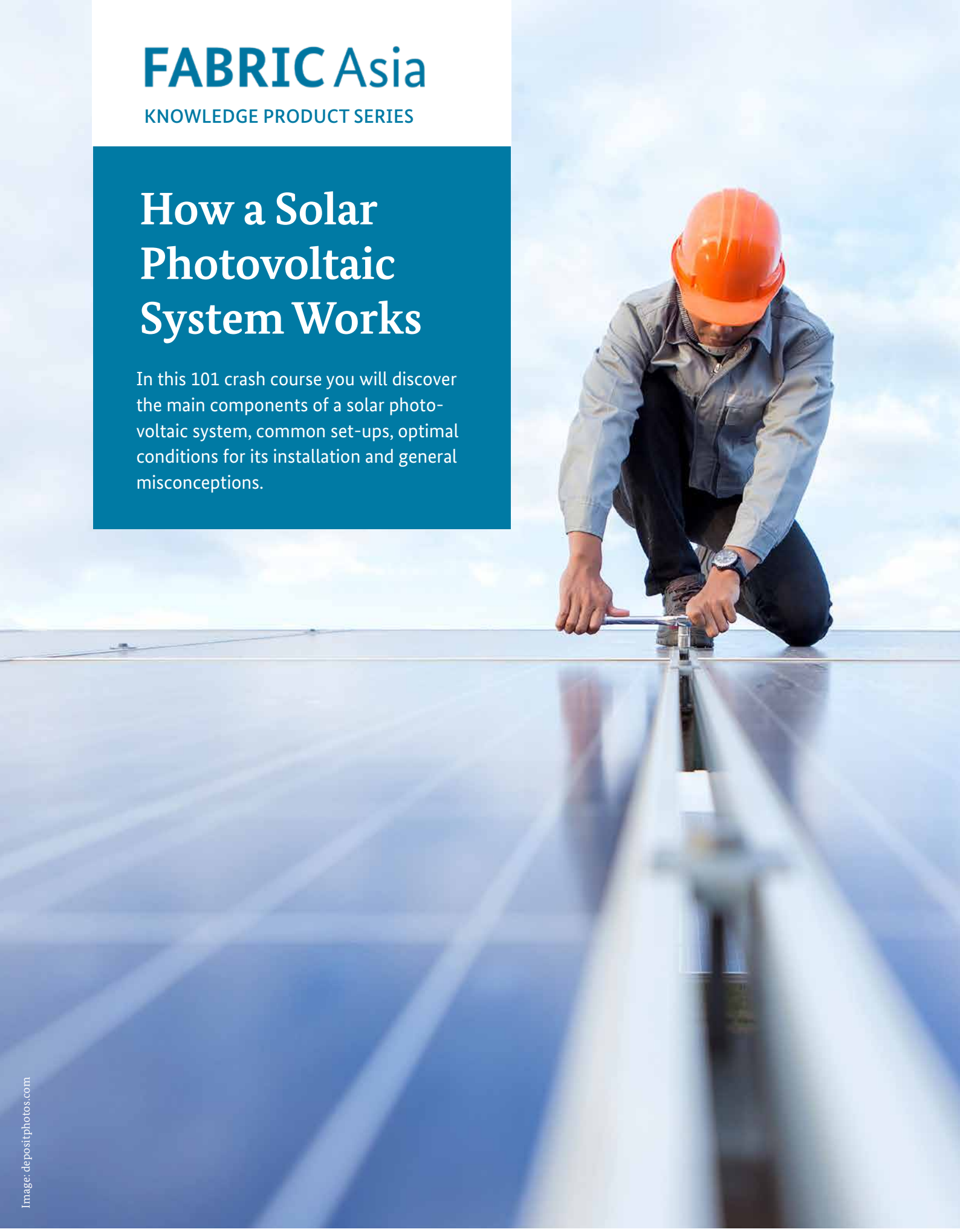
FABRIC Asia

KNOWLEDGE PRODUCT SERIES

How a Solar Photovoltaic System Works

In this 101 crash course you will discover the main components of a solar photo-voltaic system, common set-ups, optimal conditions for its installation and general misconceptions.



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Implemented by
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How a Solar Photovoltaic System Works

Who this is for

Factory owners in the textile and garment industry

In brief

Using solar energy for powering your manufacturing operations is an effective and profitable option.

Why is solar photovoltaic (PV) an effective and profitable solution for garment factories in Asia?

- Sunshine is abundant in the region.
- Electricity tariffs are rising - solar energy costs remain stable with low operational costs allowing you to reduce costs and avoid price fluctuations.
- Droughts and power cuts threaten your operations' energy supply - become more independent of national grids and imported energy!
- Factory roof space is ideal for installing panels – they act as insulation against the sun and keep your factory cool.
- Renewable energy sources are increasingly demanded by brands and retailers – become more attractive to clients and invest.

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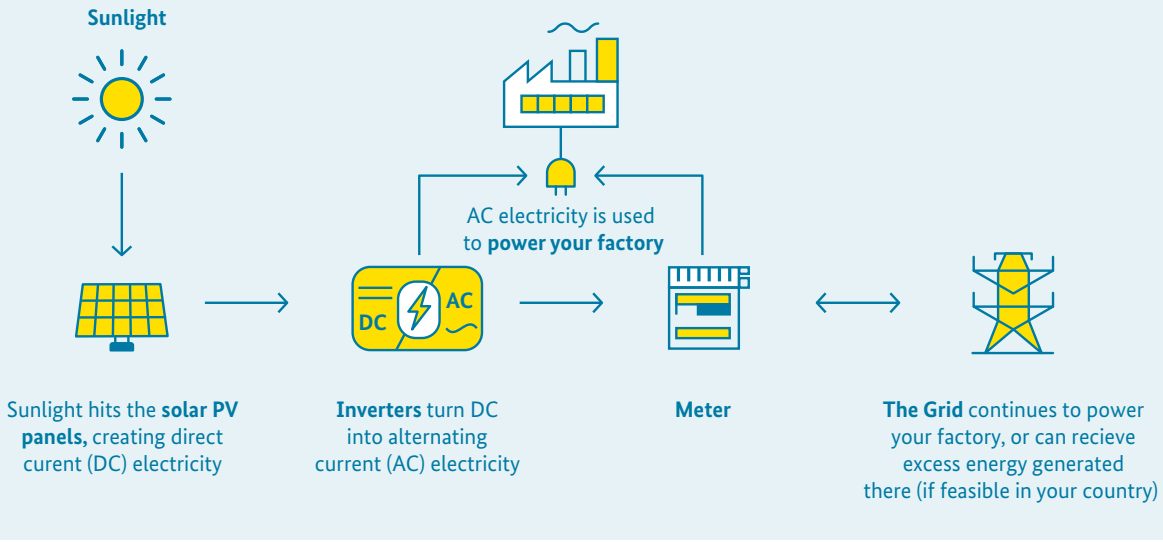
How does a solar PV system work?

Solar PV systems receive sunlight and turn it into electricity that can power your factory.



Graphic: How a solar PV system powers your factory.

Practical insight: quality matters

The **quality of the solar PV components** matters because it will not only impact the efficiency of your system, but also how long and safely the system will continue to operate. By selecting experienced solar partners, installing high-quality components and conducting proper maintenance, your solar PV system can operate for 25 years on average. For instance, high-quality inverters can operate for between 10 and 15 years. It is recommended to select high-quality components that:

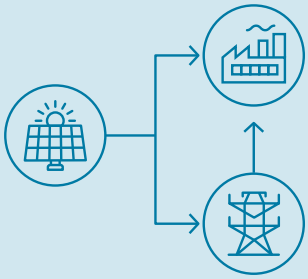
- have **certifications** that provide an assurance of the solar PV panel's safety and performance, e.g. UL, TÜV and IEC certifications.
- are **produced by Tier 1 suppliers** and aim to have warranties that last for 25 years or more. A list of Tier 1 solar panels can be found here: https://review.solar/tier-1-solar-panels-list/

The **quality of system design and installation** is just as important. It is recommended that **only experienced and certified solar PV providers design and install your PV system** to ensure its correct and safe installation.

- The performance of the solar system relies not only on individual components but on how the whole system is designed and how well the components are connected to each other. Selecting good components does not guarantee high performance.
- Experienced solar partners are familiar with potential issues during construction and operation. They can provide prevention and mitigation measures. They are also familiar with regulations, technical standards and administrative procedures.
- Engaging solar partners with reputable track records that are trusted by potential investors or financing institutions can facilitate your access to project funding, for example through bank loans.

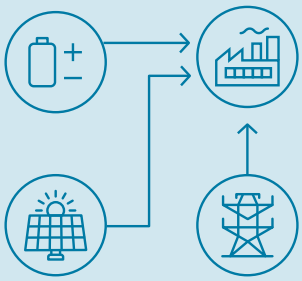
How are solar PV systems set up?

Solar PV systems have to be set up according to local conditions, regulation and your factory's specific context. Three common set ups include:



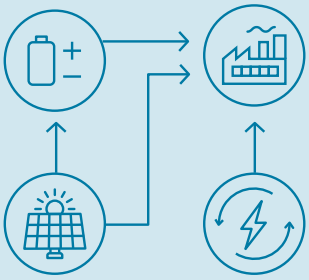
Grid-connected PV system

- Applicability: The most common set-up for factories in the region, especially in countries with a stable power grid (such as Viet Nam).
- How it works: The factory uses on-site solar power when the solar PV system generates enough power to fulfil its demand and draws power from the grid when power demand is not met.
- Advantage: The factory will be able to source electricity from the grid to power operations when the solar PV system is not generating power (for example at night or during cloudy days).



Grid-connected PV system with energy storage

- **Applicability:** This set-up is most attractive in markets where selling back to the power grid is permitted, or in an area with unstable grid supply and high dependency on expensive electricity sources like diesel generators – however, energy storage typically requires high upfront investment.
- **How it works:** An energy storage system can be integrated into a grid-connected system if allowed by the local regulation and economically viable.
- **Advantage:** The energy storage system stores excess energy generated by the PV system for later use, e.g. when electricity prices from the grid are higher.



Off-grid PV system with energy storage or other energy source

- **Applicability:** This configuration is recommended for factories that are based on isolated locations where the utility grid is not reachable and/or not reliable.
- **How it works:** An off-grid PV system needs to be complemented with a properly sized energy storage system for when the PV system is not producing energy, otherwise there will be times where energy is not available.
- **Advantage:** On-site solar PV systems can be combined with other on-site energy sources such as diesel generators, gas turbines, etc. to fulfil the factory's power demand when the grid is not reliable. This can be seen in Bangladesh, Myanmar and Cambodia.

How much electricity can your solar PV system generate?

The roof of a garment factory is often the ideal place to install a solar panel as it is a flat surface with limited shading. The amount of energy generated by a solar PV system depends on the solar radiation hitting the PV panels as well as the quality and efficiency of the solar PV system.

Influencing factors can include: geographic location, time of day, season, local weather and partially controllable elements like the local landscape.

Practical context: the importance of factory load profile assessment

To ensure the best return on investment for the on-site solar PV system, it is crucial to analyse the consumption load profile of your factory and your electricity billing structure. This information is needed to design the most suitable solar PV system configuration for the factory's needs (in terms of the size, location, connections, etc.). You should work with energy managers to analyse utility bills – ideally looking at your usage over the past two years – to understand the daily, seasonal and annual electricity consumption patterns. All information should be made readily available for advisors and/or solar PV providers to design a tailor-made PV system for you.

The system size will be determined by a combination of technical and environmental parameters, including but not limited to:

- site's load profile throughout the day/sun hours
- operational schedule
- local solar irradiation
- potential obstruction/shading in the intended space
- system quality and performance, potential losses
- limitation by national or local regulation (if any)
- factory's planning (e.g. available budget, expansion/closure plans that affect consumption, preferred size, etc.)
- investment expectations (e.g. which investment parameters to prioritize: higher returns, NPV, shortest payback time, etc.)

All of these parameters need to be identified and evaluated properly, which will be done by the solar PV solutions provider. Following this assessment, the most suitable system size can be derived based on your factory's requirements and conditions.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Key misconceptions around solar energy, explained

1. **A solar system always produces electricity during the day.**

   A PV system produces electricity from solar radiation hitting the panels. Therefore, many factors such as weather conditions, clouds, shade or dirt on the panels can reduce the electricity production.

2. **The hotter the weather, the more electricity is being produced by the solar system.**

   PV systems rely on solar radiation to produce electricity. While warmer regions tend to have a higher solar radiation and hence more solar potential, the average temperature is not always a good indicator for this purpose. For example, warmer coastal areas may have less solar radiation and potential than colder nearby mountainous regions due to their lower altitude. Moreover, solar panels are more efficient at lower operating temperatures.

3. **The power quality of solar PV systems is not good enough for production.**

   The quality of solar energy is the same as grid electricity. In fact, a solar PV system can help to raise voltage levels, contribute to power stability and reduce brownouts.

4. **With a solar PV system, the factory will not have enough power to run operations.**

   An on-site solar PV system, in most cases will not be able to replace 100% of your power consumption. However, if your factory is already powered by the local power grid, the factory will not lack power supply as you will continue to draw electricity from the grid when the solar PV system is not generating electricity.


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5. **Batteries need to be installed for the system to function, which are expensive and have to be changed frequently.**

   Energy storage systems or batteries are not a requirement for grid-connected solar PV systems. They can be included when they add economic value to the system, as determined by an experienced provider/consultant assessing your specific conditions.

6. **Solar energy is exceedingly expensive, or it takes too long to pay back the initial investment.**

   The price of solar PV systems has fallen dramatically in recent years, meaning it is more economical than ever. Becoming more independent from grid electricity and frequent price fluctuations gives your business greater flexibility and offers the potential for cost reductions in the long-term.

   Although it depends on many factors (the national market, the local financing scheme, the specific business model and the system set-up), the typical payback period for a rooftop solar PV system is around 5 to 10 years compared to an average lifespan of 25 years for a high-quality solar PV system, depending on the components used and the experience of your provider.

7. **You have to own the space where the solar PV system will be installed.**

   While being the site owner certainly helps, it is not a requirement. The bottom line is that you should have long-term access to the site for at least the lifespan of the project (if the capital for the system is paid for by you) or the duration of the solar PV contract, which is usually 15 to 25 years (if the system is financed by a third party and you enter into an on-site PPA). Doing so will allow you to accumulate sufficient cost savings from the on-site system to pay back the initial capital investment.

To explore more topics related to solar PV, please review the full set of briefing notes. Topics include:

- ☐ Introduction to commercial and industrial (C&I) renewable energy (RE) sourcing
- ☐ Assessing suitability for rooftop solar projects (technical perspective)
- ☐ Assessing the business case for on-site solar (financial perspective)
- ☐ National solar regulations and policy framework
- ☐ Different investment models for rooftop solar projects
- ☐ Local financing programmes for rooftop solar projects

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ABOUT FABRIC

The project FABRIC (Fostering and Advancing Sustainable Business and Responsible Industrial Practices in the Clothing Industry in Asia) is implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, which works on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). To successfully shape the desired economic growth in Asia's textile and garment production in a sustainable way, many parties need to be involved. GIZ's FABRIC project brings together people from the Asian industry, public sectors, NGOs and from international buyers, promoting knowledge transfer and cooperation. FABRIC is working in Bangladesh, Cambodia, Myanmar, Pakistan, Viet Nam and together with China to strengthen an industry that offers quality jobs, protects the environment and contributes to economic growth.

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