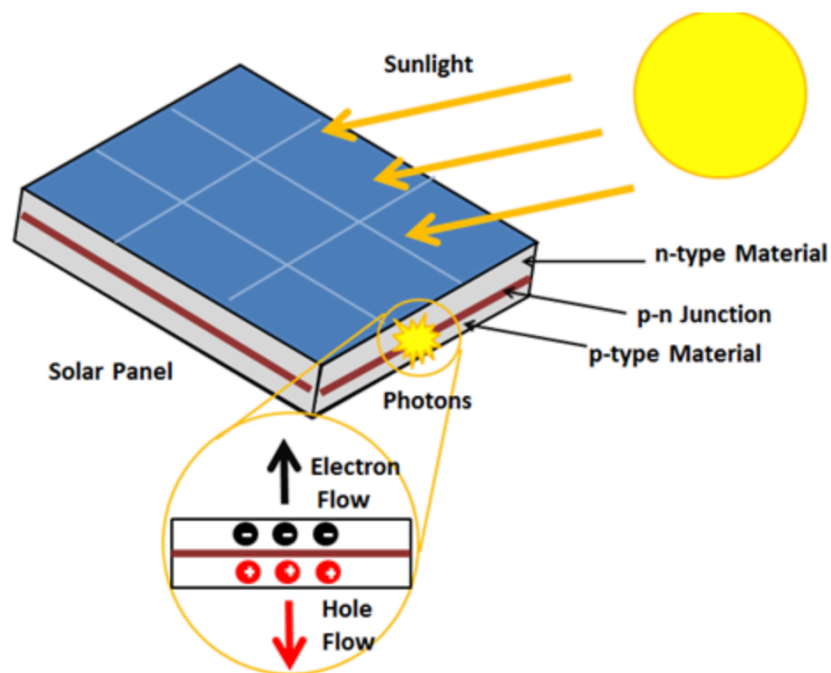
As solar technology advances, there will be even more ways to utilize solar energy.

How Does a Solar Panel Work?

Solar panels consist of photovoltaic cells that convert sunlight into usable energy through the photovoltaic effect.

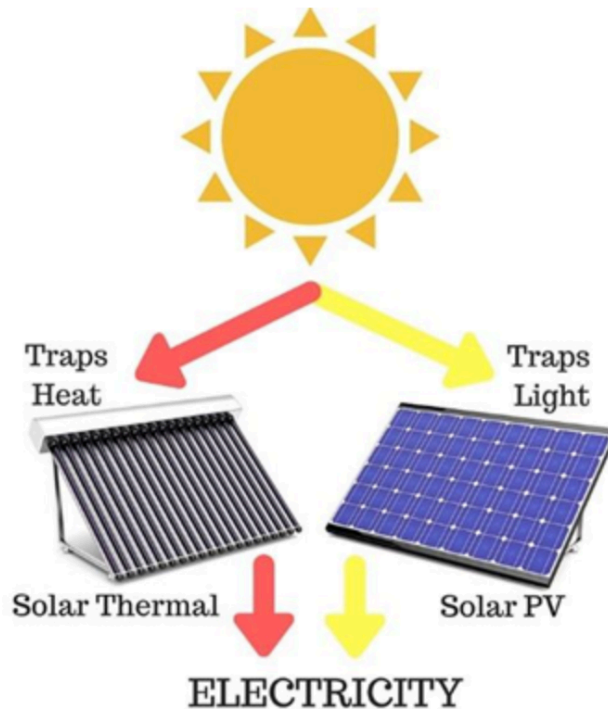
What Is the Photovoltaic Effect?

A photovoltaic cell uses positively and negatively charged layers to create an electric field. When sunlight hits the cell, it energizes and releases electrons. The negatively charged electrons are drawn to the positively charged side, creating an electrical current. This current is vital in converting solar energy into electricity to power a home' s lights, appliances, and more.



What' s the Difference Between Solar PV and Solar Thermal?

Solar PV systems convert sunlight into electrical energy, while solar thermal systems absorb the sun' s heat to generate hot water and space heating. Solar PV systems are more versatile, last longer, and are more effective year-round.



How Do Solar Panels Work on a House?

Understanding the process of how solar energy powers a home provides better insight into its efficiency and sustainability. Here's a step-by-step look:

1. The Solar Panel Detects Solar Energy

Solar panels are installed on the roof in an optimal position and angle for maximum sun exposure. This placement ensures photovoltaic cells can effectively detect and capture sunlight.

2. The Cells Produce an Electric Current

When sunlight reaches the cells, photons transfer energy to the semiconductor material, typically silicon. This releases negatively charged electrons, creating a direct current (DC), a single-direction electrical flow needed for the next step.

3. Generated Electricity Is Converted to Usable Energy

The direct current generated by the solar panels is converted into alternating current (AC) by an inverter. AC is the standard form of energy used in homes and businesses. Any excess energy generated can be stored in a solar energy storage system or sent back to the grid for credits on an energy bill through net metering.

4. Converted Electrical Energy Is Supplied

The inverter connects to the circuit breaker, which distributes the alternating currents throughout the home, powering appliances, lighting, and other electrical devices.

5. Monitor Energy Usage

A monitoring system like the AMPS home energy management system provides real-time data on energy production and usage, helping users make informed decisions about their energy consumption.

Contact Us

If you are interested in installing AMPS solar panels or have questions about solar energy, our team is here to help. We are dedicated to developing high-quality solar panels, providing outstanding solar solutions, and delivering exceptional customer service. Browse our complete solar energy solutions, including solar panels, home energy storage, and energy management, or contact us to discuss designing and installing a customized home solar panel system. Feel free to reach out to AMPS for any solar-related inquiries.

2. Trending Now

2.1 Testimonial

1. Emma Johnson

5 stars

Title: Exceptional Performance and Service

I'm extremely satisfied with AMPS solar panels. The sleek design and excellent performance exceeded my expectations. Installation was smooth, and the team was professional and responsive. Highly recommend for anyone looking to switch to solar energy!

2. Michael Turner

5 stars

Title: Efficient and Cost-Effective

AMPS offers great solar panels at a competitive price. The efficiency is impressive, and the panels have significantly reduced my electricity bills. The customer service was outstanding, guiding me through every step. A fantastic investment for my home!

3. Sophia Williams

5 stars

Title: Reliable and Durable Panels

I chose AMPS for their reputation, and they did not disappoint. The panels are durable and perform well even on cloudy days. The installation team was prompt and professional. I've recommended AMPS to my neighbors and friends, and they are equally pleased.

4. L****

4 stars

Title: Great Value for Money

The AMPS solar panels are a great value for the price. They look good on my roof and work efficiently, providing a solid return on investment. The installation process was straightforward, and the support team was always available to answer my questions. Highly recommended!

2.3 Top Solar News

2.3.1 Trade Commission Says Southeast Asia Solar Imports Harm U.S. Manufacturers

June 7, 2024

The U.S. International Trade Commission (USITC) has determined that imports of silicon solar cells and panels from Cambodia, Malaysia, Thailand, and Vietnam are causing material harm to the U.S. solar panel manufacturing industry. This finding moves the decision-making process to the Department of Commerce, which will now consider whether to implement antidumping and countervailing duties (AD/CVD) before the end of the year.

In April, the American Alliance for Solar Manufacturing Trade Committee (AASMTC) filed a petition for this AD/CVD investigation, marking the second such inquiry into solar products from Southeast Asia. The initial AD/CVD measures, extended in August 2023, targeted Southeast Asian manufacturers but allowed exemptions for those using non-Chinese wafers or at least four solar components (such as silver paste, aluminum frames, glass, backsheets, EVA sheets, junction boxes) made outside China. Consequently, affected companies have been adjusting their supply chains, leading to record-high imports from these four countries into the United States.

The Committee, comprising domestic manufacturers like First Solar, Mission Solar, and AMPS, filed the second petition due to the inadequate protection offered by the initial measures against the influx of imports.

Tim Brightbill, the lead attorney representing AASMTC, welcomed the USITC's preliminary determination, stating, "The investigations provided substantial evidence of these four countries engaging in illegal dumping and subsidizing of solar cells and modules, harming American companies and workers, and causing volatility and cost uncertainty in the U.S. solar market. Unfair trade practices by these predominantly Chinese-owned companies have resulted in billions of dollars' worth of underpriced solar products flooding the U.S. market, driving prices down by more than 50% over the past year. This makes it nearly impossible for U.S. manufacturers to compete, jeopardizing critical investments in solar manufacturing across the country. We now look forward to the Department of Commerce advancing its investigations into dumping and subsidies by these four countries."

The Department of Commerce is expected to announce its preliminary countervailing duty determinations around July 18, 2024, and its preliminary antidumping duty determinations around October 1, 2024.

US imports of crystalline silicon solar cells and panels (2022-2024)

Quantities in megawatts

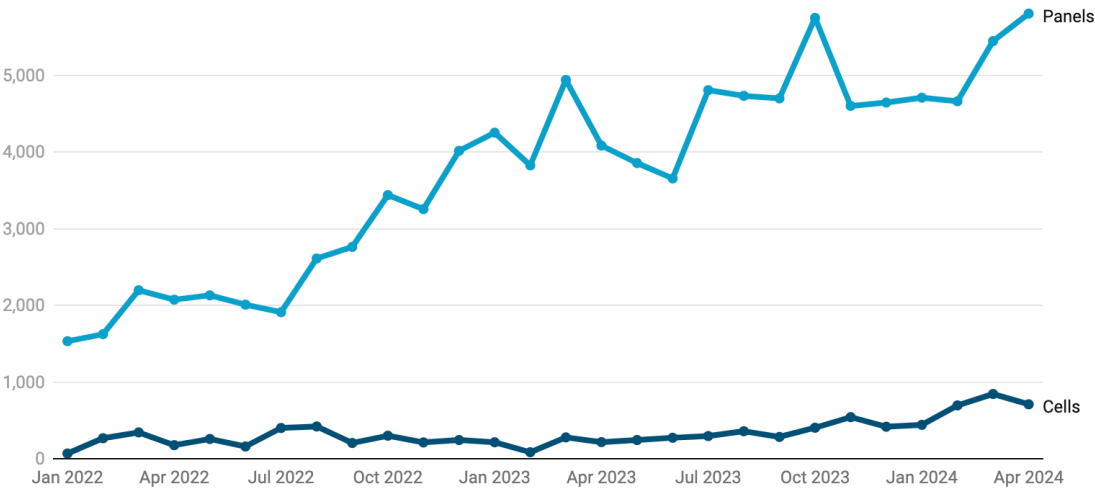


Chart: Solar Power World • Source: [USITC](#) • [Get the data](#) • Created with [Datawrapper](#)

2.3.2 US Residential Solar Takes a Hit in Q1 2024

June 6, 2024

In the first quarter of 2024, the U.S. solar industry installed 11.8 GW of new solar capacity, raising the nation's total to 200 GW. This data comes from the latest "U.S. Solar Market Insight" report by SEIA and Wood Mackenzie.

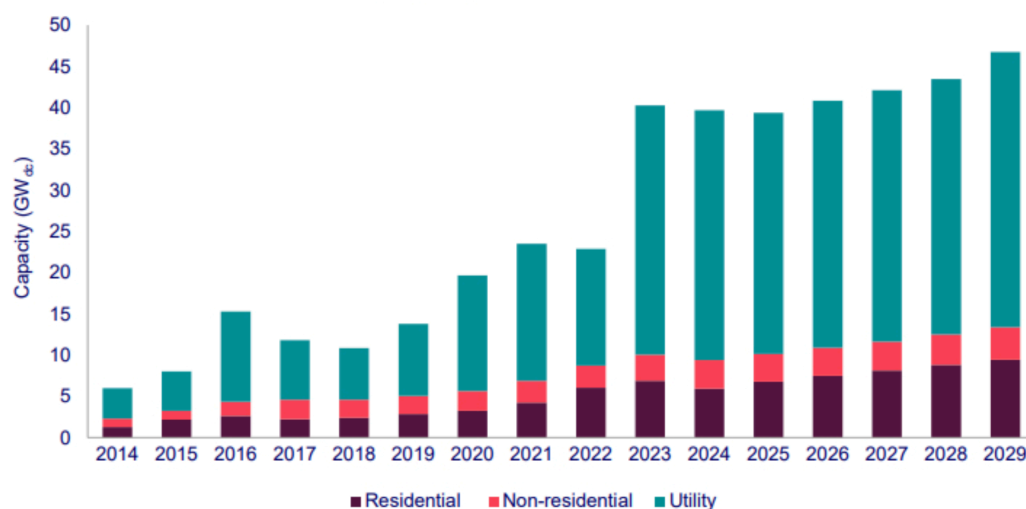
The report also finalized the 2023 figures, showing that the country added over 40 GW of new solar capacity last year. Wood Mackenzie predicts that the U.S. solar industry will install another 40 GW in 2024.

Significant growth in the utility-scale market is driving these record solar deployment figures, with nearly 10 GW of new capacity added in Q1 alone. Florida and Texas led all states in new solar capacity for Q1, with strong utility-scale growth. Other notable markets included New Mexico and Ohio, which installed 686 MW and 546 MW, respectively.

"The U.S. solar industry continues to show strength in terms of deployments," said Michelle Davis, head of global solar at Wood Mackenzie and lead author of the report. "At the same time, the solar industry faces several challenges to its continued growth, including labor availability, high voltage equipment constraints, and ongoing trade policy uncertainty."

The residential solar segment, however, faced significant setbacks. Policy changes in California contributed to the worst quarter for residential solar in two years, with installations dropping to just 1.3 GW — a 25% decline year-over-year and an 18% decrease from the previous quarter. The commercial (434 MW) and community solar (279 MW) markets remained steady year-over-year.

US solar PV installations and forecasts by segment, 2014-2029



Source: Wood Mackenzie

2.3.3 Solar PV Now Powers the Birthplace of Thomas

Edison

June 4, 2024

The birthplace and museum of Thomas Edison in Milan, Ohio, now proudly harness solar energy, honoring Edison's groundbreaking contributions to the development and innovation of electricity.

This remarkable project was made possible through the donations of several key players in the solar industry. SolarEdge provided the SolarEdge Home inverter and Power Optimizer solution, Meyer Burger supplied the rooftop solar panels, and Unirac donated the solar racking system. Additionally, National Renewable Energy Partners generously contributed their expertise and labor, ensuring a seamless installation of the latest solar technology.

The benefits of this project go beyond reducing the museum's monthly electric bills. Visitors to Edison's birthplace and museum can now explore his pioneering work in electricity within the context of modern solar energy. The solar installation has become a permanent feature of the museum, offering visitors a unique opportunity to learn about Edison's historic quest for efficient energy sources and his lasting impact on the field.

The inspiration behind this project came from Ron Cull, a board member of the Thomas Edison Birthplace Museum. He aimed to integrate solar power into this landmark to underscore Edison's visionary work in the evolution of electricity.

"By incorporating solar energy into the framework of the museum, we are not only embracing sustainability but also enriching the story of electricity, from its inception to its modern-day applications," said Cull.

2.3.4 IRS Creates Safe Harbors for Domestic Content Calculations

May 29, 2024

On May 17, the IRS issued new guidance simplifying the calculation process for three common technologies eligible for the domestic content bonus under Section 45 production tax credit (PTC) and Section 48 investment tax credit (ITC).

Notice 2024-41 introduces an elective safe harbor that allows taxpayers to more easily calculate the 10% bonus for projects using specified thresholds of U.S.-sourced content.

The notice provides elective safe harbors for solar photovoltaic (PV) systems, onshore wind facilities, and battery energy storage systems (BESS). In a separate press release, the Treasury indicated plans to supplement this guidance with safe harbor tables for additional sectors, including offshore wind facilities.

Background

To qualify for the 10% bonus, projects must meet specific thresholds for domestic-source materials. Structural iron and steel must be 100% U.S.-produced, while manufactured components currently need to be at least 40% U.S.-produced, increasing to 55% over the next few years.

Initial guidance in Notice 2023-38 required taxpayers to segregate project components into "domestic iron and steel" and "manufactured components" categories to analyze U.S.-produced thresholds. This approach posed commercial challenges, as vendors and suppliers were often reluctant to disclose "direct cost" data.

Safe Harbor Tables

Recognizing the challenges of the direct cost approach, the IRS created a safe harbor method with specific tables to simplify domestic content calculations. These safe harbors allow taxpayers to categorize components and assign a fixed percentage of the overall project cost to enumerated manufactured product components. The new guidance includes charts for solar PV systems, onshore wind facilities, and BESS. Taxpayers can use these charts to substantiate the domestic content percentage.

Example

The following example illustrates the mechanics of the safe harbor:

A taxpayer constructs a ground-mount solar tracker project and elects to use the new safe harbor to determine eligibility for the domestic content bonus. Referring to the solar PV table, the project includes six Applicable Product Categories: PV module, inverter, PV tracker or non-steel roof racking, steel photovoltaic module racking, pile or ground screw, and steel or iron rebar in the foundation. The guidance requires that the pile or ground screw and steel or iron rebar be 100% U.S.-sourced for the project to qualify. If this requirement is met, further analysis of manufactured components is needed.

The solar property has eleven Manufactured Product Component categories, and any combination above 40% will meet the current domestic content requirements. For ground-mount solar tracker projects, if the cells (36.9%), frame/backrail (5.3%), and torque tube (9.7%) are U.S.-manufactured, the total domestic content would be 51.9%, satisfying the elective safe harbor and qualifying for the 10% domestic content bonus.

Election Required

As with the domestic content election required by Notice 2023-38, taxpayers must submit a certification that a project qualifies for the bonus and affirmatively elect the safe harbor. This certification must be attached to either Form 3468 for ITCs or Form 8835 for PTCs.

Comments Requested

The Treasury has requested comments on additional technologies that should be added to the safe harbor and whether further clarity is needed when Manufactured Product Components contain a mix of foreign and domestic content.