

MOVING THE SOLAR INDUSTRY FORWARD

DNV provides independent advisory, analysis, engineering and testing services to the global solar photovoltaics (PV) and concentrating solar power (CSP) markets. We work with investors, project developers, owners, and equipment manufacturers to help manage risk throughout the entire project life cycle and to ensure the performance and safety of systems from residential rooftops to multi-megawatt power plants.

OUR SERVICES



Our team includes experts in PV system design, solar power plant operation, PV module manufacturing, PV module and inverter testing, equipment performance, and structural elements such as rooftop mounting systems and trackers. DNV's global experience includes successfully contributing to more than 3,000 solar projects.

Investors engage us to perform Independent Engineering (IE) on individual solar projects, portfolios of distributed generation projects (residential, commercial, industrial), and key system components.

Project developers and owners seek our advice and guidance. As owner's engineers we help you set the highest standards of engineering excellence in today's PV and CSP systems, providing services from site feasibility studies through turn-key design packages.

Component manufacturers turn to us to perform technology reviews of new products for successful market entry. This includes PV modules, inverters, mounting systems, and CSP components.

DNV Solar Services:

- Energy assessment.
- Independent engineering.
- Owner's engineering.
- Technology reviews.
- Pre-construction engineering.
- Environmental and permitting.
- Asset management.
- PV module and inverter testing.
- Supporting services.

DNV Solar PV Services

We offer a range of services to project owners/developers, investors and component manufacturers. For each project we work with the customer to tailor a program that meet their needs.

Energy assessment

Independent and accurate energy assessments for solar power plants:

- Bankable energy assessments.
- Preliminary pre-construction assessments.
- Resource measurement campaign design and implementation.
- Portfolio assessment.
- Operating plant performance assessments.

Independent engineering and owner's engineering

Site evaluation

Evaluate site for suitability of proposed installation, determine site-specific solar resource, analyse shading conditions, and review environmental and security conditions.

Design review

Review system design for code compliance and conformance to solar industry best practices. Evaluate key components including modules, inverters, mounting systems, trackers, balance of system, and system integration.

Performance estimate

Determine expected system performance, system power ratings, and first-year and life-time energy production (including degradation and uncertainty analysis).

Permit status review

Identify key permit and schedule milestones. Evaluate ongoing status of permits including building permits, utility interconnection, environmental, incentive reservations, and proof of progress.

Construction support

Review and evaluate construction activity progress, identify status as well as potential hurdles, and recommend solutions.

O&M review

Review operations and maintenance (O&M) plan, identify potential hurdles and recommend solutions, and determine expected O&M costs.

Overall risk assessment

Summarize and evaluate project risk, including design, technology, construction schedule, workmanship, permit compliance, and sub-system testing.



System test

Complete or spot evaluation of array, tracker, and inverter using voltage and current measurements, IV curves, as-installed array and system ratings, and independent performance monitoring.

Performance evaluation

Witness or review performance data set to verify minimum period of continued operation, and assess actual vs. predicted output and other contractual measures of acceptable performance.

Final completion

Verify the completion accuracy of all items to be listed on the Final Completion Notice.

Technology reviews

Apply a two-stage technical evaluation process to inverters, dc converters, trackers, PV modules, energy storage, and other PV balance-of-system components. Evaluations include separate reports for both internal company use and review and a final update for select distribution to financial institutions and customers. Our technology review explores the following areas:

- Product evaluation.
- Performance evaluation.
- Reliability evaluation.
- Manufacturing capability and maturity.
- Installation and O&M evaluation.
- Quality evaluation.
- Standards compliance evaluation.
- Warranty evaluation.

Pre-construction engineering

Take a project from a site feasibility study and transmission assessment through to a finished, construction-ready drawing set:

- PV power plant design and optimization.
- Preliminary through turn-key drawing packages.
- Maximize performance, reliability, and safety.

Environmental and permitting

Provide an integrated approach to the permitting process from development through operation. Services include:

- Critical issues analysis.
- Technical studies (such as noise modelling/monitoring and visual simulations).
- Environmental studies (wetlands and waters, wildlife surveys, cultural resources, and geotechnical studies).
- GIS, mapping, and field surveys.
- Comprehensive permit management.
- Agency and stakeholder engagement.
- Construction and operational compliance.

Asset management

Services for solar power plant owners and operators to support optimum system reliability and operation, performance issue identification, and energy production maximization.

PV module & inverter testing

Leading ISO 17025 accredited PV testing laboratory with both indoor and outdoor (grid-connected) testing capabilities. We test for both product performance and defects.

Product qualification program

Reliability and performance testing program designed to inform buyers and investors for managing their "Approved Vendor Lists." Manufacturers gain access to our 55+ downstream partners including the leading banks, developers, EPC firms, and insurance companies:

- Reliability testing.
- Performance testing: PAN files, LID, IAM, NOCT.

Statistical batch testing

Project level QA/QC testing to ensure minimal exposure to serial defects with statistical certainty. Ensure the product meets performance expectations.

- Serial defects.
- Performance: PAN files and LID.



Product Certification

Certification to the following standards: IEC 61215, 61646, 61730, 62108, UL 1703, 2703, JET, MCS, and CEC Listing.

Outdoor (grid-connected) testing

- Behind-the-fence PV array: no certifications required.
- Real-time web portal for data monitoring.
- Heavily instrumented.

Devices for plant monitoring

- Solar reference cells.
- Soiling stations.

Supporting services

Interconnection support services

- Renewable energy project interconnection feasibility and economic assessment.
- System and equipment modelling for EMTP, PSLF, PSS/E, Power Factory, PowerWorld, and SynerGEE Electric.
- Transmission interconnection studies (power flow, short circuit, transient stability, voltage, and harmonic analysis).
- Distribution energy grid studies for high penetrations of PV generation.

RFP generation and contract evaluations

- Government or private RFP generation.
- Technical review and input on engineering, procurement, and construction (EPC) contracts.

Training for utilities, installers, electricians, and other users

- PV basics.
- Advanced PV systems.
- Energy assessment and other simulation tools.

System testing

- Complete systems performance validation or capacity ratings.
- Individual component performance validation.
- Compliance with grid standards including country- and utility-specific requirements.

Energy storage

- Analysis of performance and benefits of combining storage with solar.
- Energy storage device technology review and testing.

Project References

80 MW SOLAR PV PROJECT

Customer: VTB Capital

Challenge: Customer needed a technical due diligence (TDD) including construction monitoring for financing 4 PV plants in Ukraine.

Approach: Provide a full TDD, site inspections, design review, energy production assessment, technology review, EPC and O&M contracts and financial model review, construction monitoring, performance ratio protocol, provisional and final acceptance. DNV monitored the construction of the project during multiple site visits.

Value: DNV's goal was to provide independent technical advice to the lenders for understanding the risks and the mitigation measures during the construction of the PV plants.

320 MW SOLAR PV PROJECT

Customer: EDF EN

Challenge: Perform an independent engineering review for the lenders of a portfolio of ground-mounted PV plants located in France and Italy.

Approach: At the development stage, DNV provided full technical due diligence through a general review of the common features applying to all projects in the program and an individual review for each project's specificities. DNV also conducted construction monitoring, provisional and final acceptance testing during the construction and operation of the PV plants.

Value: DNV provided technical advice to the lenders, including the assessment of contractual coverage of project risks, technology review and energy production assessment, through to installation and maintenance cost reviews and support during the construction.

50 MW / 100 MW SOLAR CSP PROJECTS

Customer: EIG Global Energy Partners

Challenge: Prior to the Project Construction Phase, the Customer required independent engineering services to analyse the status and feasibility of two CSP projects. Later, DNV was required to perform a monthly analysis of the construction progress.

Approach: In the first phase, DNV analysed the information provided by the Project Sponsor related to the project design, solar resource and projected annual energy output in order to assess the technical feasibility of the projects. During this phase DNV also verified the suitability of the site and environmental conditions. A detailed analysis of the main Project Agreements as EPC, O&M, PPA and Grid Connection was performed. Finally DNV also gave comments to the Financial Model and Project Risks provided by the Sponsor. During the Project Construction Phase, DNV performed a close monitoring of the main construction activities in order to identify potential risks which could hamper the achievement of the project conclusion on time and within budget.

Value to the Customer: Firstly our analysis support to the Customer enabled them to make a decision in terms of investment on these CSP projects. Later, during the Construction Phase, the Customer received monthly reports summarizing the most relevant information related to the work progress and main issues for the period.

208 MW SOLAR PV PROJECT

Customer: International EPC Contractor

Challenge: Provide a full, construction-ready design package for a utility-scale 208 MW PV plant in the desert region of Southern California.

Approach: DNV used its industry experience and state-of-the-art design strategies to optimize the electrical design of this large PV power plant. As the engineer of record on the project, DNV provided all of the required engineering drawings to support the permit process and construction.

Value: Timely delivery of design strategies to optimize performance of the system. This helped to ensure our Customer met their permitting and construction schedules. DNV worked on alternate design concepts to provide the most value to the project while maintaining a high-quality design within the project's budget.

94 MW SOLAR PV PROJECT

Customer: Two South African banks

Challenge: Provide independent engineering support to the lenders for financing a PV project in a new PV market in South Africa.

Approach: DNV conducted a site assessment, detailed technology review, design evaluation, energy yield, EPC and O&M cost/inverter reserve reviews, support during construction, tests review, performance ratio protocol, Power Purchase Agreement (PPA), the connection agreement review, the project schedule, the financial model and the permits and leases and time to completion review and drawdown certifications.

Value: The role of DNV as an Independent Engineer of the Project allowed the use of the Due Diligence report by the Banks involved in the Project financial close.