



Your global competence partner for energy storage

Supporting the entire industry value chain
from manufacturers to project developers
and financiers

VDE RENEWABLES

 **Fraunhofer**
ISE



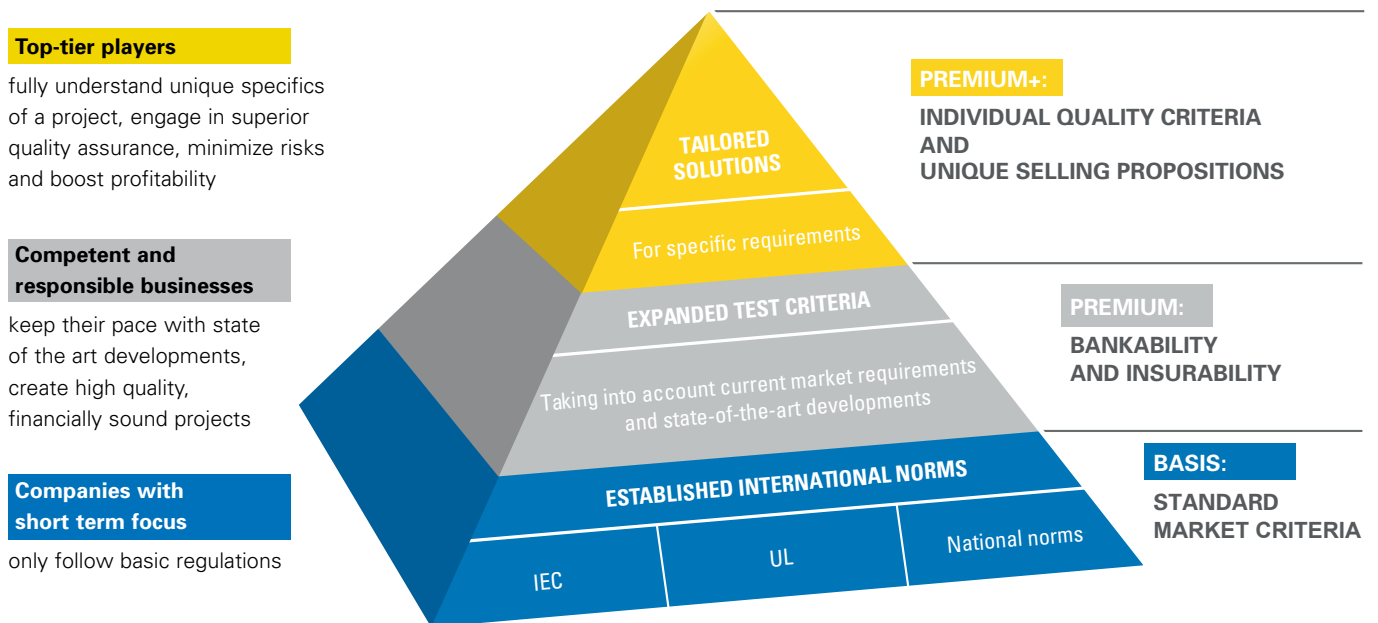
The VDE Pyramid of Quality:

The path to bankability, investability and insurability

Through our ongoing engagement of key stakeholders in the cleantech sector, especially financial institutions and insurance firms, we recognized that existing standards requirements, although important, were not sufficient to achieve bankability, investability and insurability for cleantech components and projects. These standards must be extended with additional criteria.

We have therefore developed our VDE Pyramid of Quality approach, which is our guiding principle for the development of products and services for all clean technologies.

One of the important goals of this approach, which is especially important for financial stakeholders, is **to achieve a significant reduction of operational risks, and increased reliability and sustainability**. Our track record shows that risk is reduced as you shift further up the pyramid.

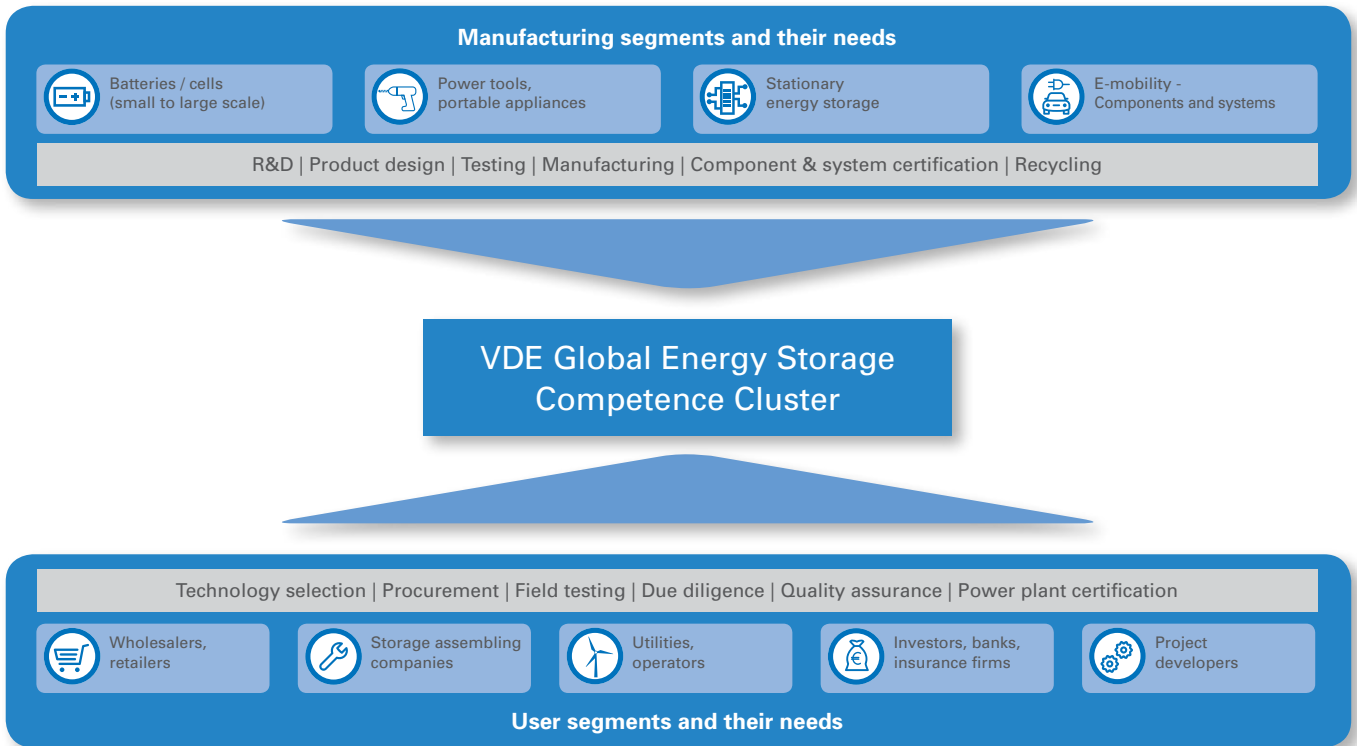


Why work with us?

- Globally recognized team with extensive technical competence across energy storage systems and clean technologies
- Proven track record with field experience
- Close links to the finance and insurance sectors allow us to directly support clients with bankability, investability and insurability matters
- On the pulse of dynamic market developments ensures that we can offer state-of-the-art solutions
- World class laboratories in key regions: Singapore, Germany and the USA



Premier expertise through the Global Energy Storage Competence Cluster

The dynamic market and the rapid development of new storage products require an internationally oriented approach. In order to effectively serve the global industry and remain at the forefront of the latest trends and innovations, **VDE Renewables**, the **Fraunhofer Institute for Solar Energy Systems ISE**, and the **Renewable Energy Test Center (RETC)** have established a **Global Energy Storage Competence Cluster (GECC)**, with VDE Prime Labs present in key regions around the world – Asia, Europe and the Americas. This network empowers us to continuously improve our collective know-how and technical services.



Energy storage presents opportunities – but also challenges

Energy storage is poised for exponential growth, and this will call for the active involvement of the renewable energy industry, utilities, automotive manufacturers, and financial and insurance institutions. The common factor in all these organizations is that **energy storage is not their core business**. On top of that, storage presents a diverse set of challenges and risks that must be overcome.

Commercial & industrial (C&I) behind-the-meter storage 	Solar PV power plant with integrated energy storage system Micro-grids and grid-connected applications 
Applications: <ul style="list-style-type: none">■ Peak shaving■ Energy time shift■ Back-up power■ Self-consumption of renewable energy	Applications: <ul style="list-style-type: none">■ Frequency regulation■ Primary control reserve■ Feed-in management■ Ramp rate control
Challenges: <p>Investment decision for an ESS is based on the expected return on investment (ROI). The intended application for the ESS should firstly be properly defined, in order to optimize system parameters. Load patterns must be analyzed in detail. Individual components and assembled systems need to be examined and characterized in the laboratory. This paves the way for creating an accurate system simulation. The ESS should also be tested in the field to ensure it operates as modelled, and should have a monitoring system in place.</p>	Challenges: <p>Building upon the C&I example, implementing a PV power plant is a challenge in itself that requires a holistic approach to quality. The plant, with its ESS, will be evaluated as a whole by potential investors, banks and insurers. The plant must be properly designed to suit the intended application. The solar resource must be correctly assessed and system performance accurately modelled. Components, especially the ESS, must be selected and tested for their suitability. Construction and installation should follow planning, and an operations & maintenance plan should be in place.</p>



Support across the storage value chain

Our clients represent a large part of the energy storage value chain. Whether an organization is looking to manufacture batteries, combine their core products with an energy storage system (ESS), deploy ESS to provide ancillary grid services, re-purpose automotive batteries for second-life applications, or invest in a storage project, the VDE Global Energy Storage Competence Cluster can support them.

Deep expertise
From R&D to commercialization

State-of-the-art
Labs and services

Strategic locations
Global reach, local support

Our combined service portfolio

Categorized according to customer segment

Services for manufacturers

- Component certification based on international standards
- Development of in-house quality criteria
- Consultancy on standards and market access requirements
- Support in the assembly of storage systems
- Accident forensics, error analysis for risk minimization
- Tailored analysis of battery cells and packs

Services for project developers

- Creation of requirement specifications
- Analysis of load profiles
- Simulation-based system design and component dimensioning
- Renewable energy yield prediction
- Advisory on component selection
- Manufacturer audits
- End-of-line tests at production lines
- Grid interconnection compliance
- Ongoing quality monitoring

Services for investors and banks

- Economic feasibility studies
- Performance guarantee and other insurance products (through insurance partners)
- Premium bankability and investability certification for entire power plants

Categorized according to technical area

Testing

- ISO17025 accredited laboratory
- Standard tests (IEC, VDE, UN)
- Customized tests at clients' request
- Development of clients' own quality assurance standards
- Abuse testing in safety chamber
- Performance testing
- Lifetime and ageing testing
- Battery management system (BMS) testing

Independent engineering & prototyping

- Development & design of batteries for:
 - Portable electronics
 - E-mobility
 - Stationary storage
- Prototyping of battery systems
- Thermal management solutions
- Development support with consulting and testing for energy storage systems

Research & development support

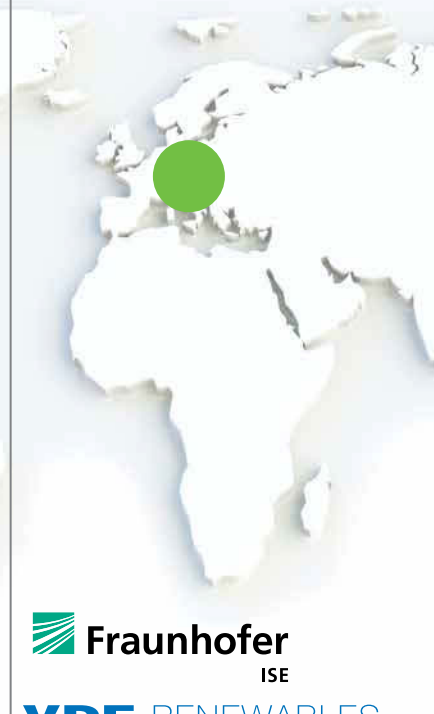
- New materials implementation
- Optimization of cell properties and operating conditions
- Optimization of cell design
- Sourcing of materials
- Technology scouting
- Training & consulting

America



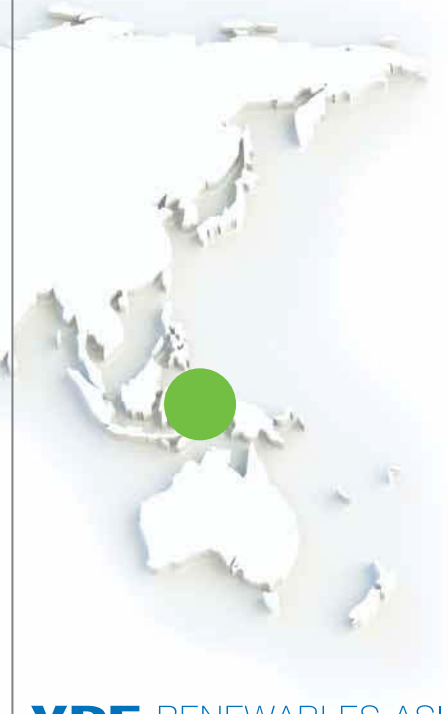
VDE AMERICAS

Europe



VDE RENEWABLES

Asia



VDE RENEWABLES ASIA

About VDE Renewables

VDE Renewables conducts the marketing, business development, and project management activities for certification and non-certification activities in the area of quality assurance for the global renewable energy sector. It is globally present and has representation in Europe, Asia and the Americas. VDE Renewables works closely with leading institutions around the world to carry out testing of components and systems according to the highest levels of quality. It focuses on bankability and insurability by working with the financial industry and tailoring products to meet stringent requirements. VDE Renewables Asia operates the ESS laboratory in Singapore.

About Fraunhofer ISE

Fraunhofer ISE offers a wide range of services for planners, system integrators, developers and investors in the area of

quality assurance. It provides tests and characterization of battery cells, modules and entire systems, simulation-based system analyses, development of optimized, application-specific system solutions, including thermal management and advanced battery management systems for the stationary and mobile sector, as well as optimized operating control strategies for energy management systems.

About RETC

RETC is a third-party test laboratory located in the Silicon Valley, highly regarded for its world-class engineering and certification testing services for photovoltaic and renewable energy products. RETC is CBTL and ISO 17025 accredited offering fast-track product introduction with unequalled engineering support from R&D, certification, bankability and field testing.

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