



PVQuick

PV System Design Tool

Professional · Quick · Easy to use



**Preliminary design and feasibility study
of photovoltaic projects**



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pvquick.com — register online and get started

PVQuick is professional web-based design software for photovoltaic power systems, used for the **preliminary design and feasibility study** of PV projects. Its core strengths are professional rigor combined with ease of use, and **AI optimization** was used extensively throughout its development.

8

steps from the site to the feasibility report

147

built-in weather stations, plus any site by latitude and longitude

1,290

pre-optimized inverter units, monofacial and bifacial

3

project categories, with 10 array operating modes

14

efficiency items make up the performance ratio

3

PV markets: China, Europe and the USA

1. What PVQuick can do and how to use it

PVQuick takes a photovoltaic project from the site to a complete preliminary design and feasibility study in **8 steps**:

1

Site information

Country/region, location, solar resource, air temperature and wind speed

5

PR and energy yield

PR efficiency chain and energy yield

2

Project

Project category, size, grid connection level, equipment selection and optimized inverter units

6

Economics

Capital investment, LCOE and financial analysis (IRR and payback period)

3

PV array design

Array design, row spacing, PV farm layout and land use

7

GHG reduction

Emission reduction analysis (CO₂, SO₂, NO_x)

4

POA irradiation

Plane-of-array irradiation for monofacial and bifacial PV modules

8

Report

Professional report on the design and feasibility study

Website: pvquick.com — register online and get started.

2. Solar resource, 3 project categories, 10 array operating modes and grid connection

Solar resource

- **147 built-in weather stations** with long-term average monthly irradiation (China 54, USA 42, Europe 51).
- Air temperature and wind speed (from Solargis and NASA POWER).
- **Any other site** by latitude and longitude, using NASA POWER satellite-derived data.
- Or enter **your own measured** monthly data, which is then added to the weather station library.
- Northern Hemisphere: latitudes **from the equator to the North Pole**.

3 project categories



Flat-laid distributed PV

Modules laid flat on the roof plane, so no row spacing needs to be calculated. Pitched roofs, greenhouse roofs, façades (90°), carports and walkway canopies, PV balconies.



Array-installed distributed PV

Tilted arrays, with the row spacing between them calculated. Flat roofs, floating PV, and elevated structures more than 2.5 m above the ground.



Ground-mounted PV plants

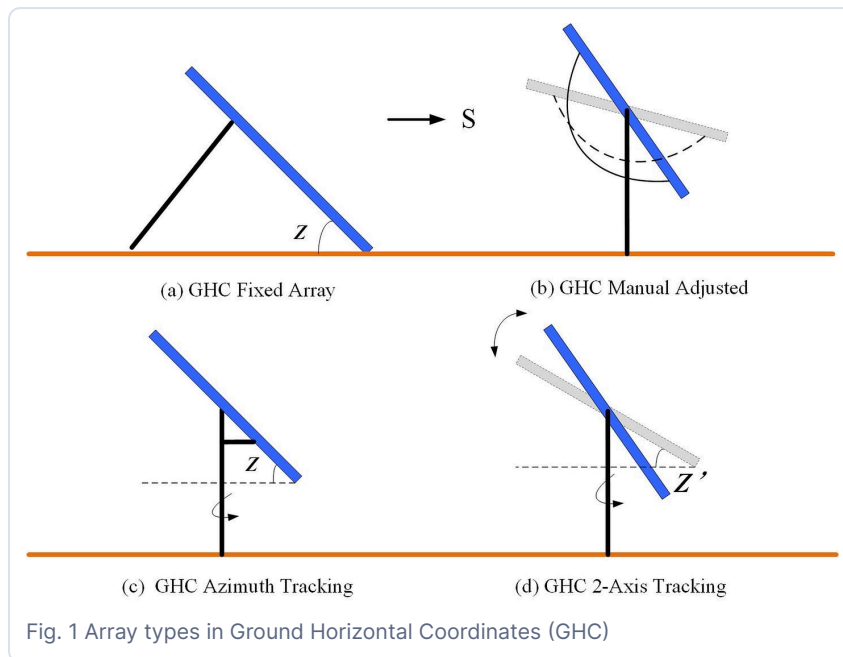
Flat terrain with all ten operating modes, or sloped land with arrays following the slope or in terraced rows.

Photo (array-installed): Σ64, "Solar Sharing Power Plant in Inashiki, Ibaraki 01", CC BY 4.0 (creativecommons.org/licenses/by/4.0), via Wikimedia Commons.

Grid connection and capacity

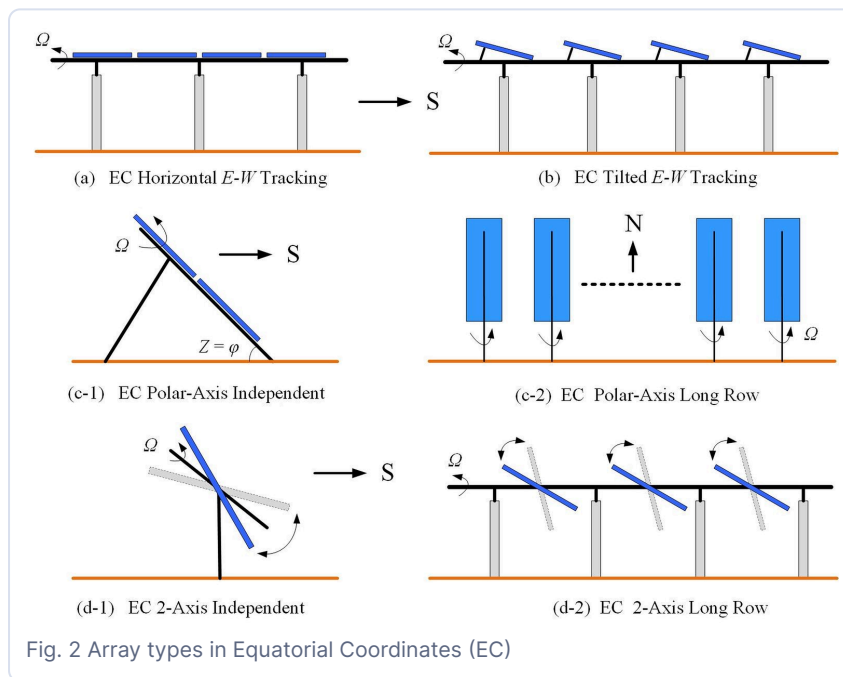
China	USA	Europe
1P-220V 3.6 – 10 kW	1P-240V 3.0 – 11.4 kW	1P-230V 4 – 10 kW
3P-380V 5 – 400 kW	3P-208V 4.33 – 50 kW	3P-400V 4 – 400 kW
10 kV 400 kW – 6 MW	3P-480V 20 – 500 kW	MV 400 kW – 20 MW
35 kV 5 – 30 MW	MV 500 kW – 20 MW	
110 kV 30 – 300 MW		

10 array operating modes



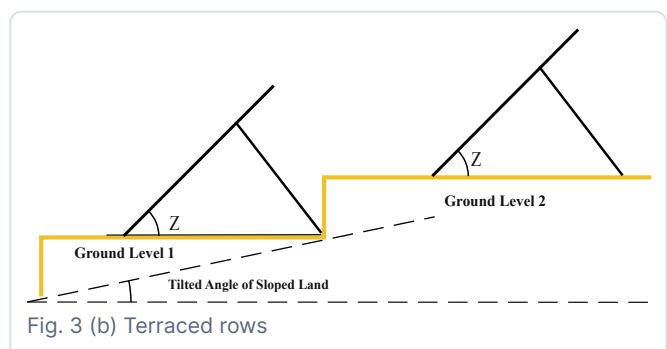
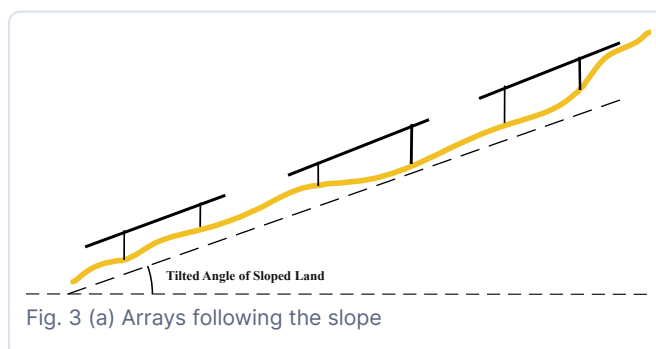
Ground Horizontal Coordinates (GHC)

- Fixed
- Manual adjustment
- Azimuth tracking
- 2-axis tracking



Equatorial Coordinates (EC)

- Horizontal E-W tracking
- Tilted E-W tracking
- Polar-axis tracking (independent or long row)
- 2-axis tracking (independent or long row)



3. Engineering design and accurate energy yield

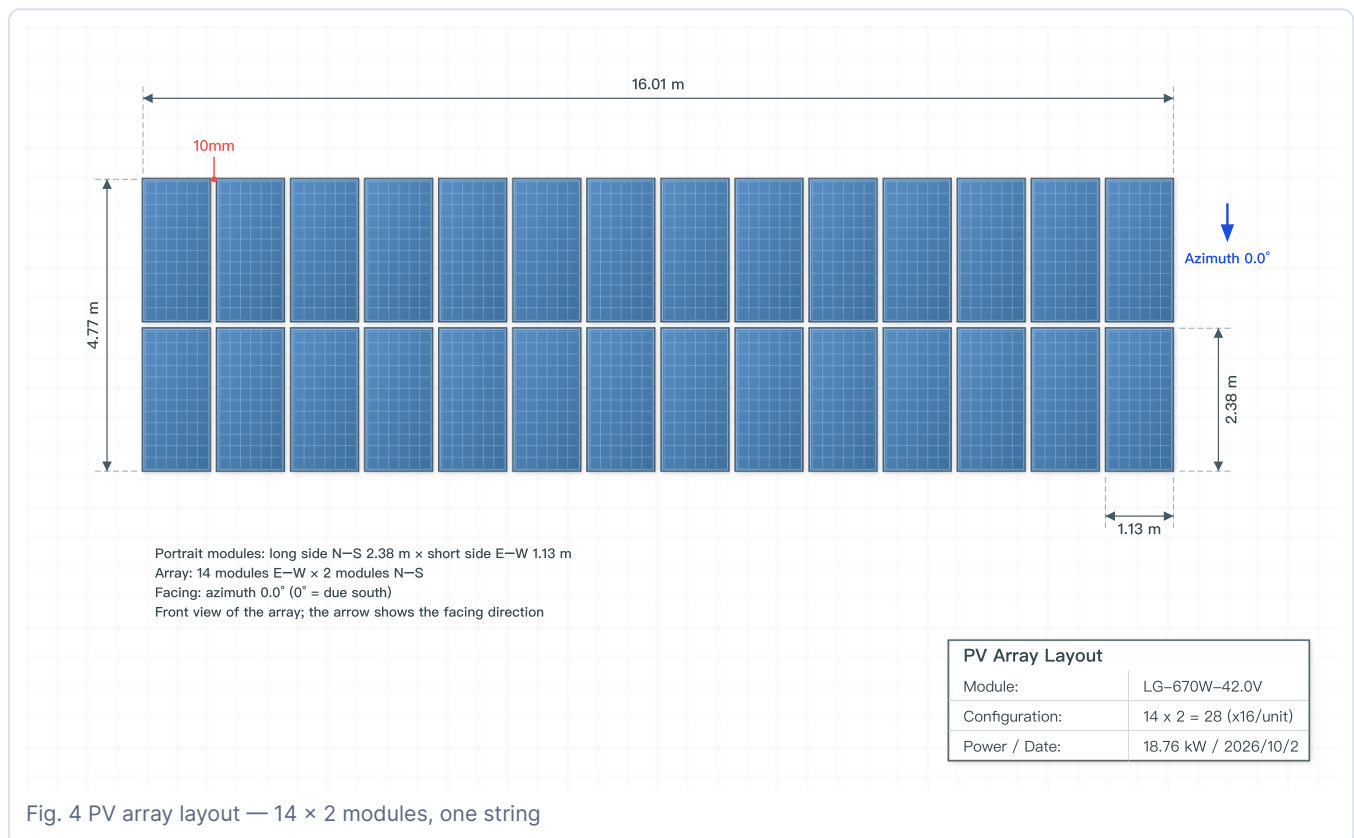
Inverter units · array design & field layout · shading losses · performance ratio

Optimized inverter units

Choose the inverter power, and PVQuick takes the matching unit from a library of **1,290 pre-optimized inverter units** (China, Europe and the USA; monofacial and bifacial PV modules), each defining the modules per string, the strings per inverter and a DC/AC ratio set by the solar resource zone of the site. The low-temperature open-circuit voltage of every string is checked against the inverter's maximum input voltage. No more trial and error across hundreds of inverters and modules.

Array design and land use

Array design, row spacing and the land area of the PV farm are calculated automatically. Row spacing follows the winter-solstice criterion: **no inter-row shading for 65% of the day length**. Layouts can be exported to PDF, DXF and KML.



Example for Figs. 4–6: 1 MW fixed array near Beijing, 10 kV grid connection.

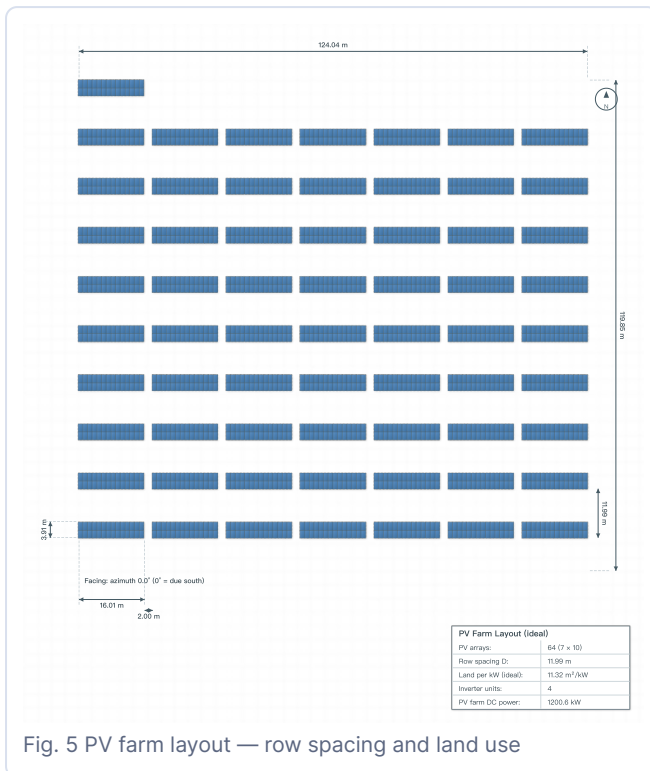


Fig. 5 PV farm layout — row spacing and land use

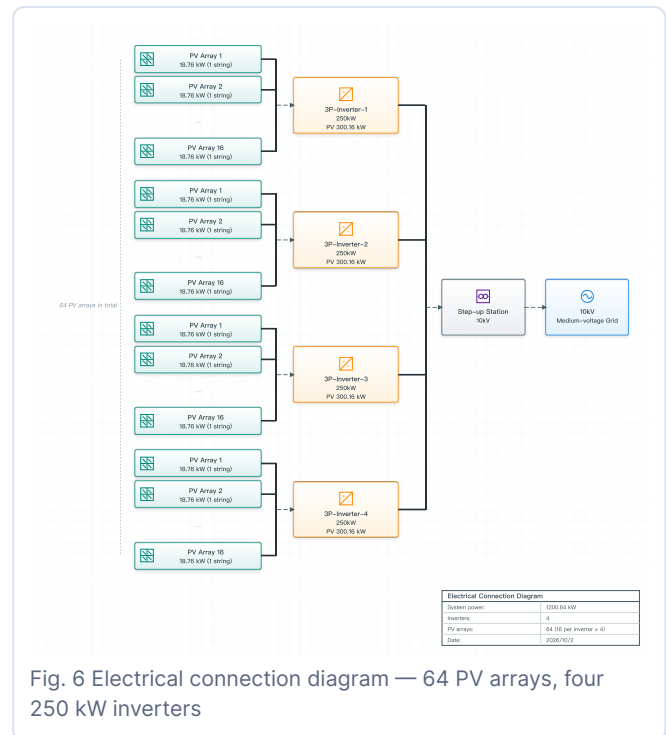
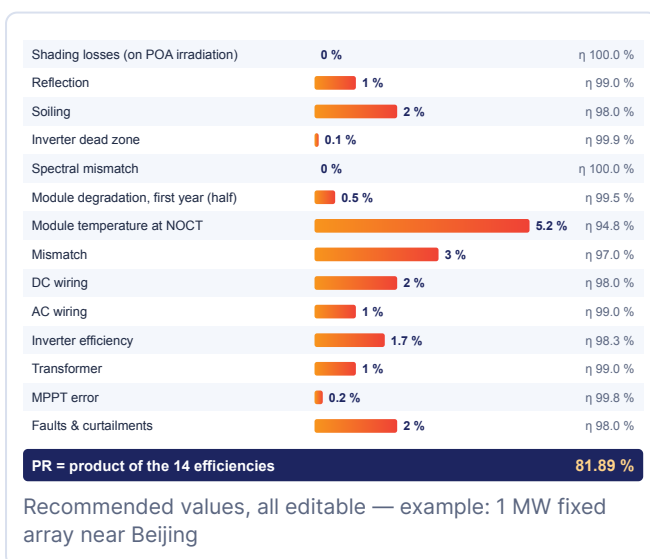


Fig. 6 Electrical connection diagram — 64 PV arrays, four 250 kW inverters

POA irradiation, shading losses and backtracking

- **POA irradiation from an anisotropic sky model:** beam, circumsolar, sky-diffuse and ground-reflected irradiance, calculated in 20-minute steps over the whole year, with daily, monthly and annual results. For bifacial modules, the front-side and rear-side irradiation are calculated separately.
- **DC/AC ratio** (PV-to-inverter capacity ratio) by solar resource zone: zone I 1.10, zone II 1.20, zone III 1.30.
- **Inter-row shading losses calculated geometrically at every time step** for the beam, diffuse and ground-reflected components, with no fixed shading factor.
- Backtracking for trackers.

Performance ratio (PR) and energy yield



14 efficiency items make up the PR: shading losses, reflection, soiling, inverter dead zone, spectral mismatch, module degradation, module temperature loss (NOCT), module mismatch, DC wiring losses, AC wiring losses, inverter efficiency, transformer efficiency, MPPT error, and faults and curtailment.

FIRST-YEAR AC ENERGY OUTPUT

$$E_{\text{out}} = \frac{Q_T}{G_{\text{STC}}} \times \text{PR} \times P_0$$

Q_T : annual plane-of-array irradiation · $G_{\text{STC}} = 1 \text{ kW/m}^2$ · P_0 : rated PV power

4. Investment, LCOE, financial analysis, emission reductions and the report

Investment, LCOE and revenue

- Capital and O&M costs by project size and grid connection level, for China, Europe and the USA.
- Levelized cost of electricity (LCOE) by the annuity and discounted-cash-flow methods.
- Revenue models: full feed-in; **full self-consumption and self-consumption with surplus electricity fed to the grid** (peak, flat and off-peak tariffs for commercial and industrial users); **net metering, net billing and buy-all/sell-all** for the USA and Europe.
- Currencies: CNY, USD and EUR.

Financial analysis

From the loan, interest, depreciation and taxes, PVQuick calculates the **equity IRR**, NPV, **payback period** and cash flow over the operating period; it can also solve for the tariff needed to reach a target IRR.

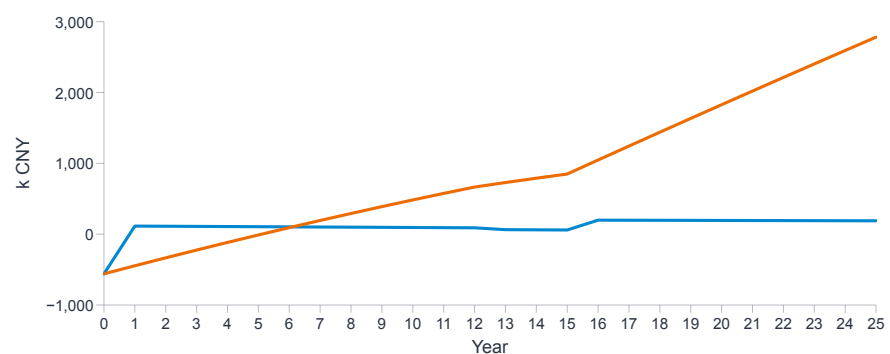


Fig. 7 Project cash flow — ■ annual net cash flow ■ cumulative net cash flow; example: 1 MW fixed array near Beijing (unit: k CNY)

Beyond grid-tied PV: PV + battery storage

Residential and commercial & industrial systems: PV, battery and inverter are sized from the daily load, and the storage costs and revenue are calculated.

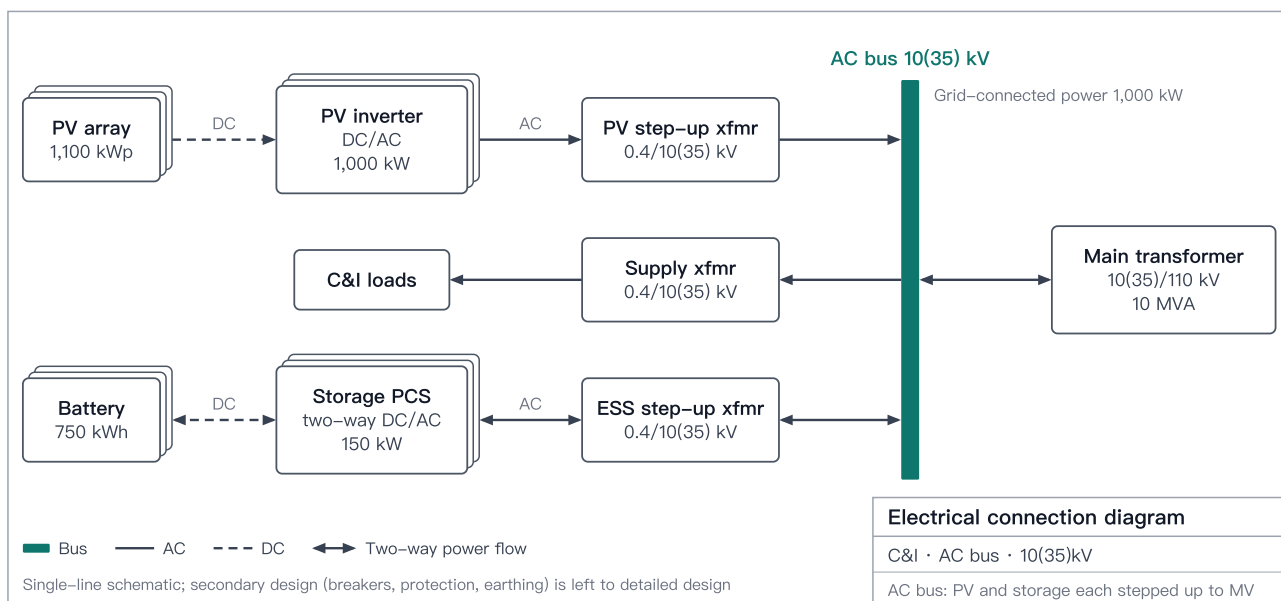


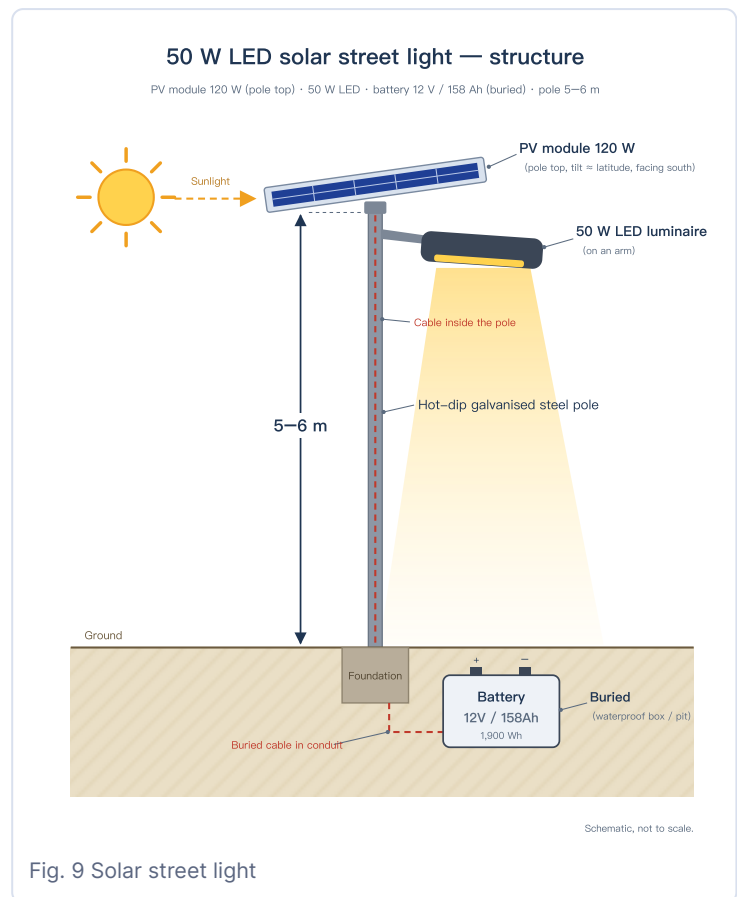
Fig. 8 Electrical connection diagram of a PV-battery project

Beyond grid-tied PV: off-grid solar street lights

The PV module and battery are sized for the site and the investment and LCOE are calculated; the design is then checked night by night against 20 years of NASA weather data.

Emission reductions and final report

- CO₂, SO₂ and NO_x emission reductions and standard coal savings compared with coal-fired generation, for the first year and the whole lifetime.
- A complete **preliminary design and feasibility report**, ready to print or save as a PDF.



5. Remarks

- 1 In the first version, the DC/AC ratio provides compensatory PV oversizing, kept at a level at which inverter clipping (power-limited operation) essentially never occurs, so that all the solar energy received on the array plane is used effectively. The upgraded version will allow users to set the DC/AC ratio according to their own needs.
- 2 In the first version, users cannot change the boundary conditions used to calculate the row spacing and the land area of the array field; if the available land is insufficient, the only options are to lower the tilt angle of the arrays or to change the project size. The upgraded version will allow users to modify the boundary conditions and, with the project size unchanged, flexibly trade off land use against shading losses.
- 3 In the first version, module temperature losses are based on the nominal operating cell temperature (NOCT). Since some places on Earth are very cold and others very hot, NOCT cannot represent all regions. The upgraded version will calculate the local average cell temperature from the climate and temperature characteristics of the project site, so that the results better match actual field conditions.
- 4 In the first version, PVQuick offers PV + storage design for distributed systems only, and off-grid design is limited to solar street lights. The upgraded version will cover, as far as possible, the application types not yet included in the first version.

6. Classification of PV Power Systems

From level I (grid-tied / off-grid) to level VI (business model). TOU tariff: time-of-use (peak / off-peak) tariff.

I	II	III	IV	V	VI (business model)
Grid-tied PV	Without storage	Flat-laid distributed PV laid flat, no row spacing to calculate	Pitched roofs	Residential	Full feed-in, or self-consumption with surplus feed-in (fixed tariff)
				Commercial and industrial, schools, hospitals, offices, etc.	Full feed-in, or self-consumption with surplus feed-in (TOU tariff)
				PV balconies, carports on private premises	Full feed-in, or self-consumption with surplus feed-in (TOU tariff)
				Greenhouse roofs	Full feed-in
			Façades	Default tilt 90°, azimuth 0° to ±90°	Full feed-in, or self-consumption with surplus feed-in (TOU tariff)
			Public carports and walkway canopies	Default tilt 0°, azimuth does not matter	Full feed-in
		Array-installed distributed PV installed in arrays, row spacing calculated	Flat roofs	Residential	Full feed-in, or self-consumption with surplus feed-in (fixed tariff)
				Commercial and industrial, schools, hospitals, offices, etc.	Full feed-in, or self-consumption with surplus feed-in (TOU tariff)
			Elevated rigid or flexible structures	Sewage treatment plants	Full feed-in, or self-consumption with surplus feed-in (TOU tariff)
				Agrivoltaics	Full feed-in
			Water-surface PV	Floating / piling / offshore	Full feed-in
		Ground-mounted PV plants full feed-in	Sloped land	Arrays following the slope	Full feed-in
				Terraced arrays	
			Horizontal coordinates, GHC (4 types)	Fixed, manual adjustment, azimuth tracking, GHC 2-axis tracking	
			Equatorial coordinates, EC (6 types)	Horizontal E-W tracking, tilted E-W tracking, polar-axis (inclined single-axis) tracking, long-row polar-axis tracking, EC 2-axis tracking, long-row EC 2-axis tracking	
	With storage	Distributed PV with storage	Fixed arrays	Residential	Self-consumption with surplus feed-in (fixed tariff)
				Commercial and industrial, schools, hospitals, offices, etc.	Self-consumption with surplus feed-in (TOU tariff)
		Grid-connected microgrids	Fixed arrays	—	Tariff within the microgrid plus the tariff for exchange with the utility grid
		PV plants with storage, hybrid power systems, regional smart grids, etc.			
	Off-grid PV	- Power supply for independent units such as schools, clinics and administrative offices (DC bus) - Household power supply (DC bus) - Off-grid microgrids and village power (DC/AC bus) - Solar street lights - PV water pumps - Vehicle and ship roofs - Portable PV power sources and commercial PV power products			

7. PVQuick AI Hub: experts online, AI answers, earn a free trial

PVQuick AI Hub

pvquick.net

Sign in with your PVQuick account (**single sign-on**) — no separate registration.



Scan to join

Experts online

Senior PV experts answer questions on the AI Hub: ask about PV design, equipment, standards, O&M or markets. Their “PV Expert” title is verified.

Xiaofu: a rising AI star in solar PV (pilot)

Xiaofu is the AI agent built on PVQuick. It replies first to every new post, with suggestions and explanations on questions about PVQuick. Its replies are labeled “AI-generated reply”. The team then follows up; the top of the topic shows the status: **Discussing** → **Accepted** → **Shipped** (or “Not planned”, with the reason).

PVQuick software

How is the rear-side irradiation of bifacial modules calculated?

Status **Discussing** → **Accepted** → **Shipped**

User
My project uses bifacial modules.

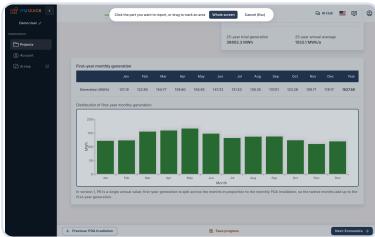
Xiaofu AI-generated reply
Front-side and rear-side irradiation are calculated separately; see step 4, POA irradiation...

PVQuick team Follow-up

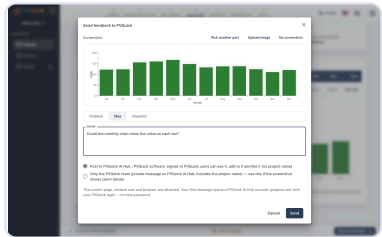
Illustration: a topic on the PVQuick AI Hub

One-click feedback

On any PVQuick page, click Feedback on the right edge, then the part with the problem; a screenshot is attached. Post it on the AI Hub, or send it to the team only if it shows client details.



Picking the part to report



The feedback dialog

★ Earn points, try the full release free (pilot)

How to earn

- **10** points on sign-up
- **+1** for a post the AI judges useful (up to 3 a week)
- **+5** when the team accepts your problem or idea
- **+5** when your answer is confirmed as the solution

How to use

- **1** point to see/download a report (once per report)
- **10** points for one more project

Contribution

Points you earn (not sign-up points) also count as contribution, which never goes down. Free Pro at the full release:

15	Active contributor	1 month
40	Senior contributor	2 months
100	Distinguished contributor	3 months

After that, a **discount** on Pro.

Pilot: the rules may change (see AI Hub). Free Pro months are settled on release-day contribution, one account per person, and checked by the team; farmed or spam posts do not count.



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