

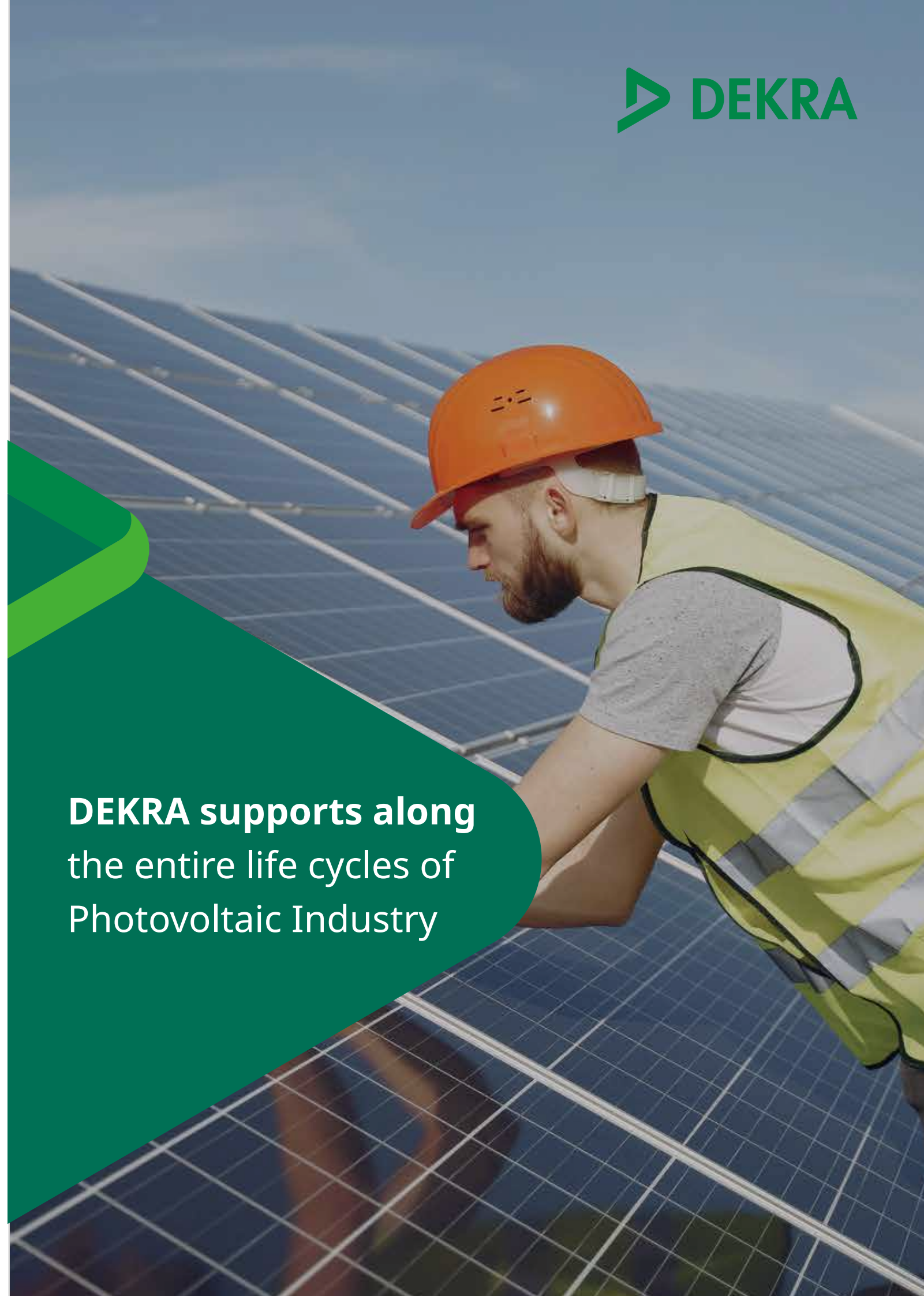


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DEKRA supports along the entire life cycles of Photovoltaic Industry





Founded in 1925 in Berlin as Deutscher Kraftfahrzeug-Überwachungs-Verein e.V., DEKRA has been active in the field of safety for almost 100 years.

DEKRA is the largest unlisted company and vehicle inspection organization in the global testing, certification and inspection industry, as well as the largest testing and certification organization in Germany.

In 2023, DEKRA's total revenue reaches EUR 4.1 billion. The company currently employs almost 49,000 people in approximately 60 countries on all continents. With qualified and independent expert services, they work for safety on the road, at work and at home.

These services range from:

- Vehicle Inspection
- Claims & Expertise
- Digital & Product Solution
- Industrial and Building Inspection
- Audit
- Temporary Work
- Advisory Service

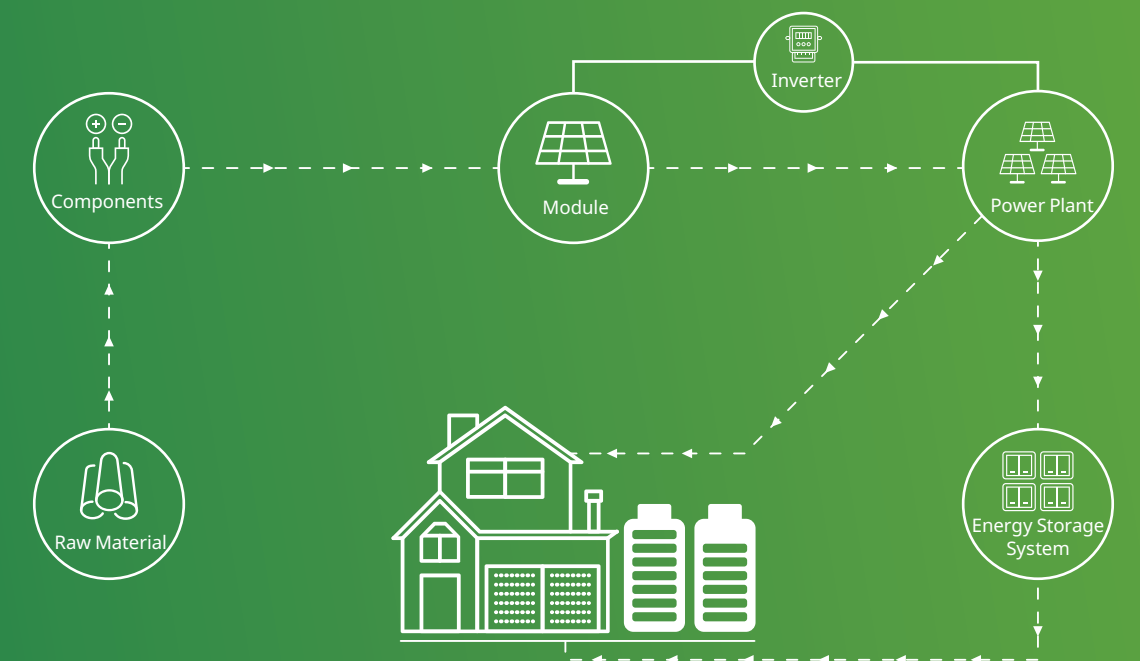
we will be the
global partner
for a
safe, secure and sustainable world

DEKRA One Stop Solution of Photovoltaic Industry

Since the Industrial Revolution, the energy mix of most countries across the world has become dominated by fossil fuels. This has major implications for the global climate, as well as for human health. To reduce CO² emissions and local air pollution, the world needs to rapidly shift towards low-carbon sources of energy renewable technologies.

Renewables are the backbone of any energy transition to achieve net zero. As the world increasingly shifts away from carbon emitting fossil fuels, understanding the current role renewables play in the decarbonisation of multiple sectors is key to ensuring a smooth pathway to net zero.

As an international expert organization, DEKRA offers a wide range of comprehensive services to address the challenges of the solar market based on national and international standards as well as industry and customer requirements. We have been accredited by IECCE as CB testing laboratory (CBTL) and offer comprehensive experience and professional team providing supply chain services for PV projects of different capacities. Our goal is to streamline and manage the testing and certification processes across international boundaries and improve both global access and time to market for our customers.



DEKRA

PV Module Test and Certification

PV modules are important components in PV power plant. Whether in open fields, deserts, on the roofs, different environments put higher demands on the quality and reliability of PV modules. DEKRA is able to provide a wide range of services for PV modules, including crystalline silicon, thin-film, integrated building and concentrated PV modules.



Test and Certification Service

- IEC/EN 61215/61730 testing and certification
- ANSI/UL 61215/61730 testing and certification
- Ammonia corrosion testing and certification
- Dynamic mechanical load testing and certification
- Transportation testing and certification of components
- CE certification (Low-voltage Directive)
- CB certification
- Factory inspection
- Global Market Access (CQC, Inmetro, JET, BIS, CEC, MCS...)
- Extended PV module test (IEC TS 63126; IEC TS 63209-1; etc)
- PID testing and certification
- Salt mist corrosion testing and certification
- Sand dust corrosion testing and certification
- Non-uniform snow load testing and certification
- Photovoltaic module STC calibration
- PV Module Life Cycle Assessment
- Panfile data package service
- Customized test solution



Quality Assurance Service

- Electro-luminescence (EL) test and infrared imaging
- RoHS compliant test
- Production line sampling and STC test
- Specific standard factory audit
- Potential induced degradation (PID) test
- Light induced degradation (LID) test
- Inspection and supervision services



Add Value Service

- IEC 62941 Quality management system certification
- Evaluation of uncertainty in production line measurement
- Lab management system training and TMP audit
- Training on standards and test methods
- CBTL CTF Audit



DEKRA

PV Components Test and Certification

A safe, high-efficiency and running well PV power plant relies on good quality PV components. The effective recognition of PV components is often ignored by the end users, and this circumstances result in a great hidden danger in each stage.

DEKRA not only supports manufacturers as well as end-use customers. We participate into the process in the first stage. We provide our service regarding to international standards, and strictly supervise the process from the design of PV components, material selection to production. We provide the great support to have risk-free operation of PV power plant.

Product

- Junction boxes for PV modules
- Glass for PV modules
- Connectors for DC/AC-application in PV systems
- Polymer materials for PV applications
- PV junction boxes with integrated electronics
- Edge seals and potting sealant for PV applications
- PV connectors with integrated electronics
- PV cable
- PV array interconnection systems
- PV plastic frame
- Front and back sheet for PV modules
- PV rack
- Encapsulation materials for PV modules

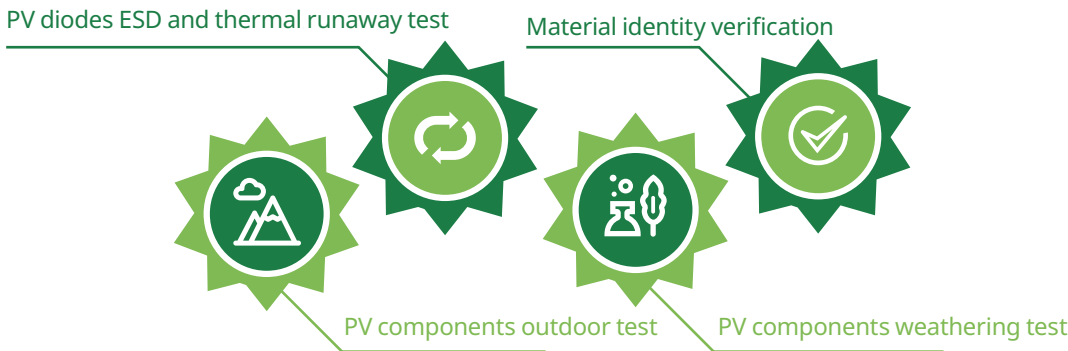


Test and Certification Service

- Testing and certification for PV junction box
- Testing and certification for glass for PV modules
- Testing and certification for PV rack
- Testing and certification for floating PV system
- Public Greencard database for PV materials
- Testing and certification for PV connectors with integrated electronics
- Testing and certification for PV array interconnection systems
- Testing and certification for front sheet and back sheet for PV modules
- Testing and certification for encapsulation materials for PV modules
- Testing and certification for edge seals and potting materials used in PV modules
- Testing and certification for plastic frame material used in PV modules



Customization Service



Add Value Service



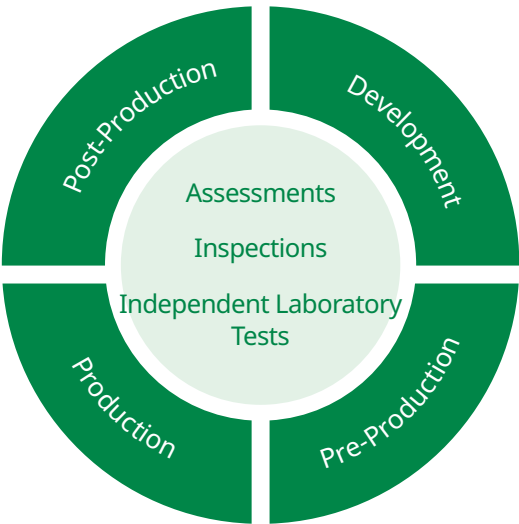
- Customer technical consultation
- Production process evaluation
- Supervision service
- Personnel training
- Customize the test scheme
- Product quality supervision
- Quality management system certification
- Product carbon footprint audit
- Failure analysis of PV power plant components
- Factory audit
- Global Market Assess
- Buyer Approval Report
- Process safety and organizational safety consulting
- Technical seminar
- Design and development program optimization
- Standard development of new product



DEKRA PV Supply Chain Service

Our audits and inspections of production lines identify potential weaknesses and risks, ensuring safe and qualified final products, thus a profitable yield. In addition, our authorized state-of-the-art test laboratory can provide durability test of PV modules and components to verify performance. This helps improve quality, performance and compatibility by reducing the risk of serious defects and critical safety issues.

The systematic quality assurance not only improves technology of PV station safety and efficiency, but also financing ability: investors and lenders can feel confident that your project is accounting for and addressing inevitable risks.



	Development	Pre-production	Production	Post-production
Expert Team	○ Supplier evaluation ○ Technical advisory			
At Factory	○ Factory audits	○ Capability assessment ○ Pre-production inspection	○ Factory inspection during production ○ In-line quality assurance	○ Pre-shipment factory inspection ○ Loading supervision
DEKRA's Authorized Laboratory	○ Module benchmarking	○ Reliability tests ○ Reference module creation	○ Fast verification of sample tests	○ Final random sample tests
On Construction Site	○ Power and IV test on site after assembly			

DEKRA Independent Laboratory Tests



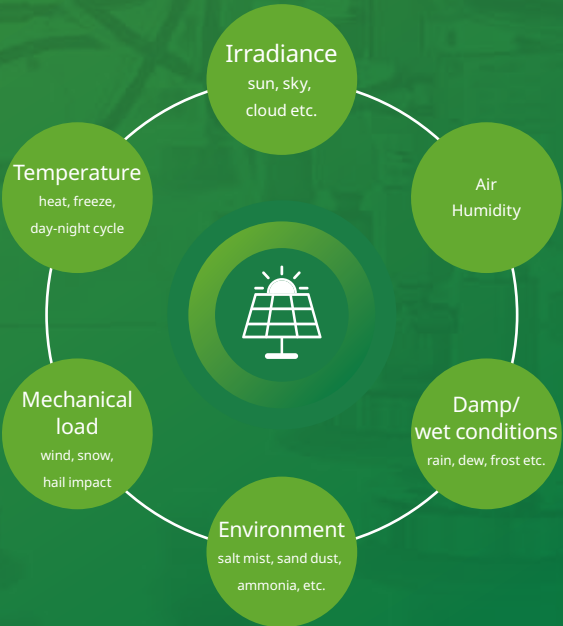
Pre-shipment Tests

- Visual inspection
- Power determination
- Electro-luminescence (EL) test
- Safety test
- Performance at different irradiance/temperature
- Thermo-graphic inspection
- Potential induced degradation (PID) test
- Light induced degradation (LID) test
- Static mechanical load
- Thermal cycling / damp heat
- Highly accurate STC measurement
- EVA gel content & peel-off test



IEC Reliability Tests And Extended Reliability Tests

- Damp heat test (DH)
- Humidity freeze test (HF)
- Impulse voltage test
- Bypass diode thermal test
- Outdoor exposure test
- Ammonia corrosion test
- UV precondition test
- Thermal cycling test (TC)
- Static mechanical load test
- Hail impact test
- Hot-spot endurance test
- Salt mist corrosion test
- Dynamic mechanical load test



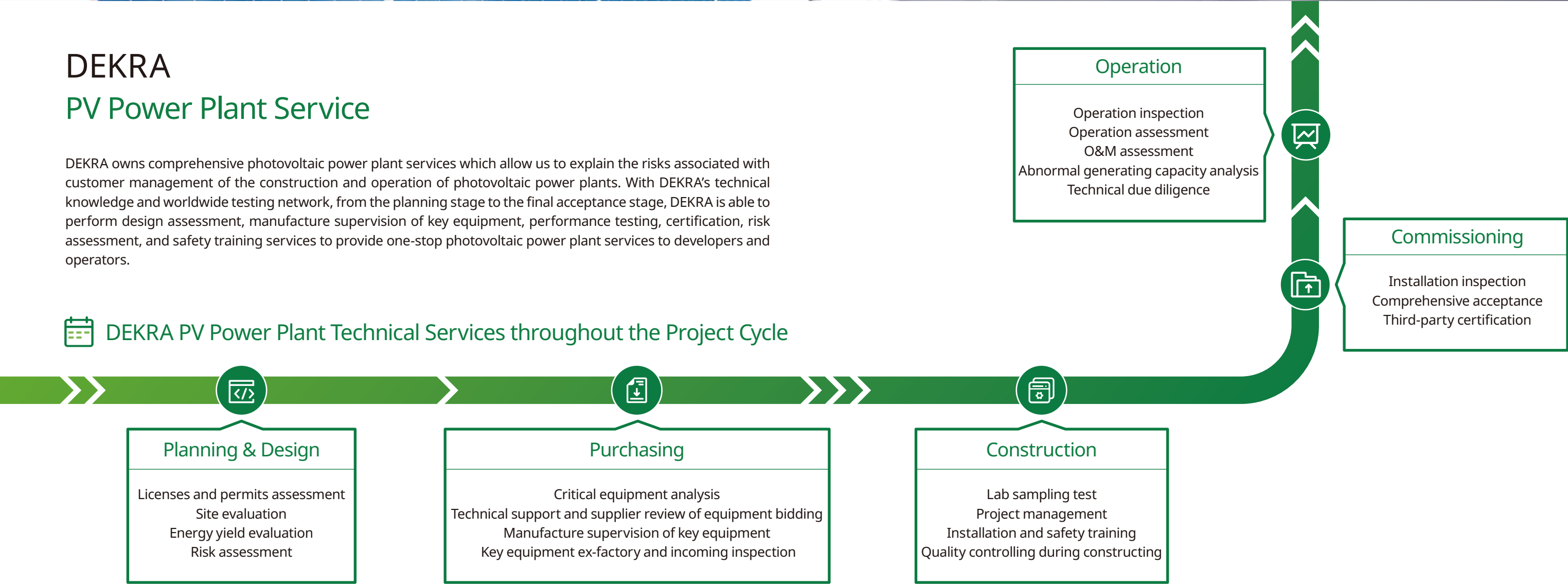


DEKRA

PV Power Plant Service

DEKRA owns comprehensive photovoltaic power plant services which allow us to explain the risks associated with customer management of the construction and operation of photovoltaic power plants. With DEKRA's technical knowledge and worldwide testing network, from the planning stage to the final acceptance stage, DEKRA is able to perform design assessment, manufacture supervision of key equipment, performance testing, certification, risk assessment, and safety training services to provide one-stop photovoltaic power plant services to developers and operators.

DEKRA PV Power Plant Technical Services throughout the Project Cycle



DEKRA

PV Energy Storage System Test and Certification

Energy storage, as an important emerging industry, serves as a crucial force in building a new power system and achieving the "dual carbon" goals. Energy storage technology enables functions such as peak shaving, load tracking, frequency regulation, and voltage regulation. Energy storage systems can also store excess electricity generated during periods of abandoned sunlight in photovoltaic power plants in energy storage batteries. During peak electricity demand, the stored energy can be delivered to the grid via inverters, significantly improving the integration of renewable energy sources such as wind and solar. It can be said that energy storage technology is an effective solution for the large-scale integration of renewable energy into the power grid.

As a globally leading testing, inspection and certification organization, DEKRA, with abundant expertise in the field of new energy, can conduct testing and certification for energy storage systems, energy storage batteries, energy storage inverters (PCS), battery management systems, and other related components according to globally recognized standards. This ensures a smooth entry of products into the international market under the protection and guidance of our experts.



Products and Associated Testing Standards

ESS

- IEC 62933
- VDE-AR-E 2510-50
- GB/T 36549
- UL 9540
- UN 3480/3536

PCS

- IEC 62109-1/-2
- IEC 62477-1
- UL 1741
- CAN/CSA - C22.2 No.107.1 - 01
- CNS 15426-1/-2
- IS 16221:Part1 Part2

BMS

- IEC 61508
- IEC 60730-1 annex H
- GB/T 34131
- UL 991/UL 1998

ESS Battery

- IEC 62619
- IEC 63056
- IEC 62133
- IEC 62040-1
- UL 9540A
- UL 1973/UL 1642
- UN 38.3 Rev.7
- GB/T 36276

DEKRA
PV Inverter Test and Certification

 Test Items and Related Test Standards



Test Item	Country/Region	Standard	
Environmental testing	/	IEC 60068-2-5 (UV) IEC 60068-2-52 (salt spray) IEC 62093	
Energy efficiency testing	/	IEC 61683	EN 50530
EMC testing	/	IEC/EN 61000 - 6 - 1 (immunity) IEC/EN 61000 - 6 - 2 (immunity) IEC/EN 61000 - 6 - 3 (emission) IEC/EN 61000 - 6 - 4 (emission)	IEC/EN 61000 - 3 - 2/ - 12 (harmonics) IEC/EN 61000 - 3 - 3/ - 11 (flicker) IEC 62920
Grid connection testing	Germany	VDE-AR-N 4105, DIN VDE V 0124-100, VDE-AR-N 4110, VDE-AR-N 4120	
	Austria	OVE-Richtlinie R 25	
	England	G98/1, G99/1, G100/1	
	Italy	CEI 0-21, CEI 0-16	
	Spain	RD1699, NTS 631, UNE 217001 IN, UNE 217002	

Test Item	Country/Region	Standard
Grid connection testing	France	VDE 0126-1-1/A1+VFR 2019, UTE C15-712-1, XP C15-712-3, Enedis-NOI-RES_10E, Enedis-PRO-RES_64E
	Czech	PPDS
	Brazil	ABNT NBR 16149/16150/62116, INMETRO ORDINANCE No.140
	South Africa	NRS 097 097-2-1:2017
	Japan	JETGR0002-1/0003-1/0003-4/0005-1
	Global CB	IEC 61727, IEC 62116
	Dubai	Dubai Electricity&Water Authority (DEWA)
	Thailand	IEC 61727, IEC 62116, MEA, PEA
	Australia, New Zealand	AS/NZS 4777.2
	Poland	PSE, PTPIREE, IRIESD
	Belgium	C10/11